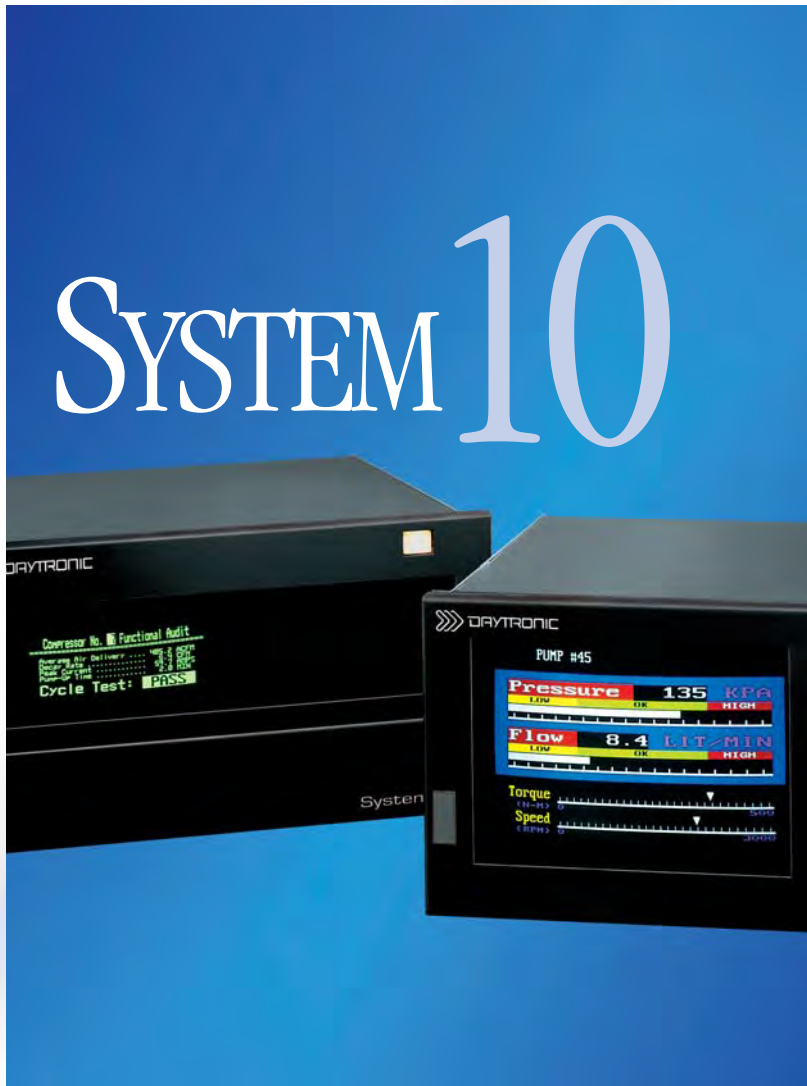


Stand Alone

MODULAR FRONT END

Data Acquisition & Control

SYSTEM 10



User's Guidebook

Version SB.8

PLEASE NOTE the following section- and figure-reference corrections for **Sections 2, 3, and 5** of this Guidebook:

When you are told to refer to:

You should actually refer to:

Section 1.B	Section 1.A.3
Section 1.C	Section 4 of the appropriate "On the Air" Booklet
Section 1.D	Section 5 of the appropriate "On the Air" Booklet
Fig. 1.E.1 (Section 1.E.1)	Fig. 1.5 (Section 1.E.1)
Fig. 1.E.2 (Section 1.E.1)	Fig. 1.6 (Section 1.E.1)
Section 1.F.1	Section 1.F.2
Section 1.F.2	Section 1.F.3
Section 1.G.2	Section 1.G.1
Section 1.G.7	Section 1.G.6
Appendix B	Section 1.B

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SYSTEM 10

USER'S GUIDEBOOK

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2.A INTRODUCTION

2.B INTERFACING OF COMPUTER, TERMINAL, PRINTER, ETC.

1. Introduction: The Computer Interface Port

2. RS-232-C Interfacing

- a. Connections
- b. Setting RS-232-C Interface Protocol
 1. Via Menu Setup Program
 2. Via Protocol Switches
 3. Via **BAUD RATE (BAU)** Command
- c. Verification of RS-232-C Interface Setup
 1. Requesting of Current Protocol Settings: **BAU** Command
 2. Verification of Interface

3. Uses of the Optional Model 10C232NET Network Adaptor

- a. "Remote" RS-232-C Interfacing
- b. "OR" Connection ("Daisy-Chaining") of Two RS-232-C Devices to a Single DataPAC or of two DataPACs to a Single RS-232-C Device
- c. Switched Connection of Two RS-232-C Devices to a Single DataPAC or of two DataPACs to a Single RS-232-C Device
- d. Connection of More Than Two RS-232-C Devices to a Single DataPAC or of More Than Two DataPACs to a Single RS-232-C Device

4. Optional RS-422 and IEEE-488 Interfacing

- a. Converting RS-232-C to RS-422 Via the Model **10E422**
- b. Converting RS-422 to IEEE-488 Via the Model **10CLB488**

5. Setting Command Terminator: **CMT** Command

- a. The Command Terminator
- b. Setting Command Terminator for DataPACs Without Keyboard
- c. Interrogating for Current Command Terminator

6. Other Computer Communications Features

- a. Setting Timeout Response: **TMO** Command
- b. Setting and Transmitting Computer Interrupt: **ITR** Command
 1. Defining an "Interrupt" Character String
 2. Initiating the "Interrupt" Transmission
- c. "Sending" to the Computer or PC-EGU: **SND** Command

7. Using the Model 10ESRE Serial Range Extender

Appendix: Modem Communications with a System 10 DataPAC

2.C COMPLETE CRT VIDEO SETUP

1. Setup of Internal CRT

- a. Setting “BVS” and “VDU” Values: **BVS** and **VDU** Commands
- b. Selecting Video Mode: **VID** Command
- c. Setting Screen Refresh Rate: **REF** Command
- d. Flagging Out-of-Scan Channels: **VSS** Command
- e. Adjustment of CRT Controls
 1. Monochrome CRT
 2. Color CRT

2. Video Pages and Directories

- a. The Nature of the “Video Page”
- b. The Page Directory: **DIR** Command
- c. The Conditional Directory: **SHO** Command

3. Calling and Interrogation of Video Pages: **PAG** Command

- a. Calling a Video Page for Display
- b. Requesting the Number of the Page on Display
- c. Requesting the Memory “Size” of a Video Page

4. General Formatting and “Word-Processor” Considerations

- a. Specifying Billboard Logo: **LGO** Command
- b. Character and Page Size
 1. Character Sizes
 2. Page Size
- c. Channel Display Fields
 1. Data Field and Video Playback Field
 2. Bit-State Field
 3. Message Field
- d. Cursor Movement: **Arrow** Keys
- e. Repeated Character Entry
- f. Insertion and Deletion of Fixed-Text Spaces: **Insert** and **Delete** Keys
 1. Space Insertion
 2. Space Deletion
- g. Insertion and Deletion of Display Lines: **Insert** and **Delete** Keys with Control
 1. Line Insertion
 2. Line Deletion
- h. Line Duplication: **Tilde** Key

5. Composing a Page Format

- a. Calling a Blank Display
- b. Entering Text Editor Mode: **Video Format** Key
- c. Setting Line Size: **Height** and **Width** Keys
- d. Setting Color or Intensity of Fixed Text within a Line: **Color** and **Background** Keys with Shift
 1. Setting Text Color within a Line of Color Display
 2. Setting Text Intensity within a Line of Monochrome Display
- e. Entering and Deleting a Data Field
 1. Entering a Data Field within a Line
 2. Deleting an “Established” Data Field
- f. Entering and Deleting a Bit-State Field
- g. Entering and Deleting a Message Field
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- i. Entering “Associated” Fixed Text

- j. Exiting Text Editor Mode: **Exit** Key
- 6. Recalling the Last Formatted Page: RCL Command**
- 7. Storing a Page Format: SAV Command**
- 8. Editing an Existing Video Page**
- 9. Setting “Sign-On” Page: SOP Command**
- 10. Deleting a Video Page from EEPROM Memory: DEL Command**
- 11. Uploading, Downloading, and Revising Video Page Formats**
 - a. Introduction
 - b. Uploading a Video Page from the DataPAC: **VUL** Command
 - c. Downloading a Video Page to the DataPAC: **VDL** Command
 - d. Finding the Last Video Uploading/Downloading Error: **VEL** Command
 - e. Revising and Transmitting Format Lines: **LNE** Command
 - 1. Revising a Line of Video page Format
 - 2. Transmitting a Line of Video Page Format
- 12. Setting Visual Effects for Channel Display Fields**
 - a. “Visual Effects” and “Status”
 - b. Setting Visual Effects for a Data Field
 - 1. Internal vs. External Control of Data-Field “Status”
 - 2. Internal (Default) Control of Data-Field “Status”: **VBC**, **VGT**, **VBT**, and **VLT** Commands
 - a. The “BIT CONTROL” STATUS (VBC) Command
 - b. The “GREATER THAN” STATUS (VGT), “BETWEEN” STATUS (VBT), and “LESS THAN” STATUS (VLT) Commands
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 - 4. Setting Visual Effects for Time and Date Channels: **VBT** Command
 - c. Setting Visual Effects for a Bit-State Field
 - 1. The Bit-State Display: Designator Pairs
 - 2. Assigning a Designator Pair to a Bit-State Field: **BSD** Command
 - 3. Specifying a New Designator Pair: **BDP** Command
 - d. Setting Text and Visual Effects for a Message Field: **MES** Command
 - 1. Entering a System Message
 - 2. Specifying New Visual Effects for an Existing Message
 - e. Setting Visual Effects for a Video Playback Field

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- 1. Introduction: System Pseudochannels**
- 2. Setup of Download Pseudochannels**
- 3. Loading One or More Download Pseudochannels with a Fixed Data Value**
 - a. Volatile Download Pseudochannels (Type “D0”)
 - b. Nonvolatile (“Keep-Alive”) Pseudochannels (Type “D1”)
- 4. Loading a Volatile Download Pseudochannel with the Reading of Another Data Channel**
 - a. Loading of a Single Channel
 - b. Loading of a Range of Channels

2.E “LOCKING” AND “UNLOCKING” OF DATA

- 1. “Locking” One or More Data Channels: LOK Command**
- 2. “Unlocking” One or More “Locked” Channels: UNL Command**

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1. **Introduction: A Limit Setup “Getting Started” Procedure**
2. **Setting Limit Values: LOL and HIL Commands**
 - a. Setting Fixed Limit Values
 - b. Setting Variable Limit Values
 - c. Some Uses of Variable Limit Values
 1. Continuous Display of Limit Value
 2. Continuous Comparison of Two Data Channels
3. **Limit-Zone Indication: LZN, LIM, and NOL Commands**
4. **Setting “Limit Logic”: LLT, LBT, and LGT Commands**

2.G SETTING OTHER DATA-CHANNEL PARAMETERS

1. **Setting Scaling Factor and Zero Offset: EMM and BEE Commands**
2. **Setting Digital Filter: FIL Commands**
3. **Setting Tare Offset: TAR Command**

2.H SYSTEM LOGIC BITS

1. **Introduction: Bits, Bit Groups, and Logic Sources**
 2. **Assignment of Logic Source: SRC Command**
 - a. “Limit Logic”
 1. Latching “Limit Logic”
 2. Nonlatching “Limit Logic”
 - b. Logic Input
 - c. External Bit Control
 1. Temporary (“Run-Time”) External Control: **BIT**, **BIN**, **BCD**, and **HEX** Commands
 - a. Setting and Reading a Single Bit or a Range of Bits: **BIT** Command
 - b. Setting a Bit Group or Range of Bit Groups
 1. Setting a Bit Group to Binary Configuration: **BIN** Command
 2. Setting a Bit Group to Binary Coded Decimal Configuration: **BCD** Command
 3. Setting One or More Bit Groups to Hexadecimal Configuration: **HEX** Command
 2. Returning to Previous Logic Source
 3. Default to External Control
 - d. “Special Bit” Assignment
 - e. “Coprocessor” Logic Sourcing
 3. **Use of EXECUTE (EXU) Commands to Set Multiple Logic Sources**
 4. **Releasing a Latched Bit: RLS Command**
 5. **Disabling the Reading of System Bits: NOB and BTS Commands**
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2.J CROSS-CHANNEL CALCULATIONS: CLC COMMAND

1. Setup of Calculate Pseudochannels
2. Resetting of "MAX" and "MIN" Channels: "CHN=" Command
3. Examples of the CALCULATE (CLC) Command
 - a. Specific Gravity Correction of Flow Measurement
 - b. Temperature-Scale Conversion
 - c. Cable Diameter Measurement
 - d. Calculation of Horsepower
 - e. Calculation of Power Factor
4. Cancelling a Calculate Pseudochannel: RST Command

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1. Introduction
2. The EXECUTE (EXU) Command
 - a. Form and Use of the EXU Command
 - b. Examples of the EXU Command
 - c. Redefinition of "Execute Base Group": XBG Command
 - d. Monitoring Execute Command Queues: CSB and PSB Commands
 - e. Powerup Delay of Execute Functions: EXM Command
 - f. Disabling All Execute Functions: NOB and BTS Commands
3. The COMMAND (CMD) Command
 - a. Specifying Conditional Bits: CDL Command
 - b. Examples of Conditional Statements
 - c. Display of Conditional Statements: SHO Command
 - d. Form and Use of the COMMAND (CMD) Command

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1. System 10 Custom Linearization
2. The LINEARIZE (LIN) Command
 - a. Setting Up a "Real" Linearization Channel
 - b. Setting Up a "Pseudochannel" Linearization Channel
3. Cancelling a Linearization Channel: RST Command

2.M INTERNAL COUNTER/TIMER FUNCTIONS

1. Event Counting Via Download Pseudochannel: INC and DEC Commands
2. Time-Interval Counting Via Timer Pseudochannel
3. Use of Timer Commands for "A-Sized" DataPACs: TMR and TBT Commands

2.N VIDEO INPUTS AND OUTPUTS

1. Introduction
2. Standard VGA Input / Output (Models 10KN3, 10KN6, 10KN8A)
3. Model 10KN7 Video Outputs
 - a. Monochrome (RS-170)
 - b. RGB Color (CGA)

2.O OPERATOR CONSOLE: MODEL 10CCONB

2.P BACKUP PROVISIONS

1. Introduction
2. Backup Storage of Channel Setup Configuration: CON Command
3. Backup Storage of Channel Calibration Constants: EMM and BEE Commands
4. Backup Storage of Video Page Formats: VUL, VDL, and LNE Commands

2.Q LCD GRAPHICS

NOTE: This manual section applies only to older LCD-display mainframes and accessories (Models 10K2C, 10K4T-D, 10LCD12A, and 10LCD12-2) equipped with the "G" Option.

1. Setup of LCD Graphics

- a. Selecting Page Type: **PGT** Commands
- b. Setup of an "XY" Page
 1. Defining Page List: **PGL** Command
 2. Setting Graph Scales: **GRX** and **GRY** Commands
 3. Setting Graph Legends: **LEG** Command
- c. Setup of a "Strip-Chart" Page
 1. Defining Recorder List: **LST** Command
 2. Defining Page List: **PGL** Command
 3. Setting Graph Scales: **GRX**, **GRY**, and **GRZ** Commands
 4. Setting Channel x Legend: **LEG** Command
 5. Setting Recording Interval: **INT** Command
 6. Setting "Strip-Chart" Display/Recorder Mode: **GZL** and **GZR** Commands
 - a. "Zero Left" Mode
 - b. "Zero Right" Mode

2. LCD Graphics Operation

- a. Clearing a Displayed "XY" Graph: **GCL** Command
- b. Raising and Lowering Graph "Pens": **PEN** Command
 1. Control of "XY" Pen
 2. Control of "Strip-Chart" Pens
- c. "Pen Off-Screen" Indication
- d. "Strip-Chart" Recorder Control
 1. Clearing the Recorder: **REC** Command
 2. Halting the Recorder: **REH** Command
 3. Restarting the Recorder: **RES** Command

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- e. "Strip-Chart" Depth Interrogation: **DPT** Command
- f. Manual Scrolling of "Strip-Chart" Pages in "Zero Left" Mode:
Arrow and **Home** Keys

2.R FRONT-PANEL KEYPAD OPERATIONS

1. Introduction
2. "**CLEAR**," "**ENTER**," "**ARROWS**," and "**FUNCTION**" Keys
 - a. The "**CLEAR**" and "**ENTER**" Keys
 - b. The "**ARROW**" Keys
 - c. The "**FUNCTION**" Key
3. Channel Interrogation
4. Channel Configuration
5. Bit Interrogation and Setting
 - a. Bit Interrogation
 - b. Setting a Bit
6. Logic Configuration
7. DataPAC Configuration
 - a. General Analog Configuration
 - b. General Logic Configuration
8. Port Configuration

2.S OPTIONAL OPERATOR'S KEYBOARDS: MODELS 10P25A AND 10P25D

1. Introduction
2. Keyboard Functions
 - a. "Key" Prompts: "**FNCTN**" Key
 - b. LCD Billboard "Scroll": "**ARROW**" Keys
 - c. Clearing LCD Billboard: "**CLEAR**" Key
 - d. Channel Interrogation: "**CHAN**" and "**STEP**" Keys
 - e. Bit Interrogation: "**BIT**" and "**STEP**" Keys
 - f. Bit Setting: "**BIT**" and "**EQUALS**" Keys
 - g. Calling a Video Page to Display: "**PAGE**" Key

SECTION 3

OPTIONAL PROCEDURES FOR SPECIFIC CARDS

3.A SPECIAL "A-CARD" FUNCTIONS

3.A.1 COUNTER/TIMER FUNCTIONS: MODEL 10ACT01 AND MODEL 10ACC-4

- a. Introduction: Counter/Timer Modes of Operation
- b. Model 10ACT01 Setup
 1. 10ACT01 Connections
 - a. General Considerations
 - b. Suppression of Noise in Low-Frequency Input
 - c. Pull-Up Resistor

- 2. 10ACT01 Configuration
 - a. Setting 10ACT01 Mode: **TYP** Command
 - b. Setting Range and Resolution: **RNG** Command
 - c. Setting Input-Amplifier Sensitivity: **SEN** Command
 - d. "Slaving" of Multiple 10ACT01's
- c. Model 10ACT01 Operation**
 - 1. Incrementing the Count: **INC** Command
 - 2. Counter/Timer Control
 - a. Holding the Count/Time Value: **COH** Command
 - b. Updating the Count/Time Value: **COU** Command
 - c. Resetting the Counter/Timer: **COR** Command
 - d. Clearing the Counter/Timer: **COC** Command
 - 3. Disabling and Enabling External Input During Timer Operation: **EID** and **EIE** Commands
- d. Model 10ACC-4 Setup and Operation**
 - 1. 10ACC-4 Connections
 - 2. 10ACC-4 Configuration
 - a. Setting Range and Resolution: **RNG** Command
 - b. Setting "Debounce" Time
 - 3. Incrementing the Count: **INC** Command
 - 4. Counter Control: **COH**, **COU**, **COR**, and **COC** Commands

3.A.2 VOLTAGE AND CURRENT OUTPUTS: MODEL 10AAO-8 AND MODEL 10CAI-8

- a. Introduction**
- b. Setup of \pm 5-Volt Outputs**
 - 1. Model 10AAO-8 Connections
 - 2. Configuration of Analog Output Channels
 - a. Setting Channel Type: **ANO** Command
 - b. Setting Channel Location: **LCT** Command
 - 3. Setting Analog Output "Source": **ANO** Command
 - a. Setting Analog Output Equal to a Fixed Millivolt Value
 - b. Setting Analog Output as a Function of a System Data Channel
 - c. Interrogating for "Source" and Value of an Analog Output
 - d. Cancelling an Analog Output: **RST** Command
- c. Setup of 4-20 mA and \pm 10-Volt Outputs: Model 10CAI-8 Buffer Interface**
 - 1. 10CAI-8 Connections
 - 2. Programming of 10CAI-8 Outputs

3.A.3 LOGIC AND DIGITAL I/O: MODEL 10AIO-16

- a. Introduction**
- b. 10AIO-16 Connections**
- c. Setup of Logic I/O Ports**
 - 1. 10AIO-16 Initialization: **ASL** Command
 - 2. Specifying Logic Inputs: **SRC** Command
 - 3. Specifying Logic Outputs
- d. Indication of Logic I/O Port Activity**
- e. Digital I/O**

3.A.4 ANALOG PEAK CAPTURE: MODEL 10A79-4

- a. Introduction: 10A79-4 Inputs and Outputs for Analog Peak Capture**
- b. Peak-Capture Setup**
 - 1. 10A79-4 Connections
 - a. Connection of Analog Inputs
 - b. Connection of Logic Inputs
 - c. Connection of Analog Outputs
 - 2. Setting Channel Mode
 - 3. Configuring 10A79-4 Subchannels
 - 4. Calibrating 10A79-4 Subchannels: **TYP** and **CCH** Commands
- c. Peak-Capture Operation**
 - 1. "Tracking" the Analog Input
 - 2. "+ Peak" Capture
 - 3. "- Peak" Capture
 - 4. Holding a "+ Peak" or "- Peak" Subchannel without Decay: **CLC** Command

3.A.5 ANALOG "MAX MINUS MIN" FUNCTION: MODEL 10A79-4

- a. The 10A79-4 "MAX-MIN" Subchannel**
- b. "MAX-MIN" Setup**
 - 1. 10A79-4 Connections
 - 2. Setting Channel Mode
 - 3. Configuring and Calibrating "MAX-MIN" Subchannels
- c. "MAX-MIN" Operation**
 - 1. "Tracking" the Analog Input
 - 2. "MAX-MIN" Measurement
 - 3. Inversion of "MAX-MIN" Polarity: **EMM** Command
 - 4. Holding a "MAX-MIN" Subchannel without Decay: **LOK** and **UNL** Commands

3.A.6 ANALOG "TRACK AND HOLD" FUNCTION: MODEL 10A79-4

- a. "Track and Hold" Outputs and Subchannels**
- b. "Track and Hold" Setup**
 - 1. 10A79-4 Connections
 - 2. Setting Channel Mode
 - 3. Setting "Track and Hold" Outputs and Subchannels
 - 4. Configuring and Calibrating "Track and Hold" Subchannels
- c. "Track and Hold" Operation**
 - 1. "Tracking" and "Holding" the Analog Input
 - 2. "Holding" a Subchannel without Decay: **LOK** and **UNL** Commands

3.A.7 BUFFERING OF ANALOG SIGNALS: MODEL 10A79-4 AND MODEL 10AAO-4

- a. Unscaled Analog Buffering with the Model 10A79-4**
- b. Scaled Analog Buffering with the Model 10AAO-4**
 - 1. Introduction

2. Setup of 10AAO-4 Outputs
 - a. Connection of Analog Inputs
 - b. Setting Output Configuration
 - c. Setting Output Gain Values
 - d. Adjusting Output Zero and Span

3.A.8 BUFFER STORAGE OF DATA OUTPUTS: MODEL 10AFIFO

a. Introduction

b. Model 10AFIFO Setup

1. Software EEPROM Enable: **BIT** Command
2. 10AFIFO Connections
3. Setup of 10AFIFO-10ACP100 Interface
 - a. Setting Protocol for the DataPAC's Computer Interface Port
 - b. Setting Output and End-of-Transmission Terminators for the DataPAC's Computer Interface Port: **OPT** and **EOT** Commands
4. Setup of FIFO Computer Port
 - a. Setting Protocol
 - b. Setting Command, Output, and End-of-Transmission Terminators for the FIFO Computer Port: **CMT**, **OPT**, and **EOT** Commands
5. Setting 10AFIFO Input Mode: **DDI** and **NDI** Commands
6. Setting 10AFIFO Output Mode: **XEN** and **XDS** Commands

c. Model 10AFIFO Operation

1. Initiating Data Transmissions in "Gated" Output Mode
 - a. Destructive Data Output: **DDO** Command
 - b. Nondestructive Data Output: **NDO** Command
2. Halting and Restarting 10AFIFO Transmissions
3. Bypassing the 10AFIFO Main Memory: **BYP** Command
4. Reaccessing 10AFIFO Memory: **RFM** Command
5. Clearing 10AFIFO Memory: **FCL** Command
6. Interrogating for Input/Output Mode: **MOD** Command
7. Checking Data Integrity: **CSF** Command

3.A.9 PID LOOP CONTROL: MODEL 10APID

a. Introduction

b. Model 10APID Subchannels

c. Model 10APID Setup

1. Setting Clamp Limit Values
2. Setting Proportional (P) Mode
3. Setting Initial "P," "I," and "D" Values for "Fixed P" Operation
4. Setting Initial "P," "I," and "D" Values for "Variable P" Operation
5. Setup of Command and Response Inputs
 - a. Setting Input Modes
 - b. Setup and Display of Digital Input(s)
 - c. Connection of Analog Input(s)
6. Enabling the Integrator
7. Setup of 10APID Outputs
 - a. Connection of Analog Command, Response, and Error-Signal Outputs
 - b. Setup and Display of Digital Error-Signal Output
8. Tuning the Control Loop

3.B SPECIAL "B-CARD" FUNCTIONS

3.B.1 "ATTACHING" A DATAPAC COMMAND SOURCE TO A SPECIFIC B CARD: ATT, DET, AND VIA COMMANDS

3.B.2 LOGIC AND DIGITAL I/O: MODEL 10BIO-16

- a. Introduction
- b. 10BIO-16 Connections
- c. Setup of Logic I/O Ports
 - 1. 10BIO-16 Initialization: **BSL** Command
 - 2. Specifying Logic Inputs: **SRC** Command
 - 3. Specifying Logic Outputs
- d. Indication of Logic I/O Activity
- e. Digital I/O
 - 1. Binary Output: **BIN**, **HEX**, and **CCH** Commands
 - a. Binary Output to Represent a Fixed Decimal Value
 - b. Binary Output to Represent a Fixed Hexadecimal Value
 - c. Binary Output to Represent the Value of a Data Channel
 - d. Cancelling the **BIN** Command: **BIT** Command
 - 2. Binary Input: "**CHN**=" and **HEX** Commands
 - a. Reading the Decimal Value of a Binary Input
 - b. Reading the Hexadecimal Value of a Binary Input
 - 3. BCD Output: **BCD** and **CCH** Commands
 - a. BCD Output to Represent a Fixed Decimal Value
 - b. BCD Output to Represent the Value of a Data Channel
 - c. Cancelling the **BCD** Command: **BIT** Command
 - 4. BCD Input: "**CHN**=" Command

3.B.3 SATELLITE NETWORK SYSTEMS: MODEL 10BD4 AND MODEL 10BD1

- a. Introduction
 - 1. The Satellite Network
 - 2. Types of Satellites
 - 3. Synopsis of Satellite Setup Procedure
 - 4. Satellite Card Status Indicators
- b. Satellite Network Setup
 - 1. Setting Command Terminator for "A-Sized" DataPAC Satellites: **CMT** Command
 - 2. Assigning Satellite Numbers: **ASN** Command
 - a. Assigning Satellite Number to the Host
 - b. Assigning Satellite Numbers to Satellites
 - 3. Network Interconnections
 - 4. Setting Interface Protocol for "A-Sized" DataPAC Satellites
 - 5. Setting Up "Global" Data Channels
 - a. Setting Host and Satellite Scan Ranges: **TER** and **SCN** Commands
 - b. Dedicating Global Channels to DataPAC Satellites and to the Host: **SAT** Command
 - c. Setting an "A-Sized" DataPAC Satellite to "Hear" Global Channels Not Dedicated to that Satellite: **DLC** and **TYP** Commands

- d. Setting a "B-Sized" DataPAC Satellite to "Hear" Global Channels Not Dedicated to that Satellite: **LCT** and **RST** Commands
- 6. Setting Up "Global" Logic Bits
 - a. Dedicating Global Bit Groups to DataPAC Satellites and to the Host: **SSB** Command
 - b. Setting an "A-Sized" DataPAC Satellite to "Hear" Global Logic Bits Not Dedicated to that Satellite: **DLB** and **SRC** Commands
 - c. Setting a "B-Sized" DataPAC Satellite to "Hear" Global Logic Bits Not Dedicated to that Satellite: **SRC** and **NOB** Commands
- 7. Setting Host and Satellites for Local Data Acquisition and for Display of Global Data
- 8. Setting Satellite "Execute Base Groups": **XBG** Command
- c. Satellite Network Operation**
 - 1. Introduction: Global Commands
 - 2. Requesting the "Location" of a Global Data Channel from Any "B-Sized" DataPAC Node: **LCT** Command
 - 3. Requesting the "Logic Source" of a Global Logic Bit from Any "B-Sized" DataPAC Node: **SRC** Command
 - 4. Disabling the "Implicit Addressing" of Global Commands from a "B-Sized" DataPAC Node: **GBL** Command
 - 5. "Explicit" Routing of Global Commands
 - a. "Opening" a Direct Command Route Between Any Two Network Nodes: **OPN** Command
 - b. Routing a Single Command Between Any Two DataPAC Nodes: **NOD** Command
 - 6. Communications Diagnosis
 - a. Requesting Error Log: **SEL** Command
 - b. Resetting Error Log: **REL** Command

Appendix: Considerations for Altering an Existing Satellite Network

3.B.4 DIGITAL "HISTORY" RECORDING AND PLAYBACK: MODEL 10BDR64 AND ACCESSORIES

Note on New History Card Products

a. Introduction

- 1. The History Card
- 2. "Frames" and "Depth"
- 3. History Card Status Indicators

b. History Memory and Time Considerations

- 1. Calculating Recorder Memory Volume
- 2. Optional Extension of History Memory
- 3. Initiating Nonvolatile History Memory: **NVH** Command
- 4. "Clearing" and "Erasing" History Memory
 - a. The **HISTORY CLEAR (HCL)** Command
 - b. Other Memory-Clearing Commands: **LST** and **DPT** Commands
 - c. "True Erasure" of History Memory: **NVH** Command
- 5. Requesting Total History Memory: **MEM** Command

c. Installation of the History Card Set

d. History Card Setup

- 1. Introduction
- 2. Entering Setup Mode: **SMD** Command
- 3. Listing Variables to Be Recorded: **LST** Command

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4. Setting Recorder Depth: **DPT**
5. Specifying "Store" Conditions: **STO** Command
 - a. The **STORE (STO)** Command
 - b. **STO** Mnemonics
 1. Data-Channel Limit Status: **ZGT, ZLT, and ZVO**
 2. Logic State of System Bit: **BIT**
 3. Logic-State Transition of System Bit: **BGL and BGH**
 4. Time Interval: **INT**
 - c. Examples of the **STO** Command
6. Specifying "Halt" Conditions: **HLT** Command
7. Setting Halt Depth: **HDP** Command
8. Defining Playback Pseudochannels: **PLA** Command
 - a. Introduction: "Normal" and "Video" Playback Pseudochannels
 - b. The **PLAYBACK (PLA)** Command and Related "Run-Time" Commands (**ZUM, FRZ, RPL**)
 - c. Special Video Playbacks: Serial Number, Time, and Date
 - d. Statistical Playbacks: **Model 10BSPC**
 1. "Continuous" Statistical Playbacks: Average, Maximum, and Minimum
 2. "Industry Standard" Statistical Playbacks: X-BAR and Range
 - e. Resetting "X-BAR" and "Range" Playbacks: **RSP** Command
 - f. Cancelling Playback Assignments: **PLA** and **RST** Commands
9. Setting Up Playback of System Bit Groups: **CHN, PLA, CCH, and BIN** Commands
10. Formatting Recorder Outputs: **IMA** Command
- e. History Card Operation**
 1. Introduction
 2. Entering Record Mode: **RMD** Command
 - a. The **RECORD MODE (RMD)** Command
 - b. Automatic Entry of **RMD** Following Powerup in "Nonvolatile History" Mode
 3. Resetting Serial Number: **RSN** Command
 - a. Resetting Next Frame to Zero
 - b. Resetting Next Frame to an Integral Number
 4. Requesting Current Halt Status: **CHS** Command
 5. Restarting a Halted Recorder: **STH** Command
 6. "Emptying" and "Reaccessing" History Memory
 - a. The **EMPTY (EMP)** Command
 - b. The **REACCESS HISTORY MEMORY (RHM)** Command
 7. "Dumping" History Memory: **HDU** Command
 - a. Frame Numbering
 - b. The **HISTORY DUMP (HDU)** Command
 8. Playback Time Search
 - a. The **ZOOM (ZUM)** Command
 - b. "Zooming" a Data Set
 - c. "Freezing" the Search Frame: **FRZ** Command
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b. Model 10BACI System Status Indicators

c. Setup of the Auxiliary Computer Interface

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4. Setting ACI Command Terminator: **CMT** Command
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2. Transmitting a Time-Coherent Data "Frame": **FCH** Command
3. The **MTC** Command
4. Response to **DSD** Command

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3. Setup of the RS-422 Auxiliary Computer Interface
4. Transmitting a Time-Coherent Data "Frame": **FCH** Command
5. Setting Up the Master Timing Clock: **CLK** and **MTC** Commands
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NOTE: This manual section applies only to older "T" versions of the Model 10KN6 Mainframe (10KN6T, 10KN6-2T, 10KN6-3T, and 10KN6-4T).

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[NOTE: This section will be included within the Guidebook itself only when a *printed* version is supplied.]

- [B] [NOTE: This appendix has been superseded by the current Guidebook **Section 1.B ("Card Insertion and Removal")**, and has been removed.]

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- [D] [NOTE: This appendix has been superseded by material in the current Guidebook **Section 1.A.3.a ("Mainframe Powerup, AC Operation")**, and has been removed.]

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DAYTRONIC

**GETTING YOUR
SYSTEM 10
ON THE AIR**

FOR "A-SIZED" MAINFRAMES



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“ON THE AIR” (A-SIZED)



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Part No. 91777

GETTING YOUR SYSTEM 10 ON THE AIR

FOR “A-SIZED” MAINFRAMES

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1 INTRODUCTION

1.a THE PURPOSE OF THIS BOOKLET

Working for the first time with an instrument system as comprehensive and versatile as the Daytronic “System 10” can be a bit overwhelming. There are so many interrelated functions the system can be made to perform—functions for data collection, display, processing, communications, reporting, and process control. And there are so many critical setup procedures, all depending on the exact requirements of your particular measurement and control application.

All users agree that System 10 is comparatively easy to set up and run. Nonetheless, we realize that even the most technically competent first users could do with a little help. The purpose of this booklet is to familiarize you with the *basic setup procedures* required for proper system operation. To keep things on as simple a level as possible, we will not discuss a number of additional—and strictly optional—procedures. These are all treated in detail in your *System 10 Guidebook*.

By walking you step-by-step through the basic system setup, this booklet will help you get your system “on the air” as quickly as possible, without initially burdening you with “all the details.”

You’ll probably want to read this booklet before you open your *System 10 Guidebook*. However, having done so, and having carefully performed all the tutorials given here, don’t neglect to study the Guidebook itself! This is not a “short-form manual,” but rather a simplified presentation of selected—but “basic”—setup procedures, along with some essential background information. Its only purpose is to GET YOU STARTED.

1.b “A-SIZED” MAINFRAMES AND EXTENDED KEYBOARDS

There are two basic types of System 10 mainframes: “A-sized” and “B-sized.” This booklet treats only A-sized mainframes. Each A-sized mainframe contains a single rack for plug-in “A Cards” only. “A Cards” include all basic System 10 SIGNAL CONDITIONER CARDS, as well as certain SPECIAL FUNCTION CARDS. These include cards for Analog Outputs, Logic Inputs and Outputs, Analog Peak Capture and Hold, FIFO Buffer Memory, PID Loop Control, and Diagnostic Testing.* Features of all presently manufactured A-sized System 10 mainframes are summarized in Appendix A of this booklet.

The procedures in this booklet require that you issue appropriate **mnemonic commands** to your system. Such commands may be issued either “locally” or “remotely.” You issue commands “locally” by typing them on an EXTENDED KEYBOARD connected to your mainframe. You issue commands “remotely” by using an EXTERNAL COMPUTER OR TERMINAL to deliver them via the mainframe’s Computer Interface Port.** Note that some A-sized mainframes are supplied with a Model 10P80A Extended Keyboard, while for other mainframes, a keyboard—either the Model 10P80A or the Model 10P80D—is optional.

* Mainframes from the “10K1/10K2” family (only) also have an “A-sized” CENTRAL PROCESSOR/ INTERFACE CARD (a version of the Model **10ACP100** or **10ACP200**), which is always installed in the rightmost “A Slot.”

** As you will see in Section 14 of this booklet, you can also arrange for one or more commands to be applied automatically on occurrence of predefined system conditions and events.

The **Model 10P80D Extended Keyboard** has a 2-line LCD “billboard” for display of command entries, system interrogation responses, and standard system prompting messages. It also has the special “keypad” setup and interrogation features of the 10KU-KD and 10K4T-KD mainframes (discussed Section 17 of this booklet and in Section 2.R of the *System 10 Guidebook*). Note also that the hand-held **Models 10P25A and 10P25D Operator’s Keyboards** can be used with A-sized mainframes to perform a limited number of “run-time” operations, as described in Section 2.S of the *System 10 Guidebook*.

FOR ALL PROCEDURES DESCRIBED IN THIS BOOKLET, IT IS ASSUMED THAT YOU ARE USING AN EXTENDED KEYBOARD FOR LOCAL MANUAL ENTRY OF SETUP AND INTERROGATION COMMANDS. REMEMBER, HOWEVER, THAT YOU CAN JUST AS EASILY ENTER ALL COMMANDS GIVEN IN THIS BOOKLET THROUGH AN EXTERNAL COMPUTER OR TERMINAL, ONCE RS-232 LINKAGE THROUGH THE COMPUTER INTERFACE PORT HAS BEEN PROPERLY ESTABLISHED. For “remote” command entry, the easy-to-use **TERMINAL** program is included in the **StartPAC V** software supplied with your mainframe—although any conventional terminal emulation package will also work.

If your mainframe does not have an extended keyboard, you will have to enter all commands “remotely.” In this case, you will need to set up your mainframe’s Computer Interface Port before any other procedures are performed. Turn now to Section 2.B of your *System 10 Guidebook* and follow the interface setup instructions given there.

1.C IF YOU NEED HELP...

If at any time you need assistance in getting your System 10 “on the air”—or if problems arise at any later time—feel free to call our CUSTOMER SERVICES DEPARTMENT at

(937) 293-2566

FAX: (937) 293-2586

TOLL-FREE: (800) 668-4745

during normal business hours (Monday through Friday, 8:00 a.m. to 5:00 p.m.). Or you can EMAIL us at

sales@daytronic.com

**New Windows®-based
System 10 Configurator Software for “A-Sized” Systems
may now be ordered free of charge from
daytronic.com**

Employing the run-time version of **Microsoft® Access 2000**, this program lets you define, store, edit, download, and manage any number of “A-sized” configurations (only). This convenient utility will save a great deal of time and effort when it comes to setting up the system. And it provides complete back-up security if an existing configuration ever needs to be reloaded.

A sequence of easy-to-use screens with complete context-sensitive HELP steps you through the entire setup process—all the way from selecting and “locating” the plug-in cards that go into the mainframe to “live” calibration of individual analog input channels, based on an appropriate user-selected method. Visit **daytronic.com** for complete details.

DO NOT PLUG IN YOUR MAINFRAME JUST YET.

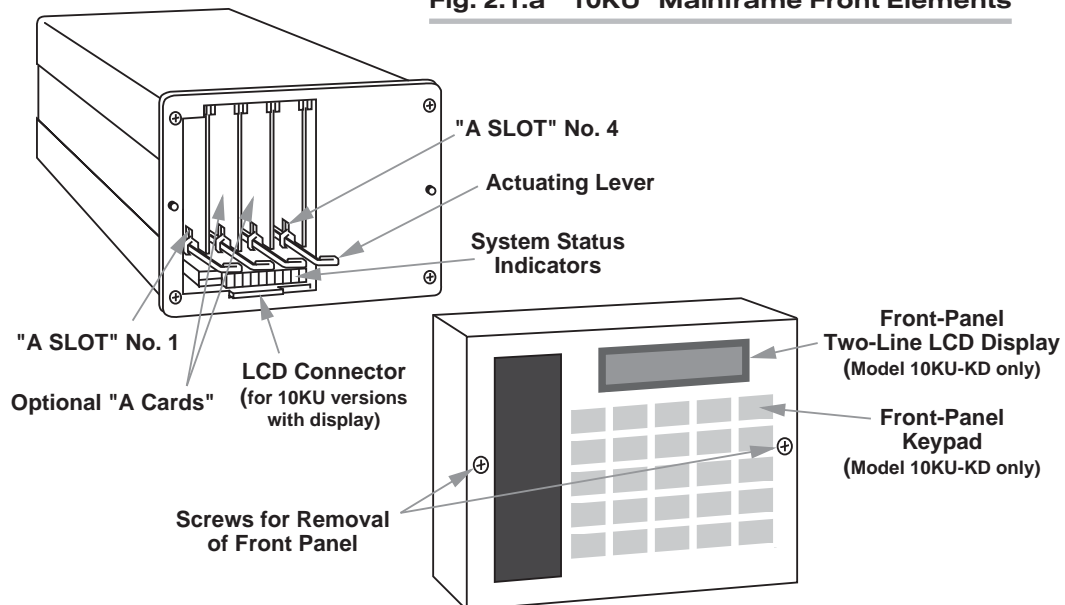
Study the appropriate front- and rear-view drawings below to familiarize yourself with your mainframe's most important physical elements. Be sure that you know the locations of your particular mainframe's

- **A Slots and A Cards**, including Central Processor/Interface Card, if present (internal)
- **System Status Indicators** (visible from the front)
- **Power Connector, Fuse, and ON/OFF Switch** (rear panel)
- **Voltage Selector Switch** (rear panel)
- **Plug-In Keyboard Connector** (front or rear panel, depending on model)
- **Computer Interface Connector** (rear panel)
- **RS-232 Protocol Switches** (internal or rear panel, depending on model)
- **EEPROM Write Protect Switch** (internal or rear panel, depending on model)

NOTE: To access the EEPROM Write Protect Switch and RS-232 Protocol Switches of a mainframe of the "10K1/10K2" family, you will have to remove the front bezel by gently prying it off the snap-on posts that secure it to the mainframe. For the other A-sized mainframes, there is no reason to remove the front bezel (you would have to unscrew it anyway), unless you need to add, remove, or "swap" A Cards.

Shown in Fig. 2.4 is the Extended Keyboard you will use to set up your system. The only difference in appearance between the 10P80A and 10P80D keyboards is that the latter incorporates a 2-line LCD ("BILLBOARD") for display of command entries, system interrogation responses, and standard system prompting messages.

Fig. 2.1.a "10KU" Mainframe Front Elements



**Fig. 2.1.b "10KU"
Mainframe Rear Elements**

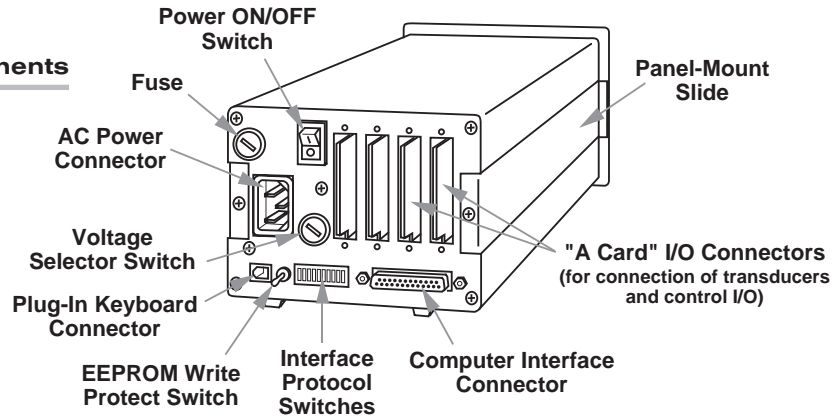
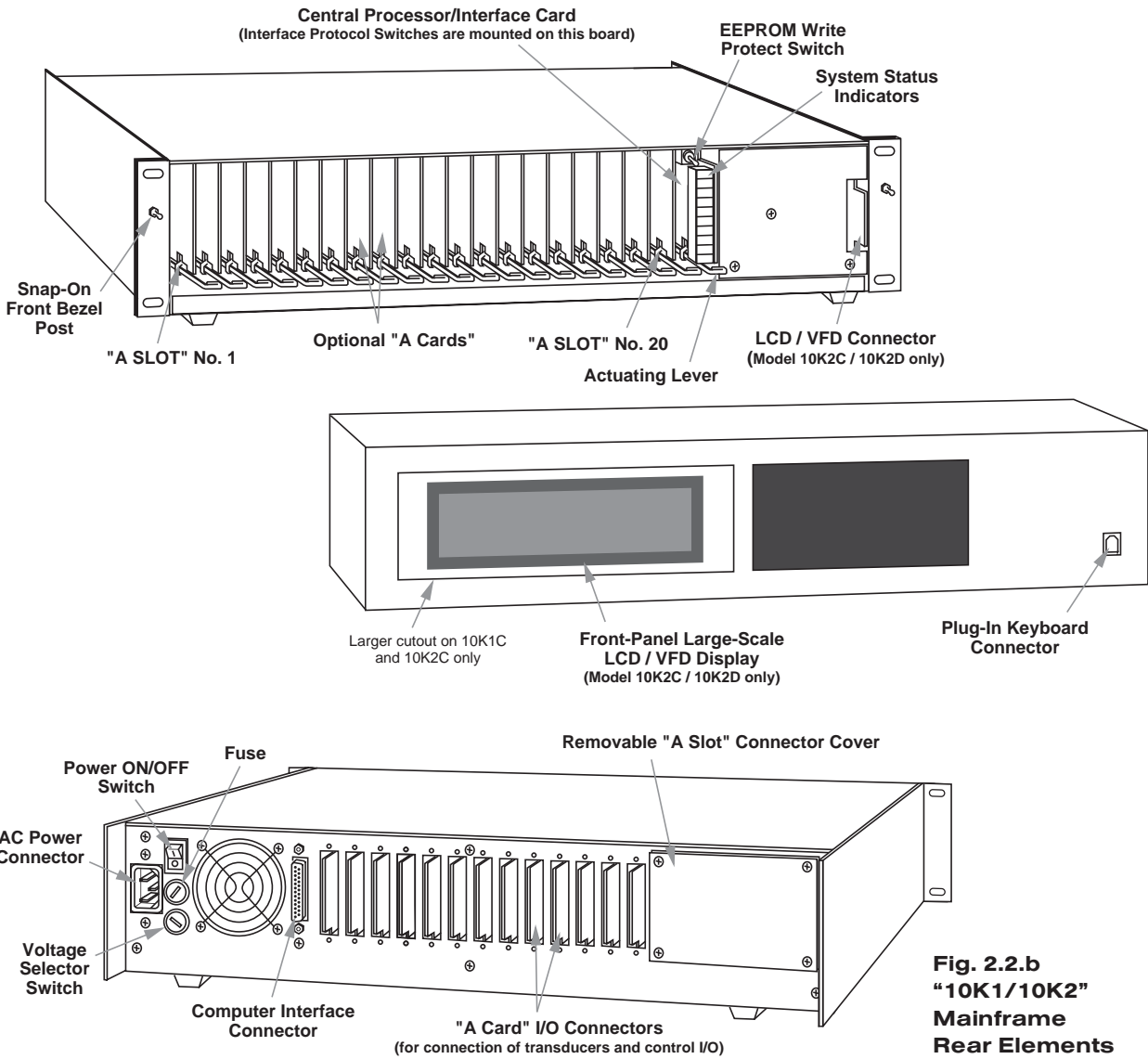


Fig. 2.2.a "10K1/10K2" Mainframe Front Elements



**Fig. 2.2.b
"10K1/10K2"
Mainframe
Rear Elements**

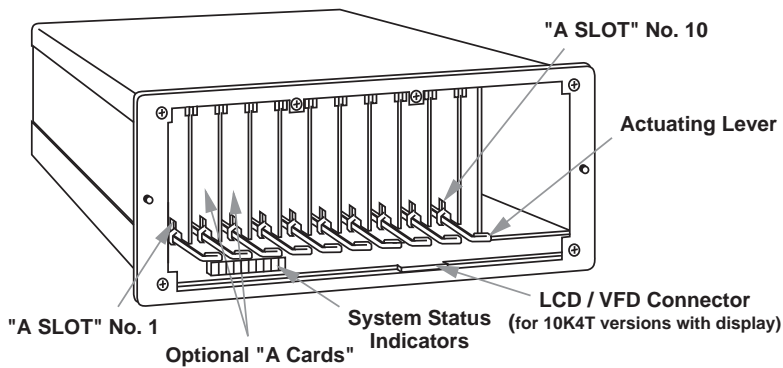


Fig. 2.3.a "10K4T" Mainframe Front Elements

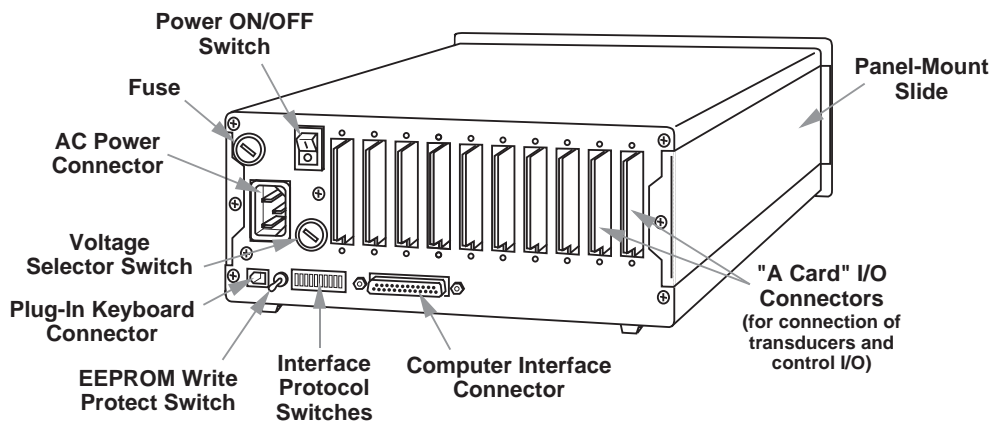
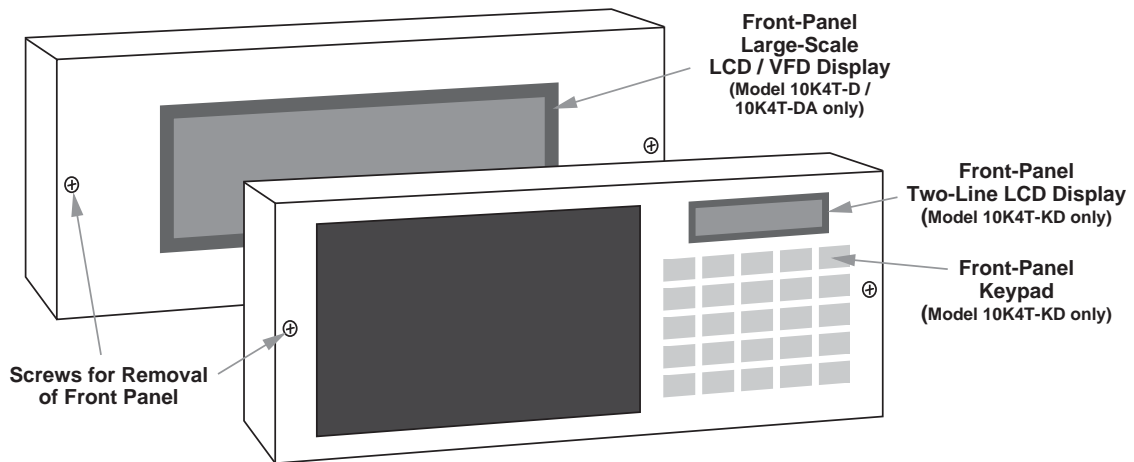


Fig. 2.3.b "10K4T" Mainframe Rear Elements

3

POWERUP

- a. **IMPORTANT:** Before powering it up, make sure your mainframe is set for the local line voltage (nominal 110 or 220 V-AC). Check the Voltage Selector Switch on the rear panel. If you need to change the voltage setting, see Section 1.A.3 of the *System 10 Guidebook*.
- b. **IMPORTANT:** Make sure the EEPROM Write Protect Switch is OFF (*downward* position) before you power up your mainframe and before you turn it off. You should always take this precaution in order to avoid sporadic writes to the EEPROM and other possible EEPROM problems.
- c. Plug the power cord supplied with your mainframe into the rear-panel AC Power Connector. Plug the other end of the cord into your primary power source.*
- d. Turn on the mainframe by depressing the top half of the rear-panel ON/OFF switch. The four front-panel System Status Indicators labelled **ERR**, **CHR**, **MNE**, and **RET** should all light for about one second, and then go off, to verify proper system powerup. If your mainframe has an integral multichannel LCD or VFD display, it will normally display Page Format No. 1 (Channels 1 through 12 with legends of "MVV") when first powered up. The display "billboard"—whether on the mainframe or a connected 10P80D keyboard—will show your company's name, or other prespecified alphanumeric "logo."

4

KEYBOARD CONNECTION AND INITIALIZATION

- a. Plug the free terminal of your keyboard's connector cord into the KEYBOARD CONNECTOR on the front or rear of the mainframe. The lock lever will snap into place as the terminal is fully engaged.
- b. Press the **HOME** key to establish proper keyboard communications with the system.**
- c. To verify proper keyboard connection, press any key. The System 10 mainframe's green Status Indicator labelled **KBD** should blink.

LEAVE THE KEYBOARD CONNECTED DURING THE SETUP PROCEDURES THAT FOLLOW.

*See Section 1.A.3 of the *System 10 Guidebook* for connection of a "**V**"-Option mainframe to a vehicle battery or other DC power source.

** If you are using a Model 10P80D Extended Keyboard with a Model 10KU, 10K1C, or 10K4TA mainframe, you must press **Home** every time power is cycled, to initialize the keyboard LCD display.

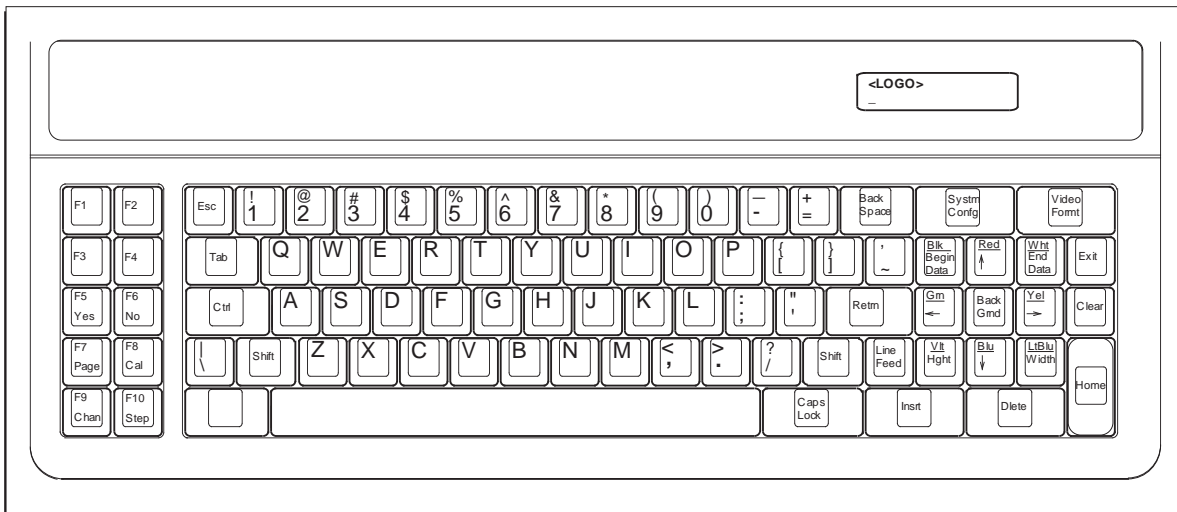


Fig. 2.4 Model 10P80D Extended Keyboard

5 LCD/VFD DATA DISPLAY SETUP

This section applies only to A-sized mainframes with *multichannel LCD or VFD data-display capability, either local or remote* (see Appendix A of this booklet for details).^{*} These mainframes can store up to 40 separate DATA DISPLAY PAGE FORMATS (or “DISPLAY PAGES”). Each LCD display page can be dedicated to up to 12 selected data channels, *including* system TIME and DATE. Each VFD display page can be dedicated to up to 12 selected data channels, *in addition to* system TIME and DATE, which are always displayed when the VFD display’s two-line “billboard” is not being used for some other purpose.

In this section, you will learn how to

- define a “logo” for the display billboard, using the **LOGO (LGO)** command
 - call a specific page to display, using the **PAGE (PAG)** command or key
 - specify a channel “list” for a given display page, using the **PAGE LIST (PGL)** command
 - specify individual channel legends, using the **LEGEND (LEG)** command
- a. Turn ON your mainframe’s EEPROM Write Protect Switch by placing it in the upward position. An alternative method for enabling the EEPROM Write Protect function—especially useful when you don’t want to have to remove the front bezel to access the switch—is to type a command of

BIT 999 = 1 [CR]

on the keyboard. Note that every keyboard-entered command must be termi-

^{*} All currently manufactured “A-sized” mainframe models with integral multichannel data display use a **vacuum fluorescent display (VFD)**.

ALSO NOTE: For a mainframe with multichannel LCD or VFD display (local or remote), you must set the **Display (DIS)** setup parameter to “2” (if it is not already set to this value) by commanding

DIS = 2 [CR].

If the mainframe has no display or if it has only a two-line “billboard” display (local or remote), the **DIS** value should be “1.”

nated by pressing the CARRIAGE RETURN (**Retrn**) key, here designated by “[CR].”

The red Status Indicator labelled **E2P** will light when the EEPROM Write Protect function has been enabled.

- b. Note the “logo” text presently in the display billboard. Change the “logo” to “ABC CORP.” by typing

LGO = ABC CORP. [CR]

Note that every keyboard-entered command must be terminated by pressing the CARRIAGE RETURN (**Retrn**) key, here designated by “[CR].”

- c. Now enter an **LGO** command to change the “logo” back to its original text, or to whatever other text you want. The “logo” text string can take up to 27 alphanumeric characters.

If your mainframe has a 7-line *LCD* display, you will set up Display Page No. 13 to display Data Channel Nos. 1, 2, 3, 4, 5, 7, 10, 28, 119, 121, 998, and 999, in that order. If it is an 8-line *VFD* display, you will set up this page to display Data Channel Nos. 1, 2, 3, 4, 5, 7, 10, 28, 119, 121, 122, and 129, in that order. In either case, you will also want to assign an appropriate engineering-unit legend to each channel, as explained in Step f, below. Your final display (if it is an LCD display) will then look like that shown in Fig. 5.1.a, below. If it is a VFD display, it will look like that shown in Fig. 5.1.b.

For every System 10 mainframe, Channel No. **998** always reads the system TIME, and Channel No. **999** always reads the system DATE. In Section 9, you will learn

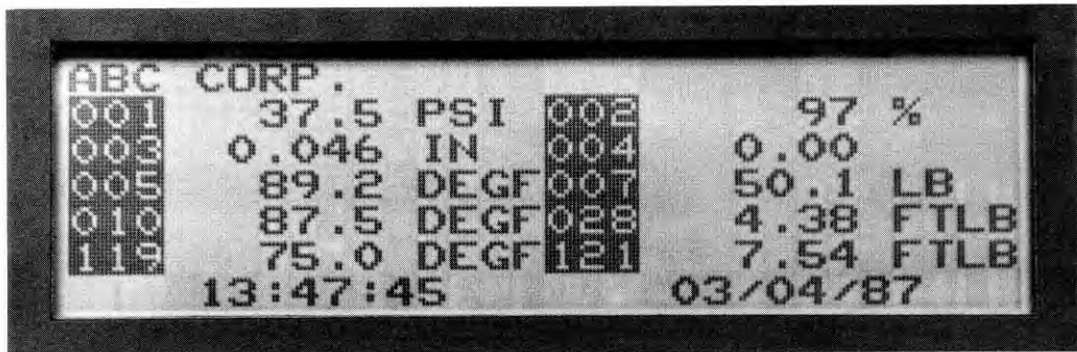


Fig. 5.1.a Multichannel LCD Display



Fig. 5.1.b Multichannel VFD Display

how to set your system's TIME and DATE. Note that TIME and DATE are included in every VFD display, in addition to the 12 user-selected data channels. Channels 998 and 999 need not therefore be specified in the "channel list" for any VFD display page.

A VFD display also has per-channel LIMIT-STATUS INDICATION: an arrow following the data reading points UP for a "HI LIMIT" violation, DOWN for a "LO LIMIT" violation, and LEFT for an "OK" (no violation) value—see Section 13 for "Limit Setup."

- d. Call Page No. 13 to display by typing

PAG 13 [CR]

You can also use the keyboard's **Page** key to call pages to display. Simply press **Page**, the number of the desired page (1 through 40), and **[CR]**.

- e. Specify the appropriate "channel list" for Page No. 13 by typing (for an LCD display)*

PGL 13 = 1,2,3,4,5,7,10,28,119,121,998,999 [CR]

or (for a VFD display)

PGL 13 = 1,2,3,4,5,7,10,28,119,121,122,129 [CR]

- f. Use the **LEG** command to assign a unit legend to each displayed channel, as shown in Fig. 5.1. For the first displayed channel (No. 1), type

LEG 1 = PSI [CR]

For the second channel (No. 2), type

LEG 2 = % [CR]

And so on for all displayed channels. Note that the fourth displayed channel (No. 4) has no legend. For it, you will type

LEG 4 = [SPACE] [CR]

A channel's displayed unit legend can have up to four alphanumeric characters, any or all of which may be spaces. For an LCD display, Channels 998 (TIME) and 999 (DATE) do not take legends.

6 SETUP OF ANALOG INPUTS: TRANSDUCER CABLING

If you ordered sensor cables with your System 10, these will be equipped with individual female 20- or 40-pin CONDITIONER CONNECTORS, all properly labelled and "keyed."

Fig. 6.1.a, below, shows the "standard" 20-pin connector for a Daytronic "10A" Conditioner Card, with *internal solder terminals* for up to eight separate transducer cables. "10A" Thermocouple Conditioners like the Models 10A9-8C and

* The channels entered via the **PGL** command need not be entered in sequential order. They will, however, always appear on the displayed page in the same order in which they are entered in the command. If fewer than twelve channels are specified for a given display page via the **PGL** command, the remaining (unspecified) data fields on that page will be automatically dedicated to a portion of the range of channel numbers "native" to that page (i.e., Channel Nos. 1-12 for Page No. 1; Channel Nos. 13-24 for Page No. 2; Channel Nos. 25-36 for page No. 3; etc.). Note too that the same channel number may be entered more than once, if desired, either within the same page list or in different lists.

Fig. 6.1.a Standard "10A" Conditioner Connector

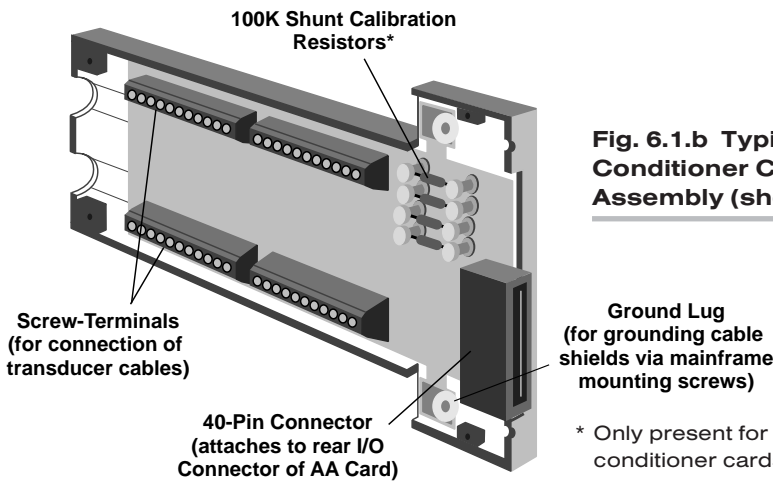
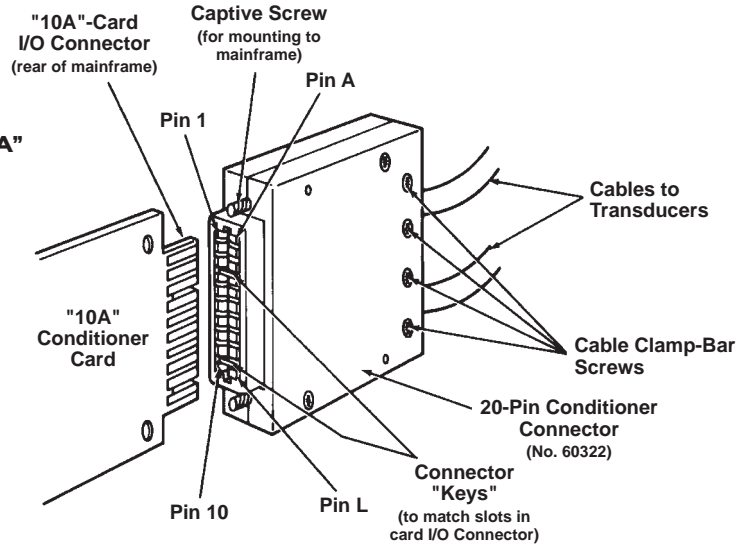


Fig. 6.1.b Typical "AA" Conditioner Connector Assembly (shown upside down)

* Only present for strain gage conditioner cards.

10A10-4 require special screw-terminal connectors, similar to that shown in Section 1.E of the *System 10 Guidebook*.*

Fig. 6.a.b shows a typical 40-pin connector for a Daytronic "AA" Conditioner Card, with labelled *screw terminals* for direct connection of transducer cable leads.

If you're supplying your own sensor cables, you should carefully read Section 1.E of the *System 10 Guidebook*, along with the individual **conditioner card subsection(s) of Section 1.E.2** that apply to your system. All necessary cabling instructions are given here.

To create your first "real-world" DATA CHANNEL, you should now connect at least one transducer to your mainframe. This should be a transducer that can be both zeroed and loaded with an arbitrary value of the measured parameter (NOT, in most cases, a Thermocouple, Thermistor, or RTD). A perfect example of such a transducer is a **load cell**.

* Several other "10A" cards require special I/O provisions. For example, the Model 10A68-2 Dual AC RMS Conditioner Card mates with a special connector board that has a separate screw-terminal block for each input channel, and the Model 10A74-4C Quad Strain Gage Track-Hold Conditioner Card will normally use a special Bridge Completion Connector in place of the standard connector. See the specific subsection of *System 10 Guidebook* Section 1.E.2 for complete details.

You will use this channel for the procedures given in the following sections. For a listing of all *preconfigured* data channels in your particular system, see the print-out in **Appendix A** of your *System 10 Guidebook*.*

NOTE: While most CONDITIONER CARDS are ready to be calibrated as soon as they are properly cabled to their respective transducers, a few of them require **special setup procedures** under certain circumstances. Be sure to check the section entitled “SETUP AND/OR OPERATING CONSIDERATIONS” in each card-specific subsection of *System 10 Guidebook Section 1.E.2* that applies to your system.

7 DATA CHANNEL CONFIGURATION

In this section, we will consider the configuration of your system’s REAL CHANNELS. A “real channel” is an analog input channel containing physical measurement data from the “real world.” There are other types of data channels that must be configured before they can be used—including ANALOG OUTPUT CHANNELS, PSEUDOCANNELS, and CONVERSION CHANNELS. You need not worry about these other types of channels right now.

NOTE: IN ALMOST ALL CASES, YOUR SYSTEM’S ANALOG-INPUT CHANNELS WILL HAVE BEEN FULLY CONFIGURED AT THE FACTORY, IN ACCORDANCE WITH SPECIFICATIONS GIVEN AT THE TIME OF ORDER. Therefore, you need not normally concern yourself (at least initially) with the configuration procedure, unless you need to *reconfigure* your system, through the addition or removal of one or more cards, the reassignment of transducer inputs, the physical interchange of cards within the mainframe, etc.

“Configuration” of a real channel ordinarily involves applying to that channel first a **TYPE (TYP)** command and then a **LOCATE (LCT)** command. In the following procedure, however, you will simply interrogate the system to confirm pre-entered **TYP** and **LCT** values for a few selected channels. YOU WILL NOT—AND SHOULD NOT—CHANGE THESE VALUES AT THIS TIME. If, in the future, you do need for some reason to reconfigure one or more real channels, refer to **Appendix C** of the *System 10 Guidebook*.

In this section you will also learn how to use the keyboard’s **Step** and **Back Space** keys for rapid sequential interrogations.

- a. Turn to **Appendix A** of your *System 10 Guidebook*.* There you will find a customized printout, which we will call the “System 10 Data Sheet.” This is a complete listing of all data channels in your system as shipped, giving important setup information for each existing real channel, including
 1. the MODEL NUMBER of the plug-in card that handles the channel
 2. the “TYPE” designation for the channel
 3. the “LOCATION” of the channel relative to the system’s A SLOTS
 4. the initial DIGITAL FILTER SETTING for the channel (0 through 9)
 5. the initial SCALING FACTOR (“EMM”) and ZERO OFFSET (“BEE”) values for the channel
 6. the initial LOW and HIGH LIMIT SETTINGS for the channel
 7. the initial “LIMIT LOGIC” SETTINGS for the channel

* PLEASE NOTE: The **System 10 Data Sheet** will be included within the *System 10 Guidebook* itself (as **Appendix A**) only when a *printed* version of the *Guidebook* is supplied with a specific System 10. WHEN THE *GUIDEBOOK* IS PROVIDED ON CD OR OTHER ELECTRONIC MEDIUM, THE DATA SHEET WILL BE PROVIDED AS A SEPARATE DOCUMENT.

8. other channel parameters that may apply (including Linearization Function, Conversion Channel assignment, Range value, and Sensitivity value)

The data sheet also shows which channels, if any, have been preassigned to CALCULATION and/or ANALOG OUTPUT functions. It lists all "EXECUTE" statements that have been pre-entered for your system, as well as all "LOGIC SOURCE" assignments for system bits. Other miscellaneous system parameters are also listed. If the mainframe has a multichannel LCD or VFD display, it gives all display-page channel lists and unit-legend assignments. Finally, it gives all relevant SERIAL NUMBERS and SOFTWARE/HARDWARE "VERSION" NUMBERS, plus all initial mainframe A-SLOT ASSIGNMENTS.

For the purposes of this tutorial procedure, you need only refer to the "CHANNEL CONFIGURATION" section of the data sheet.

- b. Since you will not be entering any setup values here, but only interrogating the system for existing values, the EEPROM Write Protect function need not be enabled. Turn OFF the mainframe's EEPROM Write Protect Switch by placing it in the *downward* position.*
- c. Enter from the keyboard a command of

TYP 1 [CR]

This is an INTERROGATION (or "READ") command. Unlike most SETUP (or "WRITE") commands, an interrogation command has no "equals" sign (=). It doesn't serve to enter (or "write") system configuration data into the Central Processor's EEPROM, but to retrieve (or "read") configuration data out of it.

The two-character (hexadecimal) "TYPE CODE" shown on the data sheet for Channel No. 1 should now appear in the billboard region of the mainframe or keyboard display. A channel's type code specifies one or more special processing factors that may apply to that channel, including range, sensitivity, linearization table, calibration procedures, etc. For example, a type of **19** signifies a "Type J" thermocouple input, and a type of **6B** signifies a ± 200 V-DC voltage input. A complete list of all channel type codes may be found in **Appendix C** of the *System 10 Guidebook*.

- d. Press the keyboard's **Step** key. This "steps" the last-entered interrogation command to the next channel in numerical sequence. Thus, the type code for Channel No. 2 should now appear on the billboard. Check the data sheet to verify that this is indeed the case.
- e. Use the **Step** key to continue "stepping" through several more channels. (For rapidly stepping through a whole range of channels, press **Step** and hold it down.)
- f. Now use the **Back Space** key to "step" *backwards* through the interrogation series.
- g. Enter from the keyboard a command of

LCT 1 [CR]

The appropriate "LOCATION" number for Channel No. 1 should now be displayed.** The location number consists of the A-SLOT NUMBER for the "A

* If you used the **BIT 999 = 1 [CR]** command to enable the EEPROM Write Protect function, you can disable this function simply by typing on the keyboard a command of **BIT 999 = 0 [CR]**.

** The default "location" number for all channels to which the "WRITE" form of the **LCT** command has not been applied is "11." For a "nonlocated" channel—for example, a "pseudochannel" or "conversion channel"—the response to **LCT x [CR]** is "N/A."

CARD” that handles the given channel, followed by the SUBCHANNEL NUMBER corresponding to this channel (1 through 8).* A-Slot capacities vary with mainframe models. A mainframe of the “10KU” family can hold up to four optional A Cards; a “10K1/10K2” mainframe, up to twenty; and a “10K4T” mainframe, up to ten.

For example, the channel corresponding to the fifth subchannel of the card occupying a Model 10K4TA’s “A SLOT No. 9” will have a location number of “95”; the channel corresponding to the first subchannel of the card occupying a 10K2D’s “A SLOT No. 18” will have a location number of “181.”

- h. Again, use the **Step** and **Back Space** keys to interrogate a continuous sequence of channels for their respective locations. Remember that this “stepping” procedure will work following any initial keyboard interrogation of the form

[MNEMONIC] n [CR]

where “n” is the number of the first argument of the desired series (Channel No., Bit No., Page No., “Execute” No., etc.).

8 SETTING SYSTEM SCAN RANGE

Before you proceed to calibrate any of your system’s data channels, you should define its default SCAN RANGE. In this section, you will learn to use the **TERMINATOR (TER)** command to do this.

- a. Enable the EEPROM Write Protect function by turning ON the EEPROM Switch (placing it in the *upward* position).**
- b. A System 10’s initial default scan range is normally preset at the factory. The typical range is from Channel No. 1 through the highest Channel Number called for by the system configuration specified at the time of order. Determine this initial range by entering from the keyboard an interrogation of

TER [CR]

The number of the current “TERMINATOR CHANNEL” will be displayed. We will call this number “ t_1 .”

- c. Refer to the **Locate (LCT)** column in Section 2 of your System 10 Data Sheet. You should already be aware of the “location” of the real channel that uses the source transducer you hooked up in Section 6, above. For example, if you cabled your real-world transducer to the first subchannel of the conditioner card in A Slot No. 3, the corresponding real channel would be the channel “located” at “31.” Find the location value of your “live” real channel in the **LCT** column. Note the corresponding CHANNEL NUMBER in the **Channel (CHN)** column. We will call this number “x.”

- d. Now enter a command of

TER = t_2 [CR]

where “ t_2 ” is a number different from “ t_1 ” and *higher than* “x.” This command assigns Channel No. t_2 to be the new system Terminator Channel. On powerup, the Central Processor’s effective scan range will always be from

* An A Slot will usually have as many “subchannels” as the number of individual analog inputs its card can handle (e.g., eight for a Model 10A9-8C, four for a Model 10A10-4, one for a Model 10A40, etc.).

** Or by commanding **BIT 999 = 1 [CR]**.

Channel No. 1 to and including Channel No. t_2 .¹ As a general rule, you'll want to maximize your system's scan speed by making the Terminator Channel Number as low as possible.

9

SETTING SYSTEM TIME AND DATE

In this section, you'll learn to apply the **TIME (TME)** and **DATE (DTE)** commands.

- a. Make sure the EEPROM Write Protect function is enabled.
- b. Set your system's internal clock-time by entering from the keyboard a command of

TME = t [CR]

where "t" is a number of up to 6 digits expressing the current time in hours, minutes, and seconds. For example, if it were now exactly 3:07 p.m., you would enter for "t" the number 150700 (for hour "15," minute "07," and second "00").²

- c. To verify this setting, ask for the current system time by commanding

TME [CR]

- d. Now set your system's internal date by commanding

DTE = d [CR]

where "d" is a number of up to 6 digits expressing the current date in month, day, and year. For example, if today were June 9, 2001, you would enter for "d" the number 60901 (for month "06," day "09," and year "01").³

- e. To verify this setting, ask for the current system date by commanding

DTE [CR]

10

DATA CHANNEL CALIBRATION

The purpose of this section is to lead you step-by-step through a typical System 10 "real-channel" calibration. As explained in Section 1.G.2 of the *System 10 Guidebook*, a number of different calibration methods are available. The method chosen for a given analog input channel will depend on the type of source transducer, the characteristics of the transducer/cable/conditioner combination, the extent of your knowledge of these characteristics, and the possibility and/or convenience of producing actual or simulated transducer inputs of known value.

¹ Unless a **SCAN (SCN)** command has been used to specify a low scan limit other than Channel No. 1 and/or a high scan limit other than Channel No. t_2 (see Section 1.F.1 of the *System 10 Guidebook*). Note too that for an A-sized mainframe, you cannot set a Terminator Channel higher than "160," which is the maximum number of channels the system can handle. The special TIME and DATE channels (Nos. 998 and 999) are always scanned.

² Though not entered in the **TME** command, separating *colons* will be shown in every display of TIME (see Fig. 5.1).

³ Though not entered in the **DTE** command, separating *slashes* will be shown in every display of DATE (see Fig. 5.1).

TO FIND OUT WHICH CALIBRATION METHOD OR METHODS MAY BE USED WITH A GIVEN CONDITIONER CARD, YOU SHOULD REFER TO THE RESPECTIVE SUBSECTION OF *SYSTEM 10 GUIDEBOOK SECTION 1.E.2*.

In very general terms, you will calibrate a signal-conditioner channel by commanding the system's Central Processor to compute and store two constant values: a **SCALING FACTOR ("m")** and a **ZERO OFFSET ("b")**. Automatically and continuously applied to all subsequent readings of the given channel, these two calibration constants define the linear proportionality expressed by the equation " $y = mx + b$."* In the following conventional "zero and span" technique, you will use the **ZERO (ZRO)** and **FORCE (FRC)** commands to define a channel's "b" and "m" values, respectively. This is known as "Two-Point" or "Deadweight" calibration.

- a. In Section 8, above, you determined the CHANNEL NUMBER of the "live" analog input channel you set up in Section 6. We will consistently refer to this channel as "Channel No. x." Thus, where "x" appears in the command syntax below, you should enter the *actual Channel Number* assigned to this channel. In Section 8, above, you ensured that Channel No. x is within the current system SCAN RANGE, as it *must* be if it is to be calibrated.

- b. You should first arrange for a "live" display of Channel No. x.

*If your mainframe has a multichannel LCD or VFD display, use the **PAG** command to invoke a display page that contains Channel No. x, as explained in Section 5, above. If "x" is a number from 1 through 12, the channel's data reading should initially appear on Display Page No. 1 (unless you have already specified a new channel list for this page); if "x" is from 13 through 24, it should appear on Page No. 2; etc.*

*If your mainframe does not have a multichannel LCD or VFD display, you will have to display Channel No. x by transmitting its data reading from the mainframe's Computer Interface Port to a receiving computer CRT or "dumb" terminal. You can use the **STREAM (STR)** command for this purpose, along with a special "header" or "tailer" that allows nonscrolling CRT display of the "datastream" output (see Sections 1.H.2 and 1.H.3 of the *System 10 Guidebook* for details). See Section 2.B of the *System 10 Guidebook* for complete setup of the interface link.*

- c. Establish a *zero input* for Channel No. x by removing all load from the source transducer.
- d. Make sure the EEPROM Write Protect function is enabled, and enter from the keyboard a command of

ZRO x [CR]

The displayed value for Channel No. x should now be *zero*. If it is not, recheck the transducer connection, the channel number, and the channel TYPE and LOCATION assignments; also make sure that Channel No. x is in fact within the current scan range (see Sections 6, 7, and 8, above). This command sets the "BEE" value for Channel No. x—that is, the ZERO OFFSET to be applied to all subsequent channel readings.

* Where "y" is the measurement value reported for the channel and "x" is the ratio of the actual voltage of the analog input signal to the positive full-scale voltage of the channel's chosen input "type." As such, "x" is a unitless number operated upon by the "slope" coefficient "m" and the offset term "b" to yield a true analog measurement. Both "m" and "b" are expressed in the engineering units of the chosen input "type."

- e. Now apply an *accurately known value of input loading* to the source transducer—a value (positive or negative) from 80% to 100% of the nominal full-scale rating.
- f. Enter a command of

FRC x = z [CR]

where “z” is the numerical value of the known input applied in Step e, in desired engineering units and with appropriate polarity. This command “forces” the data reading of Channel No. x to equal the value “z.” It thereby sets the “EMM” value for Channel No. x—that is, the SCALING FACTOR to be applied to all subsequent channel readings. Check the “live” display of Channel No. x to make sure that it reads the number “z.”

The **FRC** command also set the desired *precision* of Channel No. x. Suppose, for example, that you’re measuring “pounds,” and enter a “z” of “300.” All subsequent readings of Channel No. x will be rounded to the nearest pound. If, however, the entry is “300.0,” then all readings will be rounded to the nearest tenth of a pound.

- g. Remove all load from the source transducer. The “live” display of Channel No. x should return to zero. Check the accuracy of the calibration by applying various amounts of known loading to the transducer and noting the corresponding measurement readings on the channel’s “live” display. (You may have to repeat Steps c through g to achieve final calibration.)
- h. Do not disconnect the transducer. It will be used in some of the following procedures.

NOTE: Section 2.G of the *System 10 Guidebook* shows you how to set a data channel’s SCALING FACTOR and ZERO OFFSET directly, using the **SCALING FACTOR (EMM)** and **OFFSET (BEE)** commands, respectively. Section 2.G also tells you how to set a channel’s digital filter by means of the **FILTER (FIL)** command, and also, if desired, a “run-time” tare offset value, by means of the **TARE (TAR)** command.

11 SETUP OF CROSS-CHANNEL CALCULATIONS

In this section, you will apply the **CALCULATE (CLC)** command to define a system “CALCULATE” channel.

A CALCULATE channel is one form of System 10 “pseudochannel.” Its reported data does not represent a directly measured value, but rather a mathematical function of one or more other data channels (“real” or “pseudo”). In addition to standard algebraic operations, CALCULATE functions include square root, absolute value, maximum (most positive value), and minimum (least positive value). They permit real-time computation of such process variables as Efficiency, Horsepower, Specific Fuel Consumption, Power Factor, Lift-Drag Ratio, Spring Modulus, and many others.

The thirteen forms of the **CLC** “WRITE” command are listed in Section 2.J.1 of the *System 10 Guidebook*. Here, we will use only the first of these functions (multiplication of a single channel by a constant) to demonstrate the use of the **CLC** command. You will multiply the “live” data value for Channel No. x—the channel you calibrated in the previous section—by a given numerical constant. Examples of more complex cross-channel calculations are given in Section 2.J of the *System 10 Guidebook*.

- a. Make sure the EEPROM Write Protect function is still enabled.
- b. Apply a value of stable input loading to the source transducer of Channel No. x. Observe the displayed data value for the channel.
- c. Refer to your customized System 10 Data Sheet and choose a channel *within the current scan range but not currently used by your system*. Its present “TYPE” and “LOCATION” values are not important. We will call this “Channel No. y.”
- d. Arrange for a “live” display of the data reported by Channel No. y, preferably on the same display page that displays Channel No. x (see Section 10, Step b, above).
- e. Enter from the keyboard a command of

$$\mathbf{CLC\ y = 2(CHN\ x)\ [CR]}$$

where “y” is the number of the unused channel selected in Step c and “x” is the number of the real channel calibrated in Section 10.

Channel No. y’s display should now report a value exactly twice that of Channel No. x, and with the same precision as was specified for Channel No. x in Section 10, Step f, above.

- f. Change the input to Channel No. x, and the reading of Channel No. y should change accordingly.
- g. To change the *calculation offset constant* from “0” (assumed in the above command) to “1,” type

$$\mathbf{CLC\ y = 2.0(CHN\ x) + 1.0\ [CR]}$$

The reading of Channel No. y should now equal twice the reading of Channel No. x, plus one. Note that the offset (or “b”) term of the CALCULATE expression is to be entered with the precision desired for the final “calculated data” reading. In this case, since this term was entered as “1.0,” resolution will be to the nearest *tenth* of a unit.

Note also that we changed the decimal-point location of the “gain” (or “m”) coefficient of the CALCULATE expression from “2” to “2.0” in order to match the resolution of the offset term. It is always recommended that within a given **CLC** statement the gain coefficient and the offset term be expressed to the same resolution, as indicated by the decimal-point location. This will help prevent erroneous off-scale results. It is also recommended that you set up all of your **CLC**’s to the same decimal-place resolution. Mixing **CLC** resolutions will tend to slow down the system scan speed.

- h. You may wish at this time to set up and display a second “real-world” data channel (call it “Channel No. z”), in order to try out some of the CLC functions that operate on two channels—for example,

$$\mathbf{CLC\ y = 2.0(CHN\ x + CHN\ z)\ [CR]}$$

or

$$\mathbf{CLC\ y = (CHN\ x)(CHN\ z)/2.0 + 1.0\ [CR]}$$

12 SETUP OF LOGIC BITS AND LOGIC PORTS

12.a "SOURCING" OF LOGIC BITS

Your system's 1000 internal LOGIC BITS are numbered from "Bit No. 0" through "Bit No. 999." Before it can be used, a given bit must be assigned a **logic source**. This source will continuously tell the bit what logic state it is to assume at any time: "1" or "0." The way a bit is "sourced" also determines whether or not it will latch on being set to "Logic 1." A "latched" bit must be released (as explained in Section 13) before it can again be set.

To show you how the **LOGIC SOURCE (SRC)** command works, we will have you assign a source of "LATCHING LIMIT LOGIC" to a presently unused system bit. In Section 13, this bit will be used to observe the limit behavior of your "live" analog input Channel No. x as its transducer load is varied.

If your system has an optional **Model 10AIO-16 Universal Logic I/O Card**, you will use the **SRC** command in the following section to designate which of the 10AIO-16's I/O ports are to be Logic *Input* Ports and which are to be Logic *Output* Ports.

Before you set any logic sources, however, you must learn to use the **SET BIT (BIT)** command to set and read system logic-bit states.

1. You may disable the EEPROM Write Protect function if you want to, since it need not be enabled for the "WRITE" form of the BIT command to work.

2. First enter from the keyboard a "READ" command of

BIT 3 [CR]

The present logic state of Bit No. 3 will be displayed as either "3, 1" or "3, 0."

3. Use the **Step** key as you did in Section 7 to display a sequential range of existing bit states.

4. Now enter a "WRITE" command of

BIT 898 = 1 [CR]

(We are here assuming that Bit No. 898 is not presently involved in any of your system's preconfigured logic activities—channel "limit logic," "Execute" functions, etc. Just to be safe, however, you might want to check your "System 10 Data Sheet.")

5. Verify that Bit No. 898 has been properly "set" by commanding

BIT 898 [CR]

An answer of "898, 1" should be displayed.

6. "Reset" Bit No. 898 to "Logic 0" by commanding

BIT 898 = 0 [CR]

7. You will now assign a logic source of "LATCHING LIMIT LOGIC" to Bit No. 898. Make sure the EEPROM Write Protect function is enabled, and enter from the keyboard a command of

SRC 898 = LIM, LAT [CR]

As with any SETUP (or “WRITE”) command, you can always check to see that the command was effective by interrogating for the setup value you just specified. In this case, you would enter the corresponding “READ” command of

SRC 898 [CR]

If the above “WRITE” command was effective, you should get an answer of “LIM,LAT.” If this is not the answer you get, you will need to re-enter the SETUP command.

NOTE: In Section 13, we will want Bit No. 899 to be controlled by “NONLATCHING LIMIT LOGIC.” We do NOT have to apply an **SRC** command to this bit, however, as we just did to Bit No. 898. As we will see, the reference to any given bit by one of the three “LIMIT LOGIC” commands automatically sets the source of that bit to “NONLATCHING LIMIT LOGIC.”

12.b

INITIALIZATION OF OPTIONAL MODEL 10AIO-16

IF YOU DON'T HAVE A **MODEL 10AIO-16 UNIVERSAL LOGIC I/O CARD**, YOU CAN SKIP THIS SECTION AND PROCEED DIRECTLY TO SECTION 13, BELOW.

Your system's 1000 logic bits are divided into “BIT GROUPS” of sixteen bits each. The first bit group consists of Logic Bit Nos. 0 through 15; the second, of Bit Nos. 16 through 31; the third, of Bit Nos. 32 through 47; etc. A complete table of bit groups is given in Section 2.H of the *System 10 Guidebook*.

Before you use the **SRC** command to specify which of the 10AIO-16's LOGIC I/O PORTS are to be INPUTS and which are to be OUTPUTS, you must first “initialize” the 10AIO-16 card. You will use the **A SLOT (ASL)** command to establish a one-to-one correspondence between the 10AIO-16's sixteen Logic I/O Ports and the sixteen members of a particular system bit group.

1. Find out which A SLOT your 10AIO-16 card is in (your customized System 10 Data Sheet will tell you this, if you can't tell by looking at the main-frame's A Rack).
2. Make sure the EEPROM Write Protect function is still enabled, and enter from the keyboard a command of

ASL s = k [CR]

Here, “s” is the number of the A SLOT occupied by the 10AIO-16 and “k” is the number of a currently unused system BIT GROUP.

For example, to assign the sixteen bits of Bit Group No. 3 (= Bit Nos. 32 through 47) to the sixteen Logic I/O Ports of the 10AIO-16 in A SLOT No. 11, you would command **ASL 11 = 3 [CR]**. In this case, Bit No. 32 would now correspond to the 10AIO-16's Port No. 0, Bit No. 33 to Port No. 1, Bit No. 34 to Port No. 2, etc. (take a look at Fig. 3.A.3.1 in Section 3.A.3.c of the *System 10 Guidebook*).

Once you've assigned the 10AIO-16 to a specific system bit group, you must use the **SRC** command to indicate which of the card's sixteen ports are to be dedicated to LOGIC INPUTS. ANY LOGIC I/O PORT TO WHICH A **SRC** COMMAND HAS NOT BEEN APPLIED WILL BE AUTOMATICALLY DESIGNATED AS AN OUTPUT PORT. See Section 3.A.3 of the *System 10 Guidebook* for full details.

3. Select three bits from the bit group you specified in the above **ASL** command. Let's call them Bit Nos. b_1 , b_2 , and b_3 . If, for example, you specified Bit Group No. 3, then b_1 , b_2 , and b_3 could be any three numbers from 32 through 47.
4. Enter from the keyboard these three **SRC** commands:
 - SRC b_1 = INP, NON [CR]**
 - SRC b_2 = INP, NON [CR]**
 - SRC b_3 = INP, NON [CR]**

Since you have thus designated the three Logic I/O Ports corresponding to Bit Nos. b_1 , b_2 , and b_3 to be INPUT ports, *the individual logic state of each of these three ports will now directly and continuously control the state of its corresponding system bit* (in a NONLATCHING mode). All other ports are still automatically assumed to be OUTPUT ports. *The individual logic state of each OUTPUT port will be directly and continuously controlled by the state of its corresponding system bit.*

13 LIMIT SETUP

In this section, you will learn how to

- define HIGH and LOW limit values for a given data channel, using the **LOW LIMIT (LOL)** and **HIGH LIMIT (HIL)** commands
 - arrange for a data channel's HIGH-LIMIT violation to set a given system logic bit, using the "**GREATER THAN**" **LOGIC (LGT)** command
 - arrange for a LOW-LIMIT violation of the same channel to set another logic bit, using the "**LESS THAN**" **LOGIC (LLT)** command
 - release a "latched" bit, using the **RELEASE (RLS)** command
 - cancel a channel's existing "GREATER THAN" and "LESS THAN" LOGIC, using the **LGT** and **LLT** commands
- a. To set the LOW LIMIT value for Channel No. x (the channel you calibrated in Section 10, above), make sure the EEPROM Write Protect function is enabled, and enter from the keyboard a command of

LOL x = L [CR]

where " x " is the channel number and "L" is the desired low-limit value expressed to the required precision. In this case, it should be about 20% of the channel's full-scale reading. For example, if you're using a 50-pound load cell as source transducer for Channel No. x , which was calibrated in Section 10 to read *tenths* of a pound, then enter an "L" value of "10.0."

- b. To set the HIGH LIMIT value for Channel No. x , enter a command of

HIL x = H [CR]

where "H" is the desired high-limit value expressed to the required precision. In this case, it should be about 80% of the channel's full-scale reading. If, again, you were using a 50-pound load cell for readings precise to a tenth of a pound, then you would enter an "H" value of "40.0."

In Section 12.a, above, you used the **SRC** command to assign a logic source of "LATCHING LIMIT LOGIC" to Bit No. 898. Now you will cause this bit to be set and latched on the occurrence of a HIGH-LIMIT violation for Channel No. x .

- c. To cause Bit No. 898 to be set and latched to a state of “Logic 1” when the data value for Channel No. x exceeds the high-limit value specified by the above **HIL** command, enter a command of

LGT x = 898 [CR]

Note that we could just as well have arranged for Bit No. 898 (or any other system bit) to “go high” when Channel No. x’s data reading drops below the low-limit value specified by the **LOL** command, or when it re-enters the channel’s “OK” (“BETWEEN”) zone after either a high-limit or low-limit violation has occurred. See Section 2.F.4 of the *System 10 Guidebook* for a complete discussion of the three “LIMIT LOGIC” commands (**LGT**, **LLT**, and **LBT**).

- d. To verify the activation of Bit No. 898 on occurrence of a high-limit violation for Channel No. x, first check to make sure that the bit is still at the “Logic 0” level by commanding

BIT 898 [CR]

The response should be “898, 0.”

- e. Now increase the load applied to Channel No. x’s source transducer until it is greater than the high-limit value you entered in Step b, above. NOTE: If your mainframe has a multichannel **VFD** display, you should see the arrow displayed with Channel No. x’s data reading point *upward* as soon as the high-limit is violated.
- f. Use the **BIT** command to check the state of Bit No. 898. You should now get an answer of “898, 1,” indicating the presence of the “GREATER THAN” limit violation for Channel No. x.
- g. Decrease the transducer load until it is less than the high-limit value, but higher than the low-limit value. (If your mainframe has a multichannel **VFD** display, you should see Channel No. x’s arrow point *to the left* as soon as the data reading drops below the high-limit value, indicating that it is once more within the “OK” limit zone.) Again check the state of Bit No. 898. Since the bit is latched, you should still get an answer of “898, 1.”
- h. To “release” the latched Bit No. 898 from its “Logic 1” state, enter a command of

RLS 898 [CR]

- i. Use the **BIT** command once more to verify that Bit No. 898 has been reset to “Logic 0.”

We also want a “LESS THAN” limit condition for Channel No. x to set Bit No. 899 to “Logic 1,” but in a **NONLATCHING** fashion. That is, we want Bit No. 899 to revert automatically to a “Logic 0” state as soon as the low-limit violation of Channel No. x ceases to occur. The **RLS** command need not be applied to reset Bit No. 899, as it was to the latching Bit No. 898, above.

- j. First make sure that Bit No. 899 is currently at “Logic 0” by commanding*

BIT 899 = 0 [CR]

* The application of the WRITE form of the **BIT** command to a given bit automatically sets that bit’s logic source to “EXT, NON” (**EXTERNAL**, **NONLATCHING**). This is why we are having you set Bit 899 via the above “**BIT**=” command *before* you apply the **LLT** command to that bit.

- k. Enter from the keyboard a command of

LLT x = 899 [CR]

Bit No. 899 is now *automatically* assigned a “logic source” of “LIMIT, NON-LATCHING.” NO PREVIOUS **LOGIC SOURCE (SRC)** COMMAND NEEDS TO HAVE BEEN APPLIED TO BIT NO. 899, AS IT WAS FOR THE “LIMIT, LATCHING” SOURCE OF BIT NO. 898 (Section 12.a, Step 7, above).

REMEMBER: The reference to any logic bit by one of the three “LIMIT LOGIC” commands (**LGT**, **LLT**, or **LBT**) automatically sets the source of that bit to “NONLATCHING LIMIT LOGIC.”

- l. To verify the activation of Bit No. 899 on occurrence of a low-limit violation for Channel No. x, decrease the load applied to Channel No. x’s source transducer until it is less than the low-limit value you entered in Step a, above. An easy way to do this is to remove all load from the transducer, thus producing a reading of zero. If your mainframe has a multichannel **VFD** display, you should see the arrow displayed with Channel No. x’s data reading point *downward* as soon as the low limit is violated.
- m. Use the READ form of the **BIT** command (see Step d, above) to check the state of Bit No. 899. You should now get an answer of “899, 1,” indicating the presence of the “LESS THAN” limit violation for Channel No. x.
- n. Increase the transducer load until it is greater than the low-limit value, but less than the high-limit value. (If your mainframe has a multichannel **VFD** display, you should see Channel No. x’s arrow point *to the left* as soon as the data reading rises above the low-limit value, indicating that it is once more within the “OK” limit zone.) Again check the state of Bit No. 899. Since the bit is not latched, you should get an answer of “899, 0.”
- o. To *cancel* the “GREATER THAN” and “LESS THAN” LOGIC you have set up for Channel No. x, enter the following commands:

LGT x = N/A [CR]

LLT x = N/A [CR]

The presence of a “GREATER THAN” or “LESS THAN” limit condition for Channel No. x will now have no effect on the state of any system logic bit, including Bit No. 898 or 899.

The extremely versatile **EXECUTE (EXU)** command lets you load one or a series of standard mnemonic commands in advance, to be executed automatically upon detection of a predefined logic event. It's as though the specified command(s) are received directly from the operator or computer the moment the triggering event occurs.¹

In the following example, a given system logic bit will “go high”—i.e., will change its state *from “Logic 0” to “Logic 1”*—on detection of a HIGH-LIMIT violation of your calibrated Channel No. x. This “going high” transition will in turn trigger

- the setting of a given logic bit to “Logic 1” via the **BIT** command, and
- the loading of a constant numeric value into a special “DOWNLOAD PSEUDOCHANNEL” (which you will set up via the “WRITE” form of the **CHN** command).

NOTE: We are here assuming that your system's Channel No. 150 is presently unused. Just to be safe, however, you might want to check your “System 10 Data Sheet.” If Channel No. 150 is not an unused channel, you will probably want to select another one for this procedure.

- a. Make sure the EEPROM Write Protect function is still enabled.
- b. Arrange for a “live” display of the data reported by Channel No. 150 (see Section 10, Step b, above).
- c. We want Channel No. 150 to be a “DOWNLOAD PSEUDOCHANNEL,” so that we can load it with an arbitrary numeric constant.² You must therefore assign it a “TYPE CODE” of “D0” (“D zero”) by entering a **TYPE (TYP)** command of

TYP 150 = D0 [CR]

(for a full discussion of “Downloading of Numeric Data,” see Section 2.D of the *System 10 Guidebook*).

- d. To see how the downloading function works, enter a **CHANNEL (CHN)** command of

CHN 150 = 399 [CR]

The displayed Channel No. 150 should read “399.”

- e. To make sure that Bit No. 898 is presently at “Logic 0,” enter a command of³

BIT 898 = 0 [CR]

¹ Automatic execution of commands occurs during the “housekeeping” period at the end of a complete scan cycle (i.e., after all channels and bits have been scanned and evaluated). Command execution will be in the same sequence in which the commands are specified in the **EXECUTE (EXU)** command statement, unless the number and nature of commands to be executed require their temporary placement in a “COMMAND QUEUE” until such time as they may be put into effect. Command queues and the means of monitoring their status are discussed in Section 2.K.2(d) of the *System 10 Guidebook*.

² Download pseudochannels need not be within the current scan range. In fact, you will generally want to keep them *outside the scan* in order to maximize system speed. There are actually two types of download pseudochannels: “volatile” (or RAM-resident) and “nonvolatile” (or EEPROM-resident). The former have a type code of “D0”; the latter, of “D1.”

³ Remember that this command automatically sets the logic source of Bit No. 898 to “EXT, NON.”

f. Before you define your “EXECUTE” function, you should first set up its “trigger bit.” For this purpose you should select a currently unused bit from among your system’s *first 32 bits*.*

g. Enter a command of

LGT x = r [CR]

where “x” is again the number of the channel you calibrated in Section 10, above, and “r” is the number of the selected trigger bit (it must be a number from 0 through 31).* As you learned in the previous section, this command automatically assigns a “logic source” of “NONLATCHING LIMIT LOGIC” to Bit No. r.

h. Now command

EXU r = BIT898=1:CHN150=0 [CR]

The command string specified by an **EXU** command can take up to 32 ASCII characters, including spaces; individual commands are separated by colons.

i. Increase the load applied to Channel No. x’s source transducer until it is greater than the high-limit value you entered in Section 13, Step b, above.

j. As soon as Channel No. x’s high limit is violated, Bit No. 898 should automatically “go high” and Channel No. 150 should automatically report a value of “0.” Use the **BIT** command to verify that the state of Logic Bit No. 898 is now “1.” Observe the displayed reading of channel No. 150 to verify that it is in fact “0.”

k. Now enter a command of

BIT 897 = 0 [CR]

l. Keep the “high violation” load on the transducer, and enter a command of

EXU /r = CHN150=25:BIT897=1 [CR]

where “r” is again the number of the selected trigger bit. This command instructs the system to

- load Channel No. 150 with the number “25,” and
- set Logic Bit No. 897 to “Logic 1”

when Logic Bit No. r “goes low”—i.e., when the transition of Bit No. r *from “Logic 1” to “Logic 0”* is perceived.

m. Remove the transducer load. Channel No. 150 should now read “25.”

n. Use the READ form of the **BIT** command to verify that the state of Logic Bit No. 897 is now “1.”

o. You might now want to set up and verify an **EXU** or **EXU/** function that increments the reading of Channel No. 150 by “1,” and also “locks” (or “freezes”) a given real channel (No. “y”)**:

* This assumes that your mainframe has been initially set to employ the first two bit groups (Bits 0 through 31) for the purpose of triggering **EXECUTE (EXU)** command strings. It is possible to assign the system’s **EXU** statements to the bits of *any two* bit groups (which need not be contiguous) by means of the **EXECUTE BASE GROUP (XBG)** command, as explained in Section 2.K.2 of the *System 10 Guidebook*.

** The **LOCK (LOK)** command can be used to inhibit the automatic updating of all channels, one selected channel, or a selected range of channels. To “unlock” (resume normal updating) of Channel No. y, you must enter an **UNLOCK (UNL)** command of **UNL y [CR]**.

EXU r = INC150:LOK_y [CR]

Trigger this “bit going high” EXECUTE as you did in Step i, above. Use an interrogation of **CHN 150 [CR]** to verify that the reading of Channel No. 150 has increased by “1.” Display Channel No. *y*—or use **CHN *y* [CR]**—to verify that the reading of this channel is “locked” at its current value, regardless of the behavior of the input signal.

If your mainframe has a multichannel **LCD** or **VFD** display, you might also want to set up and verify an **EXU** or **EXU/** function that automatically calls a specific display page and sets a given channel unit legend, using the commands discussed in Section 5, above—for example,

EXU r = PAG29:LEG150=LBS [CR]

Since this EXECUTE contains a SETUP command (“**LEG=**”), the EEPROM Write Protect function must be enabled at the time the EXECUTE is triggered in order for this command to be effective.

- p. To cancel the two “EXECUTE” functions that are now activated by the “going high” and “going low” of Bit No. *r*, enter the following commands:

EXU r = N/A [CR]

EXU /r = N/A [CR]

For more examples of the **EXECUTE (EXU)** command, see Section 2.K.2 of the *System 10 Guidebook*.

15 SETTING DATA-TRANSMISSION CHARACTERISTICS

Your system can be made to transmit different kinds of “data” from its COMPUTER INTERFACE PORT, including

- numerical values contained in system DATA CHANNELS (whether these values represent actual measurements, calculations, downloaded constants, etc.), and
- “limit status” information pertaining to these values

We won’t go into the various kinds of output your system can be commanded to transmit in response to a **CHANNEL (CHN)**, **DUMP (DMP)**, **SNAPSHOT (SNP)**, **STREAM (STR)**, **HARD COPY (HCY)**, or **LIMIT ZONE (LZN)** command. All this is discussed in detail in Section 1.H of the *System 10 Guidebook*.

All you’ll do here will be to interrogate your system for a few important transmission characteristics you should be aware of. To modify these and other transmission characteristics, refer to Section 1.H.3 of the *System 10 Guidebook*.

- a. Enter a command of

OPT [CR]

For a mainframe that has just been shipped, the normal response to this interrogation should be “[0D,0A]”—that is, “zero D, zero A.” The **OUTPUT TERMINATOR** (or “**OPT**”) is a string of one or two standard ASCII characters added at the end of *every line of transmission*. In almost all cases, it is initially set to CARRIAGE RETURN, LINE FEED ([CR][LF]). In hexadecimal, this string is expressed as “[0D, 0A].”

- b. Enter a command of

EOT [CR]

For a mainframe that has just been shipped, the normal response should again be “[0D,0A].” The **END-OF-TRANSMISSION TERMINATOR** (or “**EOT**”) is a string of up to four standard ASCII characters added at the end of *every complete transmission*. Like the “OPT,” it is almost always initially set to CARRIAGE RETURN, LINE FEED ([CR][LF], or, in hexadecimal, [0D, 0A]).

- c. Now enter a command of

CMT [CR]

For a mainframe that has just been shipped, the normal response should be “[0D].” What you’ve asked for here is the current **COMMAND TERMINATOR** (or “**CMT**”). Discussed in Section 2.B.5 of the *System 10 Guidebook*, the CMT is not really a “transmission characteristic.” It is the single ASCII character recognized by your system as the termination of any command received through the Computer Interface Port. It is always set initially to CARRIAGE RETURN ([CR], or, in hexadecimal, [0D]). All *keyboard-entered* commands are always terminated with [CR].

For other (in some cases optional) transmission characteristics—including channel number “echo,” limit-zone indication, “header” and “tailer” character strings, characters per channel, column format, and intertransmission delay period—see Section 1.H.3 of the *System 10 Guidebook*.

16 COMMUNICATION WITH EXTERNAL DEVICES

16.a INTRODUCTION: SYSTEM 10 COMMUNICATION MODES

Every A-sized System 10 mainframe has a single COMPUTER INTERFACE PORT.* This port allows two-way communication with a connected computer, terminal, modem, buffered printer, recorder, operator console, or other external device capable of RS-232-C, IEEE-488, or RS-422 data interchanges. Through the Computer Interface Port, the external device can

- *issue to System 10* any MNEMONIC COMMAND in the standard command set for that system; and
- *receive from System 10* any of the various kinds of formatted data transmissions discussed in Section 1.H of the *System 10 Guidebook*, plus any and all responses to interrogations that originate from the connected device.**

In addition to its Computer Interface Port, an A-sized mainframe can accommodate optional LOGIC I/O PORTS for the transfer of logic and digital data (requires one or more **Model 10AIO-16 Universal Logic I/O Cards**—see Section 12.b, above).

* When the optional **Model 10AFIFO First-In-First-Out Buffer Memory Card** is present, an A-sized mainframe’s Computer Interface Port is effectively replaced by the 10AFIFO’s “FIFO COMPUTER PORT.” See Section 3.A.8 of the *System 10 Guidebook* for details.

** Responses to *keyboard-entered* interrogation commands will appear on the mainframe or keyboard “billboard” only.

As mentioned in Sections c and d, below, optional hardware allows conversion of the RS-232 output of the Computer Interface Port to either **IEEE-488** or **RS-422** standards, if such communications are required by your application. Also, an A-sized mainframe equipped with the “**S**” (**Satellite**) Option and an external **RS-485** Converter attached to its Computer Interface Port can represent an individual “node” within a “Satellite Network” hosted by a B-sized System 10 mainframe. Setup and operation of a “satellite” A-sized mainframe are treated in Section 3.B.3 of the *System 10 Guidebook*.

For a complete discussion of “Interfacing of Computer, Terminal, Printer, etc.” via an A-sized mainframe’s Computer Interface Port, see Section 2.B of the *System 10 Guidebook*.

16.b SETUP OF RS-232-C COMMUNICATIONS

We won’t repeat here what is presented in detail in Section 2.B.2 of your *System 10 Guidebook*. When the time comes for you to establish RS-232-C data communications with an external device, you should study this manual section carefully. There you’ll find recommended cabling for “full handshake,” “incoming handshake,” and “no handshake” interface situations.

For proper data interchange between a System 10 mainframe and a connected RS-232-C device to occur, the mainframe’s Computer Interface Port must be set to conform exactly with the protocol stipulated by the connected device. The “protocol” applying to an RS-232-C link normally involves four basic data-transfer characteristics: BAUD RATE (standard rates up to 153.6K), NUMBER OF DATA BITS (7 or 8), NUMBER OF STOP BITS (1 or 2), and PARITY (ODD, EVEN, or NONE).

For an A-sized mainframe, these interface characteristics can only be set by means of the mainframe’s PROTOCOL SWITCHES. Refer to the appropriate drawing in Section 2, above, for the location of these switches for your mainframe model. Section 2.B.2 of the *System 10 Guidebook* gives full instructions for setting the mainframe’s PROTOCOL SWITCHES.

16.c OPTIONAL IEEE-488 COMMUNICATIONS

When connected to the Computer Interface Port, the optional **Model 10CIF488A IEEE Interface Adaptor** enables any System 10 mainframe to be established as a “Talker/Listener” peripheral on a standard IEEE-488 bus, with a switch-selectable bus address from 0 through 30. See Section 2.B.4 of the *System 10 Guidebook* for a full discussion of RS-232 to IEEE-488 conversion.

16.d OPTIONAL RS-422 COMMUNICATIONS

When connected to the Computer Interface Port, the optional **Model 10E422 RS-232-C to RS-422 Converter** enables any System 10 mainframe to be linked to an external device with RS-422 I/O. Again, see Section 2.B.4 of the *System 10 Guidebook* for a full discussion of RS-232 to RS-422 conversion.

17 MAINFRAME KEYPAD FUNCTIONS

This section applies to A-sized mainframes with integral front-panel keypad (**Models 10KU-KD and 10K4T-KD**).

Section 2.R of the *System 10 Guidebook* explains in detail the use of the front-panel keypad and two-line LCD display for the “KD” mainframes. The keypad greatly simplifies system setup by letting the operator review in rapid sequence all pertinent “configuration parameters” for any selected data channel or logic bit, for the system itself, and for the Computer Interface Port. Any displayed channel or bit parameter—with the exception of channel “type”—may in turn be “stepped” through an entire range of channels or bits.

Parameters involving purely numerical values (decimal or hexadecimal) may be immediately reset via the keypad, as prompted by a cursor in the display. Parameters which involve algebraic or literal expressions (such as **CLC**, **EXU**, **SRC**, etc.) may not be modified by means of the keypad, but only through an optional **Model 10P80A or 10P80D Extended Keyboard**.

If you intend to use the front-panel keypad to configure your system, study the instructions given in Section 2.R of the *System 10 Guidebook*.

The System 10 **KEY** command lets you program a front-panel keypad for rapid entry of up to five selected System 10 commands.* Specifically, it allows any standard three-letter MNEMONIC to be communicated to the mainframe by pressing the keypad’s **FNCTN (FUNCTION)** key—and then the **0, 1, 2, 3, or 4** key. See Section 2.I of the *System 10 Guidebook* for complete details.

In the following procedure, you will use the keypad’s **FNCTN** key to ask for the system time-of-day (via the **TME** command), and to set a DOWNLOAD PSEUDOCANNEL with a given numeric value (via the “write” form of the **CHN** command).

- a. Make sure the EEPROM Write Protect function is enabled, and then use the *extended keyboard* connected to the System 10 mainframe to enter a command of

KEY 0 = TME [CR]

- b. Now press the **FNCTN** key on the mainframe’s front-panel keypad, followed by the keypad’s **0** key, followed by the keypad’s **ENTER** key. The system time-of-day reading should appear in the billboard.

- c. Enter (via extended keyboard) a command of

KEY 3 = CHN [CR]

- d. On the front-panel keypad, press the **FNCTN** key, followed by the **3** key. Then enter (via the keypad)**

150 = 1423 [ENTER]

Call Channel No. 150 to display—or use the **CHN** command—to verify that its reading has been set to “1423.”

* A handheld **Model 10P25A or 10P25D Operator’s Keyboard** may be similarly programmed (but NOT a Model 10P80A or 10P80D Extended Keyboard).

** This assumes that Channel No. 150 is still “typed” as a “D0” channel—see Section 14, Step c, above.

In this booklet we have taken you step-by-step through some important System 10 setup procedures that apply to “A-sized” mainframes. We have also briefly mentioned a number of other (essentially optional) procedures detailed in the *System 10 Guidebook*. To these we could add the following:

- setup of COUNTER/TIMER functions when the optional **Model 10ACT01 Counter/Timer Card** and/or **Model 10ACC-4 Four-Channel Totalizer Card** is present (Section 3.A.1 of the *System 10 Guidebook*)
- setup of ANALOG OUTPUT CHANNELS via the **ANALOG OUTPUT (ANO)** command when the optional **Model 10AAO-8 Voltage Output Card** is present, (Section 3.A.2)
- setup of DIGITAL I/O functions when the optional **Model 10AIO-16 Universal Logic I/O Card** is present (Section 3.A.3)
- setup of ANALOG PEAK CAPTURE, “MAX MINUS MIN,” and/or TRACK AND HOLD functions when the optional **Model 10A79-4 Four-Channel Analog Peak Capture Card** is present (Sections 3.A.4-6)
- setup of ANALOG BUFFERING functions when the optional **Model 10A79-4 Four-Channel Analog Peak Capture Card** or **Model 10AAO-4 Analog Buffer Card** is present (Section 3.A.7)
- setup of BUFFER STORAGE functions when the optional **Model 10AFIFO First-In-First-Out Buffer Memory Card** is present (Section 3.A.8)
- setup of PID LOOP CONTROL functions when the optional **Model 10APID Loop Control Card** is present (Section 3.A.9)
- setup and use of optional DIAGNOSTIC CARDS: **Model 10AST Analog Slot Test Card** and **Model 10AHM Health Monitor Card** (Section 5.C)

To minimize the danger of losing critical setup information in the event of a power interruption, be sure to turn the EEPROM Switch OFF as soon as System 10 setup is complete.

APPENDIX A

SUMMARY OF A-SIZED MAINFRAME FEATURES

Model	Available A-Card Slots	Max. No. Analog Channels ¹ / Max. No. Analog I/O ²	Max. No Logic Bits / Max.No Logic I/O ³	Data Display and Keyboard/Keypad	Available Options*
10KU	4	160 / 32	1000 / 64	OPTIONAL front-panel keypad with 2-line "billboard" LCD (10DISU); OPTIONAL remote multichannel VFD display with keyboard (10VFD-2); OPTIONAL extended or operator's keyboard with 2-line "billboard" LCD (10P80D or 10P25D)	S, V
10KU-KD	4	160 / 32	1000 / 64	Integral front-panel keypad with 2-line "billboard" LCD; OPTIONAL extended or operator's keyboard with or without 2-line "billboard" LCD (10P80D , 10P80A , 10P25D , or 10P25A)	S, V
10K1C	20	160 / 160	1000 / 320	OPTIONAL front-panel multichannel VFD display with keyboard (10VFD); OPTIONAL remote multichannel VFD display with keyboard (10VFD-2); OPTIONAL extended or operator's keyboard with 2-line "billboard" LCD (10P80D or 10P25D)	S
10K2D	20	160 / 160	1000 / 320	Integral front-panel multichannel VFD display; extended keyboard (10P80A) supplied; operator's keyboard (10P25A) OPTIONAL ⁴	—
10K4TA	10	160 / 80	1000 / 160	OPTIONAL front-panel keypad with 2-line "billboard" LCD (10DIS4T); OPTIONAL remote multichannel VFD display with keyboard (10VFD-2); OPTIONAL extended or operator's keyboard with 2-line "billboard" LCD (10P80D or 10P25D)	V

(cont'd)

* Options:

S = Satellite (required for Model 10BD4-based networks)

V = Vehicle Operation (12 or 28 V-DC)

¹ Up to 1000 channels can be handled when the "S" (Satellite) Option is present.

² Assumes all A SLOTS dedicated to analog I/O only (with eight channels per slot).

³ Assumes all A SLOTS dedicated to logic I/O only; requires one optional **Model 10AIO-16 Universal Logic I/O Card** for every group of 16 bits to serve as logic I/O.

⁴ The Model 10P80D or 10P25D keyboard may NOT be used with this mainframe.

Model	Available A-Card Slots	Max. No. Analog Channels ¹ / Max. No. Analog I/O ²	Max. No Logic Bits / Max.No Logic I/O ³	Data Display and Keyboard/Keypad	Available Options*
10K4T-KD	10	160 / 80	1000 / 160	Integral front-panel keypad with 2-line "billboard" LCD; OPTIONAL extended or operator's keyboard with or without 2-line "billboard" LCD (10P80D , 10P80A , 10P25D , or 10P25A)	S, V
10K4T-DA	10	160 / 80	1000 / 160	Integral front-panel multichannel VFD display; extended keyboard (10P80A) supplied; operator's keyboard (10P25A) OPTIONAL ^{4, 5}	—

* Options:

S = Satellite (required for Model 10BD4-based networks)

V = Vehicle Operation (12 or 28 V-DC)

¹ Up to 1000 channels can be handled when the "**S**" (**Satellite**) **Option** is present.

² Assumes all A SLOTS dedicated to analog I/O only (with eight channels per slot).

³ Assumes all A SLOTS dedicated to logic I/O only; requires one optional **Model 10AIO-16 Universal Logic I/O Card** for every group of 16 bits to serve as logic I/O.

⁴ The Model 10P80D or 10P25D keyboard may NOT be used with this mainframe.

⁵ The front bezel of the Model 10K4T-DA may itself be used as a remote VFD display (up to 25 ft.), if an optional remote power supply (available from Daytronic) is provided.



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FOR “B-SIZED” MAINFRAMES



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* This section does not (or would not normally) apply to the **Model 10KN3** mainframe. The 10KN3 has no “A-Card” rack, and therefore no analog I/O capabilities.

1 INTRODUCTION

1.a THE PURPOSE OF THIS BOOKLET

Working for the first time with an instrument system as comprehensive and versatile as the Daytronic “System 10” can be a bit overwhelming. There are so many interrelated functions the system can be made to perform—functions for data collection, display, processing, communications, reporting, and process control. And there are so many critical setup procedures, all depending on the exact requirements of your particular measurement and control application.

All users agree that System 10 is comparatively easy to set up and run. Nonetheless, we realize that even the most technically competent first users could do with a little help. The purpose of this booklet is to familiarize you with the *basic setup procedures* required for proper system operation. To keep things on as simple a level as possible, we will not discuss a number of additional—and strictly optional—procedures. These are all treated in detail in your *System 10 Guidebook*.

By walking you step-by-step through the basic system setup, this booklet will help you get your system “on the air” as quickly as possible, without initially burdening you with “all the details.”

You’ll probably want to read this booklet before you open your *System 10 Guidebook*. However, having done so, and having carefully performed all the tutorials given here, don’t neglect to study the Guidebook itself! This is not a “short-form manual,” but rather a simplified presentation of selected—but “basic”—setup procedures, along with some essential background information. Its only purpose is to GET YOU STARTED.

1.b “B-SIZED” MAINFRAMES

There are two basic types of System 10 mainframes: “A-sized” and “B-sized.” This booklet treats only B-sized mainframes. Each B-sized mainframe contains

- a single rack for plug-in “B Cards” and “V Cards”
- up to four separate racks for plug-in “A Cards”*

“B Cards” are essentially for DIGITAL processing, while “V Cards” are concerned with VIDEO-related functions and plug into the Video Backplane in the rear of the mainframe. The system’s CENTRAL PROCESSOR CARD (a version of the Model **10BCP200** or, for older systems, **10BCP100A**) and RS-232 INTERFACE CARD (a version of the Model **10BIP232**) always occupy the two rightmost “B Slots.” In all B-sized mainframes except “10KN6” versions with the “E” (Extended B Rack) Option, the leftmost B Slot (No. 1) is always occupied by the system’s VIDEO TEXT CARD (Model **10BVT60** or **10BVT65**). All other V Cards are mounted to the left of the Video Text Card.**

In any B Slot not occupied by the Central Processor Card, the RS-232 Interface Card, or a V Card, any **optional B Card** may be installed to handle your system’s

* The **Model 10KN3** mainframe is an exception; it has NO “A Card” rack. See the Table of Contents for the sections of this booklet that do NOT apply to a 10KN3 system.

** In “10KN6” versions with the “E” (Extended B Rack) Option, the first four B Slots are used for the V-Card set. See Section 3.C.1 of the *System 10 Guidebook* for more details on V-Card installation.

more complex data-acquisition and communications tasks (such as logic inputs and outputs, “history” recording and playback, network management, auxiliary computer interfacing, etc.).

“A Cards” include all basic System 10 SIGNAL CONDITIONER CARDS, as well as certain SPECIAL FUNCTION CARDS. These include cards for Analog Outputs, Analog Peak Capture and Hold, PID Loop Control, and Diagnostic Testing.¹

Features of all presently manufactured B-sized System 10 mainframes are summarized in Appendix A of this booklet.

1.C MONITOR AND KEYBOARD

Every B-sized mainframe except the Model 10KN7 provides output to drive an external large-scale VGA COLOR VIDEO DISPLAY. The Model 10KN7 has an internal 5” x 9” monochrome CRT, and provides both monochrome RS-170 and CGA-compatible “RGB” video output. The Model 10KN8A has an internal 12” COLOR CRT (multi-sync CGA/EGA/VGA).

Throughout this booklet, we will assume that you have a CRT monitor on which you can observe the current “live” values of system data channels and the current “live” states of system logic bits.² You should now make all necessary arrangements for this display before proceeding any further in this booklet. For instructions regarding the required VIDEO CONNECTIONS, see Section 2.N of your *System 10 Guidebook*.

The procedures in this booklet require that you issue appropriate **mnemonic commands** to your system. Such commands may be issued either “locally” or “remotely.” You issue commands “locally” by typing them on the **Model 10P80A Extended Keyboard** supplied with your B-sized mainframe. You issue commands “remotely” by using an EXTERNAL COMPUTER OR TERMINAL to deliver them either

- via the mainframe’s **Computer Interface Port**;
- via the **Auxiliary Computer Interface Port** provided by an optional Model 10BACIA or other “10BACI” Card; or
- via the **Satellite Interface Port** provided by an optional Model 10BD4 or 10BD1 Card.³

FOR ALL PROCEDURES DESCRIBED IN THIS BOOKLET, IT IS ASSUMED THAT YOU ARE USING AN EXTENDED KEYBOARD FOR LOCAL MANUAL ENTRY OF SETUP AND INTERROGATION COMMANDS. REMEMBER, HOWEVER, THAT YOU CAN JUST AS EASILY ENTER ALL COMMANDS GIVEN IN THIS BOOKLET THROUGH AN EXTERNAL COMPUTER OR TERMINAL, ONCE RS-232 LINKAGE THROUGH THE COMPUTER INTERFACE PORT (OR OPTIONAL AUXILIARY PORT)

¹ Certain cards—such as the Model 10AFIFO and the Model 10AIO-16—cannot be used in a B-sized mainframe.

² If you have a 10KN7 mainframe, you can use the built-in multichannel monochrome display. It is recommended, however, that you connect a suitable COLOR monitor to your 10KN7 if at all possible, at least for the video setup procedures given in Section 4.

³ As you will see in Section 14 of this booklet, you can also arrange for one or more commands to be applied automatically on occurrence of predefined system conditions and events. Note also that the handheld **Model 10P25A Operator’s Keyboard** can be used with B-sized mainframes to perform a limited number of “run-time” operations, as described in Section 2.S of the *System 10 Guidebook*.

HAS BEEN PROPERLY ESTABLISHED. For “remote” command entry, the easy-to-use **TERMINAL** program is included in the **StartPAC V** software supplied with your mainframe—although any conventional terminal emulation package will also work.

1.d IF YOU NEED HELP...

If at any time you need assistance in getting your System 10 “on the air”—or if problems arise at any later time—feel free to call our CUSTOMER SERVICES DEPARTMENT at

(937) 293-2566

FAX: (937) 293-2586

TOLL-FREE: (800) 668-4745

during normal business hours (Monday through Friday, 8:00 a.m. to 5:00 p.m.). Or you can EMAIL us at

sales@daytronic.com

2 PHYSICAL LAYOUT

DO NOT PLUG IN YOUR MAINFRAME JUST YET.

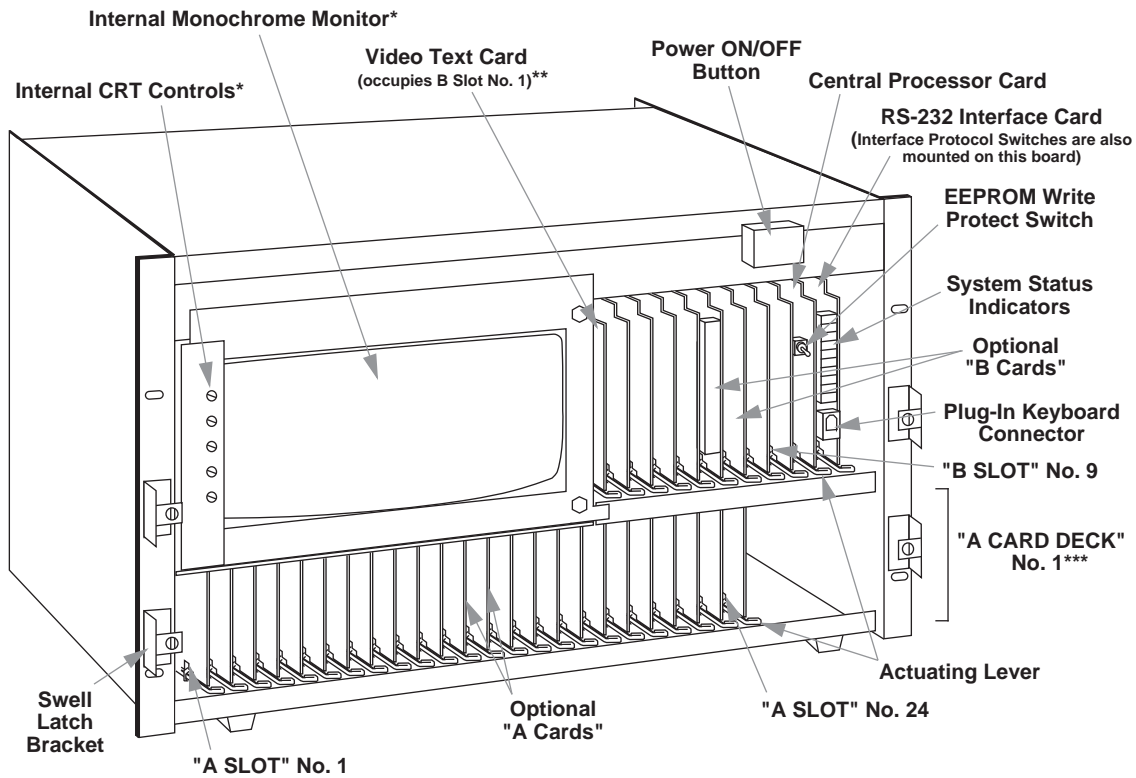
Remove your mainframe’s front bezel(s). For each bezel, pull down the two “swell-latch” levers and then pull the bezel forward. The upper bezel must be off in order for you to access your mainframe’s EEPROM Write Protect Switch and RS-232 PROTOCOL SWITCHES.

Study the appropriate front- and rear-view drawings below to familiarize yourself with your mainframe’s most important physical elements. Be sure that you know the locations of your particular mainframe’s

- **B Rack and B Cards**, including Central Processor Card and Interface Card (internal)
- **V Cards**, including Video Signal Card and Video Text Card (internal)
- **A Rack(s), A Slots, and A Cards** (internal)
- **System Status Indicators** (visible from the front)
- **ON/OFF Button** (front or rear panel)
- **Power Connector and Fuse/Circuit Breaker** (rear panel)
- **Plug-In Keyboard Connector** (front panel)
- **Computer Interface Connector** (rear panel)
- **RS-232 Protocol Switches** (internal)
- **EEPROM Write Protect Switch** (internal)
- **Power Selector Board** (rear panel, Models 10KN3, 10KN6, and 10KN7)
- **CRT Controls** (internal, Models 10KN7 and 10KN8A)
- **VGA Input Connector** (rear panel, Models 10KN3, 10KN6, and 10KN8A)
- **VGA Output Connector** (rear panel, Models 10KN3, 10KN6, and 10KN8A)
- **“RGB” and RS-170 Output Connectors** (rear panel, Model 10KN7)
- **RS-232 Formatted Output Connector** (rear panel, active only if a Model 10VFO132 card is present)

Shown in Fig. 2.3 is the Extended Keyboard you will use to set up your system.

**Fig. 2.1.a Mainframe Front Elements,
Models 10KN3, 10KN6, and 10KN7 (front bezel(s) removed)**

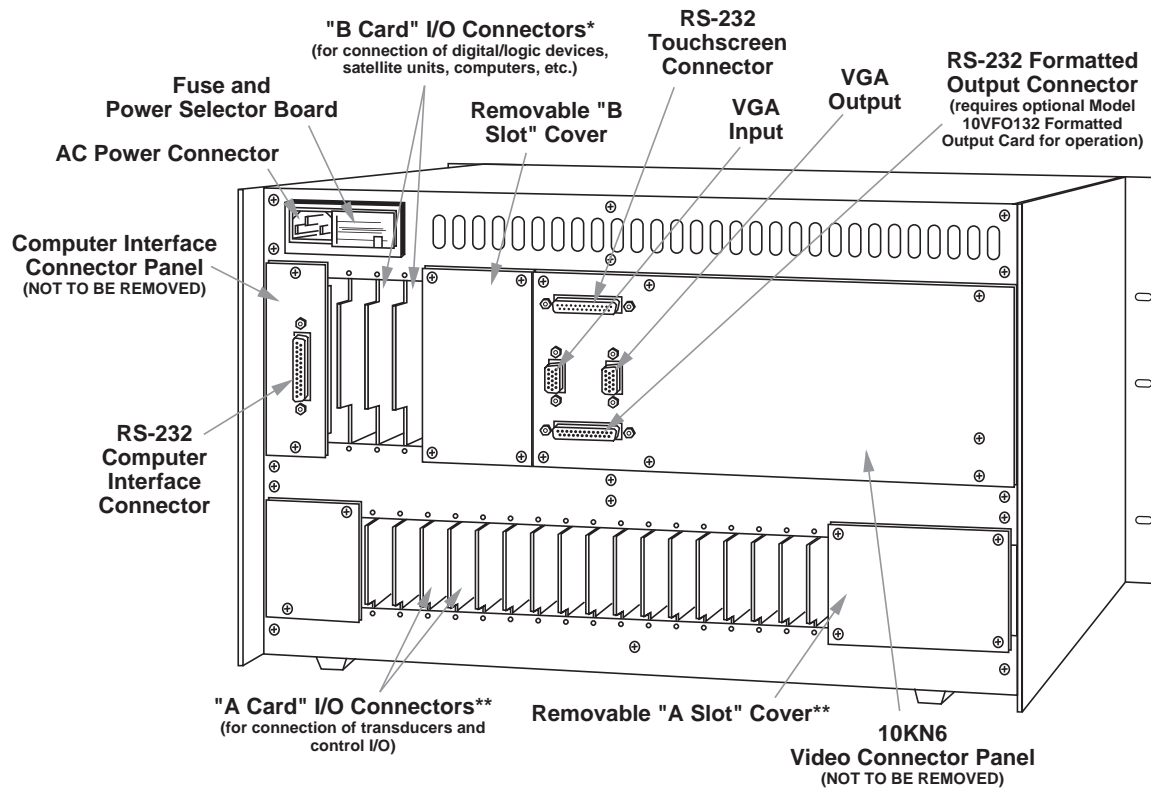


* Model 10KN7 mainframes only. On mainframes with the "E" (Extended B Rack) Option, the CRT space will be occupied by additional B Slots.

** The Video Signal Card and any other optional video cards are located to the left of the Video Text Card (connected to the mainframe's Video Backplane). For mainframes with the "E" (Extended B Rack) Option, the Video Text Card will occupy B Slot No. 4.

*** Not present on the Model 10KN3 mainframe. A "10KN6" or "10KN7" mainframe may have up to four A Decks in all.

Fig. 2.1.b Mainframe Rear Elements, Models 10KN3, 10KN6, and 10KN7 (NOTE: 10KN7 Video Connector Panel is shown separately in Fig. 2.1.c)



* Many "B Cards" come with their own rear connector assemblies (not shown here).

** Not present on the 10KN3 mainframe, which has no "A Cards."

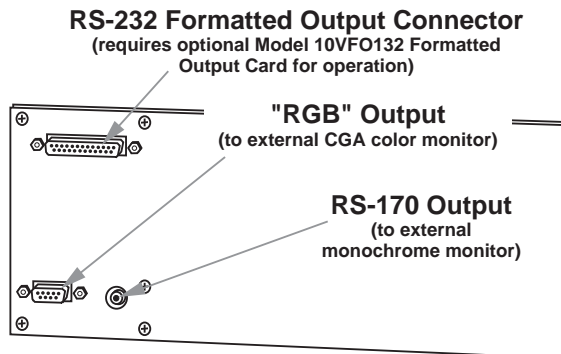
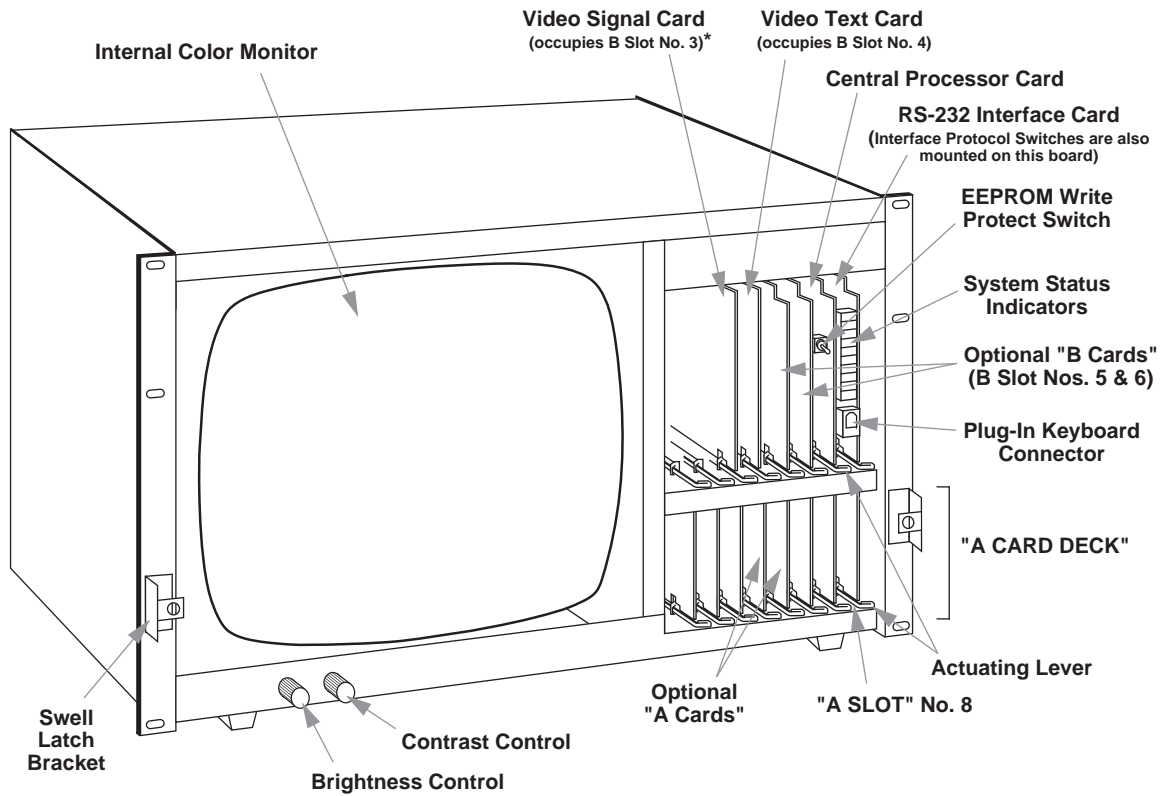


Fig. 2.1.c Model 10KN7 Video Connector Panel

Fig. 2.2.a Mainframe Front Elements, Model 10KN8A (front bezel removed)



* For the Model 10KN8A, B Slot Nos. 1 and 2 are used for optional "V Cards" only; an optional Model 10VGM500 will always go in B Slot No. 1, while an optional Model 10VFO132 will go in B Slot No. 2.

Fig. 2.2.b Mainframe Rear Elements, Model 10KN8A

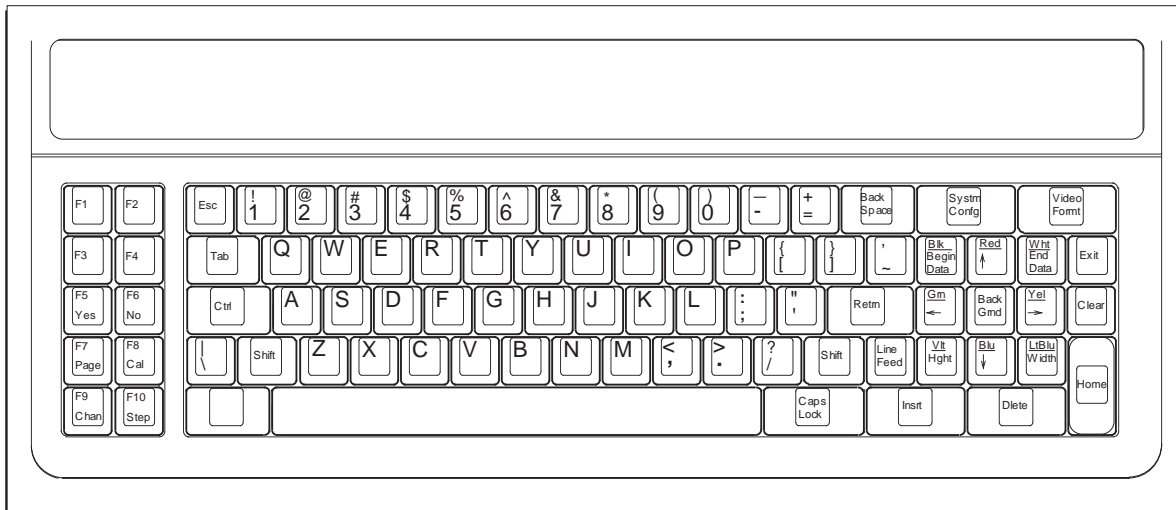
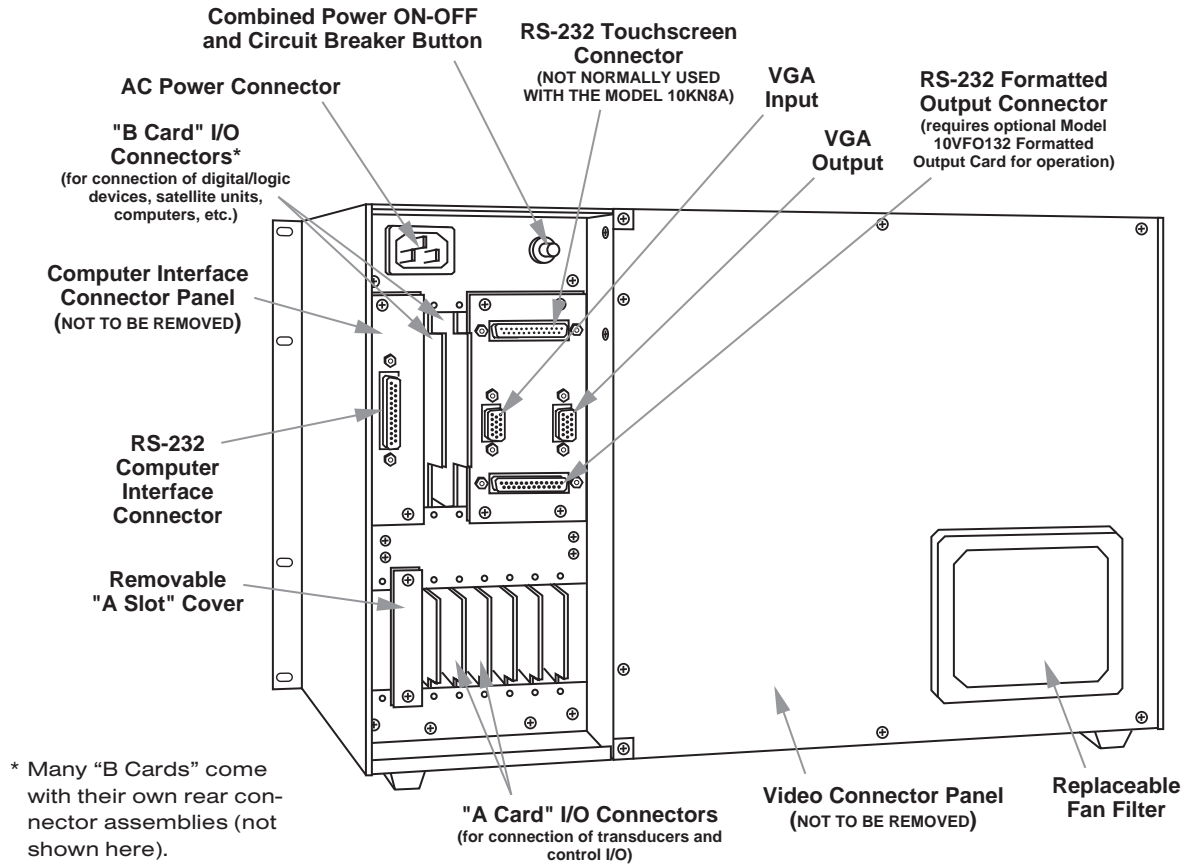


Fig. 2.3 Model 10P80A Extended Keyboard

3 POWERUP

- a. **IMPORTANT:** Before powering it up, make sure your mainframe is set for the local line voltage (nominal 110 or 220 V-AC). If it is a Model 10KN3, 10KN6, or 10KN7, check the Power Selector Board on the rear panel.* If you need to change the voltage setting, see Section 1.A.3 of the *System 10 Guidebook*.
- b. **IMPORTANT:** Make sure the EEPROM Write Protect Switch is OFF (*downward* position) before you power up your mainframe and before you turn it off. You should always take this precaution in order to avoid sporadic writes to the EEPROM and other possible EEPROM problems.
- c. Plug the power cord supplied with your mainframe into the rear-panel AC Power Connector. Plug the other end of the cord into your primary power source.
- d. Turn on the mainframe by pressing the ON/OFF button. For Model 10KN3, 10KN6, and 10KN7 mainframes, the button should light when power is ON. The four front-panel System Status Indicators labelled **ERR**, **CHR**, **MNE**, and **RET** should all light for about one second, and then go off, to verify proper system powerup. Also, the words "RAM TEST PASSED" may appear for about two seconds in the "billboard" region of your mainframe's CRT display, to be immediately replaced by your company's name, or other prespecified alphanumeric "logo."

The first time you powerup your mainframe, its initial "sign-on" video page will appear. Unless otherwise specified at the time of order, this display will include the current "logo" string, TIME, DATE, and "live" data for all channels up to and including Channel No. 15. You will learn in Section 5 how to specify a different "sign-on" page and a different "logo" text.

4 KEYBOARD CONNECTION

Plug the free terminal of your Extended Keyboard's connector cord into the KEYBOARD CONNECTOR on the front edge of the RS-232 Interface Card. The lock lever will snap into place as the terminal is fully engaged.

To verify proper keyboard connection, press any key. The System 10 mainframe's green Status Indicator labelled **KBD** should blink.

LEAVE THE KEYBOARD CONNECTED DURING THE SETUP PROCEDURES THAT FOLLOW.

* The Model 10KN8A operates ONLY from an external supply of 90 to 130 V-AC (47-63 Hz), and therefore has no Power Selector Board.

5 CRT VIDEO SETUP

As you will soon discover, your B-sized mainframe's extensive video capability is one of its premium features. Every B-sized mainframe can store up to 100 separate CRT VIDEO PAGE FORMATS (or "VIDEO PAGES").*

Each video page can be used to display a large number of "live" System 10 data channels either via digital readout or, if the **Model 10VGM500 Card** is present, via horizontal bargraph (see Section 17, below). The "live" states of system logic bits can be displayed using specific "bit designator" words. You can cause "live" alphanumeric messages to appear on display at appropriate times. When the **Model 10BDR64 History Card** is present, "playback" channels containing locally stored "historical" data can also be displayed (as explained in Section 18).

Any displayed data, logic-bit, message, or playback field—plus any adjacent "fixed text" you want to associate with that field—can instantaneously exhibit one or a combination of special **visual effects** in order to highlight important data values or call attention to various process trends, states, and alarm conditions. For the 10KN7's monochrome display, these effects include *Blink*, *Flash*, *Reverse*, and *Half Intensity*. In addition to all possible *background/foreground combinations* of the eight available colors, all color displays provide optional *Blink* and *Flash* enhancements.

Video pages can be quickly and easily composed by the operator, using simple word-processor functions through the keyboard. If desired, a host computer can recompose displayed pages, line by line, during the measurement and control process. Video pages can also be transmitted to the computer, line by line, for storage in the computer's own memory. See Section 2.C.11 of the *System 10 Guidebook* for "Uploading, Downloading, and Revising Video Page Formats."

In the present section, you will learn how to

- set important monitor parameters using the **VIDEO DISPLAY UNIT (VDU)** command
- call the mainframe's Page Directory to display, using the **DIRECTORY (DIR)** command
- call a specific video page to display, using the **PAGE (PAG)** command or key
- use the TEXT EDITOR to compose a video page for "live" data-channel readings
- recall and save a composed page, using the **RECALL (RCL)** and **SAVE (SAV)** commands
- define a "logo" for the display billboard, using the **LOGO (LGO)** command
- specify a system "sign-on page," using the **SIGN-ON PAGE (SOP)** command

NOTE: The creation of "bit-state" fields and the definition of *limit-dependent visual effects* for channel data fields will be explained later, when we get to the setup of system limit monitoring in Section 13. Note too that all the procedures outlined here are discussed in greater detail in Section 2.C of the *System 10 Guidebook*. You should refer to this section if at any point you think that more detailed information would be helpful to you.

* Usable video memory is normally 157 "blocks" of 64 bytes (or characters) each. A typical CRT video page takes 5 to 7 memory blocks, with a nominal maximum of 32. In addition to providing the *high-speed bargraph* capability discussed in Section 17 of this booklet, the **Model 10VGM500 Video Graphics Memory Option** will increase the total video memory capacity to 661 blocks (see also Section 3.C.3 of the *System 10 Guidebook*).

- a. Turn on your mainframe's EEPROM Write Protect Switch by placing it in the *upward* position. An alternative method for enabling the EEPROM Write Protect function—especially useful when you don't want to have to remove the front bezel to access the switch—is to type a command of

BIT 999 = 1 [CR]

on the keyboard. Note that every keyboard-entered command must be terminated by pressing the CARRIAGE RETURN (**Retrn**) key, here designated by "**[CR]**."

The red Status Indicator labelled **E2P** will light when the EEPROM Write Protect function has been enabled.

- b. If your mainframe is a version of the *Model 10KN3, 10KN6, or 10KN8A*, enter from the keyboard a command of either

VDU = C, 50 [CR] or VDU = C, 60 [CR]

depending on whether your local line frequency is 50 or 60 Hz, respectively ("C" stands for "COLOR MONITOR").

If your mainframe is a version of the *Model 10KN7*, enter either

VDU = M, 50 [CR] or VDU = M, 60 [CR]

again depending on your local line frequency ("M" stands for "MONOCHROME MONITOR").

- c. Call to display your mainframe's PAGE DIRECTORY by entering a command of

DIR [CR]

The Page Directory shows which of the 100 potential video pages have already been formatted and entered in nonvolatile EEPROM storage. It shows the relative amount of video memory dedicated to each stored page, and which pages (if any) are contained in the "memory extension" provided by an optional Model 10VGM500.* It also shows, after the words "PAGE DIRECTORY," the "free" video memory available in both "standard" video memory and optional "extended" memory (if present). Finally, at the bottom right corner of the display is shown the total "free" memory at your disposal (both "standard" and "extended").

Your mainframe will most likely come with a number of *prestored* video pages, including one or more initial data-display pages and the initial "blank" page (No. 100). Take note of any presently *unused* page number, which can be assigned to the practice page you are about to compose.

- d. Call to display the mainframe's prestored "blank" Page No. 100 by pressing the **Page** key and then typing **100**, followed by CARRIAGE RETURN (**Retrn**). This command, which has the general form of

PAG p [CR]

may be used to call any existing Page No. "p" to the CRT screen.

- e. Now press the **Page** key (only), followed by **Retrn**. This asks the mainframe for the number of the page currently on display. The answer (**PAG = 100**) should appear in the display "billboard."
- f. Press **Retrn** again, to remove **PAG = 100** from the billboard and replace it with your mainframe's currently specified "logo."

* Pages in "standard" video memory are shown *white on red* (for monochrome, *white on black*), and those in optional "extended" memory, *red on white* (for monochrome, *black on white*).

- g. Press the **Video Formt** (VIDEO FORMAT) key to enter TEXT EDITOR MODE. A blinking cursor will appear at the upper left (“HOME”) corner of the screen. The cursor may be moved by means of the four “ARROW” keys and the **Back Space** key.

DO NOT ATTEMPT TO MOVE THE CURSOR BY PRESSING THE SPACE BAR.

- h. Fig. 5.1, below, shows the text of the simple practice page we now wish to compose. The first screen (a) shows the page format while still in TEXT EDITOR MODE; the user-entered data fields are still occupied by channel-number entries. The second screen (b) shows the same page in LIVE DISPLAY MODE; the data fields are now occupied by “live” data readings from the measured process, and the billboard by the prespecified “logo” string.

Fig. 5.1.a Typical Composed Video Page Format, in TEXT EDITOR MODE



Fig. 5.1.b The Same Video Page Format, in LIVE DISPLAY MODE



- i. To compose the video page shown in Fig. 5.1,¹
 1. Move the screen cursor down one single-height space by pressing the “**DOWN ARROW**” key.
 2. Set a “4x4” CHARACTER SIZE² for the first line of FIXED TEXT by
 - a. First pressing the **Width** key and then **4**.
 - b. Then pressing the **Hght** (HEIGHT) key and then **4**.
 3. Set a color of *red on white* for the first line of FIXED TEXT³:
 - a. Press the **Shift** key and hold it down.
 - b. Press the key labelled **Red**.
 - c. Press the **Back Grnd** (BACKGROUND) key.
 - d. Press the key labelled **Wht** (WHITE).
 - e. Release the **Shift** key.

You may wish at this time to experiment with other foreground/background color combinations. Remember, the sequence is

[SHIFT]
CHARACTER COLOR KEY
BACKGROUND KEY
BACKGROUND COLOR KEY
[UNSHIFT]

4. Now you’re ready to enter the actual text of the line. Type the word “**WARNING!**” Press and hold down the **Shift** key (or press **Caps Lock**) to produce upper-case letters and the exclamation point (!). If you make a typing error, you can always use the **Back Space** or “**LEFT ARROW**” key and rewrite over any existing text—as long as you’re in TEXT EDITOR MODE.
5. Using the “**LEFT ARROW**” key, move the cursor back to the letter “**W**.” Press the **Insrt** (INSERT) key *once*. This inserts one *white-background* space to the left of the word “**WARNING!**,” at the position of the cursor.
6. Now reset the color of this inserted space to *white on black*:

[SHIFT], WHITE, BACKGROUND, BLACK [UNSHIFT]
7. Press the **Insrt** key several more times—thereby inserting *black-background* spaces—until the word is horizontally centered on the screen, as in Fig. 5.1. If you insert too many spaces, you can delete the space occupied by the cursor by pushing the **Dlete** (DELETE) key.
8. The cursor should still be at the left edge of the screen. Move it down three single-height spaces, via the “**DOWN ARROW**” key. Note that, for purposes of vertical formatting, you may *insert a line of spaces* of appropriate size and color by moving the cursor to the extreme left edge of the

¹ The procedure given here assumes the use of a Model 10BVS95 or 10BVS98 Video Signal Card. The procedure is slightly differently when the older 10BVS90 is present.

² ALL TEXT AND DATA CHARACTERS ON A GIVEN LINE OF THE DISPLAY MUST BE OF THE SAME SIZE (HEIGHT x WIDTH). All the character sizes shown in Fig. 2.C.4 of the *System 10 Guidebook* are possible with the exception (for a Model 10BVS95) of “2 x 1,” “3 x 1,” and “4 x 1.”

³ For *monochrome* equivalents to color settings, see Section 2.C.5(d) of the *System 10 Guidebook*.

screen, pressing the **Ctrl** (CONTROL) key, and holding it down as you press the **Insrt** (INSERT) key. Similarly, to *delete an entire line of display*, move the cursor to the extreme left of the line to be deleted, press **Ctrl**, and hold it down as you press **Dlete** (DELETE).

9. Now set the line character size to “2x2” by
 - a. First pressing the **Width** key and then 2.
 - b. Then pressing the **Hght** (HEIGHT) key and then 2.
10. Set a color for the second line of your display—say, *yellow on black*:
[SHIFT], YELLOW, BACKGROUND, BLACK, [UNSHIFT]
11. Insert a whole line of black spaces at the cursor position, as described in Step 8, above, by pressing **<Ctrl> Insrt**.
12. To enter the first portion of FIXED TEXT for the second line, type several spaces (via the SPACE BAR) and the word “**BOOST:**”
13. To start the DATA FIELD that immediately follows “BOOST:,” press the **Begin Data** key.
14. Enter *four spaces* and then **001**, which is the *channel number* that identifies this data field. Remember that the last digit of the channel-number entry must always occupy the last character space of the data field.
15. Press the **End Data** key. You have now established a *seven-space* data field. This field will normally appear as blue characters on a green background as long as you’re in the TEXT EDITOR MODE. NOTE: If you should make an error in entering the data field, you will be alerted by a specific “prompting message” in the billboard (see Section 2.C.5(e) of the *System 10 Guidebook* for details).
16. Now enter the remaining FIXED TEXT for this line: one space, followed by the unit legend “**IN HG.**” Since the whole line was inserted in Step 11 (with the foreground/background combination specified in Step 10), the letters will appear in the same color as the word “BOOST:” It is permissible, however, to specify a *new* color at any point within a given line’s FIXED TEXT. (In fact, if you had not entered the whole line in Step 11, you would have to reset the desired color upon leaving the data field.)
17. Press CARRIAGE RETURN (**Retrn**) twice, and follow the same procedure to enter the second and third data lines (entering channel numbers of **002** and **003**, respectively). NOTE: While you must reset the character size for each succeeding line, you need not reset the color, *so long as you exit the original line by pressing CARRIAGE RETURN*. Remember, too, to use the **Insrt** and **Dlete** keys for horizontal positioning of each line, as in Steps 5 and 7, above.
18. When you’re satisfied with the appearance of your display format, press the **Exit** key to leave TEXT EDITOR MODE and return to LIVE DISPLAY MODE.

As shown in Fig. 5.1.b, the channel numbers you entered in the display’s data fields will now be replaced by “live” data readings for the respective channels, while the color of each data field will now change to the color determined by the “STATUS”-defining command currently in effect for the respective channel. Unless otherwise specified by the purchaser, each mainframe is shipped with an initial status setting of white on black for every data channel, for all limit conditions.

- j. As soon as you press the **Exit** key, the billboard will announce that the page on display is “volatile”—that is, it is not yet stored in EEPROM memory. THEREFORE, IF THE MAINFRAME IS NOW TURNED OFF, THE NEWLY COMPOSED PAGE WILL BE IRRETRIEVABLY LOST.

If you want to take another look at the Page Directory at this point, to see what pages are as yet unused, simply type **DIR [CR]**, as in Step c, above.

- k. After examining the directory, you will have to “recall” to display the still volatile page you have just composed, by entering from the keyboard a command of

RCL [CR]

- l. To permanently save this page, make sure the EEPROM Write Protect function is enabled (see Step a, above), and then type

SAV n [CR]

where “n” is a page number *not presently being used*.^{*} The billboard will tell you when the page is safely in EEPROM storage. Press CARRIAGE RETURN once more to remove the billboard message.

- m. To verify the saving of the new video page, call back the Page Directory by typing **DIR [CR]**. It should show the page just placed in EEPROM storage (as “Page No. n”), with its relative memory size.

- n. Now call Page No. n to display once more by pressing the **Page** key and typing the number “n,” followed by **Retrn**. While Page No. n is still on the screen, press the **Page** key (only), followed by **Retrn**. The appropriate response (**PAG = n**) should appear in the billboard.

- o. Press **Retrn** once more and note the “logo” text presently in the display billboard. Change the “logo” to “**ABC CORP.**” by typing

LGO = ABC CORP. [CR]

- p. Now enter an **LGO** command to change the “logo” back to its original text, or to whatever other text you want. For a CRT display, the “logo” can take up to 27 alphanumeric characters, including spaces.

- q. To designate a new “sign-on” page to be displayed automatically on system powerup, you can enter a command of

SOP = p [CR]

where “p” is the number of any video page currently in EEPROM storage.

Having gone through the above page composition and storage procedure—and, ideally, having gone back and tried to compose a few video page formats of your own design—you may want to consult Section 2.C of the *System 10 Guidebook* for instructions on additional video setup procedures, including

- CRT adjustment, including VIDEO MODE and refresh rate
- DELETION of display fields and video pages
- line duplication and repeated character entry
- establishment of “ASSOCIATED” FIXED TEXT

^{*} Note that “n” could also designate an existing page in storage which you wish to *replace* with the page now on display. In this case, the system will automatically display the currently stored “Page No. n,” with the billboard question

PAGE ALREADY EXISTS AS SHOWN, DELETE?

See Section 2.C.7 of the *System 10 Guidebook* for further instructions.

- setup of BIT-STATE, MESSAGE, and VIDEO PLAYBACK FIELDS
- specification of VISUAL EFFECTS for data, bit-state, message, and video playback fields

As mentioned earlier, some of these topics will be covered when we come to LIMIT SETUP in Section 13. Setting the REFRESH RATE is covered in Section 10. Optional VIDEO BARGRAPHS (requiring the **Model 10VGM500**) will be treated in Section 17, and optional VIDEO PLAYBACK FIELDS (requiring the **Model 10BDR64**), in Section 18.

6 SETUP OF ANALOG INPUTS: TRANSDUCER CABLING

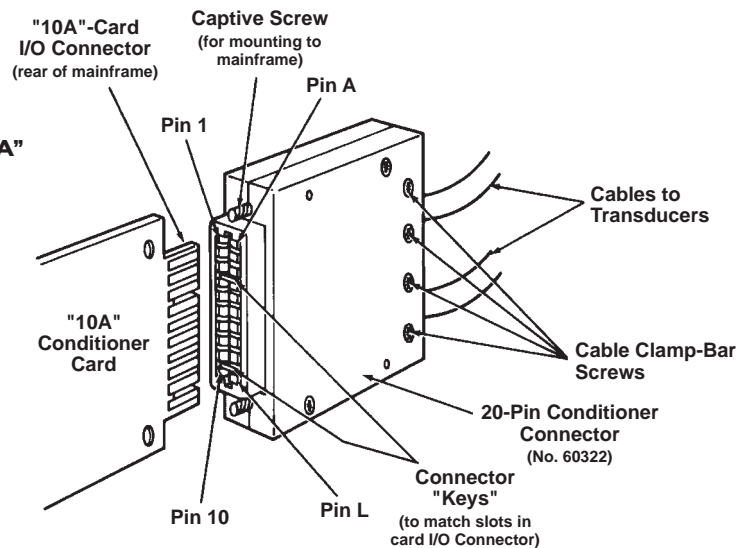
If you ordered sensor cables with your System 10, these will be equipped with individual female 20- or 40-pin CONDITIONER CONNECTORS, all properly labelled and “keyed.”

Fig. 6.1.a, below, shows the “standard” 20-pin connector for a Daytronic “10A” Conditioner Card, with *internal solder terminals* for up to eight separate transducer cables. “10A” Thermocouple Conditioners like the Models 10A9-8C and 10A10-4 require special screw-terminal connectors, similar to that shown in Section 1.E of the *System 10 Guidebook*.*

Fig. 6.a.b shows a typical 40-pin connector for a Daytronic “AA” Conditioner Card, with labelled *screw terminals* for direct connection of transducer cable leads.

If you’re supplying your own sensor cables, you should carefully read Section 1.E of the *System 10 Guidebook*, along with the individual **conditioner card subsection(s) of Section 1.E.2** that apply to your system. All necessary cabling instructions are given here.

**Fig. 6.1.a Standard “10A”
Conditioner Connector**



* Several other “10A” cards require special I/O provisions. For example, the Model 10A68-2 Dual AC RMS Conditioner Card mates with a special connector board that has a separate screw-terminal block for each input channel, and the Model 10A74-4C Quad Strain Gage Track-Hold Conditioner Card will normally use a special Bridge Completion Connector in place of the standard connector. See the specific subsection of *System 10 Guidebook* Section 1.E.2 for complete details.

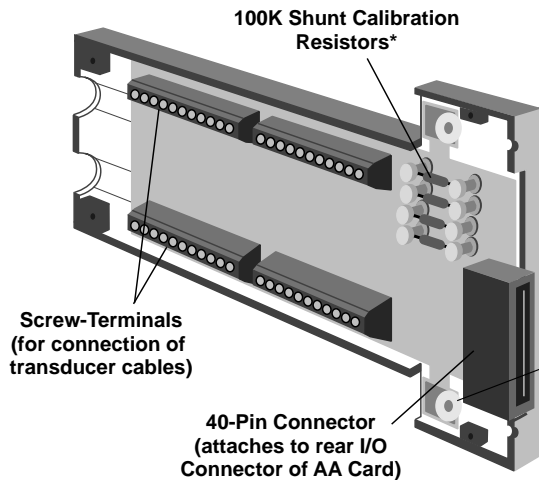


Fig. 6.1.b Typical "AA" Conditioner Connector Assembly (shown upside down)

Ground Lug
(for grounding cable shields via mainframe mounting screws)

* Only present for strain gage conditioner cards.

To create your first "real-world" DATA CHANNEL, you should now connect at least one transducer to your mainframe. This should be a transducer that can be both zeroed and loaded with an arbitrary value of the measured parameter (NOT, in most cases, a Thermocouple, Thermistor, or RTD). A perfect example of such a transducer is a **load cell**.

You will use this channel for the procedures given in the following sections. For a listing of all *preconfigured* data channels in your particular system, see the print-out in **Appendix A** of your *System 10 Guidebook*.*

NOTE: While most CONDITIONER CARDS are ready to be calibrated as soon as they are properly cabled to their respective transducers, a few of them require **special setup procedures** under certain circumstances. Be sure to check the section entitled "SETUP AND/OR OPERATING CONSIDERATIONS" in each card-specific subsection of *System 10 Guidebook Section 1.E.2* that applies to your system.

7 DATA CHANNEL CONFIGURATION

In this section, we will consider the configuration of your system's REAL CHANNELS. A "real channel" is an analog input channel containing physical measurement data from the "real world." There are other types of data channels that must be configured before they can be used—including ANALOG OUTPUT CHANNELS, PSEUDOCHANNELS, and CONVERSION CHANNELS. You need not worry about these other types of channels right now.

NOTE: IN ALMOST ALL CASES, YOUR SYSTEM'S ANALOG-INPUT CHANNELS WILL HAVE BEEN FULLY CONFIGURED AT THE FACTORY, IN ACCORDANCE WITH SPECIFICATIONS GIVEN AT THE TIME OF ORDER. Therefore, you need not normally concern yourself (at least initially) with the configuration procedure, unless you need to *reconfigure* your system, through the addition or removal of one or more cards, the reassignment of transducer inputs, the physical interchange of cards within the mainframe, etc.

"Configuration" of a real channel ordinarily involves applying to that channel first a **TYPE (TYP)** command and then a **LOCATE (LCT)** command. In the following

* PLEASE NOTE: The **System 10 Data Sheet** will be included within the *System 10 Guidebook* itself (as **Appendix A**) only when a *printed* version of the *Guidebook* is supplied with a specific System 10. WHEN THE *GUIDEBOOK* IS PROVIDED ON CD OR OTHER ELECTRONIC MEDIUM, THE DATA SHEET WILL BE PROVIDED AS A SEPARATE DOCUMENT.

procedure, however, you will simply interrogate the system to confirm pre-entered **TYP** and **LCT** values for a few selected channels. **YOU WILL NOT—AND SHOULD NOT—CHANGE THESE VALUES AT THIS TIME.** If, in the future, you do need for some reason to reconfigure one or more real channels, refer to **Appendix C** of the *System 10 Guidebook*.

In this section you will also learn how to use the keyboard's **Step** and **Back Space** keys for rapid sequential interrogations.

- a. Turn to **Appendix A** of your *System 10 Guidebook*.^{*} There you will find a customized printout, which we will call the "System 10 Data Sheet." This is a complete listing of all data channels in your system as shipped, giving important setup information for each existing real channel, including
 1. the MODEL NUMBER of the plug-in card that handles the channel
 2. the "TYPE" designation for the channel
 3. the "LOCATION" of the channel relative to the system's A SLOTS
 4. the initial DIGITAL FILTER SETTING for the channel (0 through 9)
 5. the initial SCALING FACTOR ("EMM") and ZERO OFFSET ("BEE") values for the channel
 6. the initial LOW and HIGH LIMIT SETTINGS for the channel
 7. the initial "LIMIT LOGIC" SETTINGS for the channel
 8. other channel parameters that may apply (including Linearization Function, Conversion Channel assignment, Range value, and Sensitivity value)

The data sheet also shows which channels, if any, have been preassigned to CALCULATION and/or ANALOG OUTPUT functions. It lists all "EXECUTE," "CONDITIONAL," and "COMMAND" statements that have been pre-entered for your system, as well as all "LOGIC SOURCE" and "BIT DESIGNATOR" assignments for system bits. Other miscellaneous system parameters are also listed. Finally, it gives all relevant SERIAL NUMBERS and SOFTWARE/ HARDWARE "VERSION" NUMBERS, plus all initial mainframe A-SLOT ASSIGNMENTS.

For the purposes of this tutorial procedure, you need only refer to the "CHANNEL CONFIGURATION" section of the data sheet.

- b. Since you will not be entering any setup values here, but only interrogating the system for existing values, the EEPROM Write Protect function need not be enabled. Turn OFF the mainframe's EEPROM Write Protect Switch by placing it in the *downward* position. If you enabled the EEPROM Write Protect function by commanding **BIT 999 = 1 [CR]** in Step a of Section 5, you should now disable it by entering a command of

BIT 999 = 0 [CR]

- c. Enter from the keyboard a command of

TYP 1 [CR]

This is an INTERROGATION (or "READ") command. Unlike most SETUP (or "WRITE") commands, an interrogation command has no "equals" sign (=). It doesn't serve to enter (or "write") system configuration data into the Central Processor's EEPROM, but to retrieve (or "read") configuration data out of it.

The two-character (hexadecimal) "TYPE CODE" shown on the data sheet for Channel No. 1 should now appear in the billboard region of the mainframe or keyboard display. A channel's type code specifies one or more special pro-

^{*} See note, previous page.

cessing factors that may apply to that channel, including range, sensitivity, linearization table, calibration procedures, etc. For example, a type of **19** signifies a "Type J" thermocouple input, and a type of **6B** signifies a ± 200 V-DC voltage input. A complete list of all channel type codes may be found in **Appendix C** of the *System 10 Guidebook*.

- d. Press the keyboard's **Step** key. This "steps" the last-entered interrogation command to the next channel in numerical sequence. Thus, the type code for Channel No. 2 should now appear on the billboard. Check the data sheet to verify that this is indeed the case.
- e. Use the **Step** key to continue "stepping" through several more channels. (For rapidly stepping through a whole range of channels, press **Step** and hold it down.)
- f. Now use the **Back Space** key to "step" *backwards* through the interrogation series.
- g. Enter from the keyboard a command of

LCT 1 [CR]

The appropriate "LOCATION" number for Channel No. 1 should now be displayed.*

The first digit of the location number represents the channel's "A-CARD DECK" number. For mainframes with only one A-slot rack, it is always "1." It can be "1" through "4" for a 10KN6 or 10KN7 mainframe, which permits extension of A-slot capacity by up to three additional decks (in such mainframes, the *bottom* A-card deck will always be the *highest* numbered).

The second and third "location" digits represent the A-SLOT NUMBER within the given deck for the A CARD that handles the given channel. Each deck can have up to 24 optional A cards.

The fourth "location" digit is the SUBCHANNEL NUMBER corresponding to this channel (1 through 8).**

For example, the channel corresponding to the second subchannel of the card occupying "A SLOT No. 13" of the mainframe's DECK No. 4 will have a location number of "4132"; the channel corresponding to the seventh subchannel of the card occupying "A SLOT No. 6" of a mainframe's single A-card deck will have a location number of "1067."

- h. Again, use the **Step** and **Back Space** keys to interrogate a continuous sequence of channels for their respective locations. Remember that this "stepping" procedure will work following any initial keyboard interrogation of the form

[MNEMONIC] n [CR]

where "n" is the number of the first argument of the desired series (Channel No., Bit No., Page No., "Execute" No., etc.).

* The default "location" number for all channels to which the "WRITE" form of the **LCT** command has not been applied is "1011." For a "nonlocated" channel—for example, a "pseudochannel" or "conversion channel"—the response to **LCT x [CR]** is "N/A."

** An A Slot will usually have as many "subchannels" as the number of individual analog inputs its card can handle (e.g., eight for a Model 10A9-8C, four for a Model 10A10-4, one for a Model 10A40, etc.).

8 SETTING SYSTEM SCAN RANGE

Before you proceed to calibrate any of your system's data channels, you should define its default SCAN RANGE. In this section, you will learn to use the **TERMINATOR (TER)** command to do this.

- a. Enable the EEPROM Write Protect function by turning ON the EEPROM Switch (placing it in the *upward* position) or commanding **BIT 999 = 1 [CR]**.
- b. A System 10's initial default scan range is normally preset at the factory. The typical range is from Channel No. 1 through the highest Channel Number called for by the system configuration specified at the time of order. Determine this initial range by entering from the keyboard an interrogation of

TER [CR]

The number of the current "TERMINATOR CHANNEL" will be displayed. We will call this number "t₁."

- c. Refer to the **Locate (LCT)** column in Section 2 of your System 10 Data Sheet. You should already be aware of the "location" of the real channel that uses the source transducer you hooked up in Section 6, above. For example, if you cabled your real-world transducer to the first subchannel of the conditioner card in A Slot No. 3 or the first A-card deck, the corresponding real channel would be the channel "located" at "1031." Find the location value of your "live" real channel in the **LCT** column. Note the corresponding CHANNEL NUMBER in the **Channel (CHN)** column. We will call this number "x."

- d. Now enter a command of

TER = t₂ [CR]

where "t₂" is a number different from "t₁" and *higher than "x."* This command assigns Channel No. t₂ to be the new system Terminator Channel. On powerup, the Central Processor's effective scan range will always be from Channel No. 1 to and including Channel No. t₂.^{*} As a general rule, you'll want to maximize your system's scan speed by making the Terminator Channel Number as low as possible.

9 SETTING SYSTEM TIME AND DATE

In this section, you'll learn to apply the **TIME (TME)** and **DATE (DTE)** commands.

- a. Make sure the EEPROM Write Protect function is enabled.
- b. Set your system's internal clock-time by entering from the keyboard a command of

TME = t [CR]

where "t" is a number of up to 6 digits expressing the current time in hours, minutes, and seconds. For example, if it were now exactly 3:07

^{*} Unless a **SCAN (SCN)** command has been used to specify a low scan limit other than Channel No. 1 and/or a high scan limit other than Channel No. t₂ (see Section 1.F.1 of the *System 10 Guidebook*). Note too that for a B-sized mainframe, you cannot set a Terminator Channel higher than "997"; the special TIME and DATE channels (Nos. 998 and 999) are always scanned.

p.m., you would enter for “t” the number 150700 (for hour “15,” minute “07,” and second “00”).¹

- c. To verify this setting, ask for the current system time by commanding

TME [CR]

- d. Now set your system’s internal date by commanding

DTE = d [CR]

where “d” is a number of up to 6 digits expressing the current date in month, day, and year. For example, if today were June 9, 2001, you would enter for “d” the number 60901 (for month “06,” day “09,” and year “01”).²

- e. To verify this setting, ask for the current system date by commanding

DTE [CR]

10 DATA CHANNEL CALIBRATION

The purpose of this section is to lead you step-by-step through a typical System 10 “real-channel” calibration. As explained in Section 1.G.2 of the *System 10 Guidebook*, a number of different calibration methods are available. The method chosen for a given analog input channel will depend on the type of source transducer, the characteristics of the transducer/cable/conditioner combination, the extent of your knowledge of these characteristics, and the possibility and/or convenience of producing actual or simulated transducer inputs of known value.

TO FIND OUT WHICH CALIBRATION METHOD OR METHODS MAY BE USED WITH A GIVEN CONDITIONER CARD, YOU SHOULD REFER TO THE RESPECTIVE SUBSECTION OF *SYSTEM 10 GUIDEBOOK SECTION 1.E.2*.

In very general terms, you will calibrate a signal-conditioner channel by commanding the system’s Central Processor to compute and store two constant values: a **SCALING FACTOR (“m”)** and a **ZERO OFFSET (“b”)**. Automatically and continuously applied to all subsequent readings of the given channel, these two calibration constants define the linear proportionality expressed by the equation “ $y = mx + b$.”³ In the following conventional “zero and span” technique, you will use the **ZERO (ZRO)** and **FORCE (FRC)** commands to define a channel’s “b” and “m” values, respectively. This is known as “Two-Point” or “Deadweight” calibration.

- a. In Section 8, above, you determined the CHANNEL NUMBER of the “live” analog input channel you set up in Section 6. We will consistently refer to this channel as “Channel No. x.” Thus, where “x” appears in the command syntax below, you should enter the *actual Channel Number* assigned to

¹ Though not entered in the **TME** command, separating *colons* will be shown in every display of TIME.

² Though not entered in the **DTE** command, separating *slashes* will be shown in every display of DATE.

³ Where “y” is the measurement value reported for the channel and “x” is the ratio of the actual voltage of the analog input signal to the positive full-scale voltage of the channel’s chosen input “type.” As such, “x” is a unitless number operated upon by the “slope” coefficient “m” and the offset term “b” to yield a true analog measurement. Both “m” and “b” are expressed in the engineering units of the chosen input “type.”

this channel. In Section 8, above, you ensured that Channel No. x is within the current system SCAN RANGE, as it *must* be if it is to be calibrated.

- b. You should first arrange for a “live” display of Channel No. x. If this channel does not appear on any of your system’s initial data-display pages, you will have to compose a new video page for its display, following the guidelines given in Section 5, above.
- c. At this point, you should determine whether your display’s current refresh rate is satisfactory. Every mainframe is normally preset to update *displayed* data approximately 10 times a second. You may increase or reduce this rate, if you wish, by enabling the EEPROM Write Protect function and commanding

REF = n [CR]

For the “refresh constant” (n), you should enter an integer from 1 through 60. This number is related to the actual screen “refresh rate” (R, in Hertz) by this equation: $60/n = R$ (Hz). The range of possible refresh rates is therefore 1 through 60 Hz.* For example, if you enter a refresh constant of “5,” data appearing on your screen will be updated approximately 12 times a second, while a value of 30 for “n” will yield a rate of only 2 times a second.

- d. Establish a *zero input* for Channel No. x by removing all load from the source transducer.
- e. Make sure the EEPROM Write Protect function is enabled, and enter from the keyboard a command of

ZRO x [CR]

The displayed value for Channel No. x should now be *zero*. If it is not, recheck the transducer connection, the channel number, and the channel TYPE and LOCATION assignments; also make sure that Channel No. x is in fact within the current scan range (see Sections 6, 7, and 8, above). This command sets the “BEE” value for Channel No. x—that is, the ZERO OFFSET to be applied to all subsequent channel readings.

- f. Now apply an *accurately known value of input loading* to the source transducer—a value (positive or negative) from 80% to 100% of the nominal full-scale rating.
- g. Enter a command of

FRC x = z [CR]

where “z” is the numerical value of the known input applied in Step e, in desired engineering units and with appropriate polarity. This command “forces” the data reading of Channel No. x to equal the value “z.” It thereby sets the “EMM” value for Channel No. x—that is, the SCALING FACTOR to be applied to all subsequent channel readings. Check the “live” display of Channel No. x to make sure that it reads the number “z.”

The **FRC** command also set the desired *precision* of Channel No. x. Suppose, for example, that you’re measuring “pounds,” and enter a “z” of “300.” All subsequent readings of Channel No. x will be rounded to the nearest pound. If, however, the entry is “300.0,” then all readings will be rounded to the nearest tenth of a pound.

* Please note that these rates are approximate only.

- h. Remove all load from the source transducer. The “live” display of Channel No. x should return to zero. Check the accuracy of the calibration by applying various amounts of known loading to the transducer and noting the corresponding measurement readings on the channel’s “live” display. (You may have to repeat Steps d through h to achieve final calibration.)
- i. Do not disconnect the transducer. It will be used in some of the following procedures.

NOTE: Section 2.G of the *System 10 Guidebook* shows you how to set a data channel’s SCALING FACTOR and ZERO OFFSET directly, using the **SCALING FACTOR (EMM)** and **OFFSET (BEE)** commands, respectively. Section 2.G also tells you how to set a channel’s digital filter by means of the **FILTER (FIL)** command, and also, if desired, a “run-time” tare offset value, by means of the **TARE (TAR)** command.

11

SETUP OF CROSS-CHANNEL CALCULATIONS

In this section, you will apply the **CALCULATE (CLC)** command to define a system “CALCULATE” channel.

A CALCULATE channel is one form of System 10 “pseudochannel.” Its reported data does not represent a directly measured value, but rather a mathematical function of one or more other data channels (“real” or “pseudo”). In addition to standard algebraic operations, CALCULATE functions include square root, absolute value, maximum (most positive value), and minimum (least positive value). They permit real-time computation of such process variables as Efficiency, Horsepower, Specific Fuel Consumption, Power Factor, Lift-Drag Ratio, Spring Modulus, and many others.

The thirteen forms of the **CLC** “WRITE” command are listed in Section 2.J.1 of the *System 10 Guidebook*. Here, we will use only the first of these functions (multiplication of a single channel by a constant) to demonstrate the use of the **CLC** command. You will multiply the “live” data value for Channel No. x—the channel you calibrated in the previous section—by a given numerical constant. Examples of more complex cross-channel calculations are given in Section 2.J of the *System 10 Guidebook*.

- a. Make sure the EEPROM Write Protect function is still enabled.
- b. Apply a value of stable input loading to the source transducer of Channel No. x. Observe the displayed data value for the channel.
- c. Refer to your customized System 10 Data Sheet and choose a channel *within the current scan range but not currently used by your system*. Its present “TYPE” and “LOCATION” values are not important. We will call this “Channel No. y.”
- d. Arrange for a “live” display of the data reported by Channel No. y, preferably on the same video page that displays Channel No. x (see Section 10, Step b, above).
- e. Enter from the keyboard a command of

CLC y = 2(CHN x) [CR]

where “y” is the number of the unused channel selected in Step c and “x” is the number of the real channel calibrated in Section 10.

Channel No. y’s display should now report a value exactly twice that of Channel No. x, and with the same precision as was specified for Channel No. x in Section 10, Step f, above.

- f. Change the input to Channel No. x, and the reading of Channel No. y should change accordingly.
- g. To change the *calculation offset constant* from “0” (assumed in the above command) to “1,” type

$$\text{CLC } y = 2.0(\text{CHN } x) + 1.0 \text{ [CR]}$$

The reading of Channel No. y should now equal twice the reading of Channel No. x, plus one. Note that the offset (or “b”) term of the CALCULATE expression is to be entered with the precision desired for the final “calculated data” reading. In this case, since this term was entered as “1.0,” resolution will be to the nearest *tenth* of a unit.

Note also that we changed the decimal-point location of the “gain” (or “m”) coefficient of the CALCULATE expression from “2” to “2.0” in order to match the resolution of the offset term. It is always recommended that within a given **CLC** statement the gain coefficient and the offset term be expressed to the same resolution, as indicated by the decimal-point location. This will help prevent erroneous off-scale results. It is also recommended that you set up all of your **CLC**’s to the same decimal-place resolution. Mixing **CLC** resolutions will tend to slow down the system scan speed.

- h. You may wish at this time to set up and display a second “real-world” data channel (call it “Channel No. z”), in order to try out some of the CLC functions that operate on two channels—for example,

$$\text{CLC } y = 2.0(\text{CHN } x + \text{CHN } z) \text{ [CR]}$$

or

$$\text{CLC } y = (\text{CHN } x)(\text{CHN } z)/2.0 + 1.0 \text{ [CR]}$$

12 SETUP OF LOGIC BITS AND LOGIC PORTS

12.a "SOURCING" OF LOGIC BITS

Your system's 1000 internal LOGIC BITS are numbered from "Bit No. 0" through "Bit No. 999." Before it can be used, a given bit must be assigned a **logic source**. This source will continuously tell the bit what logic state it is to assume at any time: "1" or "0." The way a bit is "sourced" also determines whether or not it will latch on being set to "Logic 1." A "latched" bit must be released (as explained in Section 13) before it can again be set.

To show you how the **LOGIC SOURCE (SRC)** command works, we will have you assign a source of "LATCHING LIMIT LOGIC" to a presently unused system bit. In Section 13, this bit will be used to observe the limit behavior of your "live" analog input Channel No. x as its transducer load is varied.

If your system has an optional **Model 10BIO-16 Universal Logic I/O Card**, you will use the **SRC** command in the following section to designate which of the 10BIO-16's I/O ports are to be Logic *Input* Ports and which are to be Logic *Output* Ports.

Before you set any logic sources, however, you must learn to use the **SET BIT (BIT)** command to set and read system logic-bit states.

1. You may disable the EEPROM Write Protect function if you want to, since it need not be enabled for the "WRITE" form of the BIT command to work.

2. First enter from the keyboard a "READ" command of

BIT 3 [CR]

The present logic state of Bit No. 3 will be displayed as either "3, 1" or "3, 0."

3. Use the **Step** key as you did in Section 7 to display a sequential range of existing bit states.

4. Now enter a "WRITE" command of

BIT 898 = 1 [CR]

(We are here assuming that Bit No. 898 is not presently involved in any of your system's preconfigured logic activities—channel "limit logic," "Execute" functions, etc. Just to be safe, however, you might want to check your "System 10 Data Sheet.")

5. Verify that Bit No. 898 has been properly "set" by commanding

BIT 898 [CR]

An answer of "898, 1" should be displayed.

6. "Reset" Bit No. 898 to "Logic 0" by commanding

BIT 898 = 0 [CR]

7. You will now assign a logic source of "LATCHING LIMIT LOGIC" to Bit No. 898. Make sure the EEPROM Write Protect function is enabled, and enter from the keyboard a command of

SRC 898 = LIM, LAT [CR]

As with any SETUP (or “WRITE”) command, you can always check to see that the command was effective by interrogating for the setup value you just specified. In this case, you would enter the corresponding “READ” command of

SRC 898 [CR]

If the above “WRITE” command was effective, you should get an answer of “LIM,LAT.” If this is not the answer you get, you will need to re-enter the SETUP command.

NOTE: In Section 13, we will want Bit No. 899 to be controlled by “NONLATCHING LIMIT LOGIC.” We do NOT have to apply an **SRC** command to this bit, however, as we just did to Bit No. 898. As we will see, the reference to any given bit by one of the three “LIMIT LOGIC” commands automatically sets the source of that bit to “NONLATCHING LIMIT LOGIC.”

12.b INITIALIZATION OF OPTIONAL MODEL 10BIO-16

IF YOU DON'T HAVE A **MODEL 10BIO-16 UNIVERSAL LOGIC I/O CARD**, YOU CAN SKIP THIS SECTION AND PROCEED DIRECTLY TO SECTION 13, BELOW.

Your system's 1000 logic bits are divided into “BIT GROUPS” of sixteen bits each. The first bit group consists of Logic Bit Nos. 0 through 15; the second, of Bit Nos. 16 through 31; the third, of Bit Nos. 32 through 47; etc. A complete table of bit groups is given in Section 2.H of the *System 10 Guidebook*.

Before you use the **SRC** command to specify which of the 10BIO-16's LOGIC I/O PORTS are to be INPUTS and which are to be OUTPUTS, you must first “initialize” the 10BIO-16 card. You will use the **B SLOT (BSL)** command to establish a one-to-one correspondence between the 10BIO-16's sixteen Logic I/O Ports and the sixteen members of a particular system bit group.

1. Remove the mainframe's upper front bezel, if it is not already off, and determine which B SLOT your 10BIO-16 card is in.
2. Make sure the EEPROM Write Protect function is still enabled, and enter from the keyboard a command of

BSL s = 1, k [CR]

Here, “s” is the number of the B SLOT occupied by the 10BIO-16 and “k” is the number of a currently unused system BIT GROUP.*

For example, to assign the sixteen bits of Bit Group No. 3 (= Bit Nos. 32 through 47) to the Logic I/O Ports of the 10BIO-16 in B SLOT No. 4, you would command **BSL 4 = 1, 3 [CR]**. In this case, Bit No. 32 would now correspond to the 10BIO-16's Port No. 0, Bit No. 33 to Port No. 1, Bit No. 34 to Port No. 2, etc. (take a look at Fig. 3.B.2.2 in Section 3.B.2.c of the *System 10 Guidebook*).

Once you've assigned the 10BIO-16 to a specific system bit group, you must use the **SRC** command to indicate which of the card's sixteen ports are to be dedicated to LOGIC *INPUTS*. ANY LOGIC I/O PORT TO WHICH A **SRC** COMMAND HAS NOT BEEN APPLIED WILL BE AUTOMATICALLY DESIGNATED AS AN *OUTPUT* PORT. See Section 3.B.2 of the *System 10 Guidebook* for full details.

* The “1” in the command argument assigns a B-card “type” code of “1” to the 10BIO-16.

3. Select three bits from the bit group you specified in the above **BSL** command. Let's call them Bit Nos. b_1 , b_2 , and b_3 . If, for example, you specified Bit Group No. 3, then b_1 , b_2 , and b_3 could be any three numbers from 32 through 47.
4. Enter from the keyboard these three **SRC** commands:
 - SRC b_1 = INP, NON [CR]**
 - SRC b_2 = INP, NON [CR]**
 - SRC b_3 = INP, NON [CR]**

Since you have thus designated the three Logic I/O Ports corresponding to Bit Nos. b_1 , b_2 , and b_3 to be INPUT ports, *the individual logic state of each of these three ports will now directly and continuously control the state of its corresponding system bit* (in a NONLATCHING mode). All other ports are still automatically assumed to be OUTPUT ports. *The individual logic state of each OUTPUT port will be directly and continuously controlled by the state of its corresponding system bit.*

13 LIMIT SETUP

In this section, you will learn how to

- define HIGH and LOW limit values for a given data channel, using the **LOW LIMIT (LOL)** and **HIGH LIMIT (HIL)** commands
 - set the VISUAL EFFECTS to occur for the CRT display of a given data channel, depending on its current limit status, using the **"LESS THAN" STATUS (VLT)**, **"BETWEEN" STATUS (VBT)**, and **"GREATER THAN" STATUS (VGT)** commands
 - create a BIT-STATE FIELD for CRT display of a given logic bit
 - arrange for a data channel's HIGH-LIMIT violation to set a given system logic bit, using the **"GREATER THAN" LOGIC (LGT)** command
 - arrange for a LOW-LIMIT violation of the same channel to set another logic bit, using the **"LESS THAN" LOGIC (LLT)** command
 - release a "latched" bit, using the **RELEASE (RLS)** command
 - cancel a channel's existing "GREATER THAN" and "LESS THAN" LOGIC, using the **LGT** and **LLT** commands
- a. To set the LOW LIMIT value for Channel No. x (the channel you calibrated in Section 10, above), make sure the EEPROM Write Protect function is enabled, and enter from the keyboard a command of

LOL x = L [CR]

where " x " is the channel number and " L " is the desired low-limit value expressed to the required precision. In this case, it should be about 20% of the channel's full-scale reading. For example, if you're using a 50-pound load cell as source transducer for Channel No. x , which was calibrated in Section 10 to read *tenths* of a pound, then enter an " L " value of "10.0."

- b. To set the HIGH LIMIT value for Channel No. x , enter a command of

HIL x = H [CR]

where " H " is the desired high-limit value expressed to the required precision. In this case, it should be about 80% of the channel's full-scale reading. If, again, you were using a 50-pound load cell for readings precise to a tenth of a pound, then you would enter an " H " value of "40.0."

- c. You will now set the **visual effects** to be exhibited by the displayed data field of Channel No. x, when the channel's data reading is LESS THAN the low-limit value established in Step a. You will specify that "low violation" data for Channel No. x is to appear, on a color monitor, as *blinking red characters on a yellow background*.¹ Enter a command of

VLT x = RYB [CR]

- d. Verify the effectiveness of the above **VLT** command by removing all load from the channel's source transducer and observing the resultant display of Channel No. x.
- e. To specify that when the data reading for Channel No. x lies BETWEEN (or is equal to one of) the two preset limit values, the channel's data should be displayed, on a color monitor, with *green characters on a white background*,² enter a command of

VBT x = GW [CR]

- f. Verify the effectiveness of the above **VBT** command by producing a transducer input between 20% and 80% of full scale and observing the resultant display of Channel No. x.
- g. Finally, to specify that when the data reading for Channel No. x is GREATER THAN the high-limit value established in Step b, above, the channel's data should be displayed, on a color monitor, as a "flashing" *alternation of blue characters on a red background with red characters on a blue background*,³ enter a command of

VGT x = BRF [CR]

- h. Verify the effectiveness of the above **VGT** command by producing an approximately full-scale transducer input and observing the resultant display of Channel No. x.
- i. Before setting "limit logic" for Channel No. x, you should arrange for the CRT display of Logic Bit Nos. 898 and 899, in order to verify that Bit No. 898 is automatically set to "Logic 1" on occurrence of a high-limit violation for Channel No. x; and Bit No. 899, on occurrence of a low-limit violation. Proceed as follows:

1. Use the **Page** key as you did in Section 5, Step d, to call to display the prestored "blank" video page (No. 100).
2. Press the **Video Formt** (VIDEO FORMAT) key to enter TEXT EDITOR MODE. Move the cursor down to about the middle of the screen.
3. Type "**BIT 898**," and then press the **Begin Data** key.
4. Type *three spaces*, followed by

#898

¹ If you have a monochrome monitor, command **VLT x = 02B [CR]** to specify *blinking black characters on a white background* for data in the "LESS THAN" zone.

² If you have a monochrome monitor, command **VBT x = 12 [CR]** to specify *half-intensity characters on a white background* for data in the "BETWEEN" zone.

³ If you have a monochrome monitor, command **VGT x = 20F [CR]** to specify a "flashing" *alternation of white characters on a black background with black characters on a white background* for data in the "GREATER THAN" zone.

The “pound” symbol (#) is absolutely necessary to identify the field as a “bit-state field.”

5. Press the **End Data** key. The bit-state field you have just created consists of seven spaces in all, which is the maximum number of spaces allowed for such a field. In LIVE DISPLAY MODE, a bit-state field will display one of two predesignated *words* describing the two possible states of the bit.
6. Move the cursor down two lines, and type “**BIT 899.**” Then press the **Begin Data** key.
7. Type three spaces, followed by
#899
8. Press the **Exit** key to leave TEXT EDITOR MODE and return to LIVE DISPLAY MODE. Since Bit Nos. 898 and 899 should each be at a “Logic 0” state, the word “**LOW**” should appear in each of the two bit-state fields you have just created, with *red characters on a white background*.^{*} When either bit changes its state from “Logic 0” to “Logic 1,” its field should read “**HIGH**” with *white characters on a black background*.

The word pair “HIGH/LOW” is the initially specified “BIT DESIGNATOR PAIR” for all system logic bits, with the abovementioned color combination for each word. You can easily change the words and colors used to display any bit, using the **BIT STATE DISPLAY (BSD)** and **BIT DESIGNATOR PAIR (BDP)** commands as explained in Section 2.C.12 of the *System 10 Guidebook*.

9. Save the page you have just formatted, as you did in Section 5, Step I.

In Section 12.a, above, you used the **SRC** command to assign a logic source of “LATCHING LIMIT LOGIC” to Bit No. 898. Now you will cause this bit to be set and latched on the occurrence of a HIGH-LIMIT violation for Channel No. x.

- j. To cause Bit No. 898 to be set and latched to a state of “Logic 1” when the data value for Channel No. x exceeds the high-limit value specified by the above **HIL** command, enter a command of

LGT x = 898 [CR]

Note that we could just as well have arranged for Bit No. 898 (or any other system bit) to “go high” when Channel No. x’s data reading drops below the low-limit value specified by the **LOL** command, or when it re-enters the channel’s “OK” (“BETWEEN”) zone after either a high-limit or low-limit violation has occurred. See Section 2.F.4 of the *System 10 Guidebook* for a complete discussion of the three “LIMIT LOGIC” commands (**LGT**, **LLT**, and **LBT**).

- k. Verify the effectiveness of the above **LGT** command by producing an approximately full-scale transducer input for Channel No. x and observing the resultant display of Bit No. 898 (it should now read “HIGH”).
- l. Decrease the transducer load until it is less than the high-limit value, but higher than the low-limit value. Since Bit No. 898 is latched, it should continue to display the word “HIGH.”

^{*} For a monochrome display, *black characters on a white background*.

- m. To “release” the latched Bit No. 898 from its “Logic 1” state, enter a command of

RLS 898 [CR]

The display of Bit No. 898 should now read “LOW.”

We also want a “LESS THAN” limit condition for Channel No. x to set Bit No. 899 to “Logic 1,” but in a NONLATCHING fashion. That is, we want Bit No. 899 to revert automatically to a “Logic 0” state as soon as the low-limit violation of Channel No. x ceases to occur. The **RLS** command need not be applied to reset Bit No. 899, as it was to the latching Bit No. 898, above.

- n. Enter from the keyboard a command of

LLT x = 899 [CR]

Bit No. 899 is now *automatically* assigned a “logic source” of “LIMIT, NON-LATCHING.” NO PREVIOUS **LOGIC SOURCE (SRC)** COMMAND NEEDS TO HAVE BEEN APPLIED TO BIT NO. 899, AS IT WAS FOR THE “LIMIT, LATCHING” SOURCE OF BIT NO. 898 (Section 12.a, Step 7, above).

REMEMBER: The reference to any logic bit by one of the three “LIMIT LOGIC” commands (**LGT**, **LLT**, or **LBT**) automatically sets the source of that bit to “NONLATCHING LIMIT LOGIC.”

- o. Verify the effectiveness of the above **LLT** command by removing all load from Channel No. x’s source transducer and observing the resultant display of Bit No. 899 (it should now read “HIGH”).
- p. Increase the transducer load until it is greater than the low-limit value, but less than the high-limit value. The display of Bit No. 899 should change from “HIGH” to “LOW” as soon as the data reading for Channel No. x rises above the low-limit value.
- q. To *cancel* the “GREATER THAN” and “LESS THAN” LOGIC you have set up for Channel No. x, enter the following commands:

LGT x = N/A [CR]

LLT x = N/A [CR]

The presence of a “GREATER THAN” or “LESS THAN” limit condition for Channel No. x will now have no effect on the state of any system logic bit, including Bit No. 898 or 899.

14 AUTOMATIC COMMAND EXECUTION

14.a SETUP OF EXECUTE FUNCTIONS

The extremely versatile **EXECUTE (EXU)** command lets you load one or a series of standard mnemonic commands in advance, to be executed automatically upon detection of a predefined logic event. It's as though the specified command(s) are received directly from the operator or computer the moment the triggering event occurs.*

In the following example, a given system logic bit will “go high”—i.e., will change its state *from “Logic 0” to “Logic 1”*—on detection of a HIGH-LIMIT violation of your calibrated Channel No. x. This “going high” transition will in turn trigger

- the calling of a given video page to display, and
- the loading of a constant numeric value into a special “DOWNLOAD PSEUDOCHANNEL” (which you will set up via the “WRITE” form of the **CHN** command).

NOTE: We are here assuming that your system's Channel No. 900 is presently unused. Just to be safe, however, you might want to check your “System 10 Data Sheet.” If Channel No. 900 is not an unused channel, you will probably want to select another one for this procedure.

1. Make sure the EEPROM Write Protect function is still enabled.
2. Arrange for a “live” display of the data reported by Channel No. 900 (see Section 10, Step b, above).
3. We want Channel No. 900 to be a “DOWNLOAD PSEUDOCHANNEL,” so that we can load it with an arbitrary numeric constant.** You must therefore assign it a “TYPE CODE” of “D0” (“D zero”) by entering a **TYPE (TYP)** command of

TYP 900 = D0 [CR]

(for a full discussion of “Downloading of Numeric Data,” see Section 2.D of the *System 10 Guidebook*).

4. To see how the downloading function works, enter a **CHANNEL (CHN)** command of

CHN 900 = 399 [CR]

The displayed Channel No. 900 should read “399.”

5. Now call the Page Directory to display by typing

DIR [CR]

* Automatic execution of commands occurs during the “housekeeping” period at the end of a complete scan cycle (i.e., after all channels and bits have been scanned and evaluated). Command execution will be in the same sequence in which the commands are specified in the **EXECUTE (EXU)** command statement, unless the number and nature of commands to be executed require their temporary placement in a “COMMAND QUEUE” until such time as they may be put into effect. Command queues and the means of monitoring their status are discussed in Section 2.K.2(d) of the *System 10 Guidebook*.

** Download pseudochannels need not be within the current scan range. In fact, you will generally want to keep them *outside the scan* in order to maximize system speed. There are actually two types of download pseudochannels: “volatile” (or RAM-resident) and “nonvolatile (or EEPROM-resident). The former have a type code of “D0”; the latter, of “D1.”

6. Before you define your "EXECUTE" function, you should first set up its "trigger bit." For this purpose you should select a currently unused bit from among your system's *first 32 bits*.*

7. Enter a command of

LGT x = r [CR]

where "x" is again the number of the channel you calibrated in Section 10, above, and "r" is the number of the selected trigger bit (it must be a number from 0 through 31).* As you learned in the previous section, this command automatically assigns a "logic source" of "NONLATCHING LIMIT LOGIC" to Bit No. r.

8. Now command

EXU r = PAGn:CHN900=0 [CR]

where "n" is the number of the video page that displays Channel No. 900.

The command string specified by an **EXU** command can take up to 31 ASCII characters, including spaces; individual commands are separated by colons.

9. Increase the load applied to Channel No. x's source transducer until it is greater than the high-limit value you entered in Section 13, Step b, above.
10. As soon as Channel No. x's high limit is violated, the video page containing Channel No. 900 should automatically appear, and the data field for this channel should report a value of "0."

11. Now enter a command of

BIT 898 = 0 [CR]

12. Call to display the video page you composed in Section 13, Step i, above, for the "live" display of Bit Nos. 898 and 899. Verify that the bit-state field for Bit No. 898 reads "LOW."

13. Keep the "high violation" load on the transducer, and enter a command of

EXU /r = DIR:CHN900=25:BIT898=1 [CR]

where "r" is again the number of the selected trigger bit. This command instructs the system to

- call the Page Directory
- load Channel No. 900 with the number "25," and
- set Logic Bit No. 898 to "Logic 1"

when Logic Bit No. r "goes low"—i.e., when the transition of Bit No. r *from "Logic 1" to "Logic 0"* is perceived.

14. Remove the transducer load. The Page Directory should automatically appear.
15. Call the video page containing Channel No. 900. That channel's data field should now read "25."

* This assumes that your mainframe has been initially set to employ the first two bit groups (Bits 0 through 31) for the purpose of triggering **EXECUTE (EXU)** command strings. It is possible to assign the system's **EXU** statements to the bits of *any two* bit groups (which need not be contiguous) by means of the **EXECUTE BASE GROUP (XBG)** command, as explained in Section 2.K.2 of the *System 10 Guidebook*.

16. Call the video page containing Bit No. 898. That bit's field should now read "HIGH."
17. You might now want to set up and verify an **EXU** or **EXU/** function that increments the reading of Channel No. 900 by "1," and also "locks" (or "freezes") a given real channel (No. "y")*:

EXU r = INC900:LOKy [CR]

Trigger this "bit going high" EXECUTE as you did in Step 9, above. Use an interrogation of **CHN 900 [CR]** to verify that the reading of Channel No. 150 has increased by "1." Display Channel No. y—or use **CHN y [CR]**—to verify that the reading of this channel is "locked" at its current value, regardless of the behavior of the input signal.

18. To cancel the two "EXECUTE" functions that are now activated by the "going high" and "going low" of Bit No. r, enter the following commands:

EXU r = N/A [CR]

EXU /r = N/A [CR]

For more examples of the **EXECUTE (EXU)** command, see Section 2.K.2 of the *System 10 Guidebook*.

14.b

SETUP OF CONDITIONAL AND COMMAND FUNCTIONS

The **COMMAND (CMD)** command is very similar to the **EXECUTE (EXU)** command, since it also permits one or more standard mnemonic commands to be instantly executed upon detection of a logic-state transition of a given "trigger" bit. The "trigger" bit for a **COMMAND (CMD)** function, however, will always be one of ten special system bits called "CONDITIONAL BITS."

The ten conditional bits are not to be confused with your system's 1000 LOGIC BITS, whose states are determined by various "logic sources," as explained in Section 12.a. The state of a CONDITIONAL BIT is determined solely by the "conditions" specified by a corresponding **CONDITIONAL (CDL)** command. These conditions can include

- the logic state(s) of one or more logic bits
- the limit conditions(s) of one or more data channels
- the occurrence of one or more clock-time readings, each registering passage of a specified time interval

Each **CONDITIONAL (CDL)** command states a logical combination of system conditions in the form of a *Boolean expression*. As you can imagine, a **CDL** statement can be fairly complicated—if, for example, you wanted to execute a series of commands when and only when either (Bit No. 56 is "0" AND Bit No. 57 is "1") OR ((Channel No. 28 has a HIGH LIMIT violation AND Channel No. 34 has a LOW LIMIT violation) AND (a clock-time interval of 20 seconds has just elapsed))! In the following procedure, we will restrict ourselves to a relatively simple example: we will cause the system to

- display the video page that contains "Download Pseudochannel" No. 900; and
- load Channel No. 900 with a constant numerical value

* The **LOCK (LOK)** command can be used to inhibit the automatic updating of all channels, one selected channel, or a selected range of channels. To "unlock" (resume normal updating) of Channel No. y, you must enter an **UNLOCK (UNL)** command of **UNL y [CR]**.

when your “live” input Channel No. x exceeds its HIGH-LIMIT value AND when Bit 899 is “HIGH.”

1. The first step is to define the combination of system conditions that will set a given conditional bit—here, Conditional Bit No. 5—to “Logic 1.” Make sure the EEPROM Write Protect function is still enabled, and enter from the keyboard a **CONDITIONAL (CDL)** command of

CDL 5 = HIL x * BIT 899 [CR]

This command can be interpreted as saying, “Set Conditional Bit 5 to ‘Logic 1’ when data for Channel No. x is in the ‘GREATER THAN’ limit zone AND when Bit No. 899 is at ‘Logic 1.’” For a complete discussion of the Boolean syntax used by the **CDL** command, see Section 2.K.3 of the *System 10 Guidebook*.

2. Next, we have to specify the commands to be automatically executed when Conditional Bit No. 5 is seen to change its state from “Logic 0” to “Logic 1.” To do so, enter the following **COMMAND (CMD)** command:

CMD 5 = PAGn:CHN900=100 [CR]

where “n” is the number of the video page that displays Channel No. 900.

3. Now we need to create the combination of conditions that will trigger the above **CMD** command. Call the video page containing Bit Nos. 898 and 899, if it is not already on display. If the bit-state field for Bit No. 899 does not already read “HIGH,” enter a command of

BIT 899 = 1 [CR]

4. To obtain the second required condition for execution of the above **CMD** command, increase the load applied to Channel No. x’s source transducer until it is greater than the high-limit value you entered in Section 13, above. As soon as Channel No. x’s high limit is violated, the video page containing Channel No. 900 should automatically appear, and the data field for this channel should report a value of “100.”

15

SETTING DATA- TRANSMISSION CHARACTERISTICS

Your system can be made to transmit different kinds of “data” from its COMPUTER INTERFACE PORT, including

- numerical values contained in system DATA CHANNELS (whether these values represent actual measurements, calculations, downloaded constants, etc.), and
- “limit status” information pertaining to these values

We won’t go into the various kinds of output your system can be commanded to transmit in response to a **CHANNEL (CHN)**, **DUMP (DMP)**, **SNAPSHOT (SNP)**, **STREAM (STR)**, **HARD COPY (HCY)**, or **LIMIT ZONE (LZN)** command. All this is discussed in detail in Section 1.H of the *System 10 Guidebook*.

All you’ll do here will be to interrogate your system for a few important transmission characteristics you should be aware of. To modify these and other transmission characteristics, refer to Section 1.H.3 of the *System 10 Guidebook*.

- a. Enter a command of

OPT [CR]

For a mainframe that has just been shipped, the normal response to this interrogation should be “[0D,0A]”—that is, “zero D, zero A.” The **OUTPUT TERMINATOR** (or “**OPT**”) is a string of one or two standard ASCII characters added at the end of *every line of transmission*. In almost all cases, it is initially set to CARRIAGE RETURN, LINE FEED ([CR][LF]). In hexadecimal, this string is expressed as “[0D, 0A].”

- b. Enter a command of

EOT [CR]

For a mainframe that has just been shipped, the normal response should again be “[0D,0A].” The **END-OF-TRANSMISSION TERMINATOR** (or “**EOT**”) is a string of up to four standard ASCII characters added at the end of *every complete transmission*. Like the “OPT,” it is almost always initially set to CARRIAGE RETURN, LINE FEED ([CR][LF], or, in hexadecimal, [0D, 0A]).

- c. Now enter a command of

CMT [CR]

For a mainframe that has just been shipped, the normal response should be “[0D].” What you’ve asked for here is the current **COMMAND TERMINATOR** (or “**CMT**”). Discussed in Section 2.B.5 of the *System 10 Guidebook*, the CMT is not really a “transmission characteristic.” It is the single ASCII character recognized by your system as the termination of any command received through the Computer Interface Port. It is always set initially to CARRIAGE RETURN ([CR], or, in hexadecimal, [0D]). All *keyboard-entered* commands are always terminated with [CR].

For other (in some cases optional) transmission characteristics—including channel number “echo,” limit-zone indication, “header” and “tailer” character strings, characters per channel, column format, and intertransmission delay period—see Section 1.H.3 of the *System 10 Guidebook*.

16 COMMUNICATION WITH EXTERNAL DEVICES

16.a INTRODUCTION: SYSTEM 10 COMMUNICATION MODES

Every B-sized System 10 mainframe has a main COMPUTER INTERFACE PORT on the rear of the Model 10BIP232 Interface Card. This port allows two-way communication with a connected computer, terminal, modem, buffered printer, recorder, operator console, or other external device capable of RS-232-C, IEEE-488, or RS-422 data interchanges.

Through the Computer Interface Port, the external device can

- *issue to System 10* any MNEMONIC COMMAND in the standard command set for that system*; and

* With the exception of the **SAVE (SAV)** and **DELETE (DEL)** commands, which are strictly keyboard-entered commands.

- *receive from System 10* any of the various kinds of formatted data transmissions discussed in Section 1.H of the *System 10 Guidebook*, plus any and all responses to interrogations that originate from the connected device.*

The optional **Model 10BACIA Auxiliary Computer Interface Card** supplies an independent “auxiliary” RS-232-C interface, operating with its own user-specified protocol, and functioning essentially identically to the main port. The use of one or more 10BACIA’s thus allows the mainframe to establish simultaneous high-speed communications with more than one external RS-232-C device.

The optional **Model 10VFO132 Formatted Output Card** provides a special RS-232-C PRINTER INTERFACE PORT for instant hard-copy reproduction of system video page formats (including all appropriate “live” data values, bit states, messages, etc., for each transmitted page). It also permits the printing of “live” data for one, all, or a selected range of system data channels, along with specified “header” and “tailer” texts, in a format specified by the user.

In addition to its main and optional RS-232-C Ports, a B-sized mainframe can accommodate optional LOGIC I/O PORTS for the transfer of logic and digital data (requires one or more **Model 10BIO-16 Universal Logic I/O Cards**—see Section 12.b, above).

As mentioned in Sections e and f, below, optional hardware allows conversion of the RS-232 output of the main Computer Interface Port to either **IEEE-488** or **RS-422** standards, if such communications are required by your application. Two special “10BACI” versions permit “auxiliary” IEEE-488 and RS-422 interfacing, respectively, independent of the main Computer Interface Port.

When equipped with a **Model 10BD4 Satellite Interface Card**, any B-sized mainframe can become a central “host” unit for a complete “Satellite Network.” Any B-sized mainframe equipped with the **Model 10BD1 Satellite Slave Card** can represent an individual “node” within this network.** Setup and operation of both “host” and “satellite” B-sized mainframes are treated in Section 3.B.3 of the *System 10 Guidebook*.

For a complete discussion of “Interfacing of Computer, Terminal, Printer, etc.” via a B-sized mainframe’s Computer Interface Port, see Section 2.B of the *System 10 Guidebook*. For setup and operation of an optional “auxiliary” interface, see Section 3.B.5.

16.b

SETUP OF “MAIN” RS-232-C COMMUNICATIONS

We won’t repeat here what is presented in detail in Section 2.B.2 of your *System 10 Guidebook*. When the time comes for you to establish RS-232-C data communications with an external device, you should study this manual section carefully. There you’ll find recommended cabling for “full handshake,” “incoming handshake,” and “no handshake” interface situations.

For proper data interchange between a System 10 mainframe and a connected RS-232-C device to occur, the mainframe’s Computer Interface Port must

* Responses to keyboard-entered interrogation commands will appear on the mainframe or keyboard “billboard” only.

** As may any A-sized mainframe equipped with the “S” (Satellite) Option and an external RS-485 Converter attached to its Computer Interface Port.

be set to conform exactly with the protocol stipulated by the connected device. The “protocol” applying to an RS-232-C link normally involves four basic data-transfer characteristics: BAUD RATE (standard rates up to 153.6K), NUMBER OF DATA BITS (7 or 8), NUMBER OF STOP BITS (1 or 2), and PARITY (ODD, EVEN, or NONE).

For a B-sized mainframe, the easiest way to set these interface characteristics is to apply the **BAUD RATE (BAU)** command via the extended keyboard.¹

To set or reset RS-232-C protocol for the main Computer Interface Port, simply command

BAU = b, d, s, p [CR]

where

- “b” is the BAUD-RATE selection code:
1 = 300 5 = 9600
2 = 1200 6 = 19.2K
3 = 2400 7 = 153.6K
4 = 4800
- “d” is the NUMBER OF DATA BITS (7 or 8)
- “s” is the NUMBER OF STOP BITS (1 or 2)
- “p” is the PARITY selection code:
0 = NONE
1 = ODD
2 = EVEN

16.c

SETUP OF “AUXILIARY” RS-232-C COMMUNICATIONS

As seen by a connected external RS-232-C device, the “AUXILIARY” COMPUTER INTERFACE provided by a **Model 10BACIA** card behaves identically to the main Computer Interface Port. That is, a standard mnemonic command issued to an auxiliary port by an RS-232-C device connected to that port will invoke from that port a response identical in form to the response the main port would produce to the same command.²

*If your mainframe has a Model 10BACIA, there are three “run-time” commands you should be aware of.³ Discussed in detail in Section 3.B.5 of the *System 10 Guidebook*, these commands are used for control of the Auxiliary Computer Interface (the “**ACI**”) either through the keyboard or through the main Computer Interface Port (the “**CIP**”).*

¹ Note that, while every B-sized mainframe has a set of PROTOCOL SWITCHES on its Interface Card, these switches are normally used only when you want to specify a default interface protocol that can not be modified by a subsequent **BAUD RATE (BAU)** command. In order for a **BAU** command to be effective, the internal protocol switches must be disabled by placing Switch No. 4 in the OFF position. See Section 2.B.2 of the *System 10 Guidebook* for full instructions.

² The Model 10BACIA is to be regarded as a system “COPROCESSOR.” In addition to an “auxiliary” RS-232-C interface, every 10BACIA also provides an on-board DATA RAM. Externally acquired numeric and logic data can thus be downloaded from the connected device to the 10BACIA itself. With each internal scan cycle, this data will be “locally” updated (at the 10BACIA), to be read from there by the system’s Central Processor. Such local handling of downloaded data by the 10BACIA helps preserve a high scan speed when a large number of inputs is involved.

³ These commands apply equally to the RS-422 and IEEE-488 versions of the 10BACIA (the Models **10BACI-422** and **10BACI-488**, respectively).

- The **ATTACH (ATT)** command lets you establish a direct and exclusive “command route” between a given command source (keyboard or CIP) and the 10BACI occupying a given B slot. It is used primarily for setup of the ACI in question or for subsequent interrogation of the ACI for its own setup parameters. It is cancelled by a **DETACH (DET)** command.
- The **VIA (VIA)** command serves as a “one-line” **ATTACH (ATT)** command. By prefixing **VIA** to any standard mnemonic command, you can route that command directly and exclusively to the Model 10BACIA occupying a given B slot, without having first to “attach” that slot to the command source (keyboard or CIP).
- The **COMMUNICATIONS (COM)** command lets you designate a “DEFAULT COMMUNICATIONS PORT” for the mainframe. This is the single system RS-232-C interface port which will respond to any and all subsequent *port-related commands* received by the mainframe from the keyboard (or triggered by an **EXECUTE (EXU)** or **COMMAND (CMD)** function). Such “port-related” commands include commands like **DUMP (DMP)**, **STREAM (STR)**, and **SEND (SND)**, all of which *initiate output from the port*. They also include commands for *setup* of a given port and its data transmissions, commands like **BAUD RATE (BAU)**, **DELAY (DLY)**, **HEADER (HDR)**, and **OUTPUT TERMINATOR (OPT)**. A full list of **COM**-affected commands is given in Section 3.B.5(d) of the *System 10 Guidebook*.

To set the protocol values for an ACI, you must issue a **BAUD RATE (BAU)** command to the 10BACIA that provides the interface, after “attaching” the 10BACIA to your command source by means of the **ATT** or **VIA** command. The form of the **BAU** command for the 10BACIA is the same as that for the main Computer Interface Port (see above). The only difference is in the baud-rate selection code “b,” which, for the 10BACIA can be any number from 2 through 9:

2 = 1200	6 = 19.2K
3 = 2400	7 = 153.6K
4 = 4800	8 = 38.4K
5 = 9600	9 = 76.8K

Note that a baud rate of 300 is not available for the 10BACIA, but that the rates of 38.4K and 76.8K *are* available, which are not offered by the mainframe’s CIP.

An ACI can have its own **OUTPUT TERMINATOR**, **END-OF-LINE TERMINATOR**, and **COMMAND TERMINATOR**, as specified by the corresponding command (**OPT**, **EOT**, or **CMT**) issued to the 10BACIA that provides the interface. Other (in some cases optional) transmission characteristics can be specified for 10BACIA outputs—including channel number “echo,” limit-zone indication, “header” and “tailer” character strings, characters per channel, column format, and intertransmission delay period—using the same commands that apply to transmissions from the CIP. See Section 15, above, for “Setting Data-Transmission Characteristics.”

16.d

SETUP OF RS-232-C COMMUNICATIONS FOR AN OPTIONAL PRINTER INTERFACE PORT

The **Model 10VFO132 Formatted Output Card** equips your B-sized mainframe with a special RS-232-C Printer Interface Port. For the rear-panel location of the 25-pin connector used by the 10VFO132, see Fig. 2.1 or 2.2 in

Section 2, above. This printer port is used for transmission of various kinds of formatted “hard-copy” output, including direct output of system video pages. Connections for the 10VFO132 port are discussed in Section 3.C.3(b) of the *System 10 Guidebook*.

There are three commands you can use to set up the interface provided by the 10VFO132, each of which is discussed in detail in Section 3.C.3(b) of the *System 10 Guidebook*:

- the **PRINTER BAUD RATE (PBR)** command specifies the interface protocol values. This command is very similar to the **BAUD RATE (BAU)** command described above, but offers a larger number of “low-end” baud rates to choose from
- the **INTERCHARACTER DELAY (ICD)** command specifies a time delay between successive character transmissions from the printer interface port (default is “no delay”)
- the **PRINTER TYPE (PTY)** command specifies whether or not the connected printer is an Epson or Epson-compatible printer*

Section 3.C.3 of the *System 10 Guidebook* also discusses the commands you will use both to format and to output various transmissions from the 10VFO132 port. These transmissions include

- the Page Directory, the currently displayed video page, or any other selected video page or range of pages; and
- current data for one, all, or a selected range of system data channels, along with optional “header” and “tailer” texts which are actually *separate precomposed video pages*

The **TEMPLATE (TMP)** command lets you create a unique “template” for the presentation of transmitted channel data. This template is a combination of variable data fields and one or more portions of fixed text, in any desired order. See Section 3.C.3(f) of the *System 10 Guidebook* for complete details.

16.e

OPTIONAL IEEE-488 COMMUNICATIONS

When connected to the Computer Interface Port, the optional **Model 10CIF488A IEEE Interface Adaptor** enables any System 10 mainframe to be established as a “Talker/Listener” peripheral on a standard IEEE-488 bus, with a switch-selectable bus address from 0 through 30. See Section 2.B.4 of the *System 10 Guidebook* for a full discussion of RS-232 to IEEE-488 conversion.

The optional **Model 10BACI-488** is equivalent to a Model 10BACIA with a 24-pin parallel port for standard Talker/Listener communications with an IEEE-488 bus (in place of the 10BACIA’s standard RS-232-C interface). Setup and use of the 10BACI-488 are treated in Section 3.B.5(f) of the *System 10 Guidebook*.

16.f

OPTIONAL RS-422 COMMUNICATIONS

When connected to the Computer Interface Port, the optional **Model 10E422 RS-232-C to RS-422 Converter** enables any System 10 mainframe to be

* This is especially important when you want to use the 10VFO132 port to print video pages containing bargraphs.

linked to an external device with RS-422 I/O. Again, see Section 2.B.4 of the *System 10 Guidebook* for a full discussion of RS-232 to RS-422 conversion.

The optional **Model 10BACI-422** is equivalent to a Model 10BACIA with an integral RS-422 hardware interface (in place of the 10BACIA's standard RS-232-C interface).^{*} Setup and use of the 10BACI-422 are treated in Section 3.B.5(e) of the *System 10 Guidebook*.

17 OPTIONAL BARGRAPH SETUP

If your mainframe doesn't have a **Model 10VGM500 Video Graphics Memory Card**, you can skip this section.

The Model 10VGM500 lets you extend your total video memory to 661 "blocks" of 64 bytes each, but it also lets you incorporate high-speed *horizontal bargraphs* in your video format pages—up to 80 bargraphs per page. There are six basic bargraph types, each represented by a letter:

- upward pointer without scale (Type A)
- solid bar without scale (Type B)
- solid bar with scale (Type C)
- downward pointer without scale (Type D)
- downward pointer with scale (Type E)
- upward pointer with scale (Type F)

In the following procedure, you will create a video page that displays your "live" input channel as a SOLID BARGRAPH WITH SCALE. First, you will specify the bargraph's size, its position on the page, and the individual data channel it is to represent. Then, prompted by a screen menu, you will enter the bargraph's "type" and range ("data zero" and "data top"). Since you're selecting a bargraph *with scale*, you will further indicate the desired spacing of the graduation marks for that scale.

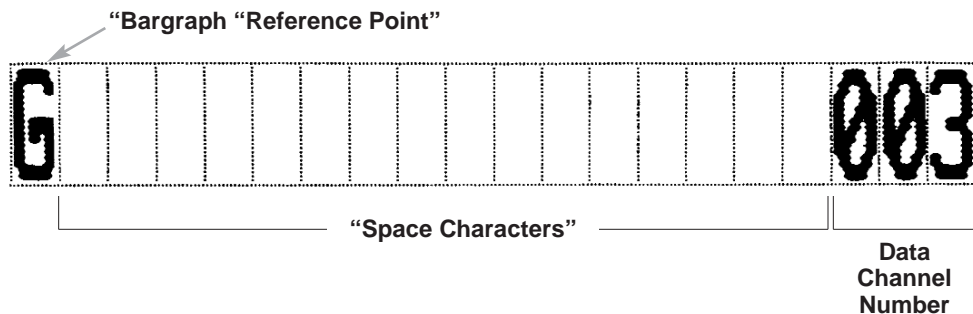
For full details on bargraph setup, see Section 3.C.4 of the *System 10 Guidebook*.

- a. Make sure the EEPROM Write Protect function is still enabled.
- b. Call your prestored "blank" page as you did in the Section 5 by pressing the **Page** key and then typing **100**, followed by CARRIAGE RETURN (**Retrn**).
- c. Press the **Video Formt** (VIDEO FORMAT) key to enter TEXT EDITOR MODE. A blinking cursor will appear at the upper left ("HOME") corner of the screen.
- d. Press the "**DOWN ARROW**" key three times, and then set a CHARACTER SIZE of "2x2" for the display line (press, in sequence, **Width, 2, Hght, 2**).
- e. Set a TEXT COLOR of *white on red* (hold down the **Shift** key and press, in sequence, **Wht, Back Grnd, Red**).

^{*} The RS-422 interface includes an extra pair of wires for communication of an *external synchronizing pulse*. This allows *timed synchronous data collection*, controlled by a master timing pulse, especially in conjunction with a **Model 10K488 Data Concentrator**.

- f. Type “**Live Input:**” This is the FIXED TEXT that is to precede the line’s bargraph.¹
- g. Press the **Caps Lock** key. The key’s red indicator light will go on when the keyboard is “locked” for CAPITAL LETTERS. Note that, while the Model 10BVS95 Graphics Video Signal Card supports lower-case letters, IT IS NECESSARY TO ENTER CAPITAL LETTERS WHEN DEFINING A BARGRAPH.
- h. The screen cursor should now be one space to the left of “Live Input:” This is the “REFERENCE POINT” for your first bargraph—that is, it is the left-most space of the intended bargraph field (see Fig. 17.1).

Fig. 17.1 20-Space Bargraph, in TEXT EDITOR MODE



- i. Press the **Begin Data** key.
- j. Enter a CAPITAL letter “**G**.”
- k. Press the SPACE BAR sixteen times, in order to enter 16 spaces. We will want a 20-space field like the one shown in the figure. The *first* space takes the field determiner “G”; the *last three* spaces take the channel number. The total number of spaces for any bargraph field cannot be fewer than nine.
- l. Now enter the number of your “live” input channel (Channel No. “x,” the one you calibrated in Section 10). Enter this as a three-digit number, using one or two leading zeros if necessary.² Remember that the last digit of the channel-number entry must always occupy the last character space of the bargraph field.
- m. Press the **End Data** key. The first bargraph setup parameter (“DATA TOP”) will now appear in the display billboard. “Data top” refers to the *upper data value of the desired range*—that is, the data reading you wish to correspond to the *right edge* of the bargraph field.³
- n. Type in the approximate *full-scale* input value for Channel No. x, in the engineering units and to the precision to which it was calibrated in Section

¹ Note that it is possible for one or more other kinds of data field to be in the same line as a bargraph.

² Actually, you can enter a one- or two-digit channel number if you wish. The three-digit number is more convenient, however, in this tutorial.

³ The default data top, which will initially appear when **End Data** is pressed, will reflect a one-to-one correspondence with the present length of the bargraph. If, as in the present case, the bar is 20 characters (= 160 pixels) long, its default data top will be “160.”

10. The data top entry can take up to 6 digits plus decimal point and polarity sign (8 digits maximum if no decimal point or sign).

- o. To enter the data-top value presently shown in the billboard, press **CARRIAGE RETURN (Retrn)**. The second bargraph setup parameter (“DATA ZERO”) will now appear in the billboard. “Data zero” refers to the *lower data value of the desired range*—that is, the data reading you wish to correspond to the *left edge* of the bargraph field.*
- p. Type in the approximate “no load” input value for Channel No. x, in the engineering units and to the precision to which it was calibrated in Section 10.
- q. To enter the data-zero value presently shown in the billboard, press **Retrn**. The third and final bargraph setup parameter (“TYPE”) will now appear in the billboard.
- r. To select a “Type C” bargraph (SOLID BARGRAPH WITH SCALE), and to specify that the bargraph is to have a graduation mark every *second* character, type in

C2

and press **Retrn**. The billboard will again display the first parameter (“DATA TOP”).

- s. To establish the bargraph you have just defined, press the **End Data** key. Like any channel data field, a bargraph will normally appear as *blue characters on a green background* as long as you are in TEXT EDITOR MODE.
- t. Press the **Exit** key to exit TEXT EDITOR MODE and return to LIVE DISPLAY MODE. You may now save the video page if you wish (see Section 5, Step I).
- u. The colors now exhibited by your “live” bargraph are continuously determined by the VISUAL EFFECTS you have already specified for Channel No. x by the “**LESS THAN**” STATUS (VLT), “**BETWEEN**” STATUS (VBT), and “**GREATER THAN**” STATUS (VGT) commands you entered in Section 13, Steps c, e, and g. Therefore—unless you have altered Channel No. x’s limit-dependent VISUAL EFFECTS since you performed the procedure in Section 13—
 - if the data for Channel No. x is in the “LESS THAN” limit zone, the bargraph foreground (bar and scale) should be *blinking red*, while the background over which the bar moves should be *yellow*
 - if the data for Channel No. x is in the “BETWEEN” limit zone, the bargraph foreground should be *green*, while the background should be *white*
 - if the data for Channel No. x is in the “GREATER THAN” limit zone, there should be a “*flashing*” alternation of *blue bar and scale on a red background with red bar and scale on a blue background*

Vary the transducer input for Channel No. x and observe the behavior of the bargraph. Verify the bargraph scaling (does the solid bar fill the entire

* The default data zero, which will initially appear when **End Data** is pressed, is “0.” Note that the *difference* between the existing DATA TOP and DATA ZERO of a bargraph must be sufficiently large to allow calculation of data increments per pixel. If such is not the case, a message will appear, and the parameter you have attempted to enter (data top or data zero) will not be accepted.

field when a full-scale load is applied?). Also verify that the appropriate bargraph color changes occur as Channel No. x's data reading violates the high- and low-limit values you set for it in Section 13.

- v. You might want to re-enter TEXT EDITOR MODE and add other types of bargraphs to the video page, dedicated either to Channel No. x or to one or more other "live" system channels.

18 OPTIONAL HISTORY RECORDING

If your mainframe doesn't have a **Model 10BDR64 History Card**, you can skip this section.

The History Card lets you make, store, and output digital recordings of numerical and logic data acquired by a B-sized mainframe.

You can instruct any one of the History Card's four independent RAM recorders to automatically record a predefined list of randomly selected data channels and logic bits. Recording can be at preset time intervals, or can be triggered by a specific combination of system logic, limit, and/or time-interval conditions. Similar conditions can also be specified for halting and restarting each recorder.

Special output commands let you transmit to an external computer, printer, or CRT display—via the mainframe's Computer Interface Port—all or part of the data recordings made by one of the four recorders since it was last interrogated. You can also output an expandable "history window" consisting of a selected range of recordings made, if desired, both *before* and *after* occurrence of a halt-triggering condition. This lets you review the specific "data history" associated with, say, a critical limit violation or process shutdown. You can select variables to appear in a recorder's output (such as time, date, serial number, etc.), and the order in which these variables are to be transmitted.

The History Card lets you play back as a live data channel the data last recorded for any given system channel or the data recorded for that channel at a specified time in the past.* Through a special "time search" function, it's possible to quickly review the values recorded by a given recorder for one or a set of data channels over a period of time. You can also "replay" all data for a given recorder's "playback" channels, from the "oldest" to the "latest," using a variable time scale. This permits "slow motion" playback of all data recorded during a fast event, or a fast review of all data recorded for a test or process of long duration. Playback of system bit groups is also possible, using specially configured BINARY "CONVERSION" CHANNELS.

For a general explanation of how the History Card works, you should read Section 3.B.4(a) of the *System 10 Guidebook*. Below, you will learn how to

- enter and exit History Card SETUP MODE, using the **SETUP MODE (SMD)** and **RECORD MODE (RMD)** commands, respectively

* When a **Model 10BSPC384 High Density History SPC Option Card** is present, you can also play back the *lowest and highest values* recorded for a given data channel since a given recording in the past, and the *continuous average value* for the data reported by the channel over the same time period. "Statistical" playback functions provided by the Model 10BSPC384 also include *X-BAR* and *RANGE*, automatically calculated over successive sampling periods for a given channel. See Section 3.B.4(d) of the *System 10 Guidebook* for complete details.

- enter a “list” of channels to be recorded by a given History Card recorder, using the **LIST (LST)** command
- set a recorder’s “depth,” using the **DEPTH (DPT)** command
- specify the condition(s) to cause a recorder to automatically begin recording data, using the **STORE (STO)** command
- specify the condition(s) to cause a recorder to automatically halt its recording of data, using the **HLT (HLT)** command
- set a recorder’s “halt depth,” using the **HALT DEPTH (HDP)** command
- set up “video playback” channels for display of historical data, using the **PLAYBACK (PLA)** command
- restart a halted recorder, using the **START FROM HALT (STH)** command
- rapidly review the values that have been reported by a set of data channels over an “historical” period of time, using the **ZOOM (ZUM)** command
- replay all historical data for a given recorder, using the **REPLAY (RPL)** command
- clear all recordings contained in a given recorder, using the **HISTORY CLEAR (HCL)** command

Be sure to study Section 3.B.4 of the *System 10 Guidebook* for full details on these and other History Card procedures.

WARNING: IF YOUR HISTORY CARD’S FUNCTIONS HAVE BEEN PREDEFINED AT THE FACTORY IN ACCORDANCE WITH SPECIFICATIONS GIVEN AT THE TIME OF ORDER, YOU MAY NOT WANT (OR NEED) TO PERFORM THE FOLLOWING PROCEDURES. IF YOU DO CHOOSE TO PERFORM THE FOLLOWING PROCEDURES, BE SURE TO “CLONE” THE CURRENT HISTORY CARD CONFIGURATION BEFORE PROCEEDING ANY FURTHER. YOU CAN THEN RESTORE THE CURRENT CONFIGURATION AFTER YOU HAVE GONE THROUGH THE TUTORIAL. CONTACT THE FACTORY FOR INSTRUCTIONS ON CLONING AND RESTORING A SYSTEM 10 CONFIGURATION.

- a. To enter History Card SETUP MODE, enter from the keyboard a command of

SMD [CR]

The card’s front-panel **SMD** indicator will light.

- b. In this exercise, you will use the History Card’s Recorder No. 1 to record data readings for only two channels: the “live” analog input channel you calibrated in Section 10 (Channel No. “x”) and the “CALCULATE” channel you defined in Section 11 (Channel No. “y”).* First, be sure the EEPROM Write Protect function is enabled. If the number “y” is greater than the number “x,” enter a command of

LST 1 = CHN x, y [CR]

If, however, “x” > “y,” enter

LST 1 = CHN y, x [CR]

Remember: the sequence of channel numbers entered in a **LIST (LST)** command must be in *ascending order*.

- c. As explained in the Introduction to Section 3.B.4 of the *System 10 Guidebook*, the “depth” of a given History Card recorder refers to the total num-

* A **LST** command can also specify one or more system “bit groups” to be recorded by a given recorder (see section 3.B.4(d) of the *System 10 Guidebook*).

ber of “frames” of data which it can hold. A “frame” of data within a recorder consists of all data-channel and logic-bit readings recorded by that recorder at a given instant of time. The maximum depth to which a recorder can be set will depend on the “list” that has been entered for that recorder, and on the portion of total system “history memory” available to it (see Section 3.B.4(b) for “History Memory and Time Considerations”).* To specify a depth of 100 (frames) for Recorder No. 1, enter a command of

DPT 1 = 100 [CR]

- d. We are now ready to tell Recorder No. 1 *when to record data for the listed channels*. You will use the **STORE (STO)** command to specify the condition or logical combination of conditions the occurrence of which will cause the recorder to instantly record and store a “frame” of data. These conditions can include

- the logic state(s) of one or more logic bits
- the limit conditions(s) of one or more data channels
- the occurrence of logic-state transitions for one or more logic bits
- the passage of a specific time interval, as registered by the system clock

Set Recorder No. 1 to record at regular 2-second intervals by entering a command of

STO 1 = INT 7 [CR]

“INT 7” is the mnemonic for a 2-second interval, as indicated in the table in Section 3.B.4(d) of the *System 10 Guidebook*. This is, of course, a relatively simple store condition. You are encouraged to study the full discussion of the **STO** command in Section 3.B.4(d), and to experiment with different conditions for automatic recording and storage of data—for example, when a given bit is perceived to go high, when a given channel reports or does *not* report a given limit violation, etc.

- e. The **HALT (HLT)** command is identical in syntax to the **STO** command. It’s used to specify the condition or logical combination of conditions the occurrence of which will cause a given recorder to stop recording data. To instruct Recorder No. 1 to halt recording when Logic Bit No. 899 is seen to change from a state of “Logic 0” to a state of “Logic 1,” command

HLT 1 = BGH 899 [CR]

- f. To instruct Recorder No. 1 to record *two* additional frames of data *after* the occurrence of a halt-triggering event (in this case, Bit 899’s going high), enter a command of

HDP 1 = 2 [CR]

This command sets the “halt depth” of Recorder No. 1 to 2 (frames).

- g. Let’s arrange to *display* the data we’re going to record. To do so, we’ll define a series of “VIDEO PLAYBACK PSEUDOCHANNELS.” In this case, we’ll restrict ourselves to the “live” analog input channel (No. x), but remember that you could set up equivalent playbacks for any and all other recorded channels (up to a total of 300 for a given History Card).

We want to be able to view the data reading that existed for Channel No. x “one frame ago,” “five frames ago,” “ten frames ago,” “fifteen frames ago,”

* By setting a given recorder’s depth to *zero*, you can *disable* that recorder, if it is not required, thereby allocating its history memory to the remaining active recorders.

“twenty frames ago,” and “twenty-five frames ago.” Enter the following **PLAYBACK (PLA) commands**:

PLA 1000 = REC 1, CHN x (-1) [CR]
PLA 1001 = REC 1, CHN x (-5) [CR]
PLA 1002 = REC 1, CHN x (-10) [CR]
PLA 1003 = REC 1, CHN x (-15) [CR]
PLA 1004 = REC 1, CHN x (-20) [CR]
PLA 1005 = REC 1, CHN x (-25) [CR]

where “x” is once again the number of your “live” input channel. The (negative) number in parentheses is the playback “search depth”—a measure of the “pastness” in time of the frame within the recorder’s memory that contains the data reading of interest.

Note that *Video Playback Pseudochannels* are numbered from 1000 through 1299. Such channels are read only by the system’s video cards. They are not included in the normal scanning of system channels, and therefore the system does not spend time in handling them.*

- h. To arrange for CRT display of the above playback series, you should
1. Use the **Page** key as you did in Section 5, Step d, to call to display the prestored “blank” video page (no. 100).
 2. Press the **Video Formt** (VIDEO FORMAT) key to enter TEXT EDITOR MODE. Move the cursor down a few spaces.
 3. Type “**01 Frames Ago:**” and then press the **Begin Data** key.
 4. Type two spaces, followed by
***1000**
The asterisk (*) is absolutely necessary to identify the field as a video playback field.
 5. Press the **End Data** key, and then press the **Retrn** key.
 6. Type “**05 Frames Ago:**” and then press the **Begin Data** key.
 7. Type two spaces, followed by
***1001**
 8. Press the **End Data** key, and then press the **Retrn** key.
 9. Type “**10 Frames Ago:**” and then press the **Begin Data** key.
 10. Type two spaces, followed by
***1002**
 11. Press the **End Data** key, and then press the **Retrn** key.
 12. Continue in this fashion to create display fields for the remaining video playbacks (Nos. 1003 through 1005).

* You can also set up “NORMAL PLAYBACK PSEUDOCHANNELS” (up to 29 per recorder), if you wish to *interrogate* the system for recorded data values by means of the **CHANNEL (CHN)** command, or to provide normal *limit monitoring* or *analog output* for playbacks.

13. Press the **Exit** key to leave TEXT EDITOR MODE and return to LIVE DISPLAY MODE.

14. Save the page you have just formatted, as you did in Section 5, Step I.

- i. Make sure the “halt-triggering” bit is currently at “Logic 0” by commanding

BIT 899 = 0 [CR]

- j. To exit History Card setup mode and allow Recorder No. 1 to begin automatic recording at 2-second intervals, command

RMD [CR]

The front-panel **SMD** indicator will go off. The **REC 1** indicator will light as soon as Recorder No. 1 has made its first recording. It will remain on until recording is halted, to indicate that at least one recording *has been made* by that recorder.

- k. Continuously vary the load on the source transducer for Channel No. x. As successive “frames” of data are recorded every two seconds, observe the displayed “playback” values to confirm that reliable history recording is in fact taking place. The first video playback field should always show the *last recorded value of Channel No. x (= “1 frame ago”)*, while the last video playback field should show *the value of Channel No. x that was recorded 25 frames “ago.”*

- l. Let Recorder No. 1 continue to record at 2-second intervals for a minute or so, and then command

BIT 899 = 1 [CR]

Since the recorder’s current “halt depth” is “2,” it should make two more recordings before halting the automatic recording of data. Verify that this is the case by watching your playback display as you continue to vary the load on the source transducer for Channel No. x.

- m. Use the **BIT** command to reset Bit No. 899 to “Logic 0.” Then restart Recorder No. 1’s automatic recording of data by commanding

STH 1 [CR]

- n. The **ZOOM (ZUM)** command lets you increase by the same number of frames the “search depth” of each playback pseudochannel assigned to a given recorder. To produce a depth offset of “2” for all playback for Recorder 1, enter a command of

ZUM 1 = 2 [CR]

As a result of this command, the “search depth” of Playback Channel No. 1000 will increase from its original “1” (frame ago) to “3” (frames ago); that of Playback Channel No. 1001, from its original “5” (frames ago) to “7” (frames ago); that of Playback Channel No. 1002, from its original “10” (frames ago) to “12” (frames ago).*

* You can also enter a **ZOOM (ZUM)** command of the general form **ZUM n = s STEP z [CR]**. Here, “s” is the search depth offset for all playbacks assigned to Recorder No. “n,” while “z” is the magnitude of a depth *increment* (expressed, again, as a number of frames) for further keyboard-controlled alteration of the search depth, using the **Back Space** and/or **Step** key. The **FREEZE (FRZ)** command lets you specify a search depth offset and (optional) increment that will not be affected by continued recordings. See Section 3.B.4(e) of the *System 10 Guidebook* for full details.

- o. Cancel the depth offset imposed by the above **ZUM** command by entering a command of

ZUM 1 = N/A [CR]

- p. Halt Recorder No. 1 once more by commanding

BIT 899 = 1 [CR]

- q. After the two additional recordings have been made, initiate a single “history replay” at a one-second rate for all playback pseudochannels set up for Recorder No. 1 by commanding

RPL 1 = INT 6 [CR]

As explained in Section 3.B.4(e) of the *System 10 Guidebook*, the effect of this command is to make Recorder No. 1’s initial “search frame” the *oldest* frame in memory, and then to successively decrease the current “search depth” one frame at a time, until the “newest” frame (the last to have been recorded) is reached. The time interval at which the replay is to step “forward” in time toward the latest recorded frame (as the search depth is continuously decreased) is here *one second* (= INT 6).

- r. To clear all recordings now contained in Recorder No. 1, command

HCL 1 [CR]

You should study Section 3.B.4(e) of the *System 10 Guidebook* for instructions on “emptying,” “dumping,” and “reaccessing” history memory. Here we will only mention the pertinent commands:

- The **EMPTY (EMP)** command is normally used *while recording is in process*. It lets you learn *what has happened since the last such interrogation*. You can use this command to output from the Computer Interface Port all frames in a given recorder—or a selected number of frames—in sequence, that have been recorded since the **EMP** command was last applied to that recorder. The precise format of this output can be established through the **OUTPUT IMAGE (IMA)** command discussed in Section 3.B.4(d) of the *System 10 Guidebook*.
- By applying a **REACCESS HISTORY MEMORY (RHM)** command, you can restore access to all frames still in storage that have been previously “emptied” by means of an **EMPTY (EMP)** command. Restored frames can then be “re-emptied,” if desired.
- The **HISTORY DUMP (HDU)** command is normally used *after recording has stopped*. It serves to define a flexible “history window” that lets you review a specified period of data history. All recorded frames “seen” through the window are “dumped” as output from the Computer Interface Port. Regions of a recorder’s history record can be dumped at any time. Such dumping is not affected by any previously applied **EMPTY (EMP)** command(s). As with **EMP**, the output format for a “history dump” can be established through the **OUTPUT IMAGE (IMA)** command.

In this booklet we have taken you step-by-step through some important System 10 setup procedures that apply to “B-sized” mainframes. We have also briefly mentioned a number of other (essentially optional) procedures detailed in the *System 10 Guidebook*. To these we could add the following:

- setup of COUNTER/TIMER functions when the optional **Model 10ACT01 Counter/Timer Card** and/or **Model 10ACC-4 Four-Channel Totalizer Card** is present (Section 3.A.1 of the *System 10 Guidebook*)
- setup of ANALOG OUTPUT CHANNELS via the **ANALOG OUTPUT (ANO)** command when the optional **Model 10AAO-8 Voltage Output Card** is present, (Section 3.A.2)
- setup of ANALOG PEAK CAPTURE, “MAX MINUS MIN,” and/or TRACK AND HOLD functions when the optional **Model 10A79-4 Four-Channel Analog Peak Capture Card** is present (Sections 3.A.4-6)
- setup of ANALOG BUFFERING functions when the optional **Model 10A79-4 Four-Channel Analog Peak Capture Card** or **Model 10AAO-4 Analog Buffer Card** is present (Section 3.A.7)
- setup of PID LOOP CONTROL functions when the optional **Model 10APID Loop Control Card** is present (Section 3.A.9)
- setup of DIGITAL I/O functions when the optional **Model 10BIO-16 Universal Logic I/O Card** is present (Section 3.B.2)
- setup of SATELLITE NETWORK SYSTEMS when the optional **Model 10BD4 Satellite Interface Card** or **Model 10BD1 Satellite Slave Card** is present (Section 3.B.3)
- extension of system “HISTORY MEMORY” when the optional **Model 10BHDM384 High Density History Memory Card** or **Model 10BSPC384 High Density History SPC Option Card** is present (Section 3.B.4)
- extension of system “VIDEO MEMORY” when the optional **Model 10VGM500 Video Graphics Memory Card** is present (Section 3.C.2)
- setup and use of optional DIAGNOSTIC CARDS: **Model 10AST Analog Slot Test Card** and **Models 10AHM and 10BDHM Health Monitor Cards** (Section 5.C)

To minimize the danger of losing critical setup information in the event of a power interruption, be sure to turn the EEPROM Switch OFF as soon as System 10 setup is complete.

APPENDIX A

SUMMARY OF B-SIZED MAINFRAME FEATURES

Model	Available A-Card Slots	Available B-Card Slots	Max. No. Analog Channels / Max. No. Analog I/O ¹	Max. No Logic Bits / Max.No Logic I/O ²	Video Capabilities ³	Available Options*
10KN3	0	8 ⁴	1000 / 0	1000 / 128 ⁵	VGA input and output ⁶ ; <i>external monitor required for data display</i> ; 2 available V-Card slots	E
10KN6	24	8 ⁴	1000 / 192	1000 / 128 ⁵	VGA input and output ⁶ ; <i>external monitor required for data display</i> ; 2 available V-Card slots	E
10KN6-2	48	8 ⁴	1000 / 384	1000 / 128 ⁵		
10KN6-3	72	8 ⁴	1000 / 576	1000 / 128 ⁵		
10KN6-4	96	8 ⁴	1000 / 768	1000 / 128 ⁵		
10KN7	24	8	1000 / 192	1000 / 128	Internal CRT (B/W, 5" x 9"); RS-170 and "RGB" (CGA) output (only); 2 available V-Card slots	—
10KN7-2	48	8	1000 / 384	1000 / 128		
10KN7-3	72	8	1000 / 576	1000 / 128		
10KN7-4	96	8	1000 / 768	1000 / 128		
10KN8A	8	2	1000 / 64	1000 / 32	Internal CRT (COLOR, 12" multi-sync (CGA/EGA/VGA)); VGA input and output ⁶ ; 2 available V-Card slots	—

* Options:

E = B-Rack Expansion

¹ Assumes all A SLOTS dedicated to analog I/O only (with eight channels per slot).

² Assumes all A SLOTS dedicated to logic I/O only; requires one optional **Model 10BIO-16 Universal Logic I/O Card** for every group of 16 bits to serve as logic I/O.

³ **NOTE: THE MODEL 10P80A EXTENDED KEYBOARD IS SUPPLIED WITH ALL B-SIZED MAINFRAMES (MODEL 10P25A OPERATOR'S KEYBOARD IS OPTIONAL).**

⁴ Expandable to 19 with "E" Option.

⁵ Expandable to 304 with "E" Option.

⁶ Fully compatible with 640 x 480 VGA format, with a horizontal refresh rate of 31.5 kHz. Will accept CGA/EGA/VGA input only from a VGA ANALOG CARD; will not accept digital video signals from CGA/EGA cards. See Section 2.N of the *System 10 Guidebook* for complete details regarding video I/O connections for B-sized mainframes.



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SYSTEM 10 GUIDEBOOK

SECTION 1

REQUIRED SYSTEM SETUP PROCEDURES

- | | |
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| SECTION 1.A | GETTING STARTED |
| SECTION 1.B | CARD INSERTION AND REMOVAL |
| SECTION 1.C | ENTRY OF MNEMONIC COMMANDS |
| SECTION 1.D | SYSTEM STATUS INDICATORS |
| SECTION 1.E | TRANSDUCER CABLING AND
CONDITIONER CARD SETUP |
| SECTION 1.F | SCAN AND TIME SETUP |
| SECTION 1.G | CONFIGURATION AND CALIBRATION
OF ANALOG INPUT CHANNELS |
| SECTION 1.H | FORMATTING AND MANAGEMENT
OF STANDARD DATA TRANSMISSIONS |

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SYSTEM 10 GUIDEBOOK

1.A GETTING STARTED

1.A.1 USING THE “ON THE AIR” TUTORIAL

If you are unfamiliar with the Daytronic “System 10,” your first step should be to study the tutorial booklet entitled *Getting Your System 10 On the Air*, which is included in this Guidebook. There is a booklet for each of the two basic types of System 10 mainframes (“A-sized” and “B-sized”).

The “On the Air” book will walk you step-by-step through the basic system setup procedure. As it does so, it will refer you to appropriate sections of this Guidebook for complete details.

The rest of the present section will offer some additional PRELIMINARY INFORMATION you ought to have before you set up and operate your System 10.

SO, UNTIL YOU HAVE STUDIED THE APPROPRIATE “ON THE AIR” BOOK—
ALONG WITH THE PRESENT GUIDEBOOK SECTION—

DO NOT POWER UP YOUR SYSTEM 10 MAINFRAME.

1.A.2 BASIC PRECAUTIONS

a. EEPROM MEMORY PROTECTION

The mainframe's EEPROM WRITE PROTECT SWITCH should be ON only for the duration of relevant system SETUP procedures. As soon as system setup (including data channel calibration) is complete, be sure to TURN THE EEPROM SWITCH OFF.

During normal operation, following initial system setup, the EEPROM may be re-enabled at any time for purposes of reconfiguration, recalibration, page editing, etc. THE EEPROM SWITCH SHOULD BE LEFT ON, HOWEVER, FOR AS SHORT A TIME AS POSSIBLE, TO MINIMIZE THE DANGER OF LOSING CRITICAL SETUP INFORMATION IN THE EVENT OF A POWER INTERRUPTION.

NEVER TURN THE MAINFRAME ON OR OFF WHEN THE EEPROM SWITCH IS ON (as indicated by the RED “E2P” indicator). FAILURE TO OBSERVE THIS PRECAUTION COULD RESULT IN THE ALTERATION OR ERASURE OF EEPROM CONTENTS.

b. CHECKING LINE-VOLTAGE SETTING

Before turning your mainframe ON for the first time, **MAKE SURE THAT IT IS SET FOR THE PROPER LINE-VOLTAGE LEVEL.** See Section 1.A.3, below. Operating the equipment on the voltage level to which it is not set can result in severe damage.

1.A GETTING STARTED

c. CIRCUIT-CARD INSERTION AND REMOVAL

All of the new Daytronic **“AA” Conditioner Cards** are “hot-pluggable”—as are all of the standard “10A” Conditioner Cards whose model number ends in **“C.”** This means that you need NOT turn off mainframe power before inserting or removing the card.

FOR ALL OTHER CONDITIONER CARDS, HOWEVER, ALWAYS MAKE SURE THAT MAINFRAME POWER IS OFF BEFORE CHANGING THE POSITION OF THE ACTUATING LEVER OF THE CARD’S SLOT.

For complete instructions on “Card Insertion and Removal,” see Section 1.B.

d. HANDLING CARDS WITH INTERNAL BATTERY

NEVER LAY DOWN A CIRCUIT BOARD CONTAINING A **LITHIUM BATTERY** ON ANY METAL OR OTHER CONDUCTIVE SURFACE, UNLESS THE BOARD HAS PROTECTIVE, VELCRO-ATTACHED MYLAR SHEETS (WHICH SHOULD NEVER BE REMOVED). Short-circuiting of the battery could occur, with possible severe damage to the instrument.

e. AIR COOLING REQUIREMENTS

ALL MAINFRAMES REQUIRE COOLING. The cooling air intake is at the bottom of each unit. When rack-mounting a System 10 mainframe, you should provide at least 1.75 inches of clearance below the unit, to ensure proper air flow. When the mainframe is used as a bench-top instrument, the installed 0.5-inch rubber feet will allow sufficient air flow.

ALSO, TO MAINTAIN PROPER AIR COOLING, THE MAINFRAME SHOULD NEVER BE OPERATED FOR ANY LENGTH OF TIME WITH ITS FRONT BEZEL(S) OFF.

f. DUST COVERS

Be sure to keep a protective “T” insert in every unused SLOT CONNECTOR, to prevent the accumulation of dust in the connector (see Section 1.B).

1.A.3 MAINFRAME POWERUP

a. AC OPERATION (ALL MODELS)

CHECK LINE-VOLTAGE SETTING

IMPORTANT: Before powering up your System 10 mainframe for the first time, **make sure that it is set to the proper NOMINAL AC LINE VOLTAGE** (110/120 OR 220 V-AC).

A-SIZED MAINFRAMES

For all A-SIZED mainframes (all “10KU,” “10K1,” “10K2,” and “10K4T” versions), the **VOLTAGE SELECTOR SWITCH** is located on the rear panel (see the corresponding diagram in the “Physical Layout” section of the “On the Air” book for A-sized mainframes).* The switch can be easily repositioned by means of a small slotted screwdriver.

If you change the voltage-level setting, **YOU MUST ALSO CHANGE THE MAINFRAME’S BUSS FUSE BEFORE POWERING UP THE MAINFRAME**, as follows:

Mainframe Family	Power Level	Required Fuse
“10KU”	110 V-AC	1 A “SLOW BLOW”
	220 V-AC	0.5 A “SLOW BLOW”
“10K1/10K2”	110 V-AC	2 A, 250 V “SLOW BLOW”
	220 V-AC	1 A, 250 V “SLOW BLOW”
“10K4T”	110 V-AC	2 A, 250 V “SLOW BLOW”
	220 V-AC	1 A, 250 V “SLOW BLOW”

For instructions, see “Changing the Fuse,” below.

B-SIZED MAINFRAMES

For all B-SIZED mainframes *except the Model 10KN8A,*** the **POWER SELECTOR BOARD** is located under the fuse (see Fig. 2.1.b in the “Physical Layout” section of the “On the Air” book for B-sized mainframes).

1. DISCONNECT THE AC POWER CORD.
2. Slide to the left the clear plastic door covering the rear-panel FUSE box.

* Older mainframe versions may not have a rear-panel VOLTAGE SELECTOR SWITCH. To convert the power level on these mainframes, it is necessary to remove the internal POWER BOARD to access the switch. Contact the Daytronic Customer Service Department for full instructions. Also, some older A-sized models are equipped with a circuit breaker instead of a fuse. The breaker need not be changed when changing from one power level to the other, since the breaker amperage automatically adjusts to the voltage setting.

** The **Model 10KN8A** operates ONLY from an external supply of 90 to 130 V-AC (47-63 Hz), and therefore has no Power Selector Board. Older “10K8” models have a rear-panel POWER CONVERTER SWITCH that slides up and down to select the desired voltage level.

1.A GETTING STARTED

3. Locate the POWER SELECTOR BOARD under the fuse. Note the number visible on this board, indicating the present nominal voltage setting (120 or 220).
4. With one finger, slightly raise up the level labelled "FUSE PULL," and then, with a needle-nosed pliers held in the other hand, pull out the POWER SELECTOR BOARD.
5. Turn over the board and reinsert it so that the value of the desired nominal voltage is visible ("100" and "240," if present, are NOT to be used).

If you change the voltage-level setting, YOU MUST ALSO **CHANGE THE MAINFRAME'S BUSS FUSE** BEFORE POWERING UP THE MAINFRAME, as follows:

Power Level	Required Fuse
120 V-AC	4 A
220 V-AC	2 A

For instructions, see "Changing the Fuse," below.

CHECK EEPROM SWITCH

When mainframe power is turned ON or OFF, the EEPROM Write Protect Switch should be **OFF** (in the *downward* position).

CONNECT POWER CORD

Plug the six-foot power cord supplied with your mainframe into the AC power connector on the rear of the unit. Plug the other end into your primary power source. The offset pin on the power connector is ground; to safely operate the mainframe from a two-contact outlet, use a 3-prong-to-2-prong adaptor and connect the green pigtail on the adaptor to earth ground.

NOTE: Since the presence of *electrical noise* can affect the ultimate integrity of your data, the noise level should be suppressed as much as possible. In particular, care should be taken to avoid utility-line problems that can interfere with or possibly even damage sensitive microprocessor-based equipment. Such noise can also be generated by electrical motors, relays, and motor control devices.

While your System 10 mainframe has internal circuitry to protect it from overvoltage transients and mild EMI, a clean line is still very desirable. No protection is provided against a dropout longer than 8 milliseconds or brownout below 95 volts. Depending on your line conditions, a number of protective devices are available (isolators, regulators, uninterruptible power supplies, etc.). Contact the Daytronic factory for more information.

TURN ON THE MAINFRAME

Refer to the respective diagram in the "Physical Layout" section of the appropriate "On the Air" book for the location of your mainframe's POWER ON/OFF switch or button.*

* Note that the **Model 10KN8A** (only) has a combined POWER ON-OFF and CIRCUIT BREAKER button.

IMPORTANT: In the event that your mainframe's fuse blows or circuit breaker trips when the unit is powered up, refer directly to Section 5.B.1 of this Guidebook ("Powerup Problems") before attempting to reset the system.

POWERUP VERIFICATION

Each time a System 10 mainframe is turned on, the four SYSTEM STATUS INDICATORS labelled **ERR**, **CHR**, **MNE**, and **RET** should all light for about one second, and then go off. This verified proper system powerup.

Whenever an *A-sized mainframe with LCD/VFD video capability* is turned on for the first time, there will normally appear a display of its DATA DISPLAY PAGE FORMAT No. 1. This page will contain a company name or other prespecified LOGO in the "billboard" region of the display, plus "live" data readings for Channel Nos. 1 through 12, with a unit legend of "MVV" for each channel. As explained in Section 5 of the "On the Air" book for A-sized mainframes, you can subsequently designate any other 12 channels for display on "Page No. 1," with any desired four-character legend for each channel. On powerup, the mainframe will *always* display this page ("No. 1").

Whenever a *B-sized mainframe with CRT video capability* is turned on, the words **RAM TEST PASSED** should appear for about two seconds in the "billboard" region of the display, to be immediately replaced by a company name or other prespecified LOGO. When the mainframe is powered up for the first time, there will normally appear a display of its VIDEO PAGE FORMAT No. 1.* As explained in Section 5 of the "On the Air" book for B-sized mainframes, you can subsequently redesign the format of this video page (if desired) and designate any other video page to be the mainframe's "SIGN-ON PAGE"—i.e., the page to appear automatically upon system powerup.

CHANGING THE FUSE

IN THE EVENT OF AN APPARENT POWER-SUPPLY FAILURE, FIRST CHECK THE MAINFRAME'S BUSS FUSE.** WHEN REPLACING A "BLOWN" FUSE, ALWAYS INVESTIGATE THE CAUSE OF OVERLOAD BEFORE REACTIVATING THE MAINFRAME. See Section 5.B.1 ("POWERUP PROBLEMS").

AS MENTIONED ABOVE, AFTER CHANGING THE MAINFRAME'S VOLTAGE-LEVEL SETTING, THE **FUSE MUST ALWAYS BE CHANGED ACCORDINGLY.**

To change the fuse of an A-SIZED mainframe, first TURN OFF THE MAINFRAME and DISCONNECT THE POWER CORD. Then use a screwdriver to turn the rear-panel FUSE slot counterclockwise, and the fuse holder will spring out.

To change the fuse of a B-SIZED mainframe other than the Model 10KN8A, first TURN OFF THE MAINFRAME and DISCONNECT THE POWER CORD. Slide to the left the clear plastic door covering the rear-panel fuse box. Then pull out on the "FUSE PULL" lever to disengage one end of the presently installed fuse from its spring clip.

* The contents of this initial "sign-on" page will depend on the application for which the system has been preconfigured at the factory. Often, for example, it will contain—in addition to TIME and DATE—a "live" display of all or some of the data channels that have been dedicated to a particular Analog Conditioner Card.

** Note that the **Model 10KN8A** (only) has no fuse; its rear-panel POWER ON-OFF button has a built-in CIRCUIT BREAKER.

1.A GETTING STARTED

b. DC OPERATION (“V” OPTION)

The System 10 “V” (VEHICLE) Option applies to all “10KU” and “10K4T” mainframes with the exception of the Model 10K4T-DA. A mainframe employing the “V” Option may NOT also be used for AC operation.

The “V” Option allows operation from nominal 12 or 28 V-DC (50 W maximum). The actual tolerance ranges are 11-16 V-DC or 23-29 V-DC, respectively. This permits universal “on-board” vehicle operation (12 V-DC for cars, 24 V-DC for trucks, and 28 V-DC for aircraft).

“V”-version mainframes are equipped with a special 3-wire DC CONNECTOR in the rear of the unit. Placement of the connector varies with mainframe model. Be sure to connect the *positive*, *negative*, and *ground* lines from your external DC source to the proper connector pins. These are clearly marked on the mainframe’s rear label. Although all “V” units are protected against accidental polarity reversal, they naturally will not work under that condition.

IMPORTANT: IN ALL CASES, THE “GROUND” PIN OF THE MAINFRAME’S REAR DC CONNECTOR SHOULD BE CONNECTED EITHER TO THE NEGATIVE TERMINAL OF THE VEHICLE BATTERY OR DIRECTLY TO THE VEHICLE CHASSIS. IT SHOULD NEVER BE LEFT UNCONNECTED. ALSO, TO MINIMIZE NOISE PICKUP, THE GROUND LEAD SHOULD BE AS SHORT AS POSSIBLE.

The configuration shown in Fig. 1.1(a), below, is normally recommended. Under conditions of *high electrical noise*, however, you should make the connections shown in Fig. 1.1(b).

Fig. 1.1(a) Normal DC Power Connections

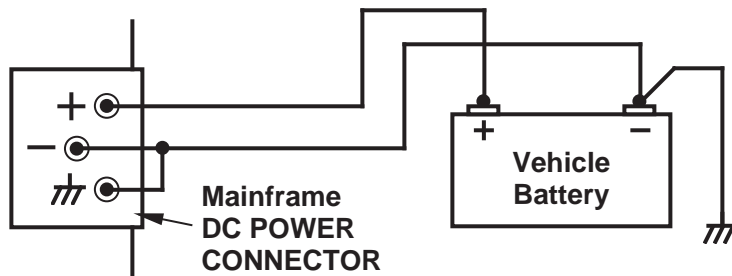
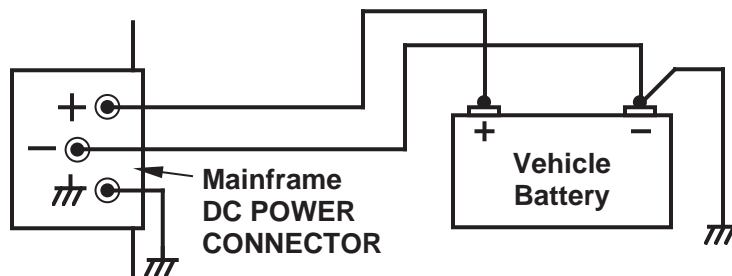


Fig. 1.1(b) DC Power Connections for High Electrical Noise



1.A.4 DISPLAY AND KEYBOARD INITIALIZATION

The creation of multichannel **LCD/VFD DATA DISPLAY PAGES** is described in Section 5 of the “On the Air” book for **A-SIZED** mainframes.

The creation of large-scale multichannel **CRT VIDEO PAGES** is described in Section 5 of the “On the Air” book for **B-SIZED** mainframes, and is treated in much greater detail in Section 2.C of this Guidebook.

As you compose LCD/VFD or CRT page formats for local or remote display of measured, stored, and/or calculated data values, you should keep the following in mind:

a. DISPLAY SETTINGS FOR A-SIZED MAINFRAMES

If your A-sized mainframe has only a *two-line “billboard” display* (local or remote), the following **DISPLAY (DIS)** command must be in effect for the display to function properly¹:

DIS = 1 [CR]²

If your A-sized mainframe has a *multichannel LCD or VFD data display* (local or remote), a command of

DIS = 2 [CR]

must be in effect.³

For a summary of both standard and optional *Data Display and Keyboard/Keypad* features available for A-sized mainframes, see Appendix A of the “On the Air” book.

b. DISPLAY SETTINGS FOR B-SIZED MAINFRAMES

The following commands are used for initial (general) setup of a B-sized mainframe’s CRT video display (local or remote). Each command is discussed in detail in Section 2.C.1 of this Guidebook:

- **B VIDEO SIGNAL (BVS)**—tells the system which version of the **Video Signal Card** is present
- **VIDEO DISPLAY UNIT (VDU)**—specifies the video format and frame rate for all system CRT’s, internal and external

¹ A **DIS** value of “1” must therefore be in effect for a Model **10KU-KD** or **10K4T-KD** mainframe, or when, for example, a Model 10KU is used with a Model **10DISU** Display Option or with a Model **10P80D** Extended Keyboard. This command must also be in effect for an A-sized mainframe with NO DISPLAY at all (i.e., for a 10KU, 10K1C, or 10K4TA with *no optional display capabilities*).

² For the entry of System 10 MNEMONIC COMMANDS, see Section 1.C of this Guidebook.

³ A **DIS** value of “2” must therefore be in effect for a Model **10K2D** or **10K4T-DA** mainframe, or when, for example, a Model 10KU, 10K1C, or 10K4TA is used with a Model **10VFD-2** Display Option.

1.A GETTING STARTED

- **VIDEO MODE (VID)**—tells a mainframe’s internal CRT whether it is to display video pages currently in EEPROM storage or an external video input from a computer or other external video-signal source
- **REFRESH (REF)**—selects the desired refresh rate for the CRT display
- **VIDEO SCAN SYMBOL (VSS)**—adds an ampersand (&) flag to the display of any and all data channels outside the current system scan range

Section 2.C.1 also explains the adjustment of a mainframe’s INTERNAL CRT CONTROLS.

NOTE: The **Model 10BVS98 VGA Video Signal Card** in a Model 10KN3, 10KN6, or 10KN8A mainframe is preset at the factory for “normal” VGA mode with *inverted vertical and horizontal sync*. If you need to change either or both sync signals to *noninverted* form, see the instructions given in Section 2.N.2 of this Guidebook (“Standard VGA Input / Output”).

C. INITIALIZATION OF OPTIONAL 10P80D KEYBOARD WITH CERTAIN A-SIZED MAINFRAMES

When a **Model 10P80D Extended Keyboard** is connected to a Model **10KU**, **10K1C**, or **10K4TA** Mainframe, you must press the keyboard’s **Home** key every time power is cycled, to initialize the keyboard’s 2-line LCD “billboard” display.⁹

SYSTEM 10 GUIDEBOOK

1.B CARD INSERTION AND REMOVAL

Your System 10 mainframe has been shipped with all purchaser-specified **A, B, and V CARDS** securely installed in their respective mainframe slots. INITIALLY, AT LEAST, THERE IS USUALLY NO NEED TO REMOVE OR REINSERT ANY PLUG-IN CARDS, unless for purposes of modifying the initial system configuration or of setting certain conditioner-card parameters per the instructions given in Section 1.E.2 of this Guidebook.*

In the normal course of system setup, troubleshooting, or general reconfiguration, however, you will probably be called upon at some point to remove an A CARD or a B CARD from the mainframe, and then to reinsert it or replace it with another card.

Fig. 1.2 shows details of System 10 SLOT CONNECTOR hardware. Note that when a mainframe is shipped, any unused slot connector will contain a protective "T" insert. This you can easily remove, if you later want to install a card in that slot. **HOWEVER, BE SURE TO KEEP AN INSERT IN EVERY UNUSED SLOT CONNECTOR, TO PREVENT THE ENTRY OF DUST INTO THAT CONNECTOR.**

To *install* an A CARD or B CARD in a mainframe slot,**

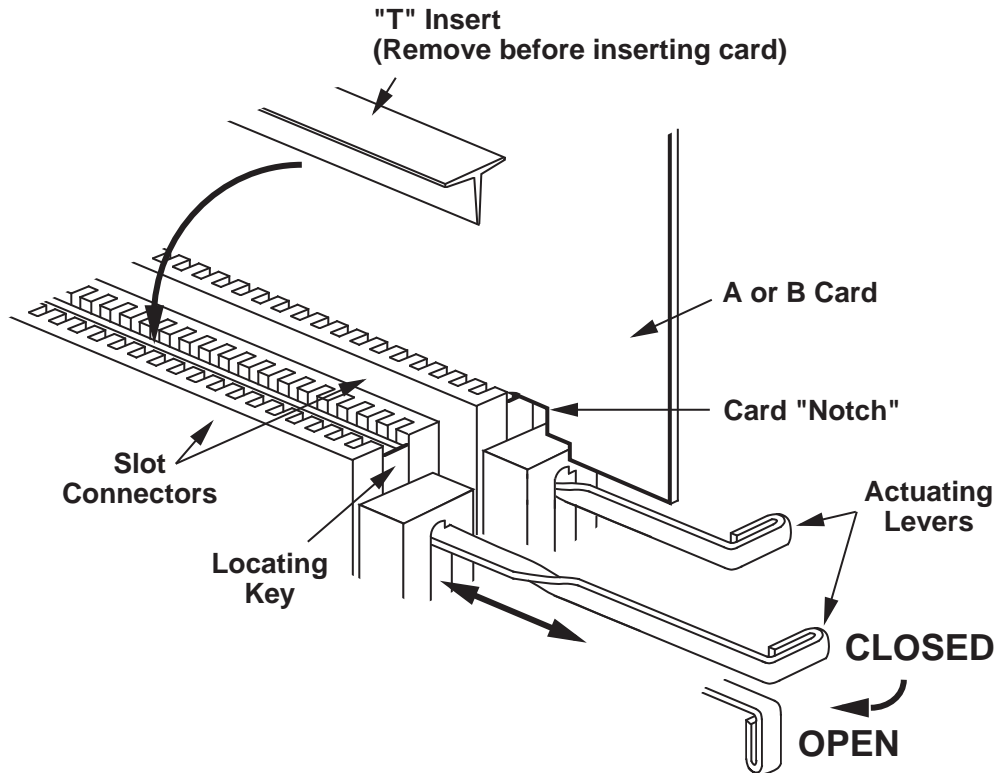
- a. Remove the appropriate FRONT BEZEL (the one that is directly in front of the card slot in question). For an A-sized mainframe, you will remove the bezel either by unscrewing it or by gently prying it off its "Snap-On Posts" (see the respective "front element" figure in Section 2 of the "On the Air" book for A-sized mainframes). For a B-sized mainframe, you will remove the bezel by pulling down the bezel's two "swell-latch" levers and then pulling it forward (see Section 2 of the "On the Air" book for B-sized mainframes).
- b. **IMPORTANT: UNLESS THE CARD BEING INSTALLED OR REMOVED IS AN "AA" CONDITIONER CARD OR A "10A" CONDITIONER CARD WHOSE MODEL NUMBER ENDS IN "C," ALWAYS MAKE SURE THAT MAINFRAME POWER IS OFF BEFORE CHANGING THE POSITION OF THE SLOT'S ACTUATING LEVER.**
- c. Make sure that any blank CONNECTOR COVER covering the rear of the slot has been removed.
- d. If a "keyed" I/O CONNECTOR is presently mounted to the mainframe at the rear of an "A SLOT," make sure that the connector matches the "key" of the conditioner card you want to insert in the slot. Otherwise, the card will not go

* Note that while I/O CONNECTORS will have been supplied by Daytronic for all installed cards, and I/O CABLES may have been supplied for all or some of them (as per the original system order), the I/O connections themselves must be made by the user, following the instructions given in Section 1.E.2 and elsewhere in this Guidebook.

** The installation of optional "V" (VIDEO) CARDS in B-sized mainframes is discussed in Section 3.C.1 of this Guidebook.

1.B CARD INSERTION AND REMOVAL

Fig. 1.2 Mainframe Slot Connector Hardware



fully into the slot. Conditioner-card "keying" is discussed in Section 1.E of this Guidebook.

- e. Remove the slot's "T" insert, if present, and then open the SLOT CONNECTOR by pulling the ACTUATING LEVER forward and turning it 90° clockwise until its front bar is vertical (pointing downward).
 - f. Gently slide the card into the open slot connector. The card must be vertical, in order for its top edge to engage in the sheet-metal groove directly above the slot connector. The NOTCH on the card should be downward and toward the front of the mainframe. If the card refuses at some point to slide further into the slot, remove the card and examine the slot for any foreign object that may be impeding the insertion (also check the card itself for any component(s) that may be catching on an adjacent card).
 - g. Align the LOCATING KEY of the slot with the notch on the lower side of the card.
 - h. Close the slot connector by turning the actuating level counterclockwise, thus engaging the locating key in the card's notch.
- IMPORTANT:** NEVER FORCE THE ACTUATING LEVER. THE CARD MUST BE FULLY INSERTED BEFORE THE SLOT CAN BE CLOSED.
- i. Push the actuating lever back in and reactivate the mainframe.

CARD INSERTION AND REMOVAL 1.B

When *removing* an A or B CARD from a mainframe slot,

- j. Again, MAKE SURE **MAINFRAME POWER IS OFF** BEFORE CHANGING THE POSITION OF THE SLOT'S ACTUATING LEVER (unless it is an "AA" or "C"-version Conditioner Card).
- k. If the card has an I/O CONNECTOR attached at its rear, make sure the connector is securely screwed to the mainframe before you pull the card out of the slot. Otherwise, the connector—and its cable—will simply fall off the rear of the unit, as soon as it disengages from the card.

IMPORTANT: After completing all system setup procedures that involve the installation and removal of plug-in cards, be sure to put all front bezels back on the mainframe. FRONT BEZEL(S) SHOULD NOT BE OFF DURING NORMAL MAINFRAME OPERATION.

SYSTEM 10 GUIDEBOOK

1.C ENTRY OF MNEMONIC COMMANDS

1.C.1 INTRODUCTION

Every System 10 is preprogrammed to perform most of its standard functions in response to the manual or automatic entry of specific ASCII MNEMONIC COMMANDS.

In very general terms, there are four main types of commands:

1. SETUP (or "WRITE") COMMANDS

These commands serve to *enter system configuration data* into the CENTRAL PROCESSOR'S nonvolatile EEPROM memory—or into that of a system COPROCESSOR. As explained in Section 1.C.4, below, a "WRITE" command will be effective only when the mainframe's EEPROM WRITE PROTECT SWITCH is ON.

2. INTERROGATION (or "READ") COMMANDS

As explained in Section 1.C.4, these commands serve to *ask the system for configuration data* currently stored in the EEPROM memory.

3. DATA INTERROGATION COMMANDS

Discussed primarily in Section 1.H of this Guidebook, these commands serve to *retrieve measured or calculated data values from the system's continuously updated DATA RAM*, either for "live" display or for transmission from a system SERIAL INTERFACE PORT.

4. IMPERATIVE COMMANDS

As a rule, these command do not actually enter or request information, but rather *instruct the system to do something*—e.g., to release a latched bit, close a shunt-calibration switch, increment a counter channel by one, "lock" a range of data channels, output a predefined interrupt character, etc.

Note that "READ" COMMANDS, DATA INTERROGATION COMMANDS, and IMPERATIVE COMMANDS are all "**RUN-TIME**" COMMANDS, since they can be applied at any time during normal system operation and do not require that the EEPROM be enabled.

Section 4 of this Guidebook is a complete **Alphabetical Directory of System Mnemonic Commands**. This is a useful reference section, giving all forms of every standard MNEMONIC COMMAND, with a brief description of the command's specific function(s) and a reference to the Guidebook section(s) in which it is discussed.

There are two basic means of DIRECT command entry:

- *locally*, via plug-in **KEYBOARD**
- *remotely*, via **RS-232-C SERIAL INTERFACE**

1.C ENTRY OF MNEMONIC COMMANDS

There are two types of keyboard:

- **EXTENDED KEYBOARD**, with or without 2-line LCD “billboard” display (Model **10P80D** or **10P80A**, respectively). This keyboard is normally used for initial setup procedures—including composition and storage of VIDEO PAGE FORMATS for a B-sized mainframe—and for subsequent “run-time” operations (e.g., calling pages for display, interrogating the system for setup and data values, initiating data transmissions and recordings, etc.).
- **OPERATOR’S KEYBOARD**, with or without 2-line LCT “billboard” display (Model **10P25D** or **10P25A**, respectively). This is a smaller, optional keyboard, which may be used to perform a limited number of operations, including channel interrogation, limit setup, page selection, etc.*

The SERIAL INTERFACE for command entry can be any of several provided by System 10 (depending on the mainframe type and card set), including

- the main **COMPUTER INTERFACE PORT** (ALL mainframes, both A-sized and B-sized)
- the **AUXILIARY COMPUTER INTERFACE PORT** provided by an optional Model 10BACI or other “10BACI” Card (B-sized mainframe only)
- the **SATELLITE INTERFACE PORT** provided by an optional Model 10BD4 or 10BD1 Card (B-sized mainframe only)
- the **FIFO COMPUTER PORT** provided by an optional Model 10AFIFO Card (A-sized mainframe only)

Mnemonic commands may also be issued to System 10 INDIRECTLY (and AUTOMATICALLY) upon occurrence of predefined system conditions and events. Use of **EXECUTE (EXU)** and **COMMAND (CMD)** statements for automatic application of commands is discussed in Section 2.K of this Guidebook.

1.C.2 CONVENTIONS USED IN COMMAND EXPRESSIONS

1. All ASCII “mnemonics” will be shown in CAPITAL LETTERS. The commands that employ them, however, are not normally case-sensitive and may be entered, if desired, with all letters in lower case.
2. *Variable numeric values or code words* will be represented by *lower-case letters or letter groups*, which will be explained, where necessary, in the accompanying Guidebook text. A *single capital letter* will sometimes be used to represent a *variable alphanumeric text string or expression* to be entered within a command (e.g., “L” will stand for a “legend”; “B” for a “Boolean algebraic expression”; “T” for a “format template”; etc.). A *dollar sign* (\$) will be used to represent an *ASCII character string* to be specified by the operator or computer.
3. Unless otherwise noted, letters or letter groups enclosed in *square brackets* (e.g., **[CR]**, **[LF]**) represent *ASCII control characters* and are not literals ([CR] = CARRIAGE RETURN; [LF] = LINE FEED; etc.).

* Use of the OPERATOR’S KEYBOARD is treated in detail in Section 2.S of this Guidebook. It allows you to designate special “PROMPT” key sequences for rapid entry of up to five selected mnemonics. The **FRONT-PANEL KEYPAD** of the Model 10KU-KD and 10K4T-KD mainframes—and of the Model 10DISU and 10DIS4T Display Options—provides similar functions, along with basic key-controlled “Channel,” “Logic,” and “Port” configuration sequences (see Section 2.R).

4. SPACES are shown in mnemonic commands and response formats throughout the Guidebook, but only for the sake of clarity. With only a few exceptions, they do not count as “command characters” and need not be included in any command entry *unless they are part of an actual “text” string*. Nor are they issued by the system in response to an interrogation, unless, again, they are part of a “text” string.
5. All commands are shown with a terminating CARRIAGE RETURN (**[CR]**). As explained in Section 2.B.5, you may set your System 10 to recognize a COMMAND TERMINATOR (or “CMT”) other than the standard [CR] for commands entered via SERIAL INTERFACE PORT. All *keyboard-entered* commands are terminated by the **Retrn** key (= [CR]).
6. For all “WRITE” commands, an asterisk (*) is shown following the terminating [CR]. This symbol is not part of the actual command, and is not to be entered. It is there to remind you that *the command will be effective only when the mainframe’s EEPROM WRITE PROTECT SWITCH is ON*—a condition which exists either
 - when the mainframe’s physical EEPROM Switch is in the upward position, or
 - when the system’s **Bit No. 999** is “high” (= *Logic 1*).

The red Status Indicator labelled **E2P** will light when the EEPROM Write Protect function has been enabled.

7. For the sake of simplicity, commands for setting or reading the attributes of DATA CHANNELS are usually shown only in *single-channel* form. In most cases, such commands can also take a *multiple-channel* (or “range”) form, where a continuous range of channels (entered as “**x TO y**”) replaces the single channel (“**x**”) in the command expression. The “range” form of a “READ” COMMAND is useful only when entered via SERIAL INTERFACE PORT, because of the keyboard’s ability to step through sequential interrogations (see Section 1.C.4, below).

Commands of a similar “range” form can also apply to LOGIC BITS, BIT GROUPS, History Card RECORDERS, and other system entities.

Even if not mentioned in the main Guidebook text, every valid “range” command form is indicated in the **Directory of Mnemonic Commands** (Section 4 of this Guidebook), under the appropriate mnemonic.

8. Regardless of its source of entry, a command *not conforming to standard syntax* will be ignored by the system. Also, in many cases, a command that attempts to enter an *unacceptable setup value* will be ignored—if, for example, you attempt to enter a numerical LOCATION value for system PSEUDO-CHANNEL, or attempt to enter a LIMIT VALUE that exceeds the system’s standard 16-bit range (± 32700).

1.C.3 COMMAND ENTRY AND DISPLAY

a. VIA KEYBOARD

As mentioned above, every keyboard-entered command is terminated by pressing the **Retrn** key (= CARRIAGE RETURN). The command will not be effective until [CR] is transmitted to System 10.

1.C ENTRY OF MNEMONIC COMMANDS

All characters typed on a properly connected keyboard will appear on the mainframe's "BILLBOARD" display as they are typed, in place of the currently specified LOGO string.* This lets you review each command entry, and to revise it, if necessary, before putting it into effect by pressing **Retrn**.

Thus, while typing in a command, you may at any delete the last-entered key-stroke by pushing the **Back Space** key. If you want to completely clear the command you are in the process of entered (thus returning the LOGO to display), press the **Clear** key.

The billboard will continue to display any keyboard-entered command statement—or the answer or prompting message invoked by that command—until **Retrn**, **Clear**, or **Exit** is subsequently pressed, whereupon the system's current LOGO will reappear in the billboard.

Unless you are in the process of entering a command and have not yet entered the terminating CARRIAGE RETURN, pressing the **Space Bar** at any time will completely erase the contents of the billboard. To return the LOGO to display, press **Retrn**, **Clear**, or **Exit**.

If you make an error in entering a command, or if a condition exists which for some reason prevents proper execution of an entered command, the system will in many cases bring the matter to your attention by displaying a "prompting message" on the billboard. If, for example, you enter a command containing a typographical error, the billboard may announce

INVALID SYNTAX, PLEASE REENTER COMMAND

Other corrective "prompts" you may encounter in the course of normal operations will be mentioned where appropriate in the following sections.

b. VIA COMPUTER INTERFACE

PLEASE NOTE: In the following discussion (and throughout this Guidebook), we will make reference to your mainframe's **COMPUTER INTERFACE PORT** as the means of entering mnemonic commands that originate from a computer, terminal, or other "remote" command source. Be aware that—as we pointed out above—there may be other serial ports within the system that can also receive remotely issued commands.

If you have an A-sized mainframe WITHOUT KEYBOARD, you will need to set up the mainframe's Computer Interface Port *before any other procedures are performed*.

IF SUCH IS THE CASE, TURN IMMEDIATELY TO **SECTION 2.B** OF THIS GUIDEBOOK AND FOLLOW THE INTERFACE SETUP INSTRUCTIONS GIVEN THERE.**

Having set up your mainframe's Computer Interface Port, you are ready to use an external computer or terminal to communicate to System 10 all of the mnemonic

* The "billboard" can be part of the mainframe's multichannel LCD/VFD or CRT data display, or it can be a separate 2-line LCD display that is provided by an external 10P80D or 10P25D keyboard or which accompanies a "KD" A-sized mainframe's front-panel keypad.

** These include instructions for setting an appropriate COMMAND TERMINATOR for commands entered via the Computer Interface Port, in the event that your computer normally terminates its transmissions with a character other than CARRIAGE RETURN ([CR]).

commands required by the procedures described in this Guidebook. As noted above, a command not conforming to standard syntax will be ignored by System 10. If a command entered via the Computer Interface Port contains a character not in the standard System 10 character set, the red **ERR** indicator will light.

1.C.4 INTERROGATING FOR SETUP VALUES

a. "READ" COMMANDS AND RESPONSES

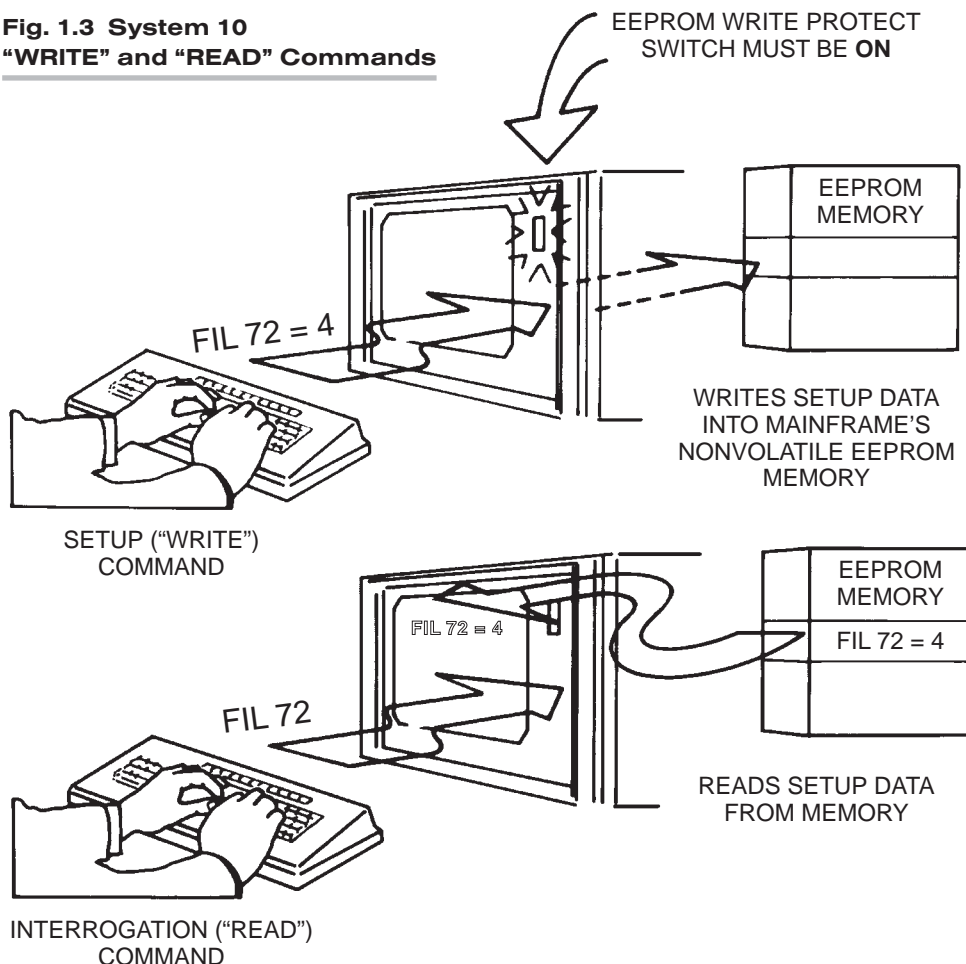
In almost all cases, a given "WRITE" command for the entry of setup data in non-volatile EEPROM has a corresponding "READ" command. By applying a "READ" command, the operator or computer can interrogate System 10 for the currently effective value of a particular setup parameter (e.g., a given channel's current "type" designation, "location," digital filter setting, limit values, scaling factor, etc.).

The general form of a "WRITE" command is

[MNEMONIC] n = [NUMERICAL VALUE(S)] [CR]*

where "n" is the assigned *number* of the data channel, logic bit, message, etc., being "set up"; [CR] is the standard COMMAND TERMINATOR; and the asterisk (*) signifies that the EEPROM Write Protect Switch must be ON for the command to be effective.

Fig. 1.3 System 10
"WRITE" and "READ" Commands



1.C ENTRY OF MNEMONIC COMMANDS

The corresponding “READ” command will have the form

[MNEMONIC] n [CR]

Remember that, unlike the “WRITE” command, the “READ” command does not require that the mainframe’s EEPROM be enabled (and the command expression is therefore not marked with “*.” Interrogation via a “READ” command is strictly a “run-time” operation; it can be done *at any time during normal running of the system*.

How System 10 answers a “READ” command will depend on how that command has been entered. Thus, if you apply a “READ” command through the keyboard (as in Fig. 1.3, above), the response will appear on the BILLBOARD:

[MNEMONIC] n = [NUMERICAL VALUE(S)]

If, however, the “READ” command has been entered via the Computer Interface Port (or some other serial port), then the system will respond by issuing *from that port* a serial-ASCII transmission with a general format of

[NUMERICAL VALUE(S)] [END-OF-TRANSMISSION TERMINATOR]

Unless otherwise specified at the time of order, every System 10 is factory-set for an END-OF-TRANSMISSION TERMINATOR (or “EOT”) of CARRIAGE RETURN, LINE FEED (**[CR][LF]**). As explained in Section 1.H.3, you can at any time specify a different EOT of one to four ASCII control characters. All RESPONSE FORMATS shown in this Guidebook will be shown with the standard transmission termination of **[CR][LF]**.

REMEMBER, A KEYBOARD-ENTERED “READ” COMMAND WILL PRODUCE ONLY A BILLBOARD DISPLAY OF THE SYSTEM’S RESPONSE; A “READ” COMMAND ENTERED VIA THE COMPUTER INTERFACE (OR OTHER) PORT WILL PRODUCE ONLY A RESPONSE OUTPUT FROM THAT PORT.

For the sake of simplicity, respective “READ” command forms will in most cases *not* be presented when SETUP (“WRITE”) commands are discussed in this and the following Guidebook sections. You should always bear in mind, however, that such commands can be applied at any time, in order to verify setup procedures, to recall forgotten setup values, to inform the computer of vital configuration data, etc.

For example, suppose that the following SETUP command has been entered to specify a *digital filter* setting of “4” for Channel No. 72:

FIL 72 = 4 [CR]*

When entered via the keyboard (as in Fig. 1.3, above), a subsequent “READ” command of

FIL 72 [CR]

will invoke a BILLBOARD response of

FIL 72 = 4

When entered via the Computer Interface Port, the same “READ” command will yield a transmission from that port of

4 [CR][LF]

(assuming again that the standard “EOT” is in effect).

By entering the “range” form of a “READ” command *via the Computer Interface Port*, you will cause the system to output a *sequence of answers*, one for each channel, bit, recorder, etc., in the specified “range.” If, for example, you enter via the Computer Interface Port a command of

FIL 72 TO 89 [CR]

the system will respond by issuing from that port the current filter constants, in sequence, for all channels from Channel No. 72 to and including Channel No. 89. (If the above “range” command is entered via the keyboard, however, the system will respond by displaying on the BILLBOARD the filter constant of Channel No. 72 *only*, until the **Step** key is pressed—see the following section).

All valid “READ” command forms can be found in the **Directory of Mnemonic Commands** (Section 4 of this Guidebook), under the appropriate mnemonics.

NOTE ALSO: If you interrogate System 10 for a *nonexistent* setup value—that is, for a value that has not yet been specified by an appropriate “WRITE” command and that has no initial “default” state—then the system will respond with a billboard display of the general form

[MNEMONIC] n = N/A

or an output of

N/A [CR][LF]

from the Computer Interface Port.

b. SEQUENTIAL KEYBOARD INTERROGATIONS

You can use the keyboard’s **Step** key for fast sequential interrogations following an initial keyboard-entered “READ” command of the form

[MNEMONIC] n [CR]

where “n” is the number of the *first* argument of the desired series (Channel Number, Logic Bit Number, Video Page Number, Message Number, “EXECUTE” Number, Conditional Bit Number, etc.)

Thus, you need only press **Step** to read data for the *next* argument in numerical sequence (i.e., for “n + 1”). By holding down the **Step** key, you can “step” rapidly through a long sequence of interrogations.

The **Back Space** key may be similarly used to “step” backwards through the interrogation series.

SYSTEM 10 GUIDEBOOK

1.D SYSTEM STATUS INDICATORS

Your mainframe's front-panel SYSTEM STATUS INDICATORS let you continuously monitor the validity of various system communication links.* The top four lights (or the first four from the left) are RED, to indicate "ERROR" or "ALERT" conditions. The remaining lights are GREEN.

For "10KU" and "10K4T" mainframe versions, the status indicators are located under the A-CARD SLOTS; for all other mainframes, they are located on the front edge of the RS-232-C Interface Card, as shown in Fig. 1.4.**



Fig. 1.4
System Status Indicators

- DTR** When this light is ON, it means that System 10 is *not* asserting **DATA TERMINAL READY**. The system input buffer is full, and it is therefore *not ready to receive data* from the connected device. This light should be on only during rapid, continuous computer outputs to System 10.
- RTS** When this light is ON, it means that System 10 has issued a **REQUEST TO SEND** to the connected device, but *has not yet received an answering CLEAR TO SEND*. This could indicate that the computer is currently too busy to accept more data, or that some other factor is preventing transmission (for instance, a disconnected cable). This light may blink during normal operation, but in any event should be ON only during continuous outputting by System 10.

* These links relate to the EEPROM memory, an external KEYBOARD (if present), and the system's MAIN COMPUTER INTERFACE PORT. All "AUXILIARY" (10BACI-supplied) and "SATELLITE" (10BD4- or 10BD1-supplied) interfaces have their own respective status indicators, for an explanation of which see the respective subsection of Section 3 of this Guidebook.

** For a "10K1/10K2" mainframe, this is the combined Central Processor/Interface Card.

1.D SYSTEM STATUS INDICATORS

- E2P** When this light is ON, it means that the System 10 **EEPROM** is enabled. The EEPROM Write Protect Switch is ON—or **Bit 999** is “high”—and the EEPROM memory is therefore ready to be written into.
- ERR** When this light is ON, it means that an **ERROR** has been detected in the transmission to System 10. That is, the system has received at its Computer Interface Port an *invalid character* (not in the standard System 10 ASCII character set).
- CHR** When this light is ON, it means that System 10 has received a valid ASCII **CHARACTER** through its Computer Interface Port (only). Usually, this light will indicate that System 10 and the connected device are “talking” at the *same baud rate*.
- MNE** When this light is ON, it means that System 10 has received through its Computer Interface Port (only) a valid **MNEMONIC COMMAND** belonging to the Central Processor command set; it will not light on receipt of a command relating to the VIDEO CARD SET, HISTORY CARD, etc.
- RET** When this light is ON, it means that the last character received by System 10 was the current COMMAND TERMINATOR (“CMT”), which is normally (but not always) set at **CARRIAGE RETURN ([CR])**—see Section 2.B.5. This indicator may be used during system troubleshooting to confirm that data communication of *some kind* is occurring.
- XMT** When this light is ON, it means that System 10 is currently **TRANSMITTING** through its Computer Interface Port.
- RCV** When this light is ON, it means that System 10 is currently **RECEIVING** through its Computer Interface Port. Whenever there is activity on the “RECEIVED DATA” line, this light will flicker.
- KBD** When this light is ON, it means that System 10 is currently receiving a character transmitted by a Daytronic plug-in **KEYBOARD**. During continuous keyboard line activity, this light will flicker.

For use of SYSTEM STATUS INDICATORS in the diagnosis of system COMMUNICATIONS PROBLEMS, see Section 5.B.5 of this Guidebook.

SYSTEM 10 GUIDEBOOK

1.E TRANSDUCER CABLING AND CONDITIONER CARD SETUP

1.E.1 GENERAL CONSIDERATIONS

If you ordered one or more sensor cables with your System 10, each supplied cable will be equipped with an individual female CONDITIONER CONNECTOR. *The type of connector will depend on the conditioner card with which it is to mate.*

There are two basic types of Daytronic conditioner cards (for complete descriptions and specifications, see the latest Daytronic *Conditioner Cards Catalog* or **Section 1.E.2**, below):

a. "10A" CARDS

Many of these cards—originally designed for Daytronic's System 10—may now be used in the **SPS6000** and **SPS8000** Systems as well. Sensor cables for most 10A cards use the female 20-pin CONDITIONER CONNECTOR (Daytronic Part No. 60322), shown in Fig. 1.5.* This connector allows direct *solder-terminal* attachment of up to eight separate transducer cables. The connector's internal solder terminals are labelled 1 through 10 and A through L. These designations corre-

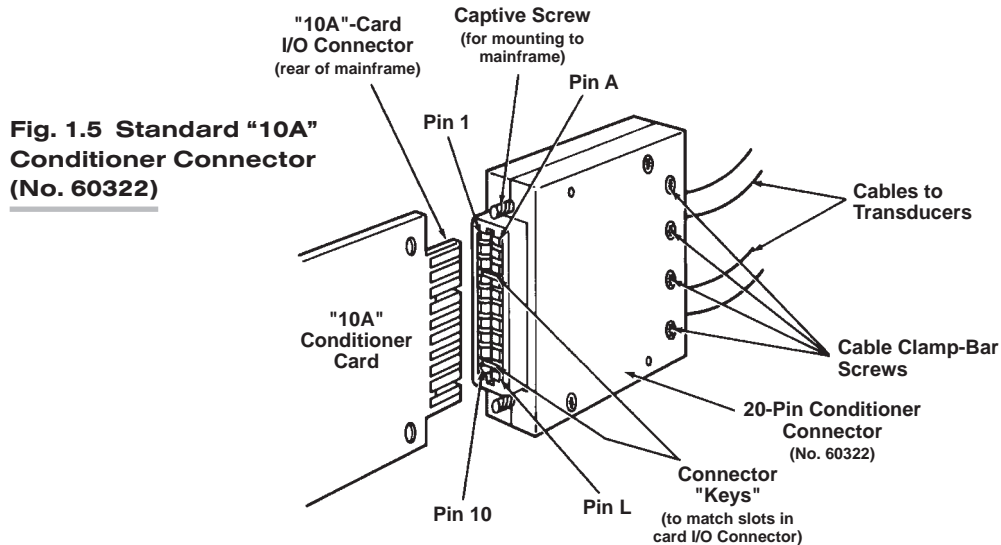


Fig. 1.5 Standard "10A" Conditioner Connector (No. 60322)

* Note that the **Model 10A68-2 Dual AC RMS Conditioner Card** mates with a special conditioner connector board that has a separate screw-terminal block for each of the two inputs, while the **Model 10A73-4 Quad 1/2 & 1/4 Bridge Strain Gage Conditioner Card** usually mates with a special 1/4-bridge, 1/2-bridge, or full-bridge COMPLETION CONNECTOR (see the respective cabling diagrams in Section 1.E.2).

1.E TRANSDUCER CABLING AND CONDITIONER CARD SETUP

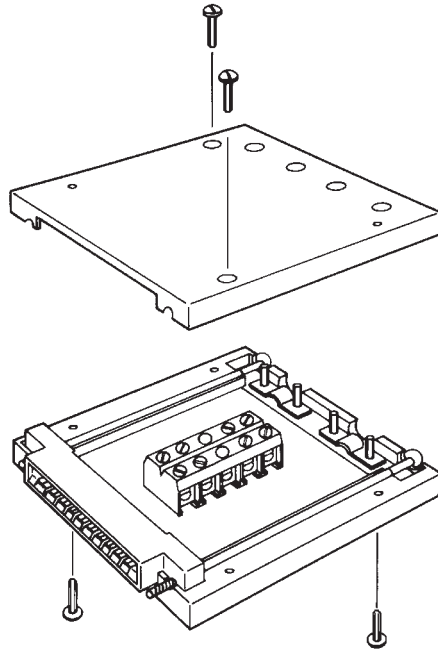


Fig. 1.6 Screw-Terminal Connector for TC Cables

spond one-to-one with the “I/O CONNECTOR PIN NUMBERS” listed in the A-card pin/terminal-assignment tables in Section 1.E.2.

Thermocouple Conditioners require special *screw-terminal* connectors, like that shown in Fig. 1.6. Each such connector can accommodate a maximum of either four or eight separate TC sensors. Positive and negative TC leads must be connected directly to screw terminals of corresponding polarity; they *cannot* be soldered.

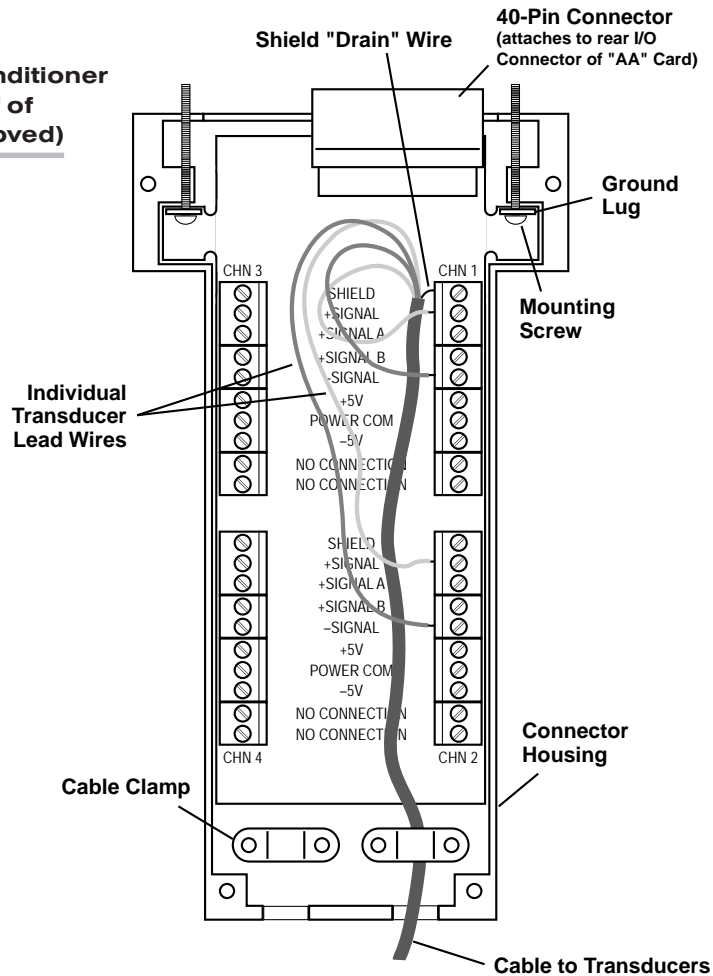
Each “10A” connector is properly labelled and “keyed.” Connector “keys” are small plastic inserts embedded between specific terminal pairs. The position of each key matches that of a slot in the rear I/O CONNECTOR of the conditioner card with which it is to mate, as shown in Fig. 1.5. The purpose of the keys is to guarantee that the conditioner connector is attached right-side-up, and that a given conditioner card is not inadvertently connected to the wrong transducer. The “10A” connector housing provides mounting screws to secure the connector to the rear of the System 10 mainframe and to provide a solid ground connection for cable shields.

b. “AA” CARDS

While functionally similar to the corresponding “10A” models, these “Advanced Analog” conditioner cards offer a number of significant enhancements, including programmable low-pass active filtering and enhanced linearity correction (where appropriate). AA-card I/O connections are established via card-specific *screw-terminal* connector assemblies, an example of which is shown in Fig. 1.7. Mounted on the internal board of the assembly is a block of clearly labelled screw terminals for each of the AA card’s available input channels. These terminals are tied to a 40-pin female connector that mates with the rear I/O CONNECTOR of the AA card.*

* An exception is the **Model AA14-4F010 Thermocouple Conditioner Card**, which uses the same 20-pin four-channel TC connector (No. 60323) as the Model 10A10-4 Thermocouple Conditioner (see Fig. 1.6, above).

Fig. 1.7 Typical "AA" Conditioner Connector (with top half of connector housing removed)



As with all "10A" connectors, every "AA" connector provides mounting screws to secure the connector and provide a solid ground connection for cable shields. While "AA" connectors do not use the plastic "key" inserts of the "10A" connectors, an offset in the mounting holes does ensure that an "AA" connector cannot be attached upside down.

To set up your System 10's ANALOG CONDITIONER CARDS, you should

- a. Make sure the mainframe is **OFF**.
- b. Connect each transducer cable to its respective "real-world" sensor, according to the appropriate cabling diagram (plus any special instructions) given in **Section 1.E.2**, below.
- c. Attach each transducer-plus-cable system to the rear I/O CONNECTOR of the respective conditioner card.

Even if you're supplying your own sensor cables, you will be furnished with a full set of labelled CONDITIONER CONNECTORS, one for every conditioner card ordered with your system. Attach each of your transducer cables to the

1.E TRANSDUCER CABLING AND CONDITIONER CARD SETUP

appropriate connector, being sure to secure each cable within its conditioner connector by means of one of the connector's two internal clamp bars.*

- d. Mount each CONDITIONER CONNECTOR to the rear of the System 10 mainframe by means of the two captive screws attached to the connector housing. **THIS IS REQUIRED FOR PROPER ESTABLISHMENT OF THE CABLE "SHIELD" CONNECTION** (see "Connection of Cable Shield," below).
- e. Refer to the respective subsection of Section 1.E.2 for every type of conditioner card in your system, to see whether there are any special "Setup and/or Operating Considerations" you should be aware of with respect to that card.

If special procedures are required for any conditioner card(s) in your system, you should now perform those procedures, carefully following the instructions given in the respective subsection of Section 1.E.2.

In Section 1.E.2 you will also find all necessary instructions for the connection and operation of any conditioner-related "Options and Accessories" that may be included in your system.

- f. If no special conditioner setup procedures are called for, you may proceed with the system setup procedures explained in Sections 1.F through 1.H of this Guidebook.

C. CONNECTION OF CABLE SHIELD

IMPORTANT: *Cable signal wires or twisted wire pairs should always be properly shielded, as indicated in the respective cabling diagram in Section 1.E.2. This will minimize the production of unwanted electrical noise from capacitive and inductive effects.*

In almost all of the cabling diagrams given in Section 1.E.2, only the "connector end" of each cable shield is shown, as represented by a gray circle surrounding either a single wire or a TWISTED PAIR of wires within the cable. The "transducer end" of each shield is not normally shown. Unless otherwise stated, every shield *should be grounded only at the connector end*. That is, every cable shield should make electrical contact only with the **GROUND LUG OF A STANDARD "10A" CONDITIONER CONNECTOR** or with a **"SHIELD" TERMINAL OF AN "AA" CONDITIONER CONNECTOR**. The drain wire tying the connector end of the shield to the connector's ground lug or "SHIELD" terminal should be as short as possible (as shown in Fig. 1.7), and the conditioner connector **MUST** be mounted securely to the rear of the System 10 mainframe.

If you're using the standard 20-pin "10A"-card connector shown in Fig. 1.5, open the connector housing and locate the L-shaped ground lug under the head of one of the two captive mounting screws. The shield wire of each attached cable should be soldered to the exposed terminal of this lug. *When reassembling the connector, be sure that the shield lug is positioned between the head of the screw and the connector's plastic base. A SLIDING LUG MAY RESULT IN NOISY, INACCURATE READINGS.*

* You may, if you wish, use your own connector for a "10A" card, in place of the standard Daytronic 20-pin connector shown in Fig. 1.5. It should be a 10-position, 20-contact edge-card connector with contact pitch of 0.156 inch (for 1/16-inch printed circuit cards).

If you're using a 40-pin "AA"-card connector like that shown in Fig. 1.7, make sure the shield wire of each attached cable is securely connected to the respective **SHIELD** terminal (which is internally connected to one of the connector housing's two ground lugs).

d. USE OF THE MODEL 10AX-2 AUXILIARY EXCITATION CARD

The **Model 10AX-2** supplies two channels of regulated, sensed ± 12 V-DC $\pm 2\%$ power (up to 20 mA) to external transducers. Though most often used to power high-output DC-to-DC LVDT's, this card may also be used with other transducers within the above voltage and current range.

The Model 10AX-2's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5, above. Standard pin assignments for the I/O Connector are given in the table below.

2-wire cabling is to be used for each 10AX-2 channel when the cable is under 20 feet in length. In this case, the channel's +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines *at the CONDITIONER CONNECTOR*. The EXCITATION lines should be paired for shielding.

4-wire cabling is to be used for each 10AX-2 channel when the cable is 20 feet or longer. In this case, the channel's +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines *at the transducer*. The EXCITATION and SENSE lines should be separately paired for shielding.

In either wiring configuration, +SIGNAL and -SIGNAL lines from the transducer are connected to the associated SIGNAL CONDITIONER CARD, as shown in the respective subsection of **Section 1.E.2**, below.

Table 1.1 Model 10AX-2 Pin Assignments

I/O Connector Pin Number	Channel Number	Line Function
1	1	+EXCITATION
A	1	-EXCITATION
2	1	+SENSE
B	1	-SENSE
6	2	+EXCITATION
F	2	-EXCITATION
7	2	+SENSE
H	2	-SENSE
4, D, 5	—	POWER COMMON

SYSTEM 10 GUIDEBOOK

CONNECTION AND SETUP OF ANALOG INPUT CARDS AND ACCESSORIES

The following System 10-compatible Conditioner Cards are treated in this section:

- Model **10A9-8C** Eight-Channel Thermocouple Conditioner
- Model **10A10-4** Quad Isolated Thermocouple Conditioner
- Model **10A15-8** Eight-Channel Thermistor Conditioner
- Model **10A16-4C** Quad Platinum RTD Conditioner
- Model **10A17-2** Dual High-Voltage Isolation RTD Conditioner
- Model **10A18-4C** Quad 100-Ohm Platinum Linear RTD Conditioner
- Model **10A30-2C** Dual LVDT Conditioner
- Model **10A31-4** Quad LVDT Conditioner
- Model **10A35** Encoder Conditioner
- Model **10A40** Frequency Input Conditioner
- Model **10A41-2C** Dual Frequency Input Conditioner
- Model **10A43** Dwell Angle Conditioner
- Model **10A45** Simmonds Shaft Torque Sensor Conditioner
- Model **10A48** Modulated Carrier Flow Conditioner
- Model **10A60-4** Quad Voltage Conditioner
- Model **10A61-2** Dual 4-20 mA Input Conditioner
- Model **10A62-8C** Eight-Channel 4-20 mA Conditioner
- Model **10A63-2** Dual Voltage Conditioner
- Model **10A64-8C** Eight-Channel Voltage Conditioner
- Model **10A65-8** Eight-Channel Low-Level Voltage Conditioner
- Model **10A68-2** Dual AC RMS Conditioner
- Model **10A69-4** Quad AC RMS Conditioner
- Model **10A70-2** Dual Strain Gage Conditioner
- Model **10A72-2C** Enhanced Dual Strain Gage Conditioner
- Model **10A73-4** Quad 1/2 & 1/4 Bridge Strain Gage Conditioner
- Model **10A74-4C** Quad Strain Gage Track-Hold Conditioner

(cont'd)

1.E.2 SYSTEM 10 ANALOG INPUT CARDS

- Model **10A76** Vibration Conditioner
- Model **10A78** AC Strain Gage Conditioner
- Model **10A96** Amplified Accelerometer Vibration Conditioner
- Model **AA14-4F010** Thermocouple Conditioner
- Model **AA30-4** LVDT Conditioner
- Model **AA41-2 / AA41-4** Frequency Input Conditioner
- Model **AA72-2 / AA72-4** Strain Gage Conditioner

PLEASE NOTE

In each individual Analog Input Card section, references will be made both to “Sections” and to “Manual Sections.”

Unless otherwise indicated, a “Section” reference—e.g., “see Section 3.a”—will always refer to a subsection of the card-specific section of the *System 10 Guidebook* which you are presently reading.

Unless otherwise indicated, a “Manual Section” reference—e.g., “see Manual Section 1.G.5”—will always refer to a section of the main body of the *System 10 Guidebook* itself.

MODEL 10A9-8C

EIGHT-CHANNEL THERMOCOUPLE CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 10A9-8C is a general-purpose conditioner with built-in reference-junction compensation. It accepts up to eight independent temperature signals from **Types B, E, J, K, R, S, and T Thermocouples**. Any desired mixture of these thermocouple types is permitted. Sensors may be grounded or ungrounded, in any desired mix. An amplifier-per-channel design with chopper stabilization and active low-pass filtering allows high-speed scan switching of high-level, stabilized signals, at exceptionally low cost per channel.

During operation, appropriate reference-junction compensation, real-time digital linearization, and engineering-unit scaling are automatically applied by the System 10 Central Processor for each type of thermocouple used.

The Model 10A9-8C includes a rear-panel connector block with screw terminals for direct attachment of TC leads (which cannot be soldered). The same connector accommodates all TC types. Since the connector assembly also contains a dual-bead **precision thermistor** for measurement of the reference-junction temperature, no external cold junction is required—although the user may supply his own Controlled Ambient Temperature Zone for reference-junction compensation, if desired.

NOTE: When the 10A9-8C is used in System 10, the reference-junction-corrected temperature is made available to the Central Processor through the **Model 10A11 Thermocouple Output Processor Card**. The purpose of the 10A11 is to proportion and sum the cold-junction reference signal and the amplified TC signal of each channel for presentation to the system's Analog Signal Bus. *One 10A11 must therefore be installed in every System 10 A-card rack containing one or more Model 10A9-8C's.*

In the event of a broken thermocouple wire or other “open TC” condition, the 10A9-8C will automatically report an indeterminate off-scale reading for the TC channel in question, with positive or negative polarity selectable on a per-channel basis (as explained in Section 3.a).

You can use an optional **Model 10CTJB-8 Thermocouple Junction Box** with a Model 10A9-8C to move the temperature-compensated reference junction to the actual site of up to eight *remote* thermocouple sensors. As explained in Section 4, below, TC leads connect directly to the 10CTJB-8's internal screw terminals, in any desired type mixture. The Junction Box then sends their signals to the 10A9-8C Conditioner via copper conductors (only).*

* The 10CTJB-8 can only be used in environments with an ambient temperature between 0° F and +140° F.

ADDITIONAL 10A9-8C SPECIFICATIONS

Measurement Range and Resolution: See Table 1, below; automatically selected—on an individual channel basis—when the channel is configured; for System 10 channel “type” codes assigned to 10A9-8C data channels, see Table 1

Linearization: Internal digital look-up via system processor; maximum error: $\pm 0.05^\circ\text{C}$

Reference-Junction Compensation: At connector block, using a built-in precision thermistor, or at remote TC site, using the **Model 10CTJB-8 Thermocouple Junction Box***

Thermocouple Break Detection (per channel): Off-scale positive or negative indication, selectable by internal programming jumpers

Amplifier (per channel):

Normal-Mode Range: $\pm 80\text{ mV}$ operating; $\pm 100\text{ V}$ without instrument damage

Common-Mode Range: $\pm 20\text{ V}$ operating; $\pm 50\text{ V}$ without instrument damage

Common-Mode Rejection Ratio: DC: -116 dB ; at 60 Hz: -120 dB

Input Impedance: Differential: $10\text{ M}\Omega$; Common-Mode: $0.5\text{ M}\Omega$

Offset: Initial: $\pm 5\text{ }\mu\text{V}$; vs. Temperature: $\pm 0.1\text{ }\mu\text{V}/^\circ\text{C}$; vs. Time: $\pm 1\text{ }\mu\text{V}/\text{month}$

Gain Accuracy: $\pm 0.05\%$ of absolute mV input range of -10 to $+80\text{ mV}$

Gain Stability: vs. Temperature: $\pm 50\text{ ppm}/^\circ\text{C}$; vs. Time: $\pm 20\text{ ppm}/\text{month}$

Filter (per channel): 2-pole modified Butterworth; 3 dB down at 1 Hz; 60 dB down at 50 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 0.75 sec

To 0.1% of final value: 4 sec

To 0.02% of final value: 8 sec

Total System Accuracy (typical, including Model 10A9-8C, Model 10A11 Thermocouple Output Processor, and system data collection and processing): see Table 1, below

Auxiliary Outputs to Mainframe Wire-Wrap Pins: None

Table 1 Thermocouple Ranges for the Model 10A9-8C

TC Type	Range	Display Resolution	Typical System Accuracy**	Maximum Expected Error**	Channel Type Code
E	-130°C to $+1000^\circ\text{C}$	0.1°C	$\pm 0.6^\circ\text{C}$	$\pm 0.8^\circ\text{C}$	20
J	-130°C to $+750^\circ\text{C}$	0.1°C	$\pm 0.8^\circ\text{C}$	$\pm 1.3^\circ\text{C}$	21
K	-75°C to $+1350^\circ\text{C}$	0.1°C	$\pm 1.1^\circ\text{C}$	$\pm 1.5^\circ\text{C}$	22
R	-20°C to $+1750^\circ\text{C}$	0.1°C	$\pm 1.3^\circ\text{C}$	$\pm 2.6^\circ\text{C}$	23
S	-20°C to $+1750^\circ\text{C}$	0.1°C	$\pm 1.3^\circ\text{C}$	$\pm 2.6^\circ\text{C}$	24
T	-130°C to $+400^\circ\text{C}$	0.1°C	$\pm 0.7^\circ\text{C}$	$\pm 1.1^\circ\text{C}$	25
B	$+480^\circ\text{C}$ to $+1820^\circ\text{C}$	0.1°C	$\pm 1.3^\circ\text{C}$	$\pm 2.6^\circ\text{C}$	26
E	-200°F to $+1800^\circ\text{F}$	0.2°F	$\pm 1.0^\circ\text{F}$	$\pm 1.4^\circ\text{F}$	28
J	-200°F to $+1400^\circ\text{F}$	0.2°F	$\pm 1.4^\circ\text{F}$	$\pm 2.2^\circ\text{F}$	29
K	-100°F to $+2500^\circ\text{F}$	0.2°F	$\pm 1.8^\circ\text{F}$	$\pm 2.6^\circ\text{F}$	2A
R	0°F to $+3200^\circ\text{F}$	0.2°F	$\pm 2.2^\circ\text{F}$	$\pm 4.6^\circ\text{F}$	2B
S	0°F to $+3200^\circ\text{F}$	0.2°F	$\pm 2.2^\circ\text{F}$	$\pm 4.6^\circ\text{F}$	2C
T	-200°F to $+750^\circ\text{F}$	0.2°F	$\pm 1.2^\circ\text{F}$	$\pm 1.8^\circ\text{F}$	2D
B	$+900^\circ\text{F}$ to $+3300^\circ\text{F}$	0.2°F	$\pm 2.2^\circ\text{F}$	$\pm 4.6^\circ\text{F}$	2E

(cont'd)

* The 10CTJB-8 can only be used in environments with an ambient temperature between 0°F and $+140^\circ\text{F}$.

** Including \pm one count of least significant digit displayed. *Can be readily improved by control of instrument temperature, calibrating at known temperatures, etc.*

TC Type	Range	Display Resolution	Typical System Accuracy*	Maximum Expected Error*	Channel Type Code
E	-130° C to +1000° C	1° C	±1° C	±2° C	10
J	-130° C to +750° C	1° C	±1° C	±2° C	11
K	-75° C to +1350° C	1° C	±1° C	±2° C	12
R	-20° C to +1750° C	1° C	±2° C	±3° C	13
S	-20° C to +1750° C	1° C	±2° C	±3° C	14
T	-130° C to +400° C	1° C	±1° C	±2° C	15
B	+480° C to +1820° C	1° C	±2° C	±3° C	16
E	-200° F to +1800° F	1° F	±1° F	±2° F	18
J	-200° F to +1400° F	1° F	±2° F	±3° F	19
K	-100° F to +2500° F	1° F	±2° F	±3° F	1A
R	0° F to +3200° F	1° F	±3° F	±5° F	1B
S	0° F to +3200° F	1° F	±3° F	±5° F	1C
T	-200° F to +750° F	1° F	±1° F	±2° F	1D
B	+900° F to +3300° F	1° F	±3° F	±5° F	1E

2 TRANSDUCER CONNECTIONS

The Model 10A9-8C's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60324, similar to the one shown in Fig. 1.5 (in Manual Section 1.E.1). This connector contains eight "±" screw-terminal pairs, one for each TC sensor. Each TC lead should be directly attached to its corresponding screw terminal (it should never be soldered). As shown in Fig. 1, each screw terminal connects internally to a specific pin on the 10A9-8C's rear 20-pin I/O CONNECTOR. Table 2 gives standard pin assignments for the I/O connector. For connection of an optional **Model 10CTJB-8 Thermocouple Junction Box**, see Section 4, below.

Since reference-junction compensation is provided by the dual-bead thermistor embedded in the Conditioner Connector, no external cold junction is required.

IMPORTANT: UNUSED THERMOCOUPLE INPUT CHANNELS should be shorted together as shown in Fig. 2, to prevent possible crosstalk from the "OPEN TC" detection circuit into working TC channels.

Table 2 Model 10A9-8C Pin Assignments

I/O Connector Pin Number	Screw Terminal	Conditioner Channel Number	Conditioner Line Function
1	1(+)	1	+SIGNAL
A	1(-)	1	-SIGNAL
2	2(+)	2	+SIGNAL
B	2(-)	2	-SIGNAL
3	3(+)	3	+SIGNAL
C	3(-)	3	-SIGNAL
4	4(+)	4	+SIGNAL
D	4(-)	4	-SIGNAL
5	5(+)	5	+SIGNAL
E	5(-)	5	-SIGNAL
6	6(+)	6	+SIGNAL
F	6(-)	6	-SIGNAL

(cont'd)

* Including ± one count of least significant digit displayed. *Can be readily improved by control of instrument temperature, calibrating at known temperatures, etc.*

10A9-8C EIGHT-CHANNEL THERMOCOUPLE CARD

I/O Connector Pin Number	Screw Terminal	Conditioner Channel Number	Conditioner Line Function
7	7(+)	7	+SIGNAL
H	7(-)	7	-SIGNAL
8	8(+)	8	+SIGNAL
J	8(-)	8	-SIGNAL
9	INTERNAL		THERMISTOR: T1
K,L	USE ONLY		THERMISTOR: GROUND (COMMON)
10			THERMISTOR: T2

Fig. 1 Model 10A9-8C Transducer Cabling

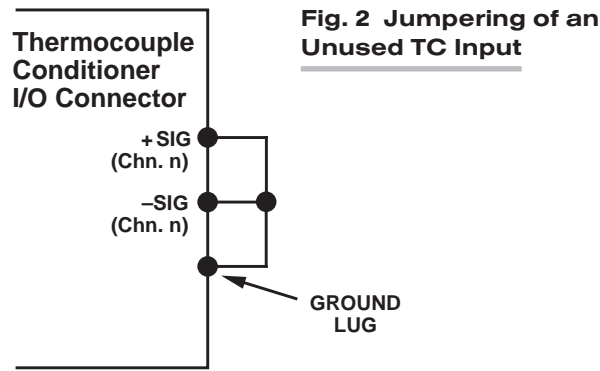
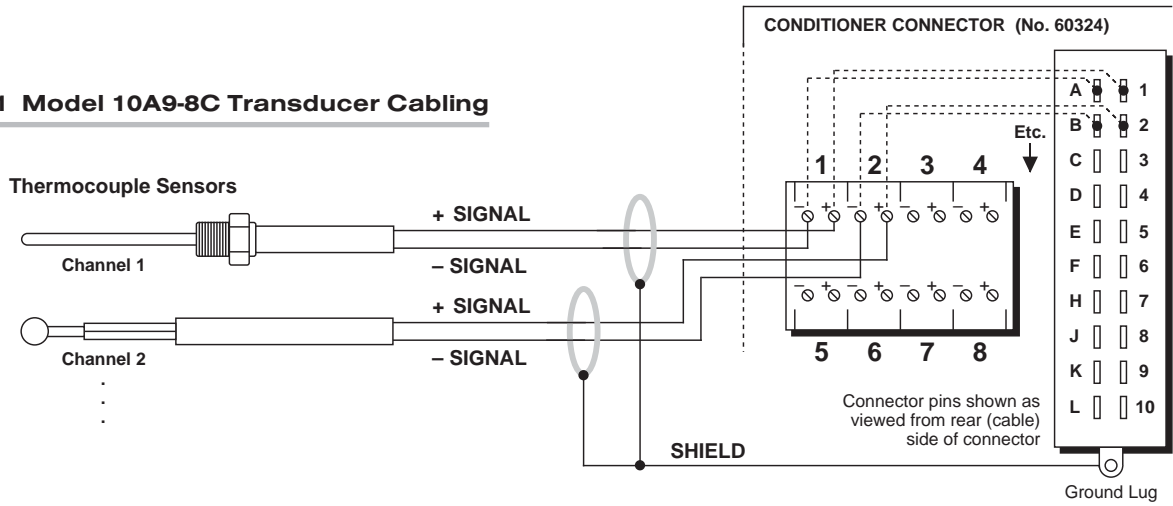


Fig. 2 Jumpering of an Unused TC Input

3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a PROGRAMMING "OPEN TC" DETECTION

In the event of a broken thermocouple wire or other "open TC" condition, the Model 10A9-8C will automatically report an indeterminate off-scale reading for the TC channel in question. The conditioner is normally preset at the factory for *positive* off-scale "open TC" indication for each channel. However, you may easily reset any channel for *negative* off-scale "open TC" indication, as follows:

1. Remove the 10A9-8C card from its mainframe slot. For "Card Insertion and Removal," see Manual Section 1.B. Since the 10A9-8C is "hot-pluggable," you need NOT turn off mainframe power before removing the card.
2. Refer to Fig. 3, below, and locate the eight sets of "OPEN TC" PROGRAMMING JUMPER PINS, one for each TC channel, on the top (component) side of the card. One "minijumper" is provided for each channel, for interconnecting any two adjacent jumper pins.
3. Position the jumper for each active channel as shown in Fig. 3 to set the desired polarity of the "OPEN TC" reading for that channel.
4. Reinsert the 10A9-8C card into its mainframe slot.

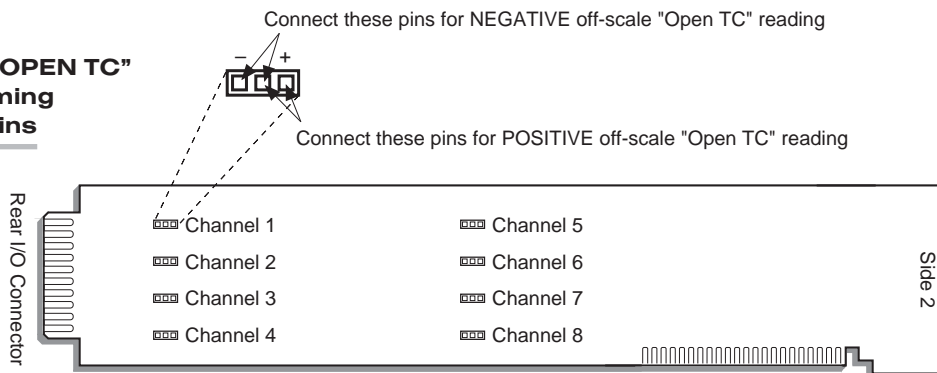
3.b CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A9-8C card when used in System 10, see the general remarks on System 10 "real-channel" configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A9-8C channel "type" codes, see Table 1, above.

REMEMBER: In System 10 (only), one **Model 10A11 Thermocouple Output Processor Card** must be installed in every A-card deck that contains one or more Model 10A9-8C cards. Note that Model 10A9-8C and Model 10A10-4 cards can share a single 10A11.

When used in System 10, the Model 10A9-8C normally employs **CPU-BASED ABSOLUTE CALIBRATION** (described in Manual Section 1.G.3.a). This means that NO calibration need be performed by the user, once each 10A9-8C-based input chan-

Fig. 3
10A9-8C "OPEN TC"
Programming
Jumper Pins



nel has been properly configured. Note, however, that the standard **ZERO (ZRO)** and **FORCE (FRC)** commands can be used to perform **TWO-POINT (DEADWEIGHT) CALIBRATION** in applications where it is desirable to force multiple TC readings to the same *exactly known* temperature.* The mainframe's **EEPROM Write Protect Switch** must be ON for these commands to be effective. See Manual Section 1.G.5 for a general discussion of this conventional "zero and span" calibration technique.

4 OPTIONAL "REMOTE" TC CONNECTIONS: MODEL 10CTJB-8 THERMOCOUPLE JUNCTION BOX

4.a PURPOSE

You can use the **Model 10CTJB-8 Thermocouple Junction Box** with a Model 10A9-8C to move the temperature-compensated reference junction to the actual site of up to eight *remote* thermocouple sensors.

NOTE: The 10CTJB-8 can only be used in environments with an ambient temperature between 0° F and +140° F.

4.b CONNECTIONS

The label on the top side of the 10CTJB-8 box shows the numbering and polarity of the unit's eight internal screw-terminal pairs, which match those of the **CONDITIONER CONNECTOR** that attaches to the 10A9-8C's rear **I/O CONNECTOR** (see Fig. 1 and the Pin-Assignment Table, above).

Introduced through the cutout on the left-hand side of the box, TC leads connect directly to these screw terminals, in any desired type mixture. The 10CJTB-8 then sends their signals to the Model 10A9-8C Conditioner Card via copper conductors (only).

The user must furnish his or her own *pin-to-pin cable* for connecting the 10CTJB-8 Junction Box to the rear **I/O CONNECTOR** of the Model 10A9-8C. Daytronic will supply appropriate solder-terminal connectors for this cable. The cable should be shielded, and should consist of stranded copper wires. While no maximum cable length is actually specified, the wire *size* and *length* combination should be such that the total per-wire resistance does not exceed 25 ohms.

* In heat balance applications, for example, it is useful to be able to zero all readings simultaneously.

MODEL 10A10-4

QUAD ISOLATED THERMOCOUPLE CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 10A10-4 is a precision conditioner designed for TC-based temperature measurements requiring *high input isolation*. With built-in reference-junction compensation, it accepts up to four independent temperature signals from **Types B, E, J, K, R, S, and T Thermocouples**. Any desired mixture of these thermocouple types is permitted. Sensors may be grounded or ungrounded, in any desired mix. An amplifier-per-channel design with chopper stabilization and active low-pass filtering allows high-speed scan switching of high-level, stabilized signals, at exceptionally low cost per channel.

All four 10A10-4 inputs are transformer-isolated, so that sensor-to-chassis and/or sensor-to-sensor common-mode voltages as high as 1500 V-DC can be accommodated at DC or low frequencies without damaging the instrument or perceptibly affecting measurement accuracy (at 60 Hz, the common-mode voltage can be as high as 1000 V-AC (rms)).

During operation, appropriate reference-junction compensation, real-time digital linearization, and engineering-unit scaling are automatically applied by the System 10 Central Processor for each type of thermocouple used. Detection of “open” thermocouples is also provided, as explained in Section 3.a.

The Model 10A10-4 includes a rear-panel connector block with screw terminals for direct attachment of TC leads (which cannot be soldered). The same connector accommodates all TC types. Since the connector assembly also contains a dual-bead **precision thermistor** for measurement of the reference-junction temperature, no external cold junction is required—although the user may supply his own Controlled Ambient Temperature Zone for reference-junction compensation, if desired.

The reference-junction-corrected temperature is made available to the Central Processor through the **Model 10A11 Thermocouple Output Processor Card**. The purpose of the 10A11 is to proportion and sum the cold-junction reference signal and the amplified TC signal of each channel for presentation to the system's Analog Signal Bus. *One 10A11 must therefore be installed in every System 10 A-card rack containing one or more Model 10A10-4's.*

You can use an optional **Model 10CTJB-8 Thermocouple Junction Box** with a Model 10A10-4 to move the temperature-compensated reference junction to the actual site of up to eight *remote* thermocouple sensors. As explained in Section 4, below, TC leads connect directly to the 10CTJB-8's internal screw terminals, in any desired type mixture. The Junction Box then sends their signals to the 10A10-4 Conditioner via copper conductors (only).*

* The 10CTJB-8 can only be used in environments with an ambient temperature between 0° F and +140° F.

10A10-4 QUAD ISOLATED THERMOCOUPLE CARD

ADDITIONAL 10A10-4 SPECIFICATIONS

Measurement Range and Resolution: See Table 1, below; automatically selected—on an individual channel basis—when the channel is configured; for System 10 channel “type” codes assigned to 10A10-4 data channels, see Table 1

Linearization: Internal digital look-up via system processor; maximum error: $\pm 0.05^\circ\text{C}$

Reference-Junction Compensation: At connector block, using a built-in precision thermistor, or at remote TC site, using the **Model 10CTJB-8 Thermocouple Junction Box***

Thermocouple Break Detection (per channel): Off-scale negative indication

Amplifier (per channel):

Common-Mode Range: At DC, ± 1500 V-DC operating and without instrument damage; at 60 Hz, ± 1000 V-AC (rms) without damage

Common-Mode Rejection Ratio: DC: -154 dB; at 60 Hz: -160 dB

Input Impedance: Differential: 10 M Ω ; Common-Mode: infinite

Offset: Initial: ± 5 μV ; vs. Temperature: ± 0.1 $\mu\text{V}/^\circ\text{C}$; vs. Time: ± 1 $\mu\text{V}/\text{month}$

Gain Accuracy: $\pm 0.02\%$ of absolute mV input range of -10 to +80 mV

Gain Stability: vs. Temperature: ± 25 ppm/ $^\circ\text{C}$; vs. Time: ± 20 ppm/month

Filter (per channel): 3-pole modified Butterworth; 3 dB down at 1 Hz; 60 dB down at 60 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 0.3 sec

To 0.1% of final value: 0.6 sec

To 0.02% of final value: 1.5 sec

Total System Accuracy (typical, including Model 10A10-4, Model 10A11 Thermocouple Output Processor, and system data collection and processing): see Table 1, below

Auxiliary Outputs to Mainframe Wire-Wrap Pins: None

Table 1 Thermocouple Ranges for the Model 10A10-4

TC Type	Range	Display Resolution	Typical System Accuracy**	Maximum Expected Error**	Channel Type Code
E	-130° C to +1000° C	0.1° C	$\pm 0.4^\circ\text{C}$	$\pm 0.6^\circ\text{C}$	20
J	-130° C to +750° C	0.1° C	$\pm 0.5^\circ\text{C}$	$\pm 0.7^\circ\text{C}$	21
K	-75° C to +1350° C	0.1° C	$\pm 0.7^\circ\text{C}$	$\pm 1.1^\circ\text{C}$	22
R	-20° C to +1750° C	0.1° C	$\pm 1.1^\circ\text{C}$	$\pm 2.1^\circ\text{C}$	23
S	-20° C to +1750° C	0.1° C	$\pm 1.1^\circ\text{C}$	$\pm 2.1^\circ\text{C}$	24
T	-130° C to +400° C	0.1° C	$\pm 0.5^\circ\text{C}$	$\pm 0.8^\circ\text{C}$	25
B	+480° C to +1820° C	0.1° C	$\pm 1.1^\circ\text{C}$	$\pm 2.1^\circ\text{C}$	26
E	-200° F to +1800° F	0.2° F	$\pm 0.8^\circ\text{F}$	$\pm 1.2^\circ\text{F}$	28
J	-200° F to +1400° F	0.2° F	$\pm 0.8^\circ\text{F}$	$\pm 1.2^\circ\text{F}$	29
K	-100° F to +2500° F	0.2° F	$\pm 1.2^\circ\text{F}$	$\pm 2.0^\circ\text{F}$	2A
R	0° F to +3200° F	0.2° F	$\pm 2.0^\circ\text{F}$	$\pm 3.8^\circ\text{F}$	2B
S	0° F to +3200° F	0.2° F	$\pm 2.0^\circ\text{F}$	$\pm 3.8^\circ\text{F}$	2C
T	-200° F to +750° F	0.2° F	$\pm 0.8^\circ\text{F}$	$\pm 1.2^\circ\text{F}$	2D
B	+900° F to +3300° F	0.2° F	$\pm 2.0^\circ\text{F}$	$\pm 3.8^\circ\text{F}$	2E

(cont'd)

* The 10CTJB-8 can only be used in environments with an ambient temperature between 0° F and +140° F.

** Including \pm one count of least significant digit displayed. *Can be readily improved by control of instrument temperature, calibrating at known temperatures, etc.*

TC Type	Range	Display Resolution	Typical System Accuracy*	Maximum Expected Error*	Channel Type Code
E	-130° C to +1000° C	1° C	±1° C	±2° C	10
J	-130° C to +750° C	1° C	±1° C	±2° C	11
K	-75° C to +1350° C	1° C	±1° C	±2° C	12
R	-20° C to +1750° C	1° C	±2° C	±3° C	13
S	-20° C to +1750° C	1° C	±2° C	±3° C	14
T	-130° C to +400° C	1° C	±1° C	±2° C	15
B	+480° C to +1820° C	1° C	±2° C	±3° C	16
E	-200° F to +1800° F	1° F	±1° F	±2° F	18
J	-200° F to +1400° F	1° F	±1° F	±2° F	19
K	-100° F to +2500° F	1° F	±2° F	±3° F	1A
R	0° F to +3200° F	1° F	±2° F	±4° F	1B
S	0° F to +3200° F	1° F	±2° F	±4° F	1C
T	-200° F to +750° F	1° F	±1° F	±2° F	1D
B	+900° F to +3300° F	1° F	±2° F	±4° F	1E

2 TRANSDUCER CONNECTIONS

The Model 10A10-4's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60324, similar to the one shown in Fig. 1.5 (in Manual Section 1.E.1). This connector contains four "±" screw-terminal pairs, one for each TC sensor. Each TC lead should be directly attached to its corresponding screw terminal (it should never be soldered). As shown in Fig. 1, each screw terminal connects internally to a specific pin on the 10A10-4's rear 20-pin I/O CONNECTOR. Table 2 gives standard pin assignments for the I/O connector. For connection of an optional **Model 10CTJB-8 Thermocouple Junction Box**, see Section 4, below.

Since reference-junction compensation is provided by the dual-bead thermistor embedded in the Conditioner Connector, no external cold junction is required.

IMPORTANT: UNUSED THERMOCOUPLE INPUT CHANNELS should be shorted together as shown in Fig. 2, to prevent possible crosstalk from the "OPEN TC" detection circuit into working TC channels.

Table 2 Model 10A10-4 Pin Assignments

I/O Connector Pin Number	Screw Terminal	Conditioner Channel Number	Conditioner Line Function
1	1(+)	1	+SIGNAL
A	1(-)	1	-SIGNAL
2			Not Committed
B			Not Committed
3	3(+)	2	+SIGNAL
C	3(-)	2	-SIGNAL
4			Not Committed
D			Not Committed
5	5(+)	3	+SIGNAL
E	5(-)	3	-SIGNAL
6			Not Committed
F			Not Committed

(cont'd)

* Including ± one count of least significant digit displayed. *Can be readily improved by control of instrument temperature, calibrating at known temperatures, etc.*

10A10-4 QUAD ISOLATED THERMOCOUPLE CARD

I/O Connector Pin Number	Screw Terminal	Conditioner Channel Number	Conditioner Line Function
7	7(+)	4	+SIGNAL
H	7(-)	4	-SIGNAL
8			Not Committed
J			Not Committed
9	INTERNAL USE ONLY		THERMISTOR: T1
K,L			THERMISTOR: GROUND (COMMON)
10			THERMISTOR: T2

Fig. 1 Model 10A10-4 Transducer Cabling

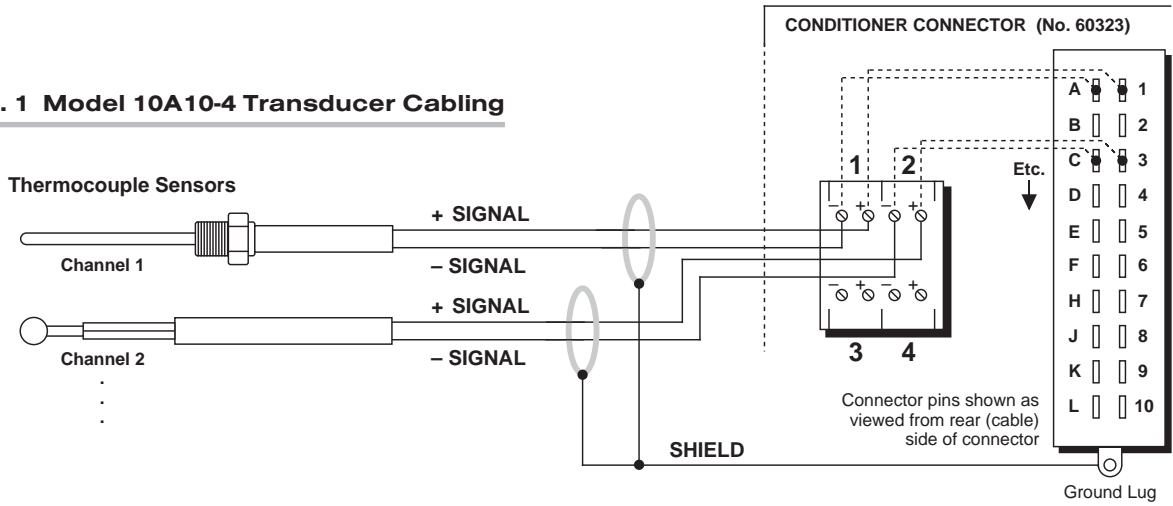
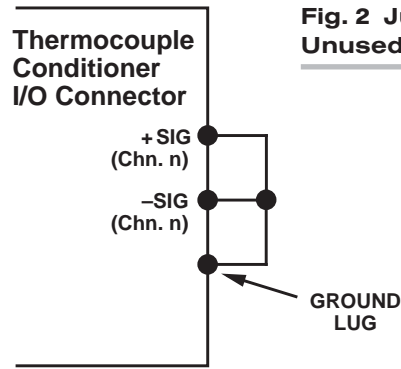


Fig. 2 Jumpering of an Unused TC Input



3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a "OPEN TC" DETECTION

In the event of a broken thermocouple wire or other "open TC" condition, the Model 10A10-4 will automatically report an indeterminate *negative* off-scale reading for the TC channel in question.

3.b CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A10-4 card, see the general remarks on System 10 "real-channel" configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A10-4 channel "type" codes, see Table 1, above.

REMEMBER: One **Model 10A11 Thermocouple Output Processor Card** must be installed in every A-card deck that contains one or more Model 10A10-4 cards. Note that Model 10A10-4 and Model 10A9-8C cards can share a single 10A11.

The Model 10A10-4 normally employs **CPU-BASED ABSOLUTE CALIBRATION** (described in Manual Section 1.G.3.a). This means that NO calibration need be performed by the user, once each 10A10-4-based input channel has been properly configured. Note, however, that the standard **ZERO (ZRO)** and **FORCE (FRC)** commands can be used to perform **TWO-POINT (DEADWEIGHT) CALIBRATION** in applications where it is desirable to force multiple TC readings to the same *exactly known* temperature.* The mainframe's **EEPROM Write Protect Switch** must be ON for these commands to be effective. See Manual Section 1.G.5 for a general discussion of this conventional "zero and span" calibration technique.

4 OPTIONAL "REMOTE" TC CONNECTIONS: MODEL 10CTJB-8 THERMOCOUPLE JUNCTION BOX

4.a PURPOSE

You can use the **Model 10CTJB-8 Thermocouple Junction Box** with a Model 10A10-4 to move the temperature-compensated reference junction to the actual site of up to four *remote* thermocouple sensors.**

NOTE: The 10CTJB-8 can only be used in environments with an ambient temperature between 0° F and +140° F.

4.b CONNECTIONS

The label on the top side of the 10CTJB-8 box shows the numbering and polarity of the unit's eight internal screw-terminal pairs, which match those of the **CONDITIONER CONNECTOR** that attaches to the 10A10-4's rear I/O **CONNECTOR** (see Fig. 1 and the Pin-Assignment Table, above).

* In heat balance applications, for example, it is useful to be able to zero all readings simultaneously.

** In the case of the 10A10-4, only four TC sensors can be connected to the 10CTJB-8. A single Model 10CTJB-8 can be dedicated to only *one* Model 10A10-4 card.

10A10-4 QUAD ISOLATED THERMOCOUPLE CARD

Introduced through the cutout on the left-hand side of the box, TC leads connect directly to these screw terminals, in any desired type mixture. The 10CJTB-8 then sends their signals to the Model 10A10-4 Conditioner Card via copper conductors (only).

The user must furnish his or her own *pin-to-pin cable* for connecting the 10CTJB-8 Junction Box to the rear I/O CONNECTOR of the Model 10A10-4. Daytronic will supply appropriate solder-terminal connectors for this cable. The cable should be shielded, and should consist of stranded copper wires. While no maximum cable length is actually specified, the wire *size* and *length* combination should be such that the total per-wire resistance does not exceed 25 ohms.

MODEL 10A15-8

EIGHT-CHANNEL THERMISTOR CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

Providing regulated excitation current, the Model 10A15-8 can condition up to eight independent temperature signals from many **3-wire, dual-thermistor-bead probes**, in any desired mix (within designated ranges, thermistor probes offer higher accuracy and greater long-term dependability than thermocouples).

All analog input channels derived from a Model 10A15-8 must be given a channel "type" code of **55** ("raw" millivolt signal), via the procedure described in Section 3.a, below.

ADDITIONAL 10A15-8 SPECIFICATIONS

Measurement Range and Resolution: See Table 1, below; automatically selected—on an individual channel basis—when the channel is configured; all 10A15-8 data channels are to be "typed" as "55" (see Section 3.a)

Excitation (per channel): As required for thermoliner transducer

Amplifier (per channel):

Input Impedance: As required for thermoliner transducer

Offset: Initial: $\pm 0.02\%$ of full scale; vs. Temperature: ± 50 ppm/ $^{\circ}\text{C}$; vs. Time: ± 20 ppm/month

Gain Accuracy: $\pm 0.02\%$ of full scale (absolute maximum input voltage range without damage is ± 9 V)

Gain Stability: vs. Temperature: ± 50 ppm/ $^{\circ}\text{C}$; vs. Time: ± 20 ppm/month

Filter (per channel): 1-pole modified Butterworth; 3 dB down at 30 Hz; 60 dB down at 100 kHz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 30 msec

To 0.1% of final value: 60 msec

To 0.02% of final value: 250 msec

Total System Accuracy (typical, including Model 10A15-8, probe interchangeability, and system data collection and processing): see Table 1, below

Auxiliary Outputs to Mainframe Wire-Wrap Pins: None

10A15-8 EIGHT-CHANNEL THERMISTOR CARD

Table 1 Thermistor Ranges for the Model 10A15-8

Range	Display Resolution	Typical System Accuracy*	Maximum Expected Error*
0° C to +100° C	0.1° C	±0.2° C	±0.3° C
+32° F to +212° F	0.1° F	±0.3° F	±0.5° F
0° C to +100° C	0.01° C	±0.2° C	±0.3° C
+32° F to +212° F	0.02° F	±0.3° F	±0.5° F

2 TRANSDUCER CONNECTIONS

The Model 10A15-8's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Standard cabling is shown in Fig. 1, below; standard pin assignments for the I/O connector are given in Table 2.

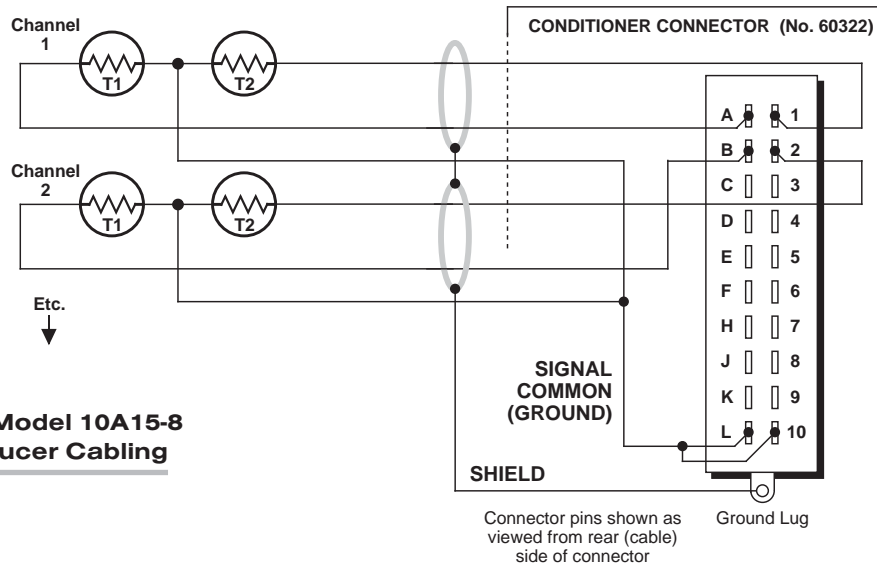


Fig. 1 Model 10A15-8 Transducer Cabling

* Including ± one count of least significant digit displayed and probe interchangeability error of ±0.15° C or ±0.25° F.

Table 2 Model 10A15-8 Pin Assignments

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	T2
A	1	T1
2	2	T2
B	2	T1
3	3	T2
C	3	T1
4	4	T2
D	4	T1
5	5	T2
E	5	T1
6	6	T2
F	6	T1
7	7	T2
H	7	T1
8	8	T2
J	8	T1
9,K		Not Committed
10,L		SIGNAL COMMON (GROUND)

3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A15-8 card, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*.

Note, however, that you should use the following special “typing” and scaling procedure when setting up any data channel (No. “x”) dedicated to the Model 10A15-8:

1. Turn ON the system EEPROM SWITCH and apply a **RESET (RST)** command to the channel:

RST x [CR]

The channel will be retyped as “55” (i.e., a direct millivolt reading from the system’s internal Called Signal Bus). Its SCALING FACTOR (“m”) will be changed to “5000,” and its ZERO OFFSET (“b”) to “0.” Its current “location” (**LCT**) assignment will not be affected.

2. If the channel’s source thermistor’s range is $0^{\circ} C$ to $+100^{\circ} C$, and its resolution is $0.1^{\circ} C$, enter the following commands:

EMM x = 100.0 [CR] and **BEE x = 0.0 [CR]**

—or, if the resolution is $0.01^{\circ} C$, enter

EMM x = 100.00 [CR] and **BEE x = 0.00 [CR]**

3. If the channel’s source thermistor’s range is $+32^{\circ} F$ to $+212^{\circ} F$, and its resolution is $0.1^{\circ} F$, enter the following commands:

EMM x = 180.0 [CR] and **BEE x = 32.0 [CR]**

—or, if the resolution is $0.02^{\circ} F$, enter

10A15-8 EIGHT-CHANNEL THERMISTOR CARD

EMM x = 180.00 [CR] and **BEE x = 32.00 [CR]**

4. Turn OFF the system EEPROM SWITCH.

The Model 10A15-8 normally employs **CPU-BASED ABSOLUTE CALIBRATION** (described in Manual Section 1.G.3.a). This means that NO calibration need be performed by the user, once each 10A15-8-based input channel has been properly configured. This includes the range/resolution-dependent **EMM** and **BEE** scaling described above.

Note, however, that the standard **ZERO (ZRO)** and **FORCE (FRC)** commands can be used to perform **TWO-POINT (DEADWEIGHT) CALIBRATION** in applications where *independently and accurately known temperature references are available*—preferably the high and low extremes to which the sensor will be subjected. In such a case, the two-point method can be used to improve the “absolute” calibration provided by the System 10 Central Processor. The mainframe’s **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this conventional “zero and span” calibration technique.

MODEL 10A16-4C

QUAD PLATINUM RTD CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 10A16-4C is designed for high-accuracy temperature measurement using platinum **Resistance Temperature Detectors (RTD's)**. Precision constant-current excitation is provided for four independent sensor channels, which may be intermixed as required. RTD inputs are normally set for four-wire cabling, with maximum excitation of one milliampere and input impedance of 10 M Ω , to eliminate common self-heating and cable-loading errors. However, for an RTD channel with shared current return and sense signals, three-wire mode is available, if desired, via an internal jumper setting (as explained in Section 3.a, below).

ADDITIONAL 10A16-4C SPECIFICATIONS

RTD Types: Platinum; DIN (European) standard with "ice-point" resistance of 50, 100, or 200 ohms, or American standard with "ice-point" of 100 ohms

Range and Resolution: See Table 1, below; automatically selected—on an individual channel basis—when the channel is configured; for System 10 channel "type" codes assigned to 10A16-4C data channels, see Table 1; for *high RTD resolution*, using a specially modified 10A16-4C card, see Section 3.c, below

Linearization: Internal digital linearization; maximum error: $\pm 0.1^\circ\text{C}$ ($\pm 0.2^\circ\text{F}$)

Excitation (per channel): Nominal 5 V-DC; 1 mA, maximum

Amplifier (per channel):

Input Impedance (Differential): 10 megohms

Offset: Initial: ± 0.1 mV; vs. Temperature: ± 0.5 $\mu\text{V}/^\circ\text{C}$; vs. Time: ± 5 $\mu\text{V}/\text{month}$

Gain Accuracy: $\pm 0.02\%$ of full scale

Gain Stability: vs. Temperature: ± 25 ppm/ $^\circ\text{C}$; vs. Time: ± 20 ppm/month

Filter (per channel): 3-pole modified Butterworth; 3 dB down at 2 Hz; 60 dB down at 25 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 0.6 sec

To 0.1% of final value: 0.8 sec

To 0.02% of final value: 1.5 sec

Total System Accuracy (typical, including Model 10A16-4C and system data collection and processing): see Table 1, below

Auxiliary Outputs: Filtered outputs available on mainframe wire-wrap pins

10A16-4C QUAD PLATINUM RTD CARD

Table 1 RTD Ranges for the Model 10A16-4C

Platinum RTD Standard	Resistance	Range	Display Resolution ³	Typical System Accuracy ⁴	Maximum Expected Error ⁴	Channel Type Code
DIN ¹	50 Ω	-150° C to +600° C	1.0° C	± 1° C	± 1.3° C	A9
DIN ¹	50 Ω	-150° C to +600° C	0.1° C	± 0.2° C	± 0.4° C	AA
DIN ¹	50 Ω	-238° F to +1112° F	1.0° F	± 1° F	± 1.5° F	AB
DIN ¹	50 Ω	-238° F to +1112° F	0.2° F	± 0.3° F	± 0.6° F	AC
DIN ¹	100 Ω	-150° C to +600° C	1.0° C	± 1° C	± 1.3° C	A1
DIN ¹	100 Ω	-150° C to +600° C	0.1° C	± 0.2° C	± 0.4° C	A2
DIN ¹	100 Ω	-238° F to +1112° F	1.0° F	± 1° F	± 1.5° F	A3
DIN ¹	100 Ω	-238° F to +1112° F	0.2° F	± 0.3° F	± 0.6° F	A4
DIN ¹	200 Ω	-150° C to +600° C	1.0° C	± 1° C	± 1.3° C	A5
DIN ¹	200 Ω	-150° C to +600° C	0.1° C	± 0.2° C	± 0.4° C	A6
DIN ¹	200 Ω	-238° F to +1112° F	1.0° F	± 1° F	± 1.5° F	A7
DIN ¹	200 Ω	-238° F to +1112° F	0.2° F	± 0.3° F	± 0.6° F	A8
American ²	100 Ω	-150° C to +600° C	0.1° C	± 0.2° C	± 0.4° C	AD
American ²	100 Ω	-238° F to +1112° F	0.2° F	± 0.3° F	± 0.6° F	AE

¹ α = 0.00385.

² α = 0.00392.

³ Note that a specially modified version of the 10A16-4C yields resolution of 0.01° C (0.02° F) when used with System 10 "custom linearization." See Section 3.c for details.

⁴ Including ± one count of least significant digit displayed.

2 TRANSDUCER CONNECTIONS

The Model 10A16-4C's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Standard *four-wire* RTD cabling is shown in Fig. 1(a), below. With separate excitation and sense lines, this mode of cabling normally yields the highest measurement accuracy. However, any 10A16-4C input channel can be set to accommodate the alternative *three-wire* cabling shown in Fig. 1(b). THE APPROPRIATE JUMPER SETTING MUST BE MADE FOR EACH 10A16-4C CHANNEL, DEPENDING ON WHETHER 4-WIRE OR 3-WIRE CABLING IS BEING USED FOR THAT CHANNEL (see the instructions in Section 3.a, below). Table 2 gives standard pin assignments for the I/O Connector.

IMPORTANT: When cabling the 10A16-4C, you can ensure static protection by connecting the SHIELD wire to **Pin 10** as well as to the connector ground lug, as shown in Fig. 1.

Table 2 Model 10A16-4C Pin Assignments

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	+SIGNAL
A	1	-SIGNAL
2	1	+CURRENT
B	1	-CURRENT
3	2	+SIGNAL
C	2	-SIGNAL
4	2	+CURRENT
D	2	-CURRENT
5	3	+SIGNAL
E	3	-SIGNAL
6	3	+CURRENT
F	3	-CURRENT

(cont'd)

QUAD PLATINUM RTD CARD 10A16-4C

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
7	4	+SIGNAL
H	4	-SIGNAL
8	4	+CURRENT
J	4	-CURRENT
10		SHIELD
9,K,L		Not Committed

Fig. 1 Model 10A16-4C Transducer Cabling

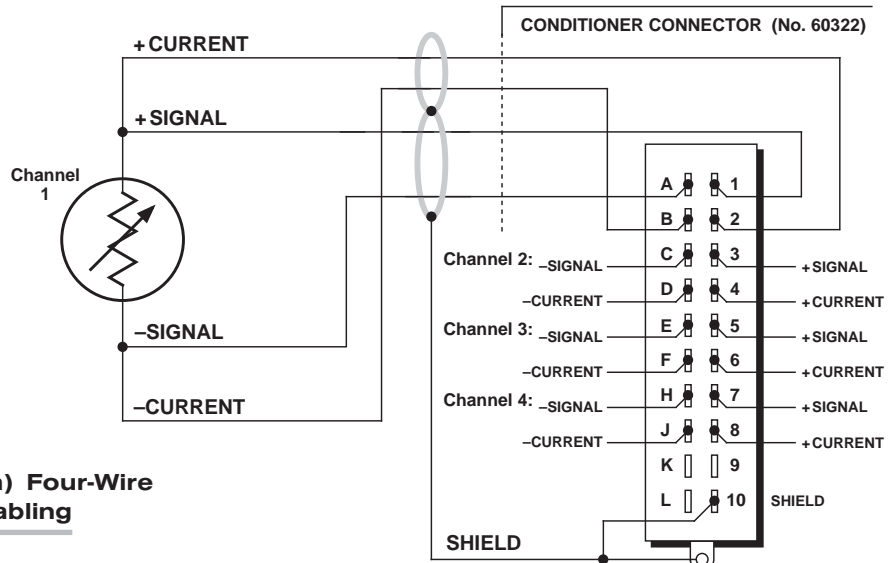


Fig. 1(a) Four-Wire RTD Cabling

Connector pins shown as viewed from rear (cable) side of connector
Ground Lug

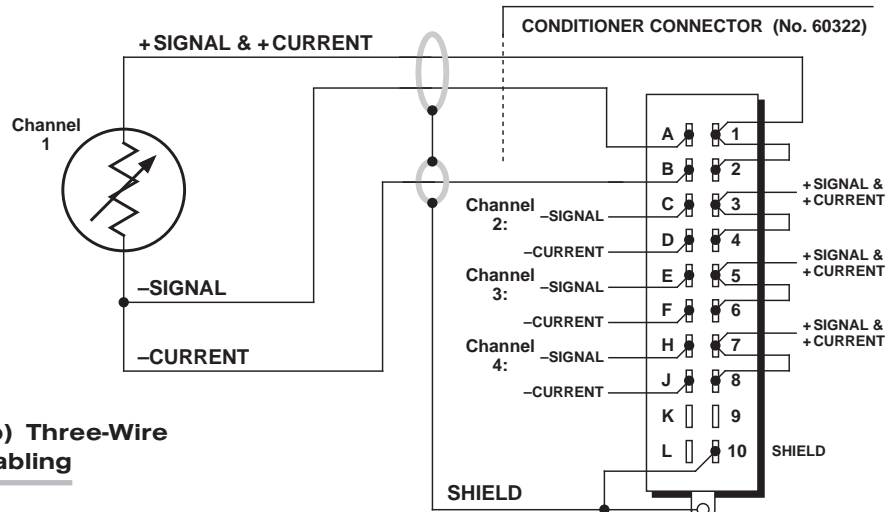
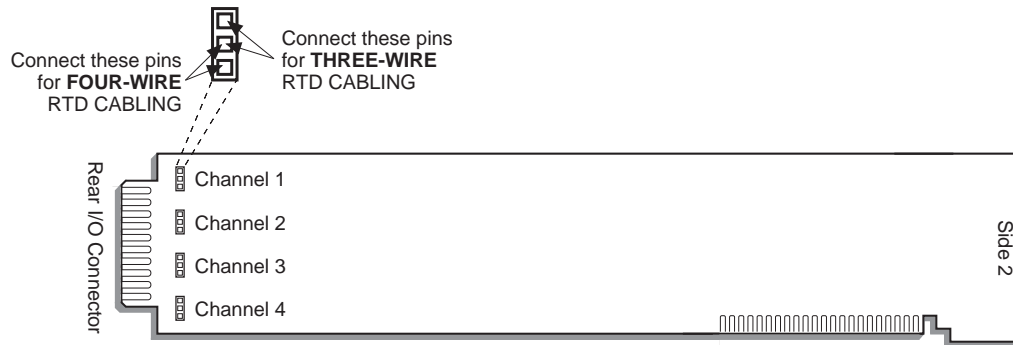


Fig. 1(b) Three-Wire RTD Cabling

Connector pins shown as viewed from rear (cable) side of connector
Ground Lug

10A16-4C QUAD PLATINUM RTD CARD

Fig. 2 10A16-4C “RTD CABLING” Programming Jumper Pins



3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a SETTING A 10A16-4C CHANNEL FOR FOUR-WIRE OR THREE-WIRE RTD CABLING

When the Model 10A16-4C is shipped, all four channels are normally set for the *four-wire* RTD cabling shown in Fig. 1(a), above, since this mode of cabling normally yields the highest accuracy. If you wish to use the *three-wire* cabling shown in Fig. 1(b) for a given 10A16-4C channel, you should

1. Remove the 10A16-4C card from its mainframe slot. For “Card Insertion and Removal,” see Manual Section 1.B. Since the 10A16-4C is “hot-pluggable,” you need NOT turn off mainframe power before removing the card.
2. Refer to Fig. 2, above, and locate the four sets of “RTD CABLING” PROGRAMMING JUMPER PINS, one for each channel, on the top (component) side of the card. One “minijumper” is provided for each channel, for interconnecting any two adjacent jumper pins.
3. Position the jumper for each active channel as shown in Fig. 2 to set the desired wiring mode for that channel.
4. Reinsert the 10A16-4C card into its mainframe slot.

3.b CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A16-4C card when used in System 10, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A16-4C channel “type” codes, see Table 1, above.

When used in System 10, the Model 10A16-4C normally employs **CPU-BASED ABSOLUTE CALIBRATION** (described in Manual Section 1.G.3.a). This means that NO calibration need be performed by the user, once each 10A16-4C-based input channel has been properly configured. Note, however, that you may subsequently improve the “absolute” calibration provided by the system processor by using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands to perform **TWO-POINT (DEADWEIGHT) CALIBRATION** on a real-time basis—but only *when independently*

and accurately known temperature references are available (preferably the high and low extremes to which the sensor will be subjected). The mainframe's **EEPROM Write Protect Switch** must be ON for these commands to be effective. See Manual Section 1.G.5 for a general discussion of this conventional "zero and span" calibration technique.

3.c HIGH RTD RESOLUTION WITH SPECIALLY MODIFIED 10A16-4C

To implement a resolution of $0.01^{\circ} C$ ($0.02^{\circ} F$) for Channel No. "x" of a specially modified 10A16-4C card, when used in System 10 (only), you need only enter the following **LINEARIZE (LIN)** command, having first turned ON the system EEPROM SWITCH:

LIN x = F1(CHN x) [CR]

The effect of this command is to apply to all readings of Channel No. x a prestored "Linearization Table No. 1." It also automatically assigns to the "linearized" Channel No. x a new "type" designation of "EA."

For a full discussion of System 10 "custom linearization," see Manual Section 2.L.

10A16-4C QUAD PLATINUM RTD CARD

MODEL 10A17-2

DUAL HIGH-VOLTAGE ISOLATION RTD CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 10A17-2 is designed for high-accuracy temperature measurement using platinum **Resistance Temperature Detectors (RTD's)** and requiring *high input isolation*. Precision constant-current excitation is provided for two independent sensor channels, which may be intermixed as required. Each input is transformer-isolated, so that sensor-to-sensor common-mode voltages as high as 1500 V-DC can be accommodated without damaging the instrument or perceptibly affecting measurement accuracy. Four-wire cabling, with maximum excitation of one milliamper and 0.004% per ohm leadwire resistance rejection, eliminates common self-heating and cable-loading errors. This conditioner is particularly useful in the utilities industry.

ADDITIONAL 10A17-2 SPECIFICATIONS

RTD Types: Platinum; DIN (European) standard with "ice-point" resistance of 50, 100, or 200 ohms, or American standard with "ice-point" of 100 ohms

Range and Resolution: See Table 1, below; automatically selected—on an individual channel basis—when the channel is configured; for System 10 channel "type" codes assigned to 10A17-2 data channels, see Table 1; for *high RTD resolution*, using a specially modified 10A17-2 card, see Section 3.b, below

Linearization: Internal digital linearization; maximum error: $\pm 0.1^\circ\text{C}$ ($\pm 0.2^\circ\text{F}$)

Excitation (per channel): Nominal 5 V-DC; 1 mA, maximum

Amplifier (per channel):

Common-Mode Range: $\pm 1500\text{ V}$ operating and without instrument damage

Common-Mode Rejection Ratio: DC: -150 dB; at 60 Hz: -160 dB; at 1 kHz and 3 kHz: infinite

Leadwire Resistance Rejection (4-wire only): 0.004% per ohm

Offset: Initial: $\pm 0.01\%$ of full scale; vs. Temperature: $\pm 10\text{ ppm}/^\circ\text{C}$; vs. Time: $\pm 10\text{ ppm/month}$

Gain Accuracy: $\pm 0.02\%$ of full scale

Gain Stability: vs. Temperature: $\pm 50\text{ ppm}/^\circ\text{C}$; vs. Time: $\pm 50\text{ ppm/month}$

Filter (per channel): 3-pole modified Butterworth; 3 dB down at 2 Hz; 60 dB down at 30 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 260 msec

To 0.1% of final value: 500 msec

To 0.02% of final value: 600 msec

Total System Accuracy (typical, including Model 10A17-2 and system data collection and processing): see Table 1, below

Auxiliary Outputs: Filtered outputs available on mainframe wire-wrap pins

Table 1 RTD Ranges for the Model 10A17-2

Platinum RTD Standard	Resistance	Range	Display Resolution ³	Typical System Accuracy ⁴	Maximum Expected Error ⁴	Channel Type Code
DIN ¹	50 Ω	-150° C to +600° C	1.0° C	± 1° C	± 1.3° C	A9
DIN ¹	50 Ω	-150° C to +600° C	0.1° C	± 0.2° C	± 0.4° C	AA
DIN ¹	50 Ω	-238° F to +1112° F	1.0° F	± 1° F	± 1.5° F	AB
DIN ¹	50 Ω	-238° F to +1112° F	0.2° F	± 0.3° F	± 0.6° F	AC
DIN ¹	100 Ω	-150° C to +600° C	1.0° C	± 1° C	± 1.3° C	A1
DIN ¹	100 Ω	-150° C to +600° C	0.1° C	± 0.2° C	± 0.4° C	A2
DIN ¹	100 Ω	-238° F to +1112° F	1.0° F	± 1° F	± 1.5° F	A3
DIN ¹	100 Ω	-238° F to +1112° F	0.2° F	± 0.3° F	± 0.6° F	A4
DIN ¹	200 Ω	-150° C to +600° C	1.0° C	± 1° C	± 1.3° C	A5
DIN ¹	200 Ω	-150° C to +600° C	0.1° C	± 0.2° C	± 0.4° C	A6
DIN ¹	200 Ω	-238° F to +1112° F	1.0° F	± 1° F	± 1.5° F	A7
DIN ¹	200 Ω	-238° F to +1112° F	0.2° F	± 0.3° F	± 0.6° F	A8
American ²	100 Ω	-150° C to +600° C	0.1° C	± 0.2° C	± 0.4° C	AD
American ²	100 Ω	-238° F to +1112° F	0.2° F	± 0.3° F	± 0.6° F	AE

¹ α = 0.00385.

² α = 0.00392.

³ Note that a specially modified version of the 10A17-2 yields resolution of 0.01° C (0.02° F) when used with System 10 "custom linearization." See Section 3.b for details.

⁴ Including ± one count of least significant digit displayed.

2 TRANSDUCER CONNECTIONS

The Model 10A17-2's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Standard four-wire RTD cabling is shown in Fig. 1, below. Table 2 gives standard pin assignments for the I/O Connector.

Table 2 Model 10A17-2 Pin Assignments

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	+CURRENT
A	1	-CURRENT
3	1	+SIGNAL
C	1	-SIGNAL
6	2	+CURRENT
F	2	-CURRENT
8	2	+SIGNAL
J	2	-SIGNAL
2,B,4,D,5,E,7,H		Not Committed
9,K,L,10		Not Committed

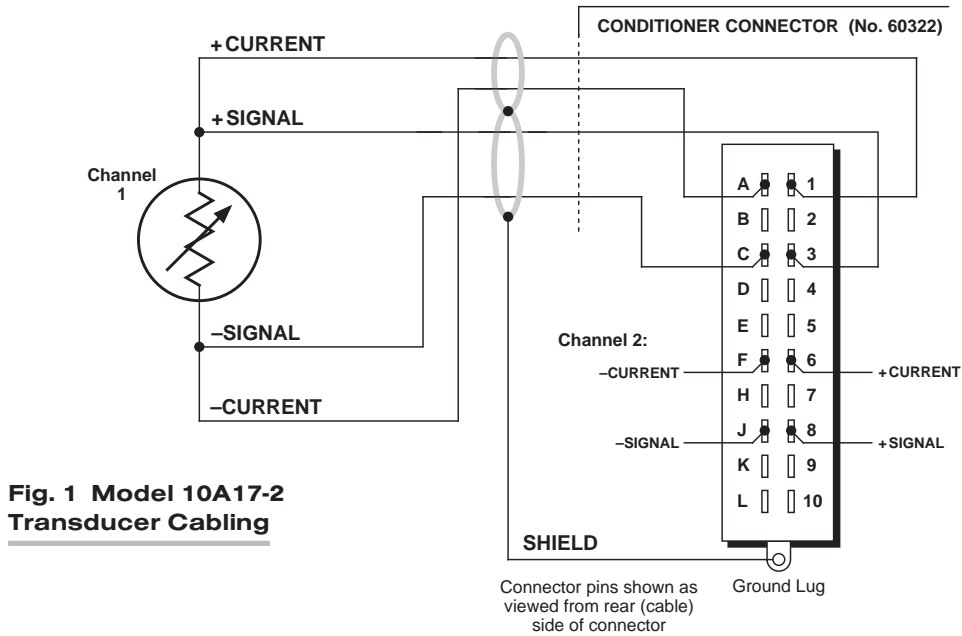


Fig. 1 Model 10A17-2 Transducer Cabling

3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A17-2 card, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A17-2 channel “type” codes, see Table 1, above.

The Model 10A17-2 normally employs **CPU-BASED ABSOLUTE CALIBRATION** (described in Manual Section 1.G.3.a). This means that NO calibration need be performed by the user, once each 10A17-2-based input channel has been properly configured. Note, however, that you may subsequently improve the “absolute” calibration provided by the system processor by using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands to perform **TWO-POINT (DEADWEIGHT) CALIBRATION** on a real-time basis—but only *when independently and accurately known temperature references are available* (preferably the high and low extremes to which the sensor will be subjected). The mainframe’s **EEPROM Write Protect Switch** must be ON for these commands to be effective. See Manual Section 1.G.5 for a general discussion of this conventional “zero and span” calibration technique.

3.b HIGH RTD RESOLUTION WITH SPECIALLY MODIFIED 10A17-2

To implement a resolution of $0.01^{\circ} C$ ($0.02^{\circ} F$) for Channel No. “x” of a specially modified 10A17-2 card, you need only enter the following **LINEARIZE (LIN)** command, having first turned ON the system EEPROM SWITCH:

LIN x = F1(CHN x) [CR]

10A17-2 DUAL HIGH-VOLTAGE ISOLATION RTD CARD

The effect of this command is to apply to all readings of Channel No. x a prestored "Linearization Table No. 1." It also automatically assigns to the "linearized" Channel No. x a new "type" designation of "EA."

For a full discussion of System 10 "custom linearization," see Manual Section 2.L.

MODEL 10A18-4C

QUAD 100-Ω PLATINUM LINEAR RTD CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 10A18-4C is a high-bandwidth conditioner card designed for temperature measurement using 100-Ω platinum **Resistance Temperature Detectors (RTD's)** of either DIN (European) or American design.* It produces an output voltage that is linearly related to actual temperature instead of resistance—with selectable accuracy (depending on the operating measurement range) of up to $\pm 0.2^\circ\text{C}$ (see Fig. 1). Since the 10A18-4C provides its own per-channel temperature curve fitting, *no further system-level linearization is required.*

Precision constant-current excitation is provided for four independent sensor channels, which may be intermixed as required. RTD inputs are normally set for four-wire cabling, with nominal excitation of one milliampere and input impedance exceeding 10 MΩ, to eliminate common self-heating and cable-loading errors. However, for an RTD channel with a shared “+SIGNAL” and “+CURRENT” line, three-wire mode is available, if desired, via an internal jumper setting (as explained in Section 3.a, below).

ADDITIONAL 10A18-4C SPECIFICATIONS

RTD Types: Platinum; DIN (European) or American standard with “ice-point” of 100 ohms (ONLY)

Linear Range and Accuracy: -200.0°C to $+600.0^\circ\text{C}$ full-scale for each RTD standard (DIN and American); accuracy of linearization will depend on the selected RTD standard and the selected operating range (see Fig. 1, which shows *worst-case error that could occur for a 10A18-4C card operating at an ambient temperature of $25^\circ \pm 10^\circ\text{C}$, six months after calibration*)**; automatically selected—on an individual channel basis—when the channel is configured; System 10 channel “type” codes assigned to 10A18-4C data channels are given in Table 2, Section 3.b, below

Excitation (per channel): Nominal 1 mA

Amplifier (per channel): Low-drift, linearized by current feedback

Normal-Mode Range: $\pm 350\text{ mV}$ operating; $\pm 5\text{ V}$ without instrument damage

(cont'd)

* For the 10A18-4C, “American” standard conforms to NIST “Reference Function.”

** With proper calibration, each operating range can be expressed, if desired, in *degrees Fahrenheit* (see Section 3.b). Note that the *expected linearity deviation* for most temperature measurements within the 10A18-4C's full -200°C to $+600^\circ\text{C}$ range are *substantially less than the maximum error values given in Fig. 1*. More detailed information is available on request from the Daytronic factory, if error reduction below the limits shown in Fig. 1 is desired. Note also that, while measurement *accuracy* is independent of the system using the 10A18-4C card, final measurement *resolution* will, in general, depend on the system. In System 10, the resolution is limited by the readout to a maximum resolution of approximately one part in 30,000 (e.g., $\pm 0.01^\circ\text{C}$ for measurements up to 300°C).

10A18-4C QUAD PLATINUM LINEAR RTD CARD

Common-Mode Range (expressed as lead-wire resistance rejection, 100 Ω maximum): 0.004%/ Ω (4-wire)

Input Impedance (Differential): Greater than 10 M Ω

Offset: Initial: $\pm 5 \mu\text{V}$; vs. Temperature: $\pm 0.2 \mu\text{V}/^\circ\text{C}$; vs. Time: $\pm 1 \mu\text{V}/\text{month}$

Gain Accuracy: $\pm 0.02\%$ of full scale

Gain Stability: vs. Temperature: $\pm 25 \text{ ppm}/^\circ\text{C}$; vs. Time: $\pm 20 \text{ ppm}/\text{month}$

Filter (per channel): 3-pole modified Butterworth; 3 dB down at 10 Hz; 60 dB down at 190 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 65 msec

To 0.1% of final value: 85 msec

To 0.02% of final value: 100 msec

Fig. 1 Range-Dependent Accuracy of the Model 10A18-4C

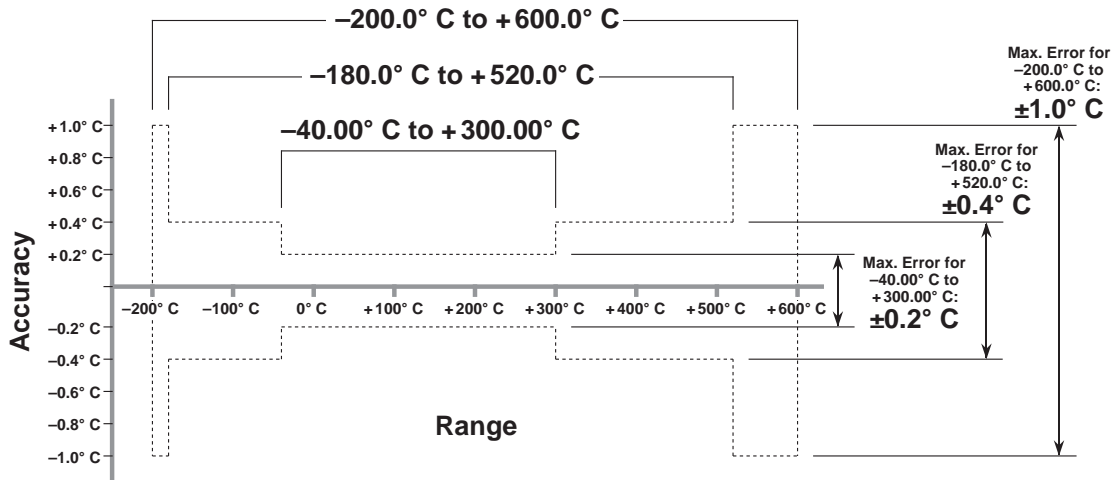


Fig. 1(a) For DIN Standard Platinum RTD's ($\alpha = 0.00385$)

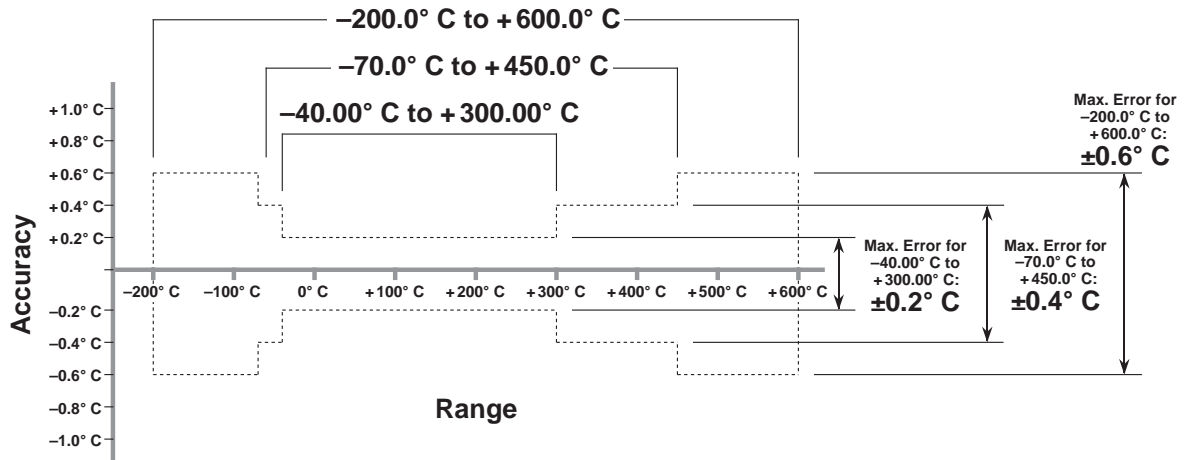


Fig. 1(b) For American Standard Platinum RTD's ($\alpha = 0.00392$)

Outputs: 10.000 mV/°C for DIN-standard transducers; 10.218 mV/°C for American-standard transducers

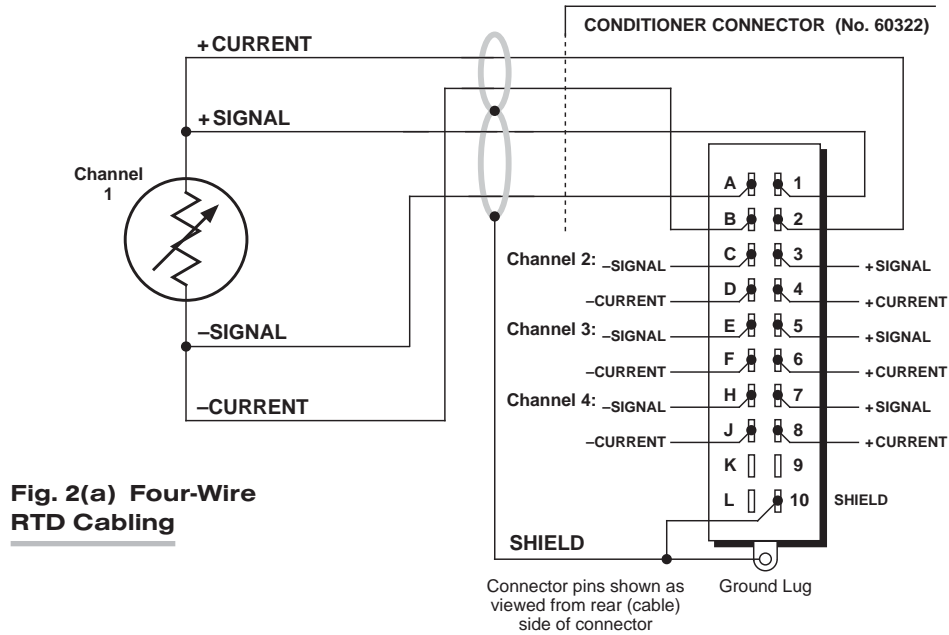
Auxiliary Outputs: Filtered outputs available on mainframe wire-wrap pins

2 TRANSDUCER CONNECTIONS

The Model 10A18-4C's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Standard *four-wire* RTD cabling is shown in Fig. 2(a), below. With separate excitation and sense lines, this mode of cabling normally yields the highest measurement accuracy. However, any 10A18-4C input channel can be set to accommodate the alternative *three-wire* cabling shown in Fig. 2(b). THE APPROPRIATE JUMPER SETTING MUST BE MADE FOR EACH 10A18-4C CHANNEL, DEPENDING ON WHETHER 4-WIRE OR 3-WIRE CABLING IS BEING USED FOR THAT CHANNEL (see the instructions in Section 3.a, below). Table 1 gives standard pin assignments for the I/O Connector.

IMPORTANT: When cabling the 10A18-4C, you can ensure static protection by connecting the SHIELD wire to **Pin 10** as well as to the connector ground lug, as shown in Fig. 2.

Fig. 2 Model 10A18-4C Transducer Cabling



10A18-4C QUAD PLATINUM LINEAR RTD CARD

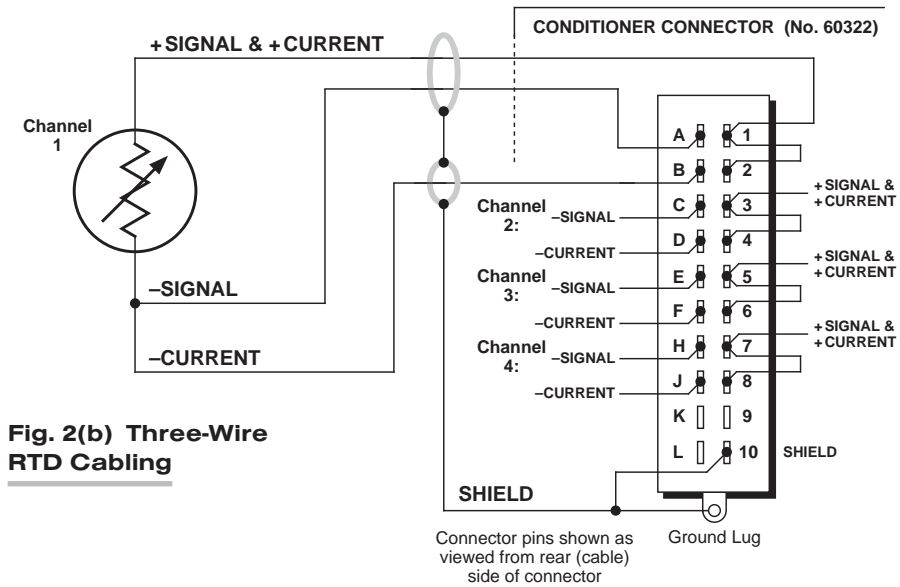


Table 1 Model 10A18-4C Pin Assignments

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	+SIGNAL
A	1	-SIGNAL
2	1	+CURRENT
B	1	-CURRENT
3	2	+SIGNAL
C	2	-SIGNAL
4	2	+CURRENT
D	2	-CURRENT
5	3	+SIGNAL
E	3	-SIGNAL
6	3	+CURRENT
F	3	-CURRENT
7	4	+SIGNAL
H	4	-SIGNAL
8	4	+CURRENT
J	4	-CURRENT
10		SHIELD
9,K,L		Not Committed

3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a SETTING A 10A18-4C CHANNEL FOR FOUR-WIRE OR THREE-WIRE RTD CABLING

When the Model 10A18-4C is shipped, all four channels are normally set for the *four-wire* RTD cabling shown in Fig. 1(a), above, since this mode of cabling normally yields the highest accuracy. If you wish to use the *three-wire* cabling shown in Fig. 1(b) for a given 10A18-4C channel, you should

1. Remove the 10A18-4C card from its mainframe slot. For “Card Insertion and Removal,” see Manual Section 1.B. Since the 10A18-4C is “hot-pluggable,” you need NOT turn off mainframe power before removing the card.
2. Refer to Fig. 3, below, and locate the four sets of “RTD CABLING” PROGRAMMING JUMPER PINS, one for each channel, on the top (component) side of the card. One “minijumper” is provided for each channel, for interconnecting any two adjacent jumper pins.
3. Position the jumper for each active channel as shown in Fig. 3 to set the desired wiring mode for that channel.
4. Reinsert the 10A18-4C card into its mainframe slot.

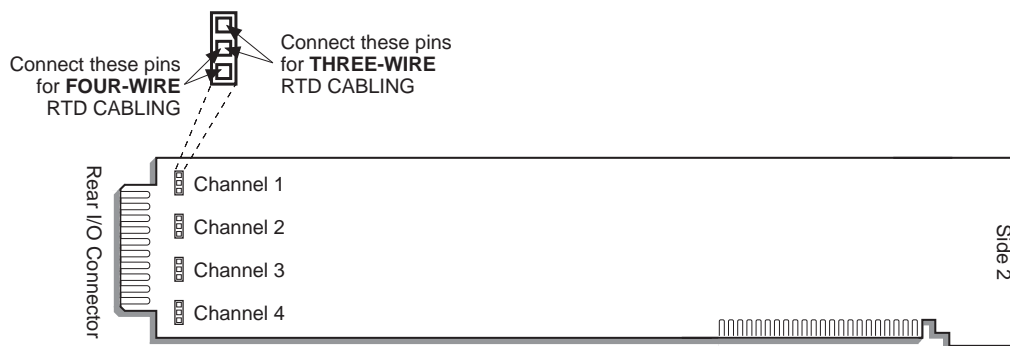
3.b CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A18-4C card when used in System 10, see the following section, along with the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*.

CALCULATED CALIBRATION

In System 10, the initial configuration and **CALCULATED CALIBRATION** of a 10A18-4C channel (No. “x”) involve direct entry of the channel’s TYPE CODE, SCALING FACTOR (“m” coefficient), and ZERO OFFSET (“b” term) via the corresponding mnemonic commands. The values of these parameters that are entered will depend on the RTD type, range, and desired engineering units (°C or °F), as given in Table 2, below. For

Fig. 3 10A18-4C “RTD CABLING” Programming Jumper Pins



10A18-4C QUAD PLATINUM LINEAR RTD CARD

increased accuracy, you may perform a subsequent **TWO-POINT (DEADWEIGHT)** calibration of a 10A18-4C channel in System 10, as explained below.*

In the following procedure, Channel No. "x" is a System 10 "REAL CHANNEL" sourced by a 10A18-4C card. Note that, with the exception of the **LOCATE (LCT)** command (Step 2), each of the commands can be applied to a continuous range of channels by entering the command in "range" form, where the single channel-number argument "x" is replaced by "x TO y" (indicating all channels from Channel No. x to and including Channel No. y).

1. Turn ON the system EEPROM SWITCH.
2. Make sure that Channel No. x has been assigned the proper A-SLOT / SUBCHANNEL "location." See Manual Section 1.G.2 for details on the **LOCATE (LCT)** command.
3. Apply a **RESET (RST)** command to Channel No. x:

RST x [CR]

The channel will be retyped as "55" (i.e., a direct millivolt reading from the system's internal Called Signal Bus). Its SCALING FACTOR ("m") will be changed to "5000" and its ZERO OFFSET ("b") to "0." Its current "location" (**LCT**) assignment will not be affected.

4. Apply the following commands to Channel No. x, using the values of "v," "m," and "b" given in Table 2 for the channel's specific TC type and range:

TYP x = v [CR]

EMM x = m [CR]

BEE x = b [CR]

Be sure to enter the "m" value as shown (with a "0" or "00" after the decimal point), if you want your measurement readout to be in tenths or hundredths of a degree, respectively.

Table 2 Calibration Values for a 10A18-4C Channel

RTD Standard	Range & Resolution	Type Code ("v")	Scaling Factor ("m")	Zero Offset ("b")
DIN	-200.0° C to +600.0° C	72	500.0	0.0
DIN	-200.00° C to +300.00° C	71	250.00	0.00
DIN	-328.0° F to +1112.0° F	72	900.0	32.0
DIN	-250.00° F to +250.00° F	70	225.00	32.00
American	-200.0° C to +600.0° C	72	489.4	0.0
American	-200.00° C to +300.00° C	71	244.88	0.00
American	-328.0° F to +1112.0° F	72	880.8	32.0
American	-250.00° F to +250.00° F	70	220.39	32.00

5. Use the **FILTER (FIL)** command to apply to Channel No. x a level of digital smoothing that is appropriate to your application:

FIL x = f [CR]

where "f" is an integer from 0 through 9 (0 = no smoothing; 9 = highest amount of smoothing). An "f" value of 1, 2, or 3 is suggested for an RTD range with *tenth-of-a-degree* resolution, and a value from 4 through 9 for a range with *hundredth-of-a-degree* resolution (see Manual Section 2.G.2 for a complete explanation of the **FIL** command).

* Accuracy may also be increased during the normal data reduction process by taking the *known linearity deviation* into account. See the second note on p. 10A18-4C.1.

6. Turn OFF the system EEPROM SWITCH.

TWO-POINT (DEADWEIGHT) CALIBRATION

If the above procedure does not yield sufficient accuracy, additional **TWO-POINT (DEADWEIGHT)** calibration may be performed on a real-time basis via the standard **ZERO (ZRO)** and **FORCE (FRC)** commands—but only *when independently and accurately known temperature references are available* (preferably the high and low extremes to which the sensor will be subjected). The mainframe's **EEPROM Write Protect Switch** must be ON for these commands to be effective. See Manual Section 1.G.5 for a general discussion of this conventional “zero and span” calibration technique.

10A18-4C QUAD PLATINUM LINEAR RTD CARD

MODEL 10A30-2C

DUAL LVDT CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 10A30-2C is for measurement of displacement, force, pressure, and other parameters obtained with a **variable reluctance transducer** or **linear variable differential transformer (LVDT)**. Based on the *synchronous carrier-demodulator* principle, it supplies regulated, remotely sensed AC excitation for two independent transducer channels—thus allowing direct measurement of *thickness* (when the two inputs are summed) or of *taper* (when their difference is calculated). It then demodulates, filters, and amplifies the resulting signals to produce system outputs precisely proportional to LVDT core displacement. The 10A30-2C automatically adjusts to the signal phase shift of the transducer in use, thereby insuring optimum sensitivity and linearity. Special input provisions exist for “long-stroke” LVDT’s (full-scale range of ± 1 inch or greater).

ADDITIONAL 10A30-2C SPECIFICATIONS

Transducer Types: 5- or 7-wire LVDT’s capable of 3280-Hz operation and having primary impedance of 80 ohms or greater (all Daytronic LVDT transducers are suitable); 3- or 5-wire variable reluctance transducers

Sensitivity Range: Accommodates full-scale ranges from ± 0.010 in. (± 0.25 mm) to ± 6.0 in. (± 15.24 cm), when used with Daytronic or equivalent transducers; for System 10 channel “type” codes assigned to 10A30-2C data channels, see Table 1, below

Standard Input (rms, full-scale): 78, 156, or 312 mV/V

Long-Stroke Input (rms, full-scale): 525 mV/V, 1.05 V/V, or 2.10 V/V

Excitation (per channel): Nominal 3.0 V-AC (rms) at 3280 Hz; 40 mA (rms), maximum

Amplifier (per channel):

Common-Mode Range: ± 5 V operating; ± 12 V without instrument damage

Common-Mode Rejection Ratio: DC and at 60 Hz: infinite; at 3 kHz: -60 dB

Input Impedance: Differential: 400 k Ω ; Common-Mode: 100 k Ω

Offset: Initial: $\pm 3\%$ of full scale; vs. Temperature: ± 20 ppm/ $^{\circ}$ C; vs. Time: $\pm 0.01\%$ f.s./month

Gain Accuracy: $\pm 0.02\%$ of full scale *typical*, following calibration*

Gain Stability: vs. Temperature: ± 50 ppm/ $^{\circ}$ C; vs. Time: ± 20 ppm/month

Filter (per channel): 3-pole modified Butterworth; 3 dB down at 6 Hz; 60 dB down at 60 Hz

(cont’d)

* Initial (uncalibrated) inaccuracy may be as great as $\pm 3\%$ of full scale. Maximum error that could occur upon replacement of a Model 10A30-2C *not followed by calibration* is $\pm 6\%$ of full scale.

Step-Response Settling Time (Full-Scale Output):

- To 1% of final value: 250 msec
- To 0.1% of final value: 400 msec
- To 0.02% of final value: 500 msec

Auxiliary Outputs: Filtered outputs available on mainframe wire-wrap pins

Table 1 10A30-2C "Type" Codes

Full-Scale Input (RMS)	Channel Type Code
78 mV/V	64
156 mV/V	63
312 mV/V	65*
525 mV/V	64
1.05 V/V	63
2.10 V/V	65*

2 TRANSDUCER CONNECTIONS

The Model 10A30-2C's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Table 2 gives standard pin assignments for the I/O Connector. With regard to 10A30-2C cabling, please note the following:

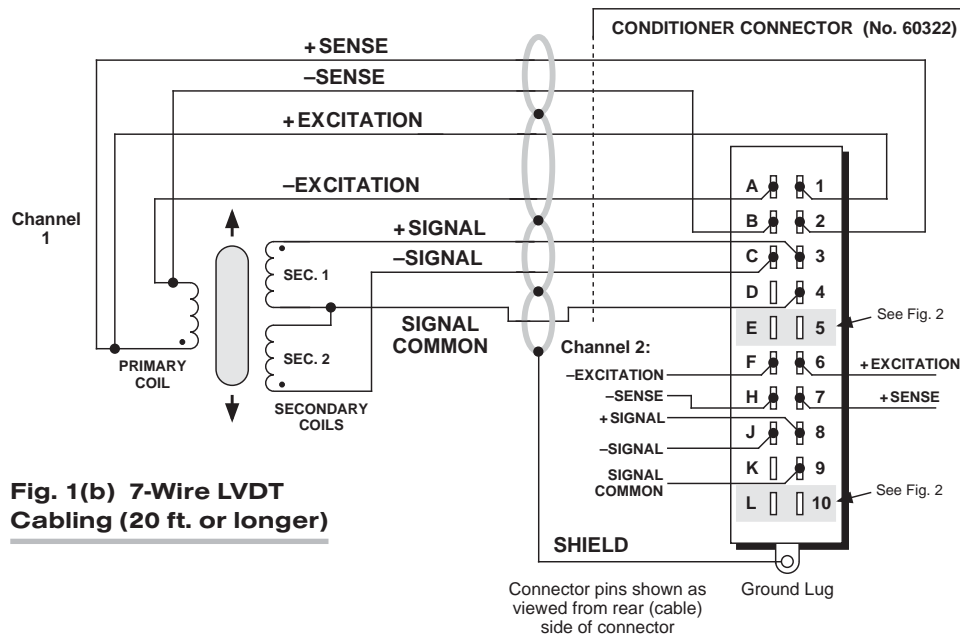
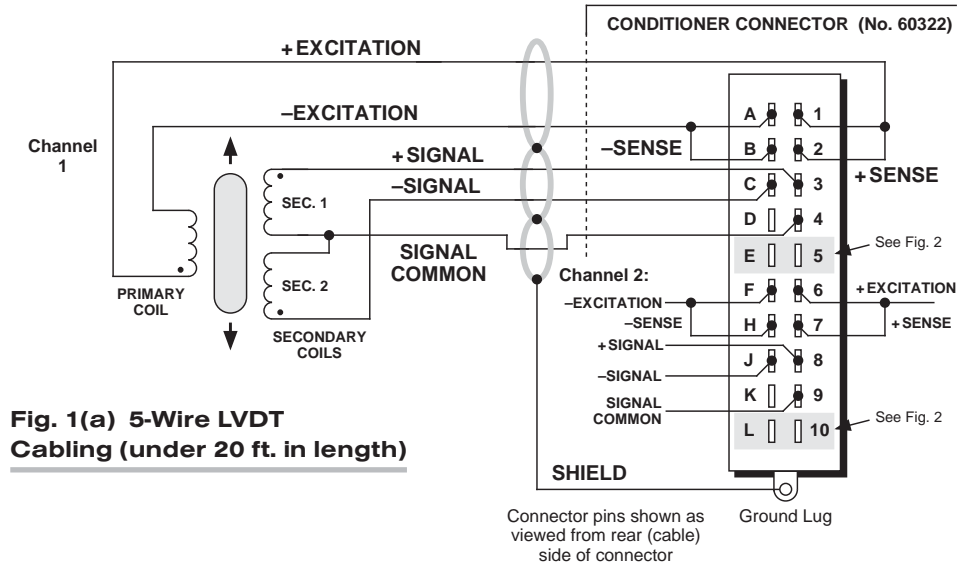
- a. 5-wire LVDT cabling (Fig. 1(a)) or 3-wire variable reluctance transducer cabling (Fig. 1(c)) is to be used when the cable is under 20 feet in length. In this case, the +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines *at the CONDITIONER CONNECTOR*.

7-wire LVDT cabling (Fig. 1(b)) or 5-wire variable reluctance transducer cabling (Fig. 1(d)) is to be used when the cable is 20 feet or longer. In this case, the +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines *at the transducer*.
- b. For each LVDT transducer connected to the 10A30-2C, you may *either*
 - connect the "center wire" that joins both series-opposed secondary coils to the conditioner connector's SIGNAL COMMON (**Pin 4 or 9**), as shown in Figs. 1(a) and 1(b); *or, alternatively (to simplify the overall cabling)*,
 - connect the transducer center wire to the CABLE SHIELD *at the transducer end*, instead of bringing this line through a cable shield to the conditioner connector's SIGNAL COMMON pin or screw terminal.
- c. Note that there are special +SIGNAL and -SIGNAL connections for use with LONG-STROKE LVDT's (full-scale range of ± 1 inch or greater). These connections are shown in Fig. 2. Thus, to allow for the larger input voltages produced by such a sensor, you would connect its +SIGNAL line to **Pin 5** (for Channel 1) or to **Pin 10** (for Channel 2), *instead of* to Pin 3 or 8, respectively. Similarly, you would connect the -SIGNAL line to **Pin E** (for Channel 1) or to **Pin L** (for Channel 2), *instead of* to Pin C or J, respectively.
- d. When wiring a variable reluctance transducer to the 10A30-2C, you must install a 10-kilohm "half-bridge completion" resistor between the -SIGNAL pin (**C or J**) and *each* of the two EXCITATION lines, as shown in Figs. 1(c) and 1(d).

* Equivalent to TYPE "30" for a 10A30-2C channel.

IMPORTANT: The \pm EXCITATION, \pm SENSE, and \pm SIGNAL pins or terminals for an UNUSED LVDT INPUT CHANNEL should be jumpered as shown in Fig. 3. If an input is left open, high-frequency oscillation can result, which can in turn produce significant interchannel crosstalk, and possibly inaccurate data readings.

Fig. 1 Model 10A30-2C Transducer Cabling



10A30-2C DUAL LVDT CARD

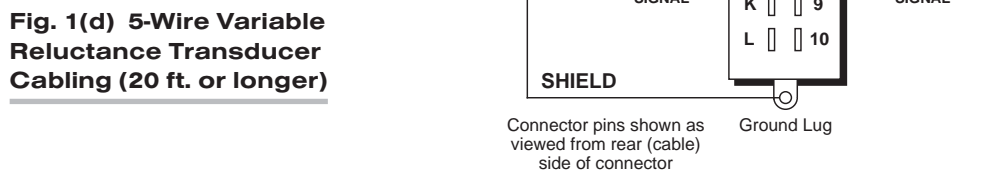
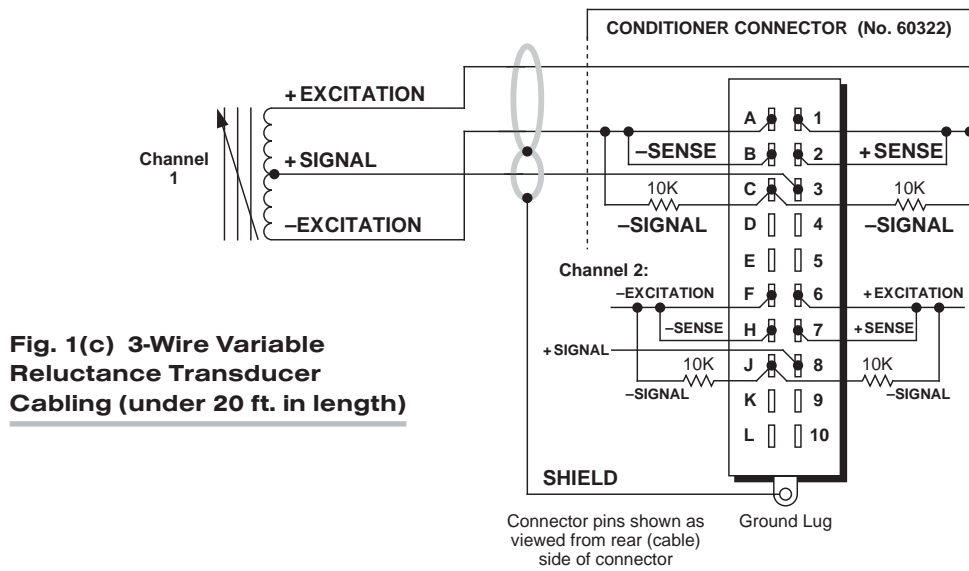


Fig. 2 Long-Stroke LVDT Connections

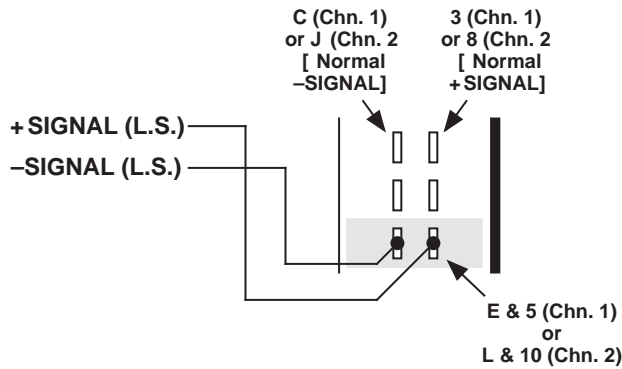


Fig. 3 Jumpering of an Unused 10A30-2C LVDT Input

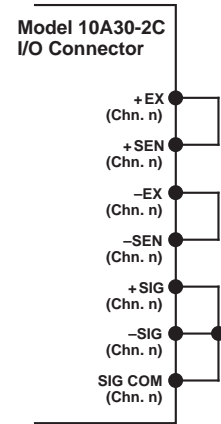


Table 2 Model 10A30-2C Pin Assignments

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	+EXCITATION (3 V-AC)
A	1	-EXCITATION (3 V-AC)
2	1	+SENSE
B	1	-SENSE
3	1	+SIGNAL
C	1	-SIGNAL
4	1	SIGNAL COMMON
D		Not Committed
5	1	+SIGNAL (LONG-STROKE)
E	1	-SIGNAL (LONG-STROKE)
6	2	+EXCITATION (3 V-AC)
F	2	-EXCITATION (3 V-AC)
7	2	+SENSE
H	2	-SENSE
8	2	+SIGNAL
J	2	-SIGNAL
9	2	SIGNAL COMMON
K		Not Committed
10	2	+SIGNAL (LONG-STROKE)
L	2	-SIGNAL (LONG-STROKE)

3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A30-2C card when used in System 10, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A30-2C channel “type” codes, see Table 1, above.

In System 10, a relatively linear Model 10A30-2C channel normally employs **TWO-POINT (DEADWEIGHT) CALIBRATION**.^{*} See Manual Section 1.G.5 for a general discussion of this conventional “zero and span” calibration technique. Note, however, the following special procedure that applies to an LVDT-based Channel No. “x”:

1. Make sure the channel has been properly “typed” and “located” (see Manual Section 1.G.1).

2. Turn ON the system EEPROM SWITCH and enter a command of

BEE x = 0 [CR]

This command sets an initial ZERO OFFSET (“b” term) of zero for Channel No. x.

3. Observing a “live” reading of the channel, mechanically adjust the fixture and physical position of the LVDT until the *lowest reading* occurs. This is the LVDT’s “electrical null” point.

4. With the transducer still in “null” position, enter a command of

ZRO x [CR]

5. Displace the LVDT probe by a precisely known distance, preferably between 80% and 100% of the transducer’s nominal full-scale rating.

6. Command

FRC x = z [CR]

where “z” is the exact value of the displacement produced in Step 5, expressed in appropriate engineering units (the precision of the final measurement will match that of the entered “z” value).

7. Repeat Steps 4, 5, and 6, if necessary, until the LVDT’s zero and span points coincide with the calibration block or micrometer reference being used.

^{*} For nonlinear channels, “custom linearization” can be used (see Manual Section 2.L).

MODEL 10A31-4

QUAD LVDT CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 10A31-4 is for measurement of displacement, force, pressure, and other parameters obtained with a **variable reluctance transducer** or **linear variable differential transformer (LVDT)**. Based on the *synchronous carrier-demodulator* principle, it supplies regulated, remotely sensed AC excitation for four independent transducer channels. It then demodulates, filters, and amplifies the resulting signals to produce system outputs precisely proportional to LVDT core displacement. The 10A31-4 automatically adjusts to the signal phase shift of the transducer in use, thereby insuring optimum sensitivity and linearity. Special input provisions exist for "long-stroke" LVDT's (full-scale range of ± 1 inch or greater).

For each of its four analog inputs, the 10A31-4 produces two displayable outputs: one with "normal" analog filtering and one with *high bandwidth* characteristics (see Specifications and Table 1, below). All four channels share a common sensed excitation of 100 mA (rms), maximum. As explained in Section 2, for cables over 25 feet in length, this limits the distance from the sense point to the transducer to about 20 feet of 18-gage wire.

The 10A31-4's eight SUBCHANNELS are assigned as follows:

Table 1 Model 10A31-4 Subchannels

Subchannel No.	Function
1	Input No. 1, low-bandwidth filter
2	Input No. 2, low-bandwidth filter
3	Input No. 3, low-bandwidth filter
4	Input No. 4, low-bandwidth filter
5	Input No. 1, high-bandwidth filter
6	Input No. 2, high-bandwidth filter
7	Input No. 3, high-bandwidth filter
8	Input No. 4, high-bandwidth filter

ADDITIONAL 10A31-4 SPECIFICATIONS

Transducer Types: 5- or 7-wire LVDT's capable of 3280-Hz operation and having primary impedance of 80 ohms or greater (all Daytronic LVDT transducers are suitable); 3- or 5-wire variable reluctance transducers

Sensitivity Range: Accommodates full-scale ranges from ± 0.010 in. (± 0.25 mm) to ± 6.0 in. (± 15.24 cm), when used with Daytronic or equivalent transducers; for System 10 channel "type" codes assigned to 10A31-4 data channels, see Table 2, below

Standard Input (rms, full-scale): 78, 156, or 312 mV/V

Long-Stroke Input (rms, full-scale): 525 mV/V, 1.05 V/V, or 2.10 V/V

(cont'd)

10A31-4 QUAD LVDT CARD

Excitation (per channel): Nominal 3.0 V-AC (rms) at 3280 Hz; 40 mA (rms), maximum

Amplifier (per channel):

Common-Mode Range: ± 5 V operating; ± 12 V without instrument damage

Common-Mode Rejection Ratio: DC and at 60 Hz: infinite; at 3 kHz: -60 dB

Input Impedance: Differential: 400 k Ω ; Common-Mode: 100 k Ω

Offset: Initial: $\pm 3\%$ of full scale; vs. Temperature: ± 20 ppm/ $^{\circ}\text{C}$; vs. Time: $\pm 0.01\%$ f.s./month

Gain Accuracy: $\pm 0.02\%$ of full scale *typical*, following calibration*

Gain Stability: vs. Temperature: ± 50 ppm/ $^{\circ}\text{C}$; vs. Time: ± 20 ppm/month

Filter (per channel):

NORMAL: 3-pole modified Butterworth; 3 dB down at 6 Hz; 60 dB down at 60 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 250 msec

To 0.1% of final value: 400 msec

To 0.02% of final value: 500 msec

HIGH BANDWIDTH: 3-pole modified Butterworth; 3 dB down at 200 Hz; 60 dB down at 2750 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 5 msec

To 0.1% of final value: 8 msec

To 0.02% of final value: 13 msec

Auxiliary Outputs: Filtered outputs available on mainframe wire-wrap pins

Table 2 10A31-4 "Type" Codes

Full-Scale Input (RMS)	Channel Type Code
78 mV/V	64
156 mV/V	63
312 mV/V	65**
525 mV/V	64
1.05 V/V	63
2.10 V/V	65**

2 TRANSDUCER CONNECTIONS

The Model 10A31-4's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Table 3 gives standard pin assignments for the I/O Connector. With regard to 10A31-4 cabling, please note the following:

- All four 10A31-4 input channels use a single, sensed excitation supply.
- 5-wire LVDT cabling (Fig. 1(a)) or 3-wire variable reluctance transducer cabling (Fig. 1(c)) is to be used when the cable is under 20 feet in length. In this case, the +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines *at the CONDITIONER CONNECTOR*.

* Initial (uncalibrated) inaccuracy may be as great as $\pm 3\%$ of full scale. Maximum error that could occur upon replacement of a Model 10A31-4 *not followed by calibration* is $\pm 6\%$ of full scale.

** Equivalent to TYPE "30" for a 10A31-4 channel.

7-wire LVDT cabling (Fig. 1(b)) or 5-wire variable reluctance transducer cabling (Fig. 1(d)) is to be used when the cable is 20 feet or longer. In this case, the +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines *at the transducer*. **NOTE:** It is important that the distance “D” from each transducer to its sensing points be *as short as possible* (at least under 20 feet when 18-gage wire is used).

- c. For each LVDT transducer connected to the 10A31-4, you should connect the “center wire” that joins both series-opposed secondary coils to the CABLE SHIELD *at the transducer end*, instead of bringing this line through a cable shield to the conditioner connector (as shown in Figs. 1(a) and 1(b)).
- d. Note that there are special +SIGNAL and -SIGNAL connections for use with LONG-STROKE LVDT’s (full-scale range of ± 1 inch or greater). Thus, to allow for the larger input voltages produced by such a sensor, you would connect its +SIGNAL line to **Pin 2, 4, 6, or 8** (*instead of to Pin 1, 3, 5, or 7, respectively*). Similarly, you would connect the -SIGNAL line to **Pin B, D, F, or J** (*instead of to Pin A, C, E, or H, respectively*).
- e. When wiring a variable reluctance transducer to the 10A31-4, you must install a 10-kilohm “half-bridge completion” resistor between the -SIGNAL pin (**A, C, E, or H**) and *each* of the two SENSE lines, as shown in Figs. 1(c) and 1(d).

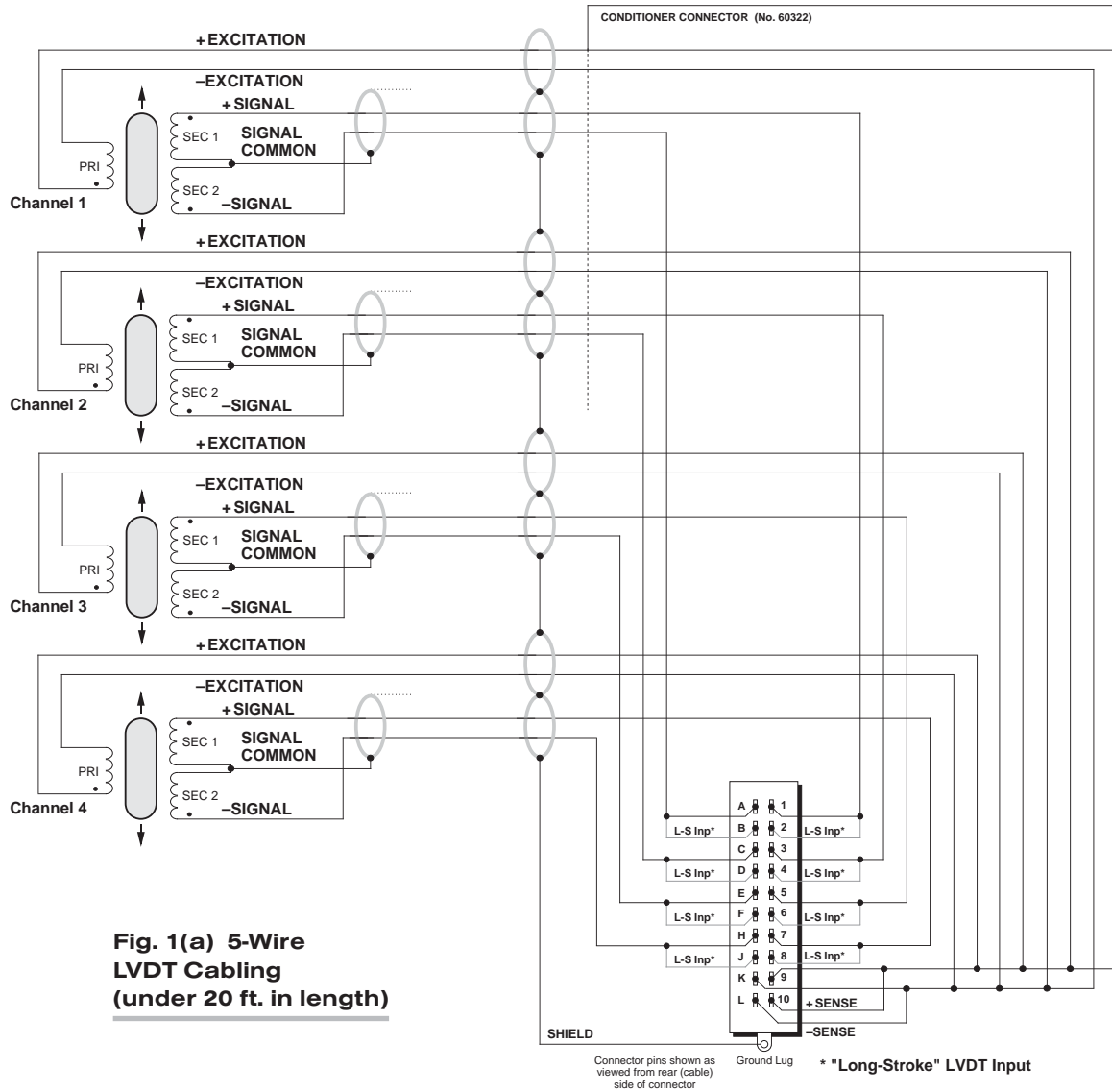
Table 3 Model 10A31-4 Pin Assignments

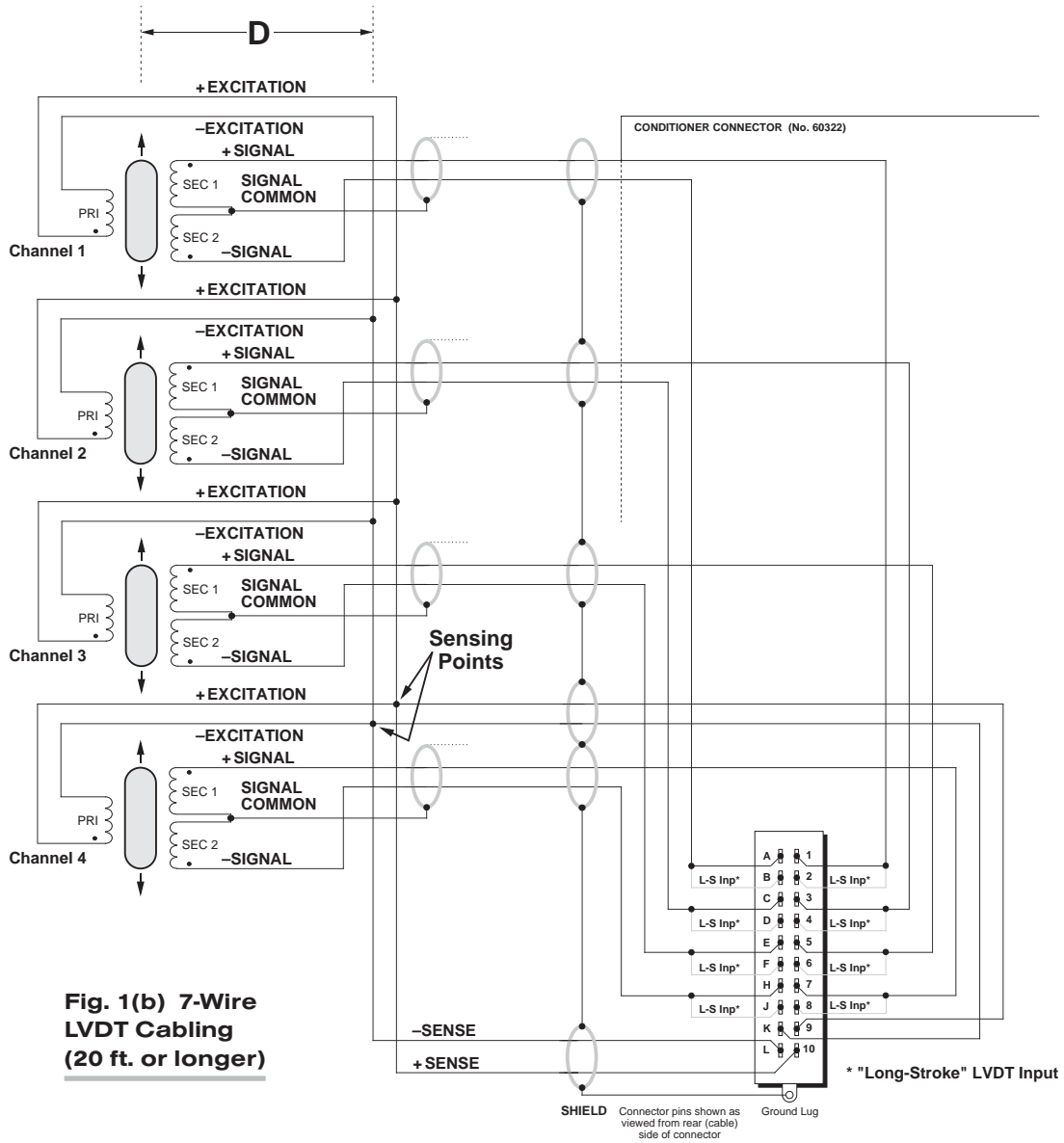
I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	+SIGNAL
A	1	-SIGNAL
2	1	+SIGNAL (LONG-STROKE)
B	1	-SIGNAL (LONG-STROKE)
3	2	+SIGNAL
C	2	-SIGNAL
4	2	+SIGNAL (LONG-STROKE)
D	2	-SIGNAL (LONG-STROKE)
5	3	+SIGNAL
E	3	-SIGNAL
6	3	+SIGNAL (LONG-STROKE)
F	3	-SIGNAL (LONG-STROKE)
7	4	+SIGNAL
H	4	-SIGNAL
8	4	+SIGNAL (LONG-STROKE)
J	4	-SIGNAL (LONG-STROKE)
9	*	+EXCITATION
K	*	-EXCITATION
10	*	+SENSE
L	*	-SENSE

* This function is common to all four channels.

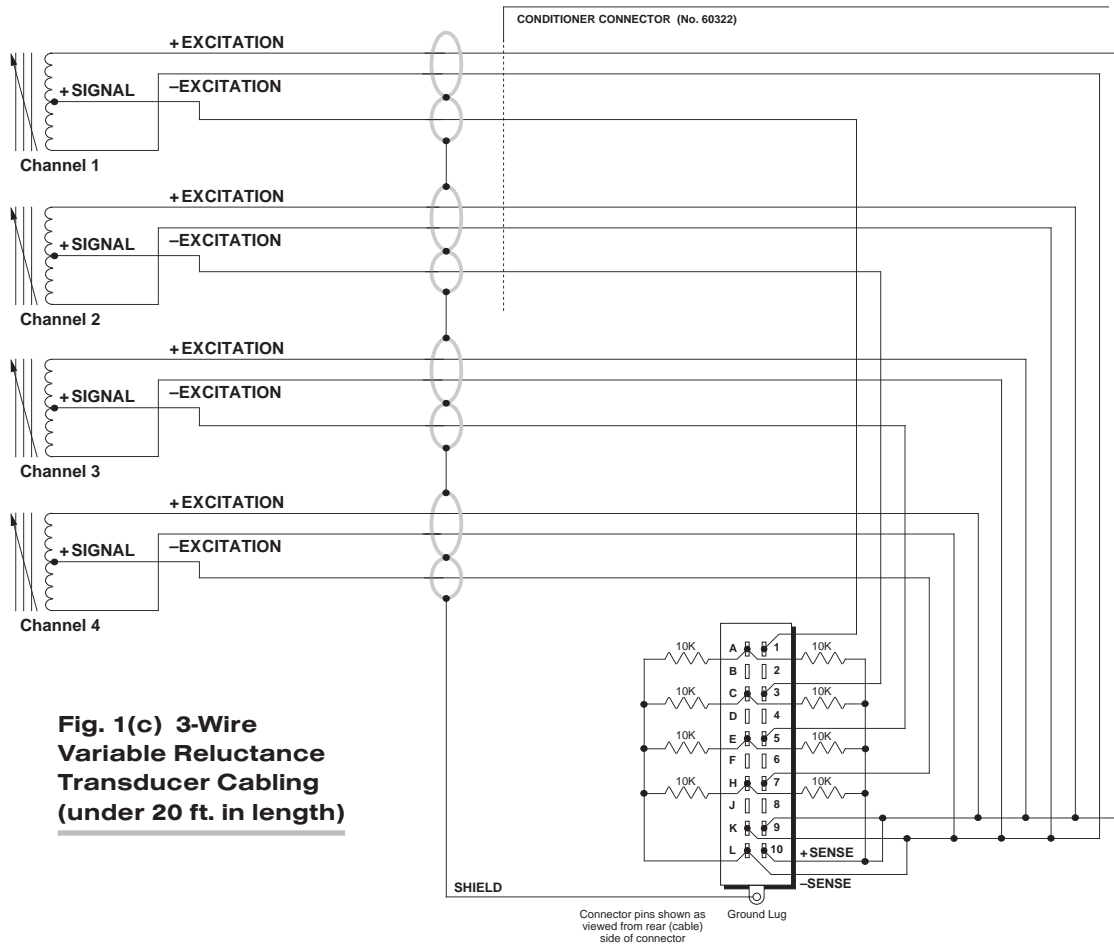
10A31-4 QUAD LVDT CARD

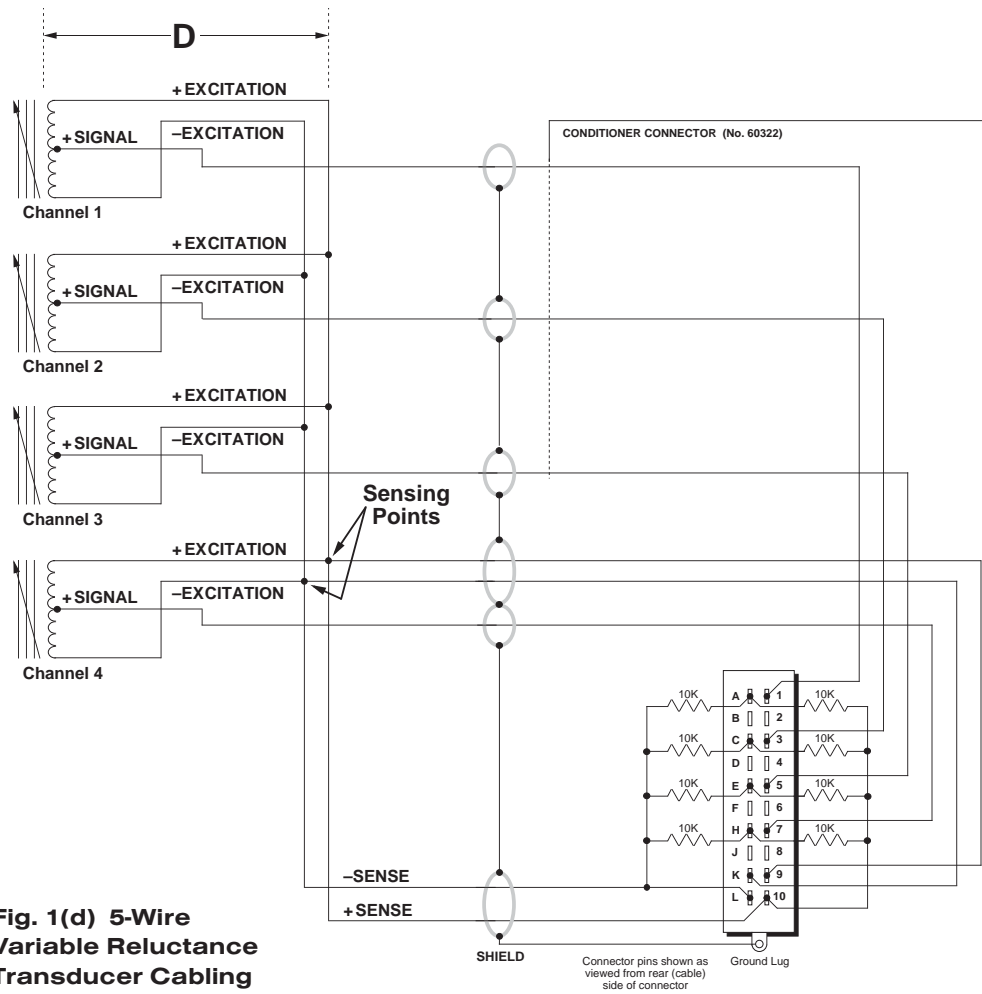
Fig. 1 Model 10A31-4 Transducer Cabling





10A31-4 QUAD LVDT CARD





**Fig. 1(d) 5-Wire
Variable Reluctance
Transducer Cabling
(20 ft. or longer)**

3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A31-4 card when used in System 10, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A31-4 channel “type” codes, see Table 2, above.

In System 10, a relatively linear Model 10A31-4 channel normally employs **TWO-POINT (DEADWEIGHT) CALIBRATION**.^{*} See Manual Section 1.G.5 for a general discussion of this conventional “zero and span” calibration technique. Note, however, the following special procedure that applies to an LVDT-based Channel No. “x”:

1. Make sure the channel has been properly “typed” and “located” (see Manual Section 1.G.1).

2. Turn ON the system EEPROM SWITCH and enter a command of

BEE x = 0 [CR]

This command sets an initial ZERO OFFSET (“b” term) of zero for Channel No. x.

3. Observing a “live” reading of the channel, mechanically adjust the fixture and physical position of the LVDT until the *lowest reading* occurs. This is the LVDT’s “electrical null” point.

4. With the transducer still in “null” position, enter a command of

ZRO x [CR]

5. Displace the LVDT probe by a precisely known distance, preferably between 80% and 100% of the transducer’s nominal full-scale rating.

6. Command

FRC x = z [CR]

where “z” is the exact value of the displacement produced in Step 5, expressed in appropriate engineering units (the precision of the final measurement will match that of the entered “z” value).

7. Repeat Steps 4, 5, and 6, if necessary, until the LVDT’s zero and span points coincide with the calibration block or micrometer reference being used.

^{*} For nonlinear channels, “custom linearization” can be used (see Manual Section 2.L).

MODEL 10A35

ENCODER CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

This single-channel, phase-encoded conditioner may be used with **incremental encoder sensors** whose outputs are quadratured to indicate “travel” and “direction of travel,” for measurement of relative linear or angular displacements over a very wide range of distances and precisions.

The 10A35 generates a count per 90° phase shift, with a maximum allowable count of ± 32700 and a speed limitation of 50 kHz, maximum. To accommodate the largest number of transducers, this count may be predivided by any integer from 1 to 256, as explained in Section 3.a. The 10A35 allows run-time “zero indexing” (resetting) and restarting of a channel’s count reading by the operator or host computer. There are also input provisions for a user-supplied auxiliary external power supply from 9 to 15 V-DC, which would allow you to keep the count “alive” during system power shut-down.

NOTE: A System 10 data channel derived from a Model 10A35 always takes a channel “type” code of **CA**, and does not require calibration.

ADDITIONAL 10A35 SPECIFICATIONS

Input Signals: ZERO INDEX (RESET), PHASE 1 (SINE), and PHASE 2 (COSINE); each input is available as a “TTL INPUT” or a “LOW-LEVEL INPUT”

Excitation: Nominal 5 V-DC; 50 mA maximum

Accuracy: Based on transducer, ± 1 digit

Auxiliary Power Supply: 9 to 15 V-DC

Auxiliary Outputs to Mainframe Wire-Wrap Pins: None

2 TRANSDUCER CONNECTIONS

The Model 10A35’s I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Standard cable connections—including connection of an optional “keep-alive” power supply—are given in Fig. 1, below. Table 1 gives standard pin assignments for the I/O Connector.

The 10A35 takes three input signals: **ZERO INDEX (RESET), PHASE 1 (SINE), and PHASE 2 (COSINE)**. Each input is available as a “TTL INPUT” or a “LOW-LEVEL INPUT.” With internal pull-up less than 1 LSTTL load, TTL INPUTS (Pins **3**, **C**, and **5**) are for use with transducers with high output levels greater than 2.4 V-DC. With 15-k Ω impedance, LOW-LEVEL INPUTS (Pins **4**, **D**, and **E**) are 200 mV minimum and 9 V maximum without damage, and are for use with transducers with high output levels of 200 mV-DC to 2.4 V-DC. Low transducer output is less than 0.8 V-DC for TTL, and less than 50 mV for LOW-LEVEL.

10A35 ENCODER CARD

An excitation of +5 V-DC is provided by the 10A35, as shown in Fig. 1. If a higher excitation level is required, the user must provide his or her own external supply, in which case the 10A35's EXCITATION OUTPUT (Pin 1) should NOT be connected to the sensor.

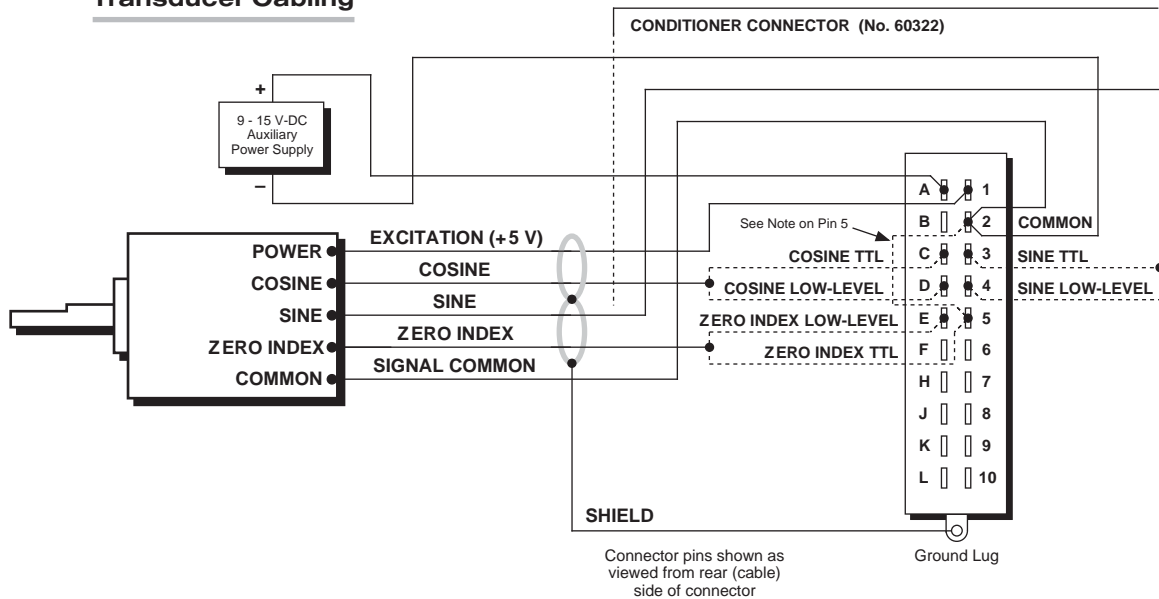
The 10A35 has input provisions for a user-supplied external power supply from 9 to 15 V-DC. This external ("Auxiliary") supply would allow you to keep the count "alive" during system power shut-down. The optional "keep-alive" supply should be connected to Pins **A** and **2**, as shown in the figure.

ALSO NOTE: When Pin **5** (ZERO INDEX TTL INPUT) is not used, it must be tied to COMMON (Pin 2).

Table 1 Model 10A35 Pin Assignments

I/O Connector Pin Number	Conditioner Line Function
1	EXCITATION OUTPUT (+5 V-DC)
A	AUXILIARY POWER SUPPLY INPUT
2	COMMON
B	Not Committed
3	SINE TTL INPUT
C	COSINE TTL INPUT
4	SINE LOW-LEVEL INPUT
D	COSINE LOW-LEVEL INPUT
5	ZERO INDEX TTL INPUT
E	ZERO INDEX LOW-LEVEL INPUT
6-10	Not Committed
F-L	Not Committed

Fig. 1 Model 10A35 Transducer Cabling



3 **SETUP AND/OR OPERATING CONSIDERATIONS****3.a CONFIGURATION AND OPERATION**

For initial configuration of the ANALOG INPUT CHANNEL dedicated to a specific Model 10A35 card when used in System 10, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. A 10A35 channel will always take a “type” code of **CA**.

COUNT PREDIVISION

To predivide the count represented by a 10A35-based Channel No. “x” by any integer from 1 through 256, you should apply the following **RANGE (RNG)** command:

RNG x = 00h [CR]

The term to the right of the equals sign consists of *two zeros*, followed by a two-character *hexadecimal number* (“h”) from 00 through FF. The decimal equivalent of the hexadecimal number “h” is to be *one less than the value of the integral divisor* by which the count is to be predivided. Note that the system EEPROM SWITCH does NOT need to be ON for the above **RNG** command to work.

Thus, for example, a “full count” of ± 32700 would call for a hexadecimal value of “00” for “h,” which will enter a divisor of (decimal) “1.” A divisor of, say, “100” would yield a full count of ± 327 , and would be entered by a value for “h” of hexadecimal “63” (equivalent to decimal “99”). See also the example under “Returning the 10A35 to 'RUN MODE',” below.

IMPORTANT: Unless an external power supply has been connected, you must use the **RANGE (RNG)** command *following every system powerup*, to *reset* the 10A35 and to *return it to “RUN MODE,”* as explained in the following sections.

ZERO-INDEXING (RESETTING) THE 10A35

You will use the following form of the **RANGE (RNG)** command to “zero-index” a 10A35-based Channel No. “x” (that is, to reset its count to zero):

RNG x = 80h [CR]

Here, the term to the right of the equals sign consists of the numbers “8” and “0,” followed by the desired divisor code “h” (explained above). Again, the system EEPROM SWITCH does NOT need to be ON for this command to work.

RETURNING THE 10A35 TO “RUN MODE”

The effect of the **RNG x = 80h [CR]** command (above) is to place the 10A35 in “RESET MODE.” IT WILL REMAIN IN RESET MODE UNTIL APPLICATION OF A **RANGE (RNG)** COMMAND OF THE FORM

RNG x = 00h [CR]

Suppose, for example, that your Model 10A35 uses Channel No. 101, and that you have set it for a full count of ± 3270 by a command of

RNG 101 = 0009 [CR]

(here, since your desired count divisor is “10,” you will enter for “h” the hexadecimal equivalent of “10 minus 1,” or “9”). To zero-index the 10A35 at any subsequent time, you need only command

10A35 ENCODER CARD

RNG 101 = 8009 [CR]

To then *restart* the 10A35's count (from zero), you would again command

RNG 101 = 0009 [CR]

MODEL 10A40

FREQUENCY INPUT CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

This single-channel conditioner is for measurement of flow, rpm, and other phenomena that can be sensed by pulse transformer transducers with two-wire isolated windings (tachometer pickups, turbine flowmeters, etc.), transistor or logic-circuit drivers, “zero-velocity” (true digital output) sensors, and similar **frequency-generating transducers**.

The 10A40 accepts a wide range of wave shapes and voltage levels, either grounded or floating—though it is not recommended for measuring frequencies under 25 Hz without special modification. The “Smart Schmitt” input threshold automatically adjusts to accommodate signals from 10 mV to 200 V. Nominal ± 5 V-DC excitation is supplied for use with a “zero-velocity” sensor.

Capacitive coupling of 0.1 or 10 μF is provided for low-frequency inputs, to eliminate false triggering by signal noise and/or any positive or negative DC offset that exists for the frequency signal. A special trigger-level control guarantees reliable triggering when the input is at the low end of the voltage range.

The System 10 Central Processor controls frequency-range selection and applies an appropriately calculated scaling factor to each measurement, if desired, following initial entry of a special **FREQUENCY CALIBRATION (FRQ)** command (see Section 3.a, below). This convenient “calculated” calibration technique can be used when the manufacturer-supplied full-scale rating of the frequency source (or the highest frequency expected to be measured) is known. A precise 2.097152-MHz crystal frequency reference ensures accuracy of all calibrations, whether “absolute,” “calculated” (via the **FRQ** command), or “two-point” (“dead-weight”).

ADDITIONAL 10A40 SPECIFICATIONS

Input:

Type: Any AC or unipolar pulse signal, grounded or floating, irrespective of waveform

Threshold Level: Accommodates signals from 100 mV to 200 V

Frequency Ranges: From 10% to 100% of 250, 500, 1000, 2000, 4000, 8000, 16000, or 32000 Hz; automatically selected—on an individual channel basis—when the channel is configured; for the System 10 channel “type” code assigned to a 10A40 data channel, see Table 1, below

Excitation: Nominal 10 (i.e., ± 5) V-DC; ± 50 mA, maximum

Measurement Characteristics (per channel):

Normal-Mode Range: ± 200 V operating and without instrument damage

Common-Mode Range: ± 50 V operating; ± 100 V, without instrument damage

Common-Mode Rejection Ratio: At 60 Hz: -120 dB; at 1 kHz: -60 dB

Input Impedance: Differential: 400 k Ω ; Common-Mode: 100 k Ω

(cont'd)

Offset: Initial: $\pm 0.05\%$ of full scale; vs. Temperature: ± 25 ppm/ $^{\circ}\text{C}$; vs. Time: ± 20 ppm/month

Gain Accuracy: $\pm 0.02\%$ of full scale

Gain Stability: vs. Temperature: ± 25 ppm/ $^{\circ}\text{C}$; vs. Time: ± 20 ppm/month

Ripple and Noise: Readings are within the stated accuracy from 10% to 100% of the frequency range in use

Filter (per channel): 3-pole modified Butterworth; 3 dB down at 2 Hz; 60 dB down at 25 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 600 msec

To 0.1% of final value: 750 msec

To 0.02% of final value: 1 sec

Auxiliary Output: Filtered output available on mainframe wire-wrap pin

Table 1 10A40 "Type" Codes

Full-Scale Range	Channel Type Code
250 Hz	40
500 Hz	41
1000 Hz	42
2000 Hz	43
4000 Hz	44
8000 Hz	45
16000 Hz	46
32000 Hz	47

2 TRANSDUCER CONNECTIONS

2.a STANDARD CABLING

The Model 10A40's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Fig. 1(a) shows recommended cabling for an *intrinsically grounded transistor or logic-circuit driver*; Fig. 1(b) for a *pulse transformer transducer* with two-wire isolated windings (tachometer, turbine flowmeter, etc.); and Fig. 1(c) for a "zero-velocity" (*true digital output*) sensor requiring 10-V excitation. Table 2 gives standard pin assignments for the I/O Connector.

Table 2 Model 10A40 Pin Assignments

I/O Connector Pin Number	Conditioner Line Function
1	+EXCITATION (+5 V-DC)
A	-EXCITATION (-5 V-DC)
2	POWER COMMON
B	Not Committed
3	+SIGNAL
C	-SIGNAL
4,D	Not Committed
5	POWER COMMON
E	0.1- μF COUPLING
6	Not Committed
F	10- μF COUPLING
7-10	Not Committed
H-L	Not Committed

Fig. 1 Model 10A40 Transducer Cabling

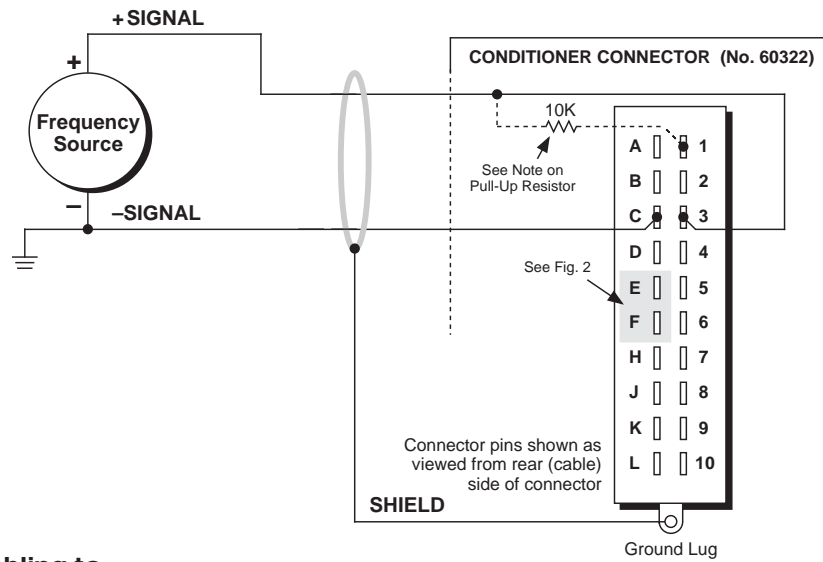


Fig. 1(a) Cabling to Grounded Frequency Sources

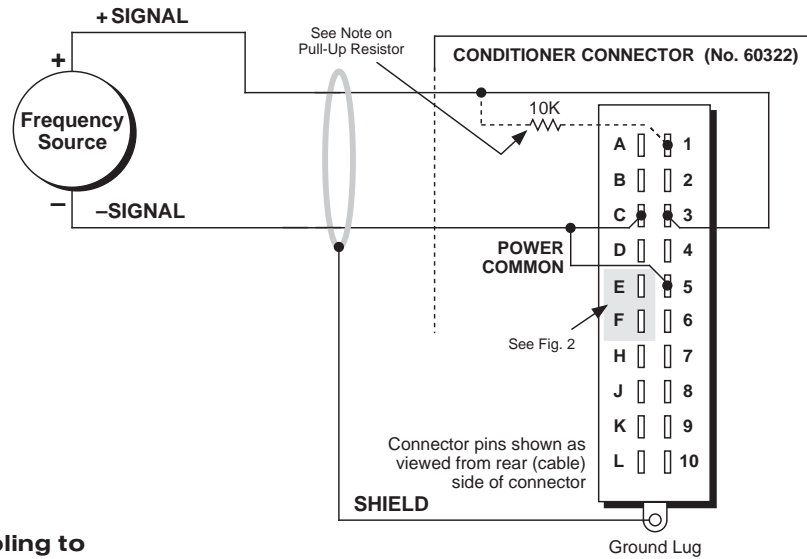


Fig. 1(b) Cabling to Ungrounded Frequency Sources

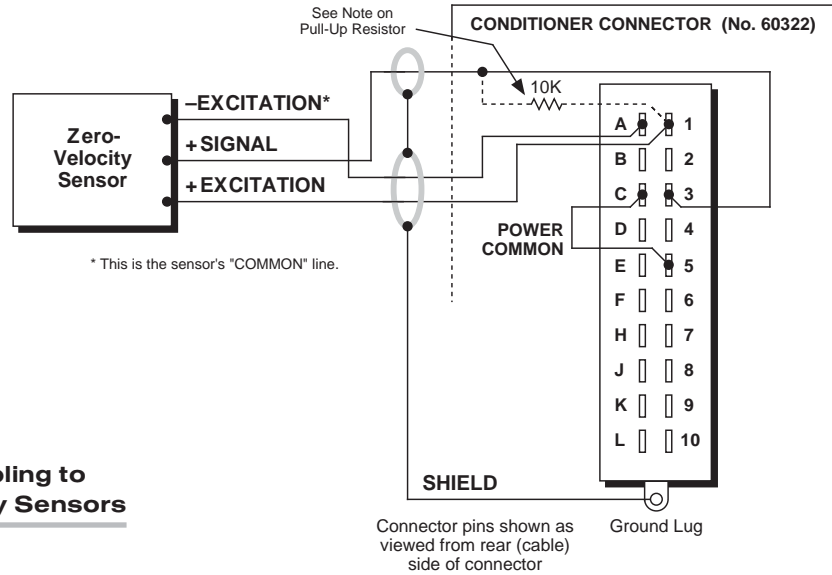


Fig. 1(c) Cabling to Zero-Velocity Sensors

2.b SPECIAL CABLING

Fig. 2 summarizes three kinds of special 10A40 connections you might need to establish:

UNGROUNDING FREQUENCY SOURCE

For a floating-source input and input from a zero-velocity sensor, where the *-SIGNAL* is not grounded at the frequency source, the *-SIGNAL* pin (**Pin C**) should be tied directly to POWER COMMON (**Pin 2** or **5**). This connection is also shown in Figs. 1(b) and 1(c), above.

ELIMINATION OF DC OFFSET

The 10A40's input channel is supplied with two *capacitive-coupled inputs* (**Pins E and F** of the rear I/O Connector provide 0.1- and 10-microfarad capacitance, respectively). These special inputs may be used with either floating or grounded configurations; they would not normally be used with zero-velocity sensors requiring 10-V excitation (see Fig. 1(c)).

Fig. 2 shows how the larger (10- μ F) capacitive coupling can be used to eliminate any positive or negative DC offset that exists for a 10A40 channel's frequency signal. Simply connect the *+SIGNAL* line from the frequency source to the 10- μ F pin (**Pin F**), instead of to the normal *+SIGNAL* pin (3). The capacitor is here in series with the *+SIGNAL* input and allows only AC to pass.

SUPPRESSION OF HIGH-FREQUENCY NOISE IN LOW-FREQUENCY INPUT

False triggering can sometimes occur, especially at the *low-frequency input range*, because of stray pickup of frequencies outside the common-mode range. Capacitive coupling of the frequency input to ground can in such cases serve to suppress unwanted signal noise. *This noise suppression is always recommended when using a MAGNETIC PICKUP as the frequency source.*

Thus, if you find your frequency reading to be unacceptably unstable or “noisy,” you should tie the 0.1- μ F pin (**Pin E**) to $-$ SIGNAL (**Pin C**), while maintaining the normal $+$ SIGNAL connection to Pin 3.

2.c PULL-UP RESISTOR

When used with an *open-collector* type sensor, the 10A40 requires a pull-up resistor (typically 10 k Ω) between the $+$ SIGNAL and the +5 V-DC EXCITATION (**Pin 1**).

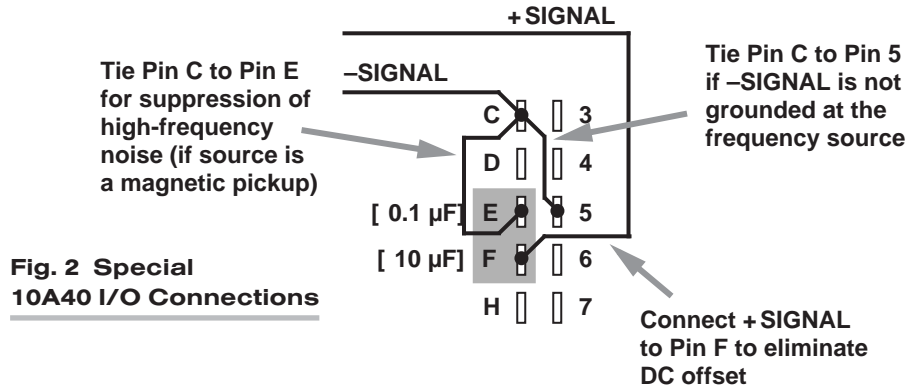


Fig. 2 Special 10A40 I/O Connections

3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a CONFIGURATION AND CALIBRATION

For initial configuration of the ANALOG INPUT CHANNEL dedicated to a specific Model 10A40 card, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A40 channel “type” codes, see Table 1, above.

You can use three calibration methods with the Model 10A40:

ABSOLUTE CALIBRATION

Described in Manual Section 1.G.3.b, this method is applicable only when the 10A40 is being used to measure *frequency itself* (in Hz). In this case, the user need only specify an appropriate SCALING FACTOR (“m” coefficient), once the 10A40-based input channel has been properly configured.

Thus, to calibrate a 10A40-based Channel No. “x,” you need only turn ON the system EEPROM SWITCH and then apply the following **SCALING FACTOR (EMM)** command:

$$\text{EMM } x = m \text{ [CR]}$$

where “m” equals *the full-scale range corresponding to the channel’s present TYPE designation, expressed to the precision desired for the channel’s data readings*. Channel “type” codes and associated full-scale ranges are given in Table 1, above. If, for example, a frequency-measuring 10A40 channel is “typed” as “43” (corresponding to a full scale of 2000 Hz) and you want the channel to read *tenths of a hertz*, you would enter an “m” value of “2000.0.”

NOTE: The accuracy of “absolute” calibration of a 10A40-based channel is limited to $\pm 0.05\%$ of full scale.

CALCULATED CALIBRATION

This is generally the most convenient means of calibrating a 10A40 channel, when the full-scale rating of the frequency source (or the highest frequency expected to be measured) is accurately known.

Thus, to calibrate a 10A40-based Channel No. “x,” you need only turn ON the system EEPROM SWITCH and then apply the following **FREQUENCY CALIBRATION (FRQ)** command:

FRQ x = i, u [CR]

For “i,” enter the manufacturer-supplied *full-scale rating* of the frequency source (or the highest frequency expected to be measured), in *hertz*. For “u,” enter the corresponding value of the measured phenomenon, expressed in the desired engineering units. You need not *zero* the channel in this case. The **FRQ** command will only work if Channel No. x has been assigned the proper “type” code (see Table 1).

Note that a channel calibrated by the **FRQ** command will report measurement data to a precision matching that of the entered “u” value. If, for example, you’re measuring “liters per minute,” and enter a “u” of “750,” then all subsequent channel readings will be rounded to the nearest liter per minute. If the entry is “750.0,” then all readings will be rounded to the nearest tenth of a liter per minute.

TWO-POINT (DEADWEIGHT) CALIBRATION

Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional “zero and span” method can be applied to a 10A40 channel if the full-scale rating of the frequency source is unknown, and if the channel’s received frequency input is an *analog of another parameter*—such as Gallons Per Minute—which has one or more independently and accurately known calibration values. It can also be used to improve the ABSOLUTE calibration of an input that measures frequency itself (beyond the 10A40 card’s inherent limit of $\pm 0.05\%$ of full scale). The mainframe’s **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

3.b TRIGGER-LEVEL ADJUSTMENT

Regardless of the method chosen, full calibration of a Model 10A40 data channel requires the following procedure, which ensures reliable triggering when the input is at the low end of the frequency range.

IMPORTANT: IF YOU ARE USING TWO-POINT (DEADWEIGHT) CALIBRATION, this adjustment must *precede* calibration of the 10A40 channel. If **ABSOLUTE** or **CALCULATED CALIBRATION** is used, it should *follow* application of the **EMM** or **FRQ** command (respectively).

1. Provide “live” display of the 10A40 channel’s data reading.
2. Remove the front bezel for the A-card rack containing the 10A40 card.
3. Without removing the 10A40 card from its slot, locate the TRIGGER-LEVEL CONTROL, which is accessible from the front of the card (see Fig. 3).
4. Using a small insulated screwdriver, turn the screw of the TRIGGER-LEVEL CONTROL fully clockwise.

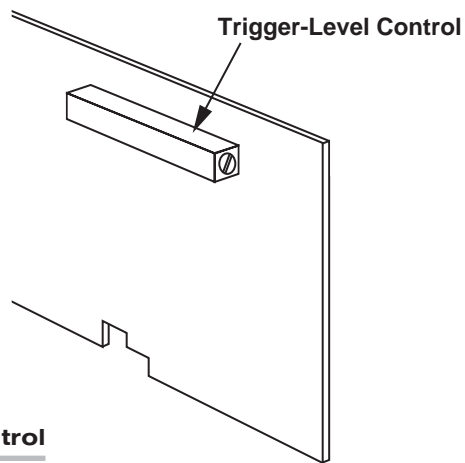


Fig. 3 10A40
Trigger-Level Control

5. Using a connected transducer as frequency source, apply an input of approximately 10% of the full-scale range for which the 10A40 has been configured.
6. Turn the TRIGGER-LEVEL CONTROL counterclockwise until the 10A40's data reading drops to zero.
7. Turn the TRIGGER-LEVEL CONTROL *clockwise* two full turns.

10A40 FREQUENCY CARD

MODEL 10A41-2C

DUAL FREQUENCY INPUT CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

Employing a 1-MHz crystal reference, the two-channel Model 10A41-2C is for measurement of flow, rpm, and other phenomena that can be sensed by pulse transformer transducers with two-wire isolated windings (tachometer pickups, turbine flowmeters, etc.), transistor or logic-circuit drivers, “zero-velocity” (true digital output) sensors, and similar **frequency-generating transducers**.

The 10A41-2C accepts a wide range of wave shapes and voltage levels, either grounded or floating—though it is not recommended for measuring frequencies under 25 Hz without special modification. The “Smart Schmitt” threshold level for each input channel may be individually selected via internal jumper connections, depending on the expected peak voltage input. This ensures reliable triggering when the input is at the low end of the voltage range. All ranges are protected against an overload of up to 200 V. Nominal ± 5 V-DC excitation is supplied for use with a “zero-velocity” sensor.

Capacitive coupling of 0.1 or 22 μ F is provided for low-frequency inputs, to eliminate false triggering by signal noise and/or any positive or negative DC offset that exists for the frequency signal.

One of four separate filter bandwidths is available for each input channel: 1.25 Hz; 2.5 Hz; 5 Hz; or 12.8 Hz. Per-channel bandwidth is selectable via internal jumpers. Each channel is normally preset for the 1.25-Hz bandwidth, which, while yielding the slowest response, also provides the *widest dynamic range for high-frequency inputs* (2% to 100% of full scale for the 1-kHz and 2-kHz ranges; 1% to 100% of full scale for ranges above 2 kHz). For faster response, you may select one of the higher filter bandwidths (see Table 1, below).

The System 10 Central Processor controls frequency-range selection and applies an appropriately calculated scaling factor to each measurement, if desired, following initial entry of a special **FREQUENCY CALIBRATION (FRQ)** command (see Section 3.c, below). This convenient “calculated” calibration technique can be used for a 10A41-2C data channel when the manufacturer-supplied full-scale rating of the frequency source (or the highest frequency expected to be measured) is known. The 1-MHz crystal frequency reference ensures accuracy of all calibrations, whether “absolute,” “calculated” (via the **FRQ** command), or “two-point” (“dead-weight”).

ADDITIONAL 10A41-2C SPECIFICATIONS

Input:

Type: Any AC or unipolar pulse signal, grounded or floating, irrespective of waveform

Threshold Level: Accommodates signals from 100 mV to 200 V

(cont'd)

10A41-2C DUAL FREQUENCY CARD

Frequency Ranges: From 10% to 100% of 250, 500, 1000, 2000, 4000, 8000, 16000, or 32000 Hz; automatically selected—on an individual channel basis—when the channel is configured; for the System 10 channel “type” codes assigned to 10A41-2C data channels, see Table 2, below

Excitation: Nominal 10 (i.e., ± 5) V-DC; ± 50 mA, maximum

Measurement Characteristics (per channel):

Normal-Mode Range: ± 200 V operating and without instrument damage

Common-Mode Range: ± 50 V operating; ± 100 V, without instrument damage

Common-Mode Rejection Ratio: At 60 Hz and 1 kHz: -60 dB

Input Impedance: Differential: 400 k Ω ; Common-Mode: 100 k Ω

Offset: Initial: $\pm 0.05\%$ of full scale; vs. Temperature: ± 25 ppm/ $^{\circ}$ C; vs. Time: ± 20 ppm/month

Gain Accuracy: $\pm 0.02\%$ of full scale

Gain Stability: vs. Temperature: ± 25 ppm/ $^{\circ}$ C; vs. Time: ± 20 ppm/month

Ripple and Noise: Readings are within the stated accuracy from 10% to 100% of the frequency range in use

Filter (per channel): 3-pole modified Butterworth; see Table 1, below

Auxiliary Output: Filtered outputs available on mainframe wire-wrap pins

Table 1 Model 10A41-2C Analog Filter Characteristics

10A41-2C Bandwidth	Response at -3 dB	Response at -52 dB	Step-Response Settling Time (Full-Scale Output)...	
			to 1% of final value	to 0.1% of final value
No. 1	1.25 Hz	12.5 Hz	770 msec	1100 msec
No. 2	2.5 Hz	25 Hz	375 msec	580 msec
No. 3	5 Hz	50 Hz	172 msec	275 msec
No. 4	12.8 Hz	128 Hz	55 msec	100 msec

Table 2 10A41-2C “Type” Codes

Full-Scale Range	Channel Type Code
250 Hz	40
500 Hz	41
1000 Hz	42
2000 Hz	43
4000 Hz	44
8000 Hz	45
16000 Hz	46
32000 Hz	47

2 TRANSDUCER CONNECTIONS

2.a STANDARD CABLING

The Model 10A41-2C’s I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Fig. 1(a) shows recommended cabling for an *intrinsically grounded transistor or logic-circuit driver*; Fig. 1(b) for a *pulse transformer transducer* with two-wire isolated windings (tachometer, turbine flowmeter, etc.); and Fig. 1(c) for a “zero-velocity” (*true digital output*) sensor requiring 10-V excitation. Table 3 gives standard pin assignments for the I/O Connector.

Fig. 1 Model 10A41-2C Transducer Cabling

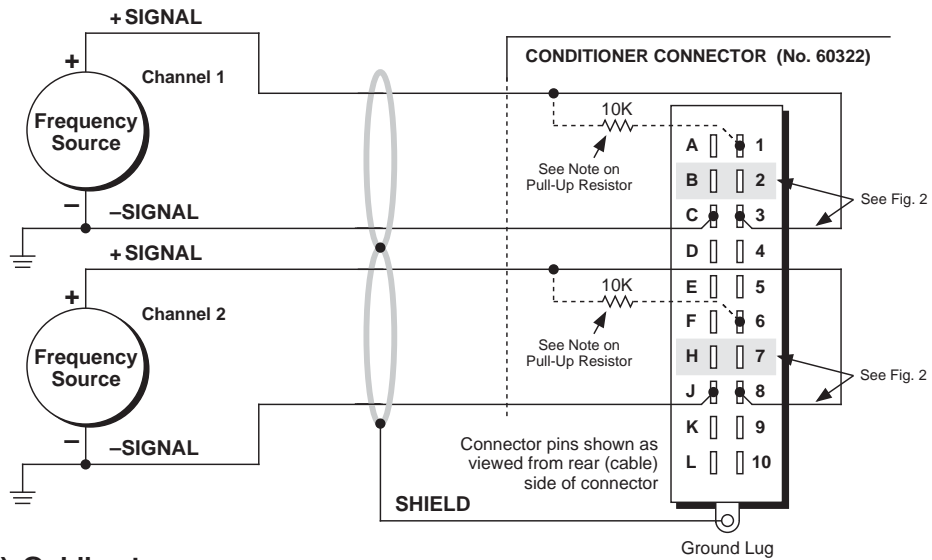


Fig. 1(a) Cabling to Grounded Frequency Sources

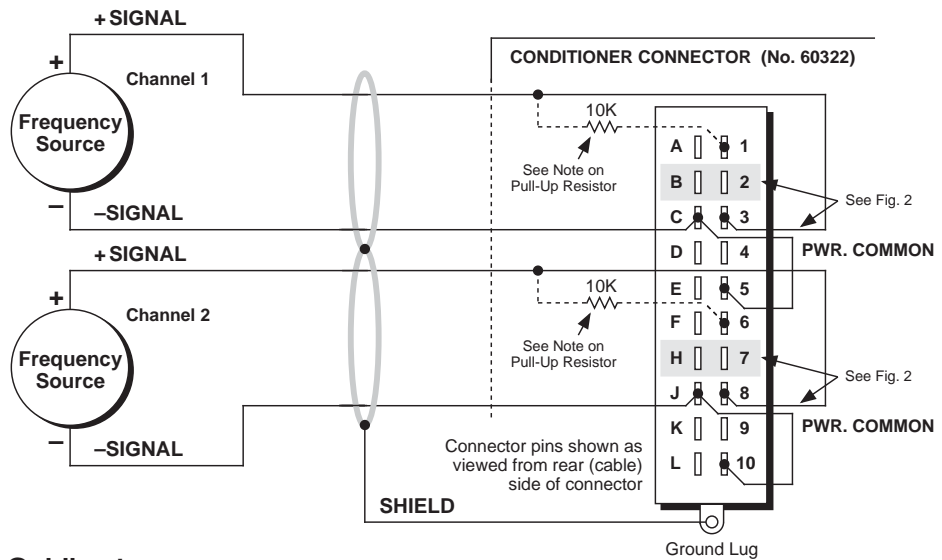


Fig. 1(b) Cabling to Ungrounded Frequency Sources

10A41-2C DUAL FREQUENCY CARD

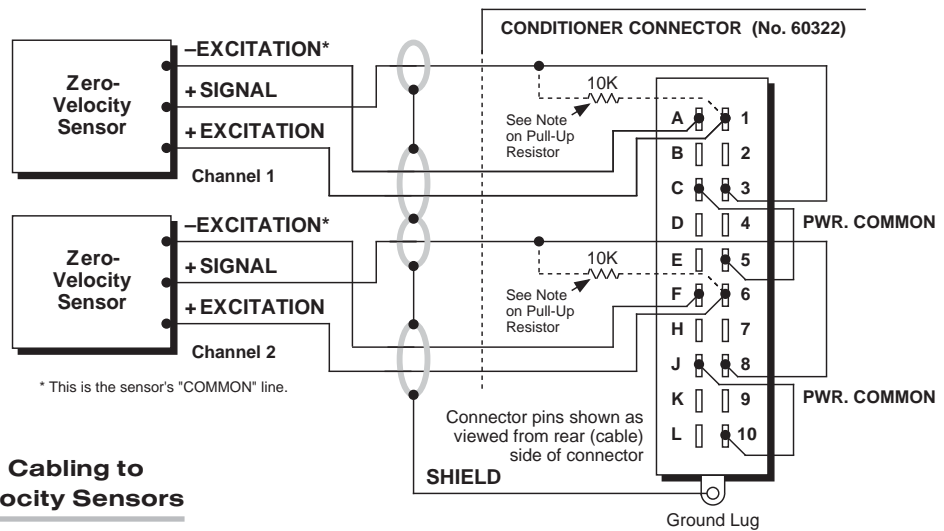


Fig. 1(c) Cabling to Zero-Velocity Sensors

Table 3 Model 10A41-2C Pin Assignments

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	+EXCITATION (+5 V-DC)
A	1	-EXCITATION (-5 V-DC)
2	1	0.1- μ F COUPLING
B	1	22- μ F COUPLING
3	1	+SIGNAL
C	1	-SIGNAL
4,D	1	Not Committed
5	1	POWER COMMON
E	1	Not Committed
6	2	+EXCITATION (+5 V-DC)
F	2	-EXCITATION (-5 V-DC)
7	2	0.1- μ F COUPLING
H	2	22- μ F COUPLING
8	1	+SIGNAL
J	1	-SIGNAL
9,K	1	Not Committed
10	1	POWER COMMON
L	1	Not Committed

2.b SPECIAL CABLING

Fig. 2 summarizes three kinds of special 10A41-2C connections you might need to establish:

UNGROUNDING FREQUENCY SOURCE

For floating-source inputs and inputs from zero-velocity sensors, where the -SIGNAL is not grounded at the frequency source, the -SIGNAL pin (**Pin C** for Chn. 1; **Pin J** for Chn. 2) should be tied directly to POWER COMMON (**Pin 5** or **10**). This connection is also shown in Figs. 1(b) and 1(c), above.

ELIMINATION OF DC OFFSET

Each 10A41-2C input channel is supplied with two *capacitive-coupled inputs* (**Pins B and H** of the rear I/O Connector provide 22-microfarad capacitance for Channels 1 and 2, respectively; **Pins 2 and 7** provide 0.1-microfarad capacitance). These special inputs may be used with either floating or grounded configurations; they would not normally be used with zero-velocity sensors requiring 10-V excitation (see Fig. 1(c)).

Fig. 2 shows how the larger (22- μ F) capacitive coupling can be used to eliminate any positive or negative DC offset that exists for a 10A41-2C channel's frequency signal. Simply connect the +SIGNAL line from the frequency source to the corresponding 22- μ F pin (**Pin B or H**), instead of to the normal +SIGNAL pin (3 or 8). The capacitor is here in series with the +SIGNAL input and allows only AC to pass.

SUPPRESSION OF HIGH-FREQUENCY NOISE IN LOW-FREQUENCY INPUT

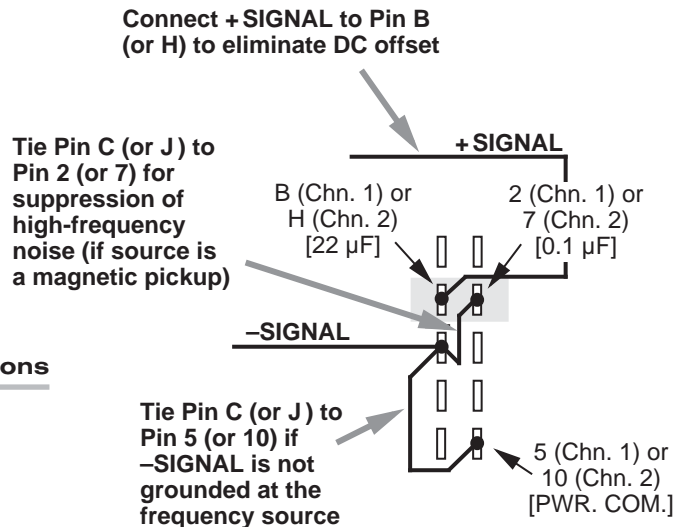
False triggering can sometimes occur, especially at the *low-frequency input range*, because of stray pickup of frequencies outside the common-mode range. Capacitive coupling of the frequency input to ground can in such cases serve to suppress unwanted signal noise. *This noise suppression is always recommended when using a MAGNETIC PICKUP as the frequency source.*

Thus, if you find a channel's frequency reading to be unacceptably unstable or "noisy," you should tie that channel's -SIGNAL (**Pin C or J**) to the corresponding 0.1- μ F pin (**Pin 2 or 7**), while maintaining the normal +SIGNAL connection (Pin 3 or 8).

2.c PULL-UP RESISTOR

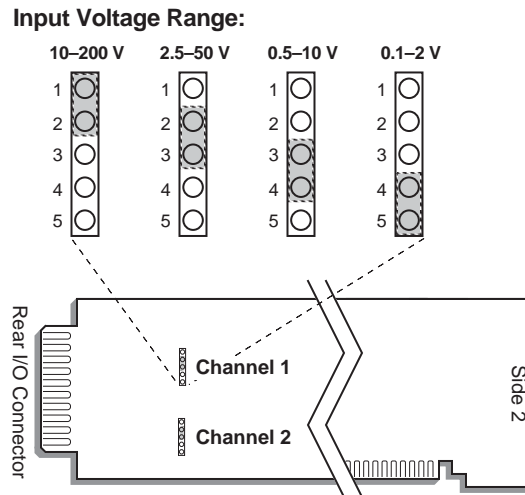
When used with an *open-collector* type sensor, a 10A41-2C channel requires a pull-up resistor (typically 10 k Ω) between the +SIGNAL and the corresponding +5 V-DC EXCITATION (**Pin 1 or 6**).

**Fig. 2 Special
10A41-2C I/O Connections**



10A41-2C DUAL FREQUENCY CARD

**Fig. 3 Model 10A41-2C
Input Voltage Jumper Pins**



3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a SELECTING INPUT VOLTAGE RANGE

Perform the following steps to select the proper *peak voltage input range* for each 10A41-2C channel. At the same time, you will be setting the *trigger level* for that channel, thereby ensuring reliable triggering when the input is at the low end of the voltage range. EACH 10A41-2C CHANNEL IS PRESET AT THE FACTORY FOR AN INPUT VOLTAGE RANGE OF 2.5 - 50 V. If you require a different range, you should

1. Remove the 10A41-2C card from its mainframe slot. For "Card Insertion and Removal," see Manual Section 1.B. Since the 10A41-2C is "hot-pluggable," you need NOT turn off mainframe power before removing the card.
2. Locate the INPUT VOLTAGE JUMPER PINS shown in Fig. 3, above. One "mini-jumper" is provided for each 10A41-2C channel, for interconnecting any two adjacent jumper pins.
3. Position the jumper for each channel as shown in Fig. 3 to set the desired voltage range for that channel. NOTE THAT ALL RANGES ARE PROTECTED AGAINST AN OVERLOAD OF UP TO 200 V.
4. Keep out the 10A41-2C card for the filter selection procedure, below.

3.b SELECTING FILTER BANDWIDTH

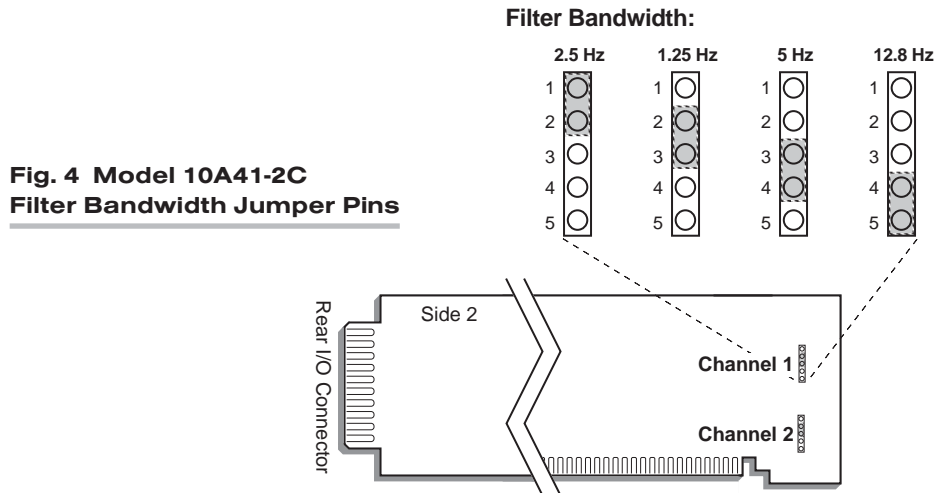
Every 10A41-2C card is preset, at the factory, for the lowest filter bandwidth (1.25 Hz). While yielding the slowest response, this setting also provides the *widest dynamic range*. If a faster response is more important than dynamic range, you may select one of three higher bandwidth values (2.5 Hz, 5 Hz, or 12.8 Hz) for a 10A41-2C's Channel No. "x," as follows:

1. Make sure Channel No. x has been properly "typed" and "located" (see Manual Section 1.G.1).
2. Locate the FILTER BANDWIDTH JUMPER PINS on the 10A41-2C board (see Fig. 4, below). One "minijumper" is provided for each channel, for interconnecting any two adjacent jumper pins.

3. Position the jumper for each channel as shown in Fig. 4 to set the desired filter bandwidth for that channel.
4. Reinsert the 10A41-2C in its mainframe slot.
5. TURN **OFF** THE SYSTEM MAINFRAME. Short both the +SIGNAL and –SIGNAL pins for Channel No. x to POWER COMMON (**Pin 5 or 10**).
6. Reactivate mainframe power.
7. You must now “zero” the channel. Turn ON the EEPROM SWITCH and enter a command of

ZRO x [CR]
8. Turn OFF the system mainframe once more, reconnect the +SIGNAL and –SIGNAL pins to the channel's normal frequency source (see cabling, above), and reactivate mainframe power.

IMPORTANT: WHENEVER YOU CHANGE THE FILTER BANDWIDTH FOR A 10A41-2C CHANNEL, YOU **MUST** PERFORM STEPS 5 THROUGH 8, ABOVE.



3.C CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A41-2C card when used in System 10, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A41-2C channel “type” codes, see Table 2, above.

You can use three calibration methods with the Model 10A41-2C:

ABSOLUTE CALIBRATION

Described in Manual Section 1.G.3.b, this method is applicable only when the 10A41-2C is being used to measure *frequency itself* (in Hz). In this case, the user need only specify an appropriate SCALING FACTOR (“m” coefficient), once the 10A41-2C-based input channel has been properly configured.

Thus, to calibrate a 10A41-2C-based Channel No. “x,” you need only turn ON the system EEPROM SWITCH and then apply the following **SCALING FACTOR (EMM)** command:

EMM x = m [CR]

where “m” equals *the full-scale range corresponding to the channel's present TYPE designation, expressed to the precision desired for the channel's data readings.* Channel “type” codes and associated full-scale ranges are given in Table 2, above. If, for example, a frequency-measuring 10A41-2C channel is “typed” as “43” (corresponding to a full scale of 2000 Hz) and you want the channel to read *tenths of a hertz*, you would enter an “m” value of “2000.0.”

NOTE: The accuracy of “absolute” calibration of a 10A41-2C-based channel is limited to $\pm 0.05\%$ of full scale.

CALCULATED CALIBRATION

This is generally the most convenient means of calibrating a 10A41-2C channel, when the full-scale rating of the frequency source (or the highest frequency expected to be measured) is accurately known.

Thus, to calibrate a 10A41-2C-based Channel No. “x,” you need only turn ON the system EEPROM SWITCH and then apply the following **FREQUENCY CALIBRATION (FRQ)** command:

FRQ x = i, u [CR]

For “i,” enter the manufacturer-supplied *full-scale rating* of the frequency source (or the highest frequency expected to be measured), in *hertz*. For “u,” enter the corresponding value of the measured phenomenon, expressed in the desired engineering units. You need not *zero* the channel in this case. The **FRQ** command will only work if Channel No. x has been assigned the proper “type” code (see Table 2).

Note that a channel calibrated by the **FRQ** command will report measurement data to a precision matching that of the entered “u” value. If, for example, you're measuring “liters per minute,” and enter a “u” of “750,” then all subsequent channel readings will be rounded to the nearest liter per minute. If the entry is “750.0,” then all readings will be rounded to the nearest tenth of a liter per minute.

TWO-POINT (DEADWEIGHT) CALIBRATION

Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional “zero and span” method can be applied to a 10A41-2C channel if the full-scale rating of the frequency source is unknown, and if the channel's received frequency input is an *analog of another parameter*—such as Gallons Per Minute—which has one or more independently and accurately known calibration values. It can also be used to improve the **ABSOLUTE** calibration of an input that measures frequency itself (beyond the 10A41-2C card's inherent limit of $\pm 0.05\%$ of full scale). The mainframe's **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

MODEL 10A43

DWELL ANGLE CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

This signal conditioner is dedicated to the monitoring of internal combustion engines. Specifically, it measures dwell angle and RPM for any engine employing an **ignition system with distributor points**. The engine can contain any standard number of cylinders, operating at any standard number of cycles. The 10A43's single true-differential input is connected across the distributor points, as shown in Fig. 1.

From the measured frequency of point closure, the 10A43 derives two linearized data "Subchannels," with corresponding analog outputs to wire-wrap pins:

- **Subchannel No. 1:** *Dwell angle* of the distributor cam shaft—i.e., the fraction of the total rotational time during which points are closed, expressed as degrees of angle
- **Subchannel No. 2:** *Engine RPM*

As explained in Section 3.a, each subchannel is calibrated by entering an appropriate System 10 **SCALING FACTOR (EMM)** command. For the "type" codes assigned to 10A43 subchannels, see Table 1, below.*

ADDITIONAL 10A43 SPECIFICATIONS

Measurement Characteristics (*applying to both channels, unless otherwise indicated*):

Normal-Mode Range: ± 15 V operating; ± 1000 V spike or ± 30 V continuous without instrument damage

Common-Mode Range: ± 15 V operating; ± 1000 V spike or ± 30 V continuous without instrument damage

Common-Mode Rejection Ratio: DC: -40 dB; at 60 Hz: -40 dB; at 1 kHz: -30 dB; at 3 kHz: -20 dB

Input Impedance: Differential: 20 k Ω ; Common-Mode: 7.5 k Ω

Offset (Dwell Angle Channel): Initial: $\pm 0.15\%$ of full scale; vs. Temperature: ± 25 ppm/ $^{\circ}$ C; vs. Time: ± 20 ppm/month

Offset (RPM Channel): Initial: $\pm 0.05\%$ of full scale; vs. Temperature: ± 25 ppm/ $^{\circ}$ C; vs. Time: ± 20 ppm/month

Gain Accuracy (Dwell Angle Channel): $\pm 0.02\%$ of full scale *typical*, following calibration**

Gain Accuracy (RPM Channel): $\pm 0.02\%$ of full scale

(cont'd)

* As shown in Table 1, the "type" code assigned to the RPM Subchannel (No. 2) will depend on the maximum expected RPM as a function of the engine's Number of Cycles divided by its Number of Cylinders.

** Initial (uncalibrated) inaccuracy may be as great as $\pm 0.15\%$ of full scale. Maximum error that could occur upon replacement of a Model 10A43 *not followed by calibration* is $\pm 0.3\%$ of full scale.

10A43 DWELL ANGLE CARD

Gain Stability: vs. Temperature: ± 25 ppm/ $^{\circ}\text{C}$; vs. Time: ± 20 ppm/month

Filter (per channel): 3-pole modified Butterworth; 3 dB down at 1.5 Hz; 60 dB down at 60 Hz

Step-Response Settling Time (Full-Scale Output):

- To 1% of final value: 600 msec
- To 0.1% of final value: 900 msec
- To 0.02% of final value: 1 sec

Auxiliary Outputs: Filtered outputs available on mainframe wire-wrap pins

Table 1 10A43 "Type" Codes

	Channel Type Code
Dwell Angle Channel	40
Engine RPM Channel:	
Maximum Expected RPM* = $K \times 7500$	40
Maximum Expected RPM* = $K \times 15000$	41
Maximum Expected RPM* = $K \times 30000$	42

2 TRANSDUCER CONNECTIONS

The Model 10A43's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Fig. 1 shows how the +SIGNAL and -SIGNAL pins are to be wired to the engine. Connect the +SIGNAL line (from **Pin 3**) directly to the "most negative" terminal of the engine's coil (i.e., the terminal which is connected to the condenser, not to the battery). Connect the -SIGNAL line (from **Pin C**) either to the *negative terminal of the vehicle battery* or directly to the *vehicle chassis* (GROUND).

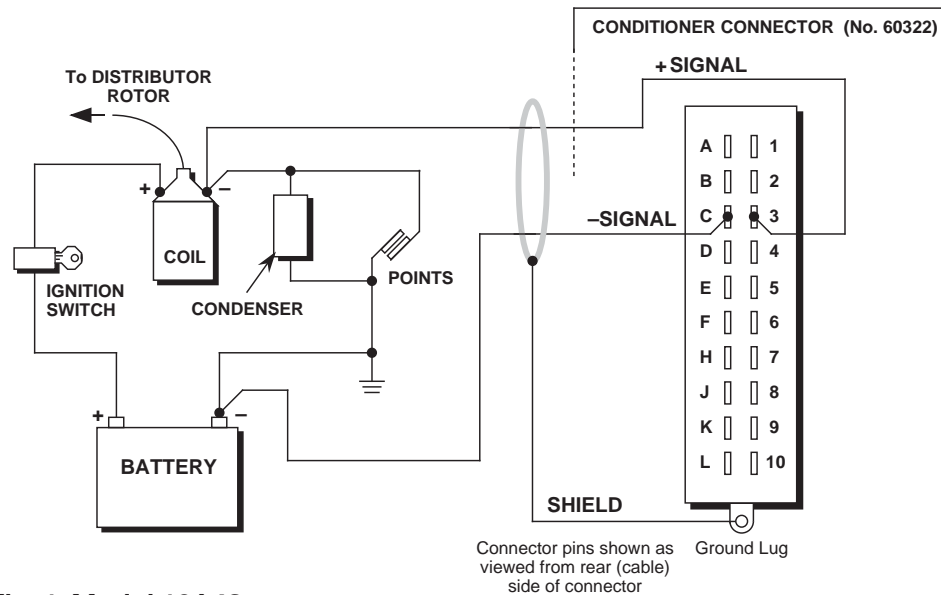


Fig. 1 Model 10A43 Transducer Cabling

* With allowable overrange of 20% of full scale. Here, $K = (\text{No. of Cycles}) / (\text{No. of Cylinders})$.

3 **SETUP AND/OR OPERATING CONSIDERATIONS**

3.a CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A43 card, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A43 channel “type” codes, see Table 1, above.

Each 10A43 subchannel is calibrated by entering an appropriate **SCALING FACTOR (EMM)** command, after first turning ON the system EEPROM SWITCH:

1. For the DWELL ANGLE SUBCHANNEL, enter a command of

EMM x = m [CR]

where “x” is the number of the system data channel that has been “located” to the 10A43's Subchannel No. 1, and “m” is a numeric value determined solely by the characteristics of the engine, as follows:

$$m = (90.0 \times \text{No. of Cycles}) / (\text{No. of Cylinders})$$

2. For the RPM SUBCHANNEL, enter the same **EMM** command, where “x” is now the number of the channel that has been “located” to the 10A43's Subchannel No. 2, and where the value “m” is at least 80% of the *maximum expected RPM to be measured*.

10A43 DWELL ANGLE CARD

MODEL 10A45

SIMMONDS SHAFT TORQUE SENSOR CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 10A45 has been specially designed to receive, condition, and process the TORQUE, REFERENCE TORQUE, and THERMISTOR signals generated by a **Simmonds Precision Model T6 Shaft Torque Sensor** operating from 30 to 32000 Hz.* Using a phase displacement technique, this sensor has proven very successful in the accurate measurement of shaft torque, speed, and temperature developed by jet and other high-power engines—even in the presence of phase modulation produced by differential radial displacement of the shaft assembly and of high torsional vibration caused by radial runout, erratic loading, etc.

Connected to the Simmonds Shaft Torque Sensor via 6- or 8-wire shielded cable, the 10A45 provides three linearized “Subchannels,” with corresponding analog outputs to wire-wrap pins:

- **Subchannel No. 1:** SHAFT TORQUE
- **Subchannel No. 2:** SHAFT SPEED in RPM
- **Subchannel No. 3:** SHAFT TEMPERATURE—this data is necessary for accurate compensation of the torsional modulus of the shaft material.

By application of a simple System 10 **CALCULATE (CLC)** command on the torque and RPM channels, *horsepower* indication is also easily obtained (see Section 3.b, below).

ADDITIONAL 10A45 SPECIFICATIONS

Input Signals: TORQUE SIGNAL, TORQUE REFERENCE, and THERMISTOR SIGNAL from Simmonds Precision Model T6 Shaft Torque Sensor, operating from 30 to 32000 Hz*; all analog input channels derived from a Model 10A45 are to be “typed” as “55” (see Section 3.a)

Thermistor Excitation: 0.5 V-DC

Measurement Characteristics (Torque and RPM Channels):

Normal-Mode Range: ± 1.4 V operating; ± 150 V without instrument damage

Input Impedance: 100 k Ω

Offset: Initial: $\pm 0.04\%$ of full scale; vs. Temperature: ± 20 ppm/ $^{\circ}$ C; vs. Time: ± 20 ppm/month

Gain Accuracy: $\pm 0.02\%$ of full scale *typical*, following calibration**

Gain Stability: vs. Temperature: ± 50 ppm/ $^{\circ}$ C; vs. Time: ± 20 ppm/month

(cont'd)

* Under special conditions, it may also be used with certain similar transducers. Contact the factory for more information.

** Initial (uncalibrated) inaccuracy may be as great as $\pm 0.05\%$ of full scale. Maximum error that could occur upon replacement of a Model 10A45 *not followed by calibration* is $\pm 0.1\%$ of full scale.

Measurement Characteristics (Temperature Channel):

Normal-Mode Range: ±0.5 V operating; ±15 V without instrument damage

Input Impedance: 1 kΩ

Offset: Initial: ±0.05% of full scale; vs. Temperature: ±50 ppm/°C; vs. Time: ±50 ppm/month

Gain Accuracy: ±0.02% of full scale *typical*, following calibration*

Gain Stability: vs. Temperature: ±100 ppm/°C; vs. Time: ±100 ppm/month

Filter (per channel): 3-pole modified Butterworth; 3 dB down at 10 Hz; 60 dB down at 60 Hz

Step-Response Settling Time (Full-Scale Output):

- To 1% of final value: 150 msec
- To 0.1% of final value: 200 msec
- To 0.02% of final value: 250 msec

Auxiliary Outputs: Filtered outputs available on mainframe wire-wrap pins

2 TRANSDUCER CONNECTIONS

The Model 10A45's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Table 1 gives standard pin assignments for the I/O Connector. With regard to 10A45 cabling, please note the following:

- a. The 6-wire cabling shown in Fig. 1(a) is to be used when the cable is under 20 feet in length. In this case, the THERMISTOR EXCITATION and THERMISTOR SIGNAL lines (**Pin A** and **Pin 2**, respectively) are tied to the corresponding SENSE lines at the *CONDITIONER CONNECTOR* (**Pin B** and **Pin 1**, respectively).
- b. The 8-wire cabling shown in Fig. 1(b) is to be used when the cable is 20 feet or longer. In this case, the THERMISTOR EXCITATION and THERMISTOR SIGNAL lines are tied to the corresponding SENSE lines at the *transducer*.

Table 1 Model 10A45 Pin Assignments

I/O Connector Pin Number	Conditioner Line Function
1	THERMISTOR SIGNAL SENSE
A	THERMISTOR EXCITATION (+0.5 V-DC)
2	THERMISTOR SIGNAL
B	THERMISTOR EXCITATION SENSE
3	TORQUE SIGNAL
C	TORQUE REFERENCE SIGNAL
4,D,5	Not Committed
E	SIGNAL COMMON
6-10, F-J	Not Committed
K	SIGNAL COMMON
L	Not Committed

Fig. 1 Model 10A45 Transducer Cabling

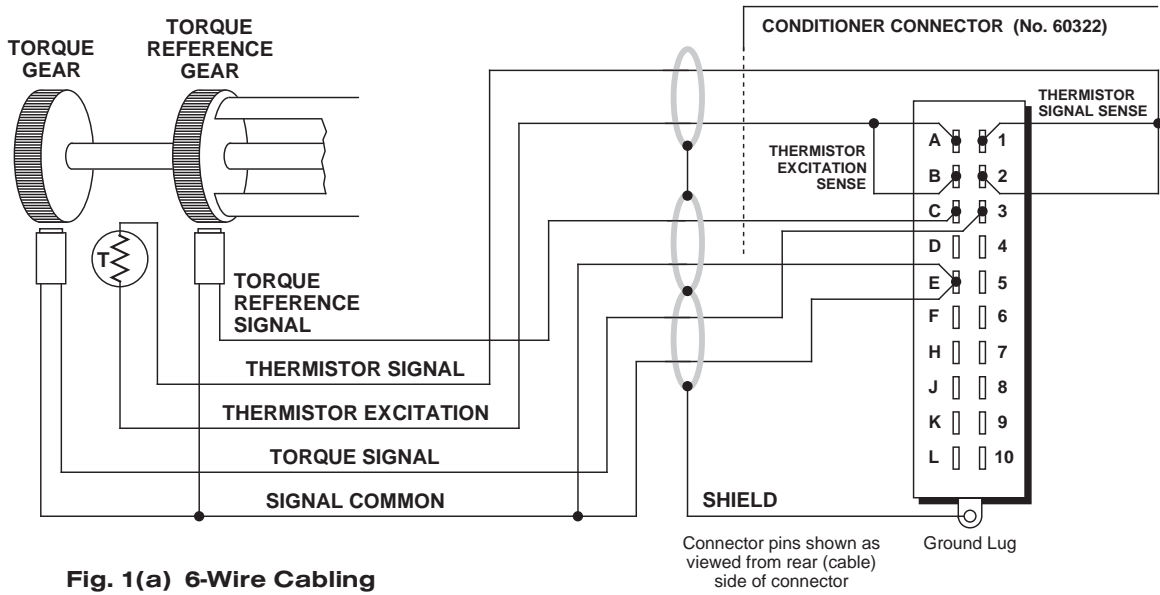


Fig. 1(a) 6-Wire Cabling (under 20 ft. in length)

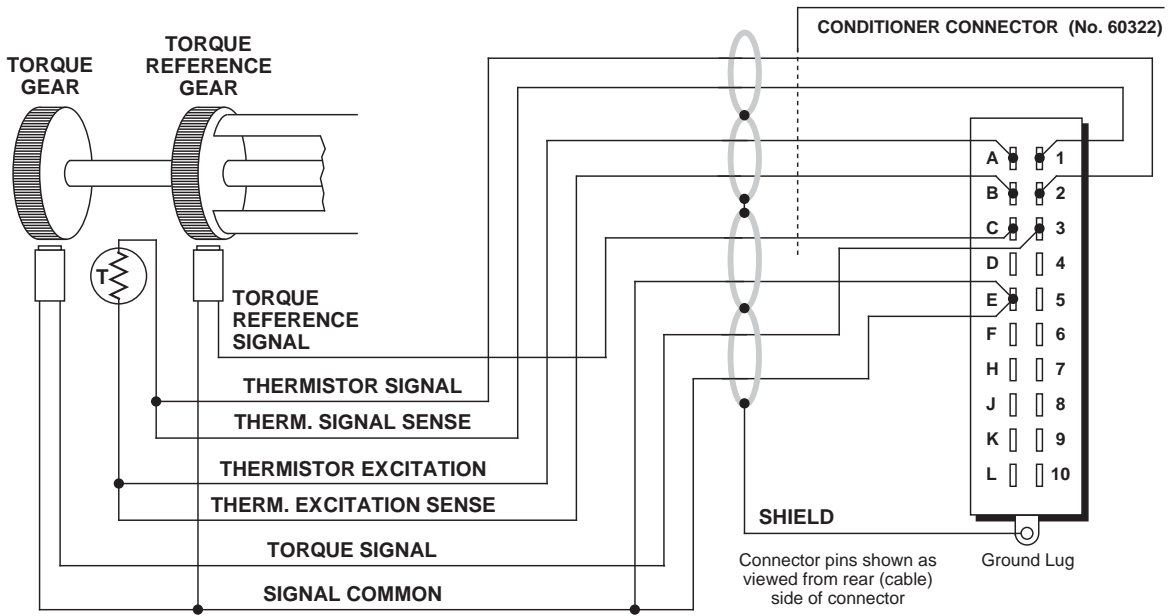


Fig. 1(b) 8-Wire Cabling (20 ft. or longer)

3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A45 card, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. All analog input channels derived from a Model 10A45 must be given a channel “type” code of **55** (“raw” millivolt signal).

The 10A45's SHAFT TORQUE SUBCHANNEL (No. 1) and SHAFT SPEED SUBCHANNEL (No. 2) both employ **TWO-POINT (DEADWEIGHT)** calibration, using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands. The mainframe's **EEPROM Write Protect Switch** must be ON for these commands to be effective. See Manual Section 1.G.5 for general instructions on this conventional “zero and span” technique.

The 10A45's SHAFT TEMPERATURE SUBCHANNEL (No. 3) employs **CPU-BASED ABSOLUTE** calibration (described in Manual Section 1.G.3.a), which means that normally NO calibration need be performed by the user, once the channel has been properly configured.

3.b HORSEPOWER CALCULATION

If system Channel No. “y” has been “located” to the 10A45's SHAFT TORQUE SUBCHANNEL (No. 1), and Channel No. “z” to the SHAFT SPEED SUBCHANNEL (No. 2), then a system “CALCULATE PSEUDOCHANNEL No. x” can be easily set up to monitor and/or display the resultant horsepower. Assuming that Channel No. y is currently reading *footpounds*, you need only turn ON the system EEPROM SWITCH and command

$$\text{CLC } x = (\text{CHN } y)(\text{CHN } z)/5252 \text{ [CR]}$$

If torque is being measured in *newton-meters*, the divisor would be “7121.”

MODEL 10A48

MODULATED CARRIER FLOW CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

Supplying a 36-kHz modulated carrier signal for excitation, the single-channel Model 10A48 is designed to condition the output of a **reluctance-pickup turbine flow-meter** operating in the range of 15 to 2200 Hz.* The use of AC excitation eliminates drag on the flowmeter impeller, which at low flow rates can cause significant error.

The 10A48 yields two linearized “subchannels,” with corresponding analog outputs to wire-wrap pins:

- **Subchannel No. 1:** VOLUMETRIC RATE OF FLOW
- **Subchannel No. 2:** a special TRANSDUCER ALIGNMENT VALUE which will be used to match the conditioner to a particular type of flowmeter (see Section 3.a, below).

Through appropriate scaling, you can express the flow-rate data in terms of any desired unit (e.g., cubic feet per minute, gallons per hour, grams per second, etc.).

In addition, the 10A48 issues a conditioned pulse-train TOTALIZER OUTPUT both from its rear I/O Connector and from a wire-wrap pin. This output (± 8.5 V at 0 to 1800 Hz) is precisely proportional to the measured rate of flow. By connecting this pulse signal as input to a **Model 10ACT01 Counter/Timer Card** or **Model 10ACC-4 Four-Channel Totalizer Card**, you can thereby count (or “totalize”) the number of flowmeter revolutions that have occurred over a given period of time. From this data, along with the calibration data supplied with the flowmeter itself and the System 10 **CALCULATE (CLC)** command, you can obtain a temperature-corrected mass-flow reading for that period. Use of the totalizer output is discussed in Section 3.c, below.

Calibration of the 10A48 involves application of the System 10 **SCALING FACTOR (EMM)** command, following adjustment of an internal phase-correction potentiometer based on the special “transducer alignment” subchannel (see Sections 3.a and 3.b).

ADDITIONAL 10A48 SPECIFICATIONS

Transducer Types and Ranges: Any reluctance-pickup turbine flowmeter producing from 15 to 2200 pulses per second, irrespective of waveform; for the System 10 channel “type” codes assigned to 10A48 data channels, see Table 1, below

Excitation: Varies with flowmeter; approximately 1 V-AC, typically, at 36 kHz

Measurement Characteristics:

Normal-Mode Range: ± 2.5 V operating; ± 12 V without instrument damage

Input Impedance: 820 k Ω

(cont'd)

* I.e., *pulses per second*, where one complete revolution of the flowmeter impeller will produce as many pulses as there are impeller blades.

Offset: Initial: $\pm 0.02\%$ of full scale; vs. Temperature: ± 20 ppm/ $^{\circ}\text{C}$; vs. Time: ± 20 ppm/month

Gain Accuracy: $\pm 0.02\%$ of full scale

Gain Stability: vs. Temperature: ± 20 ppm/ $^{\circ}\text{C}$; vs. Time: ± 20 ppm/month

Filter: 3-pole modified Butterworth; 3 dB down at 2 Hz; 60 dB down at 25 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 600 msec

To 0.1% of final value: 750 msec

To 0.02% of final value: 1 sec

Auxiliary Outputs: Filtered outputs available on mainframe wire-wrap pins

Table 1 10A48 "Type" Codes

	Channel Type Code
Flow Channel	40
Alignment Channel	55

2 TRANSDUCER CONNECTIONS

The Model 10A48's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Standard cabling is shown in Fig. 1, below; standard pin assignments for the I/O connector are given in Table 2.

Fig. 1 Model 10A48 Transducer Cabling

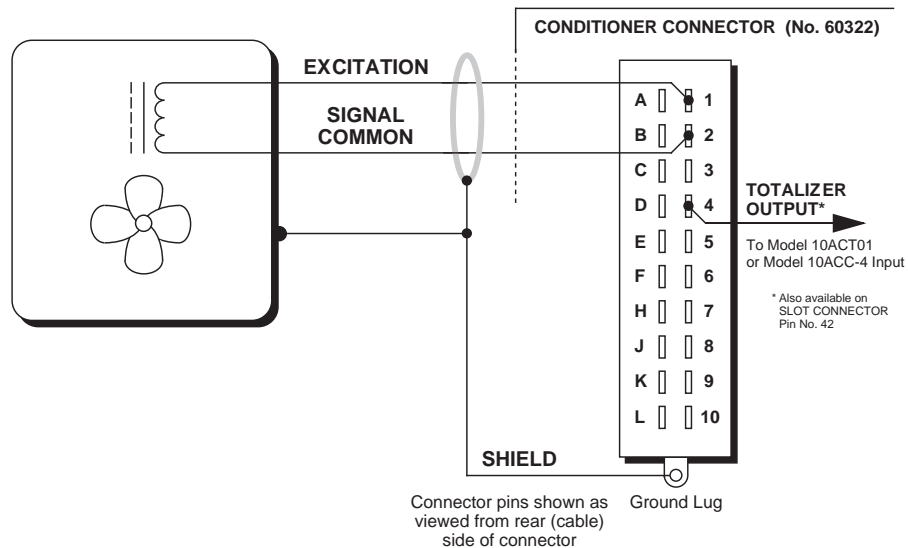


Table 2 Model 10A48 Pin Assignments

I/O Connector Pin Number	Conditioner Line Function
1	EXCITATION (approx. 1 V-AC)
2,5	SIGNAL COMMON
4	TOTALIZER OUTPUT
3, 6-10	Not Committed
A-L	Not Committed

3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a TRANSDUCER ALIGNMENT ADJUSTMENTS

1. With the proper transducer connections in place, select an unused system Channel No. "x" to read the 10A48's "ALIGNMENT" subchannel (No. 2). Turn ON the system EEPROM Switch and configure Channel No. x as follows:
 - a. Assign a "TYPE" code of "55" to Channel No. x by commanding
TYP x = 55 [CR]
 - b. "Locate" Channel No. x to the 10A48 card's Subchannel No. 2, via the **LOCATE (LCT)** command (see Manual Section 1.G.1).
 - c. Assign a SCALING FACTOR code of "10000" to Channel No. x by commanding
EMM x = 10000 [CR]
 - d. Assign a ZERO OFFSET of "0" to Channel No. x by commanding
BEE x = 0 [CR]
 - e. Assign a digital FILTER constant of "3" to Channel No. x by commanding
FIL x = 3 [CR]
2. Provide a "live" display of Channel No. x.
3. Remove the front bezel for the A-card rack containing the 10A48 card.
4. Without removing the 10A48 card from its slot, locate the two TRANSDUCER ALIGNMENT POTENTIOMETER CONTROLS, which are accessible from the front of the card.
5. Using a small insulated screwdriver, turn the screw of the *upper* control fully *clockwise*.
6. Then adjust the *lower* control until the displayed reading of Channel No. x attains a *maximum positive value*.
7. Now turn the *upper* control *counterclockwise* until you obtain a reading of 120 ± 5 .
8. Readjust the *lower* control to again obtain a maximum positive reading.
9. Readjust the *upper* control to obtain a reading of 120.
10. Continue to readjust the lower and upper controls in this fashion until a maximum reading of 120 ± 5 is obtained.

After this initial setting, there is no further need to adjust the potentiometer controls unless a different type of flowmeter or a different cable length is to be used with the 10A48.

3.b CONFIGURATION AND CALIBRATION

For initial configuration of the ANALOG INPUT CHANNEL dedicated to a Model 10A48 card's RATE-OF-FLOW subchannel (No. 1), see the general remarks on System 10 "real-channel" configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. This channel must be assigned a "type" code of **40**.

To calibrate the Model 10A48's RATE-OF-FLOW subchannel (No. 1), you should turn ON the system EEPROM Switch and apply a **SCALING FACTOR (EMM)** command of

$$\text{EMM } x = i [\text{CR}]$$

where "x" is the number of the system data channel assigned to the 10A48's Sub-channel No. 1 and "i" is the *actual flow rate at 2000 Hz, expressed in the desired engineering units*. Note that the **FREQUENCY CALIBRATION (FRQ)** command will NOT produce correct calibration for the 10A48.

3.c USE OF TOTALIZER OUTPUT TO OBTAIN A TOTAL VOLUME OR TOTAL MASS READING

As mentioned in Section 1, above, the 10A48's pulse-train TOTALIZER OUTPUT is precisely proportional to the measured rate of flow, and is issued both from the 10A48's rear I/O Connector (**Pin 4**) and from a wire-wrap pin on the mainframe's Analog Motherboard that connects to **Pin 42** of the 10A48's Slot Connector.

By connecting this signal to a **Model 10ACT01 Counter/Timer Card** or to a **Model 10ACC-4 Totalizer Card**, you can count the number of flowmeter "pulses" that have occurred over a given period of time. From this data, along with the calibration data supplied with the flowmeter itself, you can obtain a *total volume* or *total mass* reading for that period, in any desired engineering units.

1. Make sure the system EEPROM Switch is OFF, and turn OFF the System 10 mainframe.
2. Remove the 10A48 card from its mainframe slot. For "Card Insertion and Removal," see Manual Section 1.B.
3. Locate the solder pads labelled "TOTAL" on the bottom (non-component) side of the 10A48 board.
4. To make the TOTALIZER OUTPUT available both at Pin 4 of the rear I/O Connector and at Pin 42 of the Slot Connector, apply a drop of solder to bridge the two pads.
5. Reinsert the 10A48 card in its mainframe slot.
6. Connect the TOTALIZER OUTPUT to the Model 10ACT01 or 10ACC-4 (for pin connections, see the respective section of the *System 10 Guidebook*).
7. The 10ACT01 or 10ACC-4 Channel No. "y" which is to read the TOTALIZER OUTPUT must be set to a "TYPE" code of "C2" and a *count increment* (1, 10, or 100) that satisfies your total volume or mass requirements (again, see the 10ACT01 or 10ACC-4 manual section for details).

8. You must now determine a SCALING FACTOR “m” according to the equation

$$m = V \times E \times R$$

where

- “V” is the VOLUME (or MASS) EQUIVALENT for one pulse of the flowmeter, as given in the calibration data supplied with the flowmeter
 - “E” is the *conversion factor* for changing the volume or mass units given in the flowmeter datasheet to the units desired for the final volume or mass measurement; e.g., if the calibration data supplied with the flowmeter uses *cubic feet* and you want the final measurement to be in *cubic meters*, $E = 0.028$ (m^3/ft^3)
 - “R” is the “range factor”—in this case, the *count increment*—to which Channel No. y has been set in Step 7, above ($R = 1, 10, \text{ or } 100$).
9. Now set up a CALCULATE PSEUDOCHANNEL No. “z” to represent total volume or mass. Turn ON the system EEPROM Switch and enter a command of

$$CLC z = m(CHN y) + 0 [CR]$$

where “m” is the SCALING FACTOR calculated in Step 8. NOTE: Additional CALCULATE PSEUDOCHANNELS can easily be set up to produce temperature-corrected *mass flow* (see Manual Section 2.J, and contact the factory for detailed instructions).

10A48 FLOW CARD

MODEL 10A60-4

QUAD VOLTAGE CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 10A60-4 is a general-purpose conditioner allowing input of up to four **external voltage signals**. Mixed as desired, these may originate from DC-to-DC LVDT's, potentiometer-type sensors, and other 2-wire analog signal sources that *provide their own power supply*. Or they may represent the outputs of other instrument systems having various voltage levels and grounding configurations.

Inputs can be either floating (differential) or grounded (single-ended). With differential inputs, generous common-mode range and excellent common-mode rejection eliminate ground-coupling errors and other problems normally associated with off-ground signal sources. Chopper-stabilized DC amplification with active low-pass filtering yields smooth and stable measurement of the true average value of the input variable, even in the face of substantial dynamic content.

ADDITIONAL 10A60-4 SPECIFICATIONS

Transducer Types: 2-wire DC voltage sources, grounded or floating

Input Voltage Ranges: ± 0.5 , 1.0, 2.0, 5.0, 10, or 20 V-DC; automatically selected—on an individual channel basis—when the channel is configured; for the System 10 channel "type" codes assigned to 10A60-4 data channels, see Table 1, below

Amplifier (per channel):

Normal-Mode Range: ± 20 V operating; ± 200 V without instrument damage

Common-Mode Range: ± 50 V operating; ± 300 V without instrument damage

Common-Mode Rejection Ratio: DC: -60 dB; at 60 Hz: -70 dB

Input Impedance: Differential: 2 M Ω ; Common-Mode: 0.5 M Ω

Offset: Initial: ± 0.5 mV; vs. Temperature: ± 0.005 mV/ $^{\circ}$ C; vs. Time: ± 0.05 mV/month

Gain Accuracy: $\pm 0.02\%$ of full scale *typical*, following calibration*

Gain Stability: vs. Temperature: ± 50 ppm/ $^{\circ}$ C; vs. Time: ± 50 ppm/month

Filter (per channel): 3-pole modified Butterworth; 3 dB down at 10 Hz; 60 dB down at 100 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 150 msec

To 0.1% of final value: 200 msec

To 0.02% of final value: 250 msec

Auxiliary Outputs: Filtered outputs available on mainframe wire-wrap pins

* Initial (uncalibrated) inaccuracy may be as great as $\pm 1.5\%$ of full scale. Maximum error that could occur upon replacement of a Model 10A60-4 *not followed by calibration* is $\pm 3\%$ of full scale.

10A60-4 QUAD DC VOLTAGE CARD

Table 1 10A60-4 "Type" Codes

Full-Scale Range	Channel Type Code
±0.5 V-DC	5A
±1.0 V-DC	5B
±2.0 V-DC	5C
±5.0 V-DC	5D
±10.0 V-DC	5E
±20.0 V-DC	5F

2 TRANSDUCER CONNECTIONS

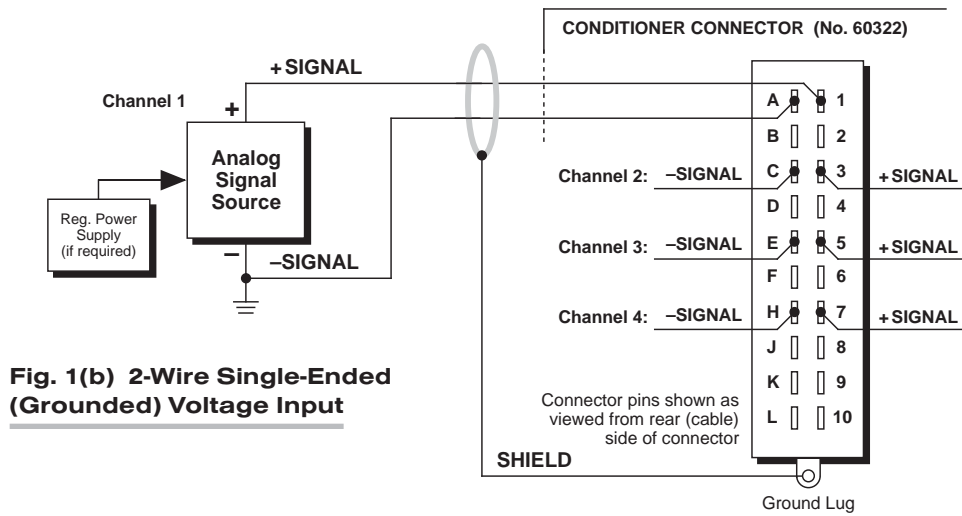
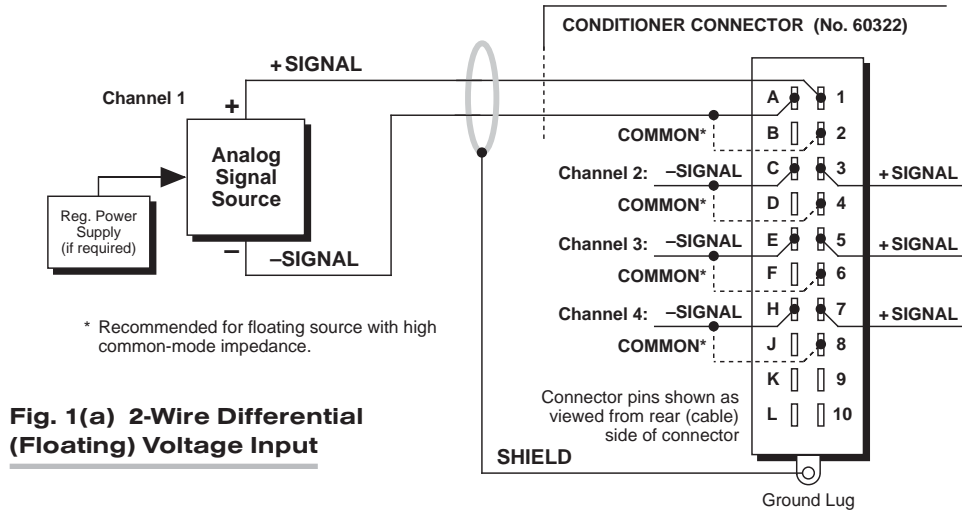
The Model 10A60-4's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Table 2 gives standard pin assignments for the I/O Connector.

Cabling for *floating inputs* is given in Fig. 1(a). NOTE: To minimize signal noise, it is recommended that for a floating (ungrounded) input with high common-mode impedance, the COMMON pin be tied to the -SIGNAL line at the connector. Cabling for *grounded inputs* is shown in Fig. 1(b).

Table 2 Model 10A60-4 Pin Assignments

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	+SIGNAL
A	1	-SIGNAL
2	1	COMMON
B		Not Committed
3	2	+SIGNAL
C	2	-SIGNAL
4	2	COMMON
D		Not Committed
5	3	+SIGNAL
E	3	-SIGNAL
6	3	COMMON
F		Not Committed
7	4	+SIGNAL
H	4	-SIGNAL
8	4	COMMON
J		Not Committed
9,K,10,L		Not Committed

Fig. 1 Model 10A60-4 Transducer Cabling



3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A60-4 card when used in System 10, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A60-4 channel “type” codes, see Table 1, above.

In System 10, you can use two calibration methods with the Model 10A60-4:

ABSOLUTE CALIBRATION

Described in Manual Section 1.G.3.b, this method is applicable only when the 10A60-4 is being used to measure *voltage itself*. In this case, the user need only specify an appropriate SCALING FACTOR (“m” coefficient), once the 10A60-4-based input channel has been properly configured.

Thus, to calibrate a 10A60-4-based Channel No. “x,” you need only turn ON the system EEPROM SWITCH and then apply the following **SCALING FACTOR (EMM)** command:

$$\text{EMM } x = (1.25) m \text{ [CR]}$$

where “m” equals *the full-scale range corresponding to the channel’s present TYPE designation, expressed to the precision desired for the channel’s data readings*. Channel “type” codes and associated full-scale ranges are given in Table 1, above.

Note that for the Model 10A60-4 (ONLY), the entered “m” value must be 1.25 times the stated full-scale range for the respective channel “type.”

If, for example, a voltage-measuring 10A60-4 channel is “typed” as “5D” (corresponding to a full scale of ± 5 V-DC) and you want the channel to read *hundredths of a volt*, you would enter an “m” value of “6.25” ($= 1.25 \times 5.00$).

NOTE: The accuracy of “absolute” calibration of a 10A60-4-based channel is limited to $\pm 1.5\%$ of full scale.

TWO-POINT (DEADWEIGHT) CALIBRATION

Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional “zero and span” method can be applied to a 10A60-4 channel if the received voltage input is an *analog of another parameter* which has one or more independently and accurately known calibration values. It can also be used to improve the ABSOLUTE calibration of an input that measures voltage itself (beyond the 10A60-4 card’s inherent limit of $\pm 1.5\%$ of full scale). The mainframe’s **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

MODEL 10A61-2

DUAL 4-20 mA CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 10A61-2 accepts one or two independent **current signals** within the ISA standard range of 4-20 mA. Both unipolar and bipolar (“zero-center”) inputs are allowed. Since the 10A61-2 does not provide excitation, the current source must supply its own power supply, if required.

Chopper-stabilized amplification with active low-pass filtering yields excellent voltage compliance and make the 10A61-2 suitable for virtually any standard Process Industry current input.

ADDITIONAL 10A61-2 SPECIFICATIONS

Input Current: 4 to 20 mA (unipolar) or 4 to 12 to 20 mA (bipolar or “zero-center”); automatically selected—on an individual channel basis—when the channel is configured; for the System 10 channel “type” codes assigned to 10A61-2 data channels, see Table 1, below

Amplifier (per channel):

Common-Mode Range: ± 50 V operating; ± 90 V without instrument damage

Common-Mode Rejection Ratio: DC: -60 dB; at 60 Hz: -75 dB

Input Impedance: Differential: 100 Ω ; Common-Mode: 125 k Ω

Burden: 2 V-DC at full scale

Offset: Initial: $\pm 0.05\%$ of full scale; vs. Temperature: ± 50 ppm/ $^{\circ}$ C; vs. Time: ± 20 ppm/month

Gain Accuracy: $\pm 0.02\%$ of full scale *typical*, following calibration*

Gain Stability: vs. Temperature: ± 50 ppm/ $^{\circ}$ C; vs. Time: ± 50 ppm/month

Filter (per channel): 3-pole modified Butterworth; 3 dB down at 10 Hz; 60 dB down at 100 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 150 msec

To 0.1% of final value: 200 msec

To 0.02% of final value: 250 msec

Auxiliary Outputs: Filtered outputs available on mainframe wire-wrap pins

* Initial (uncalibrated) inaccuracy may be as great as $\pm 0.05\%$ of full scale. Maximum error that could occur upon replacement of a Model 10A61-2 *not followed by calibration* is $\pm 0.1\%$ of full scale.

10A61-2 DUAL 4-20 MA CARD

Table 1 10A61-2 "Type" Codes

Full-Scale Range	Channel Type Code
4-20 mA	6C
4-12-20 mA	6D

2 TRANSDUCER CONNECTIONS

The Model 10A61-2's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Standard cabling is shown in Fig. 1. Table 2 gives standard pin assignments for the I/O Connector.

Table 2 Model 10A61-2 Pin Assignments

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	+TEST*
A	1	-TEST*
2	1	+SIGNAL
B	1	-SIGNAL
3	1	+SIGNAL
C	1	-SIGNAL
5	1	COMMON
4,D,E		Not Committed
6	2	+TEST*
F	2	-TEST*
7	2	+SIGNAL
H	2	-SIGNAL
8	2	+SIGNAL
J	2	-SIGNAL
10	2	COMMON
9,K,L		Not Committed

* For factory use only.

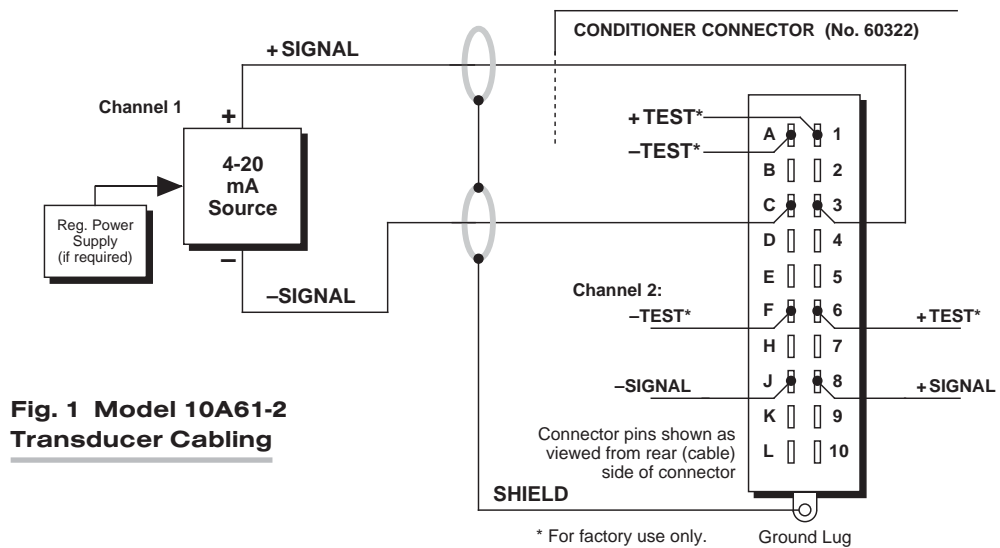


Fig. 1 Model 10A61-2 Transducer Cabling

* For factory use only.

Ground Lug

3 **SETUP AND/OR OPERATING CONSIDERATIONS**

3.a CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A61-2 card when used in System 10, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A61-2 channel “type” codes, see Table 1, above.

In System 10, you can use two calibration methods with the Model 10A61-2:

ABSOLUTE CALIBRATION

Described in Manual Section 1.G.3.b, this method is applicable only when the 10A61-2 is being used to measure *milliamperage itself*. In this case, the user need only specify an appropriate SCALING FACTOR (“m” coefficient), once the 10A61-2-based input channel has been properly configured.

Thus, to calibrate a 10A61-2-based Channel No. “x,” you need only turn ON the system EEPROM SWITCH and then apply the following **SCALING FACTOR (EMM)** command:

EMM x = m [CR]

where “m” equals the channel’s *full-scale range in milliamperes*—which is 20 mA, regardless of whether the channel is set to “unipolar” or “bipolar” mode. *This number should be expressed to the precision desired for the channel’s data readings*. If, for example, you want the channel to read *tenths of a mA*, you would enter an “m” value of “20.0.”

NOTE: The accuracy of “absolute” calibration of a 10A61-2-based channel is limited to $\pm 0.05\%$ of full scale.

TWO-POINT (DEADWEIGHT) CALIBRATION

Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional “zero and span” method can be applied to a 10A61-2 channel if the received 4-20 mA input is an *analog of another parameter* which has one or more independently and accurately known calibration values. It can also be used to improve the ABSOLUTE calibration of an input that measures milliamperage itself (beyond the 10A61-2 card’s inherent limit of $\pm 0.05\%$ of full scale). The mainframe’s **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

10A61-2 DUAL 4-20 MA CARD

MODEL 10A62-8C

EIGHT-CHANNEL 4-20 mA CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

This high-accuracy conditioner accepts up to eight independent **current signals** within the ISA standard range of 4-20 mA. Both unipolar and bipolar (“zero-center”) inputs are allowed. Since the 10A62-8C does not provide excitation, the current source must supply its own power supply, if required.

Chopper-stabilized amplification with active low-pass filtering yields excellent voltage compliance and make the 10A62-8C suitable for virtually any standard Process Industry current input.

ADDITIONAL 10A62-8C SPECIFICATIONS

Input Current: 4 to 20 mA (unipolar) or 4 to 12 to 20 mA (bipolar or “zero-center”); automatically selected—on an individual channel basis—when the channel is configured; for the System 10 channel “type” codes assigned to 10A62-8C data channels, see Table 1, below

Amplifier (per channel):

Common-Mode Range: ± 20 V operating; ± 50 V without instrument damage

Common-Mode Rejection Ratio: DC: -100 dB; at 60 Hz, 1 kHz, and 3 kHz: -150 dB

Input Impedance: Differential: 100 Ω ; Common-Mode: 500 k Ω

Burden: 2 V-DC at full scale

Offset: Initial: $\pm 0.02\%$ of full scale; vs. Temperature: ± 20 ppm/ $^{\circ}$ C; vs. Time: ± 20 ppm/month

Gain Accuracy: $\pm 0.02\%$ of full scale

Gain Stability: vs. Temperature: ± 50 ppm/ $^{\circ}$ C; vs. Time: ± 20 ppm/month

Filter (per channel): 3-pole modified Butterworth; 3 dB down at 5 Hz; 60 dB down at 100 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 170 msec

To 0.1% of final value: 240 msec

To 0.02% of final value: 270 msec

Auxiliary Outputs to Mainframe Wire-Wrap Pins: None

Table 1 10A62-8C “Type” Codes

Full-Scale Range	Channel Type Code
4-20 mA	6C
4-12-20 mA	6D

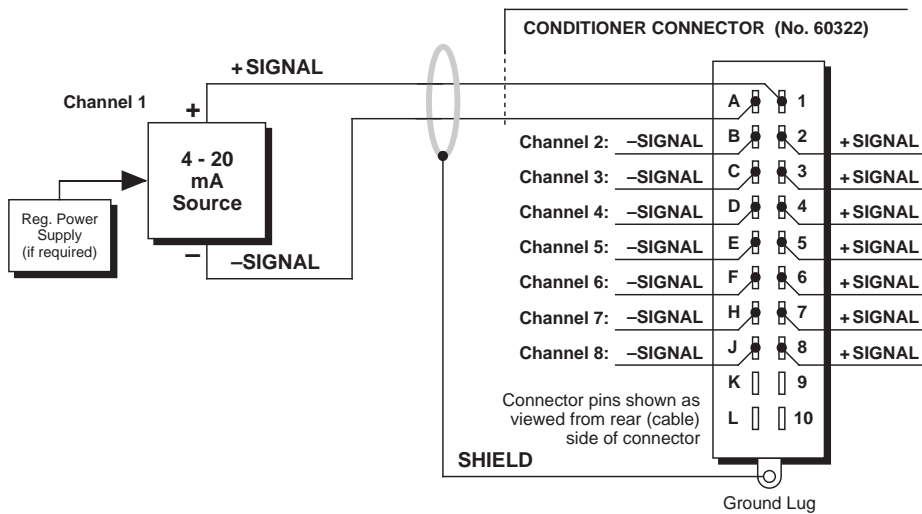
2 TRANSDUCER CONNECTIONS

The Model 10A62-8C's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Standard cabling is shown in Fig. 1. Table 2 gives standard pin assignments for the I/O Connector.

Table 2 Model 10A62-8C Pin Assignments

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	+SIGNAL
A	1	-SIGNAL
2	2	+SIGNAL
B	2	-SIGNAL
3	3	+SIGNAL
C	3	-SIGNAL
4	4	+SIGNAL
D	4	-SIGNAL
5	5	+SIGNAL
E	5	-SIGNAL
6	6	+SIGNAL
F	6	-SIGNAL
7	7	+SIGNAL
H	7	-SIGNAL
8	8	+SIGNAL
J	8	-SIGNAL
9,K,10,L		Not Committed

Fig. 1 Model 10A62-8C Transducer Cabling



3 SETUP AND/OR OPERATING CONSIDERATIONS**3.a CONFIGURATION AND CALIBRATION**

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A62-8C card when used in System 10, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A62-8C channel “type” codes, see Table 1, above.

In System 10, you can use two calibration methods with the Model 10A62-8C: “absolute” and “two-point (deadweight).” The procedure used for absolute calibration will depend on the selected “polarity” of the channel being calibrated. For a general discussion of absolute calibration, see Manual Section 1.G.3.b. Absolute calibration of a 10A62-8C-based channel yields an accuracy of $\pm 0.02\%$ of full scale.

ABSOLUTE CALIBRATION FOR A 4-20 mA CHANNEL

After you have set a 10A62-8C-based input Channel No. “x” for **UNIPOLAR (4 to 20 mA) MEASUREMENT** by giving it a “type” code of “6C” (see Table 1), you can calibrate it “absolutely” for readout in *percentage of transducer full-scale range to a precision of 0.01%*, as follows:

1. Turn ON the system EEPROM SWITCH.
2. Apply a **SCALING FACTOR (EMM)** command of
EMM x = 312.50 [CR]
3. Apply a **ZERO OFFSET (BEE)** command of
BEE x = -25.00 [CR]

In general, if “F” is the desired *engineering-units reading corresponding to a unipolar input of 20 mA*, and if the reading corresponding to a unipolar input of 0 mA is “0,” then the required **EMM** and **BEE** settings* for the channel are

$$\mathbf{EMM\ x = (3.125)F\ \text{and}\ BEE\ x = (-0.25)F}$$

ABSOLUTE CALIBRATION FOR A 4-12-20 mA CHANNEL

After you have set a 10A62-8C-based input Channel No. “x” for **BIPOLAR (“zero-center” 4 to 12 to 20 mA) MEASUREMENT** by giving it a “type” code of “6D” (see Table 1), you can calibrate it “absolutely” for readout in *percentage of transducer full-scale range to a precision of 0.1%*, as follows:

1. Turn ON the system EEPROM SWITCH.
2. Apply a **SCALING FACTOR (EMM)** command of
EMM x = 625.0 [CR]
3. Apply a **ZERO OFFSET (BEE)** command of
BEE x = -150.0 [CR]

* As always, the available resolution is subject to the System 10 operating range of ± 32700 . Thus, for example, if a full-scale input of 20 mA is to correspond to an engineering-units reading of 150 psi, you would have to enter an **EMM** value of “468.8” (the actual calculated value of $3.125 \times 150 = 468.75$ would not be accepted).

10A62-8C EIGHT-CHANNEL 4-20 MA CARD

In general, if "F" is the desired *engineering-units reading corresponding to a bipolar input of 20 mA*, and if the reading corresponding to a bipolar input of 12 mA is "0," then the required **EMM** and **BEE** settings* for the channel are

$$\mathbf{EMM\ x = (6.25)F\ \text{and}\ BEE\ x = (-1.5)F}$$

TWO-POINT (DEADWEIGHT) CALIBRATION

Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional "zero and span" method can be applied to a 10A62-8C channel if the received 4-20 mA input is an *analog of another parameter* which has one or more independently and accurately known calibration values. The mainframe's **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

* As always, the available resolution is subject to the System 10 operating range of ± 32700 (see note, previous page).

MODEL 10A63-2

DUAL VOLTAGE CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 10A63-2 is a high-accuracy conditioner allowing input of one or two **external voltage signals**. Mixed as desired, these may originate from DC-to-DC LVDT's, potentiometer-type sensors, and other 2-, 3-, or 4-wire analog signal sources, either grounded or floating—or they may represent the outputs of other instrument systems having various voltage levels and grounding configurations.

The 10A63-2 offers a wide range of input voltages. Its differential inputs, generous common-mode range, and excellent common-mode rejection eliminate ground-coupling errors and other problems normally associated with off-ground signal sources. Nominal 5 V-DC excitation is provided for external sources that require it. "1/2 Bridge Completion" terminals allow "zero-center" operation of potentiometers with resistance from 1 to 10 k Ω .

ADDITIONAL 10A63-2 SPECIFICATIONS

Transducer Types: 2-, 3-, or 4-wire DC voltage sources, grounded or floating

Input Voltage Ranges: ± 0.05 , 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, or 200 V-DC; automatically selected—on an individual channel basis—when the channel is configured; for the System 10 channel "type" codes assigned to 10A63-2 data channels, see Table 1, below

Excitation (per channel): Nominal 5 V-DC; 50 mA, maximum

Amplifier (per channel):

Normal-Mode Range: ± 200 V operating; ± 500 V without instrument damage

Common-Mode Range: ± 200 V operating; ± 300 V without instrument damage

Common-Mode Rejection Ratio: DC: -120 dB; at 60 Hz: -60 dB

Input Impedance: Differential: 1 M Ω ; Common-Mode: 0.5 M Ω

Offset: Initial: $\pm 0.02\%$ of full scale; vs. Temperature: ± 50 ppm/ $^{\circ}$ C; vs. Time: ± 20 ppm/month

Gain Accuracy: $\pm 0.02\%$ of full scale *typical*, following calibration*

Gain Stability: vs. Temperature: ± 50 ppm/ $^{\circ}$ C; vs. Time: ± 50 ppm/month

(cont'd)

* Initial (uncalibrated) inaccuracy may be as great as $\pm 1.5\%$ of full scale. Maximum error that could occur upon replacement of a Model 10A63-2 *not followed by calibration* is $\pm 3\%$ of full scale.

10A63-2 DUAL DC VOLTAGE CARD

Filter (per channel): 3-pole modified Butterworth; 3 dB down at 5 Hz; 60 dB down at 100 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 200 msec
To 0.1% of final value: 300 msec
To 0.02% of final value: 400 msec

Auxiliary Outputs: Filtered outputs available on mainframe wire-wrap pins

Table 1 10A63-2 “Type” Codes

Full-Scale Range	Channel Type Code
±50 mV-DC	61
±100 mV-DC	60
±200 mV-DC	62
±500 mV-DC	64
±1 V-DC	63
±2 V-DC	65
±5 V-DC	67
±10 V-DC	66
±20 V-DC	68
±50 V-DC	6A
±100 V-DC	69
±200 V-DC	6B

2 TRANSDUCER CONNECTIONS

The Model 10A63-2's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Table 2 gives standard pin assignments for the I/O Connector.

2-wire cabling for analog sources with no excitation from the 10A63-2 is given in Fig. 1(a); *3-wire zero-to-full-scale potentiometer* cabling is given in Fig. 1(b); *3-wire zero-center potentiometer* cabling is given in Fig. 1(c); and *4-wire DC-to-DC LVDT* cabling is given in Fig. 1(d).

Note that *floating* (ungrounded) inputs are to be grounded *at the site of the signal source*, and not at the CONDITIONER CONNECTOR. Note also that the Model 10A63-2 has “1/2 BRIDGE COMPLETION” terminals to allow bipolar (“Zero Center”) operation of potentiometers. As shown in Fig. 1(c), the 1/2 BRIDGE is powered by the potentiometer excitation. Although this excitation is normally supplied by the 10A63-2—as shown in the figure—the user may replace it with his own precision source, if desired. In this case, **Pins 1 and A** (for Channel 1) or **Pins 6 and F** (for Channel 2) would not be used. The 1/2 BRIDGE terminals would tie into the user's excitation lines (Pin 2 or 7 to +EXCITATION; Pin B or H to –EXCITATION).

Fig. 1 Model 10A63-2 Transducer Cabling

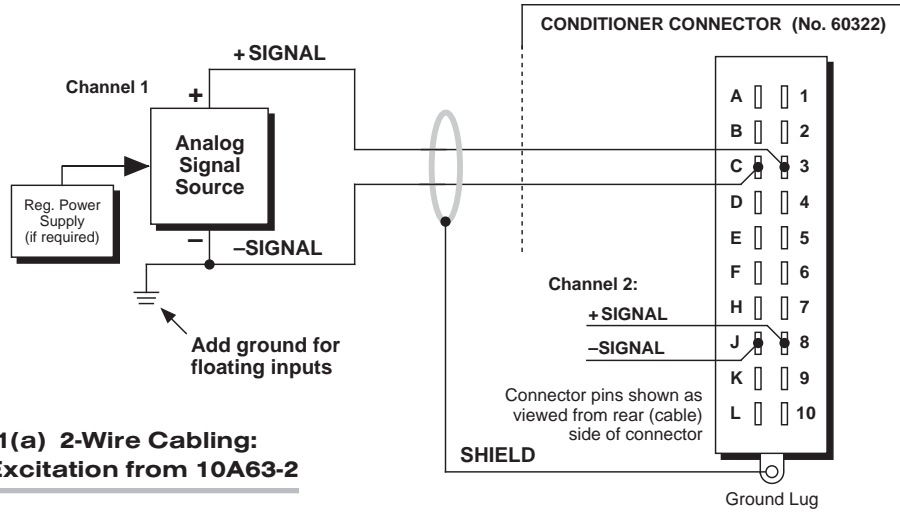


Fig. 1(a) 2-Wire Cabling: No Excitation from 10A63-2

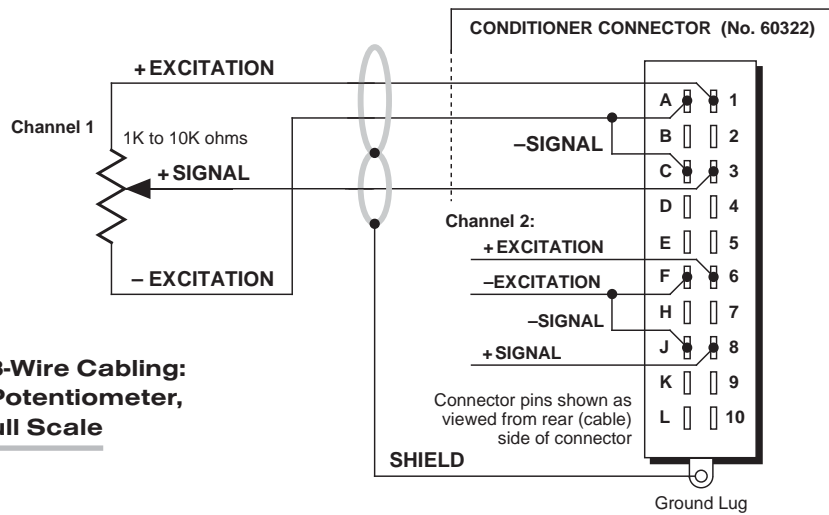


Fig. 1(b) 3-Wire Cabling: External Potentiometer, Zero to Full Scale

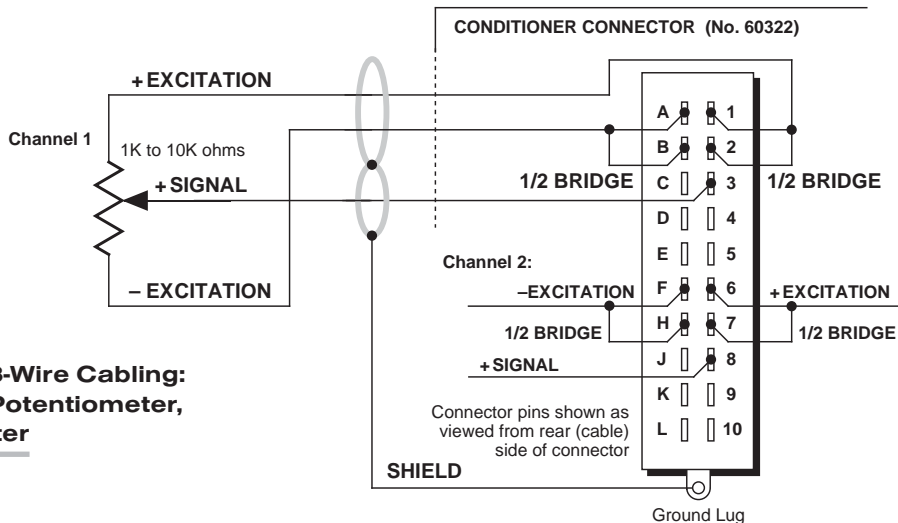
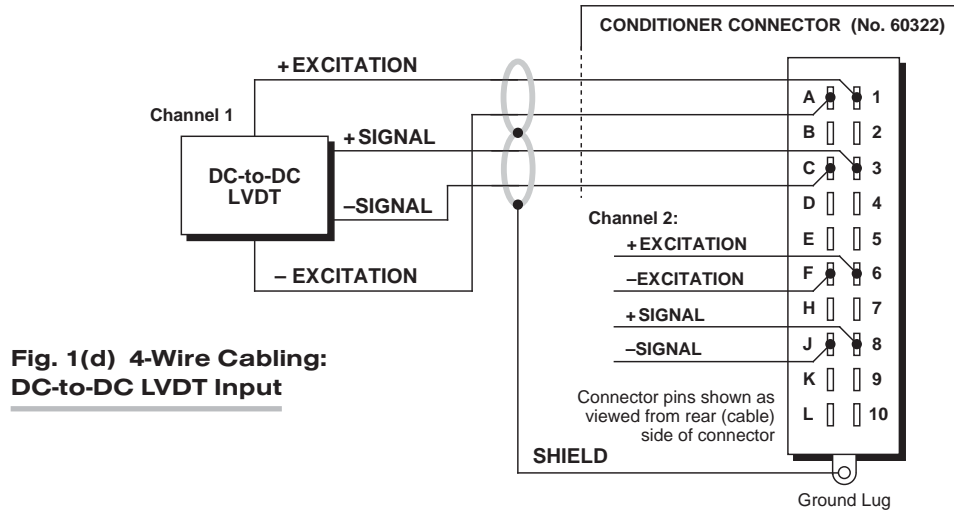


Fig. 1(c) 3-Wire Cabling: External Potentiometer, Zero Center

10A63-2 DUAL DC VOLTAGE CARD



**Fig. 1(d) 4-Wire Cabling:
DC-to-DC LVDT Input**

Table 2 Model 10A63-2 Pin Assignments

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	+EXCITATION (+5 V-DC)
A	1	-EXCITATION (-5 V-DC)
2	1	1/2 BRIDGE (TO +EXC)
B	1	1/2 BRIDGE (TO -EXC)
3	1	+SIGNAL
C	1	-SIGNAL
4,D,5,E	1	Not Committed
6	2	+EXCITATION (+5 V-DC)
F	2	-EXCITATION (-5 V-DC)
7	2	1/2 BRIDGE (TO +EXC)
H	2	1/2 BRIDGE (TO -EXC)
8	2	+SIGNAL
J	2	-SIGNAL
9,K,10,L	2	Not Committed

3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A63-2 card when used in System 10, see the general remarks on System 10 "real-channel" configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A63-2 channel "type" codes, see Table 1, above.

In System 10, you can use two calibration methods with the Model 10A63-2:

ABSOLUTE CALIBRATION

Described in Manual Section 1.G.3.b, this method is applicable only when the 10A63-2 is being used to measure *voltage itself*. In this case, the user need only specify an appropriate SCALING FACTOR ("m" coefficient), once the 10A63-2-based input channel has been properly configured.

Thus, to calibrate a 10A63-2-based Channel No. "x," you need only turn ON the system EEPROM SWITCH and then apply the following **SCALING FACTOR (EMM)** command:

EMM x = m [CR]

where "m" equals *the full-scale range corresponding to the channel's present TYPE designation, expressed to the precision desired for the channel's data readings.* Channel "type" codes and associated full-scale ranges are given in Table 1, above. If, for example, a voltage-measuring 10A63-2 channel is "typed" as "6A" (corresponding to a full scale of ± 50 V-DC) and you want the channel to read *tenths of a volt*, you would enter an "m" value of "50.0."

NOTE: The accuracy of "absolute" calibration of a 10A63-2-based channel is limited to $\pm 1.5\%$ of full scale.

TWO-POINT (DEADWEIGHT) CALIBRATION

Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional "zero and span" method can be applied to a 10A63-2 channel if the received voltage input is an *analog of another parameter* which has one or more independently and accurately known calibration values. It can also be used to improve the ABSOLUTE calibration of an input that measures voltage itself (beyond the 10A63-2 card's inherent limit of $\pm 1.5\%$ of full scale). The mainframe's **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

10A63-2 DUAL DC VOLTAGE CARD

MODEL 10A64-8C

EIGHT-CHANNEL VOLTAGE CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 10A64-8C is a high-accuracy conditioner allowing input of up to eight **external voltage signals**. Mixed as desired, these may originate from DC-to-DC LVDT's, potentiometer-type sensors, and other 2-wire analog signal sources that *provide their own power supply*. Or they may represent the outputs of other instrument systems having various voltage levels and grounding configurations.

Inputs can be either floating (differential) or grounded (single-ended). Chopper-stabilized DC amplification with active low-pass filtering yields smooth and stable measurement of the true average value of the input variable, even in the face of substantial dynamic content.

ADDITIONAL 10A64-8C SPECIFICATIONS

Transducer Types: 2-wire DC voltage sources, grounded or floating

Input Voltage Ranges: ± 5 , 10, or 20 V-DC; automatically selected—on an individual channel basis—when the channel is configured; for the System 10 channel “type” codes assigned to 10A64-8C data channels, see Table 1, below

Amplifier (per channel):

Normal-Mode Range: ± 20 V operating; ± 50 V without instrument damage

Common-Mode Range: ± 20 V operating; ± 50 V without instrument damage

Common-Mode Rejection Ratio: DC: -100 dB; at 60 Hz, 1 kHz, and 3 kHz: -150 dB

Input Impedance: Differential: 2 M Ω ; Common-Mode: 0.5 M Ω

Offset: Initial: $\pm 0.01\%$ of full scale; vs. Temperature: ± 10 ppm/ $^{\circ}$ C; vs. Time: ± 10 ppm/month

Gain Accuracy: $\pm 0.02\%$ of full scale

Gain Stability: vs. Temperature: ± 50 ppm/ $^{\circ}$ C; vs. Time: ± 20 ppm/month

Filter (per channel): 3-pole modified Butterworth; 3 dB down at 7.5 Hz; 60 dB down at 100 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 150 msec

To 0.1% of final value: 190 msec

To 0.02% of final value: 200 msec

Auxiliary Outputs to Mainframe Wire-Wrap Pins: None

10A64-8C EIGHT-CHANNEL DC VOLTAGE CARD

Table 1 10A64-8C "Type" Codes

Full-Scale Range	Channel Type Code
±5 V-DC	67
±10 V-DC	66
±20 V-DC	68

2 TRANSDUCER CONNECTIONS

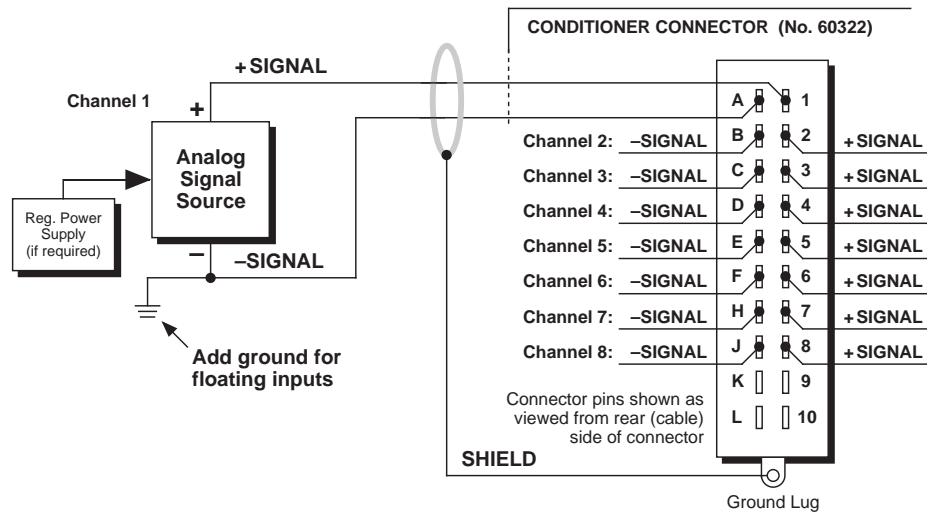
The Model 10A64-8C's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Table 2 gives standard pin assignments for the I/O Connector.

Note that *floating* (ungrounded) inputs are to be grounded *at the site of the signal source*, and not at the CONDITIONER CONNECTOR.

Table 2 Model 10A64-8C Pin Assignments

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	+SIGNAL
A	1	-SIGNAL
2	2	+SIGNAL
B	2	-SIGNAL
3	3	+SIGNAL
C	3	-SIGNAL
4	4	+SIGNAL
D	4	-SIGNAL
5	5	+SIGNAL
E	5	-SIGNAL
6	6	+SIGNAL
F	6	-SIGNAL
7	7	+SIGNAL
H	7	-SIGNAL
8	8	+SIGNAL
J	8	-SIGNAL
9,K,10,L		Not Committed

Fig. 1 Model 10A64-8C Transducer Cabling



3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A64-8C card when used in System 10, see the general remarks on System 10 "real-channel" configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A64-8C channel "type" codes, see Table 1, above.

In System 10, you can use two calibration methods with the Model 10A64-8C:

ABSOLUTE CALIBRATION

Described in Manual Section 1.G.3.b, this method is applicable only when the 10A64-8C is being used to measure *voltage itself*. In this case, the user need only specify an appropriate SCALING FACTOR ("m" coefficient), once the 10A64-8C-based input channel has been properly configured.

Thus, to calibrate a 10A64-8C-based Channel No. "x," you need only turn ON the system EEPROM SWITCH and then apply the following **SCALING FACTOR (EMM)** command:

$$\text{EMM } x = m \text{ [CR]}$$

where "m" equals *the full-scale range corresponding to the channel's present TYPE designation, expressed to the precision desired for the channel's data readings*. Channel "type" codes and associated full-scale ranges are given in Table 1, above. If, for example, a voltage-measuring 10A64-8C channel is "typed" as "68" (corresponding to a full scale of ± 20 V-DC) and you want the channel to read *tenths of a volt*, you would enter an "m" value of "20.0."

Note that "absolute" calibration of a 10A64-8C-based channel yields an accuracy of $\pm 0.02\%$ of full scale.

10A64-8C EIGHT-CHANNEL DC VOLTAGE CARD

TWO-POINT (DEADWEIGHT) CALIBRATION

Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional “zero and span” method can be applied to a 10A64-8C channel if the received voltage input is an *analog of another parameter* which has one or more independently and accurately known calibration values. The mainframe’s **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

MODEL 10A65-8

EIGHT-CHANNEL LOW-LEVEL VOLTAGE CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 10A65-8 is a high-accuracy conditioner allowing input of up to eight **low-level external voltage signals** (allowable input ranges are ± 50 , ± 100 , and ± 200 *millivolts*). Mixed as desired, these may originate from DC-to-DC LVDT's, potentiometer-type sensors, and other 2-wire analog signal sources that *provide their own power supply*. Or they may represent the outputs of other instrument systems having various voltage levels and grounding configurations.

Inputs can be either floating (differential) or grounded (single-ended). Chopper-stabilized DC amplification with active low-pass filtering yields smooth and stable measurement of the true average value of the input variable, even in the face of substantial dynamic content.

ADDITIONAL 10A65-8 SPECIFICATIONS

Transducer Types: Low-level 2-wire DC voltage sources, grounded or floating

Input Voltage Ranges: ± 50 , 100, or 200 mV-DC; automatically selected—on an individual channel basis—when the channel is configured; for the System 10 channel “type” codes assigned to 10A60-4 data channels, see Table 1, below

Amplifier (per channel):

Normal-Mode Range: ± 0.2 V operating; ± 10 V without instrument damage

Common-Mode Range: ± 20 V operating; ± 50 V without instrument damage

Common-Mode Rejection Ratio: DC: -97 dB; at 60 Hz, 1 kHz, and 3 kHz: infinite

Input Impedance: Differential: 2 M Ω ; Common-Mode: 0.5 M Ω

Offset: Initial: $\pm 0.04\%$ of full scale; vs. Temperature: ± 10 ppm/ $^{\circ}$ C; vs. Time: ± 20 ppm/month

Gain Accuracy: $\pm 0.02\%$ of full scale *typical*, following calibration*

Gain Stability: vs. Temperature: ± 50 ppm/ $^{\circ}$ C; vs. Time: ± 50 ppm/month

Filter (per channel): 3-pole modified Butterworth; 3 dB down at 4 Hz; 60 dB down at 100 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 190 msec

To 0.1% of final value: 265 msec

To 0.02% of final value: 325 msec

Auxiliary Outputs to Mainframe Wire-Wrap Pins: None

* Initial (uncalibrated) inaccuracy may be as great as $\pm 0.05\%$ of full scale. Maximum error that could occur upon replacement of a Model 10A65-8 *not followed by calibration* is $\pm 0.1\%$ of full scale.

10A65-8 EIGHT-CHANNEL LOW-LEVEL DC VOLTAGE CARD

Table 1 10A65-8 "Type" Codes

Full-Scale Range	Channel Type Code
±50 mV-DC	61
±100 mV-DC	60
±200 mV-DC	62

2 TRANSDUCER CONNECTIONS

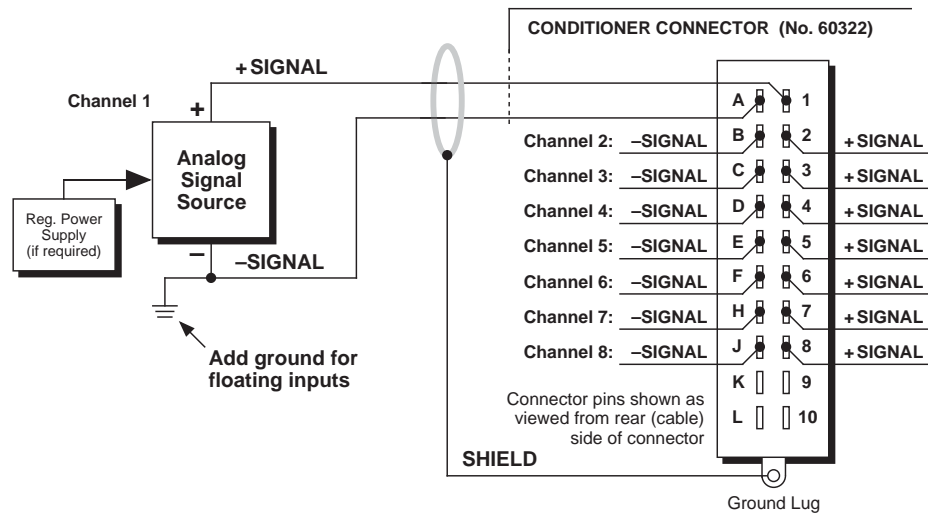
The Model 10A65-8's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Table 2 gives standard pin assignments for the I/O Connector.

Note that *floating* (ungrounded) inputs are to be grounded *at the site of the signal source*, and not at the CONDITIONER CONNECTOR.

Table 2 Model 10A65-8 Pin Assignments

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	+SIGNAL
A	1	-SIGNAL
2	2	+SIGNAL
B	2	-SIGNAL
3	3	+SIGNAL
C	3	-SIGNAL
4	4	+SIGNAL
D	4	-SIGNAL
5	5	+SIGNAL
E	5	-SIGNAL
6	6	+SIGNAL
F	6	-SIGNAL
7	7	+SIGNAL
H	7	-SIGNAL
8	8	+SIGNAL
J	8	-SIGNAL
9,K 10,L		COMMON Not Committed

Fig. 1 Model 10A65-8 Transducer Cabling



3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A65-8 card, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A65-8 channel “type” codes, see Table 1, above.

You can use two calibration methods with the Model 10A65-8:

ABSOLUTE CALIBRATION

Described in Manual Section 1.G.3.b, this method is applicable only when the 10A65-8 is being used to measure *millivoltage itself*. In this case, the user need only specify an appropriate SCALING FACTOR (“m” coefficient), once the 10A65-8-based input channel has been properly configured.

Thus, to calibrate a 10A65-8-based Channel No. “x,” you need only turn ON the system EEPROM SWITCH and then apply the following **SCALING FACTOR (EMM)** command:

$$\text{EMM } x = m \text{ [CR]}$$

where “m” equals *the full-scale range corresponding to the channel’s present TYPE designation, expressed to the precision desired for the channel’s data readings*. Channel “type” codes and associated full-scale ranges are given in Table 1, above. If, for example, a voltage-measuring 10A65-8 channel is “typed” as “62” (corresponding to a full scale of ± 200 mV-DC) and you want the channel to read *tenths of a millivolt*, you would enter an “m” value of “200.0.”

Note: The accuracy of “absolute” calibration of a 10A65-8-based channel is limited to $\pm 0.05\%$ of full scale.

10A65-8 EIGHT-CHANNEL LOW-LEVEL DC VOLTAGE CARD

TWO-POINT (DEADWEIGHT) CALIBRATION

Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional “zero and span” method can be applied to a 10A65-8 channel if the received millivoltage input is an *analog of another parameter* which has one or more independently and accurately known calibration values. It can also be used to improve the ABSOLUTE calibration of an input that measures millivoltage itself (beyond the 10A65-8 card's inherent limit of $\pm 0.05\%$ of full scale). The mainframe's **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

MODEL 10A68-2

DUAL AC RMS CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

Using the special screw-terminal connector board described in Section 2, the Model 10A68-2 accurately measures the true RMS amplitude of one or two independent **external analog AC signals**, mixed as desired, from a wide range of *voltage or current sources*—including engineering parameters conditioned by other Daytronic cards.

Since the 10A68-2 does not provide excitation, the analog source must supply *its own power supply*, if required (as is the case with many accelerometers, when used to measure the noise level or vibration factor of a dynamic process). The card is particularly useful in evaluating the *efficiency of AC electrical power systems*.

ADDITIONAL 10A68-2 SPECIFICATIONS

Transducer Types: AC signal sources (voltage or current)

Input Voltage and Current Ranges: See Table 1, below, for allowable full-scale input ranges (given for each range are the corresponding *normal-mode input impedance* (z_i), *maximum normal-mode input voltage or current with no instrument damage* (V_{\max} or I_{\max}), and *bandwidth* flat to 0.1%, 1%, and 3 dB, respectively); automatically selected—on an individual channel basis—when the channel is configured; for the System 10 channel “type” codes assigned to 10A68-2 data channels, see Table 2, below

Amplifier (per channel): Floating, with RMS Converter (see Table 1 for bandwidths)

Common-Mode Range: ± 1500 V operating and without instrument damage

Common-Mode Rejection Ratio: DC and at 60 Hz: infinite; at 1 kHz: -60 dB

Input Impedance (Common-Mode): Essentially infinite for all input ranges

Offset: Initial: $\pm 0.04\%$ of full scale; vs. Temperature: ± 20 ppm/ $^{\circ}\text{C}$; vs. Time: ± 20 ppm/month

Gain Accuracy: $\pm 0.05\%$ of full scale *typical*, following calibration*

Gain Stability (all ranges except 5 A): vs. Temperature: ± 50 ppm/ $^{\circ}\text{C}$; vs. Time: ± 20 ppm/month

Gain Stability (5-A range only): vs. Temperature: ± 500 ppm/ $^{\circ}\text{C}$; vs. Time: ± 20 ppm/month

(cont'd)

* Initial (uncalibrated) inaccuracy may be as great as $\pm 0.1\%$ of full scale for all input ranges except 5 A, for which it may be as great as $\pm 0.5\%$. Maximum error that could occur upon replacement of a Model 10A68-2 *not followed by calibration* is $\pm 0.2\%$ of full scale ($\pm 1\%$ for 5-A range).

10A68-2 DUAL AC RMS CARD

Filter (per channel): 3-pole modified Butterworth; 3 dB down at 5 Hz; 60 dB down at 30 Hz

Step-Response Settling Time (Full-Scale Output):

- To 1% of final value: 150 msec
- To 0.1% of final value: 200 msec
- To 0.02% of final value: 250 msec

Auxiliary Outputs: Filtered outputs available on mainframe wire-wrap pins

Table 1 Model 10A68-2 Input Characteristics

Range	Z _i	V _{max} or I _{max}	BW (to 0.1%)	BW (to 1%)	BW (to 3 dB)
50 mV-AC	2 KΩ	40 V-AC	40 Hz to 400 Hz	20 Hz to 2 kHz	10 Hz to 4 kHz
100 mV-AC	2 KΩ	40 V-AC	40 Hz to 400 Hz	20 Hz to 2 kHz	10 Hz to 4 kHz
200 mV-AC	2 KΩ	40 V-AC	40 Hz to 400 Hz	20 Hz to 2 kHz	10 Hz to 4 kHz
500 mV-AC	2 KΩ	40 V-AC	40 Hz to 400 Hz	20 Hz to 2 kHz	10 Hz to 4 kHz
1 V-AC	2 KΩ	40 V-AC	40 Hz to 400 Hz	20 Hz to 2 kHz	10 Hz to 4 kHz
2 V-AC	2 KΩ	40 V-AC	40 Hz to 400 Hz	20 Hz to 2 kHz	10 Hz to 4 kHz
5 V-AC	200 KΩ	140 V-AC	50 Hz to 4 kHz	20 Hz to 10 kHz	10 Hz to 20 kHz
10 V-AC	200 KΩ	140 V-AC	50 Hz to 4 kHz	20 Hz to 10 kHz	10 Hz to 20 kHz
20 V-AC	200 KΩ	140 V-AC	50 Hz to 4 kHz	20 Hz to 10 kHz	10 Hz to 20 kHz
50 V-AC	1 MΩ	630 V-AC	40 Hz to 400 Hz	20 Hz to 2 kHz	10 Hz to 4 kHz
100 V-AC	1 MΩ	630 V-AC	40 Hz to 400 Hz	20 Hz to 2 kHz	10 Hz to 4 kHz
200 V-AC	1 MΩ	630 V-AC	40 Hz to 400 Hz	20 Hz to 2 kHz	10 Hz to 4 kHz
500 V-AC	1 MΩ	630 V-AC	50 Hz to 4 kHz	20 Hz to 10 kHz	10 Hz to 20 kHz
50 mA	1 Ω	700 mA	40 Hz to 400 Hz	20 Hz to 2 kHz	10 Hz to 4 kHz
100 mA	1 Ω	700 mA	40 Hz to 400 Hz	20 Hz to 2 kHz	10 Hz to 4 kHz
200 mA	1 Ω	700 mA	40 Hz to 400 Hz	20 Hz to 2 kHz	10 Hz to 4 kHz
500 mA	1 Ω	700 mA	50 Hz to 4 kHz	20 Hz to 10 kHz	10 Hz to 20 kHz
5 A	0.01 Ω	7 A	40 Hz to 400 Hz	20 Hz to 2 kHz	10 Hz to 4 kHz

Note: Transformers are available for current inputs greater than 5 A.

Table 2 10A68-2 "Type" Codes

Full-Scale Range	Channel Type Code
50 mV-AC	61
100 mV-AC	60
200 mV-AC	62
500 mV-AC	64
1 V-AC	63
2 V-AC	65
5 V-AC	67
10 V-AC	66
20 V-AC	68
50 V-AC	6A
100 V-AC	69
200 V-AC	6B
500 V-AC	67
50 mA	61
100 mA	60
200 mA	62
500 mA	67
5 A	64

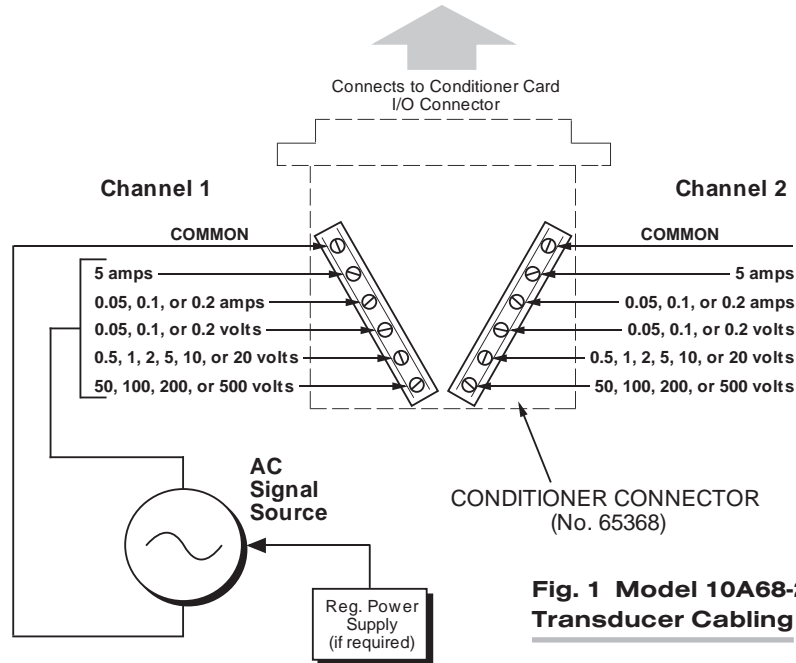


Fig. 1 Model 10A68-2 Transducer Cabling

2 TRANSDUCER CONNECTIONS

The Model 10A68-2 mates with a special CONDITIONER CONNECTOR BOARD, shown in Fig. 1. This board has a separate screw-terminal block for each of the 10A68-2's two channels. As shown in the figure, the screw terminal to which you connect an AC signal source will depend on the *input range* that has been set for that channel and whether the input represents *voltage* or *current*.

NOTE: TO MINIMIZE THE EFFECTS OF STRAY CAPACITIVE PICKUP, IT IS STRONGLY RECOMMENDED THAT ALL UNUSED INPUT TERMINALS BE TIED TO THEIR RESPECTIVE "COMMON" TERMINAL.

3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A68-2 card when used in System 10, see the general remarks on System 10 "real-channel" configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A68-2 channel "type" codes, see Table 2, above.

In System 10, you can use two calibration methods with the Model 10A68-2:

ABSOLUTE CALIBRATION

Described in Manual Section 1.G.3.b, this method is applicable only when the 10A68-2 is being used to measure *voltage* or *amperage itself*. In this case, the user need only specify an appropriate SCALING FACTOR ("m" coefficient), once the 10A68-2-based input channel has been properly configured.

10A68-2 DUAL AC RMS CARD

Thus, to calibrate a 10A68-2-based Channel No. "x," you need only turn ON the system EEPROM SWITCH and then apply the following **SCALING FACTOR (EMM)** command:

$$\text{EMM } x = m \text{ [CR]}$$

where "m" equals *the full-scale range corresponding to the channel's present TYPE designation, expressed to the precision desired for the channel's data readings.* Channel "type" codes and associated full-scale ranges are given in Table 2, above. If, for example, a voltage-measuring 10A68-2 channel is "typed" as "65" (corresponding to a full scale of 2 V-AC) and you want the channel to read *tenths of a volt*, you would enter an "m" value of "2.0."

NOTE: The accuracy of "absolute" calibration of a 10A68-2-based channel is limited to $\pm 0.1\%$ of full scale for all input ranges except 5 A, for which it is limited to $\pm 0.5\%$.

TWO-POINT (DEADWEIGHT) CALIBRATION

Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional "zero and span" method can be applied to a 10A68-2 channel if the received voltage or current input is an *analog of another parameter* which has one or more independently and accurately known calibration values. It can also be used to improve the ABSOLUTE calibration of an input that measures voltage or amperage itself (beyond the 10A68-2 card's inherent limit of $\pm 0.1\%$ or $\pm 0.5\%$ of full scale).* The mainframe's **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

* $\pm 0.5\%$ for the 5-A input range; $\pm 0.1\%$ for all other input ranges.

MODEL 10A69-4

QUAD AC RMS CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 10A69-4 accurately measures the true RMS amplitude up to four independent **external analog AC signals**, mixed as desired, from a wide range of voltage sources.

Since the 10A69-4 does not provide excitation, the voltage source must supply *its own power supply*, if required (as is the case with many accelerometers, when used to measure the noise level or vibration factor of a dynamic process). The three *millivolt* ranges (50, 100, and 200 mV-AC) are intended primarily for current measurement by means of an external shunt.

ADDITIONAL 10A69-4 SPECIFICATIONS

Transducer Types: AC signal sources (voltage only)

Input Voltage and Current Ranges: See Table 1, below, for allowable full-scale input ranges (given for each range are the corresponding *normal-mode input impedance* (z_i), *maximum normal-mode input voltage with no instrument damage* (V_{max}), and *bandwidth* flat to 0.2%, 1%, and 3 dB, respectively); automatically selected—on an individual channel basis—when the channel is configured; for the System 10 channel “type” codes assigned to 10A69-4 data channels, see Table 2, below

Amplifier (per channel): Selectable gain, followed by high-pass filter with RMS Converter (see Table 1 for bandwidths)

Common-Mode Range: ± 1000 V operating and without instrument damage

Common-Mode Rejection Ratio: DC: infinite; at 60 Hz: -60 dB

Input Impedance (Common-Mode): Infinite at DC shunted by 100 pF

Offset: Initial: $\pm 0.02\%$ of full scale; vs. Temperature: ± 20 ppm/ $^{\circ}$ C; vs. Time: ± 50 ppm/month

Gain Accuracy: $\pm 0.02\%$ of full scale *typical*, following calibration*

Gain Stability: vs. Temperature: ± 50 ppm/ $^{\circ}$ C; vs. Time: ± 50 ppm/month

Filter (per channel): 3-pole modified Butterworth; 3 dB down at 10 Hz; 60 dB down at 50 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 100 msec

To 0.1% of final value: 150 msec

To 0.02% of final value: 600 msec

Auxiliary Outputs to Mainframe Wire-Wrap Pins: None

* Initial (uncalibrated) inaccuracy may be as great as $\pm 0.2\%$ of full scale. Maximum error that could occur upon replacement of a Model 10A69-4 *not followed by calibration* is $\pm 0.4\%$ of full scale.

Table 1 Model 10A69-4 Input Characteristics

Range	Z _i	V _{max}	BW (to 0.2%)	BW (to 1%)	BW (to 3 dB)
50 mV-AC	1 KΩ	10 V-AC	45 Hz to 1 kHz	12 Hz to 3.2 kHz	10 Hz to 22 kHz
100 mV-AC	1 KΩ	10 V-AC	45 Hz to 1 kHz	12 Hz to 3.2 kHz	10 Hz to 16 kHz
200 mV-AC	1 KΩ	10 V-AC	45 Hz to 1 kHz	12 Hz to 3.2 kHz	10 Hz to 9 kHz
5 V-AC	100 KΩ	100 V-AC	45 Hz to 4 kHz	12 Hz to 20 kHz	10 Hz to 40 kHz
10 V-AC	100 KΩ	100 V-AC	45 Hz to 4 kHz	12 Hz to 10 kHz	10 Hz to 20 kHz
20 V-AC	100 KΩ	100 V-AC	45 Hz to 4 kHz	12 Hz to 5 kHz	10 Hz to 9 kHz
50 V-AC	1 MΩ	250 V-AC	45 Hz to 2 kHz	15 Hz to 9 kHz	10 Hz to 40 kHz
100 V-AC	1 MΩ	250 V-AC	45 Hz to 2 kHz	15 Hz to 9 kHz	10 Hz to 21 kHz
200 V-AC	1 MΩ	250 V-AC	45 Hz to 2 kHz	15 Hz to 9 kHz	10 Hz to 10 kHz

Table 2 10A69-4 “Type” Codes

Full-Scale Range	Channel Type Code
50 mV-AC	61
100 mV-AC	60
200 mV-AC	62
5 V-AC	67
10 V-AC	66
20 V-AC	68
50 V-AC	6A
100 V-AC	69
200 V-AC	6B

2 TRANSDUCER CONNECTIONS

The Model 10A69-4's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Table 3 gives standard pin assignments for the I/O Connector.

The wiring of each input will depend on the range selected for that input. Cabling for inputs in the 50-, 100-, and 200-mV ranges is shown in Fig. 1(a); for inputs in the 5-, 10-, and 20-V ranges, in Fig. 1(b); and for inputs in the 50-, 100-, and 200-V ranges, in Fig. 1(c).

NOTE: TO MINIMIZE THE EFFECTS OF STRAY CAPACITIVE PICKUP, IT IS STRONGLY RECOMMENDED THAT ALL UNUSED “+SIGNAL” PINS BE TIED TO THEIR RESPECTIVE “-SIGNAL” PINS. For example, if the 50-200 mV “+SIGNAL” pin (**Pin 4**) is being used for Channel 2, then the unused **Pins 3** and **D** should both be jumpered to **Pin C** (Channel 2's “-SIGNAL”). And if, for example, Channel 4 is not being used at all, then **Pins 7, 8, and J** should all be jumpered to **Pin H**.

**Fig. 1 Model 10A63-2
Transducer Cabling**

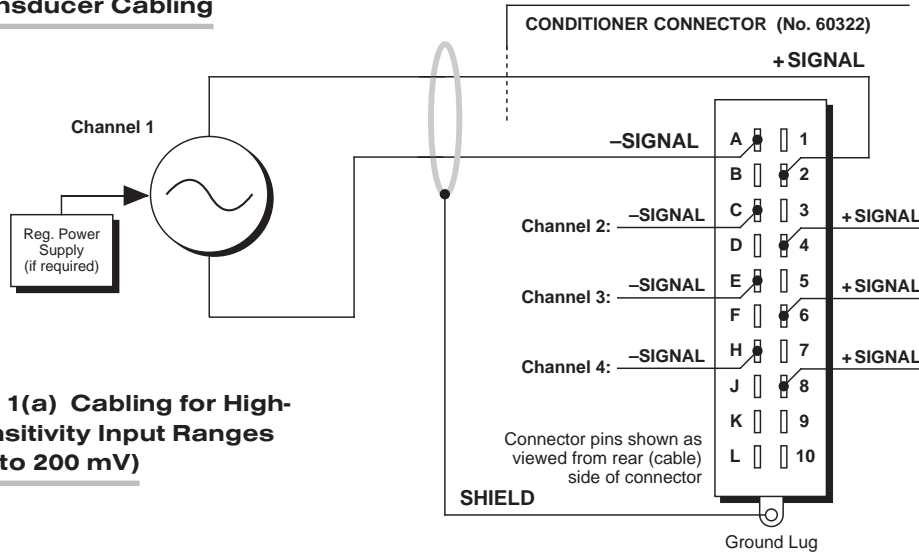


Fig. 1(a) Cabling for High-Sensitivity Input Ranges (50 to 200 mV)

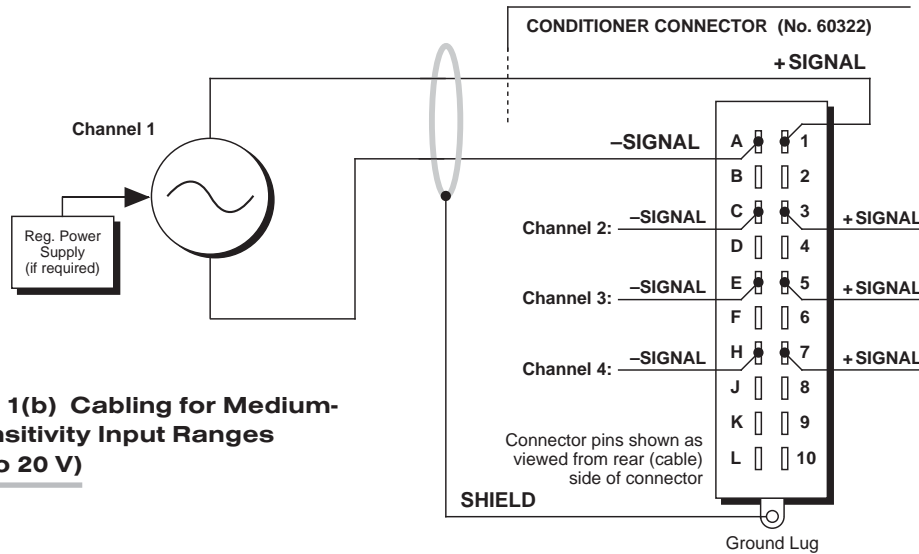


Fig. 1(b) Cabling for Medium-Sensitivity Input Ranges (5 to 20 V)

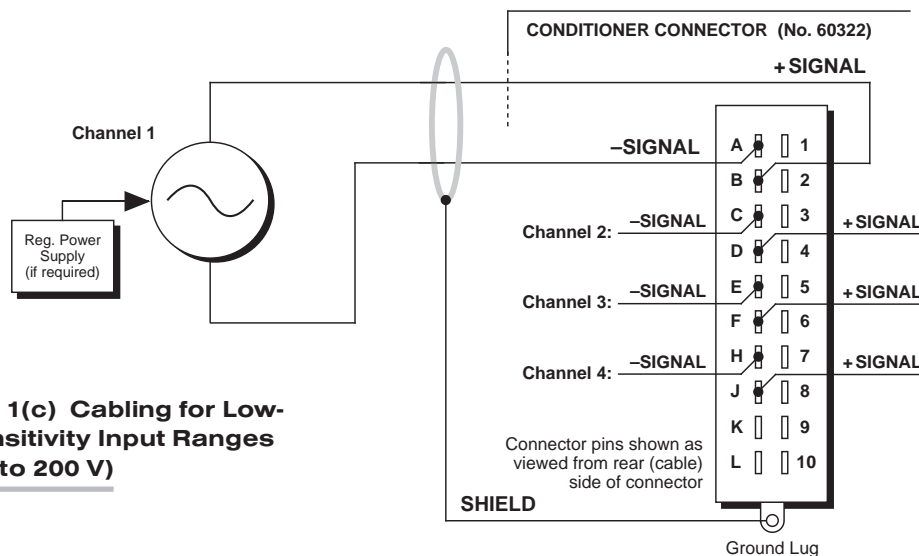


Fig. 1(c) Cabling for Low-Sensitivity Input Ranges (50 to 200 V)

Table 3 Model 10A69-4 Pin Assignments

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	+SIGNAL (5-20 V)
A	1	-SIGNAL (CHANNEL 1)
2	1	+SIGNAL (50-200 mV)
B	1	+SIGNAL (50-200 V)
3	2	+SIGNAL (5-20 V)
C	2	-SIGNAL (CHANNEL 2)
4	2	+SIGNAL (50-200 mV)
D	2	+SIGNAL (50-200 V)
5	3	+SIGNAL (5-20 V)
E	3	-SIGNAL (CHANNEL 3)
6	3	+SIGNAL (50-200 mV)
F	3	+SIGNAL (50-200 V)
7	4	+SIGNAL (5-20 V)
H	4	-SIGNAL (CHANNEL 4)
8	4	+SIGNAL (50-200 mV)
J	4	+SIGNAL (50-200 V)
9,K,10,L		Not Committed

3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A69-4 card, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A69-4 channel “type” codes, see Table 2, above.

You can use two calibration methods with the Model 10A69-4:

ABSOLUTE CALIBRATION

Described in Manual Section 1.G.3.b, this method is applicable only when the 10A69-4 is being used to measure *voltage itself*. In this case, the user need only specify an appropriate SCALING FACTOR (“m” coefficient), once the 10A69-4-based input channel has been properly configured.

Thus, to calibrate a 10A69-4-based Channel No. “x,” you need only turn ON the system EEPROM SWITCH and then apply the following **SCALING FACTOR (EMM)** command:

$$\text{EMM } x = m \text{ [CR]}$$

where “m” equals *the full-scale range corresponding to the channel’s present TYPE designation, expressed to the precision desired for the channel’s data readings*. Channel “type” codes and associated full-scale ranges are given in Table 2, above. If, for example, a voltage-measuring 10A69-4 channel is “typed” as “67” (corresponding to a full scale of 5 V-AC) and you want the channel to read *tenths of a volt*, you would enter an “m” value of “5.0.”

NOTE: The accuracy of “absolute” calibration of a 10A69-4-based channel is limited to $\pm 0.2\%$ of full scale.

Two-POINT (DEADWEIGHT) CALIBRATION

Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional “zero and span” method can be applied to a 10A69-4 channel if the received voltage or current input is an *analog of another parameter* which has one or more independently and accurately known calibration values. It can also be used to improve the ABSOLUTE calibration of an input that measures voltage or amperage itself (beyond the 10A69-4 card's inherent limit of $\pm 0.2\%$). The mainframe's **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

10A69-4 QUAD AC RMS CARD

MODEL 10A70-2

DUAL STRAIN GAGE CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 10A70-2 is a general-purpose two-channel conditioner for use with **DC-excited load cells, pressure sensors, and any other conventional strain gage transducer** employing a 4-arm bridge of nominal 350 Ω or higher, with a full-scale range of 0.75, 1.50, or 3.00 mV/V.

The 10A70-2's advanced design techniques overcome errors that traditionally plague the strain-gage conditioning process. Separate excitation for each channel uses remote sensing of bridge voltage and is slaved to a common System Reference Voltage. The result is consistently stable ratiometric measurement, unaffected by possible power-supply drift. Input impedances in excess of 10,000 $M\Omega$ are presented to signal leads to eliminate cable resistance as a source of error. Allowable cable length has virtually no practical limits.

ADDITIONAL 10A70-2 SPECIFICATIONS

Transducer Types: Conventional 4-arm strain gage bridges, nominal 350 ohms (or higher)

Input Ranges (Full-Scale): ± 0.75 , 1.50, or 3.00 mV/V; automatically selected—on an individual channel basis—when the channel is configured; for System 10 channel “type” codes assigned to 10A70-2 data channels, see Table 1, below. Since channel zeroing is by digital techniques, no input balance control is provided. The allowable input range, therefore, must include any *initial unbalance* (which, in commercially produced strain gage transducers, is usually negligible). Other transducers may have to be externally trimmed to be used with the Model 10A70-2, if zero unbalance exceeds 20% of full scale.

Excitation (per channel): Nominal 10 (i.e., ± 5) V-DC; ± 50 mA, maximum

Amplifier (per channel):

Common-Mode Range: ± 1 V operating; ± 9 V without instrument damage

Common-Mode Rejection Ratio: DC: -100 dB; at 60 Hz: -120 dB

Input Impedance: Differential: greater than 10,000 $M\Omega$; Common-Mode: greater than 10,000 $M\Omega$

Offset: Initial: ± 0.3 mV; vs. Temperature: ± 0.05 $\mu\text{V}/^\circ\text{C}$; vs. Time: ± 5 $\mu\text{V}/\text{month}$

Gain Accuracy*: $\pm 0.02\%$ of full scale *typical*, following calibration

Gain Stability: vs. Temperature: ± 50 ppm/ $^\circ\text{C}$; vs. Time: ± 50 ppm/month

(cont'd)

* Initial (uncalibrated) inaccuracy may be as great as $\pm 0.05\%$ of full scale. Maximum error that could occur upon replacement of a Model 10A70-2 *not followed by calibration* is $\pm 0.1\%$ of full scale.

10A70-2 DUAL DC STRAIN GAGE CARD

Filter (per channel): 3-pole modified Butterworth; 3 dB down at 10 Hz; 60 dB down at 100 Hz

Step-Response Settling Time (Full-Scale Output):

- To 1% of final value: 100 msec
- To 0.1% of final value: 150 msec
- To 0.02% of final value: 600 msec

Auxiliary Output: Filtered outputs available on mainframe wire-wrap pins

Table 1 10A70-2 "Type" Codes

Full-Scale Input	Channel Type Code
0.75 mV/V	70
1.50 mV/V	71
3.00 mV/V	72

2 TRANSDUCER CONNECTIONS

The Model 10A70-2's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Table 2 gives standard pin assignments for the I/O Connector. With regard to 10A70-2 cabling, please note the following:

- a. 4-wire cabling to a full-bridge strain gage transducer is given in Fig. 1(a), and is to be used when the cable is under 20 feet in length. In this case, the +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines *at the CONDITIONER CONNECTOR*. It is recommended that the resistance of the conductors not exceed 0.0001 of the bridge resistance.
- b. 6-wire cabling to a full-bridge strain gage transducer is given in Fig. 1(b), and is to be used when the cable is 20 feet or longer, or when fine wire is used. In this case, the +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines *at the transducer*.

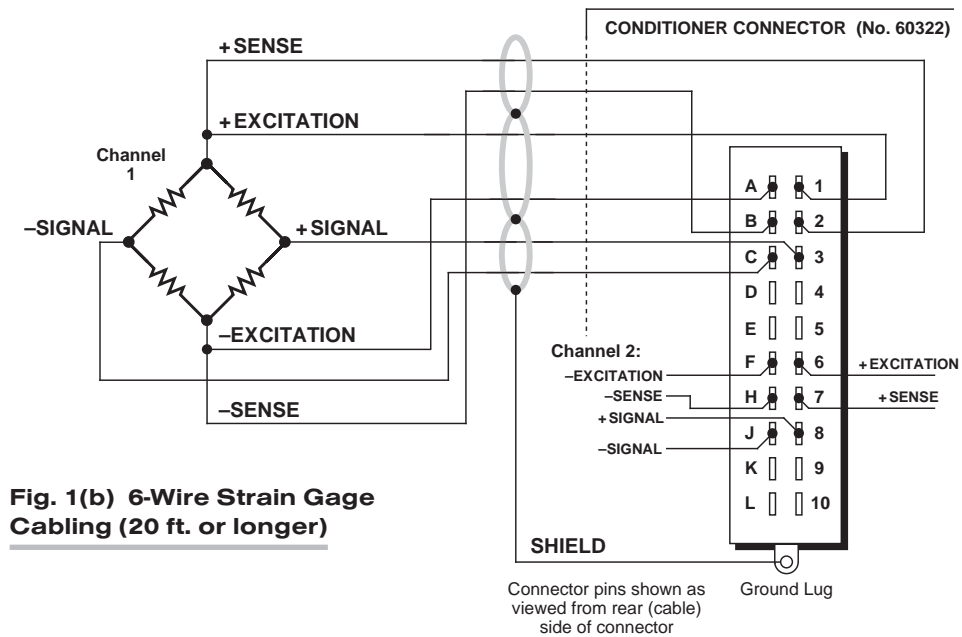
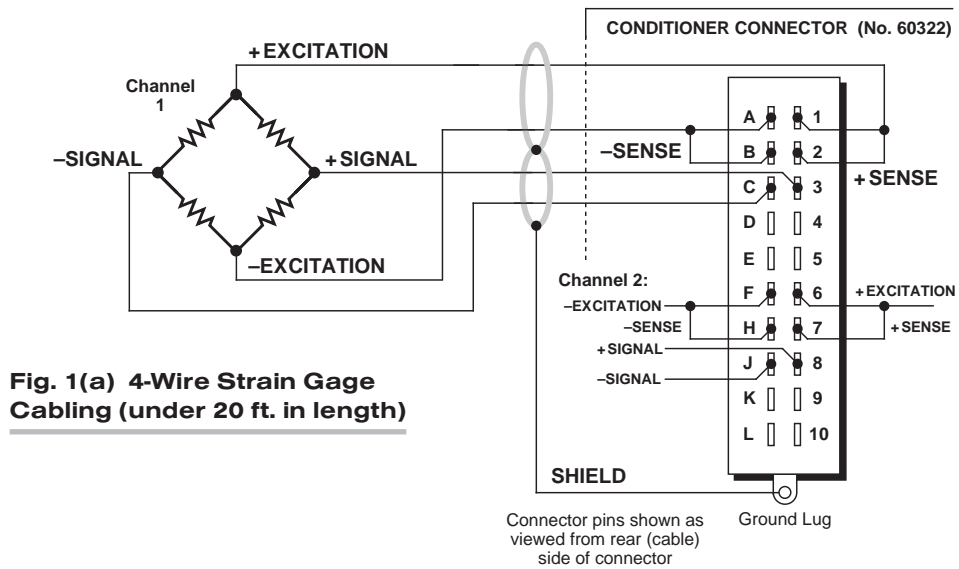
IMPORTANT: The ±EXCITATION, ±SENSE, and ±SIGNAL pins for an UNUSED STRAIN GAGE INPUT CHANNEL should be jumpered as shown in Fig. 2, below. If an input is left open, high-frequency oscillation can result, which can in turn produce significant interchannel crosstalk, and possibly inaccurate data readings.

Table 2 Model 10A70-2 Pin Assignments

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	+EXCITATION (+5 V-DC)
A	1	-EXCITATION (-5 V-DC)
2	1	+SENSE
B	1	-SENSE
3	1	+SIGNAL
C	1	-SIGNAL
4,D,5,E	1	Not Committed
6	2	+EXCITATION (+5 V-DC)
F	2	-EXCITATION (-5 V-DC)
7	2	+SENSE
H	2	-SENSE
8	2	+SIGNAL
J	2	-SIGNAL
9,K,10,L	2	Not Committed

DUAL DC STRAIN GAGE CARD 10A70-2

Fig. 1 Model 10A70-2 Transducer Cabling



10A70-2 DUAL DC STRAIN GAGE CARD

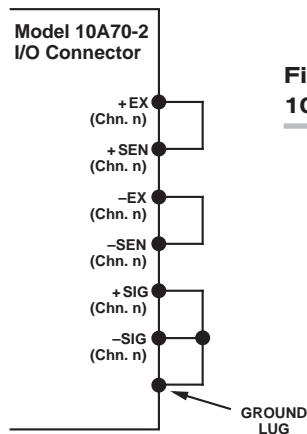


Fig. 2 Jumpering of an Unused 10A70-2 Strain Gage Input

3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A70-2 card when used in System 10, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A70-2 channel “type” codes, see Table 1, above.

In System 10, you can use two calibration methods with the Model 10A70-2 (note that this conditioner *cannot* be calibrated by the “SHUNT” CALIBRATION technique that may be applied to other Strain Gage Conditioner Cards):

CALCULATED CALIBRATION

This is generally the most convenient means of calibrating a 10A70-2 channel, when the transducer’s full-scale “mV/V” sensitivity rating is accurately known.

Thus, to calibrate a 10A70-2-based Channel No. “x,” you need only

1. Turn ON the system EEPROM SWITCH and then apply the following **MV/V CALIBRATION (MVV)** command:

MVV x = i, u [CR]

For “i,” enter the manufacturer-supplied *transducer sensitivity rating* in “mV/V, full scale.” For a “Type 70” channel (0.75 mV/V, full scale), you should enter an “i” value greater than 0.02 and less than or equal to 1.00 (mV/V). For a “Type 71” channel (1.50 mV/V, full scale), you should enter a value greater than 0.04 and less than or equal to 2.00 (mV/V). For a “Type 72” channel (3.00 mV/V, full scale), you should enter a value greater than 0.80 and less than or equal to 4.00 (mV/V).

For “u,” enter the *transducer’s nominal full-scale rating* in whatever engineering units are desired for the channel’s data reading.

The **MVV** command will only work if Channel No. x has been assigned the proper “type” code (“70,” “71,” or “72”).

2. Zero the channel by commanding

ZRO x [CR]

Note that a channel calibrated by the **MVV** command will report measurement data to a precision matching that of the entered “u” value. If, for example, you're measuring “psi,” and enter a “u” of “500,” then all subsequent channel readings will be rounded to the nearest psi. If the entry is “500.0,” then all readings will be rounded to the nearest tenth of a psi.

TWO-POINT (DEADWEIGHT) CALIBRATION

Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional “zero and span” method can be applied to a 10A70-2 channel if the full-scale “mV/V” rating of the channel's strain gage transducer is unknown, or if the final measurement accuracy provided by CALCULATED CALIBRATION does not meet the requirements of the measurement application. The mainframe's **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

10A70-2 DUAL DC STRAIN GAGE CARD

MODEL 10A72-2C

ENHANCED DUAL STRAIN GAGE CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 10A72-2C is a general-purpose two-channel conditioner for use with **DC-excited load cells, pressure sensors, and any other conventional strain gage transducer** employing a 4-arm bridge of nominal 350 Ω or higher, with a full-scale range of 0.75, 1.50, or 3.00 mV/V.

The 10A72-2C's advanced design techniques overcome errors that traditionally plague the strain-gage conditioning process. Separate excitation for each channel uses remote sensing of bridge voltage and is slaved to a common System Reference Voltage. The result is consistently stable ratiometric measurement, unaffected by possible power-supply drift. Input impedances in excess of 10,000 $M\Omega$ are presented to signal leads to eliminate cable resistance as a source of error. Allowable cable length has virtually no practical limits.

The 10A72-2C features selectable per-channel excitation (1, 5, or 10 V-DC). Using low excitation helps reduce gage heating effects in *stress analysis* of materials with low thermal conductivity. Table 1 gives the full-scale mV/V ranges that correspond to each excitation level.

In addition, the 10A72-2C lets the user select either 10-Hz or 100-Hz analog filtering for each input channel. The wideband (100-Hz) filter is specially designed for measurement of a highly dynamic input signal.

A convenient shunt calibration technique is provided. Each channel's shunt resistor may be switched in and out by software command or by means of logic-level inputs through the rear I/O CONNECTOR.

When connected to an optional **Model 10CJB-2 Dual Bridge Completion Card** (or equivalent circuitry supplied by the user*), the 10A72-2C can accept input from a two-wire 1/4-bridge, three-wire 1/4-bridge, 1/2-bridge, or full-bridge strain gage configuration. See Section 4 for details.

ADDITIONAL 10A72-2C SPECIFICATIONS

Transducer Types: Conventional 4-arm strain gage bridges, nominal 350 ohms (or higher); 1/4- and 1/2-bridge gage configurations can be accommodated by means of the **Model 10CJB-2 Dual Bridge Completion Card** described in Section 4 (or equivalent external bridge-completion circuitry supplied by the user)*

(cont'd)

* When conditioning input from a 1/4-bridge or 1/2-bridge strain gage configuration, a 10A72-2C channel should be set to "Gage" mode (see Section 3.a). If you wish to provide your own bridge-completion circuitry, you should contact the factory for instructions on connections and calibration.

10A72-2C ENHANCED DUAL DC STRAIN GAGE CARD

Input Ranges (Full-Scale): Excitation-dependent (see Table 1, below); automatically selected—on an individual channel basis—when the channel is configured; for System 10 channel “type” codes assigned to 10A72-2C data channels, see Table 1. Since channel zeroing is by digital techniques, no input balance control is provided. The allowable input range, therefore, must include any *initial unbalance* (which, in commercially produced strain gage transducers, is usually negligible). Other transducers may have to be externally trimmed to be used with the Model 10A72-2C, if zero unbalance exceeds 20% of full scale.

Excitation (per channel): Selectable 1, 5, or 10 V-DC (i.e., ± 0.5 , ± 2.5 , or ± 5 V-DC, respectively), nominal; ± 50 mA, maximum, for each voltage

Amplifier (per channel):

Common-Mode Range: ± 1 V operating; ± 8 V without instrument damage

Common-Mode Rejection Ratio: DC: -140 dB; at 60 Hz: -120 dB; at 1 kHz: -80 dB

Input Impedance: Differential: greater than 10,000 M Ω ; Common-Mode: greater than 10,000 M Ω

Offset: Initial: ± 0.01 mV; vs. Temperature: ± 0.2 μ V/ $^{\circ}$ C; vs. Time: ± 5 μ V/month

Gain Accuracy: $\pm 0.02\%$ of full scale

Gain Stability: vs. Temperature: ± 50 ppm/ $^{\circ}$ C; vs. Time: ± 20 ppm/month

Filter (per channel): 3-pole modified Butterworth

Standard Filter: 3 dB down at 10 Hz; 60 dB down at 100 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 100 msec

To 0.1% of final value: 150 msec

To 0.02% of final value: 600 msec

Wideband Filter: 3 dB down at 100 Hz; 60 dB down at 1.2 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 10 msec

To 0.1% of final value: 15 msec

To 0.02% of final value: 65 msec

Auxiliary Output: Filtered outputs (1-kHz bandwidth) available on mainframe wire-wrap pins.

Table 1 Model 10A72-2C Ranges and “Type” Codes

1-V Excitation	5V Excitation	10-V Excitation	Channel “Type” Code
7.5 mV/V	1.5 mV/V	0.75 mV/V	70
15.0 mV/V	3.0 mV/V	1.50 mV/V	71
30.0 mV/V	6.0 mV/V	3.00 mV/V	72

2 TRANSDUCER CONNECTIONS

The Model 10A72-2C's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Table 2 gives standard pin assignments for the I/O Connector. With regard to 10A72-2C cabling, please note the following:

- a. 4-wire cabling to a full-bridge strain gage transducer is given in Fig. 1(a), and is to be used when the cable is under 20 feet in length. In this case, the +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines (and also the CALIBRATION SENSE line to the +SIGNAL line) *at the CONDITIONER CONNECTOR*. It is recommended that the resistance of the conductors not exceed 0.0001 of the bridge resistance.
- b. 8-wire cabling to a full-bridge strain gage transducer is given in Fig. 1(b), and is to be used when the cable is 20 feet or longer, or when fine wire is used. In this case, the +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines (and also the CALIBRATION SENSE line to the +SIGNAL line) *at the transducer*. Note also the extra wire connected to the -SIGNAL line at the transducer, but left *unconnected* at the 10A72-2C. This wire is to be paired with the CAL SENSE line to establish proper shielding and to avoid asymmetrical dynamic loading.

IMPORTANT: The ±EXCITATION, ±SENSE, and ±SIGNAL pins for an UNUSED STRAIN GAGE INPUT CHANNEL should be jumpered as shown in Fig. 2, below. If an input is left open, high-frequency oscillation can result, which can in turn produce significant interchannel crosstalk, and possibly inaccurate data readings.

ALSO NOTE: *Logic* connections for remote control of shunt calibration (using the CONDITIONER CONNECTOR'S "NOT ±CALIBRATE" pins) are discussed in Section 3.d, below, and shown in Fig. 5. For connection of an optional **Model 10CJB-2 Dual Bridge Completion Card** to the 10A72-2C, see Section 4.b.

Table 2 Model 10A72-2C Pin Assignments

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	+EXCITATION
A	1	-EXCITATION
2	1	+SENSE
B	1	-SENSE
3	1	+SIGNAL
C	1	-SIGNAL
4	1	CAL SENSE
D	1	<u>NOT</u> +CALIBRATE
5	1	SIGNAL COMMON
E	1	<u>NOT</u> -CALIBRATE
6	2	+EXCITATION
F	2	-EXCITATION
7	2	+SENSE
H	2	-SENSE
8	2	+SIGNAL
J	2	-SIGNAL
9	2	CAL SENSE
K	2	<u>NOT</u> +CALIBRATE
10	2	SIGNAL COMMON
L	2	<u>NOT</u> -CALIBRATE

10A72-2C ENHANCED DUAL DC STRAIN GAGE CARD

Fig. 1 Model 10A72-2C Transducer Cabling

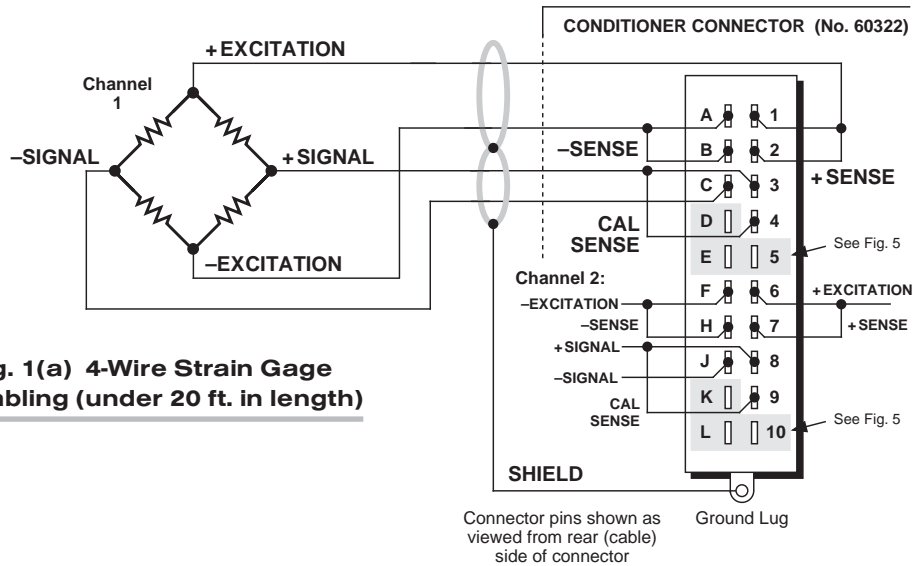


Fig. 1(a) 4-Wire Strain Gage Cabling (under 20 ft. in length)

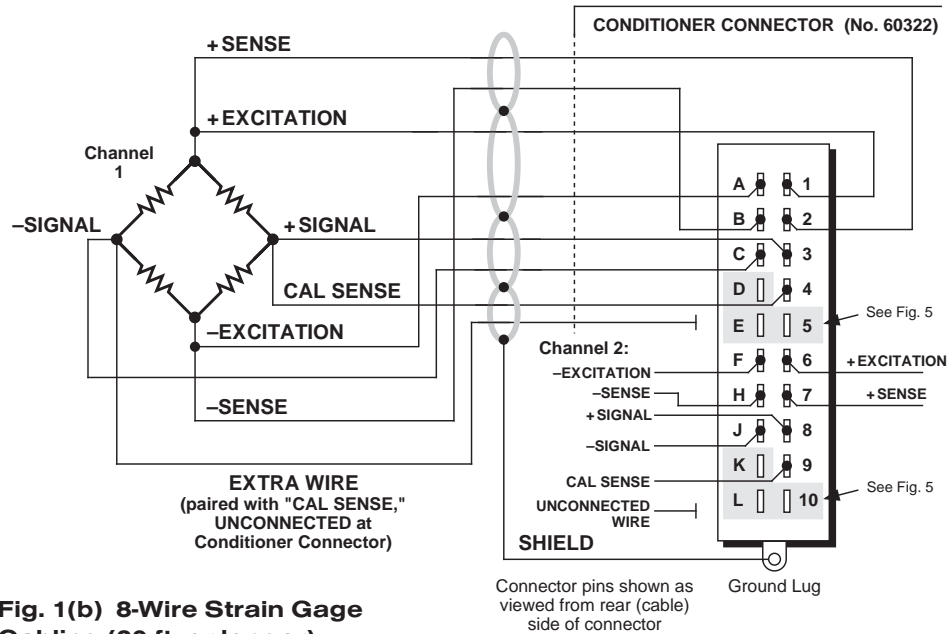


Fig. 1(b) 8-Wire Strain Gage Cabling (20 ft. or longer)

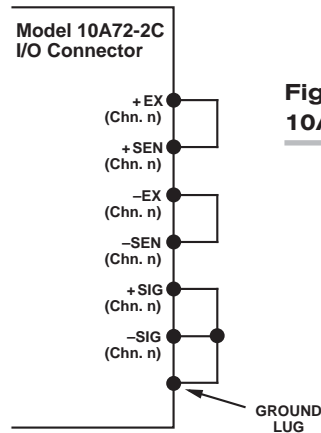


Fig. 2 Jumpering of an Unused 10A72-2C Strain Gage Input

3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a SELECTION OF CONDITIONER MODES

When receiving input from a conventional 4-arm strain gage bridge, a 10A72-2C channel should remain in the factory-set “TRANSDUCER” mode. When conditioning input from a 1/4-bridge (1-arm) or 1/2-bridge (2-arm) strain gage configuration, however, the channel should be set to “GAGE” mode, as follows:*

1. Remove the 10A72-2C card from its mainframe slot. For “Card Insertion and Removal,” see Manual Section 1.B. Since the 10A72-2C is “hot-pluggable,” you need NOT turn off mainframe power before removing the card.
2. Refer to Fig. 3 and locate the CONDITIONER MODE PROGRAMMING JUMPER PINS for Channels 1 and 2. One “minijumper” is provided for each channel, for interconnecting adjacent jumper pins.
3. Position the jumper for each channel as shown in Fig. 3 to set the desired mode for that channel.
4. Keep out the 10A72-2C card for the excitation selection procedure, below.

3.b SELECTION OF EXCITATION LEVELS

To set the DC excitation for each 10A72-2C channel, you should

1. Refer to Fig. 3 and locate the EXCITATION VOLTAGE PROGRAMMING JUMPER PINS for Channels 1 and 2. One “minijumper” is provided for each channel, for interconnecting adjacent jumper pins.
2. Position the jumper for each channel as shown in Fig. 3 to set the desired excitation for that channel (1, 5, or 10 V).
3. Keep out the 10A72-2C card for the filter selection procedure, below.

* In “GAGE” mode, the 10A72-2C requires the connection of a **Model 10CJB-2 Dual Bridge Completion Card**, or equivalent circuitry provided by the user (see Section 4). The purpose of the “GAGE” setting is to ensure compatibility with special applications of the older Model 10A72-2 where it was not required that the “CAL SENSE” line be tied to the “+ SIGNAL” line.

10A72-2C ENHANCED DUAL DC STRAIN GAGE CARD

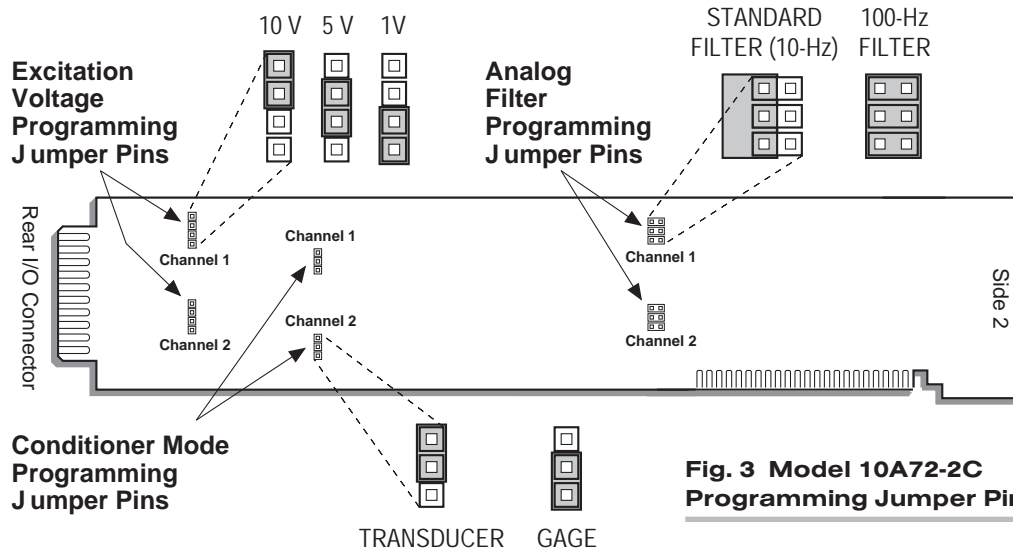


Fig. 3 Model 10A72-2C Programming Jumper Pins

3.c SELECTION OF ANALOG FILTERS

To set the analog filter for each 10A72-2C channel, you should

1. Refer to Fig. 3 and locate the ANALOG FILTER PROGRAMMING JUMPERS PINS for Channels 1 and 2. One multi-connection "minijumper" is provided for each channel.
2. Position the jumper for each channel as shown in Fig. 3 to set the filter for that channel. For the "standard" (10-Hz) filter setting, the jumper should be placed on the left vertical row of pins, with its left edge overhanging the pin block, as shown. For the 100-Hz filter setting, the jumper should be placed directly on all six pins, in order to interconnect each of the three pairs.
3. Reinsert the 10A72-2C card in its mainframe slot.

3.d CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A72-2C card when used in System 10, see the general remarks on System 10 "real-channel" configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A72-2C channel "type" codes, see Table 1, above.

In System 10, you can use three calibration methods with the Model 10A72-2C, unless it is being used with a **Model 10CJB-2 Dual Bridge Completion Card** (in which case a special calibration procedure is required, as explained in Section 4.c, below):

CALCULATED CALIBRATION

This is generally the most convenient means of calibrating a 10A72-2C channel, when the transducer's full-scale "mV/V" sensitivity rating is accurately known.

Thus, to calibrate a 10A72-2C-based Channel No. "x," you need only

1. Turn ON the system EEPROM SWITCH and then apply the following **MV/V CALIBRATION (MVV)** command:

MVV x = i, u [CR]

For “i,” enter the manufacturer-supplied *transducer sensitivity rating* in “mV/V, full scale.” For a “Type 70” channel (7.5/1.5/0.75 mV/V, full scale), you should enter an “i” value greater than 0.02 and less than or equal to 1.00 (mV/V). For a “Type 71” channel (15.0/3.0/1.50 mV/V, full scale), you should enter a value greater than 0.04 and less than or equal to 2.00 (mV/V). For a “Type 72” channel (30.0/6.0/3.00 mV/V, full scale), you should enter a value greater than 0.80 and less than or equal to 4.00 (mV/V).

For “u,” enter the *transducer’s nominal full-scale rating* in whatever engineering units are desired for the channel’s data reading—but *only if the channel is set for 10-volt excitation* (Section 3.b). **NOTE:** If the channel being calibrated is set for *1-volt excitation*, the “u” value to be entered should be *10 times* the actual value of the nominal full-scale rating. If it is set for *5-volt excitation*, “u” should be *2 times* the actual value.

The **MVV** command will only work if Channel No. x has been assigned the proper “type” code (“70,” “71,” or “72”).

2. Zero the channel by commanding

ZRO x [CR]

Note that a channel calibrated by the **MVV** command will report measurement data to a precision matching that of the entered “u” value. If, for example, you’re measuring “psi,” and enter a “u” of “500,” then all subsequent channel readings will be rounded to the nearest psi. If the entry is “500.0,” then all readings will be rounded to the nearest tenth of a psi.

TWO-POINT (DEADWEIGHT) CALIBRATION

Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional “zero and span” method can be applied to a 10A72-2C channel if the full-scale “mV/V” rating of the channel’s strain gage transducer is unknown, or if the final measurement accuracy provided by CALCULATED CALIBRATION does not meet the requirements of the measurement application. The mainframe’s **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

SIMULATED (SHUNT) CALIBRATION

Suitable for all 10A72-2C excitation levels, this method is similar to the conventional TWO-POINT (DEADWEIGHT) procedure. The difference is that the second (“span”) input is not produced by loading the source transducer, but by “simulating” a particular up-scale value of mechanical input. This known EQUIVALENT INPUT then serves to determine the SCALING FACTOR for the channel.

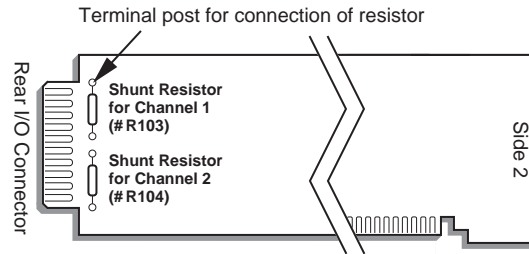
For a 10A72-2C data channel, the equivalent input is produced by shunting a resistor of known magnitude across one arm of the strain gage bridge, thereby simulating a known value of input for either a *positive* or *negative* up-scale reading. If the transducer manufacturer has supplied the exact value of the transducer’s equivalent input, it can be used as a reference point for calibrating the channel.

Equivalent input can be approximated from a knowledge of the *Shunt Calibration Resistance (R)*, the transducer’s *Bridge Resistance (B)*, and the transducer’s *Full-Scale Sensitivity (K, in mV/V full scale)*. To determine the EQUIVALENT INPUT (X) as an approximate percentage of full-scale output, you may use the following equation:

$$X = 25000B / (K(R + 0.5B)) \%$$

10A72-2C ENHANCED DUAL DC STRAIN GAGE CARD

**Fig. 4 Model
10A72-2C
Shunt
Calibration
Resistors**



Since the equivalent input is here expressed as a *percentage of full-scale output*, you must multiply it by the rated full-scale capacity of the transducer, in order to determine the *actual input simulated by the shunt*.

Shunt calibration is an easier though generally less accurate technique than two-point (deadweight) calibration. It is useful, however, when overall “deadweighting” is impossible or inconvenient, and is good for an accuracy of about 0.2% (depending, of course, on the accuracy of the specified equivalent input, and on the resistor/bridge tolerance and temperature).

The 10A72-2C is equipped with a 100-k Ω , 0.1% *calibration resistor* for each active channel. These resistors are located on turret terminals at the rear of the card (see Fig. 4). You may, if you wish, replace each channel’s installed 100K shunt resistor with a resistor of another value (strain-gage transducer manufacturers often supply such resistors with their instruments).

In System 10, a strain gage channel’s shunt resistor may be switched in and out by means of the **SHUNT CALIBRATE-POSITIVE (SHP)** or **SHUNT CALIBRATE-NEGATIVE (SHN)** command. A **RESUME (RSM)** command should then be applied to remove the shunt and resume normal channel measurement. Since these are “run-time” commands, the mainframe’s **EEPROM Write Protect Switch** need not be on for them to be effective. See Manual Section 1.G.6 for general instructions regarding the “SHUNT CALIBRATION” technique in System 10.

NOTE: Per-channel shunt calibration for the 10A72-2C can be “remotely” controlled, if desired, as an alternative to using the software “SHUNT CALIBRATE” commands provided by the system. This remote calibration control is accomplished by means of logic-level inputs to the 10A72-2C card. The relevant connections are given in Fig. 5.

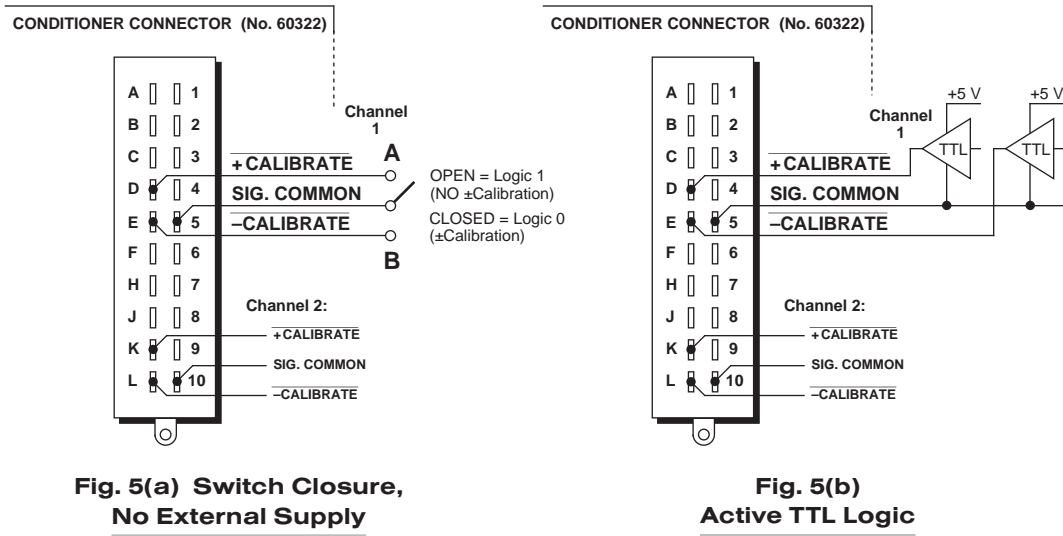
Fig. 5(a) shows how the “CALIBRATE POSITIVE” and “CALIBRATE NEGATIVE” commands can be independently applied to either active 10A72-2C channel, without the need of an external logic reference supply.

Closing the switch in Fig. 5(a) to contact point “A” will produce a *Logic 0* level at Pin D (“**NOT +CALIBRATE**”). Since this is a negative-true logic line, the *Logic 0* input will activate the “+CALIBRATE” condition of the channel. That is, it will switch in the channel’s shunt resistor for a *positive* up-scale reading. Opening the switch to disconnect the “NOT +CALIBRATE” line from SIGNAL COMMON will then return the channel to the “NO +CALIBRATE” condition.

Similarly, closing the switch to contact point “B” will produce a *Logic 0* level at Pin E (“**NOT -CALIBRATE**”), thereby switching in the channel’s shunt resistor for a *negative* up-scale reading. Opening the switch to disconnect the “NOT -CALIBRATE” line from SIGNAL COMMON will then return the channel to the “NO -CALIBRATE” condition.

You may also use active TTL logic, as illustrated in Fig. 5(b), to produce the “+CALIBRATE” or “-CALIBRATE” condition for either 10A72-2C channel.

Fig. 5 Logic Inputs for 10A72-2C Remote Shunt Calibration



4 OPTIONAL BRIDGE COMPLETION: MODEL 10CJB-2 DUAL BRIDGE COMPLETION CARD

4.a PURPOSE

The optional **Model 10CJB-2 Dual Bridge Completion Card** lets you connect each of your Model 10A72-2C's inputs to a *2-wire 1/4-bridge*, *3-wire 1/4-bridge*, *1/2-bridge*, or *full-bridge* strain gage configuration. Each 1/4-bridge configuration may use *either 120 or 350 ohms* nominal gage resistance. The function of the Model 10CJB-2 is to "complete" the connected bridge—that is, to allow it to be "seen" by the Model 10A72-2C as a full (4-arm) Wheatstone bridge.

For calibration of 10A72-2C channels originating from the Model 10CJB-2, see Section 4.c, below.

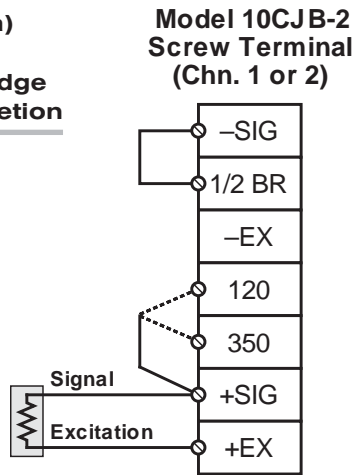
4.b 10CJB-2 TRANSDUCER CONNECTIONS

Remove the top plate of the Model 10CJB-2 box (4 screws in corners). Inside the box are two sets of labelled screw terminals, one for each of the 10A72-2C's input channels ("A" and "B"). You will connect your gage wires directly to these terminals, as shown in Fig. 6, and, if necessary, interconnect certain terminal pairs by means of jumper wires. Gage leads should enter the 10CJB-2 through the cutout on the right-hand side of the box.

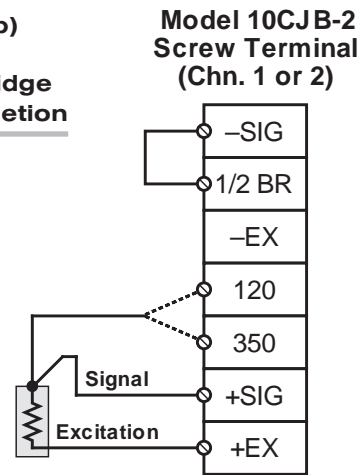
NOTE: You must furnish your own *pin-to-pin shielded cable* for connecting the 10CJB-2 to the 10A72-2C's rear I/O CONNECTOR (see Table 2 for pin assignments)—or you may use a special cable furnished by Daytronic. In either case, Daytronic will supply terminal connectors for the cable.

Fig. 6 Model 10CJB-2 Transducer Cabling

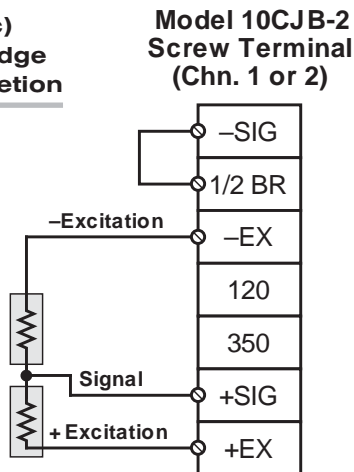
**Fig. 6(a)
2-Wire
1/4-Bridge
Completion**



**Fig. 6(b)
3-Wire
1/4-Bridge
Completion**



**Fig. 6(c)
1/2-Bridge
Completion**



**Fig. 6(d)
Full-Bridge
Connection**

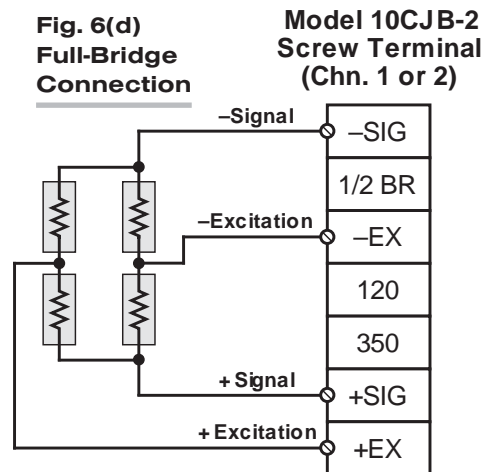


Fig. 6(a) shows connections between the 10CJB-2 and a *2-wire 1/4-bridge* gage configuration (represented by the single gage resistor). Here, you must install a jumper wire between the **-SIG** and **1/2 BR** terminals, and between the **+SIG** terminal and *either* the **120** terminal *or* the **350** terminal, depending on the nominal gage resistance.

Fig. 6(b) shows connections between the 10CJB-2 and a *3-wire 1/4-bridge* gage configuration (again represented by the single gage resistor). Here again, the **-SIG** and **1/2 BR** terminals must be tied. The gage's third (self-compensating) lead is connected *either* to the **120** terminal *or* to the **350** terminal, depending on the nominal gage resistance.

Fig. 6(c) shows connections between the 10CJB-2 and a *1/2-bridge* gage configuration (represented by the two connected gage resistors). Here again, the **-SIG** and **1/2 BR** terminals must be tied.

Fig. 6(d) shows connections between the 10CJB-2 and a *full-bridge* gage configuration (represented by the four connected gage resistors).

4.C CALIBRATION

CALCULATED CALIBRATION

You can calibrate a 10A72-2C channel receiving strain-gage input from a Model 10CJB-2 Bridge Completion Card by applying the **MV/V CALIBRATION (MVV)** command as described in Section 3.d, above. Note however that, in this case,

- for “i” (the *transducer sensitivity rating*), you should enter one of the following full-scale “mV/V” values, whichever corresponds to the channel’s “type” setting (see Table 1): **0.75** (for “Type 70”), **1.50** (for “Type 71”), or **3.00** (for “Type 72”).
- for “u” (the *nominal full-scale rating*), you should enter the full-scale *microstrain range* that corresponds to the selected transducer sensitivity rating, as given in the following table:

Table 3 Strain Gage Microstrain Ranges (10A72-2C)

Full-Scale Output (mV/V)	Full-Scale Microstrain Range
0.75	$u = 3000 / (N \cdot G)$
1.50	$u = 6000 / (N \cdot G)$
3.00	$u = 12000 / (N \cdot G)$

Here, “N” is the *number of active strain-gage arms* in the gage configuration. Thus, for a 1/4-bridge gage, N = 1; for a half-bridge gage, N = 2; and for a full-bridge gage, N = 4. “G” is the *gage factor* of the strain gage, and is normally provided by the manufacturer.

TWO-POINT (DEADWEIGHT) CALIBRATION

See Section 3.d, above, for the general procedure. Your first calibration point (entered via the **ZERO (ZRO)** command) should be *zero*. Your second calibration point (entered via the **FORCE (FRC)** command) should be expressed in *microstrain (microinches/inch)*.

SIMULATED (SHUNT) CALIBRATION

See Section 3.d, above, for the general procedure. Your EQUIVALENT INPUT value, which is entered via the **FORCE (FRC)** command—following zeroing of the channel and switching in of the shunt resistor—should be expressed in *microstrain (microinches/inch)*.

COARSE ZERO OFFSET

In the event that, during “Two-Point” or “Simulated” calibration of the 10CJB-2 channel, you are unable to set the desired span via the **FORCE (FRC)** command, you can apply a positive or negative zero offset of approximately 1 mV/V for balance correction, as follows:

1. Remove the top plate of the 10CJB-2 box and locate the three programming jumper pads for the channel in question. Labelled “A” for Channel 1 and “B” for Channel 2, the pads are near the left edge of the 10CJB-2 circuit board.
2. Place a solder drop between the center pad and either the “+” or “-” pad, depending on the desired offset polarity.
3. Re-enter your **ZRO** and **FRC** values (with or without calibration “shunt”).

10A72-2C ENHANCED DUAL DC STRAIN GAGE CARD

MODEL 10A73-4

1/2 & 1/4 BRIDGE STRAIN GAGE CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

Intended primarily for *stress analysis applications*, the Model 10A73-4 receives and conditions up to *four* independent inputs from one-arm (1/4-bridge), two-arm (1/2-bridge), and four-arm (full-bridge) **strain gage configurations** attached directly to the stressed material.

If you are measuring strain by means of a one-arm (1/4-bridge) strain gage configuration, BE SURE TO STUDY SECTION 4 FOR A DISCUSSION OF “LEAD WIRE AND NON-LINEARITY EFFECTS WITH QUARTER-BRIDGE STRAIN GAGE CONFIGURATION.”

Unless all four inputs originate from full-bridge transducers, the 10A73-4 requires external completion of each strain gage input to *full bridge*, by means of one of the following:

- a System 10 **Bridge Completion Connector**—one of the following models:
 - **10QBC-4-120** for 2- or 3-wire 120- Ω quarter-bridge connections
 - **10QBC-4-350** for 2- or 3-wire 350- Ω quarter-bridge connections
 - **10QBC-4-1K** for 2- or 3-wire 1000- Ω quarter-bridge connections
 - **10HBC-4** for 4- or 6-wire half-bridge connections
 - **10FBC-4** for 5-wire full-bridge connections
- a Daytronic **Model 10CJB-4 Quad Bridge Completion Card** (described in Section 2.b)¹;
- equivalent circuitry supplied by the user²

When the 10A73-4 is used with one of the System 10 Bridge Completion Connectors listed above, the excitation level is *fixed at 5 V-DC*. In the absence of a Bridge Completion Connector—whether or not the **Model 10CJB-4** is used—the 10A73-4 provides *selectable low-level excitation* (1, 2, or 5 V-DC) to help reduce gage heating effects in materials with low thermal conductivity.³ However, the selection of excitation level for the 10A73-4 is not “per channel”; *the same level applies to all four 10A73-4 channels*. See Section 3.a for details.

As explained in Section 3.b, the 10A73-4 can be quickly calibrated either through “calculated” calibration—involving application of the **MVV** command—or through a convenient shunt technique. Unless a System 10 Bridge Completion Connector is being used with the 10A73-4, all four shunt resistors may be switched in and out simultaneously by means of logic-level inputs through the rear I/O CONNECTOR.

¹ The 10CJB-4 contains a switch for easy selection of the common excitation level.

² If you wish to provide your own bridge-completion circuitry, you should contact the factory for instructions on connections and calibration.

³ A special modification must be made to the 10A73-4 card to allow selectable excitation when a System 10 Bridge Completion Connector is attached.

10A73-4 QUAD 1/2 & 1/4 BRIDGE DC STRAIN GAGE CARD

ADDITIONAL 10A73-4 SPECIFICATIONS

Transducer Types: 1-arm (1/4-bridge), 2-arm (1/2-bridge), or 4-arm (full-bridge) strain-gage configurations. 2-wire or 3-wire 1/4-bridge configurations may use either 120 Ω , 350 Ω , or 1 k Ω nominal gage resistance; full-bridge configurations should use 350- Ω gages (or higher) or should use 120- Ω gages with either 1-V or 2-V excitation. Unless all four inputs originate from *full-bridge* transducers, the Model 10A73-4 requires either an appropriate System 10 **Bridge Completion Connector**; a **Model 10CJB-4 Quad Bridge Completion Card**; or equivalent bridge-completion circuitry supplied by the user.

Transducer Ranges: ± 0.750 , 1.500, or 3.000 mV/V; for System 10 channel "type" codes assigned to 10A73-4 data channels, see Table 1

Excitation (for all four channels): Sensed excitation selectable 1, 2, or 5 V-DC (i.e., ± 0.5 , ± 1 , or ± 2.5 V-DC, respectively), nominal

Amplifier (per channel):

Common-Mode Range: ± 0.4 V operating; ± 5 V without instrument damage

Common-Mode Rejection Ratio: DC: -90 dB; at 60 Hz, 1 kHz, and 3 kHz: -120 dB

Input Impedance: Differential: greater than 100 M Ω ; Common-Mode: greater than 100 M Ω

Offset: Initial: $\pm 0.04\%$ of full scale; vs. temperature: ± 20 ppm/ $^{\circ}$ C; vs. time: ± 10 ppm/month

Gain Accuracy*: $\pm 0.02\%$ of full scale with 5-V excitation; $\pm 0.02\%$ of full scale with 1-V or 2-V excitation *typical*, following calibration

Gain Stability: vs. temperature: ± 50 ppm/ $^{\circ}$ C; vs. time: ± 20 ppm/month

Filter: 3-pole modified Butterworth; 3 dB down at 10 Hz; 60 dB down at 100 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 100 msec

To 0.1% of final value: 150 msec

To 0.02% of final value: 600 msec

Auxiliary Output: Filtered outputs available on mainframe wire-wrap pins

Table 1 10A73-4 "Type" Codes

Full-Scale Input	Channel Type Code
0.750 mV/V	70
1.500 mV/V	71
3.000 mV/V	72

2 GAGE / TRANSDUCER CONNECTIONS

Table 2, below, gives pin assignments for the 10A73-4's rear I/O CONNECTOR, to which appropriate BRIDGE COMPLETION CIRCUITRY must be attached, unless all four inputs originate from full-bridge transducers.

Section 2.a describes the cabling to be used with System 10 **Bridge Completion Connectors**.

Section 2.b describes the cabling to be used with the **Model 10CJB-4 Quad Bridge Completion Card**.

* Initial (uncalibrated) inaccuracy with 1-V or 2-V excitation may be as great as $\pm 0.1\%$ of full scale. Maximum error that could occur upon replacement of a Model 10A73-4 *not followed by calibration* is $\pm 0.2\%$ of full scale.

QUAD 1/2 & 1/4 BRIDGE DC STRAIN GAGE CARD 10A73-4

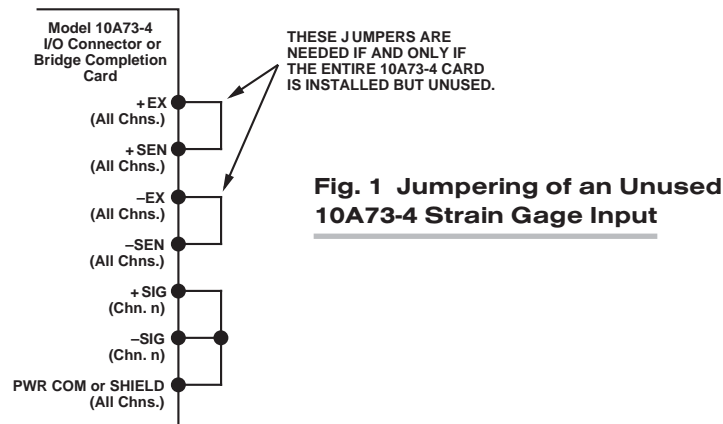
Section 2.c describes the cabling to be used in the absence of bridge-completion circuitry (i.e., connection to four full-bridge transducers).

IMPORTANT: The \pm EXCITATION, \pm SENSE, and \pm SIGNAL pins for an UNUSED STRAIN GAGE INPUT CHANNEL should be jumpered *at the I/O CONNECTOR or in the BRIDGE COMPLETION CONNECTOR* as shown in Fig. 1, below. If an input is left open, high-frequency oscillation can result, which can in turn produce significant interchannel crosstalk, and possibly inaccurate data readings.

ALSO NOTE: Logic connections for remote control of shunt calibration (using the I/O CONNECTOR'S "NOT \pm CALIBRATE" pins) are discussed in Section 3.b and shown in Fig. 8. Note that these logic-level inputs are not available for use when a Bridge Completion Card is attached to the 10A73-4.

Table 2 Model 10A73-4 Pin Assignments

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	+SIGNAL
A	1	-SIGNAL
2	1	CAL SENSE
B	*	+EXCITATION
3	2	+SIGNAL
C	2	-SIGNAL
4	2	CAL SENSE
D	*	+SENSE
5	3	+SIGNAL
E	3	-SIGNAL
6	3	CAL SENSE
F	*	-SENSE
7	4	+SIGNAL
H	4	-SIGNAL
8	4	CAL SENSE
J	*	-EXCITATION
9	*	<u>NOT</u> +CALIBRATE
K	*	EXC PROGRAMMING
10	*	<u>NOT</u> -CALIBRATE
L	*	POWER COMMON



* This function is common to all four channels.

10A73-4 QUAD 1/2 & 1/4 BRIDGE DC STRAIN GAGE CARD

2.a 1/4-, 1/2-, OR FULL-BRIDGE GAGE CONNECTIONS USING A SYSTEM 10 BRIDGE COMPLETION CONNECTOR

Each System 10 **Bridge Completion Connector** attaches directly to the rear I/O CONNECTOR of the Model 10A73-4.

Remove the top plate of the connector. Inside are four sets of labelled screw terminals, corresponding to the 10A73-4's four input channels. You will connect your gage wires directly to these terminals and, if necessary, interconnect certain terminal pairs by means of jumper wires. All gage leads should be securely clamped by means of the two cable clamps.

Fig. 2 shows per-channel connections between external strain-gage configurations and the respective System 10 Bridge Completion Connectors.

NOTE: Unlike the Model 10CJB-4, the Bridge Completion Connectors DO NOT PERMIT MIXING OF CONNECTED GAGE CONFIGURATION TYPES. That is, all gage configurations connected to the same Bridge Completion Connector must be of the same appropriate type (e.g., 120-Ω 1/4-bridge, 1/2-bridge, etc.).

When input connections involve pairs of EXCITATION, SENSE, and/or SIGNAL lines, these should be *twisted pairs* within the input cable. While it is desirable to shield such pairs individually (as shown in Fig. 2), this is not necessary; an overall cable shield is acceptable.

Note too that the *full-bridge* input connections given in Fig. 2(e) are to be used if one or more of the 10A73-4's *other* inputs derives from a less than full-bridge configuration. If all four inputs originate from full-bridge configurations, no completion circuitry is required (see Section 2.c and Fig. 4).

Fig. 2 Model 10A73-4 Strain Gage Cabling Using System 10 Bridge Completion Connectors

Fig. 2(a) Per-Channel Connections to Model 10QBC-4* for 2-Wire 1/4-Bridge Completion

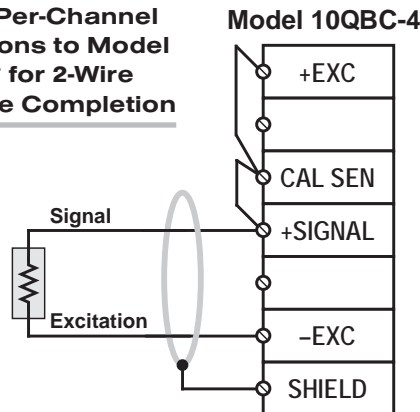
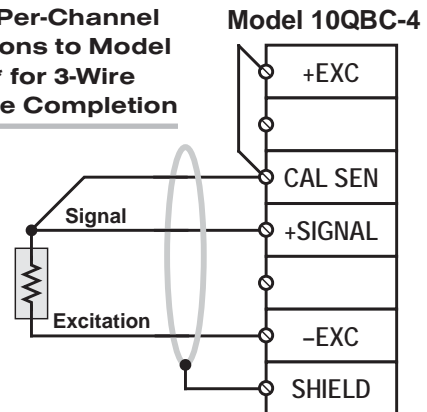


Fig. 2(b) Per-Channel Connections to Model 10QBC-4* for 3-Wire 1/4-Bridge Completion



* I.e., Model **QBC-4-120**, **QBC-4-350**, or **QBC-4-1K**.

Fig. 2(c) Per-Channel Connections to Model 10HBC-4 for 4-Wire 1/2-Bridge Completion

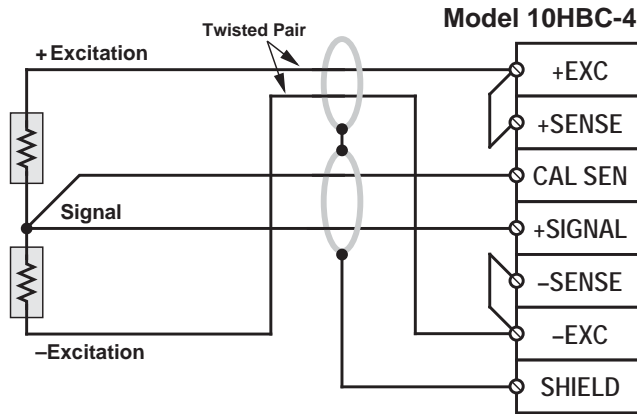


Fig. 2(d) Per-Channel Connections to Model 10HBC-4 for 6-Wire 1/2-Bridge Completion

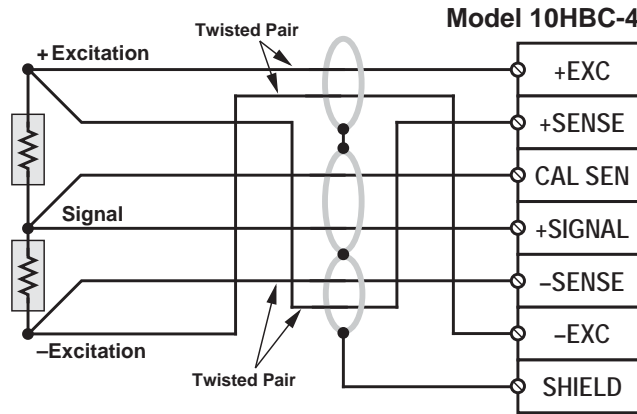
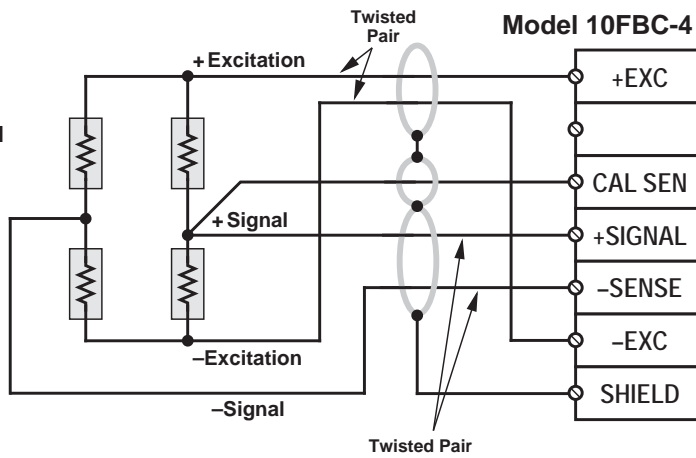


Fig. 2(e) Per-Channel Connections to Model 10FBC-4 for Full-Bridge Connection



2.b 1/4-, 1/2-, OR FULL-BRIDGE GAGE CONNECTIONS USING THE MODEL 10CJB-4

Remove the top plate of the Model 10CJB-4 box (4 screws in corners). Inside the box are four sets of labelled screw terminals, one for each of the 10A73-4's input channels ("A," "B," "C," and "D"). You will connect your gage wires directly to these terminals, as shown in Fig. 3, and, if necessary, interconnect certain terminal pairs by means of jumper wires. Gage leads should enter the 10CJB-4 through the cutout on the right-hand side of the box.

NOTE: You must furnish your own *pin-to-pin shielded cable* for connecting the 10CJB-4 to the 10A73-4's rear I/O CONNECTOR (see Table 2 for pin assignments)—or you may use a special cable furnished by Daytronic. In either case, Daytronic will supply terminal connectors for the cable.

Fig. 3(a) shows connections between the 10CJB-4 and a *2-wire 1/4-bridge* gage configuration (represented by the single gage resistor). Here, you must install a jumper wire between the **-SIG** and **1/2 BR** terminals, and between the **+SIG** terminal and *either* the **120** terminal *or* the **350** terminal, depending on the nominal gage resistance.

Fig. 3 Model 10CJB-4 Transducer Cabling

Fig. 3(a)
2-Wire
1/4-Bridge
Completion

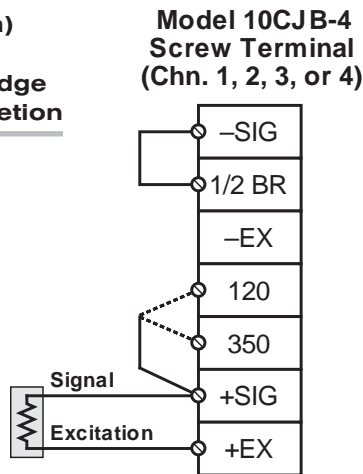


Fig. 3(b)
3-Wire
1/4-Bridge
Completion

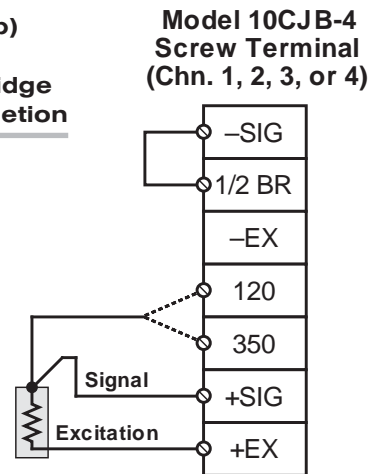


Fig. 3(c)
1/2-Bridge
Completion

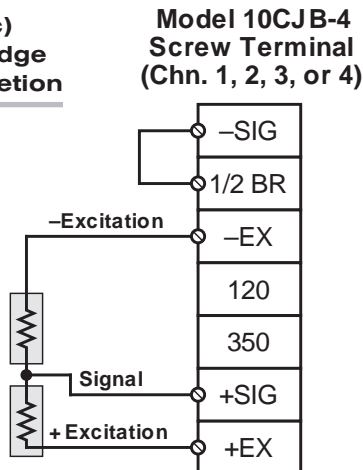
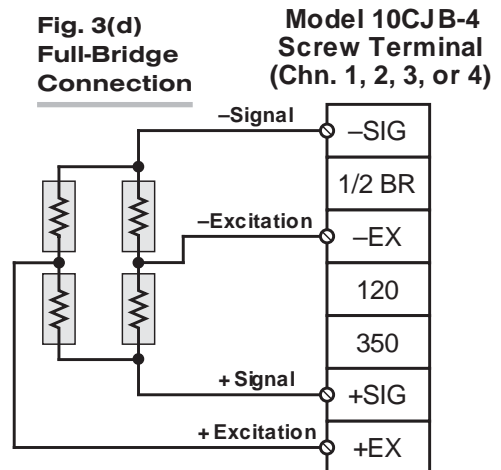


Fig. 3(d)
Full-Bridge
Connection



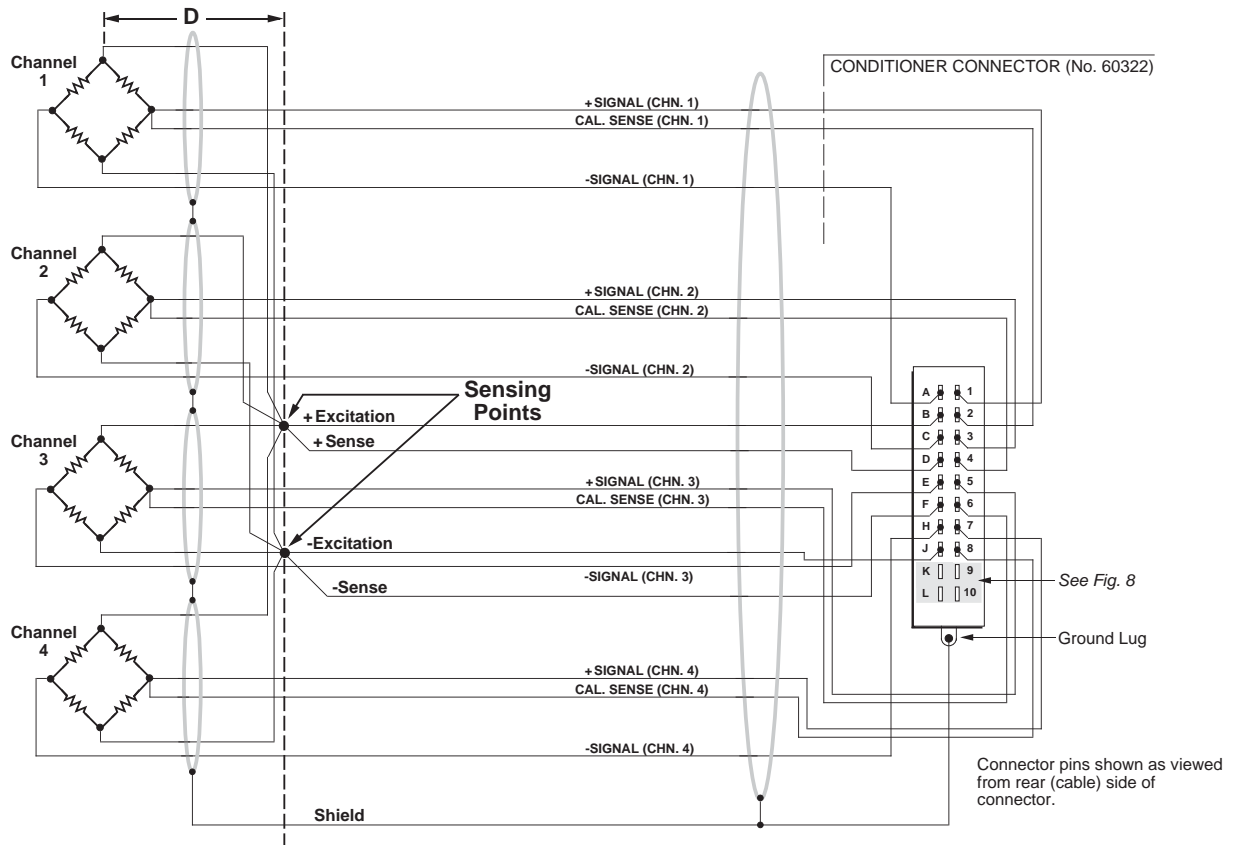


Fig. 4 10A73-4 Cabling to Four Full-Bridge Transducers

Fig. 3(b) shows connections between the 10CJB-4 and a *3-wire 1/4-bridge* gage configuration (again represented by the single gage resistor). Here again, the **-SIG** and **1/2 BR** terminals must be tied. The gage's third (self-compensating) lead is connected *either* to the **120** terminal *or* to the **350** terminal, depending on the nominal gage resistance.

Fig. 3(c) shows connections between the 10CJB-4 and a *1/2-bridge* gage configuration (represented by the two connected gage resistors). Here again, the **-SIG** and **1/2 BR** terminals must be tied.

Fig. 3(d) shows connections between the 10CJB-4 and a *full-bridge* gage configuration (represented by the four connected gage resistors).

2.C FULL-BRIDGE TRANSDUCER CONNECTIONS (WITHOUT BRIDGE COMPLETION)

In the absence of bridge-completion circuitry, the 10A73-4's I/O CONNECTOR will mate with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Pinout for the I/O CONNECTOR is given in Table 2, above. The required cabling is shown in Fig. 4, above.

Note that the main 16-wire shielded cable should contain 20- to 24-gage wires. The length of the main cable—i.e., the distance from the 10A73-4's rear I/O CONNECTOR to the two “sensing points”—may be up to 500 feet. At the sensing points, the + SENSE

10A73-4 QUAD 1/2 & 1/4 BRIDGE DC STRAIN GAGE CARD

and -SENSE lines join the corresponding EXCITATION lines, and the main cable divides into four separately shielded 5-wire cables (one to each full-bridge transducer). These secondary cables should contain 16- to 20-gage wires. It is important that the distance "D" from the sensing points to each transducer be *as short as possible*; a maximum error of 0.02% could arise for every 3.5 ft. of 20-gage wire over the distance "D," and for every 9 ft. of 16-gage wire.

3 SETUP AND/OR OPERATING CONSIDERATIONS

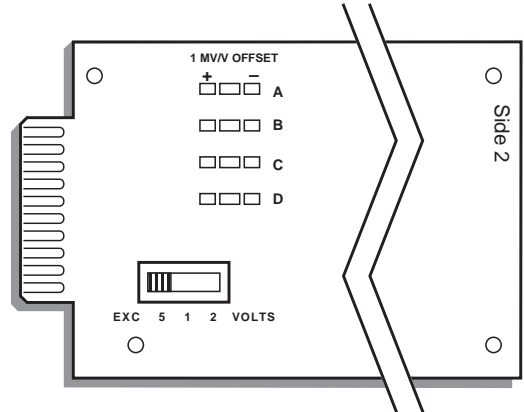
3.a SELECTION OF EXCITATION LEVEL

When a System 10 **Bridge Completion Connector** (Model **10QBC-4-120**, **10QBC-4-350**, **10QBC-4-1K**, **10HBC-4**, or **10FBC-4**) is used with the Model 10A73-4, the excitation level for all four channels is *fixed at 5 volts*, and cannot be changed without a special modification to the 10A73-4 card.

When the **Model 10CJB-4 Quad Bridge Completion Card** is used with the Model 10A73-4, you will use the three-position switch on the 10CJB-4 board to set the excitation level for all four 10A73-4 channels to 1, 2, or 5 volts. The switch is shown in Fig. 5, below.

When a Bridge Completion Card or 10CJB-4 is absent, you may use Pin K of the 10A73-4's rear I/O CONNECTOR to select the desired excitation for all four channels, as indicated in Fig. 6. Leaving Pin K open selects an excitation of 5 volts; tying Pin K to Pin L selects 2 volts; and tying Pin K to Pin J selects 1 volt.

Fig. 5 Model 10CJB-4 Offset Jumpers and Excitation Selection Switch



CONDITIONER CONNECTOR (No. 60322)

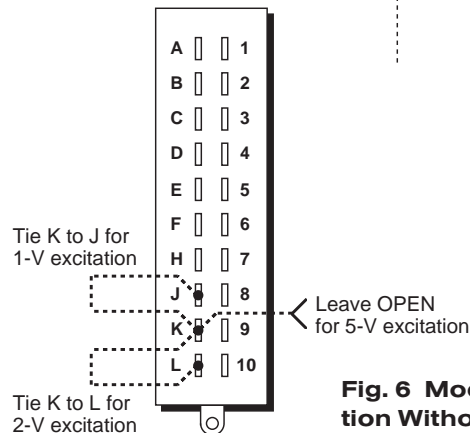


Fig. 6 Model 10A73-4 Excitation Selection Without Bridge Completion

3.b CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A73-4 card when used in System 10, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A73-4 channel “type” codes, see Table 1, above.

In System 10, when a Model 10A73-4 is connected to *quarter-bridge or half-bridge gage configurations* for purposes of stress analysis, you can perform both “CALCULATED” and “SIMULATED (SHUNT)” calibration of any of its input channels, regardless of the type of bridge completion being used for that channel. In general, the conventional “TWO-POINT (DEADWEIGHT)” method does not apply in such cases.

When a 10A73-4 is connected to *full-bridge strain gage transducers*, “TWO-POINT (DEADWEIGHT)” calibration may be applied, in addition to or as an alternative to “CALCULATED” and “SIMULATED (SHUNT)” calibration.

NOTE: If you are using a **Model 10CJB-4** for bridge completion of a 10A73-4 channel and, *prior to initial calibration*, observe a significantly nonzero reading when no load is placed on the gage(s), you may impose a *nominal ± 1 mV/V offset* by means of solder pads in the 10CJB-4 box. See Section 3.c for complete instructions.

CALCULATED CALIBRATION

To calibrate a 10A73-4-based Channel No. “x,”

1. Turn ON the system EEPROM SWITCH and then apply the following **MV/V CALIBRATION (MVV)** command:

MVV x = i, u [CR]

For “i” (the *transducer sensitivity rating*), you should enter one of the following full-scale “mV/V” values, whichever corresponds to the channel’s “type” setting (see Table 1): **0.750** (for “Type 70”), **1.500** (for “Type 71”), or **3.000** (for “Type 72”).

For “u” (the *nominal full-scale rating*), you should enter the full-scale *microstrain range* that corresponds to the selected transducer sensitivity rating, as given in the following table:

Table 3 Strain Gage Microstrain Ranges (10A73-4)

Full-Scale Output (mV/V)	Full-Scale Microstrain Range
0.750	$u = 3000 / (N \cdot G)$
1.500	$u = 6000 / (N \cdot G)$
3.000	$u = 12000 / (N \cdot G)$

Here, “N” is the *number of active strain-gage arms* in the gage configuration. Thus, for a 1/4-bridge gage, N = 1; for a half-bridge gage, N = 2; and for a full-bridge gage, N = 4. “G” is the *gage factor* of the strain gage, and is normally provided by the manufacturer.

The **MVV** command will only work if Channel No. x has been assigned the proper “type” code (“70,” “71,” or “72”). Note that a channel calibrated by the **MVV** command will report measurement data to a precision matching that of the entered “u” value.

2. Zero the channel by commanding

ZRO x [CR]

10A73-4 QUAD 1/2 & 1/4 BRIDGE DC STRAIN GAGE CARD

Two-Point (Deadweight) Calibration

PLEASE NOTE: AS MENTIONED ABOVE, THIS CALIBRATION TECHNIQUE GENERALLY APPLIES TO A MODEL 10A73-4 CHANNEL ONLY WHEN THAT CHANNEL IS CONNECTED TO A FULL-BRIDGE STRAIN GAGE TRANSDUCER, AS ARE THE FOUR CHANNELS SHOWN IN FIG. 4.

Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional “zero and span” method can be applied to a “full-bridge” 10A73-4 channel if the full-scale “mV/V” rating of the channel’s strain gage transducer is unknown, or if the final measurement accuracy provided by CALCULATED CALIBRATION does not meet the requirements of the measurement application. The mainframe’s **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

Simulated (Shunt) Calibration

This is a convenient “shunt resistor” method, where the second (“span”) input is not produced by loading the source transducer, but by “simulating” a particular up-scale value of mechanical input. This known EQUIVALENT INPUT then serves to determine the SCALING FACTOR for the channel.*

For a 10A73-4 data channel, the equivalent input is produced by shunting a resistor of known magnitude across one arm of the strain gage bridge, thereby simulating a known value of input for either a *positive* or *negative* up-scale reading. If the transducer manufacturer has supplied the exact value of the transducer’s equivalent input, it can be used as a reference point for calibrating the channel.

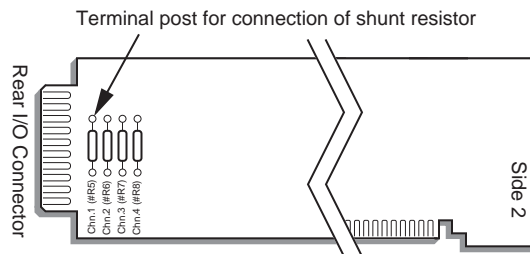
Equivalent input can be approximated from a knowledge of the *Shunt Calibration Resistance (R)*, the transducer’s *Bridge Resistance (B)*, and the transducer’s *Full-Scale Sensitivity (K, in mV/V full scale)*. To determine the EQUIVALENT INPUT (X) as an approximate percentage of full-scale output, you may use the following equation:

$$X = 25000B / K(R + 0.5B) \%$$

Since the equivalent input is here expressed as a *percentage of full-scale output*, you must multiply it by the rated full-scale capacity of the transducer, in order to determine the *actual input simulated by the shunt*.

IMPORTANT: FOR A 10A73-4 CHANNEL WITH BRIDGE COMPLETION—BY MEANS EITHER OF A SYSTEM BRIDGE COMPLETION CONNECTOR OR THE MODEL 10CJB-4—THE EQUIVALENT INPUT SHOULD BE EXPRESSED IN *MICROSTRAIN (MICROINCHES/INCH)*.

Fig. 7 Model 10A73-4 Shunt Calibration Resistors



* Shunt calibration is easier though generally less accurate than two-point (deadweight) calibration. It is good for an accuracy of about 0.2% (depending, of course, on the accuracy of the specified equivalent input, and on the resistor/bridge tolerance and temperature).

Fig. 8 Logic Inputs for 10A73-4 Remote Shunt Calibration (Without Bridge Completion)

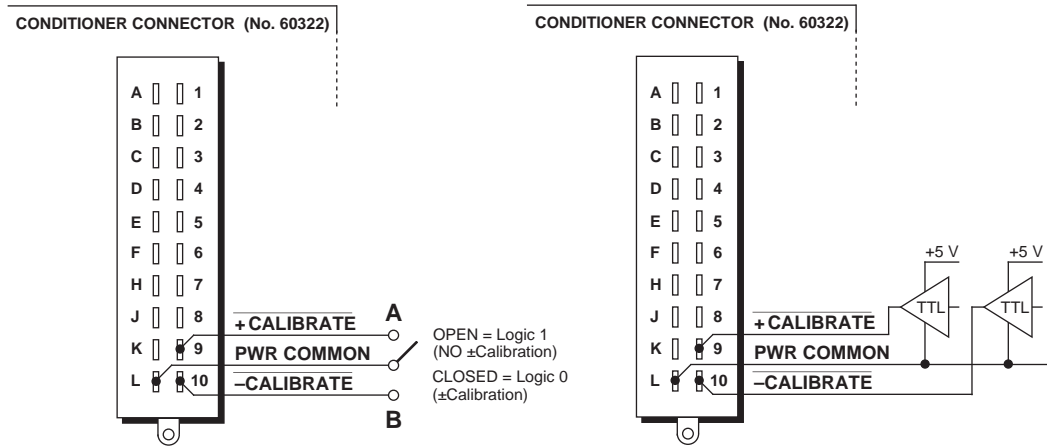


Fig. 8(a) Switch Closure, No External Supply

Fig. 8(b) Active TTL Logic

The 10A73-4 is equipped with a 100-k Ω , 0.1% *calibration resistor* for each active channel. These resistors are located on turret terminals at the rear of the card (see Fig. 7). You may, if you wish, replace each channel's installed 100K shunt resistor with a resistor of another value (strain-gage transducer manufacturers often supply such resistors with their instruments).

In System 10, a strain gage channel's shunt resistor may be switched in and out by means of the **SHUNT CALIBRATE-POSITIVE (SHP)** or **SHUNT CALIBRATE-NEGATIVE (SHN)** command. A **RESUME (RSM)** command should then be applied to remove the shunt and resume normal channel measurement. Since these are "run-time" commands, the mainframe's **EEPROM Write Protect Switch** need not be on for them to be effective. See Manual Section 1.G.6 for general instructions regarding the "SHUNT CALIBRATION" technique in System 10.

NOTE: All four channels' calibration shunts can be simultaneously and "remotely" controlled, if desired, as an alternative to using the software "SHUNT CALIBRATE" commands provided by the system, *provided that a System 10 BRIDGE COMPLETION CONNECTOR is not attached to the card.** This remote calibration control is accomplished by means of logic-level inputs to the 10A73-4 card. The relevant connections are given in Fig. 8.

Fig. 8(a) shows how the "CALIBRATE POSITIVE" and "CALIBRATE NEGATIVE" commands can be independently applied to *all four 10A73-4 channels simultaneously*, without the need of an external logic reference supply.

Closing the switch in Fig. 8(a) to contact point "A" will produce a *Logic 0* level at Pin 9 ("NOT +CALIBRATE"). Since this is a negative-true logic line, the *Logic 0* input will activate the "+CALIBRATE" condition for all four channels. That is, it will switch in each channel's shunt resistor for a *positive* up-scale reading. Opening the switch to disconnect the "NOT +CALIBRATE" line from POWER COMMON will then return all channels to the "NO +CALIBRATE" condition.

* When the 10A73-4 is using any version of the Model **10QBC-4**, **10HBC-4**, or **10FBC-4**, shunt control can only be effected via the **SHP**, **SHN**, and **RSM** commands.

10A73-4 QUAD 1/2 & 1/4 BRIDGE DC STRAIN GAGE CARD

Similarly, closing the switch to contact point “B” will produce a *Logic 0* level at Pin 10 (“NOT –CALIBRATE”), thereby switching in each channel’s shunt resistor for a *negative* up-scale reading. Opening the switch to disconnect the “NOT –CALIBRATE” line from POWER COMMON will then return all channels to the “NO –CALIBRATE” condition.

You may also use active TTL logic, as illustrated in Fig. 8(b), to produce the “+CALIBRATE” or “–CALIBRATE” condition for all four 10A73-4 channels.

3.C SETTING AN INITIAL ZERO OFFSET WITH THE MODEL 10CJB-4

Often the very process of mounting strain gages to the stressed material can introduce a significant residual strain, which will become apparent as a large nonzero offset in the data reading *prior to initial calibration*. When you are using the **Model 10CJB-4 Quad Bridge Completion Card** with the Model 10A73-4, you can remove at least a portion of this initial strain component for a given 10A73-4 channel by applying an approximate 1 mV/V positive or negative offset, as follows:

1. Remove the top plate of the 10CJB-4 box (4 screws in corners).
2. Refer to Fig. 5 and locate the set of three “1 MV/V OFFSET” jumper pads corresponding to the channel in question (like the 10CJB-4’s terminal blocks, the pad sets are labelled “A,” “B,” “C,” and “D”—corresponding to 10A73-4 Subchannel Nos 1, 2, 3, and 4, respectively).
3. Remove all load from the source gage(s).
4. Observe the data reading of the channel. If it is a *positive* nonzero value, apply a negative 1 mV/V offset by carefully placing a solder drop between the center pad and the “–” pad. If it is a *negative* nonzero value, place a solder drop between the center pad and the “+” pad.
5. Now *calibrate the channel* to remove any remaining offset.

4 LEAD-WIRE AND NONLINEARITY EFFECTS WITH QUARTER-BRIDGE STRAIN GAGE CONFIGURATION

In stress analysis applications, it often happens that the completion resistors for a quarter-bridge strain gage are located some distance from the gage. If the resistance of the wires connecting the gage to the completion circuitry is considerable, it can “desensitize” the bridge, producing less output voltage from the bridge for a given amount of strain as the wire resistance increases.

A second cause of possible inaccuracy is the slight nonlinearity inherent in all bridge configurations. This nonlinearity is proportional to the amount of “upset” of the bridge. For small amounts of strain (below about 5000 microstrain, with a gage factor of 2), the output is nearly linear. However, as the change in gage resistance increases due to increasing strain, the nonlinearity effect becomes measurable.

4.a PREVENTING THE EFFECTS OF LEAD-WIRE RESISTANCE

When connecting a Model 10A73-4 to a quarter-bridge strain gage configuration, you can eliminate all effects of reasonable lead wire resistance by using a Model **10CJB-4**

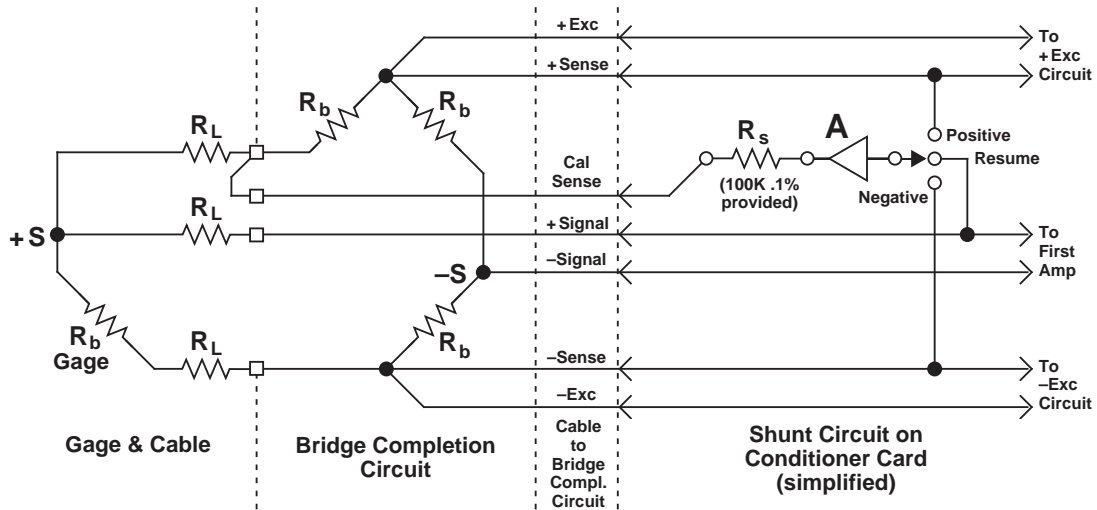


Fig. 9 Shunt Calibration with a 3-Wire, Single-Active Strain Gage

Four-Channel Bridge Completion Card in the vicinity of the gages, since the 10CJB-4 has inherent bridge-voltage sensing. WHERE THIS IS NOT POSSIBLE, YOU SHOULD USE A *SHUNT CALIBRATION* PROCEDURE with a three-wire run to the gage (see Fig. 9).*

Use the shunt **ONLY ON THE INACTIVE COMPLETION ARM, AS SHOWN, INSTEAD OF ON THE GAGE ARM.** To find the **EQUIVALENT STRAIN (S)** for a given **GAGE FACTOR (G)**, **BRIDGE RESISTANCE (R_b)**, and **SHUNT RESISTANCE (R_s)**, use this expression:

$$S = R_b / G(R_b + R_s)$$

To determine the shunt resistance required to simulate a given amount of strain, you can solve for R_s:

$$R_s = R_b (1 - GS) / GS$$

If shunt calibration is not possible, you can alternatively compensate for the effects of lead wire resistance by applying a **CORRECTED SCALING FACTOR** of

$$m_c = m (1 + R_L/R_b)$$

where "m" is the "normal" **SCALING FACTOR** ("m" coefficient), which is determined for the strain gage conditioner during calibration (see Section 3.b, above); "R_L" is the lead wire resistance; and "R_b" is the resistance of each of the three bridge-completion resistors (see Fig. 9).

Suppose, for example, that you are using a Model 10A73-4 channel for quarter-bridge strain measurement, with bridge completion provided by the Model 10QBC-4. Assume a gage factor ("G") of 2, a lead wire resistance R_L of 2.5 Ω, and a bridge resistance R_b of 350 Ω. If the 10A73-4 channel is configured for full-scale ±30,000 μS (= 0.03 S), its normal "m" factor is determined by the equation

$$m = 60,000/(N \times G)$$

as explained in Section 3.b. Since the number of gages (N) = 1,

$$m = 60,000/G = 30,000$$

* Buffered by a low-offset, low-drift, high-impedance, unity-gain amplifier (A), the solid-state shunt-calibration switch prevents the shunt current from flowing in the excitation sense lines. The switch itself is controlled by the software **SHUNT CALIBRATE-POSITIVE (SHP)**, **SHUNT CALIBRATE-NEGATIVE (SHN)**, and **RESUME (RSM)** commands.

—and the corrected SCALING FACTOR in units of STRAIN is therefore

$$m_c = (30,000) (1 + R_L/R_b) = (30,000) (1.007) = 30,210$$

This corrected factor can then be applied to the strain gage channel in question by means of the **SCALING FACTOR (EMM)** command.

4.b PREVENTING THE EFFECTS OF BRIDGE NONLINEARITY

The effects of this nonlinearity can be minimized by SHUNT CALIBRATION at 80% of the expected full-scale strain, thus distributing it more uniformly over the range. WHERE THE GAGE IS TO BE USED IN EITHER TENSION OR COMPRESSION MEASUREMENTS—BUT NOT BOTH—an additional compensating term can be employed to determine the fully corrected SCALING FACTOR:

$$m_c = m (1 + R_L/R_b \pm (GS)/2)$$

Choose the STRAIN (S) to equal 80% of the expected maximum strain. IF THE GAGE IS USED IN *TENSION* MEASUREMENT, THE TERM "(GS)/2" IS TO BE *ADDED*; IF IT IS USED IN *COMPRESSION* MEASUREMENT, THE TERM IS TO BE *SUBTRACTED*. Note too that the lead wire correction term "R_L/R_b" can be discarded if its contribution is negligible.

Using the same example as above, where "S" = 0.03, and now assuming that the gage is intended to measure TENSION only, we have

$$m_c = (30,000) (1 + R_L/R_b + (GS)/2) = (30,000) (1.037) = 31,110$$

MODEL 10A74-4C

QUAD STRAIN GAGE TRACK-HOLD CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

Intended primarily for *stress analysis applications*, the Model 10A74-4C receives and conditions up to *four* independent inputs from one-arm (1/4-bridge), two-arm (1/2-bridge), and four-arm (full-bridge) **strain gage configurations** attached directly to the stressed material.

If you are measuring strain by means of a one-arm (1/4-bridge) strain gage configuration, BE SURE TO STUDY SECTION 4 FOR A DISCUSSION OF “LEAD WIRE AND NON-LINEARITY EFFECTS WITH QUARTER-BRIDGE STRAIN GAGE CONFIGURATION.”

To minimize “time-skew” effects, each 10A74-4C input has a separate TRACK/HOLD circuit. Upon application of a “HOLD” command, the channel will instantly freeze its present value in analog memory until application of a “TRACK” command, whereupon normal tracking of the input signal is resumed. By applying a “HOLD” command simultaneously to all four channels, the user can be assured of a set of readings coherent to within a few microseconds.

As explained in Section 3.e, the TRACK/HOLD function is normally controlled through an external logic signal to the 10A74-4C’s rear I/O connector, when a System 10 Bridge Completion Connector or the optional Model 10VAC is not being used. When the conditioner is used in a “B-sized” System 10 mainframe (only), the TRACK/HOLD function may be alternatively controlled through an optional Model 10A1 Control Signal Card mounted in the same “A-card” rack.* Setup of the 10A1 for use with the 10A74-4C is discussed in Section 3.b.

Unless all four inputs originate from full-bridge transducers, the 10A74-4C requires external completion of each strain gage input to *full bridge*, by means of one of the following:

- a System 10 **Bridge Completion Connector**—one of the following models:
 - **10QBC-4-120** for 2- or 3-wire 120- Ω quarter-bridge connections
 - **10QBC-4-350** for 2- or 3-wire 350- Ω quarter-bridge connections
 - **10QBC-4-1K** for 2- or 3-wire 1000- Ω quarter-bridge connections
 - **10HBC-4** for 4- or 6-wire half-bridge connections
 - **10FBC-4** for 5-wire full-bridge connections
- a Daytronic **Model 10CJB-4 Quad Bridge Completion Card** (described in Section 2.b);
- equivalent circuitry supplied by the user**

* In System 10, the Model 10A1 uses the same system bus as the Model 10A11 Thermocouple Processor Card; therefore, a “10A” THERMOCOUPLE CONDITIONER such as the Model 10A9-8C or 10A10-4 cannot be used in the same System 10 “A-card” rack as a Model 10A1.

** If you wish to provide your own bridge-completion circuitry, you should contact the factory for instructions on connections and calibration.

10A74-4C QUAD DC STRAIN GAGE TRACK-HOLD CARD

The 10A74-4C provides selectable low-level excitation (1, 2, 5, or 10 V-DC). Using low excitation helps reduce gage heating effects in stress analysis of materials with low thermal conductivity. Note, however, that with the 10A74-4C, the selection of excitation level is not “per channel”; the same level applies simultaneously to all four 10A74-4C channels. As explained in Section 3.a, selection of the common excitation is accomplished by *on-board programming jumpers* only (even when a Model 10CJB-4 is connected).¹

Any 10A74-4C strain gage channel with external bridge completion can be calibrated by either CALCULATED or SIMULATED (SHUNT) calibration; the standard “TWO-POINT (DEADWEIGHT)” method does not apply to such channels. In this case, “calculated” calibration uses the **SCALING FACTOR (EMM)** command instead of the **MV/V CALIBRATION (MNV)** command. For shunt calibration, all four shunt resistors may be switched in and out simultaneously by software command or—when a System 10 Bridge Completion Connector or the Model 10VAC is *not* being used with the 10A74-4C—by means of logic-level inputs through the rear I/O CONNECTOR.

The **Model 10VAC Voltage Input Adaptor** is a special screw-terminal connector assembly which allows the 10A74-4C to receive up to four independent **external analog signals** in place of its normal strain gage inputs, when it is desired to apply the special TRACK/HOLD function of the 10A74-4C to these analog voltage signals. The analog signal source must provide its own power supply; the Model 10A74-4C’s standard excitation lines cannot be used.² For instructions on connection and use of the Model 10VAC, see Section 5, below.

ADDITIONAL 10A74-4C SPECIFICATIONS

Transducer Types: 1-arm (1/4-bridge), 2-arm (1/2-bridge), or 4-arm (full-bridge) strain-gage configurations; minimum allowable gage resistance will depend on bridge excitation and gage configuration, as shown in Table 1, below. Unless all four inputs originate from *full-bridge* transducers, the Model 10A74-4C requires either an appropriate System 10 **Bridge Completion Connector**; a **Model 10CJB-4 Quad Bridge Completion Card**; or equivalent bridge-completion circuitry supplied by the user. With the optional **Model 10VAC Voltage Input Adaptor**, the Model 10A74-4C can receive up to four external analog signals in place of its normal strain gage inputs (see Section 5).

Table 1 Model 10A74-4C Minimum Gage Resistances

Bridge Excitation	Gage Configuration	Minimum Gage Resistance
10 V-DC	1/4 & 1/2 Bridge	350 Ω
10 V-DC	Full Bridge	350 Ω ³
5 V-DC	1/4 & 1/2 Bridge	120 Ω
5 V-DC	Full Bridge	350 Ω
2 V-DC	1/4 & 1/2 Bridge	120 Ω
2 V-DC	Full Bridge	60 Ω
1 V-DC	1/4 & 1/2 Bridge	60 Ω
1 V-DC	Full Bridge	60 Ω

¹ The 10CJB-4’s internal excitation selection switch *does not apply to the Model 10A74-4C*.

² When the 10VAC is used with the 10A74-4C, the card’s excitation level must be set to ±5 V-DC.

³ NOTE: When the 10A74-4C is used with *four* 350-Ω full-bridge transducers at 10 V-DC excitation, a special modification of the card is required to provide proper current for excitation of each bridge. Also, no more than 16 Model 10A74-4C cards using this excitation/configuration combination for all four channels can be installed in any one System 10 “A-card” rack.

Transducer Ranges: ±7500, 15000, or 30000 microstrain; with the optional **Model 10VAC:** ±5, 10, or 20 V-DC (mixed as desired); automatically selected—on an individual channel basis—when the channel is configured; for System 10 channel “type” codes assigned to 10A74-4C data channels, see Table 2

Excitation (for all four channels): Sensed excitation jumper-selectable 1, 2, 5, or 10 V-DC (i.e., ±0.5, ±1, ±2.5, or ±5.0 V-DC, respectively), nominal; excitation not used with optional **Model 10VAC**

Amplifier (per channel)—without optional Model 10VAC:

Common-Mode Range: ±0.4 V operating; ±5 V without instrument damage

Common-Mode Rejection Ratio: DC: -90 dB; at 60 Hz, 1 kHz, and 3 kHz: -120 dB

Input Impedance: Differential: greater than 100 MΩ; Common-Mode: greater than 100 MΩ

Offset: Initial: ±12 μS; vs. Temperature: ±0.6 μS/°C; vs. Time: ±0.3 μS/month

Gain Accuracy: ±0.02% of full scale with 5-V excitation; ±0.15% of full scale for all other excitation levels

Gain Stability: vs. Temperature: ±50 ppm/°C; vs. Time: ±20 ppm/month

Analog Memory Decay Rate: Less than ±1 mV/sec*

Amplifier (per channel)—with optional Model 10VAC:

Normal-Mode Range: ±20 V operating; ±50 V without instrument damage

Common-Mode Range: ±20 V operating; ±50 V without instrument damage

Common-Mode Rejection Ratio: DC: -100 dB; at 60 Hz, 1 kHz, and 3 kHz: -150 dB

Input Impedance: Differential: 2 MΩ; Common-Mode: 0.5 MΩ

Offset: Initial: ±0.05% of full scale; vs. Temperature: ±25 ppm/°C; vs. Time: ±10 ppm/month

Gain Accuracy: ±0.04% of full scale

Gain Stability: vs. Temperature: ±50 ppm/°C; vs. Time: ±20 ppm/month

Filter: 3-pole modified Butterworth; 3 dB down at 10 Hz; 60 dB down at 100 Hz

Step Response Settling Time (Full-Scale Output):

To 1% of final value: 100 msec

To 0.1% of final value: 150 msec

To 0.02% of final value: 600 msec

Auxiliary Outputs: Filtered outputs available on mainframe wire-wrap pins**

Table 2 10A74-4C “Type” Codes

Full-Scale Input (without 10VAC)	Full-Scale Input (with 10VAC)	Channel Type Code
±7500 microstrain	±5 V-DC	70
±15000 microstrain	±10 V-DC	71
±30000 microstrain	±20 V-DC	72

* Allows essentially perfect capture of data when used in conjunction with the **Model 10A1 Control Signal Card** and appropriate computer communication commands (see Section 3.b).

** Unfiltered outputs are available on special versions. Contact the factory for details.

2 GAGE / TRANSDUCER CONNECTIONS

Table 3, below, gives pin assignments for the 10A74-4C's rear I/O CONNECTOR, to which appropriate BRIDGE COMPLETION CIRCUITRY must be attached, unless all four inputs originate from full-bridge transducers. For connection of *voltage* signals to an optional **Model 10VAC** attached to this connector, see Section 5.

Section 2.a describes the cabling to be used with System 10 **Bridge Completion Connectors**.

Section 2.b describes the cabling to be used with the **Model 10CJB-4 Quad Bridge Completion Card**.

Section 2.c describes the cabling to be used in the absence of bridge-completion circuitry (i.e., connection to four full-bridge transducers).

IMPORTANT: The \pm EXCITATION, \pm SENSE, and \pm SIGNAL pins for an UNUSED STRAIN GAGE INPUT CHANNEL should be jumpered *at the I/O CONNECTOR or in the BRIDGE COMPLETION CONNECTOR* as shown in Fig. 1, below. If an input is left open, high-frequency oscillation can result, which can in turn produce significant interchannel crosstalk, and possibly inaccurate data readings.

ALSO NOTE: *Logic* connections for remote control of shunt calibration (using the I/O CONNECTOR'S "NOT \pm CALIBRATE" pins) are discussed in Section 3.c and shown in Fig. 6. Logic connections for remote control of Track/Hold operation (using the I/O CONNECTOR'S "TRACK/NOT HOLD" pin) are discussed in Section 3.e and shown in Fig. 6. Note that these logic-level inputs are not available for use when a Bridge Completion Card or Model 10VAC Voltage Input Adaptor is attached to the 10A74-4C.

Table 3 Model 10A74-4C Pin Assignments

I/O Connector Pin Number	Conditioner Channel Number	Conditioner Line Function
1	1	+SIGNAL
A	1	-SIGNAL
2	1	CAL SENSE
B	*	+EXCITATION
3	2	+SIGNAL
C	2	-SIGNAL
4	2	CAL SENSE
D	*	+SENSE
5	3	+SIGNAL
E	3	-SIGNAL
6	3	CAL SENSE
F	*	-SENSE
7	4	+SIGNAL
H	4	-SIGNAL
8	4	CAL SENSE
J	*	-EXCITATION
9	*	<u>NOT</u> +CALIBRATE
K	*	ALTERNATE T/H INPUT
10	*	<u>NOT</u> -CALIBRATE
L	*	POWER COMMON

* This function is common to all four channels.

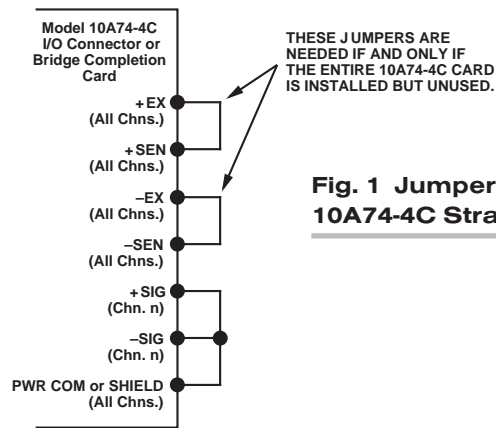


Fig. 1 Jumpering of an Unused 10A74-4C Strain Gage Input

2.a 1/4-, 1/2-, OR FULL-BRIDGE GAGE CONNECTIONS USING A SYSTEM 10 BRIDGE COMPLETION CONNECTOR

Each System 10 **Bridge Completion Connector** attaches directly to the rear I/O CONNECTOR of the Model 10A74-4C.

Remove the top plate of the connector. Inside are four sets of labelled screw terminals, corresponding to the 10A74-4C's four input channels. You will connect your gage wires directly to these terminals and, if necessary, interconnect certain terminal pairs by means of jumper wires. All gage leads should be securely clamped by means of the two cable clamps.

Fig. 2 shows per-channel connections between external strain-gage configurations and the respective System 10 Bridge Completion Connectors.

NOTE: Unlike the Model 10CJB-4, the Bridge Completion Connectors DO NOT PERMIT MIXING OF CONNECTED GAGE CONFIGURATION TYPES. That is, all gage configurations connected to the same Bridge Completion Connector must be of the same appropriate type (e.g., 120-Ω 1/4-bridge, 1/2-bridge, etc.).

When input connections involve pairs of EXCITATION, SENSE, and/or SIGNAL lines, these should be *twisted pairs* within the input cable. While it is desirable to shield such pairs individually (as shown in Fig. 2), this is not necessary; an overall cable shield is acceptable.

Note too that the *full-bridge* input connections given in Fig. 2(e) are to be used if one or more of the 10A74-4C's *other* inputs derives from a less than full-bridge configuration. If all four inputs originate from full-bridge configurations, no completion circuitry is required (see Section 2.c and Fig. 4).

10A74-4C QUAD DC STRAIN GAGE TRACK-HOLD CARD

**Fig. 2 Model 10A74-4C Strain Gage Cabling
Using System 10 Bridge Completion Connectors**

Fig. 2(a) Per-Channel Connections to Model 10QBC-4* for 2-Wire 1/4-Bridge Completion

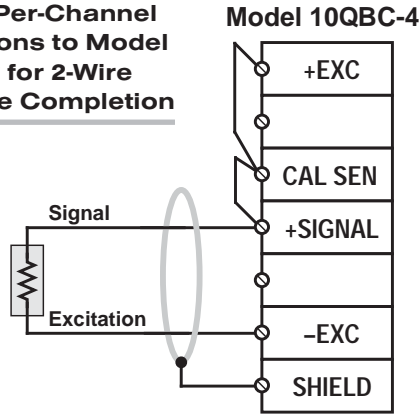


Fig. 2(b) Per-Channel Connections to Model 10QBC-4* for 3-Wire 1/4-Bridge Completion

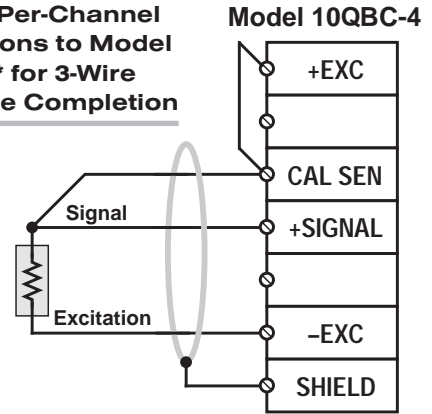


Fig. 2(c) Per-Channel Connections to Model 10HBC-4 for 4-Wire 1/2-Bridge Completion

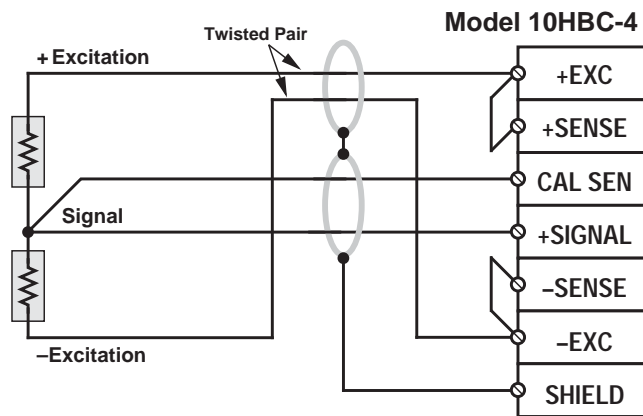
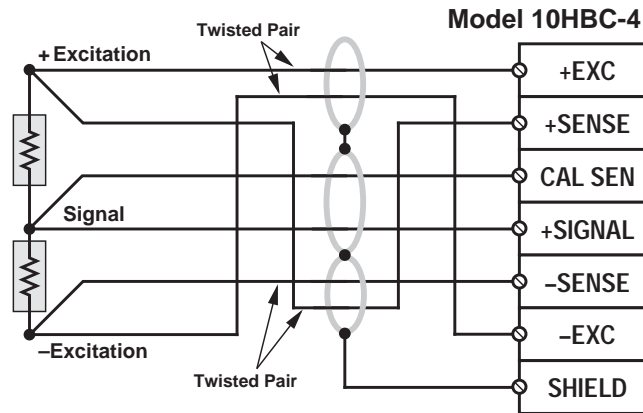
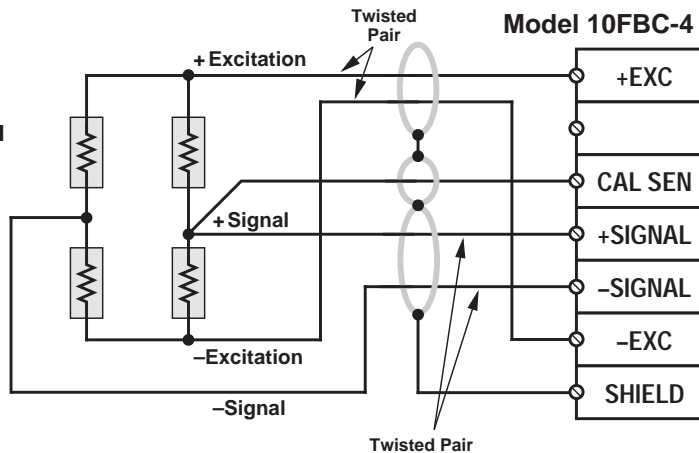


Fig. 2(d) Per-Channel Connections to Model 10HBC-4 for 6-Wire 1/2-Bridge Completion



* I.e., Model **QBC-4-120**, **QBC-4-350**, or **QBC-4-1K**.

Fig. 2(e) Per-Channel Connections to Model 10FBC-4 for Full-Bridge Connection



2.b 1/4-, 1/2-, OR FULL-BRIDGE GAGE CONNECTIONS USING THE MODEL 10CJB-4

Remove the top plate of the Model 10CJB-4 box (4 screws in corners). Inside the box are four sets of labelled screw terminals, one for each of the 10A74-4C's input channels ("A," "B," "C," and "D"). You will connect your gage wires directly to these terminals, as shown in Fig. 3, and, if necessary, interconnect certain terminal pairs by means of jumper wires. Gage leads should enter the 10CJB-4 through the cutout on the right-hand side of the box.

NOTE: You must furnish your own *pin-to-pin shielded cable* for connecting the 10CJB-4 to the 10A74-4C's rear I/O CONNECTOR (see Table 3 for pin assignments)—or you may use a special cable furnished by Daytronic. In either case, Daytronic will supply terminal connectors for the cable.

Fig. 3(a) shows connections between the 10CJB-4 and a *2-wire 1/4-bridge* gage configuration (represented by the single gage resistor). Here, you must install a jumper wire between the **-SIG** and **1/2 BR** terminals, and between the **+SIG** terminal and *either* the **120** terminal *or* the **350** terminal, depending on the nominal gage resistance.

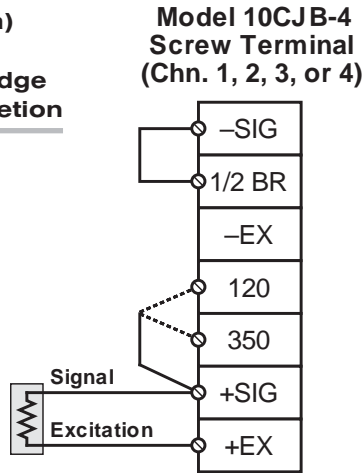
Fig. 3(b) shows connections between the 10CJB-4 and a *3-wire 1/4-bridge* gage configuration (again represented by the single gage resistor). Here again, the **-SIG** and **1/2 BR** terminals must be tied. The gage's third (self-compensating) lead is connected *either* to the **120** terminal *or* to the **350** terminal, depending on the nominal gage resistance.

Fig. 3(c) shows connections between the 10CJB-4 and a *1/2-bridge* gage configuration (represented by the two connected gage resistors). Here again, the **-SIG** and **1/2 BR** terminals must be tied.

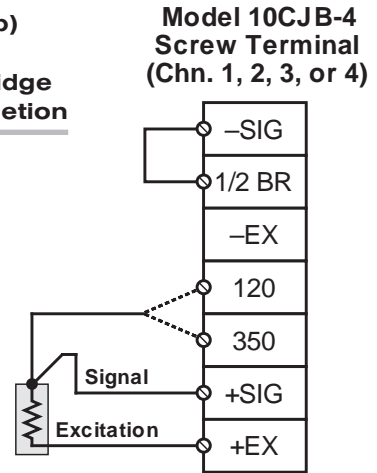
Fig. 3(d) shows connections between the 10CJB-4 and a *full-bridge* gage configuration (represented by the four connected gage resistors).

Fig. 3 Model 10CJB-4 Transducer Cabling

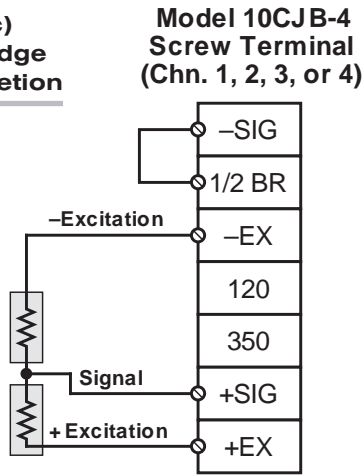
**Fig. 3(a)
2-Wire
1/4-Bridge
Completion**



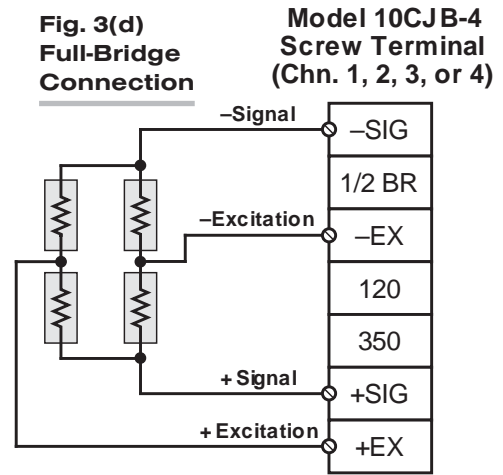
**Fig. 3(b)
3-Wire
1/4-Bridge
Completion**



**Fig. 3(c)
1/2-Bridge
Completion**



**Fig. 3(d)
Full-Bridge
Connection**



2.C FULL-BRIDGE TRANSDUCER CONNECTIONS (WITHOUT BRIDGE COMPLETION)

In the absence of bridge-completion circuitry, the 10A74-4C's I/O CONNECTOR will mate with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Pinout for the I/O CONNECTOR is given in Table 3, above. The required cabling is shown in Fig. 4.

Note that the main 16-wire shielded cable should contain 20- to 24-gauge wires. The length of the main cable—i.e., the distance from the 10A74-4C's rear I/O CONNECTOR to the two "sensing points"—may be up to 500 feet. At the sensing points, the + SENSE and -SENSE lines join the corresponding EXCITATION lines, and the main cable divides into four separately shielded 5-wire cables (one to each full-bridge transducer). These secondary cables should contain 16- to 20-gauge wires. It is important that the distance "D" from the sensing points to each transducer be *as short as possible*; a maximum error of 0.02% could arise for every 3.5 ft. of 20-gauge wire over the distance "D," and for every 9 ft. of 16-gauge wire.

QUAD DC STRAIN GAGE TRACK-HOLD CARD 10A74-4C

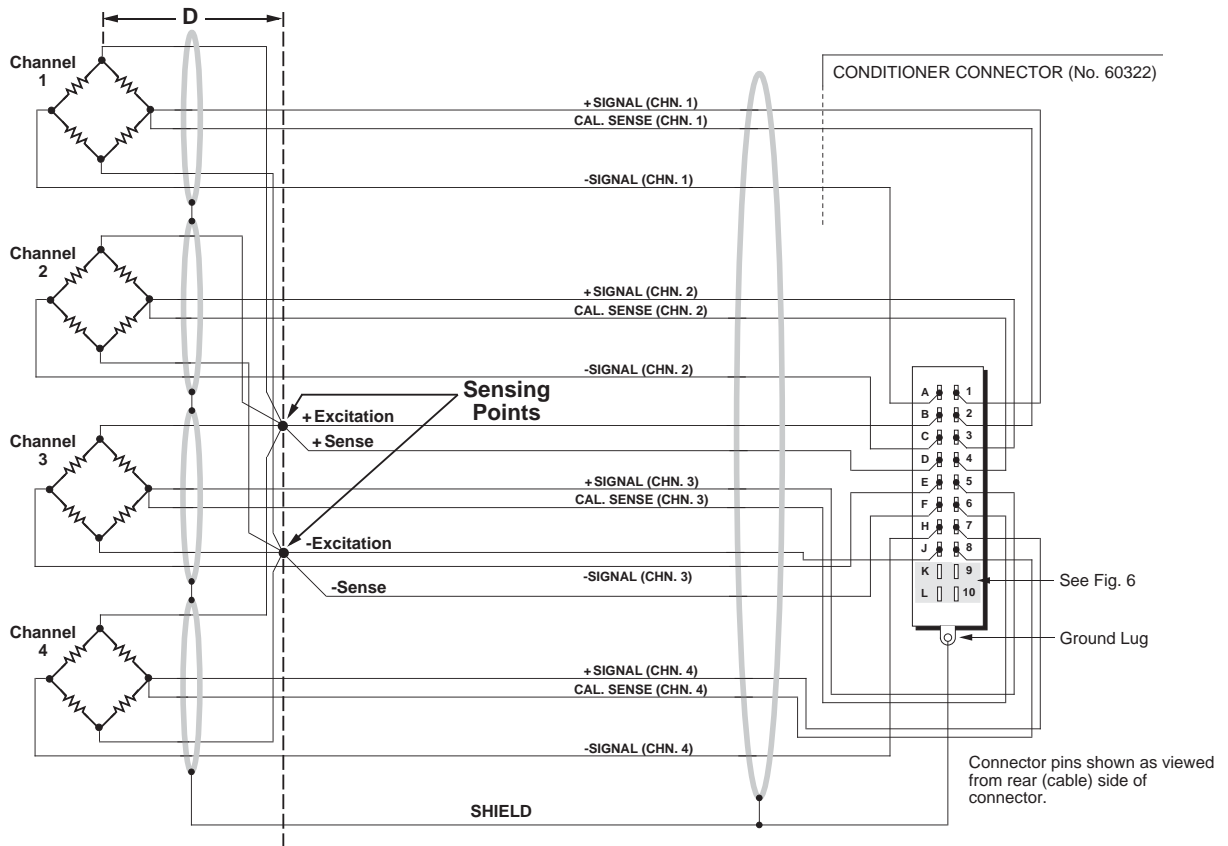


Fig. 4 10A74-4C Cabling to Four Full-Bridge Transducers

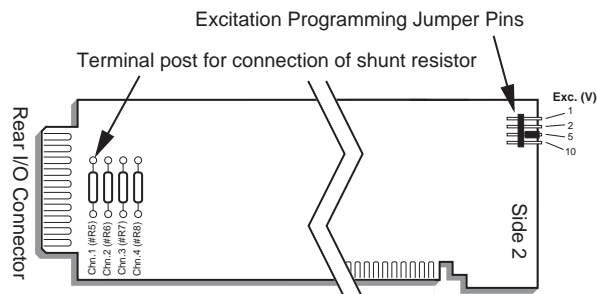
3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a SELECTION OF COMMON EXCITATION LEVEL

As shown in Fig. 5, the 10A74-4C's four pairs of EXCITATION PROGRAMMING JUMPER PINS are located at the front edge of the card. Place the single jumper connector across the pair of pins labelled with the desired excitation level: 1, 2, 5, or 10 V. You need not remove the 10A74-4C card from the System 10 mainframe in order to do this.

NOTE: The Model 10CJB-4 has an internal excitation selection switch. WHEN THE 10CJB-4 IS USED WITH A MODEL 10A74-4C, THIS SWITCH DOES NOT FUNCTION.

Fig. 5 Model 10A74-4C Excitation Programming Jumper Pins and Shunt Calibration Resistors



10A74-4C QUAD DC STRAIN GAGE TRACK-HOLD CARD

NOTE ALSO: When the optional **Model 10VAC Voltage Input Adaptor** is used with the 10A74-4C, THE EXCITATION LEVEL MUST BE SET TO 10 V-DC (i.e., ± 5 V-DC).

3.b SETUP OF MODEL 10A1 FOR TIME-COHERENT 10A74-4C DATA COLLECTION IN SYSTEM 10

Communicating over the internal Analog Signal Bus, the **Model 10A1 Control Signal Card** controls and coordinates the TRACK / HOLD function of all Model 10A74-4C cards mounted in the same "A-card" rack of a "B-sized" System 10 mainframe (only). When a 10A74-4C's rear I/O Connector is dedicated to a Bridge Completion Connector or Model 10VAC Voltage Input Adaptor, that card's TRACK / HOLD function can only be controlled by means of a Model 10A1.

In a multi-rack System 10 mainframe, a separate 10A1 is required to control the 10A74-4C cards occupying each rack. All of the mainframe's 10A1 cards will then be linked via a special interconnect cable (No. 52369), which is supplied with the cards.

To ensure that all 10A74-4C input channels in the system "capture" their data at the same instant, a single "master" 10A1 must be designated for synchronization to the system scan cycle. The System 10 scan cycle can be "slaved" in turn to an *external pulse signal* received through the RS-422 interface provided by a designated **Model 10BACI-422 Auxiliary Computer Interface Card**.

To designate the "master" 10A1, you will need to apply the **TRACK HOLD CONTROL (THC)** command. This command informs the system's Central Processor of the particular 10A1 that is to be "synced" to its scan cycle. Turn ON the system EEPROM Switch and enter a command of

THC = s [CR]

where "s" is a four-digit number consisting of the DECK No., SLOT No., and SUBCHANNEL No. of the selected 10A1 card (here, the SUBCHANNEL number is simply "1"). Thus, for example, to designate the 10A1 located in Slot 3 of a "B-sized" mainframe's Deck No. 1 as the "master" for track-hold control in that mainframe, you would enter a command of

THC = 1031 [CR]

The system's "master" 10A1 causes a continuous "HOLD" command to be applied to all 10A74-4C inputs from all mainframe decks, *except* during the few microseconds per scan when it is itself processed as a data channel. During this processing period, the "HOLD" command is released and all 10A74-4C channels are permitted to track their respective strain-gage inputs. When the processing of the 10A1-dedicated channel is complete, the 10A74-4C inputs are again "held" until the next scan. A data set with *minimal time skew* is thereby generated with each scan cycle.

3.c CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A74-4C card when used in System 10, see the general remarks on System 10 "real-channel" configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A74-4C channel "type" codes, see Table 2, above.

In System 10, when a Model 10A74-4C is connected to *quarter-bridge or half-bridge gage configurations* for purposes of stress analysis, you can perform both **"EMM-CALCULATED"** and **"SIMULATED (SHUNT)"** calibration of any of its input channels, regardless of the type of bridge completion being used for that channel. For such a channel, THE CONVENTIONAL "TWO-POINT (DEADWEIGHT)" TECHNIQUE WILL NOT WORK AND THE "MVV-CALCULATED" TECHNIQUE USED WITH OTHER STRAIN GAGE CONDITIONERS IS NOT RECOMMENDED.

When a 10A74-4C is connected to *full-bridge strain gage transducers*, “TWO-POINT (DEADWEIGHT)” calibration may be applied, in addition to or as an alternative to “EMM-CALCULATED” and “SIMULATED (SHUNT)” calibration (in this case, as before, calibration via the **MVV** command is not recommended).

NOTE: If you are using a **Model 10CJB-4** for bridge completion of a 10A74-4C channel and, *prior to initial calibration*, observe a significantly nonzero reading when no load is placed on the gage(s), you may impose a *nominal* ± 1 mV/V offset by means of solder pads in the 10CJB-4 box. See Section 3.d for complete instructions.

EMM-CALCULATED CALIBRATION

To calibrate a 10A74-4C-based Channel No. “x,” turn ON the system EEPROM SWITCH and then apply a **SCALING FACTOR (EMM)** command of

$$\text{EMM } x = m \text{ [CR]}$$

where “m” is the scaling factor corresponding to the channel’s full-scale range in *microstrain*, as given in Table 4. In calculating the numeric value of “m,” note that “N” is the number of active bridge arms (“1” for a 1/4-bridge configuration; “2” for a half-bridge configuration; and “4” for a full-bridge configuration); and “G” is the *gage factor* supplied by the strain gage manufacturer.

Table 4 Model 10A74-4C Scaling Factor (“m”) Values

Full-Scale Range (microstrain)	“m”
±7500	15,000 / (N x G)
±15000	30,000 / (N x G)
±30000	60,000 / (N x G)

TWO-POINT (DEADWEIGHT) CALIBRATION

PLEASE NOTE: AS MENTIONED ABOVE, THIS CALIBRATION TECHNIQUE APPLIES TO A MODEL 10A74-4C CHANNEL ONLY WHEN THAT CHANNEL IS CONNECTED TO A *FULL-BRIDGE STRAIN GAGE TRANSDUCER*, AS ARE THE FOUR CHANNELS SHOWN IN FIG. 4.

Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional “zero and span” method can be applied to a “full-bridge” 10A74-4C channel if the final measurement accuracy provided by EMM-CALCULATED CALIBRATION does not meet the requirements of the measurement application. The mainframe’s **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

SIMULATED (SHUNT) CALIBRATION

This is a convenient “shunt resistor” method, where the second (“span”) input is not produced by loading the source transducer, but by “simulating” a particular up-scale value of mechanical input. This known EQUIVALENT INPUT then serves to determine the SCALING FACTOR for the channel.*

For a 10A74-4C data channel, the equivalent input is produced by shunting a resistor of known magnitude across one arm of the strain gage bridge, thereby simulating a known value of input for either a *positive* or *negative* up-scale reading. If the transduc-

* Shunt calibration is easier though generally less accurate than two-point (deadweight) calibration. It is good for an accuracy of about 0.2% (depending, of course, on the accuracy of the specified equivalent input, and on the resistor/bridge tolerance and temperature).

10A74-4C QUAD DC STRAIN GAGE TRACK-HOLD CARD

er manufacturer has supplied the exact value of the transducer's equivalent input, it can be used as a reference point for calibrating the channel.

Equivalent input can be approximated from a knowledge of the *Shunt Calibration Resistance (R)*, the transducer's *Bridge Resistance (B)*, and the transducer's *Full-Scale Sensitivity (K, in mV/V full scale)*. To determine the EQUIVALENT INPUT (X) as an approximate percentage of full-scale output, you may use the following equation:

$$X = 25000B / K(R + 0.5B) \%$$

Since the equivalent input is here expressed as a *percentage of full-scale output*, you must multiply it by the rated full-scale capacity of the transducer, in order to determine the *actual input simulated by the shunt*.

IMPORTANT: FOR A 10A74-4C CHANNEL WITH BRIDGE COMPLETION—BY MEANS EITHER OF A SYSTEM BRIDGE COMPLETION CONNECTOR OR THE MODEL 10CJB-4—THE EQUIVALENT INPUT SHOULD BE EXPRESSED IN *MICROSTRAIN (MICROINCHES/INCH)*.

The 10A74-4C is equipped with a 100-k Ω , 0.1% *calibration resistor* for each active channel. These resistors are located on turret terminals at the rear of the card (see Fig. 5, above). You may, if you wish, replace each channel's installed 100K shunt resistor with a resistor of another value (strain-gage transducer manufacturers often supply such resistors with their instruments).

In System 10, a strain gage channel's shunt resistor may be switched in and out by means of the **SHUNT CALIBRATE—POSITIVE (SHP)** or **SHUNT CALIBRATE—NEGATIVE (SHN)** command. A **RESUME (RSM)** command should then be applied to remove the shunt and resume normal channel measurement. Since these are "run-time" commands, the mainframe's **EEPROM Write Protect Switch** need not be on for them to be effective. See Manual Section 1.G.6 for general instructions regarding the "SHUNT CALIBRATION" technique in System 10.

NOTE: All four channels' calibration shunts can be simultaneously and "remotely" controlled, if desired, as an alternative to using the software "SHUNT CALIBRATE" commands provided by the system, *provided that a System 10 BRIDGE COMPLETION CONNECTOR or Model 10VAC Voltage Input Adaptor is not attached to the card.** This remote calibration control is accomplished by means of logic-level inputs to the 10A74-4C card. The relevant connections are given in Fig. 6.

Fig. 6(a) shows how the "CALIBRATE POSITIVE" and "CALIBRATE NEGATIVE" commands can be independently applied to *all four 10A74-4C channels simultaneously*, without the need of an external logic reference supply.

Closing the switch in Fig. 6(a) to contact point "A" will produce a *Logic 0* level at Pin 9 ("NOT +CALIBRATE"). Since this is a negative-true logic line, the *Logic 0* input will activate the "+CALIBRATE" condition for all four channels. That is, it will switch in each channel's shunt resistor for a *positive* up-scale reading. Opening the switch to disconnect the "NOT +CALIBRATE" line from POWER COMMON will then return all channels to the "NO +CALIBRATE" condition.

Similarly, closing the switch to contact point "B" will produce a *Logic 0* level at Pin 10 ("NOT -CALIBRATE"), thereby switching in each channel's shunt resistor for a *negative* up-scale reading. Opening the switch to disconnect the "NOT -CALIBRATE" line from POWER COMMON will then return all channels to the "NO -CALIBRATE" condition.

* When the 10A74-4C is using any version of the Model **10QBC-4**, **10HBC-4**, or **10FBC-4**, shunt control can only be effected via the **SHP**, **SHN**, and **RSM** commands.

Fig. 6 Logic Inputs for 10A74-4C Remote Shunt Calibration and/or Track-Hold Control (Without Bridge Completion)

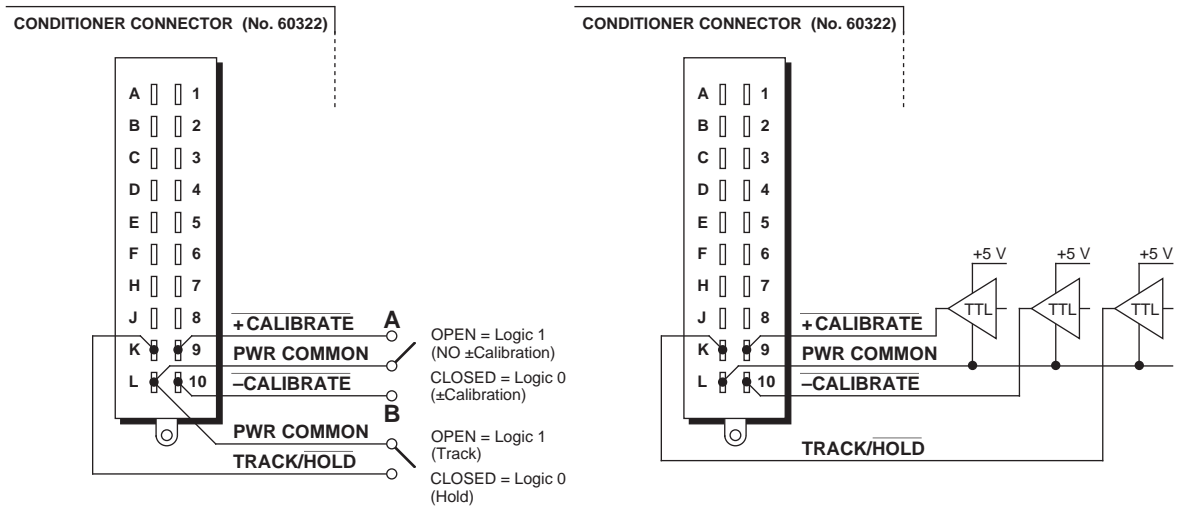


Fig. 6(a) Switch Closure, No External Supply

Fig. 6(b) Active TTL Logic

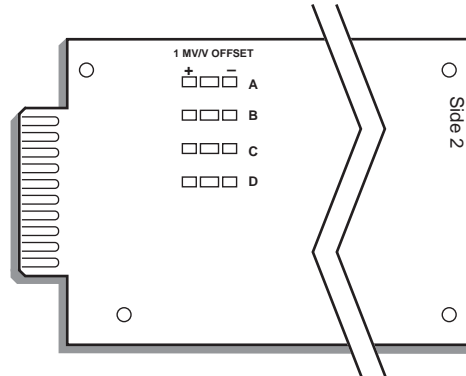
You may also use active TTL logic, as illustrated in Fig. 6(b), to produce the “+CALIBRATE” or “-CALIBRATE” condition for all four 10A74-4C channels.

3.d SETTING AN INITIAL ZERO OFFSET WITH THE MODEL 10CJB-4

Often the very process of mounting strain gages to the stressed material can introduce a significant residual strain, which will become apparent as a large nonzero offset in the data reading *prior to initial calibration*. When you are using the **Model 10CJB-4 Quad Bridge Completion Card** with the Model 10A74-4C, you can remove at least a portion of this initial strain component for a given 10A74-4C channel by applying an approximate 1 mV/V positive or negative offset, as follows:

1. Remove the top plate of the 10CJB-4 box (4 screws in corners).
2. Refer to Fig. 7 and locate the set of three “1 MV/V OFFSET” jumper pads corresponding to the channel in question (like the 10CJB-4’s terminal blocks, the pad sets are labelled “A,” “B,” “C,” and “D”—corresponding to 10A74-4C Subchannel Nos 1, 2, 3, and 4, respectively).
3. Remove all load from the source gage(s).
4. Observe the data reading of the channel. If it is a *positive* nonzero value, apply a negative 1 mV/V offset by carefully placing a solder drop between the center pad and the “-” pad. If it is a *negative* nonzero value, place a solder drop between the center pad and the “+” pad.
5. Now *calibrate the channel* to remove any remaining offset.

Fig. 7 Model 10CJB-4 Offset Jumpers



3.e CONTROL OF 10A74-4C TRACK/HOLD OPERATION VIA LOGIC INPUT

When the 10A74-4C's rear I/O CONNECTOR is not dedicated to a Model 10QBC-4, 10HBC-4, 10FBC-4, or 10VAC, its **Pin K** can be used as an alternative source of TRACK/HOLD control (see Fig. 6). As with Pins 9 and 10, logic levels for Pin K are negative true, resulting in a *Logic 1* level at the pin when it is unconnected. A *Logic 1* (0 V) level at the pin keeps all four 10A74-4C analog input channels in "TRACK" mode, while a *Logic 0* level (+5 V) keeps all four channels in the "HOLD" mode.

4 LEAD-WIRE AND NONLINEARITY EFFECTS WITH QUARTER-BRIDGE STRAIN GAGE CONFIGURATION

In stress analysis applications, it often happens that the completion resistors for a quarter-bridge strain gage are located some distance from the gage. If the resistance of the wires connecting the gage to the completion circuitry is considerable, it can "desensitize" the bridge, producing less output voltage from the bridge for a given amount of strain as the wire resistance increases.

A second cause of possible inaccuracy is the slight nonlinearity inherent in all bridge configurations. This nonlinearity is proportional to the amount of "upset" of the bridge. For small amounts of strain (below about 5000 microstrain, with a gage factor of 2), the output is nearly linear. However, as the change in gage resistance increases due to increasing strain, the nonlinearity effect becomes measurable.

4.a PREVENTING THE EFFECTS OF LEAD-WIRE RESISTANCE

When connecting a Model 10A74-4C to a quarter-bridge strain gage configuration, you can eliminate all effects of reasonable lead wire resistance by using a Model **10CJB-4 Four-Channel Bridge Completion Card** in the vicinity of the gages, since the 10CJB-4 has inherent bridge-voltage sensing. WHERE THIS IS NOT POSSIBLE, YOU SHOULD USE A *SHUNT CALIBRATION* PROCEDURE with a three-wire run to the gage (see Fig. 8).*

* Buffered by a low-offset, low-drift, high-impedance, unity-gain amplifier (A), the solid-state shunt-calibration switch prevents the shunt current from flowing in the excitation sense lines. The switch itself is controlled by the software **SHUNT CALIBRATE-POSITIVE (SHP)**, **SHUNT CALIBRATE-NEGATIVE (SHN)**, and **RESUME (RSM)** commands.

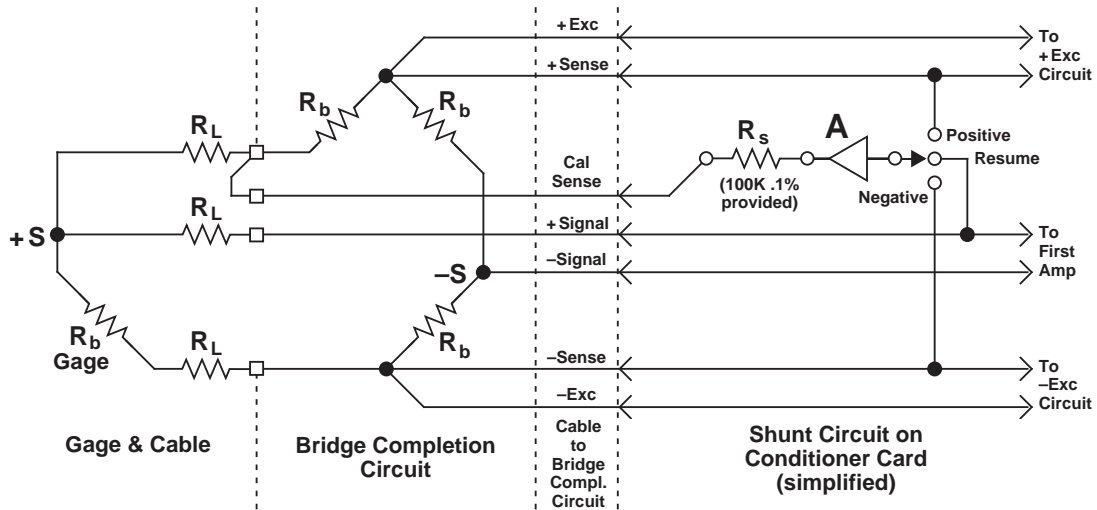


Fig. 8 Shunt Calibration with a 3-Wire, Single-Active Strain Gage

Use the shunt ONLY ON THE INACTIVE COMPLETION ARM, AS SHOWN, INSTEAD OF ON THE GAGE ARM. To find the **EQUIVALENT STRAIN (S)** for a given GAGE FACTOR (G), BRIDGE RESISTANCE (R_b), and SHUNT RESISTANCE (R_s), use this expression:

$$S = R_b / G(R_b + R_s)$$

To determine the shunt resistance required to simulate a given amount of strain, you can solve for R_s :

$$R_s = R_b (1 - GS) / GS$$

If shunt calibration is not possible, you can alternatively compensate for the effects of lead wire resistance by applying a CORRECTED SCALING FACTOR of

$$m_c = m (1 + R_L/R_b)$$

where "m" is the "normal" SCALING FACTOR ("m" coefficient), which is determined for the strain gage conditioner during calibration (see Section 3.b, above); " R_L " is the lead wire resistance; and " R_b " is the resistance of each of the three bridge-completion resistors (see Fig. 8).

Suppose, for example, that you are using a Model 10A74-4C channel for quarter-bridge strain measurement, with bridge completion provided by the Model 10QBC-4. Assume a gage factor ("G") of 2, a lead wire resistance R_L of 2.5 Ω , and a bridge resistance R_b of 350 Ω . If the 10A74-4C channel is configured for full-scale $\pm 30,000 \mu S$ (= 0.03 S), its normal "m" factor is determined by the equation

$$m = 60,000 / (N \times G)$$

as explained in Section 3.b. Since the number of gages (N) = 1,

$$m = 60,000 / G = 30,000$$

—and the corrected SCALING FACTOR in units of STRAIN is therefore

$$m_c = (30,000) (1 + R_L/R_b) = (30,000) (1.007) = 30,210$$

This corrected factor can then be applied to the strain gage channel in question by means of the **SCALING FACTOR (EMM)** command.

4.b PREVENTING THE EFFECTS OF BRIDGE NONLINEARITY

The effects of this nonlinearity can be minimized by SHUNT CALIBRATION at 80% of the expected full-scale strain, thus distributing it more uniformly over the range. WHERE THE GAGE IS TO BE USED IN EITHER TENSION OR COMPRESSION MEASUREMENTS—BUT NOT BOTH—an additional compensating term can be employed to determine the fully corrected SCALING FACTOR:

$$m_c = m (1 + R_L/R_b \pm (GS)/2)$$

Choose the STRAIN (S) to equal 80% of the expected maximum strain. IF THE GAGE IS USED IN TENSION MEASUREMENT, THE TERM "(GS)/2" IS TO BE ADDED; IF IT IS USED IN COMPRESSION MEASUREMENT, THE TERM IS TO BE SUBTRACTED. Note too that the lead wire correction term "R_L/R_b" can be discarded if its contribution is negligible.

Using the same example as above, where "S" = 0.03, and now assuming that the gage is intended to measure TENSION only, we have

$$m_c = (30,000) (1 + R_L/R_b + (GS)/2) = (30,000) (1.037) = 31,110$$

5 USE OF THE MODEL 10VAC VOLTAGE INPUT ADAPTOR WITH THE MODEL 10A74-4C

The **Model 10VAC Voltage Input Adaptor** is a special connector assembly which allows the Model 10A74-4C to receive up to four independent external analog signals *in place of its normal strain-gage inputs*, when it is desired to apply the special TRACK-HOLD function of the 10A74-4C to these analog voltage signals.

Each 10VAC voltage input can take one of three ranges: ±5 V-DC, ±10 V-DC, or ±20 V-DC. Inputs may be mixed as desired. The channel "type" code to be assigned for each voltage range is given in Table 2.

Providing screw terminals for direct connection of analog signal leads, the 10VAC attaches directly to the 10A74-4C's rear I/O CONNECTOR. Fig. 9 shows how external analog signal sources are cabled to the two screw-terminal blocks. To access the 10VAC connection board, simply remove the screws that hold together both halves of the 10VAC connector housing. Note that floating inputs are to be grounded *at the site of the signal source*, and not at the conditioner connector.

When the 10VAC is used with the 10A74-4C, THE 10A74-4C'S EXCITATION LEVEL MUST BE SET TO ±5 V-DC (see Section 3.a for the procedure).

You can use two CALIBRATION METHODS for any 10A74-4C DATA CHANNEL originating from a 10VAC:

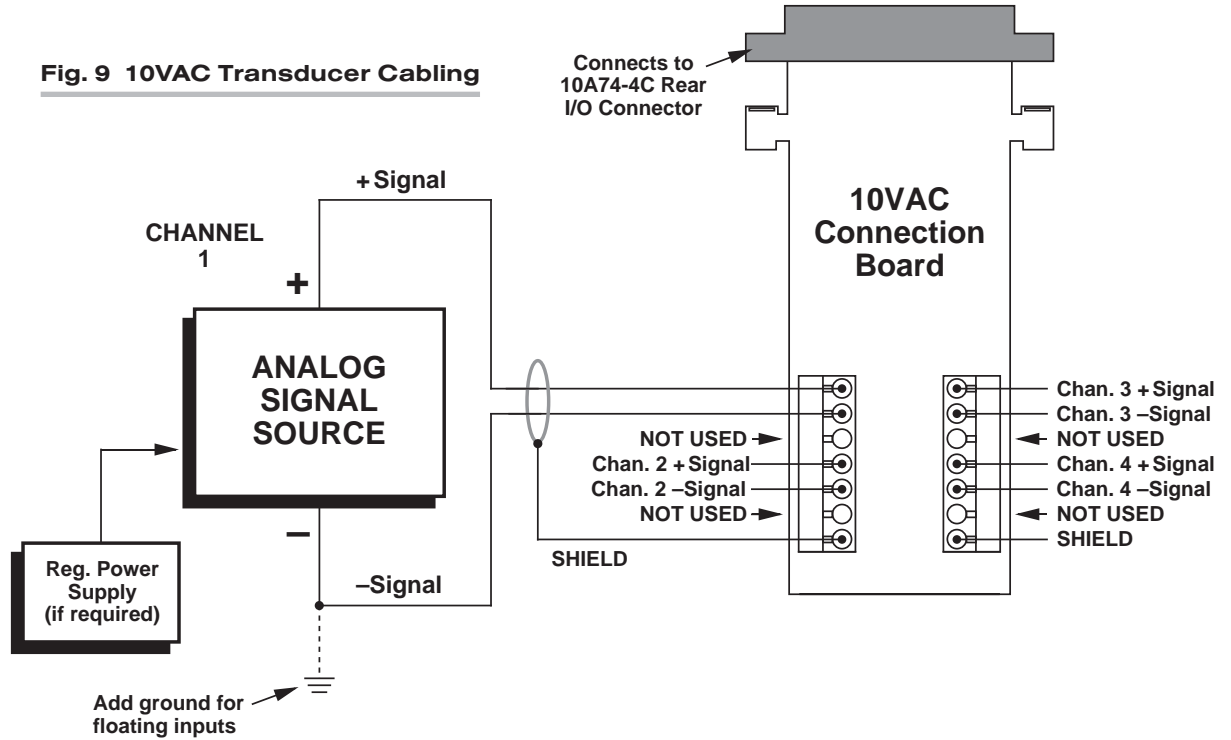
ABSOLUTE CALIBRATION

Described in Manual Section 1.G.3.b, this method is applicable only when the channel is being used to measure *voltage itself*. In this case, the user need only specify an appropriate SCALING FACTOR ("m" coefficient), once the 10VAC-based input channel has been properly configured.

Thus, to calibrate a 10VAC-based Channel No. "x," you need only turn ON the system EEPROM SWITCH and then apply the following **SCALING FACTOR (EMM)** command:

$$EMM\ x = m\ [CR]$$

Fig. 9 10VAC Transducer Cabling



where “m” equals the full-scale range corresponding to the channel’s present TYPE designation, expressed to the precision desired for the channel’s data readings. Channel “type” codes and associated full-scale ranges are given in Table 2, above. If, for example, a voltage-measuring 10VAC channel is “typed” as “72” (corresponding to a full scale of ± 20 V-DC) and you want the channel to read tenths of a volt, you would enter an “m” value of “20.0.”

NOTE: The accuracy of “absolute” calibration of a 10VAC-based channel is limited to $\pm 0.05\%$ of full scale.

TWO-POINT (DEADWEIGHT) CALIBRATION

Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional “zero and span” method can be applied to a 10VAC-based channel if the received voltage input is an *analog of another parameter* which has one or more independently and accurately known calibration values. It can also be used to improve the ABSOLUTE calibration of an input that measures voltage itself (beyond the inherent limit of $\pm 0.05\%$ of full scale). The mainframe’s **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

NOTE: When the 10VAC is attached to the 10A74-4C, the 10A74-4C’s *shunt calibration* provisions are not applicable.

For application of “TRACK” and “HOLD” commands to any 10A74-4C/10VAC DATA CHANNEL by means of a **Model 10A1 Control Signal Card** mounted in the same mainframe “A-Card Deck,” see Section 3.b Note that when the 10VAC is attached to the 10A74-4C, control of TRACK/HOLD operation by means of an external logic signal received at I/O Connector Pin “K” is no longer possible.

10A74-4C QUAD DC STRAIN GAGE TRACK-HOLD CARD

MODEL 10A76

VIBRATION CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The single-channel Model 10A76 measures the true RMS value of the vibratory component of the output signal of a conventional *strain gage accelerometer* of up to 50 mV, full scale—for which selectable excitation of 1, 5, or 10 V-DC is provided. It is ideal for any number of applications where the accurate monitoring of vibration is critical—as, for example, in the testing of motors, gear-boxes, pumps, engines, conveyors, fans, and compressors.

The 10A76 yields two “subchannels,” with corresponding analog outputs to wire-wrap pins:

- **Subchannel No. 1:** VIBRATORY COMPONENT (RMS)
- **Subchannel No. 2:** AVERAGE ACCELERATION

Providing a “front-end” signal amplifier with fixed gain of 100, the 10A76 also features a 10-Hz high-pass filter with selectable gain, followed by a band-pass filter with selectable upper cut-off frequencies. It can thus be configured for specific test or process conditions such as operating frequency or RPM, expected vibration amplitude, etc. (see Section 3, below).

As explained in Section 3.d, the 10A76 employs a combined “calculated” and “two-point” calibration procedure.

ADDITIONAL 10A76 SPECIFICATIONS

Input Range: Accepts a signal of up to 50 mV, full scale, from a conventional *strain gage accelerometer*; for “type” codes assigned to 10A76 data channels on the basis of desired pass-band cutoff frequency, Table 2, Section 3.c, below

Excitation: Selectable 1, 5, or 10 V-DC nominal; 80 mA, maximum

Amplifier:

Normal-Mode Range: ± 100 mV operating; ± 5 V without instrument damage

Common-Mode Range: ± 2 V operating; ± 5 V without instrument damage

Common-Mode Rejection Ratio: DC: -90 dB; 60 Hz: -60 dB; 1 kHz: -50 dB

Input Impedance (Differential and Common-Mode): 10^8 M Ω and 5-nanoamp bias current; for special analog filtering provisions, see the **Filter** specification, below

Offset: Initial: $\pm 0.2\%$ of full scale; vs. Temperature: ± 50 ppm/ $^{\circ}$ C

(cont'd)

Gain Accuracy*: $\pm 0.02\%$ of full scale *typical*, following calibration

Gain Stability (center of chosen passband): vs. Temperature: ± 100 ppm/ $^{\circ}\text{C}$

Filter:

- 1) **LOW-PASS:** 3-pole modified Butterworth; 3 dB down at 10 Hz; 60 dB down at 100 Hz

Step Response Settling Time (Full-Scale Output):

- To 1% of final value: 100 msec
- To 0.1% of final value: 150 msec
- To 0.02% of final value: 600 msec

- 2) **BAND-PASS:** Upper cutoff frequency for each channel selectable by command: 20, 40, 80, 125, 250, 500, 1000, or 1600 Hz (see Section 3.c)

- 3) **HIGH-PASS:** 10 Hz, with selectable gain of 1, 2, 5, 10, or 20

Auxiliary Outputs: Filtered output for RMS vibration frequency available on main-frame wire-wrap pin

2 TRANSDUCER CONNECTIONS

The Model 10A76's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Table 1 gives standard pin assignments for the I/O Connector. With regard to 10A76 cabling, please note the following:

- a. 4-wire cabling to a full-bridge strain gage transducer is given in Fig. 1(a), and is to be used when the cable is under 20 feet in length. In this case, the +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines *at the CONDITIONER CONNECTOR*.
- b. 6-wire cabling to a full-bridge strain gage transducer is given in Fig. 1(b), and is to be used when the cable is 20 feet or longer. In this case, the +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines *at the transducer*.

Table 1 Model 10A76 Pin Assignments

I/O Connector Pin Number	Conditioner Line Function
1	+EXCITATION
A	-EXCITATION
2	+SENSE
B	-SENSE
3	+SIGNAL
C	-SIGNAL
4,D	Not Committed
5	SIGNAL COMMON
E	Not Committed
6	FILTERED OUTPUT
All Other Pins	Not Committed

* Initial (uncalibrated) inaccuracy may be as great as $\pm 0.5\%$ of full scale. Maximum error that could occur upon replacement of a Model 10A76 *not followed by calibration* is $\pm 1\%$ of full scale.

Fig. 1 Model 10A76 Transducer Cabling

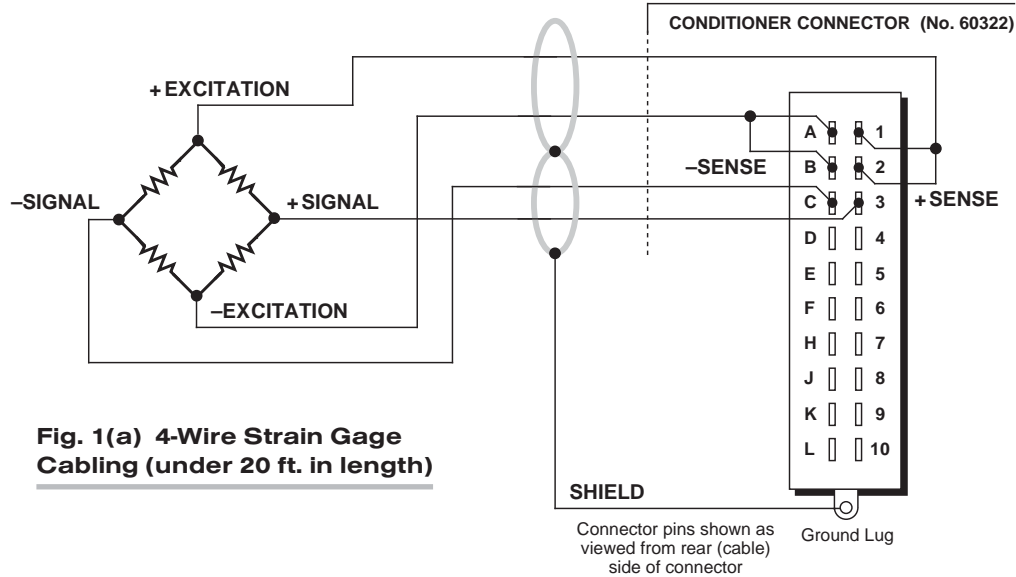


Fig. 1(a) 4-Wire Strain Gage Cabling (under 20 ft. in length)

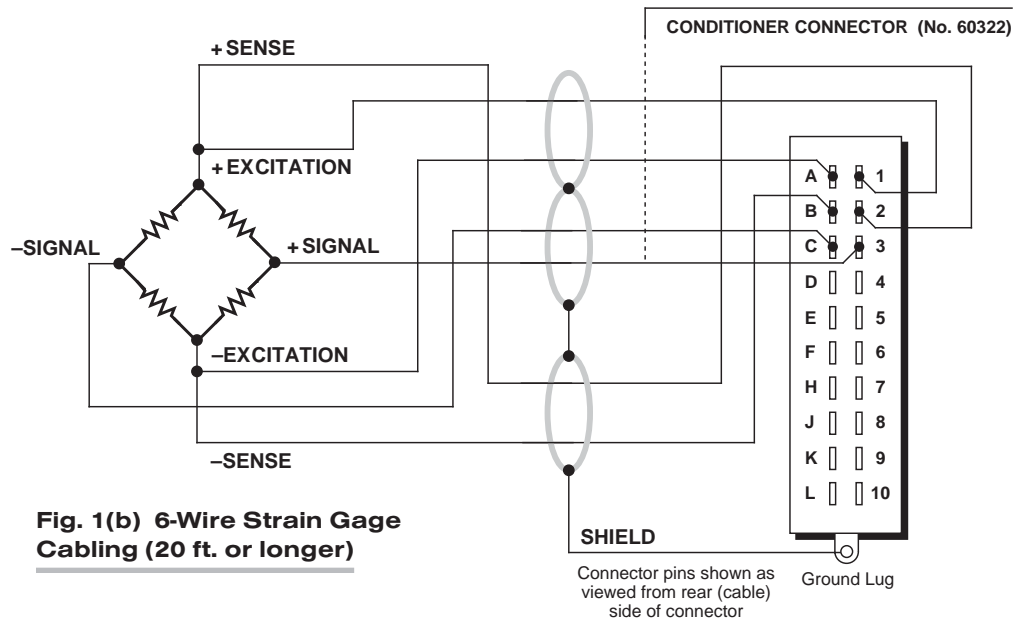


Fig. 1(b) 6-Wire Strain Gage Cabling (20 ft. or longer)

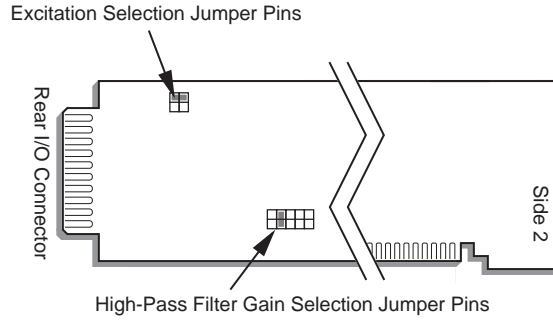
3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a SETTING EXCITATION LEVEL

1. Turn OFF mainframe power and remove the 10A76 card from its mainframe slot. For "Card Insertion and Removal," see Manual Section 1.B.
2. Refer to Fig. 2 and locate the EXCITATION SELECTION JUMPER PINS. One "mini-jumper" is provided for interconnecting any two horizontally or vertically adjacent jumper pins.

10A76 VIBRATION CARD

**Fig. 2 10A76
Excitation and Filter Gain
Selection Jumper Pins**



3. Position the jumper as shown in Fig. 3 to set the desired excitation voltage.
4. Do not reinstall the 10A76 card until you have set the high-pass filter gain (next section).

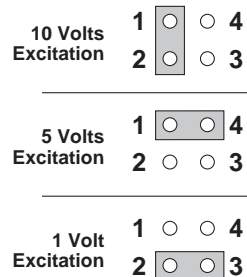
3.b SETTING HIGH-PASS FILTER GAIN

1. Locate the HIGH-PASS FILTER GAIN SELECTION JUMPER PINS shown in Fig. 2. One "minijumper" is provided for interconnecting any two vertically adjacent jumper pins.
2. Position the jumper as shown in Fig. 4 to set the desired gain (1, 2, 5, 10, or 20).
3. Reinsert the 10A76 card in its mainframe slot and reactivate mainframe power.

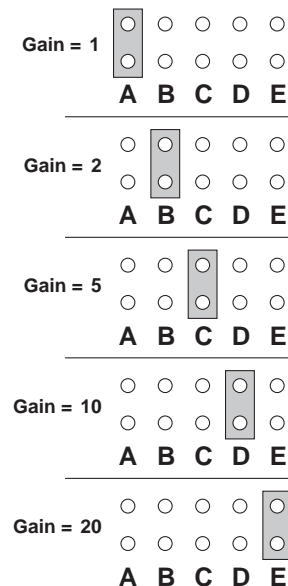
3.c SETTING BAND-PASS FILTER CUTOFF FREQUENCY

Assume here that Channel No. "x" has been "located" to the 10A76's Subchannel No. 1 ("Vibratory Component") and that Channel No. "y" has been "located" to Subchannel No. 2 ("Average Acceleration"). For data-channel "location," see Manual Section 1.G.1.

**Fig. 3 10A76 Excitation
Selection Jumper Pins**



**Fig. 4
10A76 Filter Gain
Selection Jumper Pins**



Turn ON the system EEPROM SWITCH and assign an appropriate “v” to Channel Nos. x and y, via the **TYPE (TYP)** command:

TYP x = v [CR]
TYP y = v [CR]

The number you enter for “v” will depend on the desired band-pass cutoff frequency, as follows:

Table 2 10A76 “Type” Codes

Band-Pass Cutoff Frequency	Channel Type Code (“v”)
20 Hz	40
40 Hz	41
80 Hz	42
125 Hz	43
250 Hz	44
500 Hz	45
1000 Hz	46
1600 Hz	47

3.d CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A76 card when used in System 10, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A76 channel “type” codes, see Table 2, above.

In System 10, you must use the following special procedure to calibrate a 10A76 channel. Assume here that Channel No. “x” has been “located” to the 10A76’s Subchannel No. 1 (“Vibratory Component”) and that Channel No. “y” has been “located” to Subchannel No. 2 (“Average Acceleration”). For data-channel “location,” see Manual Section 1.G.1.

1. Choose a *full-scale acceleration* value appropriate to your accelerometer. This value should be expressed in units of “g” (where “g” is the earth’s gravitational constant—approximately 32 ft/sec² or 9.80 m/sec²). We will call this full-scale acceleration value “A.”
2. Now turn ON the system EEPROM SWITCH and apply a **SCALING FACTOR (EMM)** command to Channel No. y:

EMM y = m₁ [CR]

For “m₁” (the “m” coefficient of Channel No. y’s “mx + b” linear relation, as discussed in Manual Section 1.G.2), you should enter *the larger of these two numbers*:

1.000 or (1.000 x A)

For example, if your full-scale acceleration “A” is 100 (g), you would enter “100.0” for “m₁.”

3. Orient the accelerometer HORIZONTALLY AT REST, to create a state of “zero acceleration.”
4. Enter a **ZERO (ZRO)** command of

ZRO y [CR]

(cont’d)

- Orient the accelerometer VERTICALLY AT REST, to create a state of “gravitational acceleration” (= 1 g).
- Enter a **FORCE (FRC)** command of

$$\text{FRC } y = 1.00 \text{ [CR]}$$
- You must now determine the high-pass filter gain that includes the desired full scale. Note that the effective full scale for the vibratory component of acceleration is given by

$$A \cdot m_g$$

You must therefore select from the following table a value of the factor “ m_g ” which, when multiplied by the full-scale acceleration “A,” includes the highest expected vibration reading.

Table 3

“ m_g ”	High-Pass Filter Gain
1.414	1
0.707	2
0.2828	5
0.1414	10
0.0707	20

For example, if $A = 100$ (g), and you expect a vibration reading of up to 25 (g), you should select the “ m_g ” value of “0.2828,” since $100 \times 0.2828 = 28.28$.

- Referring to the above table and the instructions given in Section 3.b, set the 10A76 to the high-pass filter gain that corresponds to the selected “ m_g ” value. For the example in Step 7, this would be “5.”
- Command

$$\text{EMM } y \text{ [CR]}$$

and note the answer. This is “ m_y ,” the scaling factor you “forced” into Channel No. y in Step 6.

- Now set the “ m ” coefficient of Channel No. x (“Vibratory Component”) by commanding

$$\text{EMM } x = m_x \text{ [CR]}$$

where the value you enter for “ m_x ” is

$$m_g \cdot m_y$$

(“ m_g ” is the factor you selected in Step 7; “ m_y ” is the answer from Step 9).

MODEL 10A78

AC STRAIN GAGE CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Model 10A78 is a single-channel conditioner of *phase-sensitive carrier-amplifier* design (rather than a two-channel, fully DC instrument). Intended for applications involving transformer-coupling to the transducer bridge (as with rotary-transformer torque sensors), this conditioner can also be used in conventional installations when high sensitivity is required or where the electrical environment is especially noisy. Responding only to the modulated carrier frequency, the 10A78 rejects extraneous voltages that can cause errors in DC systems, particularly when there is a need to “blow up” a portion of the transducer range. User-adjustable phase and symmetry controls are provided.

The Model 10A78's data channel is best calibrated by means of a “two-point (dead-weight)” or shunt-calibration technique, following an initial “calculated” calibration. The supplied calibration resistor is 59 kilohms, 1%. Note that the 10A78 can NOT be calibrated via the System 10 **MV/V CALIBRATION (MVV)** command. Note also that a specially modified version of the 10A78 is required if you wish to control the shunt-calibration process by means of logic-level inputs through the rear I/O CONNECTOR.

ADDITIONAL 10A78 SPECIFICATIONS

Transducer Types: Conventional 4-arm strain gage bridges, nominal 350 ohms (or higher)

Input Ranges (Full-Scale): ± 0.75 , 1.50, or 3.00 mV/V; automatically selected—on an individual channel basis—when the channel is configured; for the System 10 channel “type” code assigned to a 10A78 data channel, see Table 1, below. Since channel zeroing is by digital techniques, no input balance control is provided. The allowable input range, therefore, must include any *initial unbalance* (which, in commercially produced strain gage transducers, is usually negligible). Other transducers may have to be externally trimmed to be used with the Model 10A78, if zero unbalance exceeds 20% of full scale.

Excitation: Regulated 3 V-AC (rms) at 3280 Hz; 50 mA (rms), maximum

Amplifier:

Common-Mode Range: ± 1 V operating; ± 9 V without instrument damage

Common-Mode Rejection Ratio: DC and at 60 Hz: infinite; at 3 kHz: -60 dB

Input Impedance (Differential and Common-Mode): 10 M Ω

Offset: Initial: $\pm 3\%$ of full scale; vs. Temperature: $\pm 0.005\%$ f.s./ $^{\circ}\text{C}$; vs. Time: $\pm 0.02\%$ f.s./month

Gain Accuracy*: $\pm 0.02\%$ of full scale *typical*, following calibration

(cont'd)

* Initial (uncalibrated) inaccuracy may be as great as $\pm 3\%$ of full scale. Maximum error that could occur upon replacement of a Model 10A78 *not followed by calibration* is $\pm 6\%$ of full scale.

Gain Stability: vs. Temperature: ± 50 ppm/ $^{\circ}\text{C}$; vs. Time: ± 20 ppm/month
Filter: 3-pole modified Butterworth; 3 dB down at 7.5 Hz; 60 dB down at 60 Hz

Step-Response Settling Time (Full-Scale Output):

- To 1% of final value: 250 msec
- To 0.1% of final value: 350 msec
- To 0.02% of final value: 500 msec

Auxiliary Output: Filtered output available on mainframe wire-wrap pin

Table 1 10A78 "Type" Codes

Full-Scale Input	Channel Type Code
0.75 mV/V	70
1.50 mV/V	71
3.00 mV/V	72

2 TRANSDUCER CONNECTIONS

The Model 10A78's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Table 2 gives standard pin assignments for the I/O Connector. With regard to 10A78 cabling, please note the following:

- a. 4-wire strain gage cabling is given in Fig. 1(a), and is to be used when the cable is under 20 feet in length. In this case, the +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines (and also the CALIBRATION SENSE line to the +SIGNAL line) *at the CONDITIONER CONNECTOR*. It is recommended that the resistance of the conductors not exceed 0.0001 of the bridge resistance.
- b. 8-wire strain gage cabling is given in Fig. 1(b), and is to be used when the cable is 20 feet or longer, or when fine wire is used.* In this case, the +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines (and also the CALIBRATION SENSE line to the +SIGNAL line) *at the transducer*. Note also the wire connected to the -SIGNAL line, at the transducer, but left *unconnected* at the 10A78. This wire is to be paired with the CAL SENSE line for shielding purposes.

NOTE: The special 8-wire cabling shown in Fig. 1(c) is required for connecting a Model 10A78 to a **Lebow 1600 Series Transducer**. The cable should be shielded in four pairs, as shown, with the shield open at the transducer end. In the case of connection to a Lebow 1600 Series Transducer, also note that

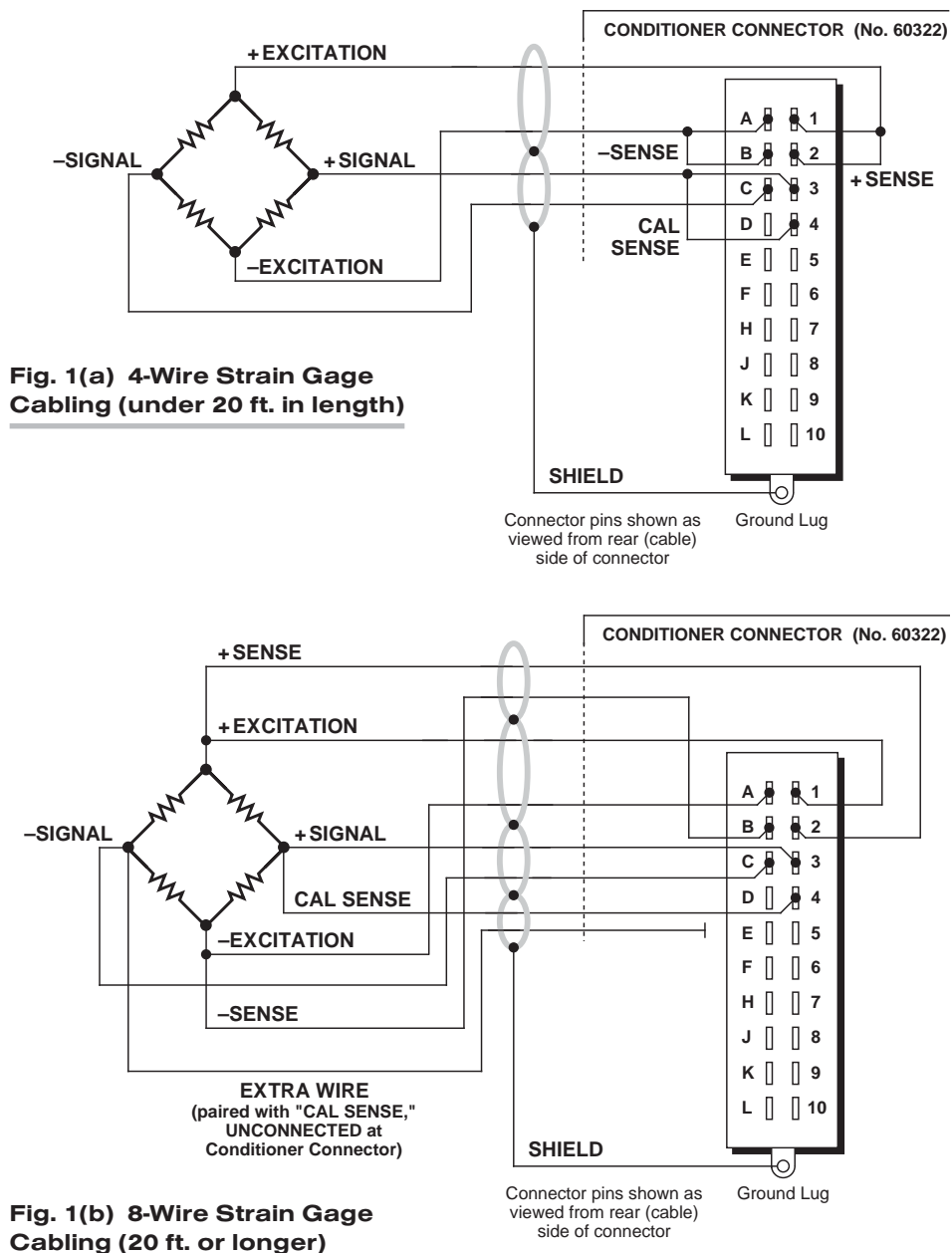
- a. SENSE and EXCITATION lines should be tied *at the transducer*.
- b. The 10A78's **Pin 5** ("LEBOW CAL") is to be connected to the "CAL" pin on the Lebow sensor (Pin 4 is not used in this case).
- c. Leave the last (extra) wire *unconnected at both ends*, and pair it with the "LEBOW CAL" line for the fourth shield.
- d. THE MODEL 10A78 MUST BE INTERNALLY SET TO "SIGNAL COMMON" MODE, via the following procedure:

* This cabling is to be used when connecting a Model 10A78 to a **Lebow 1800 Series Transducer**.

1. Turn OFF mainframe power and remove the 10A78 card from its mainframe slot. For "Card Insertion and Removal," see Manual Section 1.B.
2. Refer to Fig. 2, below, and locate the SIGNAL PROGRAMMING JUMPER PADS on the component side of the board.
3. The 10A78 is normally shipped with a solder-drop connection between the pair of jumper pads labelled "+S." When the special Lebow 1600 cabling is used, however, the connection between the "+S" pads should be removed, and a solder-drop connection should be made between the pair of jumper pads labelled "S.C."

(cont'd)

Fig. 1 Model 10A78 Transducer Cabling



10A78 AC STRAIN GAGE CARD

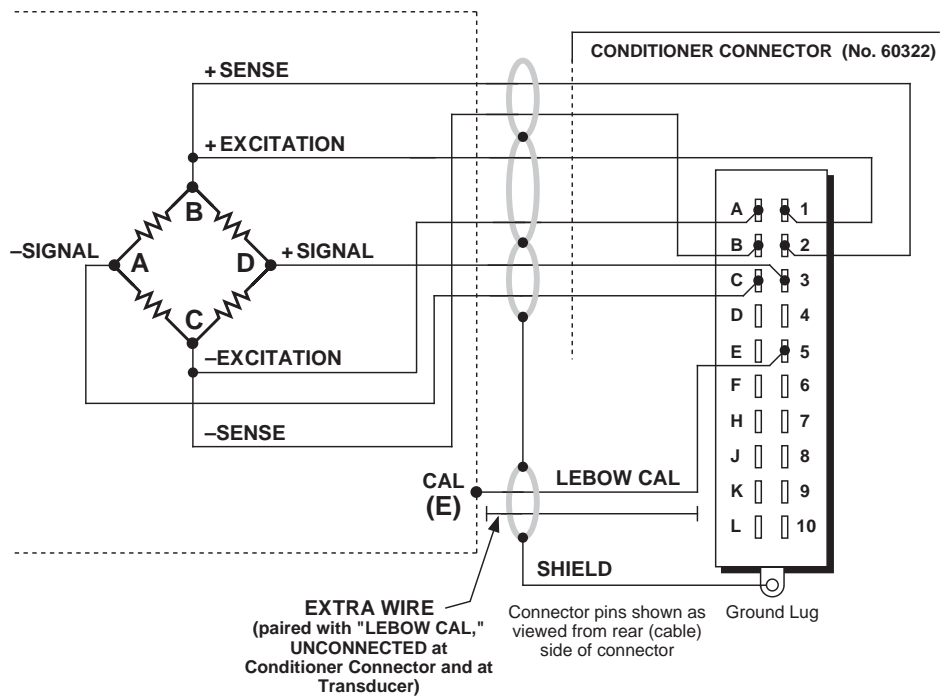


Fig. 1(c) 8-Wire Cabling to Lebow 1600 Series Transducer (ONLY)

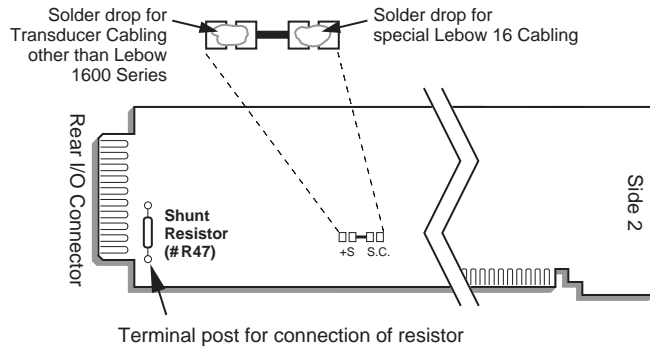
To “unblob” the “+S” jumpers, use a fine-point solder gun to heat the solder drop, until it has melted sufficiently for you to wipe it off with a clean rag. Make sure that you remove all traces of solder from the jumper pads you wish to “unblob.”

- Reinsert the 10A78 card in its mainframe slot and reactivate mainframe power.

Table 2 Model 10A78 Pin Assignments

I/O Connector Pin Number	Conditioner Line Function
1	+EXCITATION (3 V-AC)
A	-EXCITATION (3 V-AC)
2	+SENSE
B	-SENSE
3	+SIGNAL
C	-SIGNAL
4	CAL SENSE
D	SIGNAL COMMON
5	LEBOW CAL
All Other Pins	Not Committed

Fig. 2 10A78 Signal Programming Jumper Pads and Shunt Calibration Resistor



3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a PHASE AND SYMMETRY ADJUSTMENT FOR ALL TRANSDUCERS EXCEPT A LEBOW 1800 SERIES TRANSDUCER

Before you do a “two-point” or “shunt” calibration of your 10A78 *for the first time*, you should perform an initial “on-line” *phase and symmetry adjustment*. When using a **Lebow 1800 Series Transducer** (only), you should follow the special procedure given in the next section. For *any other* transducer, use the following procedure. ONCE SET FOR YOUR TRANSDUCER, THIS ADJUSTMENT NEED NOT BE REPEATED UNLESS A SIGNIFICANT CHANGE IN CABLE LENGTH OR CAPACITANCE IS REQUIRED.

- a. Turn ON the system EEPROM Switch and enter a **SCALING FACTOR (EMM)** command of

$$EMM\ x = m\ [CR]$$

where “x” is the Channel Number of the 10A78’s measurement channel, and “m” is the *full-scale input range in the desired engineering units and with the desired resolution*.

- b. Provide a “live” display of the data reported by Channel No. x.
- c. Without removing the 10A78 from its slot, locate the PHASE AND SYMMETRY CONTROLS, which are accessible from the front of the card (see Fig. 3).

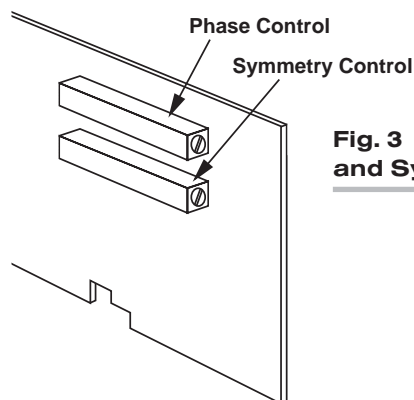


Fig. 3 10A78 Phase and Symmetry Controls

10A78 AC STRAIN GAGE CARD

- d. Load the transducer in the positive direction with a convenient “deadweight” value which is greater than one-half of full scale. Using a small insulated screwdriver, adjust the 10A78’s PHASE CONTROL until a *maximum reading* is obtained for the 10A78 channel.
- e. Remove the transducer load.
- f. Make sure the system EEPROM Switch is still ON and enter a **ZERO (ZRO)** command of
ZRO x [CR]
- g. Now switch in the 10A78’s internal shunt resistor for a *positive* up-scale reading by entering a command of
SHP x [CR]
- h. Record the reading you get.
- i. Open the positive shunt and switch in the resistor for a *negative* reading by entering a command of
SHN x [CR]
- j. Adjust the 10A78’s SYMMETRY CONTROL until the *negative* value of the reading you recorded in Step h appears.
- k. Open the negative shunt by entering a command of
RSM x [CR]
- l. You are now ready to perform “on-line calibration” of the 10A78 channel by either the “Two-Point (Deadweight)” or “Simulated (Shunt)” Calibration method (see Section 3.c, below).

3.b PHASE AND SYMMETRY ADJUSTMENT FOR A LEBOW 1800 SERIES TRANSDUCER

NOTE: WHEN USING THE 10A78 WITH A **LEBOW 1800 SERIES TRANSDUCER**, YOU SHOULD FIRST REPLACE THE 10A78’S INTERNAL 59K SHUNT RESISTOR WITH *THE CALIBRATION RESISTOR SUPPLIED WITH THE TRANSDUCER*.

- a. Locate the “CAL/RUN” Switch in the cable harness of the 1800 Series transducer. Place this switch in the “**CAL**” position.
- b. Perform *Steps a through c* of the above procedure (Section 3.a).
- c. Establish a *zero input* for the 10A78 channel by removing all load from the 1800 Series transducer.
- d. Switch in the 10A78’s internal shunt resistor for a *positive* up-scale reading by entering a command of
SHP x [CR]
- e. Using a small insulated screwdriver, adjust the 10A78’s PHASE CONTROL until a *maximum reading* is obtained for the channel.
- f. Open the positive shunt by entering a command of
RSM x [CR]

- g. Make sure the EEPROM Switch is still ON, and zero the reading of the 10A78 channel by entering a command of

ZRO x [CR]

- h. Close the channel's positive shunt once more via the **SHP** command, as in Step d, above.

- i. You will now "force" the 10A78 channel to read the "EQUIVALENT INPUT" VALUE GIVEN BY THE TRANSDUCER MANUFACTURER FOR THE CALIBRATION RESISTOR YOU INSTALLED IN THE 10A78 (for a general discussion of EQUIVALENT INPUT, see Section 3.c, below, and Manual Section 1.G.7). Enter a **FORCE (FRC)** command of

FRC x = z [CR]

where "z" is the equivalent input expressed in the desired engineering units.

- j. Open the positive shunt and switch in the resistor for a *negative* reading by entering a command of

SHN x [CR]

- k. Adjust the 10A78's SYMMETRY CONTROL to display the *negative* value of the same EQUIVALENT INPUT you entered in Step i (or some other specific negative engineering-unit value, *if such a value is given by the transducer manufacturer for the calibration resistor*).

- l. Open the negative shunt by entering a command of

RSM x [CR]

- m. Move the transducer's "CAL/RUN" Switch to the "**RUN**" position.

- n. Zero the 10A78 channel's reading once more, as you did in Step g, above.

THE LEBOW 1800 / DAYTRONIC 10A78 SYSTEM IS NOW FULLY CALIBRATED. YOU NEED NOT PERFORM A SUBSEQUENT "DEADWEIGHT" OR "SIMULATED" CALIBRATION.

3.c CONFIGURATION AND CALIBRATION

For initial configuration of the ANALOG INPUT CHANNEL dedicated to a specific Model 10A78 card when used in System 10, see the general remarks on System 10 "real-channel" configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A78 channel "type" codes, see Table 1, above.

In System 10, you can use two calibration methods with the Model 10A78 (note that this conditioner *cannot* be calibrated by the "MVV-CALCULATED" CALIBRATION technique that may be applied to other Strain Gage Conditioner Cards):

Two-POINT (DEADWEIGHT) CALIBRATION

Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional "zero and span" method can easily be applied to a 10A78 channel. The mainframe's **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

SIMULATED (SHUNT) CALIBRATION

This method is similar to the conventional TWO-POINT (DEADWEIGHT) procedure. The difference is that the second (“span”) input is not produced by loading the source transducer, but by “simulating” a particular up-scale value of mechanical input. This known EQUIVALENT INPUT then serves to determine the SCALING FACTOR for the channel.

For the 10A78’s data channel, the equivalent input is produced by shunting a resistor of known magnitude across one arm of the strain gage bridge, thereby simulating a known value of input for either a *positive* or *negative* up-scale reading. If the transducer manufacturer has supplied the exact value of the transducer’s equivalent input, it can be used as a reference point for calibrating the channel.

Equivalent input can be approximated from a knowledge of the *Shunt Calibration Resistance (R)*, the transducer’s *Bridge Resistance (B)*, and the transducer’s *Full-Scale Sensitivity (K, in mV/V full scale)*. To determine the EQUIVALENT INPUT (X) as an approximate percentage of full-scale output, you may use the following equation:

$$X = 25000B / K(R + 0.5B) \%$$

Since the equivalent input is here expressed as a *percentage of full-scale output*, you must multiply it by the rated full-scale capacity of the transducer, in order to determine the *actual input simulated by the shunt*.

Shunt calibration is an easier though generally less accurate technique than two-point (deadweight) calibration. It is useful, however, when overall “deadweighting” is impossible or inconvenient, and is good for an accuracy of about 0.2% (depending, of course, on the accuracy of the specified equivalent input, and on the resistor/bridge tolerance and temperature).

The 10A78 is equipped with a 59-k Ω , 0.1% *calibration resistor*, located on turret terminals at the rear of the card (see Fig. 2). You may, if you wish, replace the installed 59K shunt resistor with a resistor of another value (strain-gage transducer manufacturers often supply such resistors with their instruments).

In System 10, a strain gage channel’s shunt resistor may be switched in and out by means of the **SHUNT CALIBRATE-POSITIVE (SHP)** or **SHUNT CALIBRATE-NEGATIVE (SHN)** command. A **RESUME (RSM)** command should then be applied to remove the shunt and resume normal channel measurement. Since these are “run-time” commands, the mainframe’s **EEPROM Write Protect Switch** need not be on for them to be effective. See Manual Section 1.G.6 for general instructions regarding the “SHUNT CALIBRATION” technique in System 10.

NOTE: If you wish to control the shunt calibration process by means of logic-level inputs through the 10A78’s rear I/O CONNECTOR—a standard feature of other strain gage conditioner cards—you will require a *specialty modified version* of the 10A78.

MODEL 10A96

AMPLIFIED ACCELEROMETER VIBRATION CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The single-channel Model 10A96 measures the true RMS value of the vibratory component of the output signal of an *Amplified Piezoelectric Accelerometer*, for which an excitation of ± 15 V-DC is provided. It is ideal for any number of applications where the accurate monitoring of vibration is critical—as, for example, in the testing of motors, gear-boxes, pumps, engines, conveyors, fans, and compressors.

The 10A96 yields two “subchannels,” with corresponding analog outputs to wire-wrap pins:

- **Subchannel No. 1:** VIBRATORY COMPONENT (RMS)
- **Subchannel No. 2:** AVERAGE ACCELERATION

The 10A96’s “front-end” amplifier gain is user-selectable, which allows the card to accept accelerometer signals from ± 50 mV to ± 5 V. The card also features a 10-Hz high-pass filter with selectable gain, followed by a band-pass filter with selectable upper cut-off frequencies. It can thus be configured for specific test or process conditions such as operating frequency or RPM, expected vibration amplitude, etc. (see Section 3, below).

As explained in Section 3.d, the 10A96 employs a combined “calculated” and “two-point” calibration procedure.

ADDITIONAL 10A96 SPECIFICATIONS

Input Range: User-selectable gain accommodates accelerometer signal from ± 50 mV to ± 5 V, full scale; for “type” codes assigned to 10A96 data channels on the basis of desired pass-band cutoff frequency, Table 2, Section 3.c, below

Excitation: Fixed ± 15 V-DC nominal; 15 mA, maximum

Amplifier:

Normal-Mode and Common-Mode Range: ± 5 V operating; ± 7 V without instrument damage

Common-Mode Rejection Ratio: DC: -60 dB; at 60 Hz and 1 kHz: -50 dB

Input Impedance (Differential and Common-Mode): 10^8 M Ω and 5-nanoamp bias current; for special analog filtering provisions, see the **Filter** specification, below

Offset: Initial: $\pm 0.2\%$ of full scale; vs. Temperature: ± 50 ppm/ $^{\circ}$ C

Gain Accuracy*: $\pm 0.02\%$ of full scale *typical*, following calibration

(cont'd)

* Initial (uncalibrated) inaccuracy may be as great as $\pm 1.0\%$ of full scale. Maximum error that could occur upon replacement of a Model 10A96 *not followed by calibration* is $\pm 2\%$ of full scale.

Gain Stability (center of chosen passband): vs. Temperature: ± 100 ppm/ $^{\circ}$ C

Filter:

1) **LOW-PASS:** 3-pole modified Butterworth; 3 dB down at 10 Hz; 60 dB down at 100 Hz

Step Response Settling Time (Full-Scale Output):

- To 1% of final value: 100 msec
- To 0.1% of final value: 150 msec
- To 0.02% of final value: 600 msec

2) **BAND-PASS:** Selectable upper cut-off frequency for each subchannel: 20, 40, 80, 125, 250, 500, 1000, or 1600 Hz (see Section 3.c)

3) **HIGH-PASS:** 10 Hz, with selectable gain of 1, 2, 5, 10, or 20

Auxiliary Outputs: Filtered output for RMS vibration frequency available on main-frame wire-wrap pin

2 TRANSDUCER CONNECTIONS

The Model 10A96's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322, shown in Fig. 1.5 (in Manual Section 1.E.1). Table 1 gives standard pin assignments for the I/O Connector.

Fig. 1 shows 5-wire connections to a Daytronic **Model ACL3 Amplified Piezoelectric Accelerometer**. The 10A96 will work with any similar instrument with a sensitivity of 50.0 mV/g, using similar cable connections. Note that a 5-wire cable with a single shield could be used, if desired, instead of the individually shielded pairs shown in Fig. 1.

Table 1 Model 10A96 Pin Assignments

I/O Connector Pin Number	Conditioner Line Function
1	+15 V-DC EXCITATION
A	-15 V-DC EXCITATION
2,B	Not Committed
3	+SIGNAL
C	-SIGNAL
4,D,5	Not Committed
E	SIGNAL COMMON
6	Not Committed
F	FILTERED OUTPUT
All Other Pins	Not Committed

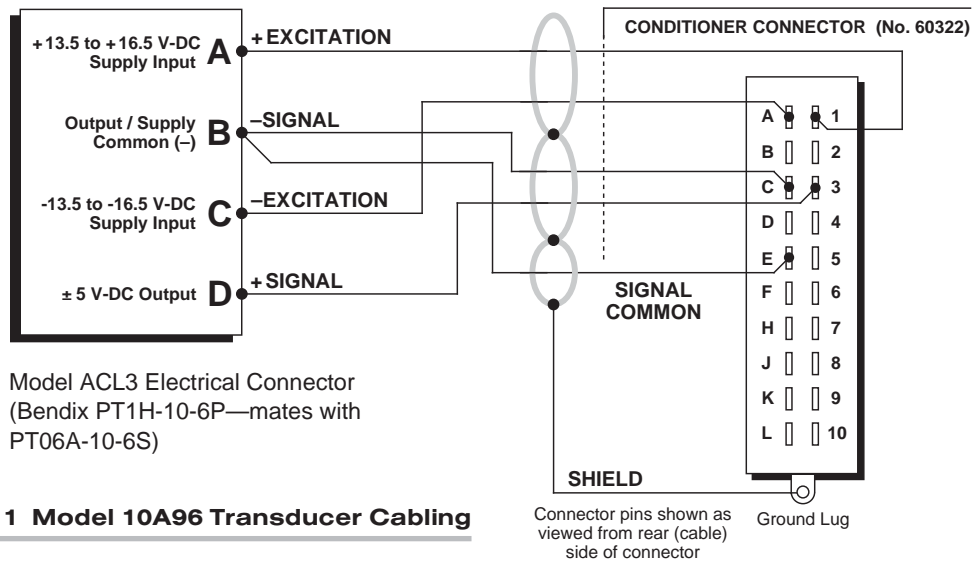


Fig. 1 Model 10A96 Transducer Cabling

3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a SETTING FRONT-END AMPLIFIER GAIN

1. Turn OFF mainframe power and remove the 10A96 card from its mainframe slot. For “Card Insertion and Removal,” see Manual Section 1.B.
2. Locate the FRONT-END AMPLIFIER GAIN SELECTION JUMPER PINS shown in Fig. 2. One “minijumper” is provided for interconnecting any two vertically adjacent jumper pins.
3. Position the jumper as shown in Fig. 3 to set the gain to the desired gain (1, 2, 5, 10, 20, 50, or 100)
4. Do not reinstall the 10A96 card until you have set the high-pass filter gain (next section).

3.b SETTING HIGH-PASS FILTER GAIN

1. Locate the HIGH-PASS FILTER GAIN SELECTION JUMPER PINS shown in Fig. 2. One “minijumper” is provided for interconnecting any two vertically adjacent jumper pins.
2. Position the jumper as shown in Fig. 4 to set the gain to set the desired gain (1, 2, 5, 10, or 20).
3. Reinsert the 10A96 card in its mainframe slot and reactivate mainframe power.

10A96 AMPLIFIED ACCELEROMETER VIBRATION CARD

Fig. 2 10A96 Amplifier and Filter Gain Selection Jumper Pins

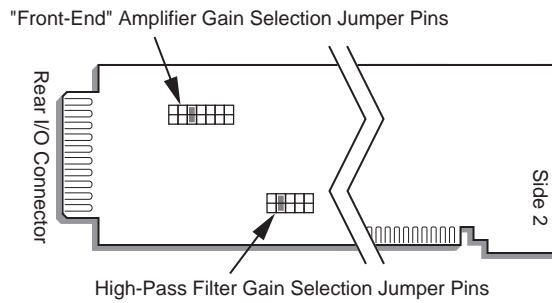


Fig. 3 10A96 Front-End Amplifier Gain Selection Jumper Pins

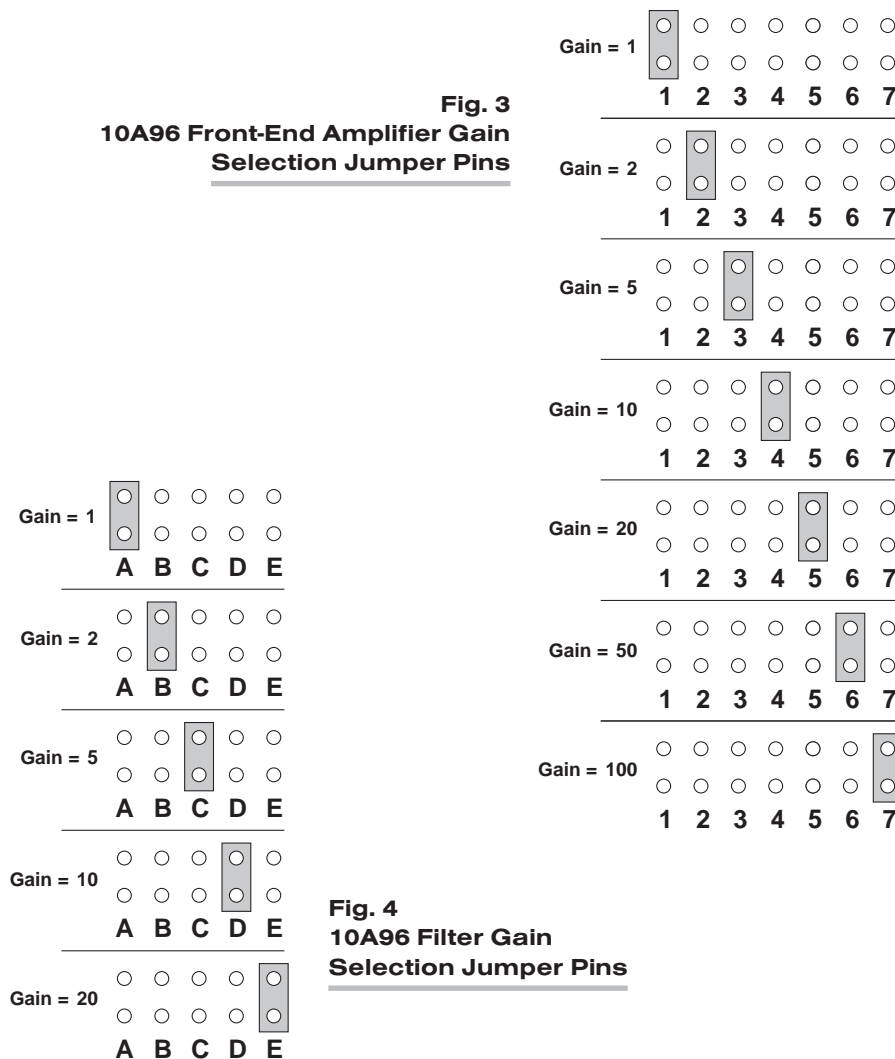


Fig. 4 10A96 Filter Gain Selection Jumper Pins

3.c SETTING BAND-PASS FILTER CUTOFF FREQUENCY

Assume here that Channel No. “x” has been “located” to the 10A96’s Subchannel No. 1 (“Vibratory Component”) and that Channel No. “y” has been “located” to Subchannel No. 2 (“Average Acceleration”). For data-channel “location,” see Manual Section 1.G.2. Turn ON the system EEPROM SWITCH and assign an appropriate “type” code “v” to Channel Nos. x and y, via the **TYPE (TYP)** command:

TYP x = v [CR]
TYP y = v [CR]

The number you enter for “v” will depend on the desired band-pass cutoff frequency, as follows:

Table 2 10A96 “Type” Codes

Band-Pass Cutoff Frequency	Channel Type Code (“v”)
20 Hz	40
40 Hz	41
80 Hz	42
125 Hz	43
250 Hz	44
500 Hz	45
1000 Hz	46
1600 Hz	47

3.d CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model 10A96 card when used in System 10, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For 10A96 channel “type” codes, see Table 2, above.

In System 10, you must use the following special procedure to calibrate a 10A96 channel. Assume here that Channel No. “x” has been “located” to the 10A96’s Subchannel No. 1 (“Vibratory Component”) and that Channel No. “y” has been “located” to Subchannel No. 2 (“Average Acceleration”). For data-channel “location,” see Manual Section 1.G.1.

1. Choose a *full-scale acceleration* value appropriate to your accelerometer. This value should be expressed in units of “g” (where “g” is the earth’s gravitational constant—approximately 32 ft/sec² or 9.80 m/sec²). We will call this full-scale acceleration value “A.”
2. Now turn ON the system EEPROM SWITCH and apply a **SCALING FACTOR (EMM)** command to Channel No. y:

EMM y = m₁ [CR]

For “m₁” (the “m” coefficient of Channel No. y’s “mx + b” linear relation, as discussed in Manual Section 1.G.2), you should enter *the larger of these two numbers*:

1.000 or (1.000 x A)

For example, if your full-scale acceleration “A” is 100 (g), you would enter “100.00” for “m₁.”

3. Disconnect any presently connected transducer from the 10A96’s rear I/O CONNECTOR, and connect an external VOLTAGE STANDARD as shown in Fig. 5, below. Set the voltage standard to 0 mV.

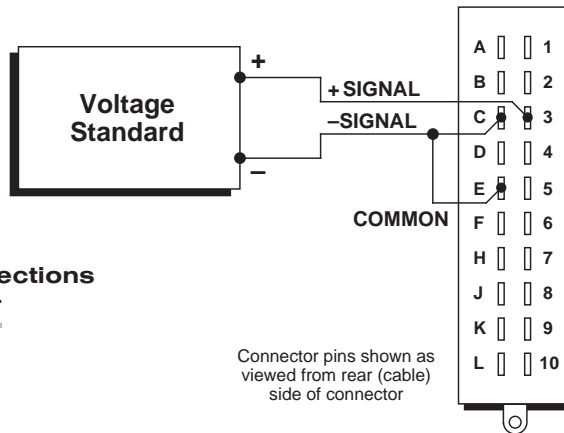


Fig. 5 Calibration Connections to 10A96 I/O Connector

Connector pins shown as viewed from rear (cable) side of connector

- With the EEPROM Switch still ON, apply a **ZERO (ZRO)** command to Channel No. y:

$$\mathbf{ZRO\ y\ [CR]}$$

- Set the voltage standard to 50 mV. Note the data reading of Channel No. y. If this reading is above 1.2 (V), then reduce the gain of the 10A96's front-end amplifier (as explained in Section 3.a) and repeat Steps 4 and 5. If the reading is less than 0.4 (V), then increase the gain of the front-end amplifier and repeat Steps 4 and 5.

- With the voltage standard still at 50 mV and the system EEPROM Switch ON, apply the following **FORCE (FRC)** command to Channel No. y:

$$\mathbf{FRC\ y = 1.000\ [CR]}$$

- You must now determine the high-pass filter gain that includes the desired full scale. Note that the effective full scale for the vibratory component of acceleration is given by

$$\mathbf{A \cdot m_g}$$

You must therefore select from the following table a value of the factor "m_g" which, when multiplied by the full-scale acceleration "A," includes the highest expected vibration reading. For example, if A = 100 (g), and you expect a vibration reading of up to 25 (g), you should select the "m_g" value of "0.2828," since 100 x 0.2828 = 28.28.

Table 3

"m _g "	High-Pass Filter Gain
1.414	1
0.707	2
0.2828	5
0.1414	10
0.0707	20

- Referring to Table 3 and the instructions given in Section 3.b, above, set the 10A96 to the high-pass filter gain that corresponds to the selected "m_g" value. For the example in Step 7, this would be a gain of "5."

9. Command

EMM y [CR]

and note the answer returned by the system. This is “ m_y ,” the scaling factor you “forced” for Channel No. y in Step 6.

10. Now set the “m” coefficient for Channel No. x (“Vibratory Component”) by commanding

EMM x = m_x [CR]

where the value you enter for “ m_x ” is

$$m_g \cdot m_y$$

(“ m_g ” is the factor you selected in Step 7; “ m_y ” is the answer from Step 9).

11. Disconnect the voltage standard from the 10A96’s rear I/O CONNECTOR and connect the transducer as shown in Fig. 1.

10A96 AMPLIFIED ACCELEROMETER VIBRATION CARD

MODEL AA14-4F010

THERMOCOUPLE CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The AA14-4F010 is a high-isolation, four-channel conditioner, accepting real-world temperature signals from **Types E, J, K, N, R, S, and T Thermocouples**. Based on NIST polynomials, linear output is produced over each thermocouple's stated operating range, and within the rated accuracy limits—*without the need for additional output processing*. See Table 1 for the “mV/degree” linear output produced by the AA14-4F010 for different TC types and ranges (°C or °F).

PLEASE NOTE: WHILE ALL FOUR CHANNELS OF A GIVEN AA14-4F010 CARD *MUST BE DEDICATED TO THE SAME TC TYPE*, INDIVIDUAL CARDS DEDICATED TO DIFFERENT TC TYPES MAY BE MIXED AS DESIRED WITHIN THE TOTAL DATA ACQUISITION SYSTEM. IT IS ALSO REQUIRED THAT THE AA14-4F010'S *CHANNEL NO. 1* BE USED.

This conditioner features **true galvanic isolation with pulse-width modulation**, allowing sensor-to-chassis or sensor-to-sensor common-mode voltages as high as 1500 V (rms) to be accommodated. Internal reference-junction compensation is automatically selected by thermocouple choice. No external cold junction is required (although the user may supply his own Controlled Ambient Temperature Zone for reference-junction purposes, if desired). A conventional Daytronic four-channel isothermal connector assembly (No. 60323, shown in Figs. 2 and 3) is supplied with each Model AA14-4F010, with screw terminals for direct connection of TC leads (which cannot be soldered), and with a **precision thermistor** for measurement of the reference-junction temperature. The same connector may be used with any TC type.

In the event of a broken thermocouple wire or other “open TC” condition, the AA14-4F010 will automatically report an indeterminate off-scale reading for the TC channel in question, with positive or negative polarity selectable on a per-channel basis (as explained in Section 3.a).

Each AA14-4F010 input channel employs an active low-pass filter with a fixed cutoff frequency of 10 Hz. A nominal ± 5 -V ANALOG OUTPUT is produced by each active AA14-4F010 input channel, for purposes of real-time signal monitoring. Each of these “Auxiliary Outputs” is available on a corresponding mainframe wire-wrap pin. Each output may be individually set, if desired, to represent the *prefiltered* value of the corresponding input (see Section 3.b).

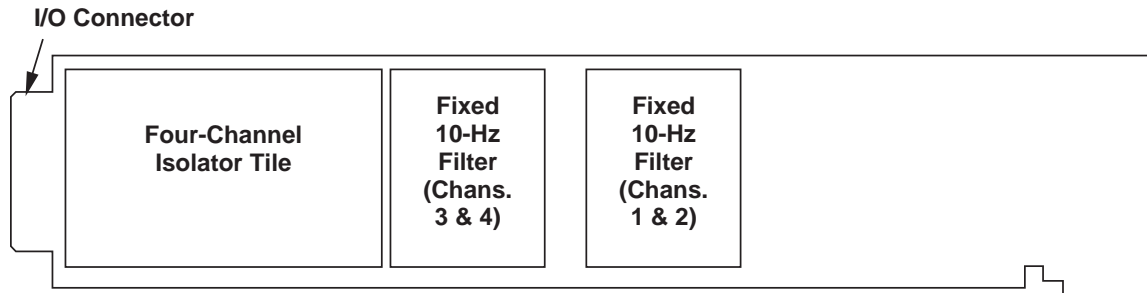
“Absolute” calibration lets you quickly set up each TC-based data channel simply by entering appropriate “type” and “range” information. During operation, appropriate reference-junction compensation, real-time digital linearization, and engineering-unit scaling are automatically applied for each type of thermocouple used. A second, two-point “zero and span” calibration technique is provided, however, for applications where it is desirable to force multiple TC readings to the same exactly known temperature.*

* In heat balance applications, for example, it is useful to be able to *zero* all readings simultaneously.

AA14-4F010 THERMOCOUPLE CARD

NOTE: Fig. 1 shows the stand-off circuit boards (or “tiles”) that provide the analog filtering and galvanic isolation for an AA14-4F010 card’s data channels. **FILTER TILES (ONLY) MAY BE INSTALLED OR REMOVED BY THE USER, IN THE FIELD. CONTACT THE DAYTRONIC SERVICE DEPARTMENT FOR COMPLETE INSTRUCTIONS.**

Fig. 1 Model AA14-4F010 Modular Card Components



ADDITIONAL AA14-4F010 SPECIFICATIONS

Number of Input Channels: Four

Thermocouple Types and Ranges: See Table 1; automatically selected—on an individual channel basis—when the channel is configured; for System 10 channel “type” codes assigned to AA14-4F010 data channels, see Table 3 (Section 3.c)

Amplifier (per channel):

Normal-Mode Range: ± 80 mV operating; ± 240 V without instrument damage

Common-Mode Range: 1200 V (rms) operating and without instrument damage

Common-Mode Rejection Ratio: DC and at 60 Hz: -130 dB

Input Impedance: Differential: 10 M Ω ; Common-Mode: 470 pF to earth

Offset: Initial: ± 10 μ V; vs. temperature: ± 0.2 μ V/ $^{\circ}$ C; vs. time: ± 0.5 μ V/month

Gain Accuracy: $\pm 0.05\%$ of full scale

Gain Stability: vs. temperature: ± 25 ppm/ $^{\circ}$ C; vs. time: ± 20 ppm/month

Filter (per channel): 3-pole modified Butterworth, 3 dB down at 10 Hz; 60 dB down at 195 Hz

Step-Response Settling Time (Full-Scale Output):

To 1% of final value: 70 msec

To 0.1% of final value: 85 msec

To 0.02% of final value: 95 msec

Auxiliary Outputs: Nominal ± 5 V-DC signals available on mainframe wire-wrap pins*; individually jumper-selectable to represent either the *filtered* or *prefiltered* value of the channel (see Section 3.b)

Power-Supply Slot Allotment: Maximum consumption of supply current from the Conditioner Card Slot is 95 mA

* The wire-wrap pins to which the AA14-4F010’s “Auxiliary Outputs” are brought are located on the respective analog motherboard within the system mainframe, and should not be confused with the DIAGNOSTIC WIRE-WRAP PINS near the front edge of the AA14-4F010 board (see Section 4).

Table 1 Thermocouple Ranges for the Model AA14-4F010

TC Type	Range	Typical Daytronic System Display Resolution*	Linear Output (mV/degree)**
E	-200° C to +1000° C	0.1° C	5.0000
E	-328° F to +1832° F	0.1° F	2.7778
J	-200° C to +1200° C	0.1° C	4.0000
J	-328° F to +2192° F	0.1° F	2.2222
K	-200° C to +1372° C	0.1° C	4.0000
K	-328° F to +2501.6° F	0.1° F	2.2222
N	-180° C to +1300° C	0.1° C	4.0000
N	-292° F to +2372° F	0.1° F	2.2222
R	-50° C to +1768° C	0.1° C	2.0000
R	-58° F to +3214.4° F	0.1° F	1.1111
S	-50° C to +1768° C	0.1° C	2.0000
S	-58° F to +3214.4° F	0.1° F	1.1111
T	-200° C to +400° C	0.1° C	5.0000
T	-328° F to +752° F	0.1° F	2.7778

2 TRANSDUCER CONNECTIONS

The Model AA14-4F010's I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60323, shown in Fig. 2. This connector contains four "±" screw-terminal pairs, one for each TC sensor. TC leads should be directly attached to the corresponding screw terminals (they should never be soldered). As shown in Fig. 3, each screw terminal connects internally to a specific pin on the AA14-4F010's rear 20-pin I/O CONNECTOR. Table 2 gives standard pin assignments for the I/O connector.

Since reference-junction compensation is provided by the dual-bead thermistor embedded in the Conditioner Connector, no external cold junction is required.

IMPORTANT: UNUSED THERMOCOUPLE INPUT CHANNELS should be shorted together as shown in Fig. 4, to prevent possible crosstalk from the "OPEN TC" detection circuit into working TC channels.

Table 2 Model AA14-4F010 Pin Assignments

I/O Connector Pin Number	Screw Terminal	Conditioner Channel Number	Conditioner Line Function
1	1(+)	1	+SIGNAL
A	1(-)	1	-SIGNAL
2			Not Committed
B			Not Committed
3	3(+)	2	+SIGNAL
C	3(-)	2	-SIGNAL
4			Not Committed
D			Not Committed

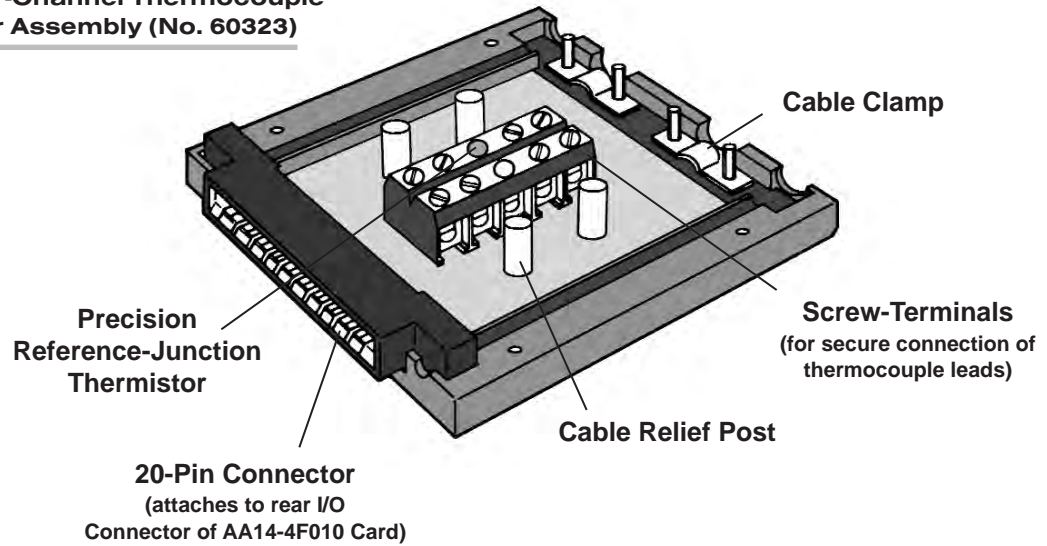
(cont'd)

* For certain restricted ranges, a resolution of 0.01° C or F may be achieved. See Table 3, Section 3.c.

** See "Auxiliary Outputs," above.

AA14-4F010 THERMOCOUPLE CARD

Fig. 2 Four-Channel Thermocouple Connector Assembly (No. 60323)



I/O Connector Pin Number	Screw Terminal	Conditioner Channel Number	Conditioner Line Function
5	5(+)	3	+SIGNAL
E	5(-)	3	-SIGNAL
6			Not Committed
F			Not Committed
7	7(+)	4	+SIGNAL
H	7(-)	4	-SIGNAL
8			Not Committed
J			Not Committed
9	INTERNAL		THERMISTOR: T1
K,L	USE		THERMISTOR: GROUND (COMMON)
10	ONLY		THERMISTOR: T2

3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a SELECTION OF "OPEN TC" POLARITY

In the event of a broken thermocouple wire or other "open TC" condition, the Model AA14-4F010 will automatically report an indeterminate off-scale reading for the TC channel in question. The conditioner is normally preset at the factory for *positive* off-scale "open TC" indication for each channel. However, you may easily reset any channel for *negative* off-scale "open TC" indication, as follows:

1. Remove the AA14-4F010 card from its mainframe slot. For "Card Insertion and Removal," see Manual Section 1.B. Since the AA14-4F010 is "hot-pluggable," you need NOT turn off mainframe power before removing the card.
2. Refer to Fig. 5, below, and locate the OPEN TC POLARITY PROGRAMMING JUMPER PINS on the top side of the Isolator Tile. One "minijumper" is provided for each channel's set of three jumper pins.

THERMOCOUPLE CARD AA14-4F010

Fig. 3 Model AA14-4F010 Transducer Cabling

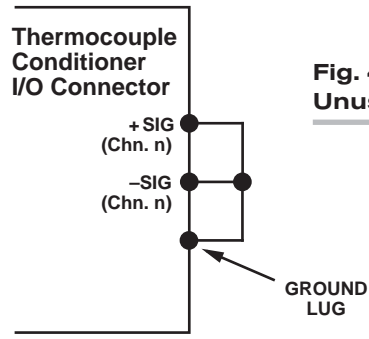
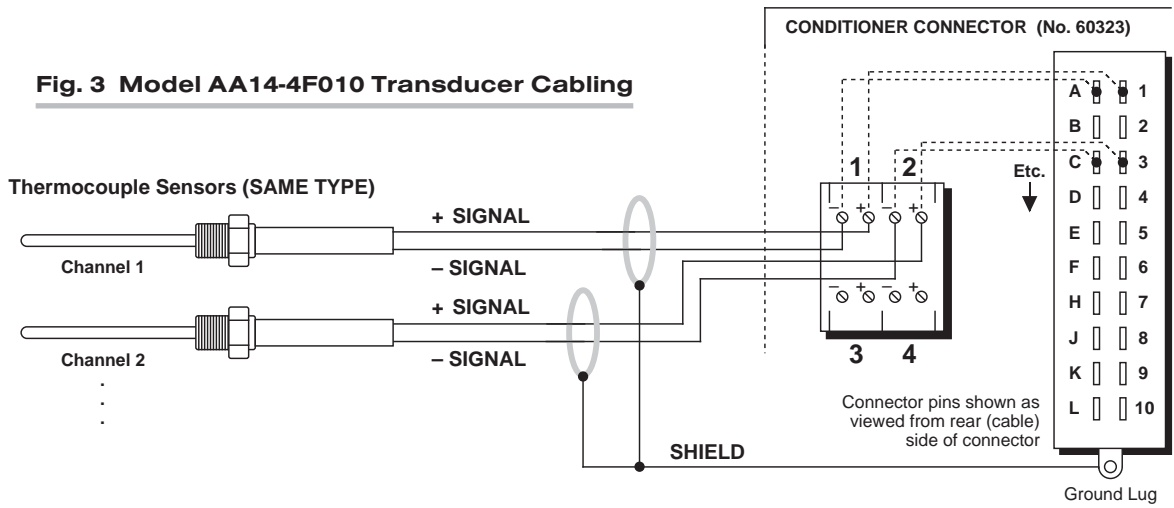
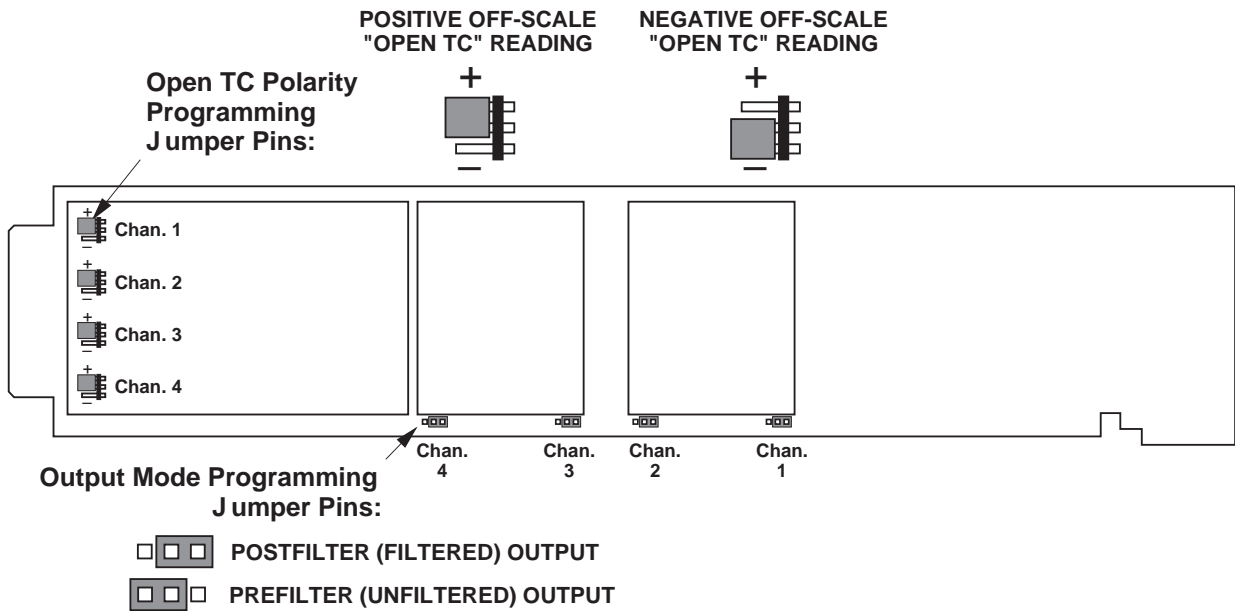


Fig. 4 Jumpering of an Unused AA14-4F010 Input

Fig. 5 Model AA14-4F010 Programming Jumper Pins



AA14-4F010 THERMOCOUPLE CARD

3. Position the jumper for each channel as shown in Fig. 5 to interconnect the pair of pins corresponding to the desired “open TC” polarity for that channel. You will need to use a small pair of needle-nosed pliers to move the jumper.
4. Reinsert the AA14-4F010 card in its mainframe slot.

3.b SELECTION OF ANALOG OUTPUT MODES

As mentioned in Section 1, each AA14-4F010 channel's ± 5 -V ANALOG OUTPUT can be set to represent either the *filtered* or *prefiltered* reading of that channel. To set the output mode for each of your AA14-4F010's active input channels,* you should

1. Remove the AA14-4F010 card from its slot (see Section 3.a, Step 1, above).
2. Refer to Fig. 5 and locate the OUTPUT MODE PROGRAMMING JUMPER PINS beneath the AA14-4F010's Filter Tile(s). One “minijumper” is provided for each channel's set of three jumper pins.
3. Position the jumper for each channel as shown in Fig. 5 to interconnect the pair of pins that corresponds to the desired output mode for that channel. You will need to use a small pair of needle-nosed pliers to move the jumper.
4. Reinsert the AA14-4F010 card in its mainframe slot.

3.c CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model AA14-4F010 card, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For AA14-4F010 channel “type” codes, see Table 3, below.

In System 10, the initial configuration and **ABSOLUTE CALIBRATION** of an AA14-4F010 channel (No. “x”) involve direct entry of the channel's TYPE CODE, SCALING FACTOR (“m” coefficient), and ZERO OFFSET (“b” term) via the corresponding mnemonic commands. The values of these parameters that are entered will depend on the TC type and the desired engineering units ($^{\circ}\text{C}$ or $^{\circ}\text{F}$), as given in Table 3, below. You may also perform a subsequent **TWO-POINT (DEADWEIGHT)** calibration of an AA14-4F010 channel in System 10, as explained below.

ABSOLUTE CALIBRATION

In the following procedure, Channel No. “x” is a System 10 “REAL CHANNEL” sourced by an AA14-4F010 card. Note that, with the exception of the **LOCATE (LCT)** command (Step 2), each of the commands can be applied to a continuous range of channels by entering the command in “range” form, where the single channel-number argument “x” is replaced by “x TO y” (indicating all channels from Channel No. x to and including Channel No. y).

1. Turn ON the system EEPROM SWITCH.
2. Make sure that Channel No. x has been assigned the proper A-SLOT / SUB-CHANNEL “location.” See Manual Section 1.G.1 for details on the **LOCATE (LCT)** command.

* The output mode setting for an UNUSED channel is immaterial, and will not affect operation of the AA14-4F010.

3. Apply a **RESET (RST)** command to Channel No. x:

RST x [CR]

The channel will be retyped as “55” (i.e., a direct millivolt reading from the system’s internal Called Signal Bus). Its SCALING FACTOR (“m”) will be changed to “5000” and its ZERO OFFSET (“b”) to “0.” Its current “location” (**LCT**) assignment will not be affected.

4. Apply the following commands to Channel No. x, using the values of “v,” “m,” and “b” given in Table 3 for the channel’s specific TC type and range:

TYP x = v [CR]

EMM x = m [CR]

BEE x = b [CR]

Be sure to enter the “m” value as shown (with a “0” or “00” after the decimal point), if you want your final measurement to be in tenths or hundredths of a degree, respectively.

Table 3 Calibration Values for an AA14-4F010 Channel

TC Type	Range & Resolution	Type Code (“v”)	Scaling Factor (“m”)	Zero Offset (“b”)
E	-200.0° C to +1000.0° C	41	1000.0	0.0*
E	-200.00° C to +250.00° C	67	250.00	0.00*
E	-328.0° F to +1832.0° F	41	1800.0	32.0
J	-200.0° C to +1200.0° C	42	1250.0	0.0*
J	-200.00° C to +250.00° C	64	312.50	0.00*
J	-328.0° F to +2192.0° F	42	2250.0	32.0
K	-200.0° C to +1372.0° C	43	1250.0	0.0*
K	-200.00° C to +250.00° C	61	312.50	0.00*
K	-328.0° F to +2501.6° F	43	2250.0	32.0
N	-180.0° C to +1300.0° C	44	1250.0	0.0*
N	-292.0° F to +2372.0° F	44	2250.0	32.0
R	-50.0° C to +1768.0° C	45	2500.0	0.0*
R	-58.0° F to +3214.4° F	45	2250.0	32.0
S	-50.0° C to +1768.0° C	46	2500.0	0.0*
S	-58.0° F to +3214.4° F	46	2250.0	32.0
T	-200.0° C to +400.0° C	47	1000.0	0.0*
T	-328.0° F to +752.0° F	47	1800.0	32.0

5. Use the **FILTER (FIL)** command to apply to Channel No. x a level of digital smoothing that is appropriate to your application:

FIL x = f [CR]

The integer “f” should be 1, 2, or 3 for a TC range with *tenth-of-a-degree* resolution, and a number from 4 through 9 for a range with *hundredth-of-a-degree* resolution (see Manual Section 2.G for a complete explanation of the **FIL** command).

6. Turn OFF the system EEPROM SWITCH.

* For a measurement reading in *degrees Kelvin* (°K), enter a “b” value of “273.2” (or “273.20”), instead of “0.0” (or “0.00”).

TWO-POINT (DEADWEIGHT) CALIBRATION

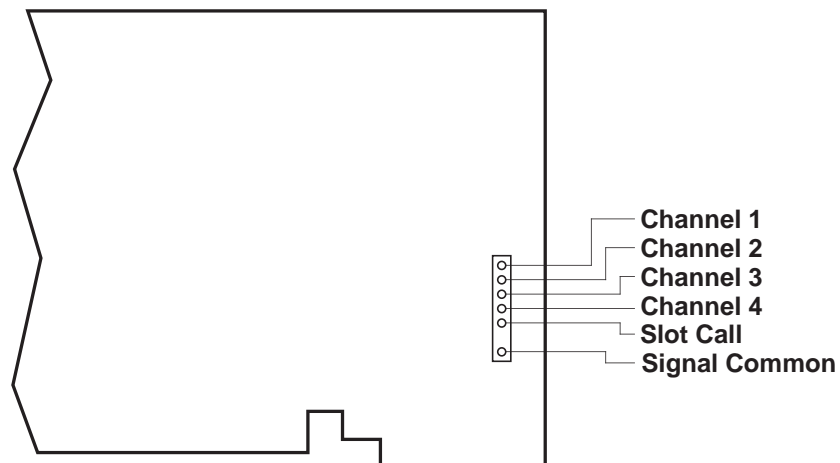
Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional “zero and span” method can be easily applied to an AA14-4F010 channel on a real-time basis, to improve the ABSOLUTE calibration of an input *when independently and accurately known temperature references are available* (preferably the high and low extremes to which the sensor will be subjected). The mainframe’s **EEPROM Write Protect Switch** must be ON for these commands to be effective. See Manual Section 1.G.5 for a general discussion of this conventional “zero and span” calibration technique.

4 DIAGNOSTIC WIRE-WRAP PINS

As a special diagnostic and service tool, the five pins shown in Fig. 6 are directly accessible from the front of an installed AA14-4F010 card. These pins allow voltmeter or oscilloscope observation of data-channel output signals. **THEIR USE IS INTENDED PRIMARILY FOR TRAINED SERVICE TECHNICIANS.** With regard to the on-board diagnostic pins, please note the following:

- PROPER ESD PRACTICE SHOULD BE OBSERVED WHEN MAKING CONTACT WITH AN AA14-4F010 BOARD INSTALLED IN A “LIVE” DAYTRONIC SYSTEM MAINFRAME. ALWAYS GROUND YOURSELF TO THE MAINFRAME CHASSIS BEFORE TOUCHING THE BOARD.
- THE ANALOG SIGNAL PRESENT AT EACH ACTIVE “CHANNEL” PIN REPRESENTS *EIGHT TENTHS (0.8)* OF THAT CHANNEL’S NOMINAL CALL-BUS VOLTAGE. For a channel delivering a standard full-scale (+5-V) output, the corresponding diagnostic pin will therefore register +4 V.
- THE ANALOG SIGNAL PRESENT AT EACH ACTIVE “CHANNEL” PIN REPRESENTS THE FILTERED CHANNEL OUTPUT, AND IS NOT AFFECTED BY THE ANALOG OUTPUT MODE CURRENTLY SELECTED FOR THAT CHANNEL (see Section 3.b).
- THE “SLOT CALL” PIN DELIVERS A LOGIC SIGNAL THAT MAY BE USED TO SYNCHRONIZE AN OSCILLOSCOPE FOR TIMING ANALYSIS OF THE AA14-4F010 CARD.

Fig. 6 Diagnostic Wire-Wrap Pins



MODEL AA30-4

LVDT CONDITIONER CARD

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The AA30-4 is a four-channel conditioner for measurement of displacement, force, pressure, and other parameters obtained with a **linear variable differential transformer (LVDT)** or **variable reluctance transducer**.

Based on the *synchronous carrier-demodulator* principle, the AA30-4 supplies regulated, remotely sensed AC excitation for each active transducer channel—thus allowing direct measurement of *thickness* (when two separate inputs are summed) or of *taper* (when their difference is calculated). It then demodulates, filters, and amplifies the resulting signals to produce system outputs precisely proportional to LVDT core displacement. The AA30-4 automatically adjusts to the signal phase shift of the transducer in use, thereby insuring optimum sensitivity and linearity.

Unlike the Model 10A30-2C or 10A31-4, the Model AA30-4 does *not* require special cabling to accommodate “long-stroke” LVDT’s (full-scale range of ± 1 inch or greater). Also, the AA30-4’s enhanced linearity correction lets it accommodate a wider range of displacement transducers.

Like most Daytronic “Advanced Analog” (“AA”) cards, the AA30-4 features optional PROGRAMMABLE LOW-PASS ACTIVE FILTERING for the removal of unwanted high-frequency measurement-signal components. Selectable analog filtering is offered for the AA30-4 from 0.2 through 200 Hz in 16 steps—or, if desired, a *fixed* filter of either 10 or 50 Hz for all channels may be specified at the time of order. When the AA30-4 is used in System 10, its filter cutoff values are set by means of an on-board 16-position switch for each channel.

A nominal ± 5 -V ANALOG OUTPUT is produced by each active AA30-4 input channel, for purposes of real-time signal monitoring. Each of these “Auxiliary Outputs” is available on a corresponding mainframe wire-wrap pin. Each output may be individually set, if desired, to represent the *prefiltered* value of the corresponding input.*

Separate excitation for each channel uses remote sensing of excitation voltage and is slaved to a common System Reference Voltage. The result is consistently stable ratio-metric measurement, unaffected by possible power-supply drift. A “Slave Excitation” input is available if the user wishes to provide an external excitation voltage and frequency instead of the AA30-4’s internal supply.**

* In the case of the Model AA30-4, an active 300-Hz filter is applied to each input channel as part of the standard signal demodulation process, prior to delivery of the signal either to an installed filter tile or to a wire-wrap pin. See “Specifications” for response characteristics of the “prefiltered” AA30-4 output.

** The external excitation input must be 2 to 3.5 V-AC (rms) and 2 to 6 kHz, referenced to “center wire” (Signal Common). See Section 3.a for details.

AA30-4 QUAD LVDT CARD

The AA30-4 is manufactured using the latest surface-mount technology, resulting in the highest immunity to shock and vibration. As explained in Section 2, I/O connections are via secure, clearly labelled screw terminals in a special AA30-4 CONNECTOR ASSEMBLY.

Fig. 1 Model AA30-4 Modular Card Components

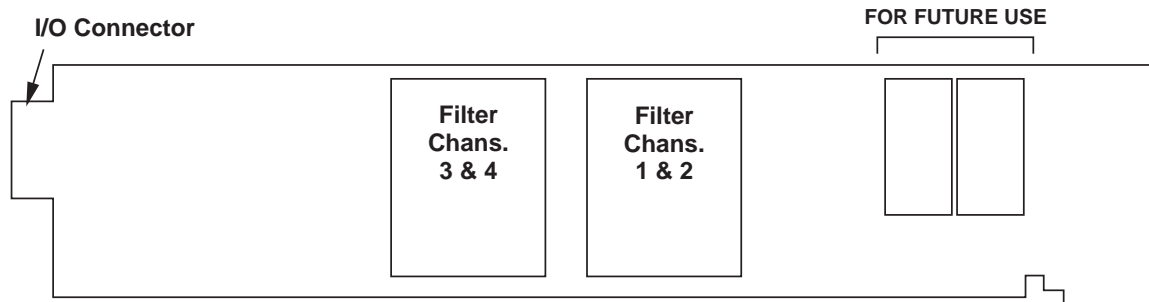


Fig. 1 shows the stand-off circuit boards (or “tiles”) that provide the analog filtering for an AA30-4 card’s data channels. **FILTER TILES (ONLY) MAY BE INSTALLED OR REMOVED BY THE USER, IN THE FIELD. CONTACT THE DAYTRONIC SERVICE DEPARTMENT FOR COMPLETE INSTRUCTIONS.**

THE FOLLOWING **AA30-4** VERSIONS ARE CURRENTLY AVAILABLE:

- Model **AA30-4F010**—Four input channels, with FIXED 10-Hz FILTERING for each
- Model **AA30-4F050**—Four input channels, with FIXED 50-Hz FILTERING for each
- Model **AA30-4F1**—Four input channels, with “F1” PROGRAMMABLE FILTERING for each*

ADDITIONAL AA30-4 SPECIFICATIONS

Transducer Types: 5- or 7-wire LVDT's capable of 3280-Hz operation and having primary impedance of 80 Ω or greater (all Daytronic LVDT transducers are suitable); 3- or 5-wire variable reluctance transducers

Input Ranges (rms, full-scale): Automatically selected—on an individual channel basis—when the channel is configured; for System 10 channel “type” codes assigned to AA30-4 data channels, see Table 1, below

Standard: 70, 140, 280, or 410 mV/V

Long-Stroke: 820 mV/V or 1.64 V/V

On-Board Excitation (per channel): Nominal 3 V-AC (rms) at 3280 Hz; 37.5 mA (rms), maximum, for each voltage, subject to 120 mA total current draw for all 4 channels

Amplifier (per channel):

Normal-Mode Range: ± 6 V operating; ± 12 V without instrument damage

Common-Mode Range: ± 5 V operating; ± 12 V without instrument damage

Common-Mode Rejection Ratio: DC: infinite; at 60 Hz: -120 dB; at 3 kHz: -60 dB

Input Impedance: Differential: 200 k Ω ; Common-Mode: 125 k Ω

Offset: Initial: $\pm 1\%$ of full scale; vs. temperature: ± 0.20 ppm/ $^{\circ}$ C; vs. time: $\pm 0.01\%$ of full scale/month

Gain Accuracy: $\pm 0.02\%$ of full scale, following calibration

* “F1” is currently the only programmable filter tile that applies to the Model AA30-4.

Gain Stability: vs. temperature: ± 50 ppm/ $^{\circ}\text{C}$; vs. time: ± 20 ppm/month

Filter (per channel): 3-pole modified Butterworth

“F1” Programmable Filtering (all four channels): Switch- or software-selectable to one of 16 different cutoff frequencies: 0.2; 0.4; 0.8; 1.0; 1.6; 2.0; 4.0; 5.0; 8.0; 10; 20; 25; 40; 50; 100; or 200 Hz (see Table 2)

Fixed Filtering (all four channels): 10 or 50 Hz (see Table 3)

Auxiliary Outputs: Nominal ± 5 V-DC signals available on mainframe wire-wrap pins*; individually jumper-selectable to represent either the *filtered* or *prefiltered* reading of the channel; “prefiltered” outputs have the following response characteristics: -3 dB at 300 Hz; -60 dB at 4.4 kHz; Step-Response Settling Time (Full-Scale Output): To 1% of final value: 2 msec; to 0.1% of final value: 2.5 msec; to 0.02% of final value: 3 msec.

Power-Supply Slot Allotment: Maximum consumption of supply current from the Conditioner Card Slot is 165 mA

Table 1 AA30-4 “Type” Codes

Full-Scale Input (RMS)	Channel Type Code
70 mV/V	5A
140 mV/V	5B
280 mV/V	5C
410 mV/V	5D
820 mV/V	5E
1.64 V/V	5F

Table 2 “F1” Programmable Filter Characteristics for “AA” Cards

Selected Frequency (Hz)	Bandwidth		Step-Response Settling Time		
	Response at -3 dB (Hz)	Response at -60 dB (Hz)	to 1% of final value (msec)	to 0.1% of final value (msec)	to 0.02% of final value (msec)
0.2	0.2	3.9	3500	4250	4750
0.4	0.4	7.8	1750	2125	2375
0.8	0.8	16	875	1063	1188
1.0	1.0	20	700	850	950
1.6	1.6	31	438	531	594
2.0	2.0	39	350	425	475
4.0	4.0	78	175	213	238
5.0	5.0	98	140	170	190
8.0	8.0	156	88	106	119
10.0	10.0	195	70	85	95
20.0	20.0	390	35	43	48
25.0	25.0	488	28	34	38
40.0	40.0	780	18	21	24
50.0	50.0	975	14	17	19
100.0	100.0	1950	7.0	8.5	9.5
200.0	200.0	3900	3.5	4.3	4.8

* The wire-wrap pins to which the AA30-4’s “Auxiliary Outputs” are brought are located on the respective analog motherboard within the system mainframe, and should not be confused with the DIAGNOSTIC WIRE-WRAP PINS near the front edge of the AA30-4 board (see Section 4).

Table 3 Fixed Filter Characteristics for "AA" Cards

Filter Designation	Bandwidth		Step-Response Settling Time		
	Response at -3 dB (Hz)	Response at -60 dB (Hz)	to 1% of final value (msec)	to 0.1% of final value (msec)	to 0.02% of final value (msec)
"F010"	10	195	70	85	95
"F050"	50	975	14	17	19

2 CONNECTIONS

2.a TRANSDUCER CONNECTIONS

The Model AA30-4's rear I/O CONNECTOR mates with the special AA30 CONDITIONER CONNECTOR, via the cable connections shown in Fig. 4. Mounted on the internal board of the connector assembly (shown in Fig. 2) is a block of nine clearly labelled screw terminals for each of the AA30-4's four input channels.

To access the connector board, simply remove the screws that hold together both halves of the connector housing. Use the two internal clamp bars to secure transducer cables once all leads have been connected.

The connector assembly's mounting screws are designed to secure the connector to the rear of the system mainframe and to provide a solid GROUND CONNECTION for cable "shields" via the two L-shaped ground lugs. An offset in the mounting holes ensures that the connector cannot be attached upside down.

With regard to AA30-4 cabling, please note the following:

- a. 5-wire LVDT cabling (Fig. 4(a)) or 3-wire variable reluctance transducer cabling (Fig. 4(c)) is to be used when the cable is under 20 feet in length. In this case, the +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines *at the CONDITIONER CONNECTOR*.

7-wire LVDT cabling (Fig. 4(b)) or 5-wire variable reluctance transducer cabling (Fig. 4(d)) is to be used when the cable is 20 feet or longer. In this case, the +SENSE and -SENSE lines are tied to the corresponding EXCITATION lines *at the transducer*.
- b. For each LVDT transducer connected to the AA30-4, you may *either*
 - connect the "center wire" that joins both series-opposed secondary coils to the conditioner connector's **CENTER WIRE** Terminal, as shown in Figs. 4(a) and 4(b); *or, alternatively (to simplify the overall cabling),*
 - connect the transducer center wire to the CABLE SHIELD *at the transducer end*, instead of bringing this line through a cable shield to the conditioner connector's CENTER WIRE Terminal.
- c. Unlike the Models 10A30-2C and 10A31-4, the Model AA30-4 does not require special connections for input of "long-stroke" LVDT signals (full-scale range of ± 1 inch or greater).
- d. When wiring a variable reluctance transducer to the AA30-4, you must install a 10-kilohm "half-bridge completion" resistor between the -SIGNAL Terminal and *each* of the two EXCITATION lines, as shown in Figs. 4(c) and 4(d).

IMPORTANT: The \pm EXCITATION, \pm SENSE, \pm SIGNAL, and CENTER WIRE terminals for an UNUSED LVDT INPUT CHANNEL should be jumpered as shown in Fig. 3, below. If an input is left open, high-frequency oscillation can result, which can in turn produce significant interchannel crosstalk, and possibly inaccurate data readings.

Fig. 2 Model AA30-4 Connector Assembly Board

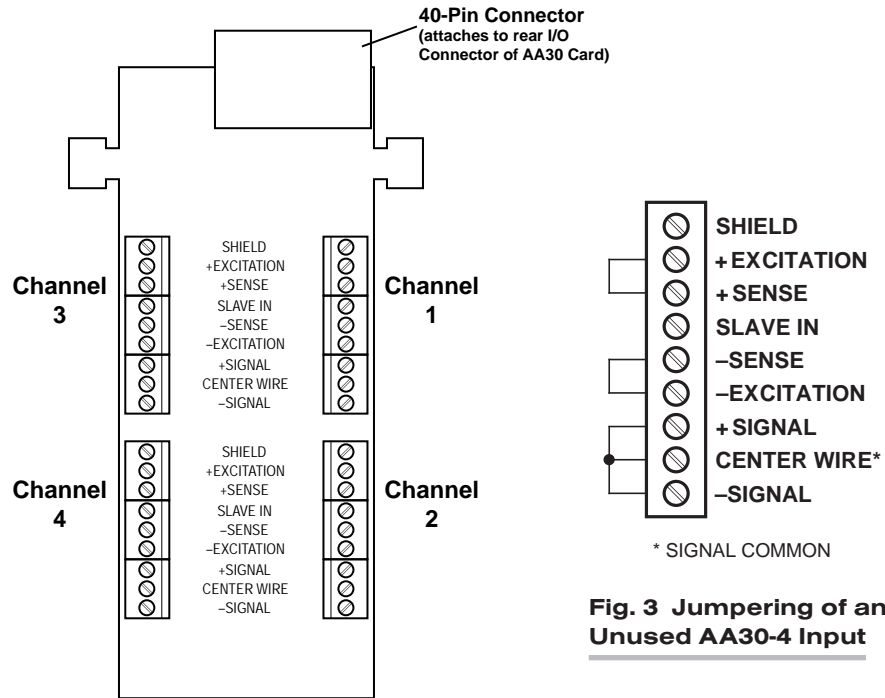


Fig. 3 Jumpering of an Unused AA30-4 Input

Fig. 4 Model AA30-4 Transducer Cabling

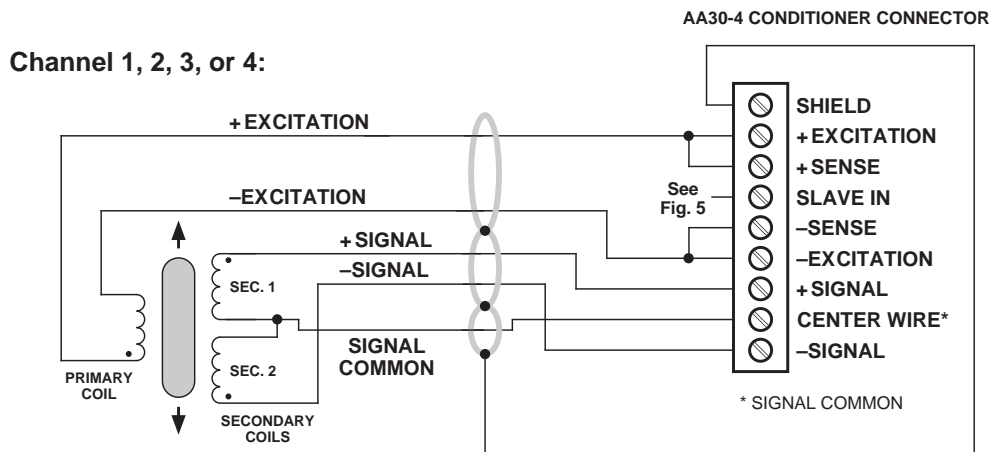


Fig. 4(a) 5-Wire LVDT Cabling (under 20 ft. in length)

AA30-4 QUAD LVDT CARD

Channel 1, 2, 3, or 4:

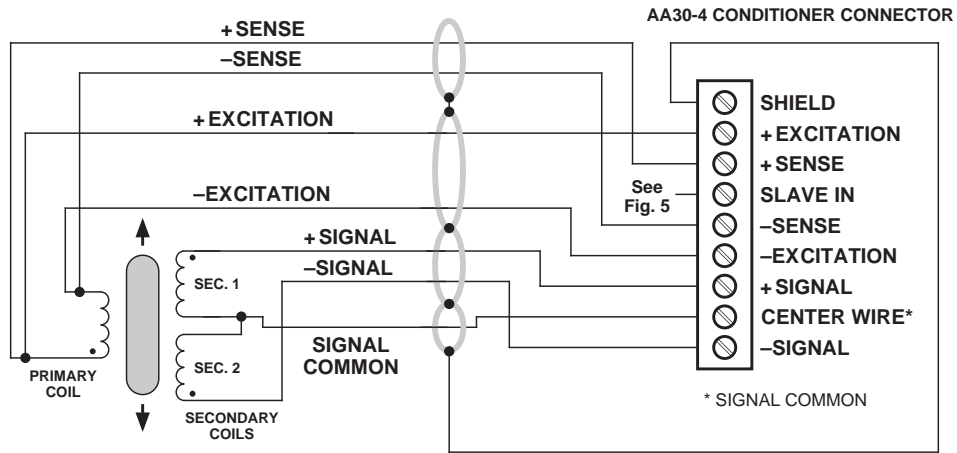


Fig. 4(b) 7-Wire LVDT Cabling (20 ft. or longer)

Channel 1, 2, 3, or 4:

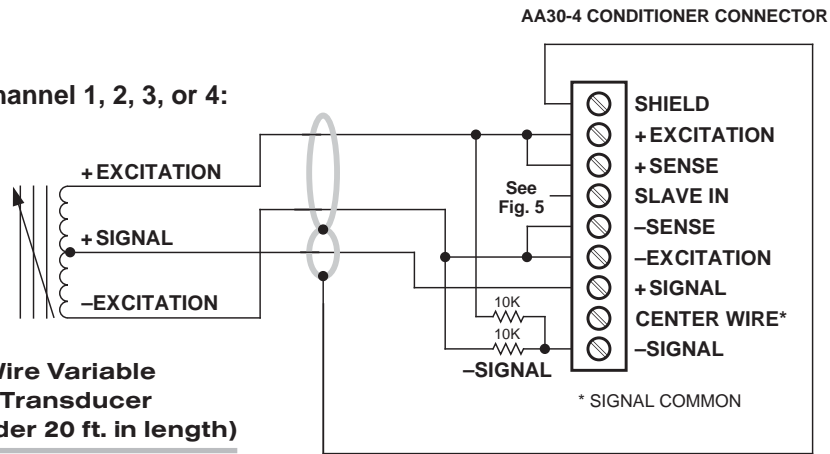


Fig. 4(c) 3-Wire Variable Reluctance Transducer Cabling (under 20 ft. in length)

Channel 1, 2, 3, or 4:

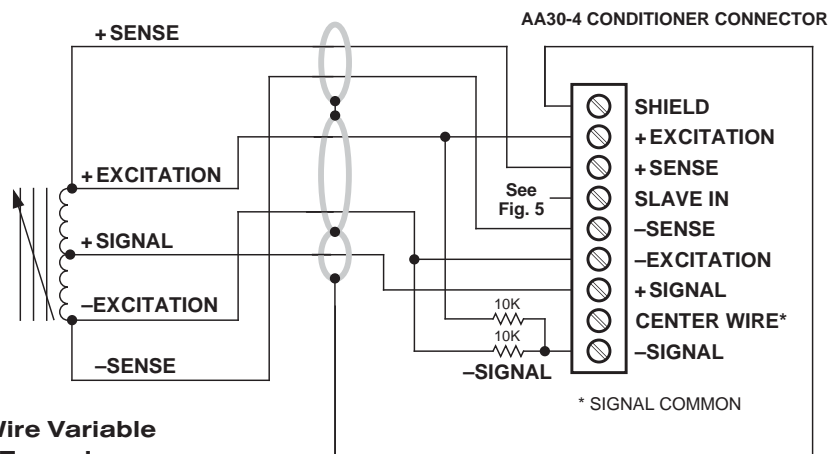


Fig. 4(d) 5-Wire Variable Reluctance Transducer Cabling (20 ft. or longer)

2.b CONNECTION OF EXTERNAL EXCITATION SOURCE

An external excitation supply furnished by the user can be optionally applied to each active AA30-4 channel, in place of the card's on-board 3280-Hz, 3-VAC (rms) reference. *The external excitation must be 2 to 6 kHz, 2 to 3.5 V-AC (rms sine wave), referenced to "center wire" (Signal Common).*

As shown in Fig. 5, below, the excitation source's positive lead will connect directly to the "SLAVE IN" terminal of each channel to which it is applied, with the negative lead connecting directly to the "CENTER WIRE" terminal. It is strongly recommended that *all AA30-4 channels be "slaved" to the same sine-wave signal source*, in order to prevent harmonic "beating" with another frequency.

As explained in Section 3.a, an appropriate jumper setting must be made for each channel that is being "slaved" to an external excitation source.

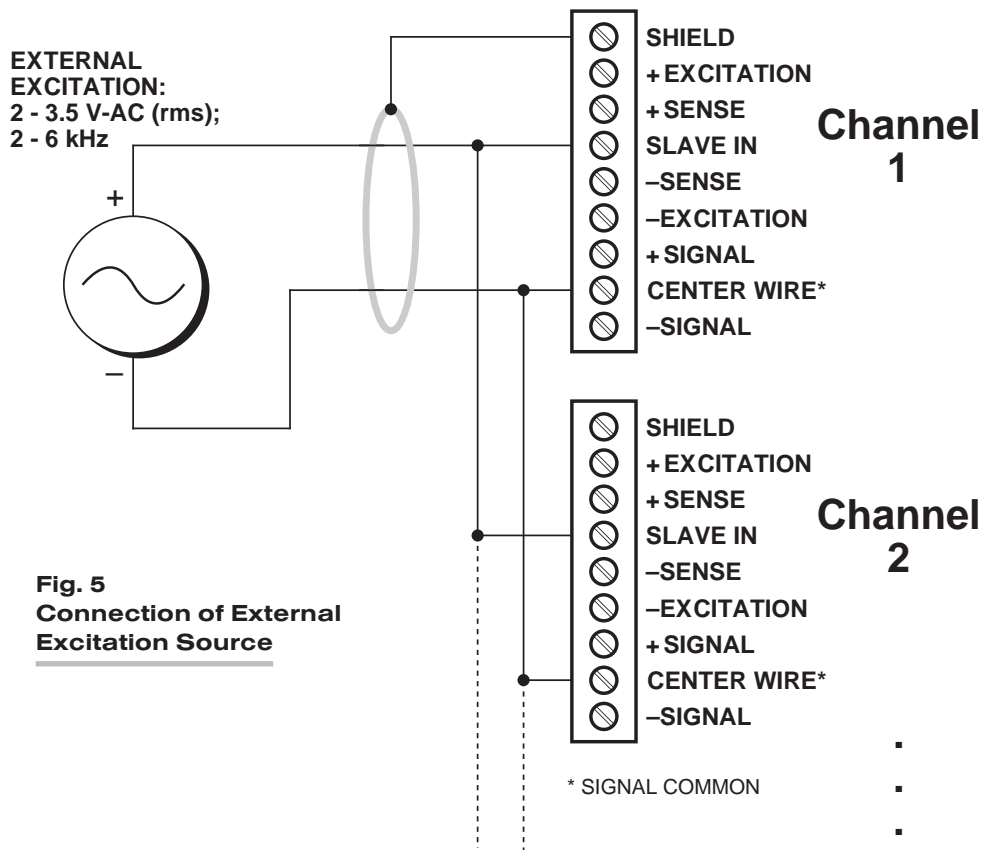


Fig. 5
Connection of External
Excitation Source

3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a SELECTION OF EXCITATION SOURCE

To enable the "SLAVE" input of a specific AA30-4 channel in order to apply an external AC excitation source to that channel, you should

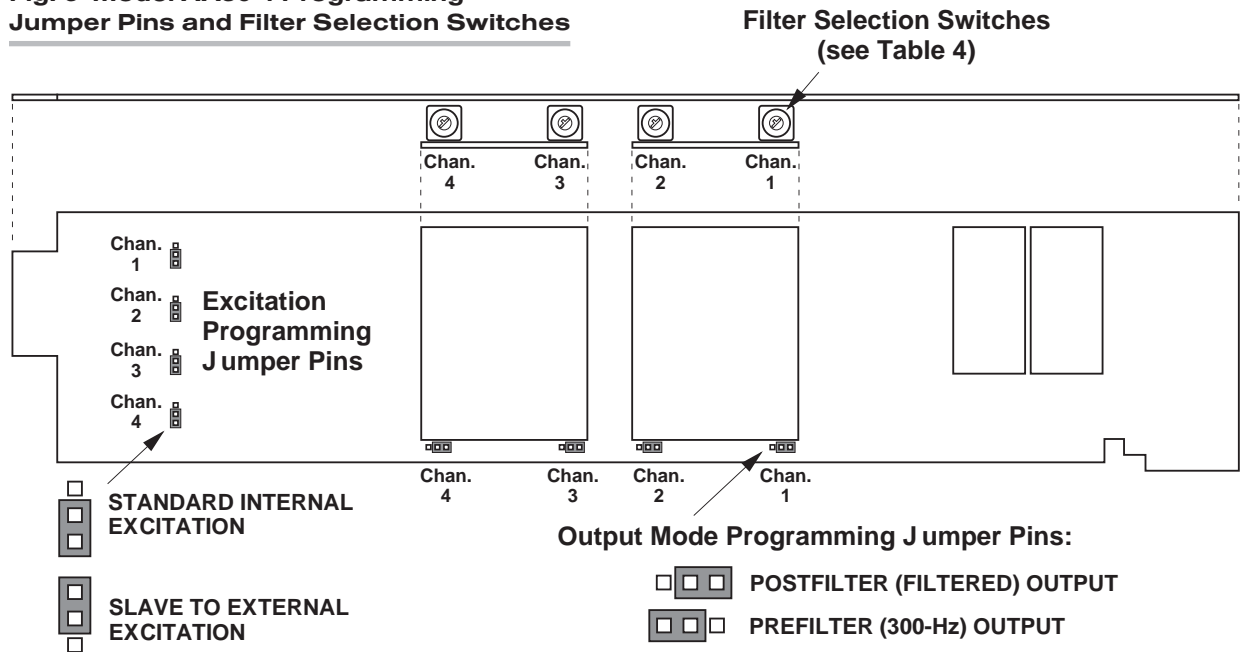
1. Remove the AA30-4 card from its mainframe slot. For "Card Insertion and Removal," see Manual Section 1.B. Since the AA30-4 is "hot-pluggable," you need NOT turn off mainframe power before removing the card.
2. Refer to Fig. 6, below, and locate the EXCITATION PROGRAMMING JUMPER PINS. One "minijumper" is provided for each channel's set of three jumper pins.
3. Position the jumper for each channel as shown in Fig. 6 to interconnect the pair of pins corresponding to the desired excitation source for that channel. You will need to use a small pair of needle-nosed pliers to move the jumper.
4. Reinsert the AA30-4 card in its mainframe slot.

3.b SELECTION OF ANALOG FILTERING

NOTE: If your AA30-4 card is equipped with FIXED ANALOG FILTERING, you may ignore this manual section.

When using an AA30-4 with PROGRAMMABLE ANALOG FILTERING in System 10, you may set an individual corner frequency for the analog filter of each active input channel,* as follows:

Fig. 6 Model AA30-4 Programming Jumper Pins and Filter Selection Switches



* The analog filter setting for an UNUSED channel is immaterial, and will not affect operation of the AA30-4.

- a. Remove the AA30-4 card from its slot (see Section 3.a, Step 1, above).
- b. Refer to Fig. 6 and locate the 16-position FILTER SELECTION SWITCHES located between the main card and the Filter Tiles.
- c. Referring to Table 4, below, set each channel's switch for the desired frequency. You will need to use a small screwdriver (or equivalent tool) to set the switch to the appropriate number/letter.
- d. Reinsert the AA30-4 card.

NOTE: In addition to the normal-mode analog filtering supplied by the AA30-4 card, System 10 can provide additional processor-controlled DIGITAL SMOOTHING on a per-channel basis. For each individual channel, you may indicate the desired amount of digital smoothing by applying a **FILTER (FIL)** command to that channel (see Manual Section 2.G.2).

Table 4 Model AA30-4 Filter Switch Settings

Cutoff Frequency	Switch Setting
0.2 Hz	7
0.4 Hz	6
0.8 Hz	5
1.0 Hz	3
1.6 Hz	4
2.0 Hz	2
4.0 Hz	1
5.0 Hz	F
8.0 Hz	0
10 Hz	E
20 Hz	D
25 Hz	B
40 Hz	C
50 Hz	A
100 Hz	9
200 Hz	8

3.C SELECTION OF ANALOG OUTPUT MODES

As mentioned in Section 1, each AA30-4 channel's ± 5 -V ANALOG OUTPUT can be set to represent either the *filtered* or *prefiltered* reading of that channel. To set the output mode for each of your AA30-4's active input channels,* you should

1. Remove the AA30-4 card from its slot (see Section 3.a, Step 1, above).
2. Refer to Fig. 6 and locate the OUTPUT MODE PROGRAMMING JUMPER PINS beneath the AA30-4's Filter Tiles. One "minijumper" is provided for each channel's set of three jumper pins.
3. Position the jumper for each channel as shown in Fig. 6 to interconnect the pair of pins that corresponds to the desired output mode for that channel. You will need to use a small pair of needle-nosed pliers to move the jumper.
4. Reinsert the AA30-4 card in its mainframe slot.

* The output mode setting for an UNUSED channel is immaterial, and will not affect operation of the AA30-4.

3.d CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model AA30-4 card when used in System 10, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For AA30-4 channel “type” codes, see Table 1, above.

In System 10, a relatively linear Model AA30-4 channel normally employs **TWO-POINT (DEADWEIGHT) CALIBRATION**.^{*} See Manual Section 1.G.5 for a general discussion of this conventional “zero and span” calibration technique. Note, however, the following special procedure that applies to an LVDT-based Channel No. “x”:

1. Make sure the channel has been properly “typed” and “located” (see Manual Section 1.G.2).

2. Turn ON the system EEPROM SWITCH and enter a command of

BEE x = 0 [CR]

This command sets an initial ZERO OFFSET (“b” term) of zero for Channel No. x.

3. Observing a “live” reading of the channel, mechanically adjust the fixture and physical position of the LVDT until the *lowest reading* occurs. This is the LVDT’s “electrical null” point.
4. With the transducer still in “null” position, enter a command of

ZRO x [CR]

5. Displace the LVDT probe by a precisely known distance, preferably between 80% and 100% of the transducer’s nominal full-scale rating.
6. Command

FRC x = z [CR]

where “z” is the exact value of the displacement produced in Step 5, expressed in appropriate engineering units (the precision of the final measurement will match that of the entered “z” value).

7. Repeat Steps 4, 5, and 6, if necessary, until the LVDT’s zero and span points coincide with the calibration block or micrometer reference being used.

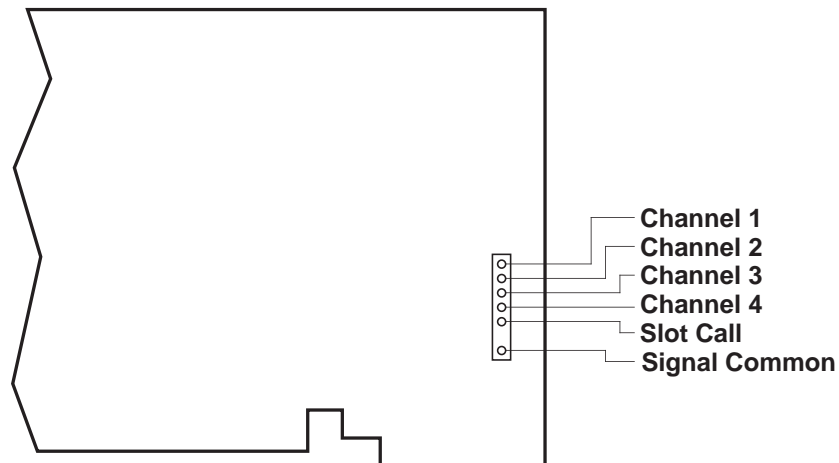
^{*} For nonlinear channels, “custom linearization” can be used (see Manual Section 2.L).

4 DIAGNOSTIC WIRE-WRAP PINS

As a special diagnostic and service tool, the five pins shown in Fig. 7 are directly accessible from the front of an installed AA30-4 card. These pins allow voltmeter or oscilloscope observation of data-channel output signals. **THEIR USE IS INTENDED PRIMARILY FOR TRAINED SERVICE TECHNICIANS.** With regard to the on-board diagnostic pins, please note the following:

- PROPER ESD PRACTICE SHOULD BE OBSERVED WHEN MAKING CONTACT WITH AN AA30-4 BOARD INSTALLED IN A “LIVE” DAYTRONIC SYSTEM MAIN-FRAME. ALWAYS GROUND YOURSELF TO THE MAINFRAME CHASSIS BEFORE TOUCHING THE BOARD.
- THE ANALOG SIGNAL PRESENT AT EACH ACTIVE “CHANNEL” PIN REPRESENTS *EIGHT TENTHS (0.8)* OF THAT CHANNEL’S NOMINAL CALL-BUS VOLTAGE. For a channel delivering a standard full-scale (+5-V) output, the corresponding diagnostic pin will therefore register +4 V.
- THE ANALOG SIGNAL PRESENT AT EACH ACTIVE “CHANNEL” PIN REPRESENTS THE FILTERED CHANNEL OUTPUT, AND IS NOT AFFECTED BY THE ANALOG OUTPUT MODE CURRENTLY SELECTED FOR THAT CHANNEL (see Section 3.c).
- THE “SLOT CALL” PIN DELIVERS A LOGIC SIGNAL THAT MAY BE USED TO SYNCHRONIZE AN OSCILLOSCOPE FOR TIMING ANALYSIS OF THE AA30-4 CARD.

Fig. 7 Diagnostic Wire-Wrap Pins



AA30-4 QUAD LVDT CARD

MODEL AA41-2

MODEL AA41-4

FREQUENCY INPUT CONDITIONER CARD

PLEASE NOTE: In this manual, "AA41" will be used to refer to BOTH the two-channel **Model AA41-2** AND the four-channel **Model AA41-4**, in cases where it is not necessary to distinguish them.

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Models **AA41-2** and **AA41-4** are two- and four-channel conditioners (respectively) for measuring rpm, flow, and other phenomena that can be sensed by pulse transformer transducers with 2-wire isolated windings (tachometer pickups, turbine flowmeters, etc.), transistor or logic-circuit drivers, "zero-velocity" (true digital output) sensors, and similar **frequency-generating transducers**.

The AA41 accepts a wide range of waveshapes and voltage levels. A "Smart Schmitt" threshold level for each input channel may be individually selected via internal jumper connections, depending on the expected peak voltage input: 0.1-2 V; 0.5-10 V; 2.5-50 V; or 10-200 V. This ensures reliable triggering when the input is at the low end of the voltage range. All ranges are protected against an overload of up to 200 V. Nominal ± 5 V-DC excitation is supplied for use with a "zero-velocity" sensor.

Standard AA-card "F1" programmable filter tiles let you tailor the dynamic frequency range and signal response of each AA41 channel to your application's requirements.* Setting a frequency channel's programmable filter to the 1.6-Hz cutoff provides the following input ranges:

- 10% to 100% of full scale for a range of 250 or 500 Hz
- 2% to 100% of full scale for a range of 1 or 2 kHz
- 1% to 100% of full scale for a range of 4, 8, 16, or 32 kHz

If a faster response is more important than dynamic range, you may select a higher "F1" bandwidth value (see Table 2). However, programmable filter settings above 25 Hz are not recommended for use with the AA41, because of inadequate usable dynamic frequency range. When the card is used in System 10, its filter cutoff values are set by means of an on-board 16-position switch for each channel.

Capacitive coupling of 0.1 or 10 microfarads is provided for low-frequency inputs, to eliminate false triggering by signal noise and/or any positive or negative DC offset that exists for the frequency signal.** A special trigger-level control guarantees reliable triggering when the input is at the low end of the frequency range, while a precise

* Or, if desired, a *fixed* filter of either 10 or 50 Hz for all channels may be specified at the time of order.

** Noise suppression is always recommended when using a *magnetic pickup* as the frequency source.

AA41-2 / AA41-4 DUAL / QUAD FREQUENCY CARD

2.4576-MHz crystal frequency reference ensures accuracy of all calibration, whether “CALCULATED” or “TWO-POINT (DEADWEIGHT).”

A nominal ± 5 -V ANALOG OUTPUT is produced by each active AA41 input channel, for purposes of real-time signal monitoring. Each of these “Auxiliary Outputs” is available on a corresponding mainframe wire-wrap pin. Note that the AA41’s Auxiliary Outputs represent *filtered (“postfilter”) channel outputs only* (unlike most other “AA” cards).

The AA41 is manufactured using the latest surface-mount technology, resulting in the highest immunity to shock and vibration. As explained in Section 2, I/O connections are via secure, clearly labelled screw terminals in a special AA41 CONNECTOR ASSEMBLY.

Fig. 1 Model AA41-2 / AA41-4 Modular Card Components

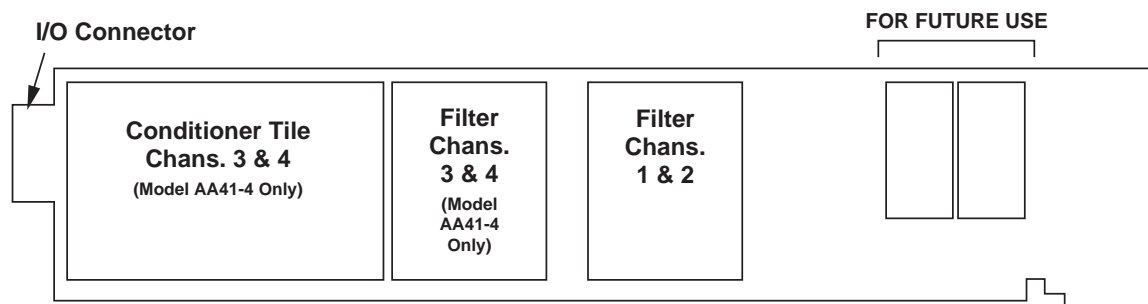


Fig. 1 shows the stand-off circuit boards (or “tiles”) that provide the analog filtering for an AA41 card’s data channels.

WARNING

THE **CONDITIONER TILE FOR CHANNELS 3 AND 4 OF A MODEL AA41-4** IS TO BE INSTALLED OR REMOVED ONLY BY A QUALIFIED TECHNICIAN, SINCE SUBSEQUENT REALIGNMENT OF THE AA41 CARD IS REQUIRED. **FILTER** TILES, HOWEVER, MAY BE INSTALLED OR REMOVED BY THE USER, IN THE FIELD. CONTACT THE DAYTRONIC SERVICE DEPARTMENT FOR COMPLETE INSTRUCTIONS.

THE FOLLOWING **AA41-2 / AA41-4** VERSIONS ARE CURRENTLY AVAILABLE:

- Model **AA41-2F010**—Two input channels, with FIXED 10-Hz FILTERING for each
- Model **AA41-2F050**—Two input channels, with FIXED 50-Hz FILTERING for each
- Model **AA41-2F1**—Two input channels, with “F1” PROGRAMMABLE FILTERING for each*
- Model **AA41-4F010**—Four input channels, with FIXED 10-Hz FILTERING for each
- Model **AA41-4F050**—Four input channels, with FIXED 50-Hz FILTERING for each
- Model **AA41-4F1**—Four input channels, with “F1” PROGRAMMABLE FILTERING for each*

* “F1” is currently the only programmable filter tile that applies to the Model AA41.

ADDITIONAL AA41-2 / AA41-4 SPECIFICATIONS

Number of Input Channels: Two for **Model AA41-2**; four for **Model AA41-4**

Inputs:

Type: Any AC or unipolar pulse signal, grounded or floating, irrespective of waveform

Threshold Level: Accommodates signals from 100 mV to 200 V

Frequency Ranges: Nominal 250, 500, 1000, 2000, 4000, 8000, 16000, or 32000 Hz, full-scale, with dynamic frequency range dependent on the selected analog filtering (see Table 2, below); automatically selected—on an individual channel basis—when the channel is configured; for the System 10 channel “type” codes assigned to AA41 data channels, see Table 1, below

Excitation: Nominal 10 (i.e., ± 5) V-DC; ± 50 mA, *total* (all channels)

Amplifier (per channel):

Normal-Mode Range: ± 200 V operating and without instrument damage

Common-Mode Range: ± 50 V operating; ± 100 V without instrument damage

Common-Mode Rejection Ratio: DC and at 60 Hz: -100 dB

Input Impedance: Differential: 200 k Ω ; Common-Mode: 125 k Ω

Offset: Initial: $\pm 0.02\%$ of full scale; vs. temperature: ± 20 ppm/ $^{\circ}$ C; vs. time: ± 10 ppm/month

Gain Accuracy: $\pm 0.02\%$ of full scale

Gain Stability: vs. temperature: ± 50 ppm/ $^{\circ}$ C; vs. time: ± 50 ppm/month

Filter (per channel): 3-pole modified Butterworth

“F1” Programmable Filtering (all four channels): Switch- or software-selectable to one of 16 different cutoff frequencies: 0.2; 0.4; 0.8; 1.0; 1.6; 2.0; 4.0; 5.0; 8.0; 10; 20; 25; 40; 50; 100; or 200 Hz (see Table 2)

Fixed Filtering (all four channels): 10 or 50 Hz (see Table 3)

Auxiliary Outputs: Nominal ± 5 V-DC signals representing *filtered* channel readings (only) available on mainframe wire-wrap pins*

Power-Supply Slot Allotment: Maximum consumption of supply and excitation current from the Conditioner Card Slot is 120 mA

Table 1 AA41 “Type” Codes

Full-Scale Input	Channel Type Code
250 Hz	40
500 Hz	41
1000 Hz	42
2000 Hz	43
4000 Hz	44
8000 Hz	45
16000 Hz	46
32000 Hz	47

* The wire-wrap pins to which the AA41’s “Auxiliary Outputs” are brought are located on the respective analog motherboard within the system mainframe, and should not be confused with the DIAGNOSTIC WIRE-WRAP PINS near the front edge of the AA41 board (see Section 4).

Table 2 "F1" Programmable Filter Characteristics for "AA" Cards

Selected Frequency (Hz)	Bandwidth		Step-Response Settling Time		
	Response at -3 dB (Hz)	Response at -60 dB (Hz)	to 1% of final value (msec)	to 0.1% of final value (msec)	to 0.02% of final value (msec)
0.2	0.2	3.9	3500	4250	4750
0.4	0.4	7.8	1750	2125	2375
0.8	0.8	16	875	1063	1188
1.0	1.0	20	700	850	950
1.6	1.6	31	438	531	594
2.0	2.0	39	350	425	475
4.0	4.0	78	175	213	238
5.0	5.0	98	140	170	190
8.0	8.0	156	88	106	119
10.0	10.0	195	70	85	95
20.0	20.0	390	35	43	48
25.0	25.0	488	28	34	38
40.0	40.0	780	18	21	24
50.0	50.0	975	14	17	19
100.0	100.0	1950	7.0	8.5	9.5
200.0	200.0	3900	3.5	4.3	4.8

Table 3 Fixed Filter Characteristics for "AA" Cards

Filter Designation	Bandwidth		Step-Response Settling Time		
	Response at -3 dB (Hz)	Response at -60 dB (Hz)	to 1% of final value (msec)	to 0.1% of final value (msec)	to 0.02% of final value (msec)
"F010"	10	195	70	85	95
"F050"	50	975	14	17	19

2 TRANSDUCER CONNECTIONS

2.a STANDARD CABLING

The Model AA41's rear I/O CONNECTOR mates with the special AA41 CONDITIONER CONNECTOR, via the cable connections shown in Fig. 3. Mounted on the internal board of the connector assembly (shown in Fig. 2) is a block of ten clearly labelled screw terminals for each of the AA41's four possible input channels.

To access the connector board, simply remove the screws that hold together both halves of the connector housing. Use the two internal clamp bars to secure transducer cables once all leads have been connected.

The connector assembly's mounting screws are designed to secure the connector to the rear of the system mainframe and to provide a solid GROUND CONNECTION for cable "shields" via the two L-shaped ground lugs. An offset in the mounting holes ensures that the connector cannot be attached upside down.

Fig. 3(a) shows recommended cabling for *intrinsically grounded transistor or logic-circuit drivers*; Fig. 3(b), for *pulse transformer transducers with two-wire isolated windings* (tachometers, turbine flowmeters, etc.); and Fig. 3(c), for "zero-velocity" (*true digital output*) sensors requiring 10-V excitation.

DUAL / QUAD FREQUENCY CARD AA41-2 / AA41-4

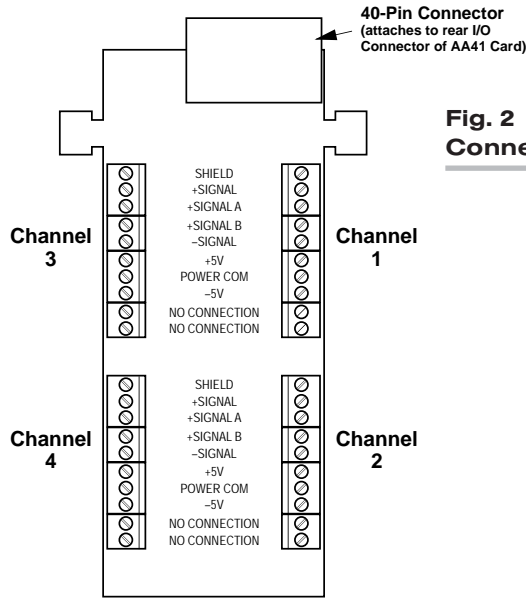


Fig. 2 Model AA41 Connector Assembly Board

2.b SPECIAL CABLING

Fig. 4 summarizes three kinds of special AA41 connections you might need to establish for a given AA41 channel:

UNGROUNDING FREQUENCY SOURCE

For floating-source inputs and inputs from zero-velocity sensors, where the *-SIGNAL* is not grounded at the frequency source, the *-SIGNAL* terminal should be tied directly to POWER COMMON. This connection is also shown in Figs. 3(b) and 3(c).

Fig. 3 Model AA41 Transducer Cabling

AA41-2: Channel 1 or 2:
AA41-4: Channel 1, 2, 3, or 4:

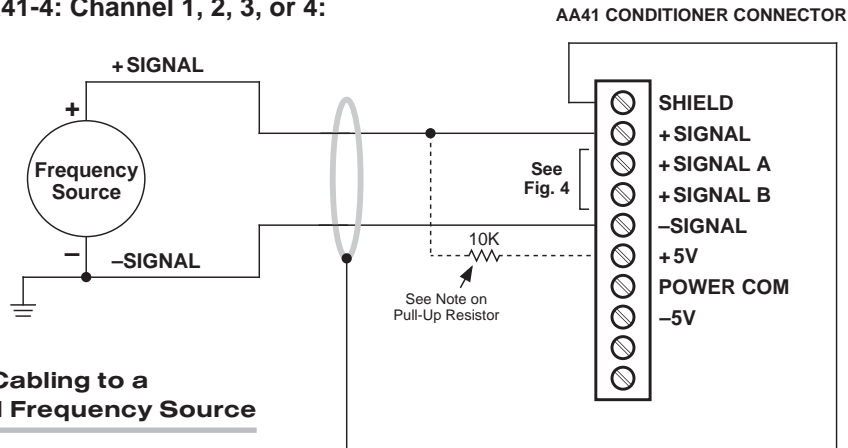
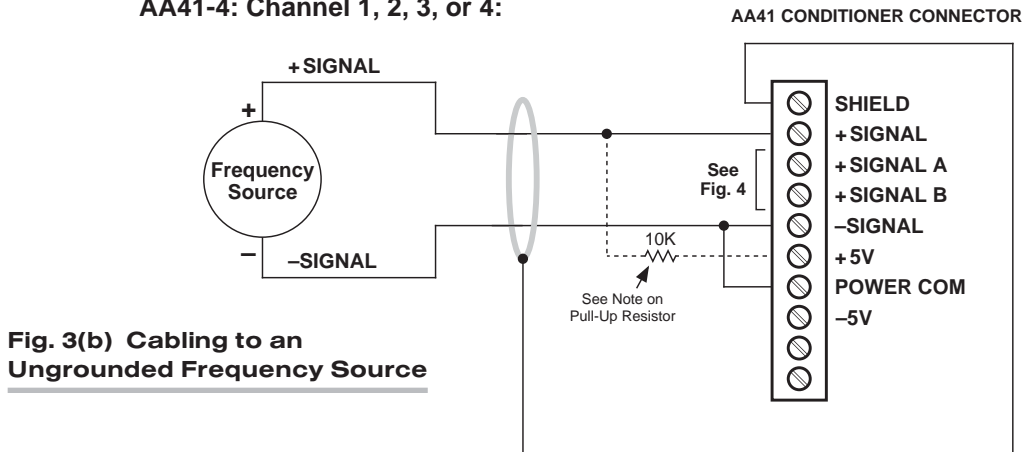


Fig. 3(a) Cabling to a Grounded Frequency Source

AA41-2 / AA41-4 DUAL / QUAD FREQUENCY CARD

AA41-2: Channel 1 or 2:
AA41-4: Channel 1, 2, 3, or 4:



AA41-2: Channel 1 or 2:
AA41-4: Channel 1, 2, 3, or 4:

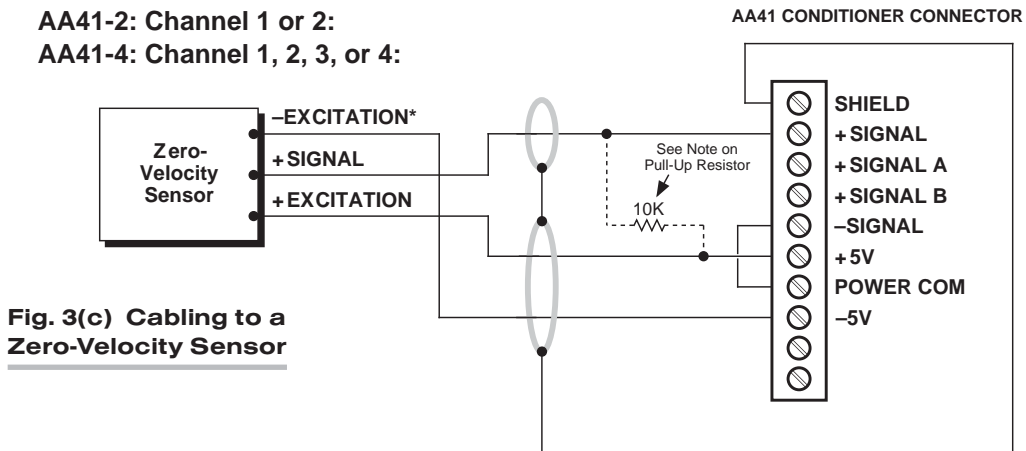
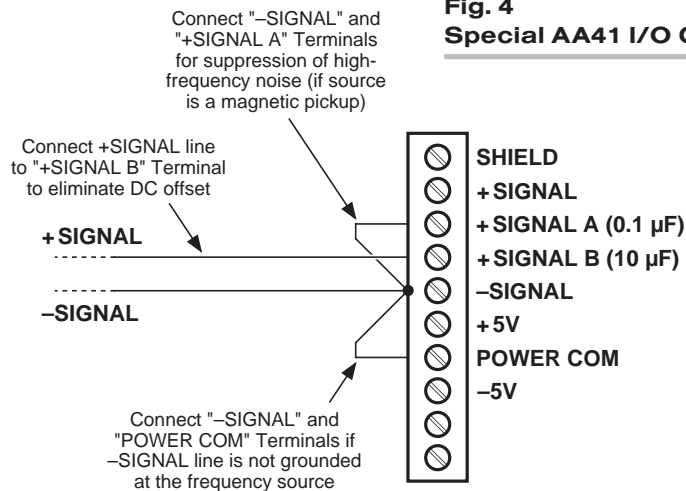


Fig. 4
Special AA41 I/O Connections



ELIMINATION OF DC OFFSET

Each AA41 input channel is supplied with two *capacitive-coupled inputs*: “+SIGNAL A” provides 0.1-microfarad capacitance, while “+SIGNAL B” provides 10-microfarad capacitance. These special inputs may be used with either floating or grounded configurations; they would not normally be used with zero-velocity sensors requiring 10-V excitation (see Fig. 3(c)).

Fig. 4 shows how the larger (10- μ F) capacitive coupling can be used to eliminate any positive or negative DC offset that exists for an AA41 channel's frequency signal. Simply connect the +SIGNAL line from the frequency source to the “+SIGNAL B” terminal instead of to the normal +SIGNAL terminal. The capacitor is here in series with the +SIGNAL input and allows only AC to pass.

SUPPRESSION OF HIGH-FREQUENCY NOISE IN LOW-FREQUENCY INPUT

False triggering can sometimes occur, especially at the *low-frequency input range*, because of stray pickup of frequencies outside the common-mode range. Capacitive coupling of the frequency input to ground can in such cases serve to suppress unwanted signal noise. *This noise suppression is always recommended when using a MAGNETIC PICKUP as the frequency source.*

Thus, if you find a channel's frequency reading to be unacceptably unstable or “noisy,” you should tie that channel's -SIGNAL terminal to the “+SIGNAL A” terminal while maintaining the normal +SIGNAL connection.

2.c PULL-UP RESISTOR

When used with an *open-collector* type sensor, an AA41 channel requires a pull-up resistor (typically 10 k Ω) between the +SIGNAL and the corresponding +5 V-DC EXCITATION.

3 SETUP AND/OR OPERATING CONSIDERATIONS**3.a SELECTION OF INPUT VOLTAGE RANGE**

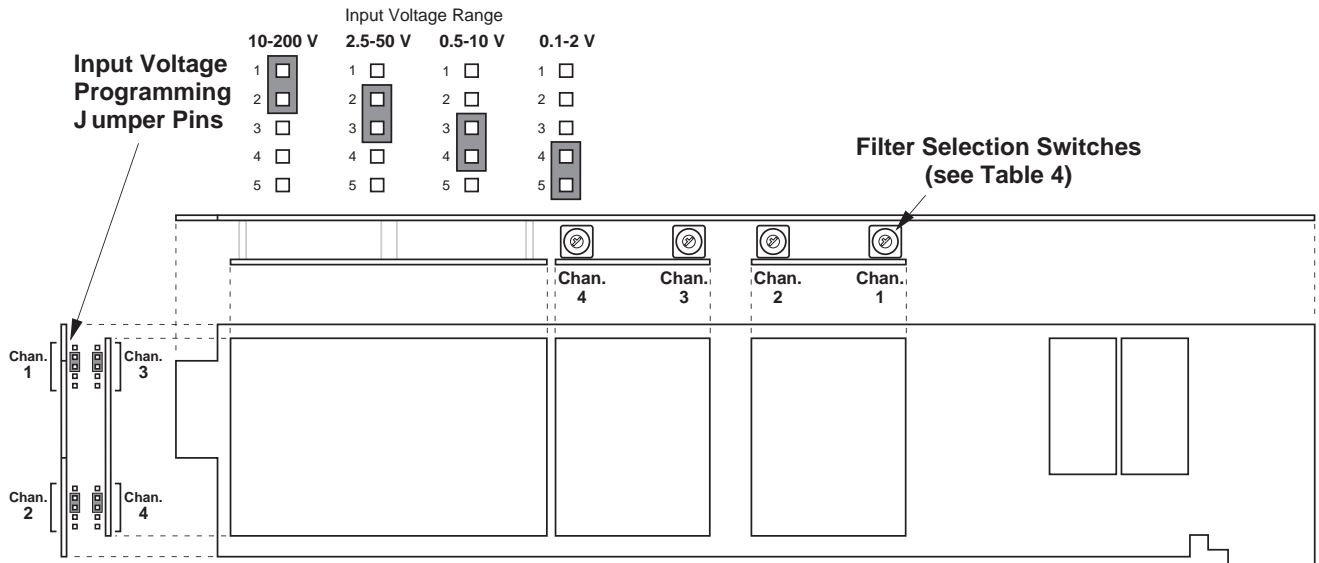
Perform the following steps to select the proper *peak voltage input range* for each active AA41 channel.* At the same time, you will be setting the *trigger level* for that channel, thereby ensuring reliable triggering when the input is at the low end of the voltage range. EACH AA41 CHANNEL IS PRESET AT THE FACTORY FOR AN INPUT VOLTAGE RANGE OF 2.5 - 50 V. If you require a different range, you should

1. Remove the AA41 card from its mainframe slot. For “Card Insertion and Removal,” see Manual Section 1.B. Since the AA41 is “hot-pluggable,” you need NOT turn off mainframe power before removing the card.
2. Refer to Fig. 5, below, and locate the INPUT VOLTAGE PROGRAMMING JUMPER PINS located on the rear edge of the card. For an AA41-4, the pins for Channels 3 and 4 are on the underside of the Conditioner Tile. One “minijumper” is provided for each channel's set of three jumper pins.

* The input voltage range setting for an UNUSED channel is immaterial, and will not affect operation of the AA41.

AA41-2 / AA41-4 DUAL / QUAD FREQUENCY CARD

Fig. 5 Model AA41 Programming Jumper Pins and Filter Selection Switches



3. Position the jumper for each channel as shown in Fig. 5 to interconnect the pair of pins corresponding to the desired input voltage range for that channel. You will need to use a small pair of needle-nosed pliers to move the jumper.
4. Reinsert the AA41 card in its mainframe slot.

3.b SELECTION OF ANALOG FILTERING

NOTE: If your AA41 card is equipped with FIXED ANALOG FILTERING, you may ignore this manual section.

When using an AA41 with PROGRAMMABLE ANALOG FILTERING in System 10, you may set an individual corner frequency for the analog filter of each active input channel,* as follows:

- a. Remove the AA41 card from its slot (see Section 3.a, Step 1, above).
- b. Refer to Fig. 5 and locate the 16-position FILTER SELECTION SWITCHES located between the main card and the Filter Tile(s).
- c. Referring to Table 4, below, set each channel's switch for the desired frequency. You will need to use a small screwdriver (or equivalent tool) to set the switch to the appropriate number/letter.
- d. Reinsert the AA41 card.

NOTE: In addition to the normal-mode analog filtering supplied by the AA41 card, System 10 can provide additional processor-controlled DIGITAL SMOOTHING on a per-channel basis. For each individual channel, you may indicate the desired amount of digital smoothing by applying a **FILTER (FIL)** command to that channel (see Manual Section 2.G.2).

* The analog filter setting for an UNUSED channel is immaterial, and will not affect operation of the AA41.

Table 4 Model AA41 Filter Switch Settings

Cutoff Frequency	Switch Setting
0.2 Hz	7
0.4 Hz	6
0.8 Hz	5
1.0 Hz	3
1.6 Hz	4
2.0 Hz	2
4.0 Hz	1
5.0 Hz	F
8.0 Hz	0
10 Hz	E
20 Hz	D
25 Hz	B
40 Hz	C
50 Hz	A
100 Hz	9
200 Hz	8

3.C CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model AA41 card when used in System 10, see the general remarks on System 10 “real-channel” configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For AA41 channel “type” codes, see Table 1, above.

In System 10, you can use three calibration methods with the Model AA41:

ABSOLUTE CALIBRATION

Described in Manual Section 1.G.3.b, this method is applicable only when the AA41 is being used to measure *frequency itself* (in Hz). In this case, the user need only specify an appropriate SCALING FACTOR (“m” coefficient), once the AA41-based input channel has been properly configured.

Thus, to calibrate an AA41-based Channel No. “x,” you need only turn ON the system EEPROM SWITCH and then apply the following **SCALING FACTOR (EMM)** command:

$$\text{EMM } x = m \text{ [CR]}$$

where “m” equals *the full-scale range corresponding to the channel’s present TYPE designation, expressed to the precision desired for the channel’s data readings*. Channel “type” codes and associated full-scale ranges are given in Table 1, above. If, for example, a frequency-measuring AA41 channel is “typed” as “43” (corresponding to a full scale of 2000 Hz) and you want the channel to read *tenths of a hertz*, you would enter an “m” value of “2000.0.”

Note that “absolute” calibration of an AA41-based channel yields an accuracy of $\pm 0.02\%$ of full scale.

CALCULATED CALIBRATION

This is generally the most convenient means of calibrating an AA41 channel, when the full-scale rating of the frequency source (or the highest frequency expected to be measured) is accurately known.

AA41-2 / AA41-4 DUAL / QUAD FREQUENCY CARD

Thus, to calibrate an AA41-based Channel No. “x,” you need only turn ON the system EEPROM SWITCH and then apply the following **FREQUENCY CALIBRATION (FRQ)** command:

FRQ x = i, u [CR]

For “i,” enter the manufacturer-supplied *full-scale rating* of the frequency source (or the highest frequency expected to be measured), in *hertz*. For “u,” enter the corresponding value of the measured phenomenon, expressed in the desired engineering units. You need not *zero* the channel in this case. The **FRQ** command will only work if Channel No. x has been assigned the proper “type” code (see Table 1).

Note that a channel calibrated by the **FRQ** command will report measurement data to a precision matching that of the entered “u” value. If, for example, you're measuring “liters per minute,” and enter a “u” of “750,” then all subsequent channel readings will be rounded to the nearest liter per minute. If the entry is “750.0,” then all readings will be rounded to the nearest tenth of a liter per minute.

TWO-POINT (DEADWEIGHT) CALIBRATION

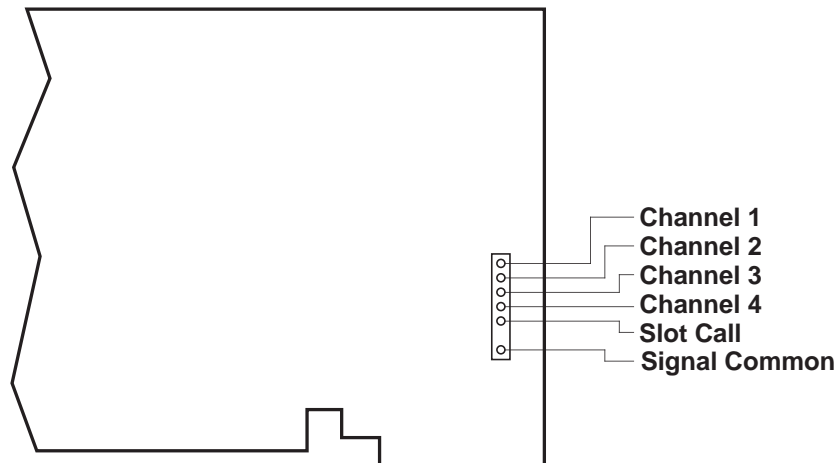
Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional “zero and span” method can be applied to an AA41 channel if the full-scale rating of the frequency source is unknown, and if the channel's received frequency input is an *analog of another parameter*—such as Gallons Per Minute—which has one or more independently and accurately known calibration values. The mainframe's **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

4 DIAGNOSTIC WIRE-WRAP PINS

As a special diagnostic and service tool, the five pins shown in Fig. 6 are directly accessible from the front of an installed AA41 card. These pins allow voltmeter or oscilloscope observation of data-channel output signals. **THEIR USE IS INTENDED PRIMARILY FOR TRAINED SERVICE TECHNICIANS.** With regard to the on-board diagnostic pins, please note the following:

- PROPER ESD PRACTICE SHOULD BE OBSERVED WHEN MAKING CONTACT WITH AN AA41 BOARD INSTALLED IN A “LIVE” DAYTRONIC SYSTEM MAIN-FRAME. ALWAYS GROUND YOURSELF TO THE MAINFRAME CHASSIS BEFORE TOUCHING THE BOARD.
- THE ANALOG SIGNAL PRESENT AT EACH ACTIVE “CHANNEL” PIN REPRESENTS *EIGHT TENTHS (0.8)* OF THAT CHANNEL’S NOMINAL CALL-BUS VOLTAGE (WHICH, FOR THE AA41 IS ALWAYS THE FILTERED CHANNEL OUTPUT). For a channel delivering a standard full-scale (+5-V) output, the corresponding diagnostic pin will therefore register +4 V.
- THE “SLOT CALL” PIN DELIVERS A LOGIC SIGNAL THAT MAY BE USED TO SYNCHRONIZE AN OSCILLOSCOPE FOR TIMING ANALYSIS OF THE AA41 CARD.
- THE “CHANNEL 3” AND “CHANNEL 4” PINS ARE ONLY ACTIVE FOR AN AA41-4 CARD.

Fig. 6 Diagnostic Wire-Wrap Pins



AA41-2 / AA41-4 DUAL / QUAD FREQUENCY CARD

MODEL AA72-2

MODEL AA72-4

STRAIN GAGE CONDITIONER CARD

PLEASE NOTE: In this manual, "AA72" will be used to refer to BOTH the two-channel **Model AA72-2** AND the four-channel **Model AA72-4**, in cases where it is not necessary to distinguish them.

1 GENERAL DESCRIPTION AND SPECIFICATIONS

The Models **AA72-2** and **AA72-4** are general-purpose two- and four-channel conditioners (respectively) for use with **DC-excited load cells, pressure sensors, and any other conventional strain gage transducer** employing a 4-arm bridge of nominal 350 Ω or higher, with a full-scale range of 0.75, 1.50, or 3.00 mV/V.

The AA72's advanced design techniques overcome errors that traditionally plague the strain-gage conditioning process. Separate excitation for each channel uses remote sensing of bridge voltage and is slaved to a common System Reference Voltage. The result is consistently stable ratiometric measurement, unaffected by possible power-supply drift. Input impedances in excess of 10,000 M Ω are presented to signal leads to eliminate cable resistance as a source of error. Allowable cable length has virtually no practical limits.

The AA72 features selectable per-channel excitation (1, 5, or 10 V-DC). Using low excitation helps reduce gage heating effects in *stress analysis* of materials with low thermal conductivity. Table 1 gives the full-scale mV/V ranges that correspond to each excitation level.

Like most Daytronic "Advanced Analog" ("AA") cards, the AA72 features optional PROGRAMMABLE LOW-PASS ACTIVE FILTERING for the removal of unwanted high-frequency measurement-signal components. Selectable analog filtering is offered for the AA72 either from 0.2 through 200 Hz in 16 steps ("F1" filtering) or from 2 through 2000 Hz in 16 steps ("F2" filtering). Or, if desired, a *fixed* filter of either 10 or 50 Hz for all channels may be specified at the time of order. When the AA72 is used in System 10, its filter cutoff values are set by means of an on-board 16-position switch for each channel.

A nominal ± 5 -V ANALOG OUTPUT is produced by each active AA72 input channel, for purposes of real-time signal monitoring. Each of these "Auxiliary Outputs" is available on a corresponding mainframe wire-wrap pin. Each output may be individually set, if desired, to represent the *prefiltered* value of the corresponding input. When such is the case, the output bandwidth is limited only by that of the AA72 card (see "Specifications").

A convenient shunt calibration technique is provided. Each channel's shunt resistor may be switched in and out by software command or by means of logic-level inputs through the rear I/O CONNECTOR.

AA72-2 / AA72-4 DUAL / QUAD DC STRAIN GAGE CARD

When connected to an optional **Model 10CJB-2 Dual Bridge Completion Card** (or equivalent circuitry supplied by the user), the AA72 can accept input from a two-wire 1/4-bridge, three-wire 1/4-bridge, 1/2-bridge, or full-bridge strain gage configuration. See Section 4 for details.

The AA72 is manufactured using the latest surface-mount technology, resulting in the highest immunity to shock and vibration. As explained in Section 2, I/O connections are via secure, clearly labelled screw terminals in a special AA72 CONNECTOR ASSEMBLY.

Fig. 1 Model AA72-2 / AA72-4 Modular Card Components

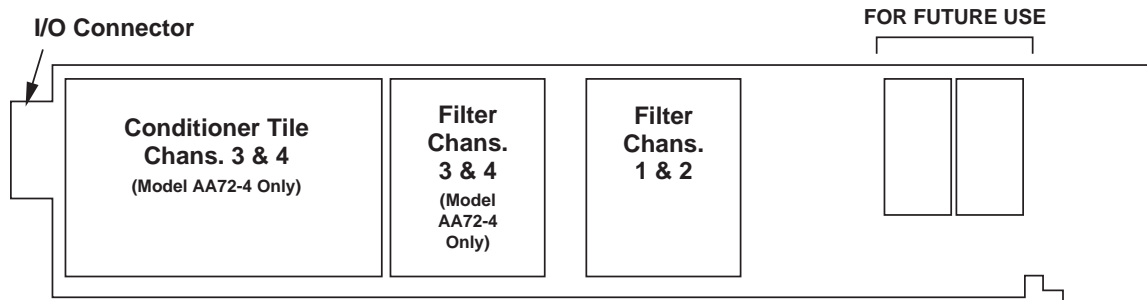


Fig. 1 shows the stand-off circuit boards (or “tiles”) that provide the analog filtering for an AA72 card’s data channels.

WARNING

THE **CONDITIONER TILE FOR CHANNELS 3 AND 4 OF A MODEL AA72-4** IS TO BE INSTALLED OR REMOVED ONLY BY A QUALIFIED TECHNICIAN, SINCE SUBSEQUENT REALIGNMENT OF THE AA72 CARD IS REQUIRED. **FILTER** TILES, HOWEVER, MAY BE INSTALLED OR REMOVED BY THE USER, IN THE FIELD. CONTACT THE DAYTRONIC SERVICE DEPARTMENT FOR COMPLETE INSTRUCTIONS.

THE FOLLOWING **AA72-2 / AA72-4** VERSIONS ARE CURRENTLY AVAILABLE:

- Model **AA72-2F010**—Two input channels, with FIXED 10-Hz FILTERING for each
- Model **AA72-2F050**—Two input channels, with FIXED 50-Hz FILTERING for each
- Model **AA72-2F1**—Two input channels, with “F1” PROGRAMMABLE FILTERING for each
- Model **AA72-2F2**—Two input channels, with “F2” PROGRAMMABLE FILTERING for each
- Model **AA72-4F010**—Four input channels, with FIXED 10-Hz FILTERING for each
- Model **AA72-4F050**—Four input channels, with FIXED 50-Hz FILTERING for each
- Model **AA72-4F1**—Four input channels, with “F1” PROGRAMMABLE FILTERING for each
- Model **AA72-4F2**—Four input channels, with “F2” PROGRAMMABLE FILTERING for each

ADDITIONAL AA72-2 / AA72-4 SPECIFICATIONS

Number of Input Channels: Two for **Model AA72-2**; four for **Model AA72-4**

Transducer Types: Conventional 4-arm strain gage bridges, nominal 350 ohms (or higher); 1/4- and 1/2-bridge gage configurations can be accommodated by means of the **Model 10CJB-2 Dual Bridge Completion Card** described in Section 4 (or equivalent external bridge-completion circuitry supplied by the user)

Input Ranges (Full-Scale): See Table 1; automatically selected—on an individual channel basis—when the channel is configured; for System 10 channel “type” codes assigned to AA72 data channels, see Table 1. Since channel zeroing is by digital techniques, no input balance control is provided. The allowable input range, therefore, must include any *initial unbalance* (which, in commercially produced strain gage transducers, is usually negligible). Other transducers may have to be externally trimmed to be used with the Model AA72, if zero unbalance exceeds 20% of full scale.

Excitation (per channel): Selectable 1, 5, or 10 V-DC (i.e., ± 0.5 , ± 2.5 , or ± 5 V-DC, respectively), nominal; ± 40 mA, maximum, for each voltage, subject to 120 mA total current draw for all four channels*

Amplifier (per channel):

Normal-Mode Range: ± 40 mV operating (± 3.6 mV/V with 10-V excitation); ± 8 V without instrument damage

Common-Mode Range: ± 1 V operating; ± 8 V without instrument damage

Common-Mode Rejection Ratio: DC and at 60 Hz: -120 dB

Input Impedance: Differential: greater than 10,000 M Ω ; Common-Mode: greater than 10,000 M Ω

Offset: Initial: ± 0.02 mV; vs. Temperature: ± 1 μ V/ $^{\circ}$ C; vs. Time: ± 5 μ V/month

Gain Accuracy: $\pm 0.02\%$ of full scale

Gain Stability: vs. Temperature: ± 50 ppm/ $^{\circ}$ C; vs. Time: ± 20 ppm/month

Filter (per channel): 3-pole modified Butterworth

“F1” Programmable Filtering (all four channels): Switch- or software-selectable to one of 16 different cutoff frequencies: 0.2; 0.4; 0.8; 1.0; 1.6; 2.0; 4.0; 5.0; 8.0; 10; 20; 25; 40; 50; 100; or 200 Hz (see Table 2)

“F2” Programmable Filtering (all four channels): Switch- or software-selectable to one of 16 different cutoff frequencies: 2; 4; 8; 10; 16; 20; 40; 50; 80; 100; 200; 250; 400; 500; 1000; or 2000 Hz (see Table 3)

Fixed Filtering (all four channels): 10 or 50 Hz (see Table 4)

Auxiliary Outputs: Nominal ± 5 V-DC signals available on mainframe wire-wrap pins**; individually jumper-selectable to represent either the *filtered* or *prefiltered* (5-kHz bandwidth) reading of the channel

Power-Supply Slot Allotment: Maximum consumption of supply current from the Conditioner Card Slot is 200 mA (the actual consumption for any given AA72 channel will depend on its transducer bridge resistance and excitation level)

* For this reason, 10-V excitation should not be used with transducer bridges of 120 Ω or lower.

** The wire-wrap pins to which the AA72’s “Auxiliary Outputs” are brought are located on the respective analog motherboard within the system mainframe, and should not be confused with the DIAGNOSTIC WIRE-WRAP PINS near the front edge of the AA72 board (see Section 5).

AA72-2 / AA72-4 DUAL / QUAD DC STRAIN GAGE CARD

Table 1 Model AA72 Ranges and "Type" Codes

1-V Excitation	5V Excitation	10-V Excitation	Channel "Type" Code
7.5 mV/V	1.5 mV/V	0.75 mV/V	70
15.0 mV/V	3.0 mV/V	1.50 mV/V	71
30.0 mV/V	6.0 mV/V	3.00 mV/V	72

Table 2 "F1" Programmable Filter Characteristics for "AA" Cards

Selected Frequency (Hz)	Bandwidth		Step-Response Settling Time		
	Response at -3 dB (Hz)	Response at -60 dB (Hz)	to 1% of final value (msec)	to 0.1% of final value (msec)	to 0.02% of final value (msec)
0.2	0.2	3.9	3500	4250	4750
0.4	0.4	7.8	1750	2125	2375
0.8	0.8	16	875	1063	1188
1.0	1.0	20	700	850	950
1.6	1.6	31	438	531	594
2.0	2.0	39	350	425	475
4.0	4.0	78	175	213	238
5.0	5.0	98	140	170	190
8.0	8.0	156	88	106	119
10.0	10.0	195	70	85	95
20.0	20.0	390	35	43	48
25.0	25.0	488	28	34	38
40.0	40.0	780	18	21	24
50.0	50.0	975	14	17	19
100.0	100.0	1950	7.0	8.5	9.5
200.0	200.0	3900	3.5	4.3	4.8

Table 3 "F2" Programmable Filter Characteristics for "AA" Cards

Selected Frequency (Hz)	Bandwidth		Step-Response Settling Time		
	Response at -3 dB (Hz)	Response at -60 dB (Hz)	to 1% of final value (msec)	to 0.1% of final value (msec)	to 0.02% of final value (msec)
2	2	40	375	430	480
4	4	80	190	215	240
8	8	160	90	110	120
10	10	200	75	90	100
16	16	320	45	55	60
20	20	400	38	43	50
40	20	800	18	22	25
50	50	1000	15	18	20
80	80	1600	9.0	11	12
100	100	2000	7.5	9.0	10
200	200	4000	4.0	4.5	5.0
250	250	5000	3.0	3.5	4.0
400	400	8000	2.0	2.2	2.5
500	500	10000	1.5	2.0	2.0
1000	1000	20000	0.75	0.9	1.0
2000	2000	40000	0.4	0.5	0.55

Table 4 Fixed Filter Characteristics for “AA” Cards

Filter Designation	Bandwidth		Step-Response Settling Time		
	Response at -3 dB (Hz)	Response at -60 dB (Hz)	to 1% of final value (msec)	to 0.1% of final value (msec)	to 0.02% of final value (msec)
“F010”	10	195	70	85	95
“F050”	50	975	14	17	19

2 TRANSDUCER CONNECTIONS

The Model AA72’s rear I/O CONNECTOR mates with the special AA72 CONDITIONER CONNECTOR, via the cable connections shown in Fig. 4. Mounted on the internal board of the connector assembly (shown in Fig. 2) is a block of eleven clearly labelled screw terminals for each of the AA72’s four possible input channels.

To access the connector board, simply remove the screws that hold together both halves of the connector housing. Use the two internal clamp bars to secure transducer cables once all leads have been connected.

The connector assembly’s mounting screws are designed to secure the connector to the rear of the system mainframe and to provide a solid GROUND CONNECTION for cable “shields” via the two L-shaped ground lugs. An offset in the mounting holes ensures that the connector cannot be attached upside down.

With regard to AA72 cabling, please note the following:

- a. 4-wire cabling to a full-bridge strain gage transducer is given in Fig. 4(a), and is to be used when the cable is under 20 feet in length. In this case, the +SENSE and –SENSE lines are tied to the corresponding EXCITATION lines (and also the CALIBRATION SENSE line to the +SIGNAL line) at the *CONDITIONER CONNECTOR*. It is recommended that the resistance of the conductors not exceed 0.0001 of the bridge resistance.
- b. 8-wire cabling to a full-bridge strain gage transducer is given in Fig. 4(b), and is to be used when the cable is 20 feet or longer, or when fine wire is used. In this case, the +SENSE and –SENSE lines are tied to the corresponding EXCITATION lines (and also the CALIBRATION SENSE line to the +SIGNAL line) at the *transducer*. Note also the extra wire connected to the –SIGNAL line at the transducer, but left *unconnected* at the AA72. This wire is to be paired with the CAL SENSE line to establish proper shielding and to avoid asymmetrical dynamic loading.

IMPORTANT: The ±EXCITATION, ±SENSE, and ±SIGNAL pins for an UNUSED STRAIN GAGE INPUT CHANNEL should be jumpered as shown in Fig. 3, below. If an input is left open, high-frequency oscillation can result, which can in turn produce significant interchannel crosstalk, and possibly inaccurate data readings.

ALSO NOTE: *Logic* connections for remote control of shunt calibration (using the CONDITIONER CONNECTOR’S “NOT ±CALIBRATE” terminals) are discussed in Section 3.d and shown in Fig 6. For connection of an optional **Model 10CJB-2 Dual Bridge Completion Card** to the AA72, see Section 4.b.

AA72-2 / AA72-4 DUAL / QUAD DC STRAIN GAGE CARD

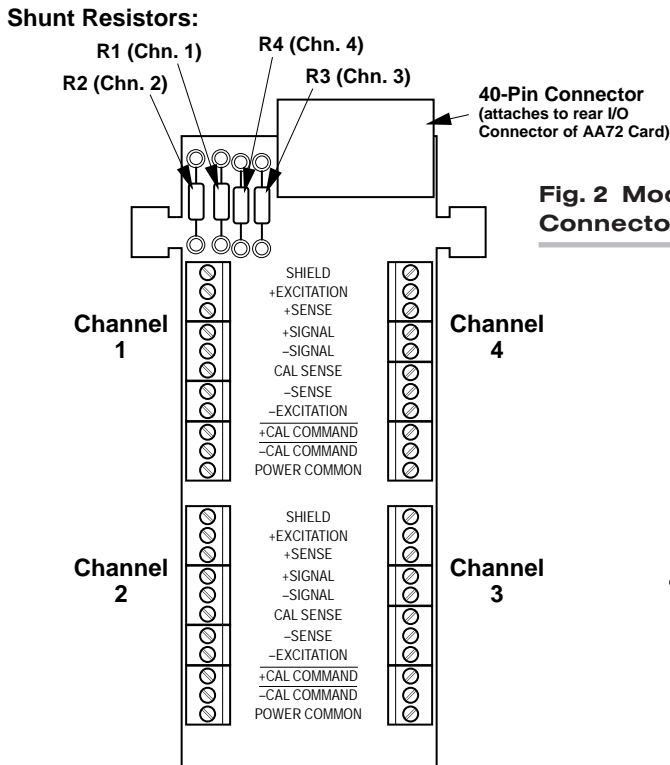


Fig. 2 Model AA72 Connector Assembly Board

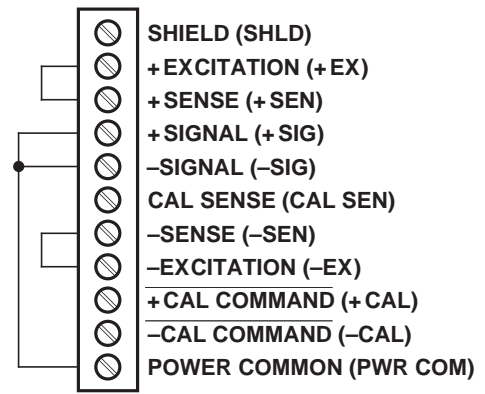


Fig. 3 Jumpering of an Unused AA72 Strain Gage Input

Fig. 4 Model AA72 Transducer Cabling

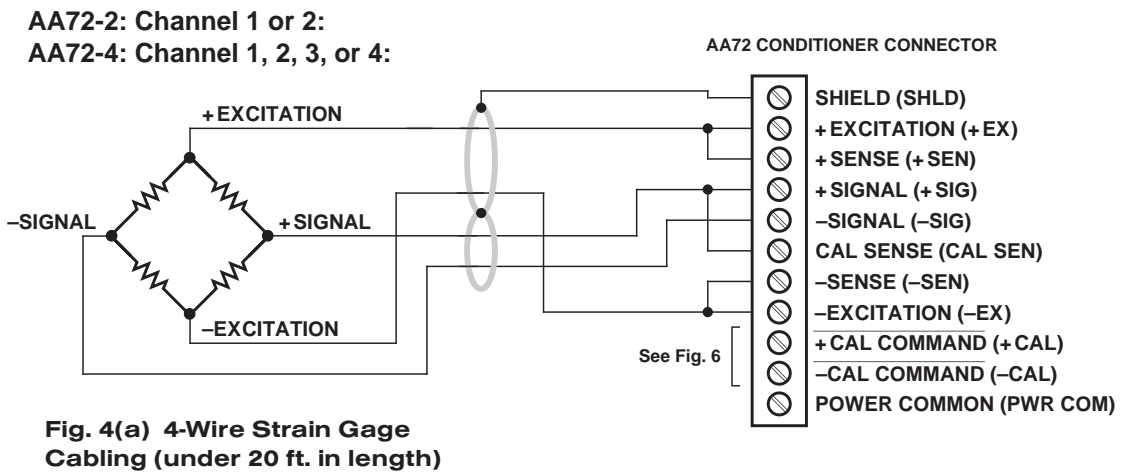
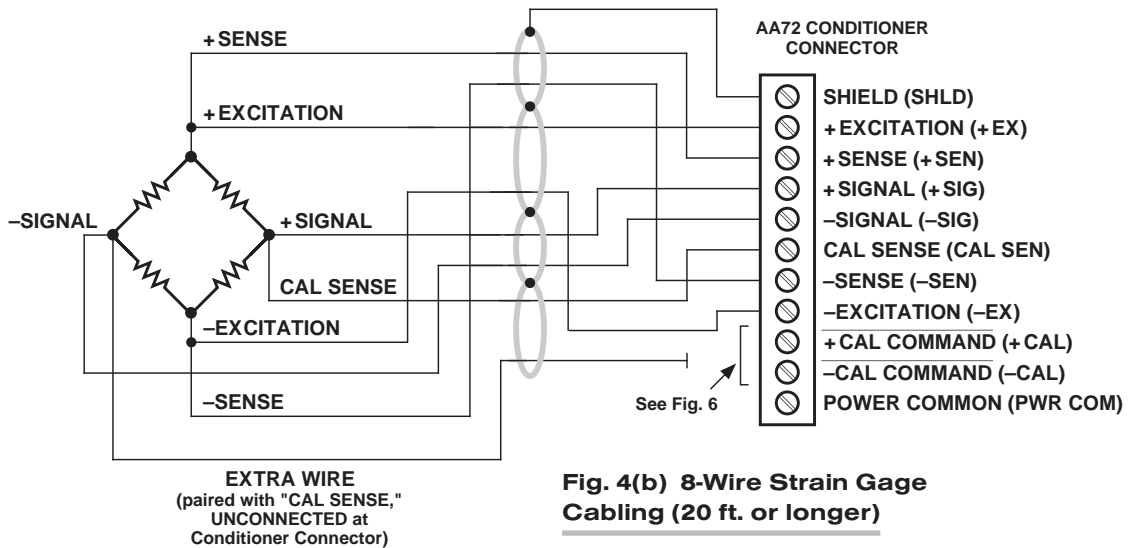


Fig. 4(a) 4-Wire Strain Gage Cabling (under 20 ft. in length)

AA72-2: Channel 1 or 2:
 AA72-4: Channel 1, 2, 3, or 4:



3 SETUP AND/OR OPERATING CONSIDERATIONS

3.a SELECTION OF EXCITATION LEVELS

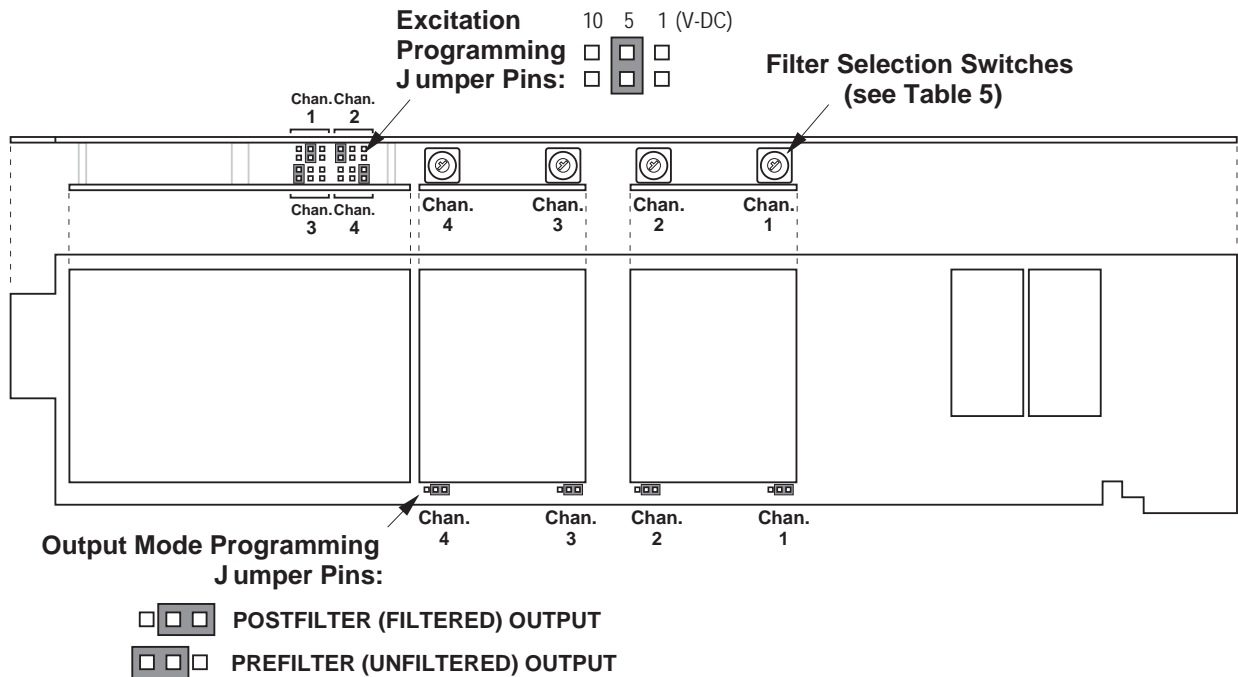
To set the DC excitation for each AA72 channel, you should

1. Remove the AA72 card from its mainframe slot. For "Card Insertion and Removal," see Manual Section 1.B. Since the AA72 is "hot-pluggable," you need NOT turn off mainframe power before removing the card.
2. Refer to Fig. 5 and locate the EXCITATION PROGRAMMING JUMPER PINS. For the four-channel Model AA72-4, these pins are located between the main card and the Conditioner Tile for Channels 3 and 4, but are nonetheless easily accessible from the top of the card. One "minijumper" is provided for each channel, for interconnecting adjacent jumper pins.
3. Position the jumper for each channel as shown in Fig. 5 to interconnect the pair of pins corresponding to the desired excitation voltage for that channel (1, 5, or 10 V).^{*} You will need to use a small pair of needle-nosed pliers to move the jumper.
4. Reinsert the AA72 card in its mainframe slot.

^{*} The excitation setting for an UNUSED channel is immaterial, and will not affect operation of the AA72. NOTE ALSO that 10-V excitation should not be used with transducer bridges of 120Ω or lower.

AA72-2 / AA72-4 DUAL / QUAD DC STRAIN GAGE CARD

Fig. 5 Model AA72 Programming Jumper Pins and Filter Selection Switches



3.b SELECTION OF ANALOG FILTERING

NOTE: If your AA72 card is equipped with FIXED ANALOG FILTERING, you may ignore this manual section.

When using an AA72 with PROGRAMMABLE ANALOG FILTERING in System 10, you may set an individual corner frequency for the analog filter of each active input channel,* as follows:

- a. Remove the AA72 card from its slot (see Section 3.a, Step 1, above).
- b. Refer to Fig. 5 and locate the 16-position FILTER SELECTION SWITCHES located between the main card and the Filter Tile(s).
- c. Referring to Table 5, below, set each channel's switch for the desired frequency. You will need to use a small screwdriver (or equivalent tool) to set the switch to the appropriate number/letter.
- d. Reinsert the AA72 card.

NOTE: In addition to the normal-mode analog filtering supplied by the AA72 card, System 10 can provide additional processor-controlled DIGITAL SMOOTHING on a per-channel basis. For each individual channel, you may indicate the desired amount of digital smoothing by applying a **FILTER (FIL)** command to that channel (see Manual Section 2.G.2).

* The analog filter setting for an UNUSED channel is immaterial, and will not affect operation of the AA72.

Table 5 Model AA72 Filter Switch Settings

Cutoff Frequency		Switch Setting
"F1" Filter	"F2" Filter	
0.2 Hz	2 Hz	7
0.4 Hz	4 Hz	6
0.8 Hz	8 Hz	5
1.0 Hz	10 Hz	3
1.6 Hz	16 Hz	4
2.0 Hz	20 Hz	2
4.0 Hz	40 Hz	1
5.0 Hz	50 Hz	F
8.0 Hz	80 Hz	0
10 Hz	100 Hz	E
20 Hz	200 Hz	D
25 Hz	250 Hz	B
40 Hz	400 Hz	C
50 Hz	500 Hz	A
100 Hz	1000 Hz	9
200 Hz	2000 Hz	8

3.c SELECTION OF ANALOG OUTPUT MODES

As mentioned in Section 1, each AA72 channel's ± 5 -V ANALOG OUTPUT can be set to represent either the *filtered* or *prefiltered* reading of that channel. To set the output mode for each of your AA72's active input channels,* you should

1. Remove the AA72 card from its slot (see Section 3.a, Step 1, above).
2. Refer to Fig. 5 and locate the OUTPUT MODE PROGRAMMING JUMPER PINS beneath the AA72's Filter Tile(s). One "minijumper" is provided for each channel's set of three jumper pins.
3. Position the jumper for each channel as shown in Fig. 5 to interconnect the pair of pins that corresponds to the desired output mode for that channel. You will need to use a small pair of needle-nosed pliers to move the jumper.
4. Reinsert the AA72 card in its mainframe slot.

3.d CONFIGURATION AND CALIBRATION

For initial configuration of ANALOG INPUT CHANNELS dedicated to a specific Model AA72 card when used in System 10, see the general remarks on System 10 "real-channel" configuration in Manual Section 1.G.1 and elsewhere in the *System 10 Guidebook*. For AA72 channel "type" codes, see Table 1, above.

In System 10, you can use three calibration methods with the Model AA72, unless it is being used with a **Model 10CJB-2 Dual Bridge Completion Card** (in which case a special calibration procedure is required, as explained in Section 4.c, below):

CALCULATED CALIBRATION

This is generally the most convenient means of calibrating an AA72 channel, when the transducer's full-scale "mV/V" sensitivity rating is accurately known.

* The output mode setting for an UNUSED channel is immaterial, and will not affect operation of the AA72.

Thus, to calibrate an AA72-based Channel No. “x,” you need only

1. Turn ON the system EEPROM SWITCH and then apply the following **MV/V CALIBRATION (MVV)** command:

MVV x = i, u [CR]

For “i,” enter the manufacturer-supplied *transducer sensitivity rating* in “mV/V, full scale.” For a “Type 70” channel (7.5/1.5/0.75 mV/V, full scale), you should enter an “i” value greater than 0.02 and less than or equal to 1.00 (mV/V). For a “Type 71” channel (15.0/3.0/1.50 mV/V, full scale), you should enter a value greater than 0.04 and less than or equal to 2.00 (mV/V). For a “Type 72” channel (30.0/6.0/3.00 mV/V, full scale), you should enter a value greater than 0.80 and less than or equal to 4.00 (mV/V).

For “u,” enter the *transducer’s nominal full-scale rating* in whatever engineering units are desired for the channel’s data reading—but *only if the channel is set for 10-volt excitation* (Section 3.a). **NOTE:** If the channel being calibrated is set for *1-volt excitation*, the “u” value to be entered should be *10 times* the actual value of the nominal full-scale rating. If it is set for *5-volt excitation*, “u” should be *2 times* the actual value.

The **MVV** command will only work if Channel No. x has been assigned the proper “type” code (“70,” “71,” or “72”).

2. Zero the channel by commanding

ZRO x [CR]

Note that a channel calibrated by the **MVV** command will report measurement data to a precision matching that of the entered “u” value. If, for example, you're measuring “psi,” and enter a “u” of “500,” then all subsequent channel readings will be rounded to the nearest psi. If the entry is “500.0,” then all readings will be rounded to the nearest tenth of a psi.

TWO-POINT (DEADWEIGHT) CALIBRATION

Using the standard **ZERO (ZRO)** and **FORCE (FRC)** commands, this conventional “zero and span” method can be applied to an AA72 channel if the full-scale “mV/V” rating of the channel’s strain gage transducer is unknown, or if the final measurement accuracy provided by CALCULATED CALIBRATION does not meet the requirements of the measurement application. The mainframe’s **EEPROM Write Protect Switch** must be ON for the **ZRO** and **FRC** commands to be effective. See Manual Section 1.G.5 for a general discussion of this calibration technique.

SIMULATED (SHUNT) CALIBRATION

Suitable for all AA72 excitation levels, this method is similar to the conventional TWO-POINT (DEADWEIGHT) procedure. The difference is that the second (“span”) input is not produced by loading the source transducer, but by “simulating” a particular up-scale value of mechanical input. This known EQUIVALENT INPUT then serves to determine the SCALING FACTOR for the channel.

For an AA72 data channel, the equivalent input is produced by shunting a resistor of known magnitude across one arm of the strain gage bridge, thereby simulating a known value of input for either a *positive* or *negative* up-scale reading. If the transducer manufacturer has supplied the exact value of the transducer’s equivalent input, it can be used as a reference point for calibrating the channel.

Equivalent input can be approximated from a knowledge of the *Shunt Calibration Resistance (R)*, the transducer’s *Bridge Resistance (B)*, and the transducer’s *Full-Scale Sensitivity (K, in mV/V full scale)*. To determine the EQUIVALENT INPUT (X) as an approximate percentage of full-scale output, you may use the following equation:

$$X = 25000B / K(R + 0.5B) \%$$

Since the equivalent input is here expressed as a *percentage of full-scale output*, you must multiply it by the rated full-scale capacity of the transducer, in order to determine the *actual input simulated by the shunt*.

Shunt calibration is an easier though generally less accurate technique than two-point (deadweight) calibration. It is useful, however, when overall “deadweighting” is impossible or inconvenient, and is good for an accuracy of about 0.2% (depending, of course, on the accuracy of the specified equivalent input, and on the resistor/bridge tolerance and temperature).

The AA72 is equipped with a 100-k Ω , 0.1% *calibration resistor* for each active channel. These resistors are located on turret terminals on the Connector Assembly Board (see Fig. 2). You may, if you wish, replace each channel’s installed 100K shunt resistor with a resistor of another value (strain-gage transducer manufacturers often supply such resistors with their instruments).

In System 10, a strain gage channel’s shunt resistor may be switched in and out by means of the **SHUNT CALIBRATE-POSITIVE (SHP)** or **SHUNT CALIBRATE-NEGATIVE (SHN)** command. A **RESUME (RSM)** command should then be applied to remove the shunt and resume normal channel measurement. Since these are “run-time” commands, the mainframe’s **EEPROM Write Protect Switch** need not be on for them to be effective. See Manual Section 1.G.6 for general instructions regarding the “SHUNT CALIBRATION” technique in System 10.

NOTE: Per-channel shunt calibration for the AA72 can be “remotely” controlled, if desired, as an alternative to using the software “SHUNT CALIBRATE” commands provided by the system. This remote calibration control is accomplished by means of logic-level inputs to the AA72 card. The relevant connections are given in Fig. 6.

Fig. 6(a) shows how the “CALIBRATE POSITIVE” and “CALIBRATE NEGATIVE” commands can be independently applied to any active AA72 channel, without the need of an external logic reference supply.

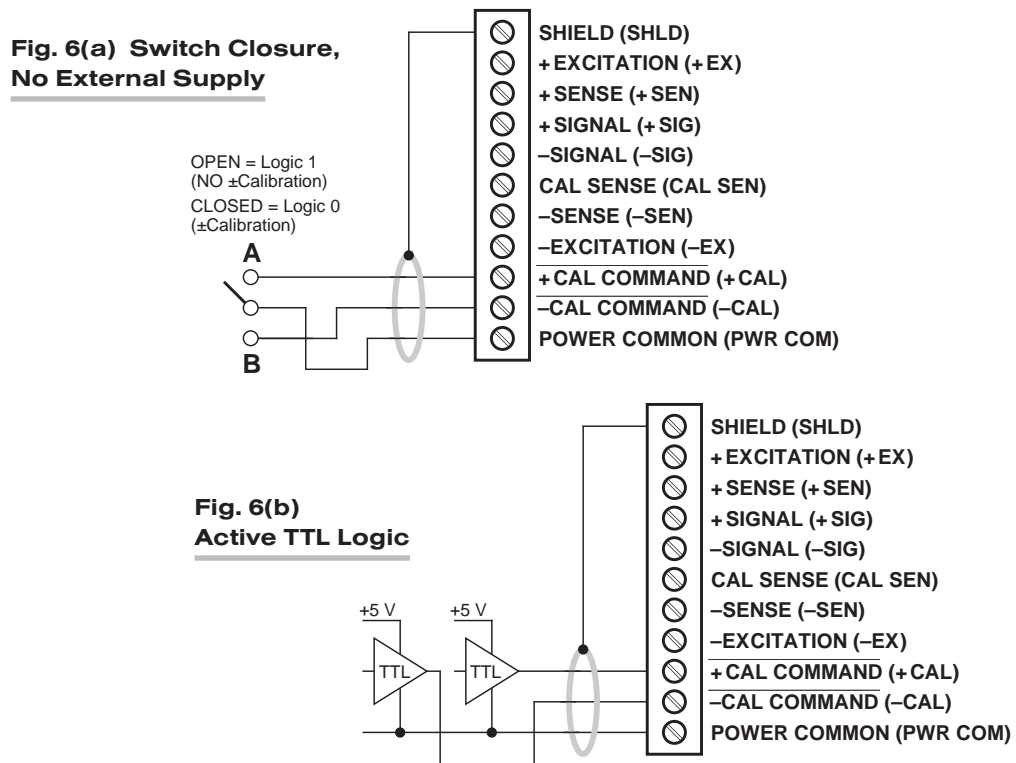
Closing the switch in Fig. 6(a) to contact point “A” will produce a *Logic 0* level at the “NOT +CAL COMMAND” terminal. Since this is a negative-true logic line, the *Logic 0* input will activate the “+CALIBRATE” condition of the channel. That is, it will switch in the channel’s shunt resistor for a *positive* up-scale reading. Opening the switch to disconnect the “NOT +CALIBRATE” line from POWER COMMON will then return the channel to the “NO +CALIBRATE” condition.

Similarly, closing the switch to contact point “B” will produce a *Logic 0* level at the “NOT -CAL COMMAND” terminal, thereby switching in the channel’s shunt resistor for a *negative* up-scale reading. Opening the switch to disconnect the “NOT -CALIBRATE” line from POWER COMMON will then return the channel to the “NO -CALIBRATE” condition.

You may also use active TTL logic, as illustrated in Fig. 6(b), to produce the “+CALIBRATE” or “-CALIBRATE” condition for either AA72 channel.

AA72-2 / AA72-4 DUAL / QUAD DC STRAIN GAGE CARD

Fig. 6 Logic Inputs for AA72 Remote Shunt Calibration



4 OPTIONAL BRIDGE COMPLETION: MODEL 10CJB-2 DUAL BRIDGE COMPLETION CARD

4.a PURPOSE

The optional **Model 10CJB-2 Dual Bridge Completion Card** lets you connect each of your Model AA72's inputs to a *2-wire 1/4-bridge, 3-wire 1/4-bridge, 1/2-bridge, or full-bridge* strain gage configuration.* Each 1/4-bridge configuration may use *either 120 or 350 ohms* nominal gage resistance. The function of the Model 10CJB-2 is to "complete" the connected bridge—that is, to allow it to be "seen" by the Model AA72 as a full (4-arm) Wheatstone bridge.

For calibration of AA72 channels originating from the Model 10CJB-2, see Section 4.c, below.

4.b 10CJB-2 TRANSDUCER CONNECTIONS

Remove the top plate of the Model 10CJB-2 box (4 screws in corners). Inside the box are two sets of labelled screw terminals, one for each of the AA72's input channels ("A" and "B"). As shown in the following figures, you will connect your gage wires directly to these terminals, and, if necessary, interconnect certain terminal pairs by means of jumper wires. Gage leads should enter the 10CJB-2 through the cutout on the right-hand side of the box.

* Two 10CJB-2 units may be used, if desired, with a Model **AA72-4**.

NOTE: A SPECIAL DAYTRONIC CABLE MUST BE USED TO CONNECT THE 10CJB-2 TO THE AA72'S REAR I/O CONNECTOR. Contact the Daytronic Service Department for full details.

Fig. 7(a) shows connections between the 10CJB-2 and a 2-wire 1/4-bridge gage configuration (represented by the single gage resistor). Here, you must install a jumper wire between the **-SIG** and **1/2 BR** terminals, and between the **+SIG** terminal and *either* the **120** terminal *or* the **350** terminal, depending on the nominal gage resistance.

Fig. 7(b) shows connections between the 10CJB-2 and a 3-wire 1/4-bridge gage configuration (again represented by the single gage resistor). Here again, the **-SIG** and **1/2 BR** terminals must be tied. The gage's third (self-compensating) lead is connected *either* to the **120** terminal *or* to the **350** terminal, depending on the nominal gage resistance.

Fig. 7(c) shows connections between the 10CJB-2 and a 1/2-bridge gage configuration (represented by the two connected gage resistors). Here again, the **-SIG** and **1/2 BR** terminals must be tied.

Fig. 7(d) shows connections between the 10CJB-2 and a full-bridge gage configuration (represented by the four connected gage resistors).

Fig. 7 Model 10CJB-2 Transducer Cabling

Fig. 7(a)
2-Wire
1/4-Bridge
Completion

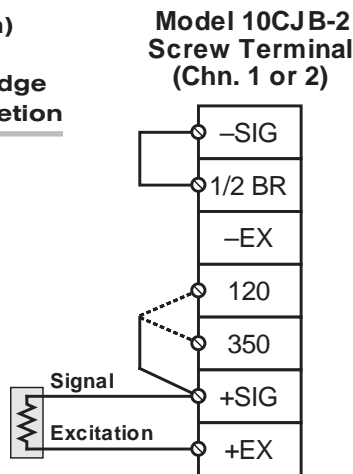


Fig. 7(b)
3-Wire
1/4-Bridge
Completion

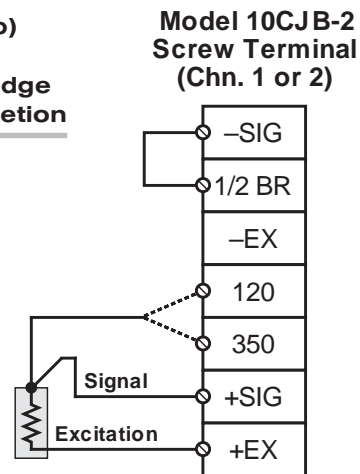


Fig. 7(c)
1/2-Bridge
Completion

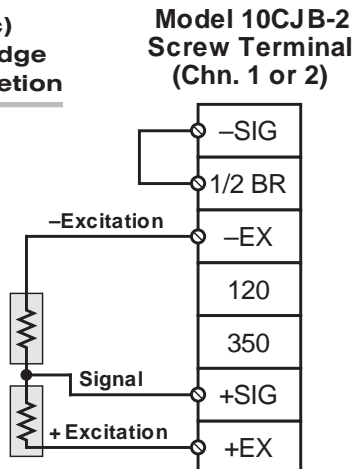
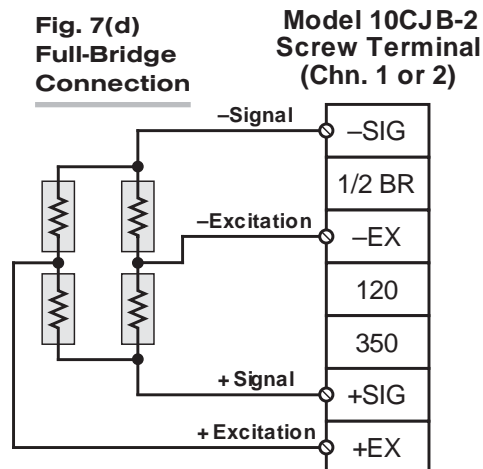


Fig. 7(d)
Full-Bridge
Connection



4.C CALIBRATION

CALCULATED CALIBRATION

You can calibrate an AA72 channel receiving strain-gage input from a Model 10CJB-2 Bridge Completion Card by applying the **MV/V CALIBRATION (MVV)** command as described in Section 3.d, above. Note however that, in this case,

- for “i” (the *transducer sensitivity rating*), you should enter one of the following full-scale “mV/V” values, whichever corresponds to the channel’s “type” setting (see Table 1): **0.75** (for “Type 70”), **1.50** (for “Type 71”), or **3.00** (for “Type 72”).
- for “u” (the *nominal full-scale rating*), you should enter the full-scale *microstrain range* that corresponds to the selected transducer sensitivity rating, as given in the following table:

Table 6 Strain Gage Microstrain Ranges (AA72)

Full-Scale Output (mV/V)	Full-Scale Microstrain Range
0.75	$u = 3000 / (N \cdot G)$
1.50	$u = 6000 / (N \cdot G)$
3.00	$u = 12000 / (N \cdot G)$

Here, “N” is the *number of active strain-gage arms* in the gage configuration. Thus, for a 1/4-bridge gage, N = 1; for a half-bridge gage, N = 2; and for a full-bridge gage, N = 4. “G” is the *gage factor* of the strain gage, and is normally provided by the manufacturer.

TWO-POINT (DEADWEIGHT) CALIBRATION

See Section 3.d, above, for the general procedure. Your first calibration point (entered via the **ZERO (ZRO)** command) should be *zero*. Your second calibration point (entered via the **FORCE (FRC)** command) should be expressed in *microstrain (microinches/inch)*.

SIMULATED (SHUNT) CALIBRATION

See Section 3.d, above, for the general procedure. Your EQUIVALENT INPUT value, which is entered via the **FORCE (FRC)** command—following zeroing of the channel and switching in of the shunt resistor—should be expressed in *microstrain (microinches/inch)*.

COARSE ZERO OFFSET

In the event that, during “Two-Point” or “Simulated” calibration of the 10CJB-2 channel, you are unable to set the desired span via the **FORCE (FRC)** command, you can apply a positive or negative zero offset of approximately 1 mV/V for balance correction, as follows:

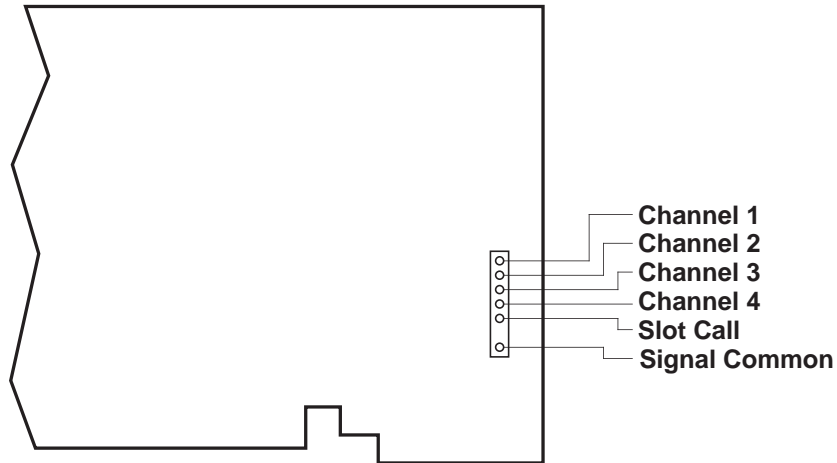
1. Remove the top plate of the 10CJB-2 box and locate the three programming jumper pads for the channel in question. Labelled “A” for Channel 1 and “B” for Channel 2, the pads are near the left edge of the 10CJB-2 circuit board.
2. Place a solder drop between the center pad and either the “+” or “-” pad, depending on the desired offset polarity.
3. Re-enter your **ZRO** and **FRC** values (with or without calibration “shunt”).

5 DIAGNOSTIC WIRE-WRAP PINS

As a special diagnostic and service tool, the five pins shown in Fig. 8 are directly accessible from the front of an installed AA72 card. These pins allow voltmeter or oscilloscope observation of data-channel output signals. **THEIR USE IS INTENDED PRIMARILY FOR TRAINED SERVICE TECHNICIANS.** With regard to the on-board diagnostic pins, please note the following:

- PROPER ESD PRACTICE SHOULD BE OBSERVED WHEN MAKING CONTACT WITH AN AA72 BOARD INSTALLED IN A "LIVE" DAYTRONIC SYSTEM MAIN-FRAME. ALWAYS GROUND YOURSELF TO THE MAINFRAME CHASSIS BEFORE TOUCHING THE BOARD.
- THE ANALOG SIGNAL PRESENT AT EACH ACTIVE "CHANNEL" PIN REPRESENTS *EIGHT TENTHS (0.8)* OF THAT CHANNEL'S NOMINAL CALL-BUS VOLTAGE. For a channel delivering a standard full-scale (+5-V) output, the corresponding diagnostic pin will therefore register +4 V.
- THE ANALOG SIGNAL PRESENT AT EACH ACTIVE "CHANNEL" PIN REPRESENTS THE FILTERED CHANNEL OUTPUT, AND IS NOT AFFECTED BY THE ANALOG OUTPUT MODE CURRENTLY SELECTED FOR THAT CHANNEL (see Section 3.c).
- THE "SLOT CALL" PIN DELIVERS A LOGIC SIGNAL THAT MAY BE USED TO SYNCHRONIZE AN OSCILLOSCOPE FOR TIMING ANALYSIS OF THE AA72 CARD.
- THE "CHANNEL 3" AND "CHANNEL 4" PINS ARE ONLY ACTIVE FOR AN AA72-4 CARD.

Fig. 8 Diagnostic Wire-Wrap Pins



AA72-2 / AA72-4 DUAL / QUAD DC STRAIN GAGE CARD

SYSTEM 10 GUIDEBOOK

1.F SCAN AND TIME SETUP

1.F.1 SETTING SYSTEM BASE CHANNEL: SBC

The **SYSTEM BASE CHANNEL (SBC)** command is useful only when you need a way to distinguish the data-channel ranges of multiple System 10 mainframes operating in the same environment. IN MOST SYSTEM 10 APPLICATIONS, YOU WILL HAVE NO REASON TO CHANGE THE BASE CHANNEL FROM ITS NORMAL DEFAULT VALUE OF "1."

If you want to change the current base channel, enter a command of

SBC = x [CR]*

where "x" is any CHANNEL NUMBER from "1" through the number that would result in a *highest* channel at the system limit of "997."

WARNING: This is a fairly drastic step, and should only be done *at the beginning of the configuration process*, before any actual channels have been defined. Changing the base channel will automatically shift all channel numbers accordingly, as well as the current **TERMINATOR (TER)** and **SCAN (SCN)** settings (see next section). You should also review all CALCULATES, EXECUTES, DIGITAL I/O, and other configuration statements that may contain channel-number references. *Any such statements will need to be individually revised to correspond to the new channel-number sequence.*

1.F.2 DEFINITION OF SCAN RANGE

NOTE: DEFINITION OF SYSTEM SCAN RANGE SHOULD PRECEDE THE CALIBRATION OF SYSTEM DATA CHANNELS (SECTION 1.G).

There are two mnemonic commands by which you can specify the precise range of data channels to be scanned by the System 10 Central Processor.* The **TERMINATOR (TER)** command is a "WRITE" command, and thus requires the EEPROM Write Protect Switch to be ON. The **SCAN (SCN)** command, on the other hand, is ordinarily a "RUN-TIME" command, and does not require the EEPROM to be enabled.

The data reported by any system channel outside the currently effective scan range will not be updated with each scan cycle. You should especially bear this in mind when outputting data for a range of channels via the **DUMP (DMP)**, **STREAM (STR)**, **HARD COPY (HCY)**, **SNAPSHOT (SNP)**, or **LIMIT ZONE (LZN)** commands (see Section 1.H.2)—or when applying the **ZERO (ZRO)**, **FORCE (FRC)**, and **TARE (TAR)** commands to one or more data channels (see Sections 1.G.5 and 2.G.3).

* Every mainframe's initial default scan range is normally preset at the factory, the typical range being from Channel No. 1 through the highest channel number called for by the system configuration specified at the time of order.

1.F SCAN AND TIME SETUP

System PSEUDOCHANNELS reporting *constant* values defined by the operator or computer via the “CHN=” or some similar command are normally assigned numbers *above* that of the highest channel to be scanned (see Section 2.D.1). Also note that Channel Nos. 998 (TIME) and 999 (DATE) are always scanned, regardless of the **TER** and **SCN** commands currently in effect.

a. SETTING DEFAULT SCAN RANGE: TER

The **TERMINATOR (TER)** command defines the *default scan range* to be automatically in effect upon each System 10 powerup. This is the continuous range of data channels from the current SYSTEM BASE CHANNEL (“SBC”)—normally Channel No. 1—up to and including the last-specified TERMINATOR (“TER”) CHANNEL. Thus, following a command of

TER = x [CR]*

where “x” is the Channel Number of the TERMINATOR CHANNEL, the system will scan from Channel No. 1 (or other presently specified SBC) through Channel No. x, on every system powerup and until application of an overriding **SCAN (SCN)** command.*

b. SETTING TEMPORARY SCAN RANGE: SCN

The default scan range defined by the last-entered **TER** command can be overridden *on a run-time basis* (while data acquisition is in process) by entering a **SCAN (SCN)** command *with the EEPROM disabled (i.e., EEPROM Switch OFF)*.

The **SCAN (SCN)** lets you specify the *first and last* data channels of a scanned array, so that the system scans from Channel No. x through Channel No. y (where $y \geq x$):

SCN = x, y [CR]

As soon as system power is cycled after entry of the above “run-time” **SCN** command, the effective scan range will revert to that defined by the last-entered **TERMINATOR (TER)** command.

Note, however, that the entry of a **SCAN (SCN)** command *with the EEPROM Switch ON* will in fact establish a new default scan range that will override the currently specified **TER** range and that *will* be automatically in effect upon each System 10 powerup. Normally, you would do this when you want to scan a subrange of channels within the **TER** range that *begins with a channel higher than the current system base channel*. If, for example, the present “SBC” is Channel No. 1 and the present “TER” is Channel No. 60, and you wanted the default scan range to be from Channel No. 20 through Channel No. 40, you would turn ON the EEPROM Switch and command

SCN = 20, 40 [CR]*

* For an “A-sized” mainframe without the “S” (Satellite) Option, the **TER** channel cannot be higher than “160”; for all other mainframes, it cannot be higher than “997.”

C. FLAGGING OUT-OF-SCAN CHANNELS: VSS

For “B-sized” System 10 mainframes only, you can arrange for the display of *any data channel presently outside the effective scan range* to be prefixed by an *ampersand (&)*. This is to alert the operator to the possibility that the displayed data reading for that channel may be invalid, if it is a “REAL” CHANNEL.

To produce ampersand flagging of all displayed out-of-scan channels, make sure the EEPROM Switch is ON, and apply a **VIDEO SCAN SYMBOL (VSS)** command of

VSS = 1 [CR]*

To *cancel* ampersand flagging, command

VSS = 0 [CR]*

1.F.3 SETTING SYSTEM TIME AND DATE: TME AND DTE

To set your System 10's *internal clock-time* (“t”), make sure the EEPROM Switch is ON and command

TME = t [CR]*

where “t” is a number of up to 6 digits expressing the current time in hours, minutes, and seconds. For example, commanding

TME = 150724 [CR]*

sets the clock-time to 15:07:24 (= 3:07:24 p.m.). Though not entered in the **TIME (TME)** command, the separating *colons* will be shown in every time display.

NOTE: The reporting of TIME is assigned automatically to **CHANNEL NO. 998** (only).

To set the *internal date* (“d”), make sure the EEPROM Switch is ON and command

DTE = d [CR]*

where “d” is a number of up to 6 digits expressing the current date in month, day, and year. For example, commanding

DTE = 60901 [CR]*

sets the date to 06/09/01 (= June 9, 2001). Though not entered in the **DATE (DTE)** command, the separating *slashes* will be shown in every date display.

NOTE: The reporting of DATE is assigned automatically to **CHANNEL NO. 999** (only).

For setting the VISUAL EFFECTS of the TIME and DATE displays, see Section 2.C.12(b).

SYSTEM 10 GUIDEBOOK

1.G CONFIGURATION AND CALIBRATION OF ANALOG INPUT CHANNELS

1.G.1 SETUP OF “REAL” (ANALOG INPUT) CHANNELS: TYP AND LCT

Before it can be calibrated for accurate reporting of “real world” measurement data, a System 10 “REAL” (ANALOG INPUT) CHANNEL must first be “configured” (or “initialized”).

1. For the “**TYPING**” and “**LOCATING**” of a real channel via the **TYPE (TYP)** and **LOCATE (LCT)** commands, refer to Section 7 (“Data Channel Configuration”) of the “On the Air” book for your mainframe type (“A-sized” or “B-sized”), located in the front of this Guidebook. The TYPE CODES applicable to each Conditioner Card model are given in the respective subsection of **Section 1.E.2** of this Guidebook.
2. Once a real channel has been assigned an appropriate TYPE CODE based on an installed “source” Conditioner Card and has been “located” to a specific subchannel of that card, you may proceed to enter other channel setup parameters either before or after the channel has been calibrated—**ASSUMING THAT THE CHANNEL HAS NOT BEEN PRECONFIGURED AT THE FACTORY, PRIOR TO SHIPMENT (CHECK YOUR CUSTOMIZED “SYSTEM 10 DATA SHEET” IN APPENDIX A OF THIS GUIDEBOOK).***

These other channel setup parameters include:

- the channel’s “**Filter**” **Constant (FIL)**, if you want it to be a value other than the real-channel default of “5”—see Section 2.G.2
- the channel’s **High / Low Limits (HIL, LOL)**, if you want them to be values other than the defaults of “3000” and “-3000,” respectively—see Section 2.F.2
- the channel’s “**Limit Logic**” (**LLT, LBT, LGT**) variables, if you want them to be values other than the default of “N/A”—see Section 2.F.4

* PLEASE NOTE: The **System 10 Data Sheet** will be included within the *System 10 Guidebook* itself (as **Appendix A**) only when a *printed* version of the *Guidebook* is supplied with a specific System 10. WHEN THE *GUIDEBOOK* IS PROVIDED ON CD OR OTHER ELECTRONIC MEDIUM, THE DATA SHEET WILL BE PROVIDED AS A SEPARATE DOCUMENT.

1.G CONFIGURATION AND CALIBRATION OF ANALOG INPUT CHANNELS

1.G.2 METHODS OF CALIBRATION

System 10 channels requiring CALIBRATION are those that contain physical measurement data from the “real world.” These include

- “**REAL**” (**ANALOG INPUT**) **CHANNELS** “sourced” by Daytronic SIGNAL CONDITIONER CARDS*
- **Peak Capture / Track-Hold** channels based on “real” channels (for the calibration of channels derived from the **Model 10A79-4 Analog Peak Capture Card**, see Section 3.A.4 of this Guidebook)

All other channel types—“PSEUDOCHANNELS,” “CONVERSION CHANNELS,” etc.—do not require calibration.**

In most cases, several alternative calibration methods will be available for a data channel originating from a given Conditioner Card. Which method you choose will depend on

- the type of *source transducer* for the channel
- the precise characteristics of the transducer/cable/conditioner combination
- the extent of your knowledge of these characteristics
- the possibility and/or convenience of producing actual or simulated transducer inputs of accurately known value

In general terms, you will calibrate a signal-conditioner channel by commanding the System 10 Central Processor to compute and store two constant values: a **SCALING FACTOR (“m”)**—also called “multiplier” or “gain” factor—and a **ZERO OFFSET (“b”)**. Automatically and continuously applied to all subsequent readings of the given channel, these two CALIBRATION CONSTANTS define the linear proportionality expressed by the equation $y = mx + b$, where “y” is the *measurement value* reported for the channel and “x” is the *ratio of the actual voltage of the analog input signal to the positive full-scale voltage of the channel’s chosen input “TYPE.”* As such, “x” is a unitless number operated upon by the “slope” coefficient “m” and the offset term “b” to yield a true analog measurement. Both “m” (**EMM**) and “b” (**BEE**) are to be expressed *in the engineering units of the chosen input “TYPE.”*

PLEASE NOTE: As explained in Section 1.G.3, “ABSOLUTE” calibration of a frequency-, current-, or voltage-measuring channel involves the direct setting of the channel’s “m” and “b” constants by application of the **SCALING FACTOR (EMM)** and **ZERO OFFSET (BEE)** commands, respectively. For all other calibration techniques, it is normally the case that both “m” and “b” are *automatically calculated and stored by the Central Processor during the run-time calibration procedure, and are NOT ENTERED DIRECTLY BY THE USER* via the **EMM** and **BEE** commands.

In fact, certain **EMM** and **BEE** values (other than the normal defaults) are automatically loaded for certain channel types as soon as those types are defined. Thus, for a thermocouple-based “real” channel or other channel capable of “ABSOLUTE (CPU)” calibration, specific “m” and “b” values are loaded as soon as the channel is “typed.” These values should normally NOT BE CHANGED.

* With the exception of channels based on the **Model 10A35 Encoder Conditioner Card**.

** Except for LINEARIZATION (“LIN”) channels, whose calibration is strictly based on prestored “look-up” tables (see Section 2.L).

The most likely reason you would have for changing a “real” channel’s current **EMM** value would be to change the effective *decimal-point precision* for that channel’s data reading. However, if you wish to *calibrate* a channel by directly entering its two calibration constants, you will have to use an “x” value that is, as mentioned above, the ratio of the actual input to the stated positive full-scale range. For example, if the channel is assigned a “TYPE” designation of “61” (= VOLTAGE INPUT CHANNEL, 50 mV-DC full scale), and the actual input is currently +45 mV, then $x = 0.9$ (and NOT “45”). If the 45-mV input corresponds to a measurement of, say, 1000 kPa, then for “ $y = mx + b$ ” we can write

$$1000 \text{ kPa} = m \text{ (kPa)} (0.9) + 0 \text{ (kPa)}$$

which yields an “m” (to the nearest kPa) of “1111” for the ± 50 -mV range, plus-or-minus the inherent initial accuracy of the conditioner. There are exceptions to this procedure, including certain VOLTAGE and CURRENT conditioners (10A60-4, 10A61-2) and THERMOCOUPLE conditioners that have their own linearization standards. Contact the factory for precise instructions.

As the examples given below will make clear, the *PRECISION* (i.e., decimal-point location) of the measurements reported by a given “real” channel will always match the precision of one of the numbers entered by the operator or computer during the calibration procedure.

The basic System 10 calibration methods are listed below, and are described in the following Guidebook sections. TO FIND OUT WHICH CALIBRATION METHOD OR METHODS MAY BE USED WITH A GIVEN CONDITIONER CARD, YOU SHOULD REFER TO THE RESPECTIVE SUBSECTION OF **SECTION 1.E.2** OF THIS GUIDEBOOK.

- **ABSOLUTE CALIBRATION (CPU)**—see Section 1.G.3(a)
- **ABSOLUTE CALIBRATION**—see Section 1.G.3(b)
- **CALCULATED CALIBRATION (FRQ)**—see Section 1.G.4(a)
- **CALCULATED CALIBRATION (MVV)**—see Section 1.G.4(b)
- **CALCULATED CALIBRATION (OTHER)**—see Section 1.G.4(c)
- **TWO-POINT (DEADWEIGHT) CALIBRATION**—see Section 1.G.5
- **SIMULATED (SHUNT) CALIBRATION**—see Section 1.G.6

1.G.3 ABSOLUTE CALIBRATION

a. CPU-BASED ABSOLUTE CALIBRATION

This form of “ABSOLUTE” CALIBRATION applies primarily to *temperature-measuring channels*. Here, the zero and scaling characteristics of the sensor/conditioner combination are fixed and known (by the System 10 Central Processor). Since the “m” (**EMM**) and “b” (**BEE**) values for such channels are prestored in System 10 memory, with suitable engineering-unit scaling, THERE IS NO NEED FOR ANY FURTHER CALIBRATION PROCEDURES ON THE PART OF THE USER, once the channel’s TYPE CODE has been specified.

Note that for a thermocouple-based “real” channel or other channel capable of CPU-base absolute calibration, specific **EMM** and **BEE** values are automatically loaded as soon as the channel is “typed.” THESE INITIALLY LOADED CALIBRATION CONSTANTS SHOULD NOT NORMALLY BE CHANGED.

1.G CONFIGURATION AND CALIBRATION OF ANALOG INPUT CHANNELS

b. ABSOLUTE CALIBRATION FOR A FREQUENCY, CURRENT, OR VOLTAGE CHANNEL: EMM

This form of “ABSOLUTE” CALIBRATION applies primarily to *frequency-, current-, and voltage-measuring channels* when it is frequency, current, or voltage (respectively) that is actually being measured—that is, when the received measurement signal is not an analog of some other parameter.

Here it is necessary to apply a SCALING FACTOR (“m” coefficient) which is *equal to the full-scale range corresponding to the channel’s present TYPE designation, expressed to the precision desired for the channel’s data reading.** This is done by means of the **SCALING FACTOR (EMM)** command.

Suppose, for example, that Channel No. x has been given a TYPE CODE of “67,” and has been “located” to a Model 10A63-2 Dual Voltage Conditioner Card. This channel is to be used to measure *voltage* itself, with a resolution of ± 1 mV. It may be calibrated “absolutely” simply by entering an **EMM** command of

EMM x = 5.000 [CR]*

since the stated full-scale range for “TYPE 67” is ± 5 V, and since we wish the channel to read to the nearest *thousandth* of a volt.

Before choosing absolute calibration for a frequency, current, or voltage channel, you should note that the resulting accuracy is limited to either the stated “initial offset” accuracy or the stated “gain accuracy” of the respective Conditioner Card, whichever represents a greater error value (for individual card specifications, see the respective subsection of **Section 1.E.2** of this Guidebook).

1.G.4 CALCULATED CALIBRATION

a. FREQUENCY INPUT CHANNEL: FRQ

This form of “CALCULATED” CALIBRATION is used exclusively with *frequency-measuring channels*, when the manufacturer-supplied full-scale rating of the frequency source (or the highest frequency expected to be measured) is known. This method involves sending an appropriate **FREQUENCY CALIBRATION (FRQ)** command to the System 10. It is generally faster, more convenient, and inherently more accurate alternative to “Two-Point (Deadweight)” calibration of a frequency input channel—although final accuracy of calibration will depend, of course, on the accuracy of the transducer manufacturer’s specifications.

For complete instructions, refer to the subsection of **Section 1.E.2** of this Guidebook that treats the channel’s “source” Frequency Input Conditioner Card (10A40, 10A41-2C, or AA41-2 / AA41-4).

b. STRAIN GAGE INPUT CHANNEL: MVV

This form of “CALCULATED” CALIBRATION is used exclusively with *channels originating from Strain Gage Conditioners* (with the exception of the Models 10A74-

* Channels of TYPE “5A” through “5F” (Model 10A60-4 Quad Voltage Conditioner Card, etc.) are exceptions. For such channels, you must enter an “m” value which is *1.25 times the stated full-scale range* for the respective TYPE.

4C and 10A78), when the manufacturer-supplied transducer sensitivity (in mV/V, full-scale) is known. This method involves sending appropriate **MILLIVOLT/VOLT CALIBRATION (MVV)** and **ZERO (ZRO)** commands to the System 10. It is generally faster, more convenient, and inherently more accurate alternative to “Two-Point (Deadweight)” calibration of a strain gage input channel—although final accuracy of calibration will depend, of course, on the accuracy of the transducer manufacturer’s specifications.

For complete instructions, refer to the subsection of **Section 1.E.2** of this Guidebook that treats the channel’s “source” Strain Gage Conditioner Card (10A70-2, 10A72-2C, 10A73-4, or AA72-2 / AA72-4).

C. OTHER CHANNEL TYPES

“CALCULATED” CALIBRATION may also be employed with a channel originating from a *Model 10A74-4C Quad Strain Gage Track-Hold Conditioner, Model 10A43 Dwell Angle Conditioner, Model 10A48 Modulated Carrier Flow Conditioner, Model 10A76 Vibration Conditioner, or Model 10A96 Amplified Accelerometer Vibration Conditioner Card.*

The precise commands sent to the System 10 will vary with the conditioner card that sources the channel. See the respective subsection of **Section 1.E.2** for complete instructions.

1.G.5 TWO-POINT (DEADWEIGHT) CALIBRATION: ZRO AND FRC

This is a conventional “zero and span” technique accomplished by the **ZERO (ZRO)** and **FORCE (FRC)** commands. It may be used for most types of “real” channel when the application of one or more accurately known transducer loads is possible. It can even be used with temperature-measuring channels (in place of standard “Absolute (CPU)” calibration, when it is desirable to force multiple temperature readings to the same exactly known temperature. The only Conditioner Cards to which it is not normally applicable (in its standard form) are the Models 10A43, 10A48, 10A74-4C, 10A76, and 10A96.

A TUTORIAL OVERVIEW of this calibration method is given in Section 10 (“Data Channel Calibration”) of the “On the Air” book for your mainframe type (“A-sized” or “B-sized”), located in the front of this Guidebook. If you have not already done so, you should study this section to familiarize yourself with the procedure, which is given in slightly more detail below.

1. Provide “Live” Channel Data Display

Using the guidelines given in Section 5 of the “On the Air” book, you should first arrange for a “live” display of the channel to be calibrated.

NOTE: If your System 10 does not have LCD/VFD or CRT video capability, you can “display” the channel to be calibrated by transmitting its data reading from the Computer Interface Port to a receiving CRT terminal. You can use the **STREAM (STR)** command for this purpose, along with a special **HEADER** or **TAILER** that allows *nonscrolling* CRT display of the system’s “datastream” output (see Sections 1.H.2(d) and 1.H.3 of this Guidebook for details).

1.G CONFIGURATION AND CALIBRATION OF ANALOG INPUT CHANNELS

Also, you should make sure that all channels to be calibrated are *within the currently effective SCAN RANGE*. See Section 1.F.2. Applying the **ZERO (ZRO)** or **FORCE (FRC)** command to an *unscanned* channel will probably result in an erroneous data reading for that channel.

2. Set Default Scaling: EMM Command

It is recommended that you enter the following **SCALING FACTOR (EMM)** command in order to set the “m” constant of the channel being calibrated (Channel No. “x”) to the initial default value of “5000,” if it does not already have this value (this command requires that the mainframe’s EEPROM Switch be ON):

EMM x = 5000 [CR]*

3. First Calibration Point: ZRO Command

a. If possible, establish a *zero input* for the channel by removing all load from the source transducer. If it is impossible or inconvenient to produce a transducer input of zero—as, for example, with absolute pressure measurements—then you can use a nonzero “CAL1” point. In this case, you would apply an *accurately known* value of input loading to the source transducer—a value (positive or negative) less than 20% of the nominal full-scale rating.

b. If the channel originates from an *LVDT Conditioner Card* (Model 10A30-2C, 10A31-4, or AA30-4), a command of

BEE x = 0 [CR]*

should first be entered, with the EEPROM Switch ON (where “x” is the Channel Number of the LVDT-based channel being calibrated). Then you should mechanically adjust the fixture and physical position of the LVDT until the *lowest reading occurs*. This is the LVDT’s “electrical null” point.

c. If you established a true *zero input* for Channel No. x in Step a, above, by removing all load from the source transducer, make sure the EEPROM Switch is ON, and enter a command of

ZRO x [CR]*

This command sets Channel No. x’s **ZERO OFFSET (BEE)** term such that the existing (zero) input yields a reading of *exactly zero*.*

NOTE: If there are a number of channels to be calibrated, you can, if you wish, zero all or some of them at the same time—perhaps during an initial system “zero” condition—by using the “range” form of the **ZERO (ZRO)** command:

ZRO x TO y [CR]*

* Entering the **ZRO x [CR]** command *with the mainframe’s EEPROM Switch OFF* is equivalent to entering the **TAR x [CR]** command, discussed in Section 2.G.3 of this Guidebook. That is, it will offset the reading of Channel No. x to zero, but will store this offset—now “temporary”—in *volatile RAM memory*. It will not affect the “permanent” ZERO OFFSET (“b”) value for Channel No. x presently contained in nonvolatile EEPROM. To restore the stored calibration offset (“b”), thus removing the temporary RAM-stored offset, you may either (1) recycle mainframe power, or (2) interrogate for Channel No. x’s current “b” value by commanding **BEE x [CR]**; note the answer “b,” make sure the EEPROM Switch is OFF, and then enter a command of **BEE x = b [CR]**.

If you established a *known nonzero input* for Channel No. x in Step a, make sure the EEPROM Switch is ON, and enter a command of

ZRO x = z₁ [CR]*

where “z₁” is the numerical value of the known input, with appropriate polarity. This command sets Channel No. x’s **ZERO OFFSET (BEE)** term such that the existing (nonzero) input yields a reading of “z₁.”

4. Second Calibration Point: FRC Command

- a. Apply an *accurately known* value of input loading to the source transducer—a value (positive or negative) from 80% to 100% of the nominal full-scale rating.

- b. Command

FRC x = z [CR]*

where “z” is the numerical value of the known input, with appropriate polarity. This command “forces” the data reading of Channel No. x to equal the value “z,” thereby setting the **SCALING FACTOR (EMM)** value that is to be applied to all subsequent readings of the channel.*

NOTE: For a “real” channel, the **FRC** command also sets the desired *precision*. If, for example, you’re measuring “pounds,” and enter a “z” of “300,” then all subsequent readings will be rounded to the nearest pound. If the entry is “300.0,” then all readings will be rounded to the nearest *tenth* of a pound.

Despite its apparent “WRITE” form, the **FRC** command—like both forms of the **ZRO** command—is strictly “IMPERATIVE” (see Section 1.C.1); it has no corresponding “READ” form.

5. Readjust Calibration Points, If Required

If necessary, repeat Steps 3 and 4, above, to obtain the most accurate “zero and span.” If, for example, the channel originates from an *LVDT Conditioner Card* (Model 10A30-2C, 10A31-4, or AA30-4), you should repeat the application of **ZRO** and **FRC** commands until the LVDT’s zero and span points coincide precisely with the calibration block or micrometer reference being used.

1.G.6 SIMULATED (SHUNT) CALIBRATION: SHP, SHN, AND RSM

This calibration technique is used primarily with *channels originating from Strain-Gage Conditioners* (with the exception of the Model 10A70-2).** It is similar to the

* In normal setup, you need not necessarily apply the **FRC** command to a channel *immediately* after you zero that channel—although for any given channel, application of **ZRO** must always *precede* application of **FRC**. You may, if you wish, apply other commands to other channels or to the system itself, between the applications to the same channel of **ZRO** and **FRC**.

** Although applied principally to strain gage transducers using a known *shunt resistance*, “simulated” calibration can also be useful when calibrating Frequency, Current, or Voltage inputs, particularly when the “simulating” input is an exact voltage reference standard, perhaps generated by an external calibrator.

1.G CONFIGURATION AND CALIBRATION OF ANALOG INPUT CHANNELS

“Two-Point (Deadweight)” calibration discussed in the previous section, except that second (“span”) input is not produced by loading the source transducer, but by “simulating” a particular up-scale value of mechanical input. This known EQUIVALENT INPUT then serves to determine the channel’s effective SCALING FACTOR (“m”).

For a channel originating from a Daytronic *Strain Gage Conditioner Card* (with the exception of the Model 10A70-2), the equivalent input is produced by shunting a resistor of known magnitude across one arm of the strain gage bridge, thereby simulating a known value of input for either a *positive* or *negative* up-scale reading. If the transducer manufacturer has supplied the exact value of the transducer’s equivalent input, it can be used as a reference point for calibrating the channel.

Equivalent input can be approximated from a knowledge of the *Shunt Calibration Resistance (R)*, the transducer’s *Bridge Resistance (B)*, and the transducer’s *Full-Scale Sensitivity (K, in mV/V full scale)*. To determine the EQUIVALENT INPUT (X) as an approximate percentage of full-scale output, you may use the following equation:

$$X = 25000B / K(R + 0.5B) \%$$

Since the equivalent input is here expressed as a *percentage of full-scale output*, you must multiply it by the rated full-scale capacity of the transducer, in order to determine the *actual input simulated by the shunt*.

Shunt calibration is an easier though generally less accurate technique than two-point (deadweight) calibration. It is useful, however, when overall “deadweighting” is impossible or inconvenient, and is good for an accuracy of about 0.2% (depending, of course, on the accuracy of the specified equivalent input, and on the resistor/bridge tolerance and temperature).

For the value and location of the per-channel SHUNT CALIBRATION RESISTOR(S) installed on a specific Strain Gage Conditioner Card, see the respective subsection of **Section 1.E.2** of this Guidebook. You may, if you wish, replace each channel’s installed shunt resistor with a resistor of another value (strain-gage transducer manufacturers often supply such resistors with their instruments).

As explained below, a System 10 strain gage channel’s shunt resistor is switched in and out by means of the **SHUNT CALIBRATE-POSITIVE (SHP)** or **SHUNT CALIBRATE-NEGATIVE (SHN)** command. A **RESUME (RSM)** command must then be applied to remove the shunt and resume normal channel measurement. Since these are “run-time” commands, the mainframe’s EEPROM Write Protect Switch need not be on for them to be effective.

NOTE: For most Strain Gage Conditioner Cards, shunt calibration can be “remotely” controlled, if desired, as an alternative to using the software commands provided by the system.* This remote calibration control is accomplished by means of *logic-level inputs to the card’s rear I/O CONNECTOR*. For the external logic interconnections specific to a given card, see the respective subsection of **Section 1.E.2** of this Guidebook.

* “Remote” shunt calibration control can be either *per-channel* (as with the Models 10A72-2C and AA72-2 / AA72-4) or *all channels together* (as with the Models 10A73-4 and 10A74-4C). Note that the **Model 10A78** must be specially modified before it can accept logic inputs for remote shunt calibration of its single strain gage channel.

1. **Provide “Live” Channel Data Display**

See Section 1.G.5, Step 1 (above).

2. **Set Default Scaling: EMM Command**

See Section 1.G.5, Step 1 (above).

3. **First Calibration Point: ZRO Command**

a. Establish a *zero input* for Strain Gage Channel No. x by removing all load from the source transducer.

b. Make sure the EEPROM Switch is ON, and enter a command of

ZRO x [CR]*

This command sets Channel No. x’s **ZERO OFFSET (BEE)** term such that the existing (zero) input yields a reading of *exactly zero*. See the comments regarding the **ZERO (ZRO)** command in Section 1.G.5, above.

4. **Switch In the Shunt Resistor**

To close and latch Channel No. x’s SHUNT CALIBRATION SWITCH for a *positive* up-scale reading, command*

SHP x [CR]

For a *negative* up-scale reading, command*

SHN x [CR]

As mentioned above, these are “run-time” commands, and so the main-frame’s EEPROM Write Protect Switch need not be on for them to be effective.

5. **Second Calibration Point: FRC Command**

Command

FRC x = z [CR]*

where “z” is the known EQUIVALENT INPUT produced by the shunt, with appropriate polarity. This command “forces” the data reading of Channel No. x to equal the value “z,” thereby setting the **SCALING FACTOR (EMM)** value that is to be applied to all subsequent readings of the channel. See the comments regarding the **FORCE (FRC)** command in Section 1.G.5, above.

6. **Switch Out the Shunt Resistor to Resume Normal Measurement**

Before Channel No. x can resume normal measurement, its SHUNT CALIBRATION SWITCH must be unlatched (i.e., reset) by entering a “run-time” command of*

RSM x [CR]

NOTE: To unlatch any and all latched calibration conditions that may exist on any system measurement channels, command

RSM [CR]

* Or, alternatively, use the appropriate *logic-level input* to the conditioner card’s rear I/O CONNECTOR (if applicable).

SYSTEM 10 GUIDEBOOK

1.H FORMATTING AND MANAGEMENT OF STANDARD DATA TRANSMISSIONS

1.H.1 INTRODUCTION: TYPES OF TRANSMISSIONS

A System 10 mainframe can be made to transmit different kinds of "data" from its Computer Interface Port. In this section we will be concerned only with the transmission from this port of *numerical values contained in system DATA CHANNELS* (whether these values represent actual measurements, calculations, downloaded constants, etc.), and of *"limit status" information* pertaining to these values.*

Depending on the requirements of your application, you can instruct System 10 to issue from its Computer Interface Port any one of several different types of serial ASCII outputs that represent *channel data retrieved from the system's continuously updated DATA RAM*. The respective DATA INTERROGATION COMMANDS are summarized in the following table.

Table 1.2 Summary of DATA INTERROGATION Commands

Name of Command	System 10 will respond by Transmitting Data for...	Optional Output Formatting Available for Transmission
CHANNEL (CHN)	one or a selected range of data channels, in sequence and <i>one time only</i>	Channel-Number "Echo"; Limit-Zone Indication; Alternative OUTPUT and/or TRANSMISSION Terminator
DUMP (DMP)	all scanned data channels** or a selected range of channels, in sequence and <i>one time only</i>	Channel-Number "Echo"; Limit-Zone Indication; Alternative OUTPUT and/or TRANSMISSION Terminator
SNAPSHOT (SNP)	all scanned data channels** or a selected range of channels, in sequence and <i>one time only, as a time-coherent data set</i>	Channel-Number "Echo"; Limit-Zone Indication; Alternative OUTPUT and/or TRANSMISSION Terminator
STREAM (STR)	one data channel, all scanned channels**, or a selected range of channels, in sequence, <i>continuously repeated</i> until commanded to halt	Limit-Zone Indication; HEADER and/or TAILER string; Number of Characters per Channel; Columnar Format; Alternative OUTPUT and/or TRANSMISSION Terminator

(cont'd)

* Note, however, that System 10 can also transmit (among other kinds of "data")
a. *configuration* data, in response to a specific "READ" command (see Section 1.C.4)
b. *bit-state* data, in response to a **BIT** command (see Section 2.H.2(c))
c. a *pre-entered character string*, on receipt of a command such as **INTERRUPT (ITR)** or **SEND (SND)** (see Section 2.B.6)

** Transmission of "all scanned channels" includes Channel Nos. 998 (TIME) and 999 (DATE).

1.H FORMATTING AND MANAGEMENT OF STANDARD DATA TRANSMISSIONS

Name of Command	System 10 will respond by Transmitting Data for...	Optional Output Formatting Available for Transmission
HARD COPY (HCY)	one data channel, all scanned channels*, or a selected range of channels, in sequence and <i>one time only</i>	Limit-Zone Indication; HEADER and/or TAILER string; Number of Characters per Channel; Columnar Format; Alternative OUTPUT and/or TRANSMISSION Terminator
LIMIT ZONE (LZN)	“limit-status” information for one or a selected range of data channels, in sequence and <i>one time only</i>	Alternative OUTPUT and/or TRANSMISSION Terminator

Note that ANY transmission from the Computer Interface Port may be instantly halted by application of an **ESCAPE (ESC)** command, which is described in Section 1.H.2(d), below.

Specific forms for each command in Table 1.2 are given in the following section. Optional formatting of transmissions is treated in Section 1.H.3. For complete instructions on connecting an *external receiving device*—computer, terminal, printer, recorder, etc.—to your System 10’s Computer Interface Port, see Section 2.B of this Guidebook.

Note here that

- a. Each of the commands in Table 1.2 is a “RUN-TIME” COMMAND and may be entered either via the System 10’s plug-in keyboard (if present) or via its Computer Interface Port.

Regardless of the means of entry, the **DUMP (DMP)**, **SNAPSHOT (SNP)**, **STREAM (STR)**, and **HARD COPY (HCY)** commands will always produce an output from the Computer Interface Port *only*. These commands will never cause requested data to be displayed on the system “billboard,” even when they are entered through the keyboard.

The **CHANNEL (CHN)** and **LIMIT ZONE (LZN)** commands, on the other hand, *will* produce an appropriate billboard response, but *only* when they are entered via the keyboard—in which case no output from the Computer Interface Port will be produced. When entered via the Computer Interface Port, the **CHN** and **LZN** commands will, like the other DATA INTERROGATION COMMANDS, produce appropriate output from that port (only).

- b. When using the multichannel or “range” (x TO y) form of the **DUMP (DMP)**, **SNAPSHOT (SNP)**, **STREAM (STR)**, **HARD COPY (HCY)**, and **LIMIT ZONE (LZN)** commands, you should take care that the specified range of data channels to be transmitted is *within or equal to the system’s currently specified SCAN RANGE* (see Section 1.F.2).**
- c. Every *data value* transmitted in response to one of the above commands can take a maximum of *seven characters*, in addition to a *minus sign*, if applicable. Maximum data precision is one part in ± 32767 (16 bits). Scaling multiplier fac-

* Transmission of “all scanned channels” includes Channel Nos. 998 (TIME) and 999 (DATE).

** Unless, of course, you deliberately want the transmission to include *unscanned* and therefore “frozen” data values, or DOWNLOAD PSEUDOCHANNELS that are outside the scan range.

tors, however, permit data values to be *scaled* or *expressed* by numbers within the range of -3276700 through 3276700. Any numeric character can be replaced by a decimal point.

Note too that data scaled to produce numbers larger than allowed by 16-bit precision will be automatically counted by increments greater than “1,” or will have one or more dummy zeros added, as may be required. Dummy zeros are *not* shown to the right of a decimal point.

- d. A time delay between successive channel transmissions can be specified via the **DELAY (DLY)** command, as explained in Section 1.H.4, below.

1.H.2 SPECIFIC TRANSMISSION COMMANDS

With regard to the *per-channel responses* shown below, note that

- “x” is the *Channel Number* of the transmitted channel
- “w” is the *data value* for this channel currently in System 10 RAM memory
- “z” is a number indicating the *LIMIT ZONE* in which this data value currently lies*:
 - z = **1** indicates data in the **LESS THAN** limit zone
 - z = **2** indicates data in the **BETWEEN** limit zone
 - z = **3** indicates data in the **GREATER THAN** limit zone
- *Spaces* are shown in the responses only for the sake of clarity; they are not transmitted.
- Parentheses () indicate *optional* elements within the response format (as further explained in Section 1.H.3). They are not themselves part of the transmission.
- All transmissions are shown with System 10’s standard *line-and-transmission termination* of **[CR][LF]** (= CARRIAGE RETURN, LINE FEED). You can specify alternative terminating characters for every output line and/or for every complete transmission from the Computer Interface Port by means of the **OUTPUT TERMINATOR (OPT)** and **END OF TRANSMISSION TERMINATOR (EOT)** commands, as explained in Section 1.H.3.

a. CHANNEL (CHN) COMMAND

Command:	Response (transmission from Computer Interface Port or answer appearing on mainframe “billboard” display, depending on means of command entry):
CHN x [CR]	Outputs (x), w (, z) [CR][LF] for Channel No. x only; billboard will display CHN x = w only, even if the LIMITS (LIM) command is in effect (see Section 1.H.3(b))

(cont’d)

* See Section 2.F.3 of this Guidebook for definitions of the three limit zones. Until a **HIGH LIMIT (HIL)** command has been applied to a given data channel, its effective high-limit value will be +3000 mV (or “scaled” equivalent); until a **LOW LIMIT (LOL)** command has been applied, the effective low-limit value will be -3000 mV or equivalent. For limit setting, see Section 2.F.2.

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CHN x TO y [CR] Outputs **(x,) w (, z) [CR][LF]** for all data channels from Channel No. x to and including Channel No. y ($y \geq x$); billboard will display data for Channel No. x *only* (you may use the keyboard's **Step** key to produce sequential readings on the billboard for a *range* of channels, following an initial keyboard entry of **CHN x [CR]**—see Section 1.C.4(b))

Note that the “WRITE” (or “**CHN=**”) form of the **CHANNEL (CHN)** command has several important uses, as summarized in Guidebook Section 4 under the **CHN** mnemonic. For instance, it lets you load a particular DOWNLOAD PSEUDOCHANNEL No. x with a fixed data value or with the current reading of another data channel (see Section 2.D).

Also note that on both an EXTENDED KEYBOARD and an OPERATOR'S KEYBOARD, you may enter a **CHANNEL (CHN)** command by means of the **Chan** key. Thus, to interrogate for the current data reading of, say, Channel No. 27, you need only press the **Chan** key and then type **27 [CR]**. You may then use the **Step** key, as mentioned above, to produce a sequence of billboard channel readings starting with Channel No. 28.

b. DUMP (DMP) COMMAND

Command: **Response** (transmission from Computer Interface Port only, regardless of means of entry, *one time only*):

DMP [CR] Outputs **(x,) w (, z) [CR][LF]** for *all scanned channels*, including Nos. 998 (TIME) and 999 (DATE)

DMP x TO y [CR] Outputs **(x,) w (, z) [CR][LF]** for all channels from Channel No. x to and including Channel No. y ($y \geq x$)

c. SNAPSHOT (SNP) COMMAND

This command permits the “dumping” of a data set without the *time-skew* effects that arise when data values reported by different channels reflect measurements made at different times. In this case, each “dump” is automatically preceded by an instantaneous locking of the System 10 DATA RAM and is followed by an unlocking of the RAM (see the **LOCK (LOK)** and **UNLOCK (UNL)** commands, Section 2.E).

Command: **Response** (transmission from Computer Interface Port only, regardless of means of entry, *one time only*):

SNP [CR] Outputs **(x,) w (, z) [CR][LF]** for *all scanned channels*, including Nos. 998 (TIME) and 999 (DATE)

SNP x TO y [CR] Outputs **(x,) w (, z) [CR][LF]** for all channels from Channel No. x to and including Channel No. y ($y \geq x$)

d. STREAM (STR) AND ESCAPE (ESC) COMMANDS

Command: **Response** (transmission from Computer Interface Port only, regardless of means of entry, *continuously repeated* until cancelled by **ESCAPE (ESC)**):

STR [CR] Outputs **x, w (, z) [CR][LF]** for *all scanned channels*, including Nos. 998 (TIME) and 999 (DATE), along with specified HEADER and/or TAILER

STR x [CR] Outputs **x, w (, z) [CR][LF]** for Channel No. x only, along with specified HEADER and/or TAILER

STR x TO y [CR] Outputs **x, w (, z) [CR][LF]** for all channels from Channel No. x to and including Channel No. y ($y \geq x$), along with specified HEADER and/or TAILER

To halt a transmission produced in response to any of the above **STREAM (STR)** commands, you must apply the **ESCAPE (ESC)** command. This you may do by pressing the keyboard's **Esc** key or by transmitting either the mnemonic **ESC** or the ASCII [**Esc**] character (= hex 1B) to System 10 via the Computer Interface Port. When applied, the **ESC** command not only terminates *any* transmission from the Computer Interface Port currently in progress, but also has the effect of clearing any partial command that has been entered.

For use of a special "header" or "tailer" string to allow *nonscrolling* CRT display of the datastream output, see Section 1.H.3(c), below.

e. HARD COPY (HCY) COMMAND

Command: **Response** (transmission from Computer Interface Port only, regardless of means of entry, *one time only*):

HCY [CR] Outputs **x, w (, z) [CR][LF]** for *all scanned channels*, including Nos. 998 (TIME) and 999 (DATE), along with specified HEADER and/or TAILER

HCY x [CR] Outputs **x, w (, z) [CR][LF]** for Channel No. x only, along with specified HEADER and/or TAILER

HCY x TO y [CR] Outputs **x, w (, z) [CR][LF]** for all channels from Channel No. x to and including Channel No. y ($y \geq x$), along with specified HEADER and/or TAILER

f. LIMIT ZONE (LZN) COMMAND

Command: **Response** (transmission from Computer Interface Port or answer appearing on mainframe "billboard" display, depending on means of command entry):

LZN x [CR] Outputs **z [CR][LF]** for Channel No. x only; billboard will display the words **BELOW LIMITS** (for $z = 1$), **BETWEEN LIMITS** (for $z = 2$), or **ABOVE LIMITS** (for $z = 3$)

(cont'd)

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LZN x TO y [CR]

Outputs **z [CR][LF]** for all data channels from Channel No. **x** to and including Channel No. **y** ($y \geq x$); billboard will display limit-zone information for Channel No. **x** *only* (you may use the keyboard's **Step** key to produce sequential limit-zone readings on the billboard for a *range* of channels, following an initial keyboard entry of **LZN x [CR]**—see Section 1.C.4(b)

1.H.3 FORMATTING OF TRANSMISSIONS

Note that **ECHO (ECO)**, **NO CHANNEL (NCH)**, **LIMITS (LIM)**, and **NO LIMITS (NOL)** are all “RUN-TIME” COMMANDS, and so the mainframe’s EEPROM Write Protect Switch need not be on for them to be effective. As in the previous section, “**x**” here indicates CHANNEL NUMBER, “**w**” indicates DATA VALUE, and “**z**” indicates LIMIT-ZONE INDICATOR NUMBER (1, 2, or 3).

a. CHANNEL-NUMBER “ECHO”: ECO AND NCH

To produce a per-channel format of

x, w (, z) [CR][LF]

for every transmission from the Computer Interface Port in response to a **CHANNEL (CHN)**, **DUMP (DMP)**, or **SNAPSHOT (SNP)** command, enter a command of

ECO [CR]

ECHO (ECO) is automatically in effect for the **STREAM (STR)** and **HARD COPY (HCY)** commands, and cannot be revoked (for responses to these commands) via the **NO CHANNEL (NCH)** command.

To cancel the Channel-Number “echo” for all **CHN**, **DMP**, and **SNP** transmissions, enter the **NO CHANNEL (NCH)** command:

NCH [CR]

Note that the **NO CHANNEL (NCH)** command is automatically in effect, by default, on mainframe powerup.

b. LIMIT-ZONE INDICATION: LIM AND NOL

To produce a per-channel format of

(x,) w, z [CR][LF]

for every transmission from the Computer Interface Port in response to a **CHANNEL (CHN)**, **DUMP (DMP)**, or **SNAPSHOT (SNP)** command, and a per-channel format of

x, w, z [CR][LF]

for all responses to a **STREAM (STR)** or **HARD COPY (HCY)** command, enter a command of

LIM [CR]

This command does not affect the displayed answer to a keyboard-entered **CHN x [CR]** command.

To cancel limit-zone indication for all transmissions to which it applies, enter the **NO LIMITS (NOL)** command:

NOL [CR]

Note that the **NO LIMITS (NOL)** command is automatically in effect, by default, on mainframe powerup.

C. "HEADER" AND "TAILER" STRINGS: HDR AND TLR

The **HEADER (HDR)** and **TAILER (TLR)** commands are intended for use when the Computer Interface Port is linked to an RS-232-c terminal or printer.

To specify an ASCII character string to be transmitted at the *beginning* of each data set issued from the Computer Interface Port in response to either a **STREAM (STR)** or **HARD COPY (HCY)** command, make sure the EEPROM Switch is ON and enter a command of

HDR = "\$" [CR]*

To specify an ASCII character string to be transmitted at the *end* of each data set issued in response to an **STR** or **HCY** command, enter

TLR = "\$" [CR]*

The HEADER or TAILER string "\$" may consist of up to 80 standard ASCII characters. *It must be entered within quotation marks (" ")*, which are not actually transmitted.

NOTE: In addition to alphanumeric text, a transmission header or tailer may contain one or more standard ASCII CONTROL CHARACTERS (Line Feed, Form Feed, Carriage Return, etc.) Each such character must be entered within the "\$" string as a *hexadecimal word enclosed in square brackets*. Two-character hexadecimal equivalents for standard ASCII control characters are given in Table 1.3, below (although the HDR or TLR string is not limited to the characters shown in this list).

For example, the command specifying a HEADER of

[CR][LF]TEST NO. 5[CR][LF]

would take this form:

HDR = "[0D][0A]TEST NO. 5[0D][0A]"*

A TAILER string in which the text "END OF TEST NO. 5" is preceded by Carriage Return, Line Feed and followed by Form Feed (to ensure that each data set is printed on a fresh page) would be entered as

TLR = "[0D][0A]END OF TEST NO. 5[0C]"*

The keyboard's **Line Feed** key may be used for direct entry of the Line Feed character (hex [0A]).

To cancel the system's currently specified header or tailer string, command, respectively,

HDR = N/A [CR]* or **TLR = N/A [CR]***

When entered through the Computer Interface Port, a "READ" command of **HDR [CR]** or **TLR [CR]** will cause the system to output from that port the currently

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specified HEADER or TAILER string (respectively). However, System 10 will *not* answer a keyboard-entered interrogation of **HDR [CR]** or **TLR [CR]**—i.e., a bill-board display of the current HEADER or TAILER string will *not* appear.

Table 1.3 Hexadecimal Coding of ASCII Control Characters

ASCII Character	Hex	ASCII Character	Hex
NULL	00	DLE	10
SOH	01	DC1	11
STX	02	DC2	12
ETX	03	DC3	13
EOT	04	DC4	14
ENQ	05	NAK	15
ACK	06	SYNC	16
BELL	07	ETB	17
BS	08	CAN	18
HT	09	EM	19
LF	0A	SUB	1A
VT	0B	ESC	1B
FF	0C	FS	1C
CR	0D	GS	1D
SO	0E	RS	1E
SI	0F	US	1F

USE OF HEADER OR TAILER TO PROVIDE NONSCROLLING “DATASTREAM” DISPLAY

You may use the **HEADER (HDR)** or **TAILER (TLR)** command to prevent scrolling of successive data sets transmitted to a CRT terminal via the **STREAM (STR)** command—and thus to achieve *in-place updating of all data within one displayed set*.

Simply include the **[HOME]** character as the *first* character in the HEADER string, or as the *final* character in the TAILER string. This will automatically drive the CRT cursor to the upper left corner of the screen, so that the display of each transmitted data set will begin at the same place.

However, since there is no universal ASCII **[HOME]** character, you will have to consult the literature accompanying your printer or terminal to find the specific CONTROL CHARACTER which it will recognize as **[HOME]**. The corresponding hexadecimal word (in square brackets) will be what you actually enter in your HEADER or TAILER string.

d. CHARACTERS PER CHANNEL: CPC

To format the DATA FIELD for all **STREAM (STR)** and **HARD COPY (HCY)** transmissions, you may use the **CHARACTERS PER CHANNEL (CPC)** command:

CPC = n [CR]*

where “n” is the desired *number of character spaces* you wish to constitute the data field for each channel transmission (including leading spaces). It may be any integer from 2 through 9, and is initially set at “8.”

Commanding, for example,

CPC = 9 [CR]*

permits transmission of a data *value* of seven characters (the maximum allowed), plus *two leading spaces*.

e. COLUMNAR FORMAT: CLM

To cause data sets transmitted in response to a **STREAM (STR)** or **HARD COPY (HCY)** command to be displayed or printed in *parallel columns*, you may apply the **COLUMNS (CLM)** command:

CLM = n [CR]*

where “n” is the *number of columns* desired, and is initially set at “1.” The maximum number of columns that can be displayed will depend on the *width* of the individual columns (all columns must be of the same width).

A column may have a *minimum* of 9 character spaces, to allow for

- channel number (3 spaces)
- comma (1 space)
- data field (2 spaces, where the **CPC** is the minimum of “2”—see previous section)
- 3 spaces to separate the column from an adjacent column to its immediate right*

A column may have a *maximum* of 17 character spaces, to allow for

- channel number (3 spaces)
- comma (1 space)
- data field (9 spaces, where the **CPC** is the maximum of “9”—see previous section)
- comma (1 space)
- limit-zone indicator (1 space—see the **LIM** command, Section 1.H.3(b))
- 2 column-separating spaces

f. ALTERNATIVE LINE AND/OR TRANSMISSION TERMINATION

SPECIFYING OUTPUT (“END-OF-LINE”) TERMINATOR: OPT

In almost all cases, every System 10 is factory-set to end every *line* of transmission from its Computer Interface Port with CARRIAGE RETURN, LINE FEED (**[CR][LF]**). If you require a different **OUTPUT TERMINATOR** in order to communicate effectively with a specific computer, printer, or other receiving device, you can use the following setup command:

OPT = \$ [CR]*

where the OUTPUT TERMINATOR string “\$” may consist of one or two ASCII CONTROL CHARACTERS (only).**

As with the **HEADER (HDR)** and **TAILER (TLR)** commands, above, every OPT character must be entered as a *hexadecimal word*. If the OPT has only one char-

* The three *separator spaces* must be included in all columns with a data field of 8 spaces or fewer.

** If the system has an **ASSIGN SATELLITE NUMBER (ASN)** other than “0,” the OPT cannot be set to any value other than **[0D]** (for **ASN**, see Section 3.B.3(b)).

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acter, it should be enclosed in *square brackets* (e.g., **OPT = [0A] [CR]***, which would cause each line of output to be terminated by a Line Feed). If two characters are entered, both should be within the same pair of brackets, separated by a comma (e.g., **OPT = [0D,0C] [CR]***, which would cause each line of output to be terminated by Carriage Return, Form Feed). For the allowed OPT characters, see Table 1.3, above.

Entering an **OUTPUT TERMINATOR (OPT)** character or characters will automatically enter the same character(s) as the current **END OF TRANSMISSION TERMINATOR (EOT)** (see below).

SPECIFYING END OF TRANSMISSION TERMINATOR: EOT

If no **END OF TRANSMISSION TERMINATOR (EOT)** command has been entered, the system will end every complete transmission from its Computer Interface Port—including every response to a “READ” COMMAND entered at that port—with the same character(s) specified by the last-entered **OUTPUT TERMINATOR (OPT)** command (with an initial default of **[CR][LF]**).

If, however, you want an end-of-*transmission* (EOT) terminator that is different from the current end-of-*line* (OPT) terminator, command

EOT = \$ [CR]*

where the END OF TRANSMISSION TERMINATOR string “\$” may consist of *up to four* ASCII CONTROL CHARACTERS (only).*

As with the **OUTPUT TERMINATOR (OPT)** command, each character must be entered as a *hexadecimal word*. If the EOT has only one character, it should be enclosed in *square brackets* (e.g., **EOT = [0C] [CR]***, which would cause each complete transmission to be terminated by a Form Feed). If two, three, or four characters are entered, they should all be within the same pair of brackets, separated by commas (e.g., **EOT = [0A,0C,07] [CR]***). For the allowed EOT characters, see Table 1.3, above.

Obviously, since a command of **OPT = \$ [CR]*** automatically loads a command of **EOT = \$ [CR]***, an **EOT** command specifying a *different* “\$” string from that entered by the last **OPT** command must always *follow* that **OPT** command.

1.H.4 SETTING INTERTRANSMISSION DELAY: DLY

The **DELAY (DLY)** command lets you set a *time delay* from 0 through 100 milliseconds, to occur between successive data transmissions from the Computer Interface Port that are produced in response to any valid DATA INTERROGATION COMMAND or to any valid “READ” COMMAND of the “range” form. Such a delay would avoid overrunning the computer input buffer when full handshake protocols are not implemented. The initial default **DLY** value is “0” (= NO DELAY).

The command has this form:

DLY = s [CR]*

where “s” is the desired intertransmission delay period in *milliseconds* ($0 \leq s \leq 100$).

* If the system has an **ASSIGN SATELLITE NUMBER (ASN)** other than “0,” the EOT cannot be set to any value other than **[0D]** (for **ASN**, see Section 3.B.3(b)).



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SECTION 3

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- SECTION 3.C.5** **VIDEO TOUCHSCREEN OPERATION:
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* Applies only to older "T" versions of the Model 10KN6 Mainframe (10KN6T, 10KN6-2T, 10KN6-3T, and 10KN6-4T).

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SECTION 4

ALPHABETICAL DIRECTORY OF SYSTEM 10 MNEMONIC COMMANDS

SECTION 4.A INTRODUCTION

SECTION 4.B COMMAND DIRECTORY

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APPENDICES

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APPENDIX N	PER-CHANNEL PROCESSING SPEEDS

* This section will be included within the Guidebook itself only when a *printed* version is supplied.

Note: The former “Appendix B” has been superseded by the current Guidebook **Section 1.B (“Card Insertion and Removal”)**. The former “Appendix D” has been superseded by material in the current Guidebook **Section 1.A.3.a (“Mainframe Powerup, AC Operation”)**.

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Appendix C

Data-Channel Reconfiguration

1. Uses of the RESET (RST) Command

If Channel No. *x* is a "REAL" (ANALOG INPUT) CHANNEL, a command of **RST *x* [CR]** will change the channel's current "TYPE" designation to "55."* The channel will now represent a direct millivolt reading of the DataPAC's internal "Called Signal Bus." The **RST** command will also reset the channel's SCALING FACTOR ("m" coefficient) to "5000," and its ZERO OFFSET ("b" term) to "0" (zero).

The initial channel "TYPE" code of a "REAL" (ANALOG INPUT) CHANNEL, a "CONVERSION" CHANNEL, or a DOWNLOAD or TIMER PSEUDOCHANNEL is normally set by means of a **TYPE (TYP)** command of the form **TYP *x* = *v* [CR]**. Other channel types are "autotyping." *The "TYPE" assignment for an "autotyping" channel is not—and cannot—be made by entering a TYP command.* Instead, the channel is automatically "typed" by the special command that serves to set it up. Examples of "autotyping" channels are a CALCULATE PSEUDOCHANNEL (set up by a **CALCULATE (CLC)** command), a LINEARIZATION PSEUDOCHANNEL (set up by a **LINEARIZE (LIN)** command), an ANALOG OUTPUT CHANNEL (set up by an **ANALOG OUTPUT (ANO)** command, and a VIDEO PLAYBACK PSEUDOCHANNEL (set up by a **PLAYBACK (PLA)** command).

To cancel the current "TYPE" assignment of an "autotyping" channel, the **RESET (RST)** command must be applied. Such a channel cannot be "reset" simply by commanding **TYP *x* = N/A [CR]**. In fact, the "WRITE" form of the **TYPE (TYP)** command will have *no effect at all* when applied to an "autotyping" channel.

If Channel No. *x* is a "CONVERSION" CHANNEL, an ANALOG OUTPUT CHANNEL, or a PSEUDOCHANNEL of any kind, a command of **RST *x* [CR]** will retype the channel to "D0." This is the type designation of a VOLATILE DOWNLOAD PSEUDOCHANNEL (see Section 2.D.1). If the channel is originally an "autotyping" channel, a subsequent interrogation for its respective setup value will return "N/A." For example, if you reset CALCULATE PSEUDOCHANNEL No. *x* by means of **RST *x* [CR]**, a subsequent inquiry of **CLC *x* [CR]** will return "N/A"—or if you reset ANALOG OUTPUT CHANNEL No. *x* by **RST *x* [CR]**, a command of **ANO *x* [CR]** will return "N/A."

RESET (RST) may also be used to discontinue the reading of a given channel or range of channels by a "B-sized" DataPAC SATELLITE, when the command is issued to the SATELLITE itself (see Section 3.B.3(b)), or to cancel the "location" of one or a range of VOLATILE DOWNLOAD PSEUDOCHANNELS to the Model 10BACI (see Section 3.B.5(c.7)).

NOTE: **RESET (RST)** is a "setup" command, and requires that the DataPAC's EEPROM WRITE PROTECT SWITCH be ON. It can take the standard "range" form of **RST *x* TO *y* [CR]**.

2. Data-Channel Reconfiguration

The following reconfiguration procedure is commonly used when an ANALOG INPUT CHANNEL'S transducer is being replaced, when the conditioner card to which it is "located" is being replaced, or when the calibration of the channel is questionable.

* NOTE: In 10ACP100/10BCP100 versions prior to "6.5," the **RST** command retypes *all* channels, including PSEUDOCHANNELS, to "55."

Appendix C

DATA-CHANNEL RECONFIGURATION

1. You should first turn ON the DataPAC's EEPROM SWITCH and apply a **RESET (RST)** command to the channel (No. "x"):

RST x [CR]

The channel will be retyped as "55." Its "m" value will be changed to "5000," and its "b" to "0."
NOTE THAT THE **RST** COMMAND WILL NOT AFFECT THE CHANNEL'S CURRENT "LOCATION" (**LCT**) ASSIGNMENT (for an explanation of DATA-CHANNEL "location," see Section 1.G.1.

2. You will now wish to "retype" the channel, using a **TYPE (TYP)** command of

TYP x = v [CR]

where "v" is the appropriate TYPE CODE as given in the table below. Type codes for individual "A-sized" CONDITIONER CARDS are also given in Section 1.E.2.

----- NOTE -----

You should use the following special procedure to set the TYPE for a DATA CHANNEL dedicated to the **Model 10A15-8 Thermistor Conditioner Card**:

- a. Apply a **RST x [CR]** command to the channel (as in Step 1, above). You must now use the **SCALING FACTOR (EMM)** and **ZERO OFFSET (BEE)** commands to set an appropriate "m" coefficient and "b" term, respectively, for the channel's "y = mx+b" equation (Section 1.G.2).

- b. If your thermistor's range is *0 to +100 degrees C*, and its resolution is *0.1 degree C*, enter

EMM x = 100.0 [CR] and BEE x = 0.0 [CR]

If its resolution is *0.01 degree C*, enter

EMM x = 100.00 [CR] and BEE x = 0.00 [CR]

- c. If your thermistor's range is *32 to +212 degrees F*, and its resolution is *0.1 degree F*, enter

EMM x = 180.0 [CR] and BEE x = 32.0 [CR]

If its resolution is *0.02 degree F*, enter

EMM x = 180.00 [CR] and BEE x = 32.00 [CR]

-
3. Then select the desired digital filter setting for the channel, using the **FILTER (FIL)** command (see Section 2.G.2). The filter value can be varied now or later to suit the application.
 4. Now recalibrate the channel by any of the calibration procedures specified for the respective conditioner card in Section 1.E.2. For general calibration considerations, see Section 1.G.
 5. **IF A CONDITIONER CARD IS BEING MOVED TO A DIFFERENT DATAPAC "SLOT," YOU SHOULD USE THE LOCATE (LCT) COMMAND TO "RELOCATE" ITS ANALOG INPUT CHANNEL(S).** First turn OFF the EEPROM SWITCH and DataPAC POWER. Reposition the card in the desired mainframe SLOT (see Section 1.B for "Card Insertion and Removal"). Then reactivate the DataPAC and turn ON the EEPROM SWITCH.

If the DataPAC is "A-sized," enter a command of

LCT x = ab [CR]

where "x" is the channel number, "a" is the channel's SLOT NUMBER, and "b" is its SUBCHANNEL NUMBER.

If the DataPAC is "**B-sized**," enter a command of

LCT x = abc [CR]

where "x" is the channel number, "a" is now the channel's DECK NUMBER, "b" is now its SLOT NUMBER, and "c" is its SUBCHANNEL NUMBER.

IN EITHER CASE, THE TYPING OF AN ANALOG INPUT CHANNEL SHOULD ALWAYS *PRECEDE* THE A-SLOT LOCATING OF THAT CHANNEL. For more details on the **LOCATE (LCT)** command, see Section 1.G.1

System 10 Channel TYPE Codes

Thermocouple Channels (10A9-8C, 10A10-4)

Type B, 1° C resolution	16
Type B, 1° F resolution	1E
Type B, 0.1° C resolution	26
Type B, 0.2° F resolution	2E
Type E, 1° C resolution	10
Type E, 1° F resolution	18
Type E, 0.1° C resolution	20
Type E, 0.2° F resolution	28
Type J, 1° C resolution	11
Type J, 1° F resolution	19
Type J, 0.1° C resolution	21
Type J, 0.2° F resolution	29
Type K, 1° C resolution	12
Type K, 1° F resolution	1A
Type K, 0.1° C resolution	22
Type K, 0.2° F resolution	2A
Type R, 1° C resolution	13
Type R, 1° F resolution	1B
Type R, 0.1° C resolution	23
Type R, 0.2° F resolution	2B
Type S, 1° C resolution	14
Type S, 1° F resolution	1C
Type S, 0.1° C resolution	24
Type S, 0.2° F resolution	2C
Type T, 1° C resolution	15
Type T, 1° F resolution	1D
Type T, 0.1° C resolution	25
Type T, 0.2° F resolution	2D

Type N, -180.0°C to +1300.0°C	44
Type N, -292.0°F to +2372.0°F	44
Type R, -50.0°C to +1768.0°C	45
Type R, -58.0°F to +3214.4°F	45
Type S, -50.0°C to +1768.0°C	46
Type S, -58.0°F to +3214.4°F	46
Type T, -200.0°C to +400.0°C	47
Type T, -328.0°F to +752.0°F	47

Thermistor Channels* (10A15-8)

ALL	55
-----	----

Platinum RTD Channels (10A16-4C, 10A17-2)

50 DIN, 1° C resolution	A9
50 DIN, 0.1° C resolution	AA
50 DIN, 1° F resolution	AB
50 DIN, 0.2° F resolution	AC
100 DIN, 1° C resolution	A1
100 DIN, 0.1° C resolution	A2
100 DIN, 1° F resolution	A3
100 DIN, 0.2° F resolution	A4
200 DIN, 1° C resolution	A5
200 DIN, 0.1° C resolution	A6
200 DIN, 1° F resolution	A7
200 DIN, 0.2° F resolution	A8
100 AMERICAN, 0.1° C resolution	AD
100 AMERICAN, 0.2° F resolution	AE

Thermocouple Channels (AA14-4F010)

Type E, -200.0°C to +1000.0°C	41
Type E, -200.00°C to +250.00°C	67
Type E, -328.0°F to +1832.0°F	41
Type J, -200.0°C to +1200.0°C	42
Type J, -200.00°C to +250.00°C	64
Type J, -328.0°F to +2192.0°F	42
Type K, -200.0°C to +1372.0°C	43
Type K, -200.00°C to +250.00°C	61
Type K, -328.0°F to +2501.6°F	43

Platinum RTD Channels (10A18-4C)

100 DIN, 0.1° C resolution	72
100 DIN, 0.01° C resolution	71
100 DIN, 0.1° F resolution	72
100 DIN, 0.01° F resolution	70
100 AMERICAN, 0.1° C resolution	72
100 AMERICAN, 0.01° C resolution	71
100 AMERICAN, 0.1° F resolution	72
100 AMERICAN, 0.01° F resolution	70

(cont'd)

* See the special typing procedure given above for the 10A15-8.

LVDT Channels

(10A30-2C, 10A31-4)

78 mV/V rms	64
156 mV/V rms	63
312 mV/V rms	65 ¹
525 mV/V rms ("long-stroke")	64
1.05 V/V rms ("long-stroke")	63
2.10 V/V rms ("long-stroke")	65 ¹

LVDT Channels

(AA30-4)

70 mV/V rms	5A
140 mV/V rms	5B
280 mV/V rms	5C
410 mV/V rms	5D
820 mV/V rms ("long-stroke")	5E
1.64 V/V rms ("long-stroke")	5F

Incremental Pulse Encoder Channels

(10A35)

ALL	CA
-----	----

Frequency Channels

(10A40, 10A41-2C, AA41-2, AA41-4)

250 Hz	40
500 Hz	41
1000 Hz	42
2000 Hz	43
4000 Hz	44
8000 Hz	45
16000 Hz	46
32000 Hz	47

Dwell Angle Conditioner Channels

(10A43)

Dwell Angle Channel	40
Engine RPM Channel ² :	
Max. Expected RPM = K x 7500	40
Max. Expected RPM = K x 15000	41
Max. Expected RPM = K x 30000	42

Simmonds Shaft Torque Channels³

(10A45)

ALL	55
-----	----

Modulated Carrier Flow Conditioner Channels³

(10A48)

Flow Channel	40
Alignment Channel	55

DC Voltage Channels

(10A60-4)

±0.5 V-DC	5A
±1.0 V-DC	5B
±2.0 V-DC	5C
±5.0 V-DC	5D
±10.0 V-DC	5E
±20.0V-DC	5F

DC Voltage and Current Channels

(10A61-2, 10A62-8C, 10A63-2, 10A64-8C, 10A65-8)

±50 mV-DC	(10A63-2, 10A65-8)	61
±100 mV-DC	(10A63-2, 10A65-8)	60
±200 mV-DC	(10A63-2, 10A65-8)	62
±500 mV-DC	(10A63-2)	64
±1 V-DC	(10A63-2)	63
±2 V-DC	(10A63-2)	65
±5 V-DC	(10A63-2, 10A64-8C)	67
±10 V-DC	(10A63-2, 10A64-8C)	66
±20 V-DC	(10A63-2, 10A64-8C)	68
±50 V-DC	(10A63-2)	6A
±100 V-DC	(10A63-2)	69
±200 V-DC	(10A63-2)	6B
4-20 mA	(10A61-2, 10A62-8C)	6C
4-12-20 mA	(10A61-2, 10A62-8C)	6D

(cont'd)

¹ Equivalent to Type "30" for these LVDTConditioner Cards.

² Where K = (No. of Cycles) / (No. of Cylinders). See the sheet for this conditioner in Section 1.E.2.

³ See the sheet for this conditioner in Section 1.E.2.

Appendix C

DATA-CHANNEL RECONFIGURATION

AC RMS Voltage and Current Channels

(10A68-2, 10A69-4)

50 mV-AC	61
100 mV-AC	60
200 mV-AC	62
500 mV-AC (10A68-2 only)	64
1 V-AC (10A68-2 only)	63
2 V-AC (10A68-2 only)	65
5 V-AC	67
10 V-AC	66
20 V-AC	68
50 V-AC	6A
100 V-AC	69
200 V-AC	6B
500 V-AC (10A68-2 only)	67
50 mA (10A68-2 only)	61
100 mA (10A68-2 only)	60
200 mA (10A68-2 only)	62
500 mA (10A68-2 only)	67
5 A (10A68-2 only)	64

Strain Gage Channels

(10A70-2, 10A73-4, 10A78)

0.75(0) mV/V	70
1.50(0) mV/V	71
3.00(0) mV/V	72

Strain Gage Channels

(10A72-2C, AA72-2, AA72-4)

7.5 / 1.5 / 0.75 mV/V	70
15.0 / 3.0 / 1.50 mV/V	71
30.0 / 6.0 / 3.00 mV/V	72

Strain Gage Channels

(10A74-4C)

±7500 microstrain	70
±15000 microstrain	71
±30000 microstrain	72

Vibration Channels

(10A76, 10A96)

Band-Pass Cut-Off Frequency:	
20 Hz	40
40 Hz	41
80 Hz	42

125 Hz	43
250 Hz	44
500 Hz	45
1000 Hz	46
1600 Hz	47

Binary Conversion Channels

(Section 3.B.2(e))

Binary (BIN) Output	B1
Binary (BIN) Input	B4
Binary Coded Decimal (BCD) Output	B2
Binary Coded Decimal (BCD) Input	B3

Counter/Timer Channels

(10ACT01, 10ACC-4; Section 3.A.1)

Frequency	C0
Period (1/f)	C1
Totalizer (Event Counter)	C2
Timer	C3

Download and Timer

Pseudochannels

(Sections 2.D, 3.B.3(b.5), 3.B.4(d.8), 3.B.5(c.7))

Volatile Download Pseudochannel	D0
Nonvolatile (EEPROM-resident) Download Pseudochannel	D1
Incremental One-Second Counter Pseudochannel	D2
Decremental One-Second Counter Pseudochannel	D3
Global Download Pseudochannel ("A-sized" Satellite DataPAC)	D4
Video Playback Pseudochannel ("History Playback")	D9
10BACI Volatile Download Pseudochannel	DA

Analog Output Channels

(Section 3.A.2(b.2))

ANO x = m (CHN y) + b	E0
ANO x = e	E1

(cont'd)

Calibration and Linearization Pseudochannels

(Sections 3.A.4(b.4), 2.L)

Calibration Conversion Pseudochannel	E8
"Real" Linearization Channel ($LIN_x = F_n(CHN_x)$)	EA
"Pseudochannel" Linearization Channel ($LIN_y = F_n(CHN_x)$)	EA

Calculation Pseudochannels

(Section 2.J)

$CLC\ x = m(CHN\ y + CHN\ z) + b$	F0
$CLC\ x = m(CHN\ y - CHN\ z) + b$	F1
$CLC\ x = m(CHN\ y)(CHN\ z) + b$	F2
$CLC\ x = m(CHN\ y) / (CHN\ z) + b$	F3
$CLC\ x = (CHN\ y) / (CHN\ z)^m + b$	F4
$CLC\ x = m(CHN\ y)(CHN\ z) / m + b$	F5
$CLC\ x = m(CHN\ y) + b$	F6
$CLC\ x = m / (CHN\ y) + b$	F7
$CLC\ x = m(SQR\ CHN\ y) + b$	F8
$CLC\ x = m(ABS\ CHN\ y) + b$	F9
$CLC\ x = m(MAX\ CHN\ y) + b$	FA
$CLC\ x = m(MIN\ CHN\ y) + b$	FB
$CLC\ x = (CHN\ y) / m + b$	FC

Appendix E

"Rebooting" the System

----- CAUTION ! -----

THIS PROCEDURE IS INTENDED TO ERASE ALL CONTENTS OF THE DATA-PAC'S CENTRAL PROCESSOR EEPROM MEMORY. It should be performed ONLY

- upon installation of new software which specifically requires a new system "personality"
- after replacement of the CENTRAL PROCESSOR's EEPROM following failure of this component
- when a severe software defect has been encountered
- following complete system collapse, which has occurred *while the EEPROM was enabled (switch ON)*. (You should note that if such collapse was the result of some hardware error, the "rebooting" procedure will probably NOT be effective.)

In any event, you should contact the Daytronic Customer Service Department before you attempt this procedure, to determine whether it is really necessary, or whether an alternative method exists for clearing the software or reinitializing the system.

To "reboot" a DataPAC, you should

1. Turn OFF the power and remove the appropriate FRONT BEZEL to expose the DataPAC's INTERFACE CARD (for an "A-Sized" DataPAC, this is the **Model 10ACP100**, which is either underneath the A-CARD array (Models 10KU, 10KU-KD, 10K4T, etc.) or in the rightmost A SLOT (Models 10K1, 10K1C, 10K2, 10K2C, etc.); for a "B-Sized" DataPAC, it is the **Model 10BIP232**, which is always in the rightmost B SLOT). NOTE: IF THERE ARE ANY CONNECTIONS TO THE COMPUTER INTERFACE PORT, DISCONNECT THEM AT THIS TIME. IF A COMPUTER OR OTHER EXTERNAL DEVICE IS TRYING TO COMMUNICATE WITH THE SYSTEM DURING A "REBOOT," THE SYSTEM MAY NOT REBOOT CORRECTLY.
2. Locate the two gold terminal posts near the front edge of the INTERFACE CARD. Temporarily connect these two posts by laying the shaft of a small screwdriver across the tops of the posts. The post nearest the front edge is connected to SYSTEM COMMON.
3. While the two posts are thus connected, place the DataPAC's EEPROM SWITCH in the *upward* ("ON") position.
4. Turn ON the power. The red **E2P** indicator should light, along with the red **ERR** indicator and the green **CHR**, **MNE**, and **RET** indicators.
5. When all five of the indicator lights mentioned in Step 4 are ON, disconnect the two terminal posts by removing the screwdriver. For a System 10 with video capabilities, the video will announce "EEPROM INITIALIZATION."

Appendix E

"REBOOTING" THE SYSTEM

6. For a System 10 with video capabilities, the internal rebooting routine will take about *seven minutes*. When it is over, the video screen will return to its normal powerup page and all SYSTEM STATUS INDICATORS will go out except for **E2P** and possibly **MNE**. For a System 10 without video capabilities, it may take only *three minutes* to reboot. When it is over, all SYSTEM STATUS INDICATORS will go out except for **E2P**.
7. Turn OFF the EEPROM SWITCH.
8. The EEPROM HAS NOW BEEN TOTALLY CLEARED. Reconnect any connections to the Computer Interface Port. You will have to *reconfigure* and *recalibrate* the system, following the instructions given in Section 1 of this Guidebook.

Appendix H

Linearization Techniques with System 10

For "Method A" ("Look-Up Table with System 10 'L' Option"), see also
Section 2.L of this Guidebook.

Linearization Techniques with System 10

Signals derived from nonlinear sensors can adversely affect the observed system accuracy. It is therefore desirable to do all that is possible to "linearize" such signals—that is, to "bend" their characteristic curves to achieve at least approximately "straight-line" performance. There are two principal ways of doing this: via **LOOK-UP TABLE** (System 10 "L" Option) and via **"CALCULATE" FUNCTIONS**. Each of these methods is described below. The actual choice of method will be determined by several factors, as shown in the following table:

<u>Linearization Method</u>	PRO	CON
METHOD A: LOOK-UP TABLE ("L" Option)	<ol style="list-style-type: none"> 1. Same table can be shared by more than one signal of a given type (e.g., TC or RTD). 2. Higher speed. 3. Able to "straighten" curves with greater nonlinearity (typically greater than 5%). 4. Better ultimate accuracy. 	<ol style="list-style-type: none"> 1. Additional cost (see System 10 price list). 2. A maximum of eight tables can be installed in the DataPAC's CENTRAL PROCESSOR CARD. 3. Requires factory installation if external computer is not available. 4. Requires adequate curve information to generate tables.
METHOD B: "CALCULATE" FUNCTIONS	<ol style="list-style-type: none"> 1. Available at no additional cost, provided that an adequate number of unused data channels is available. 2. Easily modified in the field, with or without external computer. 3. Individual "curve-bending" function available to each signal. 4. Relatively high accuracy (0.2% or better) attainable from signals under 4% initial nonlinearity. 	<ol style="list-style-type: none"> 1. Each linearization requires <u>one</u> CALCULATE for the first segment and <u>four</u> CALCULATES for each additional segment. A 1%-2% nonlinear curve typically requires three segments (i.e., <u>nine</u> separate CALCULATE channels, in addition to the SOURCE channel—see the example below). 2. Decreases overall system scan speed, due to additional channels being used.

METHOD A: LOOK-UP TABLE (System 10 "L" Option)

The "Custom Linearization (L) Option" can be added to any System 10 DataPAC with a CENTRAL PROCESSOR CARD containing SOFTWARE VERSION "8.8" or higher. It can linearize up to eight different nonlinear inputs.* A total of 256 59-segment breakpoints are used to profile the input curve at any selected position on the curve. Specific linearization tables can be entered at the factory or can be downloaded by the user, by means of a Daytronic "SofPAC" program included in the option. This software will run on an IBM PC or Daytronic Industrial Personal Computer (IPC).

Linearization of a given ANALOG DATA CHANNEL No. "X1" can be initiated by means of a computer- or operator-entered command of this general form:

$$\text{LIN } X1 = F_n(\text{CHN } X2) \text{ [CR]}$$

where "n" designates the particular linearization table—one of a possible eight user-designated "functions" (F)—which is to operate on Channel No. "X2" (in the case of analog-channel linearization, $X1 = X2$).

* This option is of particular use in linearizing RTD inputs for 0.01-degree resolution. It is also recommended for flowmeter and special thermocouple channels, where it can normally achieve better than manufacturer's accuracy specifications.

METHOD B: "CALCULATE" FUNCTIONS

This method is ideal for signals generated by load cells, LVDT's, and other transducers, where variation from the ideal straight line is only slight. Using calibration data obtained from known inputs, the procedure employs the DataPAC's "CALCULATE" PSEUDOCHANNELS to construct a linear characteristic segment-by-segment, assuming a linear interpolation between the known calibration points. The following example, using three output "segments," will illustrate the technique. Additional segments may be added by restating the CALCULATES used in preceding segments, until the desired linearity is achieved.

The procedure was originally conceived for a large steel mill with sensors of over 500,000-pound range and 2% to 3% nonlinearity. It has subsequently been applied to outputs from relative humidity sensors, in order to obtain a linear constant for correcting "live" observed horsepower on combustion engines.

1. DETERMINATION OF LINEARIZATION SEGMENTS

- a. The first step in linearization of an actual sensor channel is to prepare a table of "mV/V" outputs versus known input values, similar to Table 1, below. In the present example, the sensor is a 4000-pound strain gage load cell. A simple one-point calibration of the 4000-lb endpoint yields a nonlinearity as great as 1.5% of full scale in the middle portion of the sensor's rated range.

Table 1.

<u>Applied Load (lbs)</u>	<u>Measured mV/V Output</u>
0	0.0
500	0.320
1000	0.636
1500	0.952
2000	1.256
2500	1.560
3000	1.852
3500	2.148
4000	2.440

The more measurement points we include in the table, the greater the accuracy of the final result. Also, it is important that these calibration measurements be made as carefully as possible, to minimize errors that may arise from other sources.

- b. The next step is to produce a plot of Linearity error in "% of full scale." From this plot we may determine the output "segments" that will yield the desired degree of correction.

The procedure is as follows:

1. Divide the full-scale output (in "mV/V") by the full-scale input (in "lbs"), to obtain a **SCALE FACTOR** (in "mV/V/lb"). In our example, the SCALE FACTOR will be 2.44 mV/V divided by 4000 lbs, or 0.00061 mV/V/lb.
2. Multiply each input value in the table by this SCALE FACTOR, to obtain a set of **NORMALIZED OUTPUTS** (in "mV/V"). The NORMALIZED OUTPUTS for our example are shown in Table 2, below.

Table 2.

<u>Applied Load (lbs)</u>	<u>Measured Output (mV/V)</u>	<u>Normalized Output (mV/V)</u>	<u>mV/V Error</u>	<u>% Error</u>
0	0.0	0.0	0.0	0.0
500	0.320	0.305	0.015	0.62
1000	0.636	0.61	0.026	1.07
1500	0.952	0.915	0.037	1.52
2000	1.256	1.22	0.036	1.48
2500	1.560	1.525	0.035	1.43
3000	1.852	1.83	0.022	0.90
3500	2.148	2.135	0.013	0.53
4000	2.44	2.44	0.0	0.0

3. Subtract each NORMALIZED OUTPUT from the corresponding measured output, to obtain the "**MV/V ERROR**" for each calibration point. Convert each "MV/V ERROR" value to "**% ERROR**" by first multiplying by 100 and then dividing by the full-scale "mV/V" value (in our exam-

ple, this is 2.44 mV/V—see Table 2, above).

4. Now plot each "% ERROR" against the corresponding "Applied Load" (in lbs). See Fig. 8.D.1. Construct an "error band" on this plot by marking values above and below each plotted "% ERROR" point that differ from the plotted point by the desired maximum allowable linearity error. Draw straight lines between successive upper allowable-error values to produce the "plus" line of the error band; connect the lower values to produce the "minus" line. In our example, we wish to achieve correction between plus or minus 0.1% of full scale.
5. Starting at the origin, use a straight-edge to construct the fewest number of straight-line segments that approximately connect all "% ERROR" points over the total input range without exceeding the boundaries of the plus and minus error-band lines. Note the input values at which each "segment" begins and ends. Fig. 8.D.1 shows that our 4000-pound sensor will require three segments to achieve the desired linearity correction (i.e., to within $\pm 0.1\%$ of full scale). These segments are 0 to 1500 pounds, 1500 to 2500 pounds, and 2500 to 4000 pounds.

NOTE: Since it is the nature of transducer linearity errors in general to be smooth and free of discontinuities, you should be suspicious of any points on the "% ERROR" curve that depart abruptly from the overall shape of the curve. Such "off-line" points most likely result from random measurement errors, and any attempt to accommodate them can needlessly—and sometimes harmfully—complicate the linearization procedure.

2. SETUP OF "SIMULATED INPUT" CHANNEL

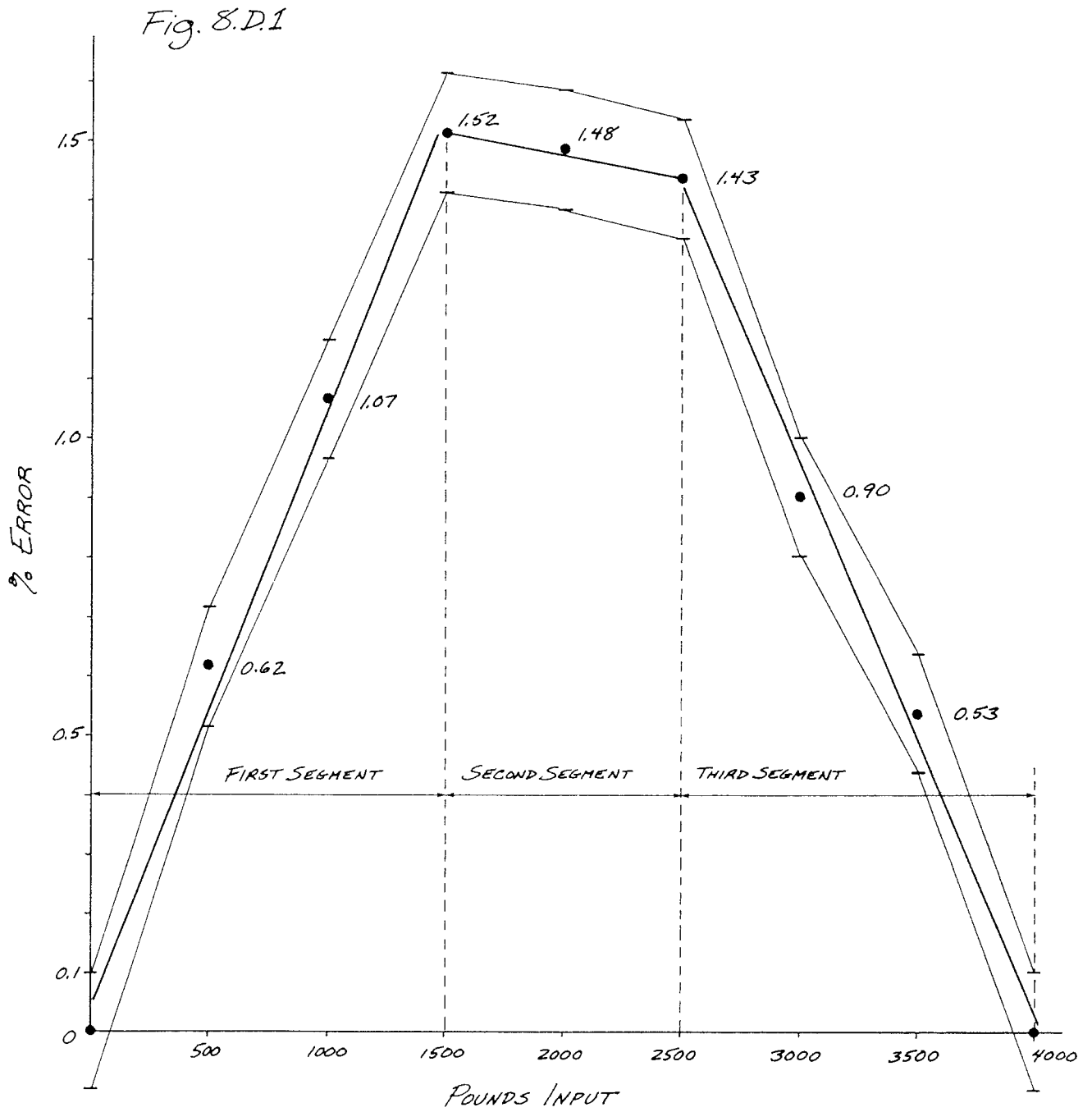
You will now establish a temporary PSEUDOCHANNEL, to be used for downloading various "mV/V" values to simulate inputs from the sensor. This "SIMULATED INPUT" CHANNEL can have any desired Channel Number. Here, we will assign it Channel No. 399—a number which is assumed to be well above the range of scanned system channels. To set up this channel for downloading, simply enter a command of

TYP 399 = DO [CR] *

The "*" in this and subsequent command expressions merely indicates that the DataPAC's EEPROM WRITE PROTECT SWITCH must be ON for the command to be effective. Also, make sure that the TYPE code entered for Channel No. 399 is "D" followed by zero, not the letter "O."

3. SETUP OF "OUTPUT" CHANNEL FOR THE FIRST SEGMENT

We will want to produce output values in pounds corresponding to first-segment "mV/V" values entered into the "SIMULATED INPUT" CHANNEL (set up in Step 2, above). For this purpose we need a special "OUTPUT" CHANNEL for this segment. In Step 6, below, this channel will be reconfigured to replace the "SIMULATED INPUT"—which is used only for this setup procedure—with a real strain gage input.



- a. First we must calculate the **SCALING FACTOR** for the first segment (0 to 1500 lbs). This we do by dividing the applied load corresponding to the endpoint of the segment (1500 lbs) by the "mV/V" output corresponding to that load (from Table 1, this is 0.952 mV/V). The resulting **SCALING FACTOR** is therefore 1575.6 lb/mV/V.
- b. We now set up the first-segment "OUTPUT" CHANNEL by entering a **CALCULATE (CLC)** command:

CLC 51 = 1575.6(CHN 399) + 0 [CR] *

For a full discussion of the **CALCULATE (CLC)** command, see Section 5.B.4 of the System 10 Manual. Here, we have chosen "51" as the Channel Number for the first-segment "OUTPUT" CHANNEL. Note that the offset term, although it is "0," must nevertheless be included in the **CLC** statement, in order to specify the resolution of the values to be reported by Channel No. 51 ("0" for units, "0.0" for tenths, etc.). You cannot, however, specify a resolution that exceeds one part in 32768 for the total range of the measurement.

Channel No. 51 will now display load values in pounds corresponding to whatever "mV/V" value is downloaded into Channel No. 399. Since the **SCALING FACTOR** has been determined by calibration values for the first segment, the readings of Channel No. 51 will provide a linear interpolation for any "mV/V" input values falling within this segment. Such readings will therefore be "correct" for this segment—at least to the greatest extent possible, based on the available calibration data. They will NOT, however, be correct for any input values falling in subsequent segments of the curve, which may contain nonlinearities not yet taken into account.

- c. To check progress so far, enter the following command:

CHN 399 = 0.952 [CR]

This loads a "SIMULATED INPUT" of 0.952 (mV/V), which is the input value of the endpoint of the first segment. Channel No. 51 should now report the corresponding reading of 1500 (lbs).

4. SETUP OF CALCULATE CHANNELS FOR THE SECOND SEGMENT

The first segment required only one CALCULATE PSEUDOCHANNEL: the "OUTPUT" CHANNEL No. 51. However, for each subsequent segment of the linearizing operation, four separate CALCULATE PSEUDOCHANNELS must be established. We must therefore allocate eight additional system channels for the linearization of our three-segment characteristic curve. We will choose Nos. 52 through 59.

(It would be convenient for you at this point to compose a CRT page showing all the channels concerned in this procedure. In our example, they are Nos. 51 through 59, and No. 399. For "Video Setup via the Extended Keyboard," see Section 3.D of the System 10 Manual. This page can be deleted at the end of the procedure.)

We will refer to the four PSEUDOCHANNELS as

- a. the "ZERO" CHANNEL
- b. the "ABSOLUTE VALUE" CHANNEL
- c. the "ERROR" CHANNEL
- d. the "OUTPUT" CHANNEL

Each group of four channels draws data from the "OUTPUT" CHANNEL of the preceding segment, provides the necessary linearizing corrections for its own segment, and produces an "OUTPUT" CHANNEL for use by the following segment. The four channels are identical in form for each segment, but will use different values, to be determined during the procedure for each segment.

- a. The "ZERO" CHANNEL (No. "n") is set up by a **CALCULATE (CLC)** command of the general form

$$\text{CLC } n = 1(\text{CHN } (n-1)) - b [\text{CR}] *$$

where "n-1" is the Channel Number of the preceding segment's "OUTPUT" CHANNEL and where "b" is the value of the input at the beginning of the segment in question. This CALCULATE "zeroes" the output at the beginning of the segment.

- b. The "ABSOLUTE VALUE" CHANNEL (No. "n+1") represents the absolute value of the "ZERO" CHANNEL, and is set up by a command of the general form

$$\text{CLC } n+1 = 1(\text{ABS CHN } n) + 0 [\text{CR}] *$$

- c. The "ERROR" CHANNEL (No. "n+2") sums the "ZERO" CHANNEL and the "ABSOLUTE VALUE" CHANNEL, divides the sum by two, and multiplies it by a ratio of known linearity error to actual (nonlinear) input increment. The general command is

$$\text{CLC } n+2 = m(\text{CHN } n + \text{CHN } (n+1)) + 0 [\text{CR}] *$$

where "m" = $0.5(E/(I-E))$; "E" is linearity error; "I" is input increment for the segment.

- d. The "OUTPUT" CHANNEL (No. "n+3") adds the "ERROR" CHANNEL to the "OUTPUT" CHANNEL of the preceding segment (No. "n-1"), and thereby represents a linear extrapolation of that segment. It is set up by a command of the general form

$$\text{CLC } (n+3) = 1(\text{CHN } (n-1) + \text{CHN } (n+2)) + 0 [\text{CR}] *$$

a. SETUP OF "ZERO" CHANNEL FOR THE SECOND SEGMENT

For each segment following the first segment, the "ZERO" CHANNEL is merely the preceding segment's "OUTPUT" CHANNEL, minus the value of the input at the beginning of the segment. Thus, in our example, we can set up the second segment's "ZERO" CHANNEL (No. 52) by entering a command of

$$\text{CLC 52} = 1(\text{CHN 51}) - 1500 [\text{CR}] *$$

With Channel No. 399 still holding the value of 0.952 (mV/V) entered in Step 3.c, above, Channel No. 52 should now read "0."

b. SETUP OF "ABSOLUTE VALUE" CHANNEL FOR THE SECOND SEGMENT

This channel (No. 53) is set up by the following command:

$$\text{CLC 53} = 1(\text{ABS CHN 52}) + 0 [\text{CR}] *$$

At this point, Channel No. 53's reading should also be "0."

c. SETUP OF "ERROR" CHANNEL FOR THE SECOND SEGMENT

1. We must first determine the linearity error for the second segment, using our original calibration data. Referring to Table 1, we see that for an applied load of 1500 pounds (the end of the first segment), the measured output is 0.952 mV/V. If there were no linearity error, the slope of the second segment (in lbs/mV/V) would equal that of the first. See Fig. 8.D.2. Thus, in the ideally linear case,

$$1500/0.952 = L/1.560$$

where "L" is the load that would correspond to the endpoint of an "ideal" second segment—that is, one which is linear with respect to the first segment. Solving for "L," we find this value to be 2458 (lbs).

However, as we can see from Table 1, the actual load corresponding to a measured output of 1.560 mV/V is 2500 lbs. The difference between this value and the calculated "ideal" endpoint load (2458 lbs) is the LINEARITY ERROR ("E") for the second segment (= 42 lbs).

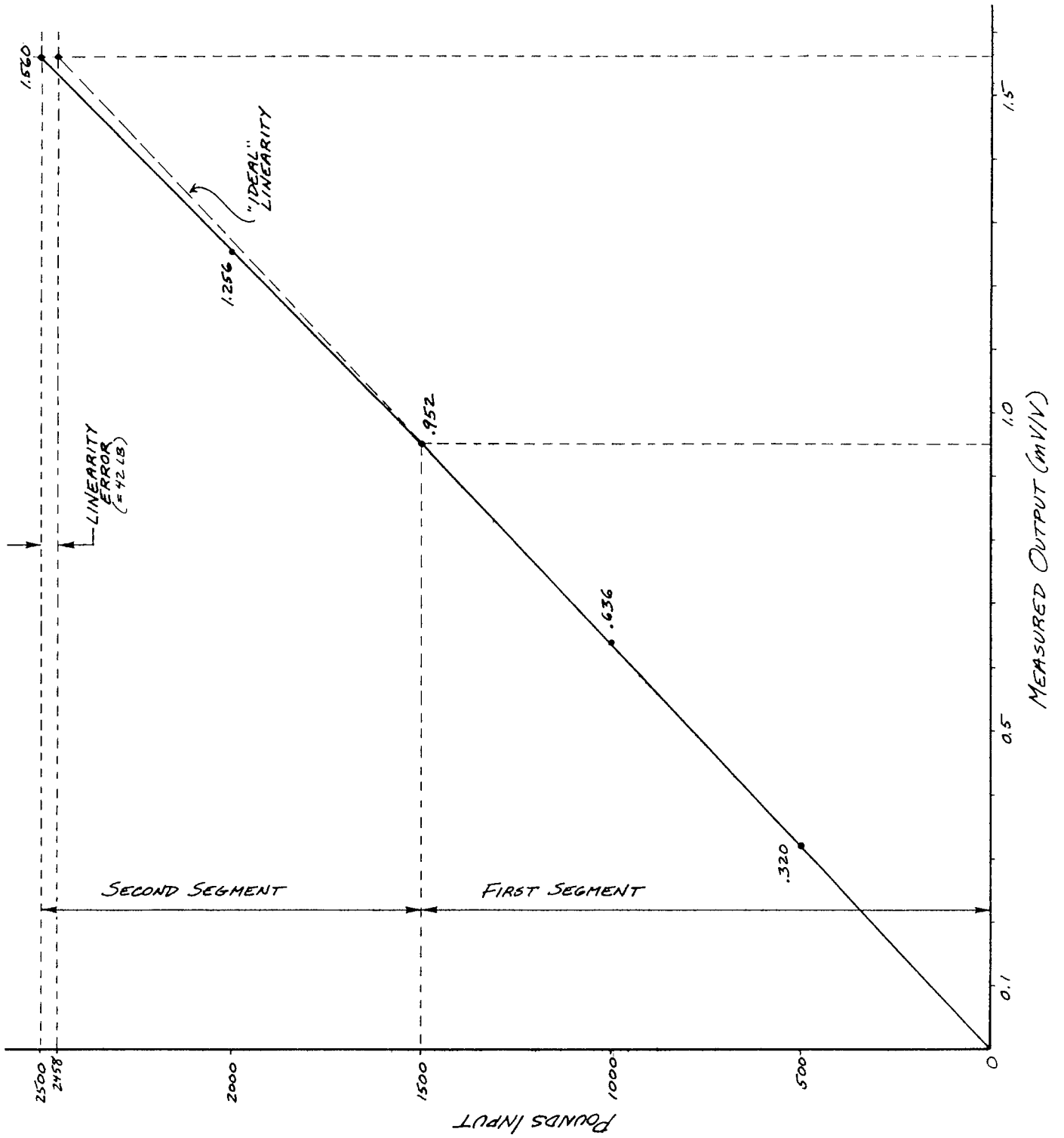
2. We must next calculate an appropriate SCALING FACTOR ("m") for the "ERROR" CHANNEL we are going to set up, based on the LINEARITY ERROR "E." The value of "m" is given by the following equation:

$$m = 0.5(E/(I-E))$$

where "I" is the input increment for the segment in question. In our example, E = 42 lbs and I = 1000 lbs, yielding an "m" of 0.02192.

3. We are now ready to enter the **CALCULATE (CLC)** command for the second segment's "ERROR" CHANNEL (No. 54), using the above value of "m" as the scaling coefficient:

Fig. 8.D.2



$$\text{CLC 54} = .02192(\text{CHN 52} + \text{53}) + 0 \text{ [CR] } *$$

4. Now load the "SIMULATED INPUT" CHANNEL (No. 399) with the "mV/V" value for the endpoint of the second segment:

$$\text{CHN 399} = 1.560 \text{ [CR]}$$

Channel No. 54 should now read the LINEARITY ERROR of the segment (42 [lbs]).

d. SETUP OF "OUTPUT" CHANNEL FOR THE SECOND SEGMENT

We obtain this channel (No. 55) by simply summing the "ERROR" CHANNEL (No. 54) and the "OUTPUT" CHANNEL of the first segment (No. 51):

$$\text{CLC 55} = 1(\text{CHN 51} + \text{CHN 54}) + 0 \text{ [CR] } *$$

Channel No. 54 should now give a reading of 2500 [lbs], which is the "corrected" (linearized) output at the end of the second segment.

The system is now linearized for any inputs from 0 to 2500 pounds.

5. SETUP OF CALCULATE CHANNELS FOR THE THIRD SEGMENT

You will repeat for the third and final segment the procedures given in Step 4, above. Channels Nos. 56 through 59 will be used for the four CALCULATE PSEUDOCHANNELS. The "ZERO" CHANNEL and "ABSOLUTE VALUE" CHANNEL for this segment are to be entered, respectively, as follows:

$$\text{CLC 56} = 1(\text{CHN 55}) - 2500 \text{ [CR] } *$$

$$\text{CLC 57} = 1(\text{ABS CHN 56}) + 0 \text{ [CR] } *$$

With the "SIMULATED INPUT" CHANNEL (No. 399) still reading 1.560 (mV/V), both Channel No. 56 and Channel No. 57 should read "0."

The LINEARITY ERROR for the third segment is found to be 155 lb, yielding a SCALING FACTOR ("m") of 0.05762 for the "ERROR" CHANNEL statement:

$$\text{CLC 58} = .05762(\text{CHN 56} + \text{CHN 57}) + 0 \text{ [CR] } *$$

Load a "SIMULATED INPUT" of 2.440 (mV/V)—corresponding to the endpoint of the third segment:

$$\text{CHN 399} = 2.440 \text{ [CR]}$$

Then set up the "OUTPUT" CHANNEL for this segment:

$$\text{CLC 59} = 1(\text{CHN 55} + \text{CHN 58}) + 0 \text{ [CR] } *$$

Channel No. 59 will now provide linearized output readings for all input values from zero to full scale.

6. RECONFIGURATION FOR "REAL" INPUT

The only remaining step is to replace the "SIMULATED INPUT" Pseudochannel No. 399 by a "real" analog input in the setup statement for the first-segment "OUTPUT" CHANNEL (Step 3.b, above). Thus, if in our example the "real" transducer channel to be linearized is System Data Channel No. 12, the first-segment "OUTPUT" CHANNEL would be re-established as follows:

$$\text{CLC } 51 = 1575.6(\text{CHN } 12) + 0 \text{ [CR] } *$$

As shown in Step 5, above, final linearized data for Channel No. 12 would then be displayed via **CALCULATE** Pseudochannel No. 59.

Note that a data channel must be calibrated to read directly in "milli-volts per volt." if it is to replace the "SIMULATED INPUT." To do this, we need to

1. **scale** the channel (No. x) by entering a command of the form

$$\text{MVV } x = i, i \text{ [CR] } *$$

where "i" is the nominal full-scale "mV/V" rating of the channel's strain gage transducer.

2. **zero** the channel (No. x) by entering a command of the form

$$\text{ZRO } x \text{ [CR] } *$$

In our example, we would therefore enter the following commands to calibrate Channel No. 12 in "mV/V":

$$\text{MVV } 12 = 2.44, 2.44 \text{ [CR] } *$$

$$\text{ZRO } 12 \text{ [CR] } *$$

Appendix L.1

Binary Transmission Mnemonics

----- PLEASE NOTE -----

The MNEMONIC COMMANDS described in this Appendix can be used to output CHANNEL DATA, BIT-GROUP DATA, and SYSTEM MESSAGES in BINARY FORMAT instead of ASCII. They are recognized by any version of the **Model 10BACI or 10BACIA Auxiliary Computer Interface Card** or by any "**A-sized**" **DataPAC** (any version of the Model 10KU, 10K1, 10K2, 10K4T, etc.) with reference to its RS-232-C Computer Interface Port.

These commands were initially intended for proprietary use only. They are not discussed elsewhere in the *System 10 Guidebook*. Daytronic assumes no responsibility for possible consequences of the use of these commands, nor is it intended by Daytronic to change their functionality in future System 10 products.

1. The **DUMP SYSTEM DATA (DSD)** Command

To transmit in "2'S COMPLEMENT" BINARY FORMAT all data for the continuous range of channels from Channel No. x to and including Channel No. y, you need only command

DSD x TO y [CR]

This command will output a series of two bytes for each DATA CHANNEL within the specified range, followed by a checksum byte or byte pair.

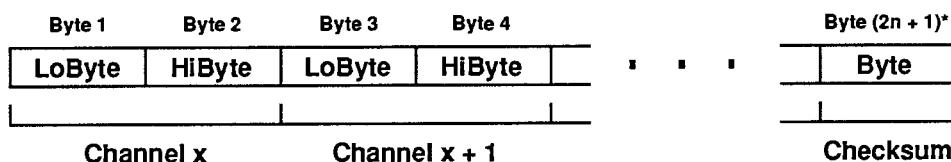
DSD TRANSMISSION FROM PORTS OTHER THAN "NEW BACI'S": 10BACIA, 10BACI-422, OR 10BACI-488 (see Fig. 1):

When the **DSD** command is recognized with reference to an RS-232, RS-422, or IEEE-488 port other than that of a *Model 10BACIA, 10BACI-422, or 10BACI-488 Auxiliary Computer Interface Card*, the two bytes transmitted for every channel are, in order,

1. the *least significant byte of the "word integer" for the channel's current data value.*
2. the *most significant byte of the "word integer" for the channel's current data value, with the most significant bit of this byte being the SIGN BIT ("0" = positive; "1" = negative)*

In this case, the checksum will consist of a single byte which represents the modulo-256 summation of all preceding bytes in the transmission. Its value should be compared to that of the same summation as performed by the receiving device, to determine whether the transmission was successful.

Fig. 1 Transmission Format for **DSD** Command (Ports Other Than 10BACIA, 10BACI-422, or 10BACI-488)



* Where n = the number of channels in the transmitted range (x TO y).

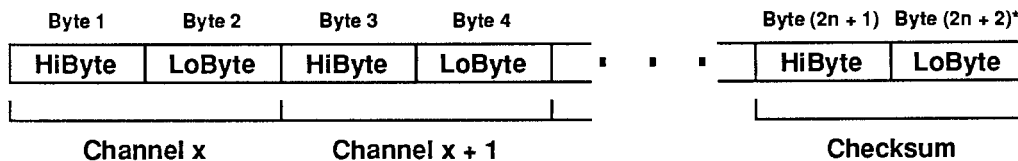
DSD TRANSMISSION FOR "NEW BACI's": 10BACIA, 10BACI-422, AND 10BACI-488 (see Fig. 2)

When the **DSD** command is recognized with reference to the port of a *Model 10BACIA, 10BACI-422, or 10BACI-488 Auxiliary Computer Interface Card*, the two bytes transmitted for every channel are, in order,

1. the *most significant byte of the "word integer" for the channel's current data value*, with the *most significant bit* of this byte being the *SIGN BIT* ("0" = positive; "1" = negative)
2. the *least significant byte of the "word integer" for the channel's current data value*.

In this case, the checksum will consist of a byte pair (or "word") which represents the modulo-65536 summation of all preceding "words" in the transmission. The *most significant byte* of the checksum "word" is transmitted before the least significant byte. Again, the checksum value should be compared to that of the same summation as performed by the receiving device, to determine whether the transmission was successful.

Fig. 2 Transmission Format for **DSD** Command (10BACIA, 10BACI-422, and 10BACI-488)



* Where n = the number of channels in the transmitted range (x TO y).

2. The **DUMP SYSTEM FIELD DATA (DSF)** Command

To transmit in "2'S COMPLEMENT" BINARY FORMAT all data for the continuous range of channels from Channel No. x to and including Channel No. y—along with the respective "limit status" and decimal-point location for each data value—you need only command

DSF x TO y [CR]

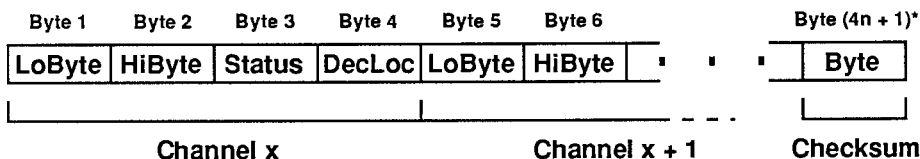
When recognized with reference to an RS-232, RS-422, or RS-488 port (including ANY "BACI" version), this command will output a series of four bytes for each DATA CHANNEL within the specified range, followed by a modulo-256 checksum byte (see Fig. 3).

The four bytes transmitted for every channel are, in order,

1. the *least significant byte of the "word integer" for the channel's current data value*
2. the *most significant byte of the "word integer" for the channel's current data value*, with the *most significant bit* of this byte being the *SIGN BIT* ("0" = positive; "1" = negative)
3. the channel's current *LIMIT STATUS*, coded as follows:
 - 00 (hex) = "LESS THAN" status (LOW-LIMIT violation)
 - 40 or 80 (hex) = "BETWEEN" status (NO violation)
 - C0 (hex) = "GREATER THAN" status (HIGH-LIMIT violation)
4. the *decimal-point location of the channel's current data*. The value of this byte ranges from 0 to 9. A value from 0 through 7 indicates how many digits to the left of the rightmost digit of the channel's integer value the decimal point is to be placed for display purposes. A byte value of 8 indicates that one dummy zero is to be placed to the right of the rightmost digit of the channel's integer value, while a byte value of 9 indicates that two dummy zeros are to be used.

The **DSF** checksum byte represents the modulo-256 summation of all preceding bytes in the transmission. Its value should be compared to that of the same summation as performed by the receiving device, to determine whether the transmission was successful.

Fig. 3 Transmission Format for **DSF** Command



* Where n = the number of channels in the transmitted range (x TO y).

3. The **DUMP SYSTEM BIT DATA (DSB)** Command

To transmit in BINARY FORMAT all data for the continuous range of SYSTEM BIT GROUPS from BIT GROUP No. k to and including BIT GROUP No. l, you need only command

DSB k TO l [CR]

This command will output two bytes for each BIT GROUP within the specified range, followed by a modulo-256 checksum byte. For an explanation of SYSTEM BIT GROUPS and their numbering, see Section 2.H.1 of this Guidebook.

The two bytes transmitted for every BIT GROUP are, in order,

1. the *first eight bits* of the BIT GROUP, the lowest bit being the rightmost (least significant) bit
2. the *last eight bits* of the BIT GROUP, the lowest bit being the rightmost (least significant) bit

As with the **DSF** transmission, above, the checksum byte represents the modulo-256 summation of all preceding bytes in the transmission. Its value should be compared to that of the same summation as performed by the receiving device, to determine whether the transmission was successful.

4. The **DUMP SYSTEM MESSAGE (DSM)** Command

To transmit in BINARY (ASCII-CODED) FORMAT any pending System 10 "message"—possibly generated in response to a valid MNEMONIC COMMAND—you need only command

DSM [CR]

The resulting transmission will be terminated by CARRIAGE RETURN (the current "OPT"). If no "message" is pending, a null string will be issued (i.e., a single CARRIAGE RETURN).

By applying an initial **DSM** command to a 10BACI Auxiliary Interface Card, you set up nondisruptive "handshake" control. That is, each subsequent "message" will be transmitted *only on request by another DSM command*, and then *only one "message" at a time*.

(cont'd)

App. L.1

BINARY TRANSMISSION MNEMONICS

NOTE: Before applying a **DSM** command to an "A-sized" DataPAC (ONLY), you should first make sure that the DataPAC has not been given a "Satellite Number" of "0" by applying an **ASSIGN SATELLITE NUMBER (ASN)** command of

ASN = n [CR]*

where "n" is some number *other than zero*. See Section 3.B.3.b for a complete discussion of the **ASN** command). Note that the above **ASN** command will automatically change the DataPAC's current COMMAND TERMINATOR (CMT), OUTPUT TERMINATOR (OPT), and END-OF-TRANSMISSION TERMINATOR (EOT) to **CARRIAGE RETURN (0D)**.^{*} You can subsequently change the CMT, OPT, or EOT to some value other than "0D" without affecting the operation of the binary transmission commands. The **ASN** command should NOT be applied to a Model 10BACI Auxiliary Computer Interface

^{*} In "BINARY MODE," transmission of the current OPT applies only to the **DSM** command.

Appendix N

Per-Channel Processing Speed

1. Introduction

As part of the new "System 10/2000" enhancements, the Model 10BCP100 Central Processor for all "B-sized" DataPACs has been replaced by the faster Model **10BCP200**, while the firmware program flow has been significantly streamlined. As a result, the processing time for any given channel "type" has been improved by 5% to 60% (depending on type). The table below shows the exact percent of improvement for various channel types.

In addition, you can now use the information given in the table to calculate your overall system scan rate, as explained in Section 4, below. This in turn allows more effective design of high-speed data acquisition applications.

2. Overview of the 10BCP200 Scan Cycle

A simplified diagram of the 10BCP200 scan cycle is given in Fig. 1, below.

The cycle begins by loading the address of the first channel to be scanned, using the table created from "LOCATE" (LCT) information, and by setting the appropriate amplifier gains for A/D conversion. While conversion is being performed, the BCP200 can devote itself to "process peripherals" (keyboard, communications, exchanges with other "B Cards," etc.).

As soon as digitization of the channel's analog signal is complete, the value is passed to the FILTER processor. If the channel's current "FIL" value is 0 (= NO digital filter), the filter processing is bypassed. If the "FIL" value is not zero and the data value is *not significantly different* from the reading obtained in the previous scan, further processing of the value is suspended. If the value is different, however, the filter processing is performed, along with linearization (if the channel is a TC, RTD, or "LIN" channel) and "mx + b" scaling to the desired engineering units (using the channel's current "m" and "b" calibration constants). The engineering-units answer is then compared to the channel's current limit values, and all necessary annunciation/control functions are exercised.

If the channel is not the designated "TERMINATOR" channel (last one in the scan), the channel counter is incremented and the cycle is repeated with the next channel in sequence.

Only when all "REAL" analog channels have been processed does the processing of system LOGIC BITS and "EXECUTE" functions occur, assuming that the **BITS (BTS)** command is in effect.*

The system time-of-day clock is then updated. If the **CLK = ON** command is not in effect, the present scan cycle will be at an end and the next scan cycle will begin immediately. If, however, **CLK = ON** is in effect, the scanning process will be paused until the time-of-day clock registers its next *tenth of a second*. This is used in SYNCHRONOUS DATA COLLECTION to ensure that the scan is initiated exactly ten times a second—assuming that a small enough number of channels are being scanned (see Appendix M for details).

* As explained in Section 2.H.5, a **NO BITS (NOB)** command will disable the reading of all system LOGIC BITS with each scan cycle, thereby disabling all **EXECUTE (EXU)** commands and other commands that depend on the reading of system logic-bit states. To cancel the **NOB** command, thus resuming the reading of system bits with each scan, you can enter the **BITS (BTS)** command.

Fig. 1 Scan Cycle Diagram

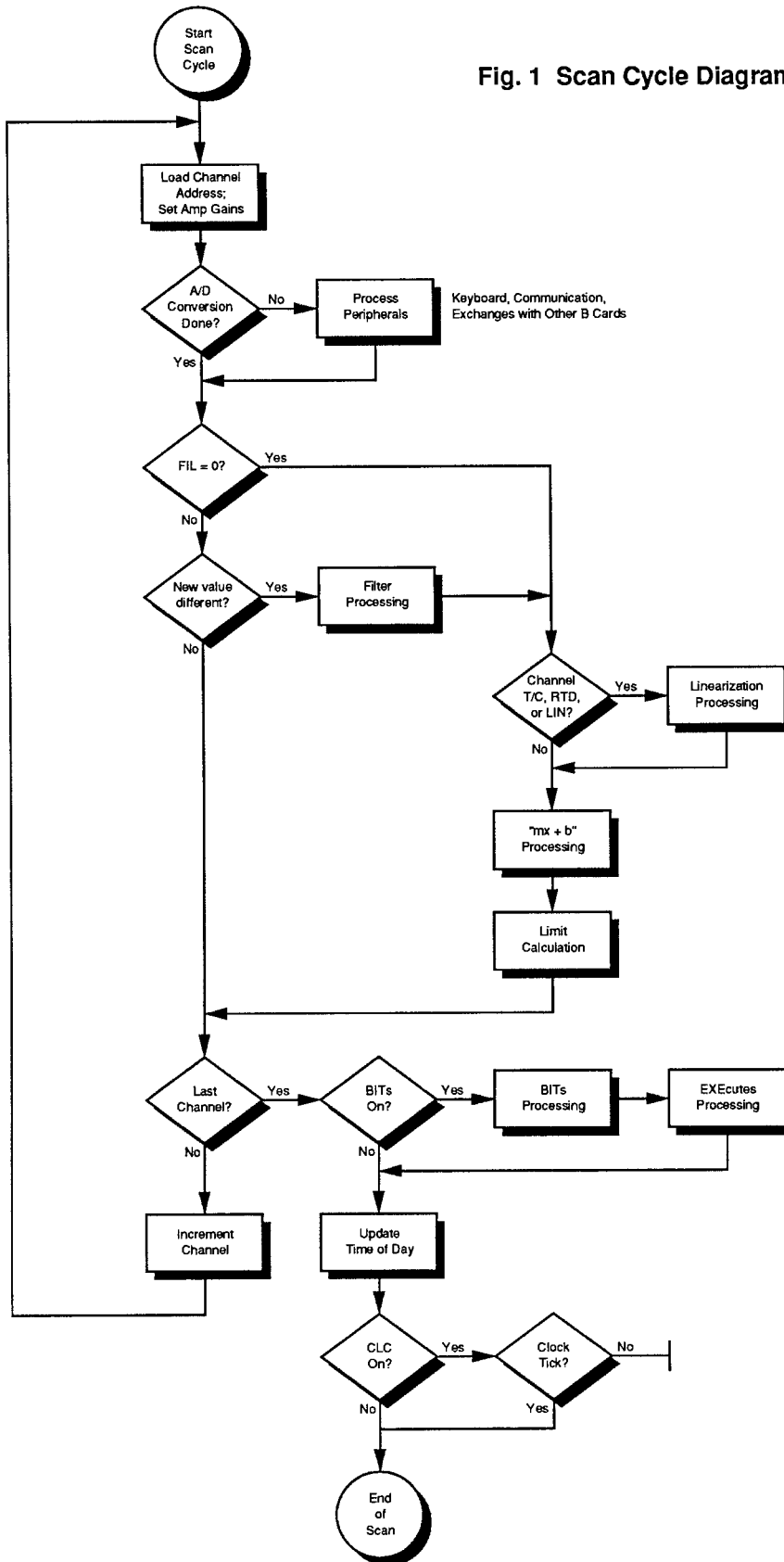


Table 1 Comparison of Per-Channel Processing Speeds

Analog Input Channels

—with **NO FILTER** and **NO BITS (NOB)** command in effect:

Channel Type and No.	System 10		System 10/2000		Percent Improvement
	Dwell Time (μ sec)	Speed (chns/sec)	Dwell Time (μ sec)	Speed (chns/sec)	
Thermocouple (1X/2X)	430	2325	360	2777	16
LVDT (3X)	370	2702	294	3401	21
Frequency (4X)	362	2762	294	3401	19
Voltage (5X/6X)	350	2857	294	3401	16
Strain (7X)	378	2645	294	3401	22
RTD (AX)	485	2062	356	2809	27

—with **FILTER = 5** and **NO BITS (NOB)** command in effect:

Channel Type and No.	System 10		System 10/2000		Percent Improvement
	Dwell Time (μ sec)	Speed (chns/sec)	Dwell Time (μ sec)	Speed (chns/sec)	
Thermocouple (1X/2X)	340	2941	250	4000	26
LVDT (3X)	332	3012	248	4032	25
Frequency (4X)	332	3012	248	4032	25
Voltage (5X/6X)	332	3012	248	4032	25
Strain (7X)	332	3012	248	4032	25
RTD (AX)	339	2950	253	3953	25

Pseudochannels

—with **NO BITS (NOB)** command in effect:

Channel Type and No.	System 10		System 10/2000		Percent Improvement
	Dwell Time (μ sec)	Speed (chns/sec)	Dwell Time (μ sec)	Speed (chns/sec)	
Binary Output (B1)	378	2646	227	4405	40
BCD Output (B2)	551	1815	235	4255	57
BCD Input (B3)	572	1748	237	4219	59
Frequency (C0)	488	2049	322	3106	34
Download (D0/D1)	248	4032	164	6098	34
Increment (D2)	299	3344	183	5464	39
Analog Output (E0)*	482	2075	291	3436	40
Analog Output (E1)*	458	2183	263	3802	43
Calculate \pm (F0/F1)	840	1190	538	1859	36
Calculate x (F2)	864	1157	561	1783	35
Calculate \div (F3/F4)	678	1475	495	2020	27

* An "E0" ANO is a function of some other channel; an "E1" ANO is a constant.

3. Comparison of "System 10" and "System 10/2000" Processing Speed

The above table lists the approximate "10" and "10/2000" processing time in microseconds for different data-channel types, plus the equivalent scan speeds in channels per second.

For ANALOG INPUT channels, processing speeds are given for both "NO DIGITAL FILTER (FIL = 0)" and for "FIL = 5." You will note that the processing speed is actually *faster* with a filter set to 5 than it is with no filter at all. The reason is that with no filter, noise in the signal causes a channel's data reading to vary more widely from scan to scan. With each scan, therefore, a new value must be computed, with all necessary scaling and linearization (when applicable). With a filter of "5" in effect, relatively little change in the channel's data reading is observed by the system from scan to scan, and a new value need not be calculated with each scan. The result is improved throughput when a moderate amount of filtering is present.

The processing rates given in the table for both ANALOG INPUT channels and PSEUDOCHANNELS assume that the **NO BITS (NOB)** command is in effect—that is, that the processing of system LOGIC BITS has been disabled. When **BITS (BTS)** is in effect, the processing of bits will add approximately *6 milliseconds* to each scan period, which is also dependent on the number and complexity of active "EXECUTE" functions. When EXECUTES are present, it is therefore helpful to use a CALCULATE channel as explained in the following section, to obtain a true measure of scan speed.

4. Calculation of Scan Rate

If no "EXECUTE" functions are present, you can calculate the total scan rate from the speeds given in the table above. For example, suppose your "System 10/2000" measures 100 LVDT channels and 200 strain channels. Assume also that **FIL = 5** for each channel and that the **NOB** command is in effect. From the table we can see that to process all the LVDT channels will take $100 \times 248 \mu\text{sec} = 24,800 \mu\text{sec}$. To process all the strain channels will take $200 \times 248 \mu\text{sec} = 49,600 \mu\text{sec}$. A "housekeeping" overhead of 50 μsec should be added to the processing time, yielding a total of $24,800 + 49,600 + 50 = 74,450 \mu\text{sec}$ per scan. This is equivalent to *20 updates per second*. If the **BTS** command were in effect (but with no "EXECUTE" functions), you would add 6 msec to the scan period.

If "EXECUTE" functions are present, the best way to calculate the overall scan rate is to set up a CALCULATE PSEUDOCHANNEL whose reading approximates the running scan rate in channels per second. For this operation you would need three otherwise unused scanned DATA CHANNELS (Nos. x, y, and z), one otherwise unused LOGIC BIT (No. r), and one EXECUTE function tied to Bit No. r.

1. Set up Channel No. x to count successive scans, automatically incrementing by "1" with each scan cycle.* Enter a command of

CLC x = 1(CHN x) + 1 [CR]*

At the beginning of the scan-measuring process, Channel x must be set to zero via a **CHN x = 0 [CR]** command.

2. Set up Channel No. y to be an INCREMENTAL TIMER PSEUDOCHANNEL, incrementing by "1" every time the system's clock-time reading increments by one second since the channel was last scanned (see Section 2.D.2). Enter a command of

* For a more accurate determination of scan rate, an external program can be written to interrogate this CALCULATE channel directly after a precise period of time (say, 60 or 120 seconds of scanning a given number of channels). You can then easily calculate the number of scans per second—or conversely, the number of microseconds required to scan each channel.

TYP y = D2 [CR]*

At the beginning of the scan-measuring process, Channel y must be set to zero via a CHN y = 0 [CR] command.

3. Set up Channel No. z to approximate the running number of channels per second:

CLC z = m (CHNx) / (CHNy) [CR]*

where "m" is the total number of scanned channels.

4. To establish a high limit of 32000 for Channel x (to prevent overranging), command

HIL x = 32000 [CR]*

5. To arrange for Bit No. r to be set to *Logic 1* when the HIGH LIMIT of Channel x is exceeded, command

LGT x = r [CR]*

6. Finally, to *reset* both Channel x and Channel y to zero (and thus begin the scan-measuring sequence over again) when the HIGH LIMIT of Channel x is exceeded, command

EXU r = CHNx=0:CHNy=0 [CR]*



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SECTION 5

PLEASE NOTE the following section- and figure-reference corrections for **Section 5** of this Guidebook:

**When you are
told to refer to:**

**You should
actually refer to:**

Section 1.B

Section 1.A.3

Section 1.C

Section 4 of the appropriate
“On the Air” Booklet

Section 1.D

Section 5 of the appropriate
“On the Air” Booklet

Fig. 1.E.1 (Section 1.E.1)

Fig. 1.5 (Section 1.E.1)

Fig. 1.E.2 (Section 1.E.1)

Fig. 1.6 (Section 1.E.1)

Section 1.F.1

Section 1.F.2

Section 1.F.2

Section 1.F.3

Section 1.G.2

Section 1.G.1

Section 1.G.7

Section 1.G.6

Appendix B

Section 1.B

Section 5.A

Introduction



System 10 Guidebook

The field service support program for *System 10* is based on the assumption that most users are neither equipped nor inclined to attempt repair of the electronic hardware supporting this instrumentation. The main thrust of the present Guidebook section is therefore *to help the typical user isolate possible malfunctions and attribute them correctly to*

- *failure to set up the general system or a specific system element properly;*
- *the presence of internal or external conditions that are preventing proper operation of the system (e.g., a blown fuse, a disconnected or unshielded cable);*
- *failure to observe proper operational procedures and/or restrictions; or*
- *hardware or software failure of a specific internal element that can then be removed for repair or replacement.*

Section 5.B gives "Possible Solutions to Specific Problems" that may arise during normal operation of your DataPAC. No special test equipment or electronic expertise is required.

You should keep in mind, however, that the "possible solutions" here offered are in general *those which might lead to correction of the perceived problem through actions which the typical user can easily take*. In each case, other, more complex internal factors—hardware, software, or both—may be contributing to the problem. IF ALL OF THE LISTED "POSSIBLE SOLUTIONS" TO AN OBSERVED MALFUNCTION ARE INEFFECTIVE IN ELIMINATING THE MALFUNCTION—OR IF YOU OBSERVE A MALFUNCTION NOT COVERED IN SECTION 5.B—YOU SHOULD CALL THE DAYTRONIC CORPORATION SERVICE DEPARTMENT AT

(937) 293-2566

OR CONTACT THE AUTHORIZED SERVICE FACILITY NEAREST YOU.

FOR DETAILS CONCERNING THE OBTAINING OF SERVICE BOTH UNDER WARRANTY AND AFTER THE WARRANTY PERIOD HAS EXPIRED, SEE THE **DAYTRONIC CORPORATION PRODUCT SERVICE POLICY**.

When the problem seems to involve the functioning of a particular MNEMONIC COMMAND, you should refer to Section 4 of this Guidebook (**Alphabetical Directory of System 10 Mnemonic Commands**) to see whether the proper command syntax has been observed, and also whether the command is actually contained in the relevant Software Version(s) within your system.

IF YOU FIND THAT YOUR SYSTEM'S INTENDED FUNCTIONS REQUIRE THE UPDATING OF A PARTICULAR SOFTWARE VERSION OR VERSIONS, YOU SHOULD AGAIN CONTACT THE DAYTRONIC SERVICE DEPARTMENT OR NEAREST AUTHORIZED SERVICE FACILITY.

Section 5.B

Possible Solutions to Specific Problems



System 10 Guidebook

POWERUP PROBLEMS

Problem	Possible Cause	Possible Solution
a. The DataPAC does not power up (no fan noise; front-panel indicators do not light).	The power cord is not properly connected.	Make sure the power cord connection is good (see Section 1.B.1).
	The DataPAC fuse has blown (Models 10KU, 10K4, 10K6, 10K7).	<ol style="list-style-type: none"> 1. Disconnect the power cord and any external devices (printer, computer, monitor, etc.) 2. Remove the fuse and replace it with one of proper size and amperage: nominal 120 V-AC takes a 2.5-amp fuse; nominal 220 V-AC takes a 1.25-amp fuse. 3. Reconnect the power cord and turn ON the DataPAC.
	The DataPAC CIRCUIT BREAKER has tripped (Models 10K1, 10K2, 10K8).	Reset the circuit breaker by depressing the combined ON-OFF/ CIRCUIT BREAKER button on the rear of the DataPAC.
	The DataPAC is receiving nominal 120 V-AC power but is set for nominal 220 V-AC.	Convert the DataPAC to nominal 120 V-AC power (see Appendix D).
b. The FUSE continues to blow, or the CIRCUIT BREAKER to trip, after every attempt to power up the DataPAC.	Some DataPAC element or elements are consistently producing an overload condition. This procedure will allow you to isolate any plug-in circuit board that may be responsible.	<ol style="list-style-type: none"> 1. Disconnect the power cord and any external devices (printer, computer, monitor, etc.). 2. Open the SLOT CONNECTOR for every SLOT occupied by a circuit board (pull out the SLOT's ACTUATING LEVER and turn it 90 degrees clockwise—see Appendix B). 3. Replace the fuse or reset the circuit breaker (as above). 4. Reconnect the power cord and turn ON the DataPAC. 5. If the fuse now blows or the circuit-breaker trips, disconnect the power cord and contact the Daytronic Service Dept. The problem is most likely in the Power Supply or some other internal element not easily accessible to the operator. 6. If the DataPAC continues to run, turn it OFF and close <i>one</i> of the circuit-board SLOT CONNECTORS (turn the ACTUATING LEVER counterclockwise until the LOCATING KEY engages in the card's NOTCH—see Appendix B). 7. Turn ON the DataPAC again. 8. If the fuse now blows or the circuit-breaker trips, disconnect the power cord, remove the card whose SLOT CONNECTOR you just closed, and replace it with one of the same model, if available. Call the Daytronic Service Dept. to arrange for repair or replacement.

(cont'd)

5.B.1

POWERUP PROBLEMS

Problem	Possible Cause	Possible Solution
		9. If the DataPAC continues to run, repeat Steps 6, 7, and 8 until the board causing the overload is discovered.
c. The DataPAC's front-panel ERR, CHR, MNE, and RET indicators do not light up momentarily on powerup.		Contact the Daytronic Service Dept.

DATA-CHANNEL PROBLEMS

5.B.2

Problem	Possible Cause	Possible Solution
a. There is <i>no</i> data reading for a given "REAL" ANALOG INPUT CHANNEL.	The channel's INPUT-SIGNAL CABLE is not properly connected or wired.	Make sure the input-signal cable connection is good (see Section 1.E.1). Also make sure that the cable configuration is appropriate to the specific transducer (or other analog signal source) and to the "type" of CONDITIONER CARD receiving the signal (for "Specific Conditioner Connections and Setup Considerations," see Section 1.E.2).
	The channel is not properly set up.	<ol style="list-style-type: none"> 1. Apply a RESET (RST) command to the channel (see Appendix C). 2. "Retype" the channel via an appropriate TYPE (TYP) command (see Appendix C). 3. Verify that the channel is properly "located," using the LCT x [CR] interrogation (see Section 1.G.2). "Relocate" the channel, if necessary, via the LOCATE (LCT) command (see Appendix C). 4. Recalibrate the channel, via an appropriate technique (see Section 1.G).
	The channel's present MOTHERBOARD SLOT is faulty.	<ol style="list-style-type: none"> 1. Turn OFF DataPAC power. 2. Remove the channel's CONDITIONER CARD from its present SLOT, having first disconnected the transducer cable from the card's rear I/O CONNECTOR (see Appendix B for "Card Insertion and Removal"). 3. Reinstall the CONDITIONER CARD in another SLOT (see again Appendix B). 4. Reconnect the transducer cable to the card (in its new SLOT). 5. Turn ON the DataPAC. 6. "Retype" the channel via an appropriate TYPE (TYP) command (see Appendix C). 7. "Relocate" the channel via an appropriate LOCATE (LCT) command (see Appendix C). 8. Recalibrate the channel, via an appropriate technique (see Section 1.G).
The channel's CONDITIONER CARD is faulty.	<ol style="list-style-type: none"> 1. Turn OFF DataPAC power. 2. Replace the channel's CONDITIONER CARD with one of the same model which is known to be working properly (if available). 3. Turn ON the DataPAC. 4. Apply a RESET (RST) command to the channel (see Appendix C). 	

(cont'd)

5.B.2

DATA-CHANNEL PROBLEMS

Problem	Possible Cause	Possible Solution
		5. "Retype," verify "location," and recalibrate the channel, as above.
b. A given "REAL" ANALOG INPUT CHANNEL is reporting <i>incorrect</i> data.	<p>A wrong or improperly wired INPUT-SIGNAL CABLE is connected to the channel's CONDITIONER CARD.</p> <p>The channel is not properly set up.</p> <p>Two or more channels with unassociated "type" designations have been "located" to the same A SLOT.</p>	<p>Refer to Section 1.E.2 ("Specific Conditioner Connections and Setup Considerations").</p> <ol style="list-style-type: none">1. Apply a RESET (RST) command to the channel (see Appendix C).2. "Retype" the channel via an appropriate TYPE (TYP) command (see Appendix C).3. Verify that the channel is properly "located," using the LCT x [CR] interrogation (see Section 1.G.2). "Relocate" the channel, if necessary, via the LOCATE (LCT) command (see Appendix C).4. Recalibrate the channel, via an appropriate technique (see Section 1.G). <p>Make sure that all channels "located" to a given A SLOT have the same "type" designation or have "type" designations relating to the same CONDITIONER CARD (see Appendix C for a full list of "type" codes).</p>
c. The data reading for a given "REAL" ANALOG INPUT CHANNEL is <i>unstable</i> .	<p>The channel's INPUT-SIGNAL source is not properly grounded.</p> <p>The channel's INPUT-SIGNAL CABLE is not properly shielded.</p> <p>If it is a FREQUENCY INPUT CHANNEL, there may be stray pickup of frequencies outside the common-mode range.</p> <p>The measurement signal may have unusually high dynamic content.</p>	<p>Refer to Section 1.E, along with the literature accompanying the source transducer, and verify proper connections both at the signal source and at the CONDITIONER CARD'S I/O CONNECTOR.</p> <p>Make sure that the cable is shielded as shown in the respective diagram in Section 1.E.2. The "SHIELD" wire must make contact with the DataPAC mainframe (see the note on "Connection of Cable 'Shield,'" Section 1.E.1). Also make sure that there are no high-voltage wires near the input cable.</p> <p>Refer to Section 1.E.2.10A40 or 3.A.1(b.1) for use of capacitive-coupled inputs for "Suppression of Noise in Low-Frequency Input."</p> <p>Enter the FILTER (FIL) command to increase the amount of digital filtering applied to the channel by the CENTRAL PROCESSOR (see Section 2.G.2). If signal instability persists, contact the Daytronic Service Dept. for modification of the cutoff frequency of the conditioner's analog filter.</p>

DATA-CHANNEL PROBLEMS

5.B.2

Problem	Possible Cause	Possible Solution
d. The data reading for a given "REAL" ANALOG INPUT CHANNEL is <i>not being updated</i> .	The channel is not being scanned by the DataPAC's CENTRAL PROCESSOR. A LOCK (LOK) command is in effect for the channel.	Make sure the channel in question is within the DataPAC's current SCAN RANGE (i.e., its number is less than or equal to that specified by the latest TERMINATOR (TER) command and is within the range specified by the latest SCAN (SCN) command—see Section 1.F.1). Channels outside the present SCAN RANGE will not be displayed with an ampersand flag ("&") unless a command of VSS = 1 [CR] * is in effect (Section 1.F.1(c)). Apply an appropriate UNLOCK (UNL) command (see Section 2.E).

5.B.3

LOGIC-BIT PROBLEMS

Problem	Possible Cause	Possible Solution
a. A given LOGIC BIT does not operate properly.	The bit has not been assigned a proper LOGIC SOURCE for the desired application.	Refer to Sections 2.H.1 and 2.H.2 and review the current LOGIC-SOURCE assignment for the bit (use a command of SRC r [CR] to interrogate). Use the SRC command to reset the LOGIC SOURCE, if necessary. (Note that it is always possible for a bit to be automatically set or reset by an "External Bit Control" command such as BIT, BIN, BCD, or HEX that is embedded in an existing EXECUTE (EXU) or COMMAND (CMD) sequence—see Section 2.K.)
	The bit has been assigned a LOGIC SOURCE of "LIMIT LOGIC," and the limit-value settings for the DATA CHANNEL associated with the bit are incorrect.	Refer to Sections 2.H.2(a), 2.F.4, and 2.F.2. Make sure that the HIGH-LIMIT value of the channel associated with the bit is in fact <i>higher</i> than the LOW-LIMIT value (see the HIL and LOL commands).
	The bit's LATCH has not been released.	Apply a RELEASE (RLS) command to the bit (see Section 2.H.4).
b. One or more individual LOGIC I/O PORTS of a 10AIO-16 or 10BIO-16 Card do not operate properly.	The reading of system bits has been disabled by a NO BITS (NOB) command.	Enter a BITS (BTS) command (see Section 2.H.5).
	The 10AIO-16 or 10BIO-16 has not been properly initialized.	Refer to Section 3.A.3(c.1) or 3.B.2(c.1), respectively, and apply the proper A SLOT (ASL) or B SLOT (BSL) command. A given BIT GROUP should not be assigned to more than one Logic I/O Card.
c. All of the LOGIC I/O PORTS of a 10AIO-16 or 10BIO-16 Card are set to <i>Logic 1</i> upon the setting to <i>Logic 1</i> of any one port.	The LOGIC I/O connection is not good.	Make sure the LOGIC I/O CONNECTOR is tightly connected to the rear pins of the 10AIO-16 or 10BIO-16 Card.
	The LOGIC REFERENCE VOLTAGE is not being supplied.	For the 10AIO-16, Pin 10 ("VCC") <i>must</i> be tied either to Pin L (Isolated + 5 V-DC) or to the user's external supply (up to + 24 V-DC); see Section 3.A.3(b). For the 10BIO-16, Pin 1 or 49 ("VCC") <i>must</i> be tied either to Pin 3 (Isolated + 5 V-DC) or to the user's external supply (up to + 24 V-DC); see Section 3.B.2(b).
d. The front-panel indicator lights for <i>unused</i> LOGIC INPUTS of a 10AIO-16 or 10BIO-16 Card are flickering.	The unused logic inputs are picking up stray voltages.	Desensitize the unused logic inputs by tying them all to COMMON (for the 10AIO-16, Pin 9; for the 10BIO-16, any even-numbered pin from Pin 2 through Pin 50—see Section 3.A.3(b) or 3.B.2(b), respectively).
e. An external logic device is not actuated when the corresponding bit is set.	Logic connections are not good.	Make sure all LOGIC I/O connections are good both at the 10AIO-16 or 10BIO-16 I/O CONNECTOR and at the external device.

(cont'd)

LOGIC-BIT PROBLEMS

5.B.3

Problem	Possible Cause	Possible Solution
	The LOGIC OUTPUT signal is of the wrong polarity to actuate the device.	Verify proper connection of drive signals to the device. Remember that Universal Logic I/O levels are <i>negative true</i> (i.e., GROUND when the bit is at <i>Logic 1</i> ; + 5 V-DC when the bit is at <i>Logic 0</i>); see Section 3.A.3(c.3) or 3.B.2(c.3).
	If the external device is a relay, it is either defective or an <i>input</i> relay.	Verify that the relay is an <i>output</i> type and is functioning properly.

5.B.4

VIDEO PROBLEMS

Problem	Possible Cause	Possible Solution
a. There is no display on the DataPAC's internal CRT; nothing appears on the display BILLBOARD.	The DataPAC is not powered up.	Check power cord connections for the DataPAC, and make sure it is turned on.
	The display is set to EXTERNAL VIDEO MODE.	Apply a command of VID = INT [CR] *, or press the System Config key (see Section 2.C.1(b)).
	The CRT BRIGHTNESS CONTROL has been turned down.	Adjust the CRT BRIGHTNESS CONTROL (see Section 2.C.1(e)).
	An "A Card" is not seated properly in its SLOT, and is shorting out the DataPAC's 12-V video supply.	<ol style="list-style-type: none">1. Turn OFF the DataPAC.2. Make sure each card has been properly inserted in the appropriate SLOT (see Appendix B for "Card Insertion and Removal").3. Turn ON the DataPAC.
	The CRT FUSE has blown.	Contact the Daytronic Service Dept. for instructions. CAUTION: HIGH VOLTAGE!
b. There is no display on the DataPAC's External Monitor; nothing appears on the display BILLBOARD.	The monitor is not powered up.	Check power cord connections for the monitor, and make sure it is turned on.
	The monitor is not properly connected to the DataPAC.	Check the cable connection between the DataPAC and the monitor; if a Model 10CVIOP Video I/O Processor is being used, make sure that the proper I/O connections have been made (see Section 2.N).
	The CRT BRIGHTNESS CONTROL has been turned down.	Adjust the CRT BRIGHTNESS CONTROL (see Section 2.C.1(e)).
	The CRT FUSE has blown.	Contact the Daytronic Service Dept. for instructions. CAUTION: HIGH VOLTAGE!
c. There is no display on the DataPAC's CRT (internal or external); R1, R2, R3, or R4 appears in the BILLBOARD on power-up, instead of RAM TEST PASSED .	Defective 10BVT60 RAM.	Contact the Daytronic Service Dept.
d. The left edge of the display page cannot be seen (internal or external CRT).	The CRT is set to the wrong <i>video format</i> .	If the system contains at least one COLOR CRT, enter a command of VDU = C, 50 [CR] * or VDU = C, 60 [CR] *; if the system contains one or more MONOCHROME CRT's only, enter VDU = M, 50 [CR] * or VDU = M, 60 [CR] * (see Section 2.C.1 and Problem e, below).
e. The CRT display scrolls and/or shimmers.	The CRT is set to the wrong <i>video frame rate</i> .	If your local line frequency is 50 Hz, enter a command of VDU = C, 50 [CR] * or VDU = M, 50 [CR] *; if 60 Hz, enter VDU = C, 60 [CR] * or VDU = M, 60 [CR] * (see Section 2.C.1 and Problem d, above).

VIDEO PROBLEMS

5.B.4

Problem	Possible Cause	Possible Solution
f. Keystrokes go only part way across the screen (internal or external CRT).	The CRT is set to the wrong "BVS" number.	If the DataPAC contains a Model 10BVS90 Video Signal Card, enter a command of BVS = 90 [CR] * ; if it contains a Model 10BVS95 Graphics Video Signal Card, enter BVS = 95 [CR] * (see Section 2.C.1).
g. The display is scrambled (internal or external CRT).		Contact the Daytronic Service Dept.
h. A CHANNEL DISPLAY FIELD does not display the correct DATA, BIT-STATE, MESSAGE, or VIDEO PLAYBACK.	The CHANNEL DISPLAY FIELD has not been properly set up.	<ol style="list-style-type: none"> 1. Press the Video Formt key to enter TEXT EDITOR MODE. 2. Refer to Section 2.C.5 and verify that the CHANNEL DISPLAY FIELD has been properly set up. Make sure that the field's Channel, Bit, or Message Number is correct (a LOGIC-BIT Number must be preceded by "#"; a MESSAGE Number, by "\$"; and a VIDEO PLAYBACK Number, by "*"). 3. Press the Exit key to return to LIVE DISPLAY MODE.
	The CHANNEL DISPLAY FIELD'S foreground is set to the same color or intensity as its background.	Refer to Section 2.C.12, and review the "STATUS"-defining command(s) currently in effect for the field. For a DATA FIELD, these will be VBC , VGT , VBT , VLT , and STS ; for a BIT-STATE FIELD, BSD and BDP ; for a MESSAGE FIELD, MES ; and for a VIDEO PLAYBACK FIELD, STS .
	IF A MESSAGE FIELD is <i>blank</i> , instead of displaying the desired MESSAGE, DataPAC power has been recycled, and the MESSAGE text has defaulted to blank.	Reenter the MESSAGE (MES) command (see Section 2.C.12(d)).
	If it is a VIDEO PLAYBACK FIELD, the system "history memory" may be inaccessible.	Make sure the system History Card is in RECORD MODE (see Section 3.B.4(e.2)), and that it is not disconnected from its SLOT. The RMD command must be applied after every powerup in order to activate all current playbacks. If any "10BHM" and/or 10BSPC Cards are present, make sure that none of them is disconnected from its SLOT.
i. Keystrokes are not being correctly interpreted when in "TEXT EDITOR" MODE.	Lower-case symbols are being entered into a DataPAC containing a Model 10BVS90 Video Signal Card along with a Model 10BVT60 Video Text Card of Software Version "9.0" or higher.	Press the Caps Lock key before entering "TEXT EDITOR" MODE, or replace the Model 10BVS90 with a Model 10BVS95 Graphics Video Signal Card.

5.B.5

COMMUNICATIONS PROBLEMS

Problem	Possible Cause	Possible Solution
a. The DataPAC and the connected HOST COMPUTER (or other device) do not communicate; there is no response to a MNEMONIC COMMAND entered via the DataPAC's COMPUTER INTERFACE PORT.	The RS-232-C CABLE between the two devices is disconnected. IN THIS CASE, THE DATAPAC'S FRONT-PANEL CHR , MNE , RET , AND RCV INDICATORS WILL NOT LIGHT WHEN COMMUNICATION IS ATTEMPTED.	Connect the RS-232-C interface cable between the DataPAC's COMPUTER INTERFACE PORT and the external device (see Section 2.B.2(a)).
	The RS-232-C CABLE between the two devices is improperly wired. IN THIS CASE, THE DATAPAC'S FRONT-PANEL CHR , MNE , AND RET INDICATORS WILL NOT LIGHT WHEN COMMUNICATION IS ATTEMPTED; THE RCV INDICATOR MAY OR MAY NOT LIGHT.	Refer to Section 2.B.2(a) for suggested cabling ("full handshake" is recommended); rewire as necessary.
	The RS-232-C PROTOCOL settings of the two devices do not match. IN THIS CASE, THE DATAPAC'S FRONT-PANEL RCV INDICATOR WILL LIGHT WHEN COMMUNICATION IS ATTEMPTED, BUT NOT CHR , MNE , OR RET .	Refer to Section 2.B.2(b). Both devices must be set to the same BAUD RATE, NUMBER OF DATA BITS, NUMBER OF STOP BITS, AND PARITY. If you are using the MODEL 10CIF488 IEEE Interface Adaptor, see Section 2.B.4(b); here, both the 10CIF488's SERIAL PORT and the DataPAC's COMPUTER INTERFACE PORT must be set to an RS-232-C protocol of 153.6K Baud, 8 Data Bits, 2 Stop Bits, and No Parity.
	The DataPAC is set to recognize a COMMAND TERMINATOR different from that transmitted by the connected RS-232-C device. IN THIS CASE, THE DATAPAC'S FRONT-PANEL CHR , MNE , AND RET INDICATORS MAY OR MAY NOT LIGHT WHEN COMMUNICATION IS ATTEMPTED.	Reset the DataPAC's COMMAND TERMINATOR via the CMT command (see Section 2.B.5). The DataPAC is initially set to recognize a COMMAND TERMINATOR of CARRIAGE RETURN. (Note that the DataPAC's MNE indicator will <i>not</i> light even on reception of a properly terminated command, if that command does not belong to the CENTRAL PROCESSOR'S command set—e.g., if it is a "VIDEO," "HISTORY," or "SATELLITE" command. If the "smart" card to which the command is addressed has its own front-edge MNE indicator—as do the Models 10BDR64 and 10BD4—this indicator will light on reception of the command at the DataPAC's COMPUTER INTERFACE PORT.)
	The DataPAC has been inappropriately set to "SATELLITE" mode. IN THIS CASE, THE FRONT-PANEL CHR , MNE , RET , AND RCV INDICATORS WILL LIGHT IN THE NORMAL WAY WHEN COMMUNICATION FROM THE CONNECTED DEVICE TO THE DATAPAC IS ATTEMPTED, WHILE NO OUTPUT RESPONSE WILL BE OBSERVED FROM THE DATAPAC TO THE CONNECTED DEVICE.	Refer to Section 3.B.3(b.2) and enter a command of ASN = 0 [CR] *. This applies to all "A-sized" DataPACs and to all "B-sized" DataPACs with Model 10BCP100 Software Version earlier than "9.1."

(cont'd)

COMMUNICATIONS PROBLEMS

5.B.5

Problem	Possible Cause	Possible Solution
	<p>An invalid MNEMONIC COMMAND has been received at the DataPAC's COMPUTER INTERFACE PORT. IN THIS CASE, THE DATAPAC'S FRONT-PANEL CHR, RET, AND RCV INDICATORS WILL PROBABLY LIGHT WHEN THE COMMAND IS TRANSMITTED, BUT NOT MNE.</p> <p>A command has been entered which applies only to a "smart" card not presently installed in the DataPAC.</p> <p>A command has been entered which is recognized by the DataPAC only when it is received through the keyboard.</p>	<p>Refer to Section 4 of this Guidebook and retransmit the correct command syntax. (Note that the DataPAC's MNE indicator will <i>not</i> light even on reception of a valid command, if that command does not belong to the CENTRAL PROCESSOR'S command set—e.g., if it is a "VIDEO," "HISTORY," or "SATELLITE" command. If the "smart" card to which the command is addressed has its own front-edge MNE indicator—as do the Models 10BDR64 and 10BD4—this indicator will light on reception of the command at the DataPAC's COMPUTER INTERFACE PORT.)</p> <p>Refer to Section 4 of this Guidebook for the specific card or cards to which each command applies.</p> <p>Examples of such commands are SAVE (SAV) and DELETE (DEL) (see Section 4 for details).</p>
<p>b. Incorrect data or no data is being transmitted from the DataPAC's COMPUTER INTERFACE PORT in response to a received command.</p>	<p>The RS-232-C CABLE is not properly connected or wired.</p> <p>The RS-232-C PROTOCOL settings of the DataPAC do not match those of the receiving device.</p> <p>A transmission-initiating command is being typed on a disconnected keyboard. IN THIS CASE, THE DATAPAC'S FRONT-PANEL KBD INDICATOR WILL NOT LIGHT WHEN A KEY IS PRESSED.</p> <p>A standard "READ" COMMAND—or a CHANNEL (CHN) or LIMIT ZONE (LZN) command—is being entered via the keyboard.</p> <p>The DataPAC is set to transmit an OUTPUT TERMINATOR and/or END-OF-TRANSMISSION TERMINATOR different from the corresponding communications terminators recognized by the receiving device.</p>	<p>See above.</p> <p>See above. The selected BAUD RATE must, of course, be one to which the receiving device (computer, printer, etc.) is compatible.</p> <p>Make sure the keyboard connection is good (see Section 1.C). If the KBD indicator fails to light, even when the terminal of the keyboard connector cord is fully engaged in the DataPAC's KEYBOARD CONNECTOR, contact the Daytronic Service Dept.</p> <p>As explained in Sections 1.A.3(d) and 1.H.1, such commands will NOT produce output from the COMPUTER INTERFACE PORT when they are entered through the keyboard.</p> <p>Refer to Section 1.H.3(g) and apply the OPT command to reset the DataPAC's OUTPUT TERMINATOR and END-OF-TRANSMISSION TERMINATOR, <i>if they are to be the same</i>. If they are to be different, apply a separate EOT command following the OPT command. The DataPAC is initially set to transmit an OUTPUT TERMINATOR and END-OF-TRANSMISSION TERMINATOR of CARRIAGE RETURN, LINE FEED.</p>

(cont'd)

5.B.5

COMMUNICATIONS PROBLEMS

Problem	Possible Cause	Possible Solution
	A B-SLOT <i>other than</i> that dedicated to the COMPUTER INTERFACE PORT has been designated to be the DataPAC's DEFAULT COMMUNICATIONS PORT; any transmission-initiating command entered by keyboard or contained in an EXECUTE (EXU) or COMMAND (CMD) string will therefore NOT be responded to by the COMPUTER INTERFACE PORT.	Return the function of DEFAULT COMMUNICATIONS PORT to the DataPAC's COMPUTER INTERFACE PORT by entering a command of COM = 26 [CR] * (see Section 3.B.5(d.1)).
c. There is no response to a MNEMONIC COMMAND entered via the DataPAC's plug-in KEYBOARD.	<p>No keyboard entry is being received by the DataPAC's CENTRAL PROCESSOR, because the keyboard is not properly connected. IN THIS CASE, THE DATAPAC'S FRONT-PANEL KBD INDICATOR WILL NOT LIGHT WHEN A KEY IS PRESSED.</p> <p>Though physically connected to the DataPAC, the keyboard has been electronically "attached" to a Model IPC (Industrial Personal Computer) or AGU (Advanced Graphics Unit) also connected to the DataPAC. IN THIS CASE, THE RED INDICATOR LIGHT ON THE KEYBOARD'S SYSTEM CONFG KEY SHOULD BE ON.</p> <p>An invalid MNEMONIC COMMAND has been entered.</p> <p>A command has been entered which applies only to a "smart" card not presently installed in the DataPAC.</p> <p>A command has been entered <i>without</i> a terminating CARRIAGE RETURN ([CR]).</p> <p>A command has been entered which is not recognized by the DataPAC when it is received through the keyboard.</p> <p>A B-SLOT <i>other than</i> that dedicated to the COMPUTER INTERFACE PORT has been designated to be the DataPAC's DEFAULT COMMUNICATIONS PORT; any <i>port-related</i> "WRITE," "READ," or IMPERATIVE commands entered by keyboard will therefore NOT be recognized and/or responded to by the COMPUTER INTERFACE PORT.</p>	<p>Make sure the keyboard connection is good (see Section 1.C). If the KBD indicator fails to light, even when the terminal of the keyboard connector cord is fully engaged in the DataPAC's KEYBOARD CONNECTOR, contact the Daytronic Service Dept.</p> <p>Return the keyboard to the DataPAC by pressing the System Confg (SYSTEM CONFIGURATION) key (see the <i>IPC</i> or <i>AGU Manual</i> for details). System Confg is also used to control the DataPAC's VIDEO MODE (see Section 5.B.4(a), above, and Section 2.C.1(b)).</p> <p>Refer to Section 4 of this Guidebook and retype the correct command syntax.</p> <p>Refer to Section 4 of this Guidebook for the specific card or cards to which each command applies.</p> <p>Press CARRIAGE RETURN to put the entered command into effect.</p> <p>Examples of such commands are HDR [CR], TLR [CR], ITR [CR], CON [CR], and all forms of the LNE, VDL, and VUL commands (see Section 4 for details).</p> <p>Return the function of DEFAULT COMMUNICATIONS PORT to the DataPAC's COMPUTER INTERFACE PORT by entering a command of COM = 26 [CR] * (see Section 3.B.5(d.1)).</p>

COMMUNICATIONS PROBLEMS

5.B.5

Problem	Possible Cause	Possible Solution
d. There is an incorrect response or no response to a keyboard request for setup values pertaining to the DataPAC's COMPUTER INTERFACE PORT (CMT , OPT , EOP , CPC , DLY , etc.).	A B-SLOT <i>other than</i> that dedicated to the COMPUTER INTERFACE PORT has been designated to be the DataPAC's DEFAULT COMMUNICATIONS PORT (see above)	Return the function of DEFAULT COMMUNICATIONS PORT to the DataPAC's COMPUTER INTERFACE PORT (see above).

5.B.6

HISTORY CARD PROBLEMS

Problem	Possible Cause	Possible Solution
a. The History Card's front-panel RAM indicator goes ON each time power is cycled.		Contact the Daytronic Service Dept.
b. The History Card's front-panel CONFIG ERROR indicator goes ON each time power is cycled.	Insufficient memory is detected for the existing recorder configuration.	Make sure that no "History Option" Cards (Model "10BHM" or 10BSPC) have been removed or disconnected. If all memory cards are present, contact the Daytronic Service Dept.
c. The History Card's front-panel MNE indicator does not light when a command relating to the History Card is entered via the DataPAC's COMPUTER INTERFACE PORT.		See Section 5.B.5(a), above.
d. A recorder does not record data; the corresponding front-panel REC indicator does not light.	<p>The recorder has been halted in accordance with the conditions specified by a HALT (HLT) command applying to that recorder.</p> <p>The History Card is not in RECORD MODE; IN THIS CASE, THE FRONT-PANEL SET UP MODE INDICATOR WILL BE ON.</p> <p>The DataPAC is not powered up.</p>	<p>Apply a START FROM HALT (STH) command to the recorder (see Section 3.B.4(e.5)). Note that if "nonvolatile history" is in effect, a halted recorder will remain halted—even upon cycling of power—until application of STH.</p> <p>Exit SETUP MODE by entering a RECORD MODE (RMD) command (see Section 3.B.4(e.2)).</p> <p>Check power cord connections for the DataPAC, and make sure it is turned on.</p>
e. A recorder does not record data at the desired time-interval rate.	The time interval has not been properly entered in the recorder's STORE (STO) expression.	Refer to Section 3.B.4(d.5) and reenter the recorder's STO expression. No more than one interval ("INT") term can be included in this expression.
f. A recorder or recorders do not operate with the DEPTH values that have been specified by the user.	The DEPTH of a given recorder (and of all higher-numbered recorders) has been automatically adjusted to provide a memory volume sufficient for the recorder's entered LIST.	Either (1) reduce the size of the recorder's LIST statement (see Sections 3.B.4(b.1) and 3.B.4(d.3)), or (2) expand the total history memory by means of optional "10BHM" and/or 10BSPC Card(s) (see Section 3.B.4(b.2)).
g. A recorder does not accept an entered LST , STO , or HLT command.	The command statement is too long.	Re-enter the command with a shorter LST , STO , or HLT expression (LST can take up to 78 characters—see Section 3.B.4(d.3); STO and HLT can take up to 16 MNEMONIC terms and up to 15 OPERATORS—see Sections 3.B.4(d.5) and 3.B.4(d.6)). Also note that the LST sequence must be entered in ascending order.

HISTORY CARD PROBLEMS

Problem	Possible Cause	Possible Solution
h. A recorder does not transmit the full range of FRAMES specified by an EMP or HDU command.	The SERIAL-NUMBER range corresponding to the range of FRAMES to be "emptied" or "dumped" is <i>discontinuous</i> .	Reapply the EMP or HDU command.
i. System PLAYBACKS are not active following powerup.	The RECORD MODE (RMD) command has not been entered since power was last recycled.	Apply the RMD command (see Section 3.B.4(e.2) for details).
j. A keyboard-entered NONVOLATILE HISTORY (NVH) command is not effective.	DataPAC power has not been recycled.	Recycle power following entry of the NVH command.

5.B.7.

AUXILIARY COMPUTER INTERFACE PROBLEMS

NOTE: The COMPUTER INTERFACE PORT problems and solutions treated in Sections 5.B.5(a) and (b), above, may also apply to a DataPAC's AUXILIARY COMPUTER INTERFACE PORT (ACI)—except that in the case of an ACI, an **ASN = 0** setting for the DataPAC is not required. Also, for an ACI to respond to a *port-related* "WRITE," "READ," or IMPERATIVE COMMAND entered via the DataPAC's keyboard or via an **EXECUTE (EXU)** or **COMMAND (CMD)** function, a **COMMUNICATIONS (COM)** command of **COM = s [CR]*** is required, where "s" is the number of the SLOT occupied by the Model 10BACI in question (see Section 3.B.5(d.1)).

Section 5.C

Optional Diagnostic Tools



System 10 Guidebook

5.C.1

Model 10AEX-20 "A Card" Extender Board

The Model 10AEX-20 lets you operate any System 10 "A CARD" outside its designated A SLOT, by bringing the appropriate SLOT connections out the front of the DataPAC mainframe. It thus permits direct access to all of the card's "on-board" hardware, while at the same time maintaining any and all of the card's rear connections (to transducer, contact closures, other system cards, etc.). The Extender Board may thus be used for purposes of signal tracing, waveform observation, adjustment of internal controls, or various other diagnostic or service functions.

To "extend" a given A CARD outside its SLOT, you merely

- a. Turn OFF the DataPAC and remove the A CARD, following the instructions given in Appendix B ("Card Insertion and Removal").
- b. Pull forward the 10AEX-20's actuator lever and turn it clockwise as far as possible, thus opening the 44-pin SLOT CONNECTOR.
- c. Aligning the A CARD with the 10AEX-20, insert the A CARD'S rear I/O CONNECTOR into the 10EX-20's (vertical) 20-pin female connector, and insert the A CARD'S front SLOT TERMINALS into the 10AEX-20's SLOT CONNECTOR.
- d. Lock the card into place and close the SLOT CONNECTOR by turning the 10AEX-20's actuator lever counterclockwise.
- e. Insert the 10AEX-20 with mounted A CARD into the DataPAC's A SLOT, just as you would any standard A CARD.
- f. Reactivate the DataPAC. AS WITH ANY PLUG-IN CIRCUIT CARD, TURN OFF DATAPAC POWER BEFORE REMOVING THE 10AEX-20.

The Model 10AST is a special diagnostic and service tool. Plugging directly into the SLOT CONNECTOR of any DataPAC A SLOT, its front section protrudes from the slot. Through an array of labelled terminal posts, it allows voltmeter or oscilloscope observation of power and reference voltages, logic and calibration signals, data-bus lines, and all other signals pertinent to the slot in question. The 10AST also lets the system *read and display* the slot's Signal Common, Power Common, AC and/or DC Reference, Input Signals, and ± 9 V-DC Power Supply levels, as it would any standard DataPAC DATA CHANNELS (see Section b, below).

Insert the 10AST just like any standard A CARD (see Appendix B for "Card Insertion and Removal"), seating its SLOT TERMINALS in the 44-pin SLOT CONNECTOR of the A SLOT to be monitored (it will not, or course, make contact with any connector mounted at the *rear* of the SLOT). AS WITH ANY PLUG-IN CIRCUIT CARD, TURN OFF DATAPAC POWER BEFORE REMOVING THE 10AST.

a. MODEL 10AST TEST POINTS

Beginning in the upper left corner of the terminal-post array, the following test points (in order) are made available by the 10AST for operator observation. NOTE: IN EACH CASE THE VOLTMETER'S POSITIVE LEAD SHOULD BE CONNECTED TO THE TERMINAL POST IN QUESTION, WHILE THE NEGATIVE LEAD IS CONNECTED EITHER TO ONE OF THE **PWR. COM (POWER COMMON)** POSTS (FOR MEASUREMENT OF POWER-SUPPLY VOLTAGES) OR TO ONE OF THE **SIG. COM (SIGNAL COMMON)** POSTS (FOR MEASUREMENT OF CONDITIONER SIGNALS).

1. WW (IO) #4, #3, #2, #1

—the four Wire-Wrap pins (44 through 41) respectively, of the slot into which the 10AST has been inserted. If no signals are wire-wrapped to the slot, no signals are here available.

2. CAL #2, #1

—the logic-signal inputs to the conditioner card as a result of **SHUNT CALIBRATION—POSITION (SHP)**, **SHUNT CALIBRATION—NEGATIVE (SHN)**, and **RESUME (RSM)** commands being issued by the operator via the CENTRAL PROCESSOR (see Section 1.G.7 of this Guidebook).

3. SIG IN x.1, x1

—a means of displaying various signals on the 10AST's SUBCHANNEL NOS. 1, 2, and 3 (see below for the relevant setup procedure). The "x1" input is a one-to-one input; the "x.1" input attenuates the signal.

4. ISOLATED SUPPLY, COM

—a means of observing the DataPAC motherboard's Isolated +5-V Supply and Common signals.

5. TC REF, BUS, ENABLE

—the output signals sent by a Thermocouple Conditioner (10A9-8, 10A10-4, etc.) to the Model 10A11 Thermocouple Output Processor Card: TC REF is the reference-junction diode signal; TC BUS is the Thermocouple Conditioner SUBCHANNEL output signal; TC ENABLE is the Thermocouple Conditioner slot call signal.

6. HIGH BYTE

—a logic signal issued by the CENTRAL PROCESSOR that controls the transfer of data to digital processing boards. When the data's *least significant bit* is being transferred, this pin will be at *Logic 0*; when the data's *most significant bit* is being transferred, it will be at *Logic 1*.

7. STROBE

—a logic signal issued by the CENTRAL PROCESSOR to the analog card slot enabling signal output from the selected SUBCHANNEL of that slot.

8. DATA BUS 8, 7, 6, 5, 4, 3, 2, 1

—the 8-bit (one-byte) word used by the CENTRAL PROCESSOR for issuance of setup conditions and for the retrieval of data from digital signal processing boards (used in conjunction with the HIGH BYTE signal, above).

9. AC REF

—the 3 V-AC, 3280-Hz reference signal used by A-CARDS as oscillator inputs or to drive circuit power amplifiers. Normal reading with voltmeter on DC range is 0.000 ± 0.010 V-DC; normal reading with a "true rms" voltmeter on AC "x20" range is 3.000 ± 0.010 V-AC (rms).

10. DC REF

—the 5 V-DC reference signal used by A-CARDS as reference or circuit drive signals. Normal reading is $+5.0000 \pm 0.0005$ V-DC with no drift.

11. CALL BUS

—the analog signal-conditioner output that goes to the system A/D conversion circuits.

12. SUB CHAN. BIT #4, #2, #1

—the 3-bit address issued by the CENTRAL PROCESSOR to select the appropriate conditioned channel output to be placed on the CALL BUS.

13. SLOT CALL

—a logic-signal input from the CENTRAL PROCESSOR that causes the signal conditioner's output to be placed on the Call Bus or Data Bus.

14. PWR. COM

—two pins available for connection of meter negative lead for measuring power-supply voltages.

15. SIG. COM

—two pins available for connection of meter negative or scope ground lead for measuring or monitoring of conditioner signals.

16. +9V

—the +9 V-DC CMOS power output of the analog rack Linear Regulator Board. Normal reading is $+8.90$ V-DC (+ 0.10, - 0.40 V-DC).

17. -9V

—the -9 V-DC CMOS power output of the analog rack Linear Regulator Board. Normal reading is -8.90 V-DC (+ 0.10, - 0.40 V-DC).

b. DISPLAYING TEST SIGNALS AS DATA CHANNELS

1. Make sure the DataPAC's EEPROM Switch is OFF, and turn OFF the DataPAC.
2. Install the 10AST into the desired A-CARD SLOT.
3. Turn the DataPAC back ON and set the EEPROM Switch to the ON position (the red **E2P** indicator should light).
4. Set up a system video page to display DATA CHANNEL NOS. 1 through 8 (see Section 1.d or 2.c for video setup).
5. Enter a **TYPE (TYP)** command of

TYP 1 TO 8 = 55 [CR]*
6. Enter the following series of **LOCATE (LCT)** commands, where "d" is the number of the A-CARD "DECK" in which the 10AST is located (if it is an "A-Sized" DataPAC, omit this number), and where "s" is the number of the A-CARD SLOT occupied by the 10AST:

LCT 1 = ds1 [CR]*
LCT 2 = ds2 [CR]*
LCT 3 = ds3 [CR]*
LCT 4 = ds4 [CR]*
LCT 5 = ds5 [CR]*
LCT 6 = ds6 [CR]*
LCT 7 = ds7 [CR]*
LCT 8 = ds8 [CR]*

NOTE: The red SUBCHANNEL LED INDICATORS on the Model 10AST should light as these location assignments are made.

7. The following data will now be displayed for system DATA CHANNEL NOS. 1 through 8:

Channel	Reads
1	SIGNAL INPUT as connected to the 10AST's SIG. IN x.1 or x1 pins
2	SIGNAL INPUT as connected to the 10AST's SIG. IN x.1 or x1 pins
3	SIGNAL INPUT as connected to the 10AST's SIG. IN x.1 or x1 pins
4	DC REF value, 5000 ± 1 count
5	+9 V-DC POWER SUPPLY output divided by 2 and missing a decimal point, 4450 (+ 50, - 200) counts
6	-9 V-DC POWER SUPPLY output divided by 2 and missing a decimal point, -4450 (- 50, + 200) counts
7	SIGNAL COMMON, 0 ± 1 count
8	POWER COMMON, 0 ± 10 counts

a. INTRODUCTION

The "A-sized" Model **10AHM** Health Monitor Card lets the system read and display all pertinent power and reference voltages. It has its own independent temperature-stabilized reference source to verify the accuracy of all measurements. The companion Model **10BDHM** is a "B-sized" card which, when connected to the 10AHM via the supplied cable, can be used to monitor B-Deck voltage supplies, plus critical software handshake lines and other dynamic signals.

b. INSTALLATION AND CONFIGURATION

The 10AHM may be installed in any unoccupied "A" SLOT, and the 10BDHM in any unoccupied "B" SLOT. See Appendix B for "Card Insertion and Removal." The 10AHM's rear connector should be connected to that of the 10BDHM by means of the cable supplied with the 10BDHM. **BE SURE TO TURN OFF POWER BEFORE INSTALLING AND INTERCONNECTING THE 10AHM AND 10BDHM CARDS.**

If the 10AHM is used alone, up to 8 subchannels will be used to monitor various reference voltages. These are Subchannel Nos. 1 through 8 of the table below. If the 10BDHM is used along with the 10AHM, there will be up to 21 subchannels in all (Nos. 1 through 21). Note that you need not use all of the available 10AHM/10BDHM subchannels; you may, if desired, use any continuous range of subchannels within the main subchannel sequence, so long as the first subchannel is No. 1. For example, you may choose to use only Subchannel Nos. 1 through 3, or Subchannel Nos. 1 through 12. Remember, however, that the subchannels you use must constitute a *continuous range beginning with Subchannel No. 1* (you cannot, for example, choose only Subchannels 1, 5, 7, and 13 or the range of Subchannel Nos. 8 through 15).

You will therefore dedicate to your 10AHM (or 10AHM/10BDHM) a continuous range of up to 8 (or up to 21) otherwise unused system DATA CHANNELS. You will do so by "locating" these channels appropriately. You will then need to specify appropriate TYPE CODES, "m" (SCALING FACTOR) values, "b" (ZERO OFFSET) values, and DIGITAL FILTER values to each 10AHM or 10AHM/10BDHM subchannel. You will also most likely want to apply specific LIMIT VALUES to certain subchannels for continuous automatic monitoring by the system (recommended alarm limits are given in the following section).

1. Using the **TYPE (TYP)** command, you should first assign the required TYPE CODE to each 10AHM- or 10AHM/10BDHM-dedicated channel, as given in the table below. If, for example, the continuous range of channels you have selected for assignment to 10AHM Subchannel Nos. 1 through 4 begins with Channel No. x, you would command

TYP x = 55 [CR]*
TYP x+1 = 71 [CR]*
TYP x+2 = 71 [CR]*
TYP x+3 = 55 [CR]*

2. You will now use two **LOCATE (LCT)** commands (only) to specify the continuous range of system channels being dedicated to the 10AHM/10BDHM. If this range of channels is Channel No. x to and including Channel No. n, you would enter these two **LCT** commands:

LCT x = DSS1 [CR]*
LCT x+1 TO n = DSS2 [CR]*

where "D" is the number of the "A Deck" occupied by the 10AHM card, and "SS" is the number of the A-Deck SLOT occupied by that card (with leading zero, if necessary).

Table 1. 10AHM/10BDHM Subchannels

Subchannel Number	TYPE Code	SCALING FACTOR (EMM)	Function
1	55	20.000	V_{in}
2	71	2.5000	Independent Reference
3	71	2.7768	AC Reference
4	55	5.000	DC Reference
5	55	10.000	+9 (+8.9) V
6	55	10.000	-9 (-8.9) V
7	70	1.2500	Signal Common
8	55	5.000	Power Common
9	55	5.00	+5 V Microprocessor Rail
10	55	10.00	B-Deck +12 V
11	55	10.00	B-Deck -12 V
12	55	5.00	ISO-5 Supply (+6 V)
13	55	5.00	EEPROM Enable
14	55	5.00	Service Request
15	55	5.00	Peripheral Overrun
16	55	5.00	Carriage Return
17	55	5.00	Δ Service Request
18	55	5.00	Δ Peripheral Overrun
19	55	5.00	Δ Carriage Return
20	70	1.2500	B-Deck Signal Common
21	55	5.000	B-Deck Power Common

- Using the **SCALING FACTOR (EMM)** command, assign the required "m" coefficient to each dedicated 10AHM/10BDHM channel, as given in the table above.
- Using the range form of the **ZERO OFFSET (BEE)** command, assign a "b" term of ZERO ("0") to each dedicated 10AHM/10BDHM channel:

BEE x TO n = 0 [CR]*

where again "x" is the first channel dedicated to the 10AHM/10BDHM and "n" is the last.

- Using the range form of the **FILTER (FIL)** command, assign a filter constant of "9" to each dedicated 10AHM/10BDHM channel.
- Use the **LOW LIMIT (LOL)** and **HIGH LIMIT (HIL)** commands to set appropriate limit values for selected channels, as desired (see Section 2.F).

C. 10AHM/10BDHM SUBCHANNELS

10AHM Subchannels:

Subchannel No. 1: Used to measure various voltages referenced to SIGNAL COMMON with a clip lead. May be used to troubleshoot cards in conjunction with the Model 10AST Analog Slot Test Card (see Section 5.C.2, above).

Subchannel No. 2: An on-board +2.5000-V reference, temperature-stabilized in its own oven. This is used to track the gain drift, if any, of the A/D and its amplifier. Suggested alarm limits: 2.4995 to 2.5005.

Subchannel No. 3: Measures the amplitude of the system AC Reference, which controls the excitation levels for LVDT and AC strain gage cards. Its frequency (3276.8 Hz) also provides sync for a variety of cards. Suggested alarm limits: 2.9980 to 3.0020.

Subchannel No. 4: Measures the system DC Reference. Since System 10 is ratiometric, this should always read 5.000 ± 0.001 V. Deviations indicate trouble with the Model **10BIP232** RS-232 Interface Card. Suggested alarm limits: 4.998 to 5.002.

Subchannel Nos. 5 and 6: Measure the ± 9 -volt supplies, which are factory-set to ± 8.90 V. Normal loading effects should not result in more than 0.3-V drop. Suggested alarm limits: 8.50 to 9.00.

Subchannel No. 7: Measures the local (A-Deck) SIGNAL COMMON. Large deviations from 0 indicate excessive current, and thus possible faulty modules on the A Deck. Faulty input wiring can occasionally cause this also. Suggested alarm limits: ± 0.0010 .

Subchannel No. 8: Measures the local (A-Deck) POWER COMMON. As with SIGNAL COMMON, large deviations from 0 indicate excessive current, and thus possible faulty modules on the A Deck. Faulty input wiring can occasionally cause this also. Suggested alarm limits: ± 0.080 .

10BDHM Subchannels:

Subchannel No. 9: Measures the microprocessor's +5-V rail. Suggested alarm limits: 4.75 to 5.25.

Subchannel Nos. 10 and 11: Measure the B-Deck ± 12 -V supplies. These power the A/D, RS-232 I/O, internal monitor, etc. Suggested alarm limits: $\pm 12.00 \pm 0.60$.

Subchannel No. 12: Measures the "ISO-5 V" supply for Model 10BIO-16 Universal Logic I/O Cards. This supply is factory-set for 6.00 V (the extra volt is for the burden of the overcurrent protection circuit on each 10BIO-16). Suggested alarm limits: 6.00 ± 0.30 .

Subchannel No. 13: Measures the EEPROM Enable signal on the B Deck. This signal is active low.

Subchannel Nos. 14, 15, and 16: Measure the state of the "handshake" lines among the B-Deck cards. These active low lines toggle briefly when messages move from board to board. A persisting logic low (> 0.7 V) indicates internal communications problems or one or more external devices that are not ready to receive data from the System 10.

Subchannel Nos. 17, 18, and 19: These channels are "stretched" versions of Nos. 14, 15, and 16 and are used to verify that messages are being properly sent.

Subchannel Nos. 20 and 21: B-Deck counterparts of Nos. 7 and 8, above. Note that somewhat looser tolerances are in order on the B Deck.

Section 4.A

Introduction



System 10 Guidebook

The purpose of this Guidebook section is to supply a quick-reference directory of all System 10 MNEMONIC COMMANDS that are of use to the operator. It contains an alphabetical listing of the basic three-letter MNEMONICS recognized by various System 10 "smart" elements (CENTRAL PROCESSOR, VIDEO CARDS, HISTORY CARD, SATELLITE CARD, etc.). For each MNEMONIC, the following are given:

1. the NAME applied to the MNEMONIC (and from which, in most cases, it is literally derived);
2. the GENERAL (FUNCTIONAL) CATEGORY to which the MNEMONIC belongs;
3. the FORM (SYNTAX) of each command beginning with the MNEMONIC; and
4. a brief description of the FUNCTION of each form of the command.

For complete information on any given MNEMONIC COMMAND, you may refer to the GUIDEBOOK SECTION(S) listed for that MNEMONIC. The section or sections printed in **boldface** contain the *primary* discussion(s) of the MNEMONIC, and should therefore be consulted first.

For "Conventions Used in Command Expressions," you should review Section 1.C.2 of this Guidebook. In particular, note that all commands are shown in the Directory with the DataPAC's "standard" COMMAND TERMINATOR of **CARRIAGE RETURN ([CR])**. You may at any time set your DataPAC to recognize a different COMMAND TERMINATOR for all commands entered through the COMPUTER INTERFACE PORT, AUXILIARY COMPUTER INTERFACE ("ACI") PORT, or FIFO COMPUTER PORT (Model 10AFIFO), via the **COMMAND TERMINATOR (CMT)** command (see Section 2.B.5). Also note that, unless altered by means of an **OUTPUT TERMINATOR (OPT)** or **END OF TRANSMISSION TERMINATOR (EOT)** command (Section 1.H.3(f)), every standard RESPONSE FORMAT—as issued by the COMPUTER INTERFACE PORT or an ACI PORT in response to a "READ" or "DATA INTERROGATION" COMMAND—will be terminated by **CARRIAGE RETURN, LINE FEED ([CR][LF])**.*

If an "E" appears in the **EEPROM** column following a given command form, it tells you that the DataPAC's EEPROM Write Protect Switch must be ON for that command to be effective.** In almost all cases, such a command is a "WRITE" (or "SETUP") COMMAND—see Section 1.C.1.

If an "R" appears in the **RANGE** column following a given command form, it tells you that the command can take a "range" form. This means that the variable argument (CHANNEL, BIT, BIT GROUP, RECORDER, etc.) can be entered as a *number range* (**x TO y, r TO q, k TO l, n TO m**, etc., respectively). The range form of a "WRITE" (SETUP) COMMAND may be entered either through the DataPAC's plug-in keyboard or through its COMPUTER INTERFACE, ACI, or FIFO COMPUTER PORT. The range form of a "READ" (INTERROGATION) COMMAND, however, will only be effective when entered through the COMPUTER INTERFACE, ACI, or FIFO COMPUTER PORT. As explained in Section 1.C.4, when such a command is entered via the *keyboard*, only the *first* answer of the requested series will be displayed on the DataPAC BILLBOARD. You may then, however, use the keyboard's **STEP** key to display the answer for the next argument in numerical sequence, and continue thereby to "step" as far as you wish through a whole range of answers.

If an "I" appears in the **IMPL ADDRESS** column following a given command form, it tells you that the command is one which is "implicitly" addressed. This means that, in a SATELLITE NETWORK SYSTEM, if the command is entered at a "B-sized" DataPAC "NODE" where the **GBL = ON [CR]** command is in effect, the HOST DataPAC's CENTRAL PROCESSOR knows immediately which other network NODE to route the command to, by virtue of the GLOBAL DATA CHANNEL(S) or GLOBAL LOGIC BIT(S) contained in the command itself. It therefore needs no other ("explicit") instructions—such as an **OPEN (OPN)** or **NODE (NOD)** command—in order to send that command to the unique NODE to which it applies (see Sections 3.B.3(c.1 through c.5)). Note that there are many commands which contain a DATA-CHANNEL or LOGIC-BIT argument but which are *not* "implicitly" addressed.

To assist in GENERAL SYSTEM TROUBLESHOOTING, there are also listed for each MNEMONIC the main product(s) in which the relevant command software resides, and also, for each listed product, the

* The initial END-OF-TRANSMISSION TERMINATOR for a FIFO COMPUTER PORT (Model 10AFIFO) is **CARRIAGE RETURN, 3 LINE FEEDS ([CR][LF][LF][LF])**.

** Commands relating to the Model 10AFIFO are an exception. For most of them, the "E" indicates that the 10AFIFO EEPROM must be enabled (not the DataPAC EEPROM).

INTRODUCTION

FIRST SOFTWARE VERSION that permits the command to function in most, if not all of the ways here described.

Note here that the "implicit addressing" of commands, as explained above, is enabled only by 10ACP100 or 10BCP100 software of Version "9.0" or higher.

The following table lists the MNEMONIC COMMANDS included in the Directory.

Table 4.A.1 Commands Included in the Directory

ADD	ADDRESS	DHT	DEFAULT HEADER/TAILER
ANO	ANALOG OUTPUT	DIR	DIRECTORY
ASL	A SLOT	DIS	DISPLAY
ASN	ASSIGN SATELLITE NUMBER	DLB	DOWNLOAD BITS
ATC	ASSOCIATED TEXT COLOR	DLC	DOWNLOAD CHANNELS
ATT	ATTACH	DLY	DELAY
BAU	BAUD RATE	DMP	DUMP
BCD	BINARY CODED DECIMAL	DPT	DEPTH
BCP	B CENTRAL PROCESSOR	DSB*	DUMP SYSTEM BIT DATA
BDP	BIT DESIGNATOR PAIR	DSD*	DUMP SYSTEM DATA
BEE	ZERO OFFSET ("b")	DSF*	DUMP SYSTEM FIELD DATA
BFC	BUTTON FIELD COLOR	DSM*	DUMP SYSTEM MESSAGE
BIN	BINARY	DTE	DATE
BIT	SET BIT	ECO	ECHO
BLS	BLANK LINE SUPPRESS	EID	EXTERNAL INPUT DISABLE
BOF	BUTTONS OFF	EIE	EXTERNAL INPUT ENABLE
BON	BUTTONS ON	EMM	SCALING FACTOR ("m")
BSD	BIT STATE DISPLAY	EMP	EMPTY
BSL	B SLOT	EOI	END OR IDENTIFY
BTS	BITS	EOL	END OF LINE
BVS	B VIDEO SIGNAL	EOP	END OF PAGE
BVT	B VIDEO TEXT	EOT	END OF TRANSMISSION
BYP	BYPASS	ESC	ESCAPE
CAL	CALIBRATE	EXM	EXECUTE MODE
CAT	CATALOG	EXU	EXECUTE
CCH	CONVERSION CHANNEL	FCH	FRAME CHANNELS
CDL	CONDITIONAL	FCL	FIFO CLEAR
CHN	CHANNEL	FDM	FLOATING POINT DUMP
CHS	CURRENT HALT STATUS	FIL	FILTER
CLC	CALCULATE	FPF	FLOATING POINT FORMAT
CLK	CLOCK	FRC	FORCE
CLM	COLUMNS	FRQ	FREQUENCY CALIBRATION
CLQ	CLEAR QUEUE	FRZ	FREEZE
CLS	CLEAR SCREEN	GBL	GLOBAL
CMD	COMMAND	GCL	GRAPH CLEAR
CMT	COMMAND TERMINATOR	GRX	GRAPH RANGE X
COC	COUNTER CLEAR	GRY	GRAPH RANGE Y
COH	COUNTER HOLD	GRZ	GRAPH RANGE Z
COLD	BOOTV	GZL	GRAPH ZERO LEFT
COM	COMMUNICATIONS	GZR	GRAPH ZERO RIGHT
CON	CONFIGURE	HCL	HISTORY CLEAR
COR	COUNTER RESET	HCY	HARD COPY
COU	COUNTER UPDATE	HDP	HALT DEPTH
CPC	CHARACTERS PER CHANNEL	HDR	HEADER
CPL	CHANNELS PER LINE	HDU	HISTORY DUMP
CSB	COMPUTER STATUS BIT	HEX	HEXADECIMAL
CSF	CHECKSUM FIFO	HIL	HIGH LIMIT
DDI	DESTRUCTIVE DATA INPUT	HLT	HALT
DDO	DESTRUCTIVE DATA OUTPUT	ICD	INTERCHARACTER DELAY
DEC	DECREMENT	IMA	OUTPUT IMAGE
DEL	DELETE	INC	INCREMENT
DET	DETACH	INT	INTERVAL
DFC	DATA FIELD COLOR		

**A binary transmission command, not described in this directory. See Appendix L.1.

ITR	COMPUTER INTERRUPT	SAT	SATELLITE
KEY	KEY	SAV	SAVE
LBT	"BETWEEN" LOGIC	SBC	SYSTEM BASE CHANNEL
LCT	LOCATE	SBL	SHOW BUTTON LOCATIONS
LEG	LEGEND	SCN	SCAN
LGO	LOGO	SEL	SATELLITE ERROR LOG
LGT	"GREATER THAN" LOGIC	SEN	SENSITIVITY
LIM	LIMITS	SHN	SHUNT CALIBRATE-NEGATIVE
LIN	LINEARIZE	SHO	SHOW
LLT	"LESS THAN" LOGIC	SHP	SHUNT CALIBRATE-POSITIVE
LNE	LINE	SMD	SETUP MODE
LOK	LOCK	SND	SEND
LOL	LOW LIMIT	SNP	SNAPSHOT
LST	LIST	SOP	SIGN-ON PAGE
LZN	LIMIT ZONE	SRC	LOGIC SOURCE
MEM	MEMORY	SSB	SATELLITE SYSTEM BITS
MES	MESSAGE	STH	START FROM HALT
MOD	MODE	STO	STORE
MTC	MASTER TIMING CLOCK	STR	STREAM
MVV	MILLIVOLT/VOLT CALIBRATION	STS	STATUS
NCH	NO CHANNEL	TAR	TARE
NDI	NONDESTRUCTIVE DATA INPUT	TBT	TIMER BIT
NDO	NONDESTRUCTIVE DATA OUTPUT	TER	TERMINATOR
NOB	NO BITS	THC	TRACK HOLD CONTROL
NOD	NODE	TLR	TAILER
NOL	NO LIMITS	TME	TIME
NVH	NONVOLATILE HISTORY	TMO	TIMEOUT
OPN	OPEN	TMP	TEMPLATE
OPT	OUTPUT (END-OF-LINE) TERMINATOR	TMR	TIMER
PAG	PAGE	TST	TOUCHSCREEN TYPE
PBR	PRINTER BAUD RATE	TYP	TYPE
PEN	PEN	UNL	UNLOCK
PGL	PAGE LIST	VBC	"BIT CONTROL" STATUS
PGT	PAGE TYPE	VBT	"BETWEEN" STATUS
PLA	PLAYBACK	VDL	VIDEO DOWNLOAD
PRI	PRINT PAGE	VDU	VIDEO DISPLAY UNIT
PRT	PRINT CHANNEL DATA	VEL	VIDEO ERROR LOG
PSB	PERIPHERAL STATUS BIT	VGT	"GREATER THAN" STATUS
PTY	PRINTER TYPE	VIA	VIA
RCL	RECALL	VID	VIDEO MODE
REC	RECORDER CLEAR	VLT	"LESS THAN" STATUS
REF	REFRESH	VSS	VIDEO SCAN SYMBOL
REH	RECORDER HALT	VUL	VIDEO UPLOAD
RES	RECORDER START	XBG	EXECUTE BASE GROUP
REL	RESET ERROR LOG	XDS	TRANSMISSION DISABLE
RFM	REACCESS FIFO MEMORY	XEN	TRANSMISSION ENABLE
RHM	REACCESS HISTORY MEMORY	ZRO	ZERO
RLS	RELEASE	ZUM	ZOOM
RMD	RECORD MODE		
RNG	RANGE		
RPL	REPLAY		
RSM	RESUME		
RSN	RESET SERIAL NUMBER		
RSP	RESET STATISTICAL PLAYBACK		
RST	RESET		

Section 4.B

Command Directory



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PLEASE NOTE

In most cases, a MNEMONIC COMMAND supported by the Model **10BVT60** Video Text Card will be supported by the Model **10BVT65** "Touchscreen" Video Text Card. Likewise, a command supported by the Model **10BCP100** Central Processor Card will in most cases be supported by the Model **10BCP100A** Central Processor Card.

COMMAND	E P R O M	R A N D O M	I M P L E M E N T A T I O N	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
ADD ADDRESS ADD [CR]				10BACI-488 Operation	3.B.5 Suppl. 3	10BACI-488	
				Reads the current IEEE-488 bus address setting of the 10BACI-488 to which the command is directed; returns the current decimal address value (0 through 30).			
ANO ANALOG OUTPUT				Analog Channel Setup	3.A.2(b.2); 3.A.2(b.3) ; 3.B.3(c.4)	10ACP100 10BCP100 10KU	1.0 1.0 1.0
ANO x = e [CR]	E	R	I	Types Chn. x as "E1" (ANALOG OUTPUT) and sets it to a fixed millivolt value e (-5000 mV e 5000 mV).			
ANO x = m(CHN y) + b [CR]	E	R	I	Types Chn. x as "E0" (ANALOG OUTPUT) and sets it as a function of Chn. y (m and b are constants).			
ANO x [CR]	E	R	I	Reads current "data source" assignment for ANALOG OUTPUT CHANNEL x; returns e , m(CHNy)+b , or N/A (the latter appears if a "WRITE" form of the ANO command has not been applied to Chn. x or if Chn. x has been reset via a RESET (RST) command).			
ASL A SLOT				Logic I/O Setup	3.A.3(c.1)	10ACP100 10KU	8.0 8.0
ASL s = k [CR]	E			Assigns BIT GROUP k to the Model 10AIO-16 occupying A SLOT s.			
ASL s = N/A [CR]	E	R		Cancels current BIT-GROUP assignment for the Model 10AIO-16 occupying A SLOT s.			
ASL s [CR]			R	Reads current BIT-GROUP assignment for the Model 10AIO-16 occupying A SLOT s; returns k or N/A .			
ASN ASSIGN SATELLITE NUMBER				Satellite Network Setup	3.B.3(b.2)	10ACP100 10BCP100 10KU 10CON/CCON	8.9 8.9 8.9 1.0
ASN = n [CR]	E			Assigns a Satellite No. of "n" to the network member (NODE) to which the command is directly issued (0 n 99), and determines network role of the NODE: n = 0 for HOST; n > 0 for SATELLITE. Automatically sets the OUTPUT TERMINATOR ("OPT") and END-OF-TRANSMISSION TERMINATOR ("EOT") of the node to CARRIAGE RETURN ([0D]).			
ASN [CR]				Reads current Satellite No. of the NODE to which the command is directly issued; returns n .			
ATC ASSOCIATED TEXT COLOR				CRT Video Setup	—	10BVT60	1.0
ATC = c [CR]	E			Specifies foreground/background color or intensity combination for the display of all "associated" FIXED TEXT when in TEXT EDITOR mode; c is a two-character COLOR/INTENSITY code—see Table 2.C.2.			

COMMAND	E P R O M	R A N G E	I M P L A D D R	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
ATC [CR]				Reads current color/intensity setting for "associated" FIXED TEXT in TEXT EDITOR mode; returns c .			
ATT ATTACH				General System Operation; Satellite Network; Aux. Comp. Interface	3.B.1; 3.B.3(b.2); 3.B.5(a); 3.B.5(c.1); 3.B.5(d.1)	10BCP100 10BACI	8.1 1.0
ATT = s [CR]				"Attaches" B SLOT s to the DataPAC command source (keyboard or COMPUTER INTERFACE PORT) from which the command originates. Cancelled by DETACH (DET) command.			
ATT [CR]				Reads the B SLOT currently "attached" to the DataPAC command source from which the command originates; returns s or, if no B SLOT is currently attached, "0."			
BAU BAUD RATE				Computer Interface Setup	2.B.2(b); 2.B.2(c); 3.B.5(c.3); 3.B.5(d.1)	10BCP100 10BACI	1.0 1.0
BAU = b, d, s, p [CR]	E			Sets Baud rate and other RS-232-C protocols for COMPUTER INTERFACE PORT: b = Baud rate: 1 = 300, 2 = 1200, 3 = 2400, 4 = 4800, 5 = 9600, 6 = 19.2K, 7 = 153.6K; d = No. of Data Bits: 7 or 8; s = No. of Stop Bits: 1 or 2; p = Parity: 0 = NONE, 1 = ODD, 2 = EVEN			
BAU [CR]				Reads current protocol values for COMPUTER INTERFACE PORT; returns b,d,s,p .			
BCD BINARY CODED DECIMAL				Digital I/O Setup	2.H.2(c.1); 3.B.3(e.3)	10ACP100 10BCP100 10KU 10BACI	1.0 1.0 1.0 1.0
BCD k = d [CR]		R		Sets BIT GROUP k to encode in BCD form the decimal value d (-7999 d 7999); overrides any other bit-control sources for the bits of BIT GROUP k.			
BCD k = CHN c [CR]		E		Types Chn. c as "B2" (BCD CONVERSION CHANNEL) and causes BIT GROUP k to encode in BCD form the current data value for Chn. c (see CONVERSION CHANNEL (CCH) command); overrides any other bit-control sources for the bits of BIT GROUP k. A subsequent interrogation of LCT c [CR] will return N/A .			
BCD k [CR]		R		Returns d, the decimal value currently represented by the BCD configuration of BIT GROUP k—unless a command of BCD k = CHN c [CR] has been entered, in which case it returns CHNc .			
BCP B CENTRAL PROCESSOR				10BACIA Setup	3.B.5 Suppl. 1; 3.B.5 Suppl. 2; 3.B.5 Suppl. 3	10BACIA 10BACI-422 10BACI-488	
BCP = 100 [CR]	E			Informs all system 10BACIA's, 10BACI-422's, and 10BACI-488's that the DataPAC CENTRAL PROCESSOR is a Model 10BCP100 or 10BCP100A.			
BCP = 200 [CR]	E			Informs all system 10BACIA's, 10BACI-422's, and 10BACI-488's that the DataPAC CENTRAL PROCESSOR is a Model 10BCP200.			
BCP [CR]				Reads current BCP setting; returns 100 or 200 .			

COMMAND	E P R O M	R A N G E	I M P L E M E N T A T I O N	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
BDP BIT DESIGNATOR PAIR				CRT Video Setup	2.C.12(c)	10BVT60 10CON/CCON	6.0 1.0
BDP q = s₁, TERM₁: s₂, TERM₂ [CR]	E			Defines BIT DESIGNATOR PAIR q; 1 ≤ q ≤ 32; s ₁ and s ₂ are "STATUS" codes (see Table 2.C.3); TERM ₁ and TERM ₂ are "words" of up to 7 characters each. Replaces like-numbered pair in Table 2.C.4.			
BDP q = s₁ : s₂ [CR]	E			Changes to s ₁ and s ₂ the "STATUS" codes of an existing BIT DESIGNATOR PAIR q.			
BDP q [CR]				Reads current definition of BIT DESIGNATOR PAIR q; returns s₁, TERM₁: s₂, TERM₂ .			
BEE ZERO OFFSET ("b")				Analog Channel Setup	1.G.2; 1.G.5; 2.G.1; 2.J.1; 2.P.3; 3.B.3(c.1)	10ACP100 10BCP100 10KU	1.0 1.0 1.0
BEE x = b [CR]	E	R	I	Sets to b the ZERO OFFSET to be applied to Chn. x; may also be used to reset the precision of a CALCULATE PSEUDOCHANNEL (see Section 2.J.1).			
BEE x [CR]			R	Reads current ZERO OFFSET for Chn. x; returns b .			
BFC BUTTON FIELD COLOR				Touchscreen Video Setup	3.C.5(d.1)	10BVT65	1.0
BFC = c [CR]	E			Specifies foreground/background color or intensity combination for the display of every BUTTON upon application of a SHOW BUTTON LOCATIONS (SBL) command or upon entry of TEXT EDITOR mode; c is a two-character COLOR/INTENSITY code—see Table 2.C.2.			
BFC [CR]				Reads current color/intensity setting for button display after SBL or in TEXT EDITOR mode; returns c .			
BIN BINARY				Digital I/O Setup	2.H.2(c.1); 3.B.2(e.1); 3.B.4(d.9)	10ACP100 10BCP100 10KU 10BACI	1.0 1.0 1.0 1.0
BIN k = d [CR]			R	Sets BIT GROUP k to encode in BINARY form the decimal value d (-32000 ≤ d ≤ 32000); overrides any other bit-control sources for the bits of BIT GROUP k.			
BIN k = CHN c [CR]			E	Types Chn. c as "B1" (BINARY CONVERSION CHANNEL) and causes BIT GROUP k to encode in BINARY form the current data value for Chn. c (see CONVERSION CHANNEL (CCH) command); overrides any other bit-control sources for the bits of BIT GROUP k. A subsequent interrogation of LCT c [CR] will return N/A .			
BIN k [CR]			R	Returns d , the decimal value currently represented by the BINARY configuration of BIT GROUP k—unless a command of BIN k = CHN c [CR] has been entered, in which case it returns CHNc .			

COMMAND	E P R O M	R A N D O M	I M P L E M E N T A T I O N	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE VERSION
BIT SET BIT				System Logic Bits; FIFO Buffer Setup	2.H.2(c); 2.H(Appendix); 3.A.8(b.1); 3.B.2(e.1); 3.B.2(e.3)	10ACP100 10BCP100 10KU 10BACI 10AFIFO	1.0 1.0 1.0 1.0 1.0
BIT r = I [CR]		R		Sets logic state of LOGIC BIT r (I = 0 or 1); overrides any other bit-control source for Bit r.			
BIT r = INT [CR]		R		Returns control of LOGIC BIT r to the LOGIC SOURCE specified by the last-entered LOGIC SOURCE (SRC) command for that bit; overrides any other "external" bit-control source for Bit r.			
BIT 999 = 1 [CR]				Turns ON EEPROM Write Protect Switch for the DataPAC or Model 10AFIFO to which the command is issued.			
BIT 999 = 0 [CR]				Turns OFF EEPROM Write Protect Switch for the DataPAC or Model 10AFIFO to which the command is issued.			
BIT r [CR]		R		Reads logic state of LOGIC BIT r; returns r,0 or r,1 .			
BLS BLANK LINE SUPPRESS				Formatted Output Card Setup	3.C.3(d.3)	10VFO132	1.0
BLS = 1 [CR]				Suppresses all unused lines at the bottom of any VIDEO PAGE transmitted from the Model 10VFO132 in response to a PRINT PAGE (PRI) command.			
BLS = 0 [CR]				Cancels 10VFO132 blank line suppression.			
BLS [CR]				Reads current status of 10VFO132 blank line suppression; returns 1 or 0 .			
BOF BUTTONS OFF				Touchscreen Video Setup	3.C.5(b.2)	10BVT65	1.0
BOF [CR]				Disables all touchscreen buttons (see also BUTTONS ON (BON) command).			
BON BUTTONS ON				Touchscreen Video Setup	3.C.5(b.2)	10BVT65	1.0
BON [CR]				Enables all touchscreen buttons; in effect, by default, on DataPAC powerup (see also BUTTONS OFF (BOF) command).			
BSD BIT STATE DISPLAY				CRT Video Setup	2.C.12(c)	10BVT60 10CON/CCON	6.0 1.0
BSD r = q [CR]		E R		Assigns BIT DESIGNATOR PAIR q to the BIT-STATE FIELD displaying LOGIC BIT r. See Table 2.C.4 for standard BIT DESIGNATOR PAIRS.			
BSD r = /q [CR]		E R		Assigns BIT DESIGNATOR PAIR q to the BIT-STATE FIELD displaying LOGIC BIT r, but inverts logic-state polarity of the pair.			
BSD r [CR]		R		Reads the BIT DESIGNATOR PAIR currently assigned to the BIT-STATE FIELD displaying LOGIC BIT r; returns q or /q .			
BSL B SLOT				Logic I/O Setup	3.B.2(c.1)	10BCP100	1.0
BSL s = 1, k [CR]		E		Assigns BIT GROUP k to the Model 10BIO-16 occupying B SLOT s.			
BSL s = 255 [CR]		E		Cancels current BIT-GROUP assignment for the Model 10BIO-16 occupying B SLOT s.			

COMMAND	E P R O M	R A N G E	I M P L A D D R	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
BSL s [CR]				Reads current BIT-GROUP assignment for the Model 10BIO-16 occupying B SLOT s; returns 1,k or 255 .			
BTS BITS				System Logic Bits	2.H.5; 2.K.2(f)	10ACP100 10BCP100 10KU	8.1 8.1 8.9
BTS [CR]				Cancels NO BITS (NOB) command, to resume normal reading of system LOGIC BITS with each scan cycle. May be used to re-enable system EXECUTE (EXU) functions (see Section 2.K.2(e)). In effect on powerup, by default.			
BVS B VIDEO SIGNAL				CRT Video Setup	2.C.1(a); 2.N.2; 3.C.4(b)	10BVT60 10CON/CCON	9.0 1.0
BVS = 90 [CR]	E			Sets DataPAC for operation with Model 10BVS90 Video Signal Card.			
BVS = 95 [CR]	E			Sets DataPAC for operation with Model 10BVS95 Graphics Video Signal Card.			
BVS [CR]				Reads current Video Signal Card setting; returns 90 or 95 .			
BVT B VIDEO TEXT				Touchscreen Video Setup	3.C.5(a)	10BVT65	1.0
BVT [CR]				Asks the DataPAC whether or not a Model 10BVT65 is present; if so, returns 65 ; if not, returns NO .			
BYP BYPASS				FIFO Buffer Operation	3.A.8(c.3)	10AFIFO	1.0
BYP = ON [CR]				Initiates "FIFO bypass" for all outputs from the DataPAC's COMPUTER INTERFACE PORT (Model 10ACP100). Principally used to obtain quick responses to "READ" COMMANDS received at the Model 10AFIFO's FIFO COMPUTER PORT which do not relate to the 10AFIFO itself; each such answer is transferred directly to the 10AFIFO's output buffer. When the bypass is ON, the 10AFIFO's standard input and output modes (DDI , NDI , XEN , and XDS) are suppressed. Can be entered only through the FIFO COMPUTER PORT.			
BYP = OFF [CR]				Cancels "FIFO bypass"; all outputs from the 10ACP100 are again received by and stored in the 10AFIFO's main memory; all standard FIFO input and output modes are again applicable. Can be entered only through the FIFO COMPUTER PORT.			
BYP [CR]				Reads current "FIFO bypass" status; returns ON or OFF .			
CAL CALIBRATE				Touchscreen Video Setup	3.C.5(b.3)	10BVT65	1.0
CAL [CR]	E			Initiates touchscreen recalibration sequence; the DataPAC's EEPROM Switch should be ON.			
CAT CATALOG				Formatted Output Card Operation	3.C.3(c.1)	10VFO132	1.0
CAT [CR]				Transmits DataPAC PAGE DIRECTORY from Model 10VFO132 PRINTER INTERFACE PORT.			

COMMAND	E P R O M	R A N G E	I M P L E M E N T A T I O N	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE VERSION
CCH CONVERSION CHANNEL				Digital I/O and Peak Capture Card Setup	3.A.4(b.4); 3.B.2(e.1); 3.B.2(e.3); 3.B.4(d.9)	10ACP100 10BCP100 10KU	8.9 8.9 8.9
CCH c = x [CR] CCH c [CR]	E			Establishes DATA CHANNEL x as "data source" for CONVERSION CHANNEL c. Reads the DATA CHANNEL currently assigned to CONVERSION CHANNEL c; returns x or N/A (the latter appears if the "WRITE" form of the CCH command has not been applied to Chn. c or if Chn. c has been reset via a RESET (RST) or TYPE (TYP) command).			
CDL CONDITIONAL				Automatic Command Execution	2.K.1; 2.K.3(a); 2.K.3(b) 3.B.4(e.2)	10BVT60 10CON/CCON	7.0 1.0
CDL q = B [CR] CDL q = N/A [CR] CDL q [CR]	E E R			Defines the logical combination of system conditions that will set CONDITIONAL BIT q to Logic 1 (1 q 10; B is a Boolean expression of up to 16 MNEMONIC terms and up to 15 OPERATORS—see Section 2.K.3). NOTE: When entering a CDL command via the Computer Interface Port, the expression "B" should not exceed 73 characters. Cancels the current definition of CONDITIONAL BIT q. Reads the current definition of CONDITIONAL BIT q; returns B or N/A .			
CHN CHANNEL				Data Trans- mission; System Pseudo- channels; Digital Input Setup	1.H.1; 1.H.2(a); 2.D.3; 2.D.4; 2.J.2; 2.M.2; 3.A.2(b.3); 3.B.2(e.2); 3.B.2(e.4); 3.B.3(c.1); 3.B.4(d.9); 3.B.5(d.1)	10ACP100 10BCP100 10KU 10BACI	1.0 1.0 1.0 1.0
CHN x [CR] CHN x = w [CR] CHN x = CHN a [CR]	R (E) R I R I			Reads current data for Chn. x. When entered through COMPUTER INTERFACE PORT, outputs x,w,z , where x = Channel No. (optional—see ECHO (ECO) command); w = data value for Chn. x; z = LIMIT-ZONE Indicator No. (optional—see LIMITS (LIM) command). When entered through keyboard, displays CHN x = w only, even when the LIM command is in effect. Chn. x can be an ANALOG INPUT CHANNEL ("REAL," "PSEUDO," or "CONVERSION") or an ANALOG OUTPUT CHANNEL. The "range" form (CHN x TO y [CR]) is identical in effect to the "range" form of the DUMP (DMP) command. The mnemonic CHN may also be entered by pressing the keyboard's Chan key, <i>for purposes of interrogation only</i> . Loads Chn. x with fixed data value w. Chn. x is normally a DOWNLOAD PSEUDOCHANNEL (VOLATILE or NONVOLATILE), a TIMER PSEUDOCHANNEL (INCREMENTAL or DECREMENTAL), or an ANALOG OUTPUT CHANNEL; it may, however, be a PSEUDOCHANNEL of any type, or even a scanned "REAL" CHANNEL—in which case the downloaded value is immediately overwritten with the next scan (see, for example, the procedure for resetting "MAX" and "MIN" CALCULATE PSEUDOCHANNELS, Section 2.J.2). The EEPROM Switch must be ON only if Chn. x is a NONVOLATILE ("KEEP-ALIVE") DOWNLOAD PSEUDOCHANNEL (Type "D1"). Loads Chn. x with the current reading of DATA CHANNEL a, where Chn. x is a VOLATILE DOWNLOAD PSEUDOCHANNEL (only). An interrogation of CHN x			

COMMAND	E P R O M	R A N G E	I M P L E M E N T A T I O N	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
CHN x TO y = CHN a, b [CR]			I				[CR] following this command will return the current data value of Chn. x, and <i>not</i> CHNa . Loads each VOLATILE DOWNLOAD PSEUDOCHANNEL in the range from x through y with the current reading of the corresponding DATA CHANNEL in the range from a through b ($y > x$; $b > a$; $(y-x) = (b-a)$). An interrogation of CHN x TO y [CR] following this command will return the current data values of Chns. x through y, and <i>not</i> CHNa,b .
CHN x = BIN k [CR]	E		I				Types Chn. x as "B4" (BINARY INPUT "REAL" CHANNEL), and dedicates it to the reading of the BINARY configuration of BIT GROUP k. An interrogation of CHN x [CR] following this command will return the decimal equivalent of this configuration, and <i>not</i> BINK . A subsequent interrogation of LCT x [CR] will, however, return BINK .
CHN x = BCD k [CR]	E		I				Types Chn. x as "B3" (BCD INPUT "REAL" CHANNEL), and dedicates it to the reading of the BCD configuration of BIT GROUP k. An interrogation of CHN x [CR] following this command will return the decimal equivalent of this configuration, and <i>not</i> BCDk . A subsequent interrogation of LCT x [CR] will, however, return BCDk .
CHS CURRENT HALT STATUS				History Card Operation	3.B.4(e.4)	10BDR64	1.0
CHS n [CR]		R					Reads current "halt status" of Model10BDR64 Recorder n; returns r,q ($r = \text{no. of FRAMES recorded so far since occurrence of the predefined "halt" condition}$; $q = \text{total HALT DEPTH of the recorder}$).
CLC CALCULATE				Pseudo- channel Setup	2.J; 3.A.4(c.4); 3.B.3(c.4);	10ACP100 10BCP100 10KU	1.0 1.0 1.0

Defines CALCULATE PSEUDOCHANNEL x as a function of one or more other DATA CHANNELS (m and b are constants, where the entered b value determines the precision of Chn. x); gives Chn. x a corresponding TYPE CODE ("F6," "FC," "F0," etc.—see Section 2.J):

CLC x = m(CHN y) + b [CR]	E	I	Multiplication of a single channel by a constant.
CLC x = (CHN y)/m + b [CR]	E	I	Division of a single channel by a constant.
CLC x = m(CHN y + CHN z) + b [CR]	E	I	Addition of two channels.
CLC x = m(CHN y - CHN z) + b [CR]	E	I	Subtraction of one channel from another.
CLC x = m(CHN y)(CHN z) + b [CR]	E	I	Multiplication of two channels.
CLC x = (CHN y)(CHN z)/m + b [CR]	E	I	Multiplication of two channels, divided by a constant.
CLC x = m(CHN y)/(CHN z) + b [CR]	E	I	Division of one channel by another (scaled numerator).
CLC x = (CHN y)/(CHN z)m + b [CR]	E	I	Division of one channel by another (scaled denominator).
CLC x = m/(CHN y) + b [CR]	E	I	Division of a constant by a channel.
CLC x = m(SQR CHN y) + b [CR]	E	I	Square root of a channel.
CLC x = m(ABS CHN y) + b [CR]	E	I	Absolute value of a channel.

COMMAND	E P R O M	R A N D O M	I M P L E M E N T A T I O N	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
CLC $x = m(\text{MAX CHN } y) + b$ [CR]	E		I				
CLC $x = m(\text{MIN CHN } y) + b$ [CR]	E		I				
CLC x [CR]		R	I				
CLK CLOCK				General System Setup	3.B.5 Suppl. 2	10BCP200	
CLK = ON [CR]	E						Synchronizes scanning of data channels to the time-of-day clock by pausing at the end of each scan until the clock registers its next tenth of a second.
CLK = OFF [CR]	E						Cancels delay between successive scan cycles.
CLK [CR]							Reads current CLOCK setting; returns ON or OFF .
CLM COLUMNS				Formatting of Data Transmissions	1.H.3(e); 3.B.5(c.5); 3.B.5(d.1)	10ACP100 10BCP100 10KU 10BACI	1.0 1.0 1.0 1.0
CLM = n [CR]	E						Sets columnar format for STREAM (STR) and HARD COPY (HCY) transmissions from COMPUTER INTERFACE PORT (n = no. of columns).
CLM [CR]							Reads current column-number specification for STREAM (STR) and HARD COPY (HCY) transmissions; returns n .
CLQ CLEAR QUEUE				Formatted Output Card Operation	3.C.3(c.3)	10VFO132	1.0
CLQ [CR]							Clears a "queue" of VIDEO PAGES yet to be transmitted from the Model 10VFO132 PRINTER INTERFACE PORT.
CLS CLEAR SCREEN				Touchscreen Video Operation	3.C.5(d.3)	10BVT65	1.0
CLS = n [CR]							Temporarily disables all active BUTTONS on the currently displayed VIDEO PAGE for "n" seconds (1 ≤ n ≤ 60), so that the screen may be cleaned without activating any BUTTONS.
CMD COMMAND				Automatic Command Execution	2.K.1; 2.K.3(d); 3.B.4(e.2)	10BVT60 10CON/CCON	7.0 1.0
CMD q = \$ [CR]	E						Specifies one or more commands to be executed upon transition of CONDITIONAL BIT q from <i>Logic 0</i> to <i>Logic 1</i> (\$ is an ASCII string of up to 32 characters; command delimiter is colon (:)).
CMD /q = \$ [CR]	E						Specifies one or more commands to be executed upon transition of CONDITIONAL BIT q from <i>Logic 1</i> to <i>Logic 0</i> .
CMD q = N/A [CR]	E						Cancels existing CMD command applying to the <i>Logic 0</i> to <i>Logic 1</i> transition of CONDITIONAL BIT q.

COMMAND	E P R O M	R A N G E	I M P L A D R	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST	
				CATEGORY	SECTION(S)		SOFTWARE	VERSION
CMD /q = N/A [CR] CMD q [CR] CMD /q [CR]	E			Cancels existing CMD command applying to the <i>Logic 1 to Logic 0</i> transition of CONDITIONAL BIT q. Reads the command(s) to be executed upon the <i>Logic 0 to Logic 1</i> transition of CONDITIONAL BIT q; returns \$ or N/A . Reads the command(s) to be executed upon the <i>Logic 1 to Logic 0</i> transition of CONDITIONAL BIT q; returns \$ or N/A .				
CMT COMMAND TERMINATOR CMT = c [CR] CMT [CR]	E			Communi- 2.B.5; 10ACP100 8.0 cations 3.A.8(b.3); 10BCP100 8.0 Setup 3.B.3(b.1); 10KU 8.0 3.B.5(c.4); 10BACI 1.0 3.B.5(d.1) 10AFIFO 1.0				
				1) If a Model 10AFIFO is not connected to the DataPAC's COMPUTER INTER- FACE PORT, specifies character c to be recognized as the COMMAND TERMINATOR for all commands received via the COMPUTER INTERFACE PORT; c must be an ASCII CONTROL CHARACTER entered as a hexadecimal word in brackets ("[00]" through "[1F]" only, excluding the [Esc] character—see Table 1.H.2). 2) If a Model 10AFIFO is connected to the DataPAC's COMPUTER INTERFACE PORT (Model 10ACP100), specifies the COMMAND TERMINATOR c for all commands received by the 10AFIFO from its connected RS-232-C device; c must be an ASCII CONTROL CHARACTER entered as a hexadecimal word in brackets ("[00]" through "[1F]" only, excluding the [Esc] character—see Table 1.H.2). Can be issued to the 10AFIFO <i>only</i> through the FIFO COMPUTER PORT; enabling of the 10AFIFO EEPROM must precede entry of the command (see SET BIT (BIT) command); the DataPAC's EEPROM Switch must also be ON. Also changes to the COMMAND TERMINATOR recognized by the connected 10ACP100 (on DataPAC powerup, the 10AFIFO will assume the existing COMMAND TERMINATOR of the 10ACP100—see Section 3.A.8(b.3)).				
				1) If a Model 10AFIFO is <i>not</i> connected to the DataPAC's COMPUTER INTERFACE PORT, reads the currently effective COMMAND TERMINATOR for the COMPUTER INTERFACE PORT; usually entered via keyboard, but will also be recognized by the DataPAC when entered via COMPUTER INTERFACE PORT with termination of CARRIAGE RETURN ([CR]), regardless of the COMMAND TERMINATOR currently in effect for that port; returns c . 2) If a Model 10AFIFO is connected to the DataPAC's COMPUTER INTERFACE PORT (Model 10ACP100), reads the currently effective COMMAND TERMINA- TOR for the FIFO COMPUTER PORT; can be issued to the 10AFIFO <i>only</i> through the FIFO COMPUTER PORT, and is effective when terminated by CARRIAGE RETURN ([CR]), regardless of the 10AFIFO COMMAND TERMINATOR currently in effect; returns c .				
COC COUNTER CLEAR COC x [CR]				Counter/ 3.A.1(c.2); 10ACP100 8.0 Timer Card 3.A.1(d.4) 10BCP100 8.0 Operation 10KU 8.0				
				Releases COUNTER RESET (COR) command, resuming normal updating (from zero) of the scanned data reading of Model 10ACT01 or 10ACC-4 "COUNTER" Chn. x; automatically in effect on application of a TYPE (TYP) or RANGE (RNG) command to Chn. x.				

COMMAND	E P R O M	R A N G E	I M P L A D D R	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
COH COUNTER HOLD				Counter/ Timer Card Operation	3.A.1(c.2); 3.A.1(d.4)	10ACP100 10BCP100 10KU	8.0 8.0 8.0
COH x [CR]				Inhibits updating of the scanned data reading of Model 10ACT01 or 10ACC-4 "COUNTER" Chn. x.			
COLD BOOTV				CRT Video Rebooting	—	10BVT60 10CON/CCO	7.0 1.0
COLD BOOTV	E			Displays menu page with further instructions for selective "rebooting" of VIDEO CARD SET.			
COM COMMUNICATIONS				Communi- cations Setup	3.B.5(a); 3.B.5(d.1)	10BCP100 10BACI	9.0 1.0
COM = s [CR]	(E)			Designates the AUXILIARY COMPUTER INTERFACE provided by the Model 10BACI installed in B SLOT s to be the DataPAC's DEFAULT COMMUNICATIONS PORT (DCP). If the EEPROM Switch is OFF, the command will <i>temporarily</i> assign the function of DCP to the specified port; on powerup, the DCP will be the port specified by the last COM command to have been entered with the EEPROM Switch ON.			
COM = 26 [CR] COM [CR]	(E)			Returns the DataPAC's COMPUTER INTERFACE PORT to the function of DCP. Reads the B SLOT of the current DEFAULT COMMUNICATIONS PORT; returns s or 26.			
CON CONFIGURE				Backup Storage	2.P.2; 3.B.3(c.4)	10ACP100 10BCP100 10KU	1.0 1.0 1.0
CON x = \$ [CR]	E		I	Sets Chn. x to the CONFIGURATION encoded by ASCII string \$ (100 characters maximum).			
CON x [CR]		R	I	Reads current CONFIGURATION of Chn. x; can only be entered via COMPUTER INTERFACE PORT, and outputs \$.			
COR COUNTER RESET				Counter/ Timer Card Operation	3.A.1(c.2); 3.A.1(d.4)	10ACP100 10BCP100 10KU	8.0 8.0 8.0
COR x [CR]				Sets and holds at zero the scanned data reading of Model 10ACT01 or 10ACC-4 "COUNTER" Chn. x, unless the COUNTER HOLD (COH) command is in effect for that channel.			
COU COUNTER UPDATE				Counter/ Timer Card Operation	3.A.1(c.2); 3.A.1(d.4)	10ACP100 10BCP100 10KU	8.0 8.0 8.0
COU x [CR]				Releases COUNTER HOLD (COH) command, updating the scanned data reading of Model 10ACT01 or 10ACC-4 "COUNTER" Chn. x; automatically in effect on application of a TYPE (TYP) or RANGE (RNG) command to Chn. x.			

COMMAND	E P R O M	R A N D O M	I M P L E M E N T A T I O N	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE VERSION
CPC CHARACTERS PER CHANNEL				Formatting of Data	1.H.3(d); 3.B.5(c.5);	10ACP100 10BCP100	8.0 8.0
				Transmissions	3.B.5(d.1)	10KU 10BACI	8.0 1.0
	CPC = n [CR]	E		Formats the per-channel DATA FIELD for all STREAM (STR) and HARD COPY (HCY) transmissions from the COMPUTER INTERFACE PORT (n = no. of DATA-FIELD spaces; 2 n 9).			
CPC [CR]				Reads the number of DATA-FIELD spaces currently specified for all STR and HCY transmissions; returns n.			
CPL CHANNELS PER LINE				Formatted Output Card Setup	3.C.3(f.1)	10VFO132	7.0
	CPL = n [CR]	E		Sets maximum number of channels to be included in each line of output issued by the Model 10VFO132 in response to a PRINT CHANNEL DATA (PRT) command (1 n 25).			
	CPL [CR]			Reads maximum number of channels to be included in each line of PRT output; returns n.			
CSB COMPUTER STATUS BIT				Automatic Command Execution	2.H.2(d); 2.K.2(d)	10ACP100 10BCP100 10KU	8.1 8.1 8.1
	CSB = r [CR]	E		Assigns "special bit" LOGIC SOURCE to LOGIC BIT r: r will be at Logic 1 only when the COMPUTER COMMAND QUEUE is empty.			
	CSB = N/A [CR] CSB [CR]	E		Cancels current COMPUTER STATUS BIT assignment. Reads current COMPUTER STATUS BIT assignment; returns r or N/A .			
CSF CHECKSUM FIFO				FIFO Buffer Operation	3.A.8(c.7)	10AFIFO	1.0
	CSF = SUM [CR]	E		Stores the checksum value of the 10AFIFO's existing EEPROM contents and the checksum value of its existing RAM contents.			
	CSF [CR]			Returns [Field 1] , [Field 2] , [Field 3] ; if the 10AFIFO CODE EEPROM checksum is equal to the prestored value, "Field 1" is PASSED ; if the 10AFIFO EEPROM checksum is equal to the value stored by the last CSF = SUM [CR] command, "Field 2" is PASSED ; if the 10AFIFO RAM checksum is equal to the value stored by the last CSF = SUM [CR] command, "Field 3" is PASSED . If any of these checksums FAILS, the corresponding field will contain some 4-character hexadecimal word.			
DDI DESTRUCTIVE DATA INPUT				FIFO Buffer Setup	3.A.8(b.5)	10AFIFO	1.0
	DDI [CR]	E		Places the Model 10AFIFO in "CYCLIC" INPUT MODE; the 10AFIFO's main memory will continuously receive and store consecutive DATA RECORDS from the DataPAC's COMPUTER INTERFACE PORT (Model 10ACP100), rewriting over the oldest contents of the 10AFIFO's main memory when it is full. Requires the "FIFO bypass" to be OFF (see BYPASS (BYP) command). Enabling of the 10AFIFO EEPROM must precede entry of the command (see SET BIT (BIT) command). Can be entered only through the FIFO COMPUTER PORT; see also MODE (MOD) command.			

COMMAND	E P R O M	R A N G E	I M P L A D D R	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
DDO DESTRUCTIVE DATA OUTPUT DDO [CR]				FIFO Buffer Operation	3.A.8(c.1)	10AFIFO	1.0
Causes the Model 10AFIFO to output through the FIFO COMPUTER PORT the oldest DATA RECORD in the 10AFIFO's main memory, one time only. A copy of this DATA RECORD is retained in the 10AFIFO's <i>output buffer</i> , the previous contents of which are <i>destroyed</i> (for retransmission of output-buffer contents, see NONDESTRUCTIVE DATA OUTPUT (NDO) command). Only effective when the 10AFIFO is in "GATED" OUTPUT MODE (see TRANSMISSION DISABLE (XDS) command) and the "FIFO bypass" is OFF (see BYPASS (BYP) command); can be entered only through the FIFO COMPUTER PORT.							
DEC DECREMENT DEC x [CR]			R I	Internal Counter Functions	2.M.1; 3.B.3(c.1); 3.D.5(c.7)	10ACP100 10BCP100 10KU 10BACI	8.1 8.1 8.1 1.0
Decrements by "1" the current data value of DOWNLOAD PSEUDOCHANNEL x.							
DEL DELETE DEL p [CR]			E	CRT Video Setup	2.C.10	10BVT60 10CON/CCON	1.0 1.0
Deletes VIDEO PAGE FORMAT No. p from EEPROM storage; requires special confirmation, and can only be entered through the keyboard.							
DET DETACH DET [CR]				General System Operation; Satellite Network; Aux. Comp. Interface	3.B.1; 3.B.3(b.2); 3.B.5(c.1)	10BCP100 10BACI	8.1 1.0
Cancels the ATTACH (ATT) command, detaching the B CARD presently "attached" to the DataPAC command source (keyboard or COMPUTER INTERFACE) from which the command originates; a subsequent interrogation of ATT [CR] will return "0" (zero).							
DFC DATA FIELD COLOR DFC = c [CR] DFC [CR]			E	CRT Video Setup	—	10BVT60	1.0
Specifies foreground/background color or intensity combination for the display of all DATA FIELDS when in TEXT EDITOR mode; c is a two-character COLOR/INTENSITY code—see Table 2.C.2.							
Reads current color/intensity setting for DATA FIELDS in TEXT EDITOR mode; returns c .							
DHT DEFAULT HEADER/TAILER DHT = h, t [CR] DHT [CR]			E	Formatted Output Card Setup	3.C.3(e.2)	10VFO132	7.0
Specifies DEFAULT "HEADER" PAGE h and DEFAULT "TAILER" PAGE t for Model 10VFO132 PRINT CHANNEL DATA (PRT) transmissions.							
Reads current 10VFO132 DEFAULT "HEADER" and "TAILER" specification; returns h, t .							

COMMAND	E P R O M	R A N G E	I M P L E M E N T A T I O N	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
DIR DIRECTORY DIR [CR]				CRT Video Operation	2.C.2(b)	10BVT60 10CON/CCON	1.0 1.0
				Calls DataPAC PAGE DIRECTORY to display.			
DIS DISPLAY DIS = 1 [CR] DIS = 2 [CR] DIS [CR]				General System Setup	1.A.4	10ACP100 10KU	1.0 1.0
	E			This command must be in effect for proper functioning of an "A-sized" DataPAC with <i>two-line "billboard" display</i> , local or remote (e.g., a Model 10KU-KD or 10K4T-KD, or a Model 10KU that is being used with a Model 10DISU Display Option or with a Model 10P80D Extended Keyboard); must also be in effect for an "A-sized" DataPAC with <i>no display</i> (e.g., a Model 10KU, 10K1C, or 10K4T with <i>no optional display capabilities</i>).			
	E			This command must be in effect for proper functioning of an "A-sized" DataPAC with <i>multichannel LCD or VFD data display</i> , local or remote (e.g., a Model 10K2D or 10K4T-DA, or a Model 10KU, 10K1C, or 10K4T that is being used with a Model 10VFD-2 Display Option).			
				Reads current DIS setting for an "A-sized" DataPAC; returns 1 or 2 .			
DLB DOWNLOAD BITS DLB = k [CR] DLB = k, I [CR] DLB = N/A [CR] DLB [CR]				Satellite Network Setup	3.B.3(b.6)	10BD4	3.0
	E			Causes the Model 10BD4 to download GLOBAL BIT GROUP k to each "A-sized" DataPAC SATELLITE in the network, with each 10BD4 scan cycle; the command must be applied <i>to the HOST</i> (each "A-sized" SATELLITE should first be set to "hear" all or part of the GLOBAL LOGIC BITS which have <i>not</i> been dedicated to that SATELLITE via the SATELLITE SYSTEM BITS (SSB) command; this may be done by assigning to each such bit a local LOGIC SOURCE of " SAT ," via one or more LOGIC SOURCE (SRC) commands applied <i>to the SATELLITE</i> —see Section 3.B.3(b.6)).			
	E			Causes the Model 10BD4 to download all GLOBAL BIT GROUPS from k through I to each "A-sized" DataPAC SATELLITE in the network, with each 10BD4 scan cycle; k < I.			
	E			Cancels the downloading of GLOBAL BIT GROUPS to every "A-sized" SATELLITE with each 10BD4 scan cycle.			
				Reads the GLOBAL BIT GROUP(S) to be downloaded to every "A-sized" SATELLITE with each 10BD4 scan cycle; returns k ; k,I ; or N/A .			
DLC DOWNLOAD CHANNELS DLC = x [CR] DLC = x, y [CR] DLC = N/A [CR]				Satellite Network Setup	3.B.3(b.5)	10BD4	3.0
	E			Causes the Model 10BD4 to download GLOBAL DATA CHANNEL x to each "A-sized" DataPAC SATELLITE in the network, with each 10BD4 scan cycle; the command must be applied <i>to the HOST</i> (each "A-sized" SATELLITE should be set to "hear" all or part of the GLOBAL DATA CHANNELS which have not been dedicated to that SATELLITE via the SATELLITE (SAT) command; this may be done by assigning to each such channel a local "type" code of "D4," via one or more TYPE (TYP) commands—see Section 3.B.3(b.5)).			
	E			Causes the Model 10BD4 to download all GLOBAL DATA CHANNELS from x through y to each "A-sized" DataPAC SATELLITE in the network, with each 10BD4 scan cycle; 1 < x < y < 998.			
	E			Cancels the downloading of GLOBAL DATA CHANNELS to every "A-sized" SATELLITE with each 10BD4 scan cycle.			

COMMAND	E P R O M	R A N G E	I M P L A D R	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
DLC [CR]				Reads the GLOBAL DATA CHANNEL(S) to be downloaded to every "A-sized" SATELLITE with each 10BD4 scan cycle; returns x; x,y; or N/A .			
DLY DELAY				Data	1.H.4;	10ACP100	1.0
				Trans- mission	3.B.5(c.5); 3.B.5(d.1)	10BCP100 10KU	1.0 1.0
				Setup		10BACI	1.0
DLY = s [CR]	E			Sets time delay between successive channel data transmissions from COMPUTER INTERFACE PORT in response to a DUMP (DMP), STREAM (STR), HARD COPY (HCY), SNAPSHOT (SNP), or LIMIT ZONE (LZN) command to s milliseconds (0 s 100).			
DLY [CR]				Reads current intertransmission time delay setting; returns s.			
DMP DUMP				Data	1.H.1;	10ACP100	1.0
				Trans- mission	1.H.2(b); 3.B.5(d.1)	10BCP100 10KU	1.0 1.0
						10BACI	1.0
DMP [CR]				Transmits current data for all scanned DATA CHANNELS, including Chns. 998 (TIME) and 999 (DATE), from COMPUTER INTERFACE PORT, only once; outputs x,w,z per channel, where x = Channel No. (optional—see ECHO (ECO) command); w = data value; z = LIMIT-ZONE Indicator No. (optional—see LIMIT (LIM) command).			
DMP x TO y [CR]				Transmits current data, once only, for Chns. x through y only (y x).			
DPT DEPTH				History Card	2.Q.2(e);	10BDR64	1.0
				Setup; LCD	3.B.4(b.4);	10ACP100G	4.0
				Graphics	3.B.4(d.4)		
				Operation			
DPT n = d [CR]	E	R		Sets to d the DEPTH of Model 10BDR64 Recorder n (0 d 32767; DEPTH of "0" disables recorder).			
DPT n [CR]			R	Reads current DEPTH of Model 10BDR64 Recorder n; returns d .			
DPT [CR]				Reads both <i>maximum</i> and <i>current</i> DEPTH of the DataPAC's LCD STRIP-CHART RECORDER; returns m,c (m = maximum DEPTH; c = current DEPTH). To <i>update</i> the displayed answer to a DPT [CR] interrogation, press the keyboard's Step key. When current DEPTH (c) becomes equal to maximum DEPTH (m), an answer of m,m will be returned. There is no corresponding DPT "WRITE" COMMAND for the STRIP-CHART RECORDER.			
DSB DUMP SYSTEM BIT DATA				See Appendix L.1 ("Binary Transmission Mnemonics").			
DSD DUMP SYSTEM DATA				See Appendix L.1 ("Binary Transmission Mnemonics").			
DSF DUMP SYSTEM FIELD DATA				See Appendix L.1 ("Binary Transmission Mnemonics").			
DSM DUMP SYSTEM MESSAGE DATA				See Appendix L.1 ("Binary Transmission Mnemonics").			

COMMAND	E P R O M	R A N G E	I M P L E M E N T A T I O N	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
DTE DATE				General System Setup	1.F.3	10ACP100 10BCP100 10KU 10CON/CCON	1.0 1.0 1.0 1.0
DTE = d [CR]	E			Sets the DataPAC's internal date (d is a 5- or 6-digit number: month-day-year, to be displayed with separating slashes (/)).			
DTE [CR]				Reads current date value; returns d .			
ECO ECHO				Formatting of Data Transmissions	1.H.3(a); 3.B.5(c.5); 3.B.5(d.1)	10ACP100 10BCP100 10KU 10BACI	1.0 1.0 1.0 1.0
ECO [CR]				Causes Channel Numbers to be included in all transmissions issued from COMPUTER INTERFACE PORT in response to a CHANNEL (CHN) , DUMP (DMP) , or SNAPSHOT (SNP) command; automatically in effect for all STREAM (STR) and HARD COPY (HCY) transmissions. Cancelled by NO CHANNEL (NCH) command for all CHN , DMP , and STR transmissions.			
EID EXTERNAL INPUT DISABLE				Counter/ Timer Card Operation	3.A.1(c.3)	10ACP100 10BCP100 10KU	8.0 8.0 8.0
EID x [CR]				Disconnects from the Model 10ACT01 that uses Chn. x any and all external signals and logic commands received at its rear I/O CONNECTOR. Cancelled by EXTERNAL INPUT ENABLE (EIE) command.			
EIE EXTERNAL INPUT ENABLE				Counter/ Timer Card Operation	3.A.1(c.3)	10ACP100 10BCP100 10KU	8.0 8.0 8.0
EIE x [CR]				Cancels EXTERNAL INPUT DISABLE (EID) command, reconnecting all external signals and logic commands received by the Model 10ACT01 that uses Chn. x; automatically in effect on application of a TYPE (TYP) or RANGE (RNG) command to Chn. x.			
EMM SCALING FACTOR ("m")				Analog Channel Setup	1.G.2; 1.G.3(b); 1.G.5; 2.G.1; 2.P.3; 3.A.5(c.3) 3.B.3(c.1)	10ACP100 10BCP100 10KU	1.0 1.0 1.0
EMM x = m [CR]	E	R	I	Sets to m the SCALING FACTOR to be applied to Chn. x; may be used to reset the precision of a "REAL" ANALOG INPUT Chn. x.			
EMM x [CR]			R	Reads current SCALING FACTOR for Chn. x; returns m .			
EMP EMPTY				History Card Operation	3.B.4(e.3); 3.B.4(e.6)	10BDR64	1.0
EMP n [CR]				Outputs from the DataPAC COMPUTER INTERFACE PORT all FRAMES of Model 10BDR64 Recorder n, in sequence, that have been recorded since the EMP command was last applied to that recorder. See also the REACCESS HISTORY MEMORY (RHM) command.			
EMP n = f [CR]				Outputs in sequence a selected number of FRAMES that have been recorded by Model 10BDR64 Recorder n since the EMP command was last applied to that			

COMMAND	E M P R O M	R A N G E	I M P L A D D R	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
				recorder (f = no. of FRAMES to be "emptied," starting from the "oldest" FRAME not emptied by a prior EMP command). See also the REACCESS HISTORY MEMORY (RHM) command.			
EOI END OR IDENTIFY EOI = OPT ON, EOT ON [CR] EOI = OPT ON, EOT OFF [CR] EOI = OPT OFF, EOT ON [CR] EOI = OPT OFF, EOT OFF [CR] EOI [CR]	E			10BACI-488 Setup	3.B.5 Suppl. 3	10BACI-488	
				Effective only if directed to a Model 10BACI-488 . If OPT ON is entered, the last byte of the OUTPUT TERMINATOR will be accompanied by an invocation of the END OR IDENTIFY (EOI) function for all 10BACI-488 transmissions; if OPT OFF , no EOI will follow the OPT. If EOT ON is entered, the last byte of the END-OF-TRANSMISSION TERMINATOR will invoke the EOI for all 10BACI-488 transmissions; if EOT OFF , no EOI will follow the EOT.			
				Reads current END OR IDENTIFY settings for the Model 10BACI-488 to which the command is directed; returns OPT ON, EOT ON; OPT ON, EOT OFF; OPT OFF, EOT ON; or OPT OFF, EOT OFF .			
EOL END OF LINE EOL = \$ [CR] EOL [CR]	E			Formatted Output Card Setup	3.C.3(d.1)	10VFO132	1.0
				Specifies one or more printer CONTROL CHARACTERS to be transmitted at the end of each line of output issued from the Model 10VFO132 PRINTER INTERFACE PORT in response to a PRINT PAGE (PRI) or PRINT CHANNEL DATA (PRT) command (\$ is a string of up to 8 ASCII CONTROL CHARACTERS, each of which must be entered as a hexadecimal word in brackets—see Table 1.H.2).			
				Reads current END-OF-LINE specification for 10VFO132 output; returns \$.			
EOP END OF PAGE EOP = \$ [CR] EOP [CR]	E			Formatted Output Card Setup	3.C.3(d.2)	10VFO132	1.0
				Specifies one or more printer CONTROL CHARACTERS to be transmitted at the end of each page of output issued from the Model 10VFO132 PRINTER INTERFACE PORT in response to a PRINT PAGE (PRI) or PRINT CHANNEL DATA (PRT) command (\$ is a string of up to 8 ASCII CONTROL CHARACTERS, each of which must be entered as a hexadecimal word in brackets—see Table 1.H.2).			
				Reads current END-OF-PAGE specification for 10VFO132 output; returns \$.			
EOT END OF TRANSMISSION TERMINATOR EOT = \$ [CR]	E			Formatting of Data Transmissions	1.H.3(f); 2.B.4(b); 3.A.8(b.3); 3.A.8(b.4); 3.B.5(c.5); 3.B.5(d.1)	10ACP100 10BCP100 10KU 10BACI 10AFIFO	8.1 8.1 8.1 1.0 1.0
				1) If a Model 10AFIFO is <i>not</i> connected to the DataPAC's COMPUTER INTERFACE PORT, specifies an END-OF-TRANSMISSION TERMINATOR for the COMPUTER INTERFACE PORT different from the current OUTPUT (END-OF-LINE) TERMINATOR for that port—see OUTPUT TERMINATOR (OPT) command (\$ is a string of one to four ASCII CONTROL CHARACTERS entered as hexadecimal word(s) in brackets—see Table 1.H.2). Application of EOT must always <i>follow</i> application of OPT .			
				2) If a Model 10AFIFO is connected to the DataPAC's COMPUTER INTERFACE PORT (Model 10ACP100), specifies an END-OF-TRANSMISSION TERMINATOR for the FIFO COMPUTER PORT different from the current OUTPUT (END-OF-LINE) TERMINATOR for that port—see OUTPUT TERMINATOR (OPT) command.			

COMMAND	E E P R O M	R A N G E	I M P L E M E N T S	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE VERSION
EOT [CR]				<p>Application of EOT must always <i>follow</i> application of OPT. Can be issued to the 10AFIFO <i>only</i> through the FIFO COMPUTER PORT; enabling of the 10AFIFO EEPROM must precede entry of the command (see SET BIT (BIT) command). Does not affect the current END-OF-TRANSMISSION TERMINATOR for the 10ACP100, which is <i>fixed</i> at CARRIAGE RETURN ("[0D]") as long as the 10ACP100 is connected to the 10AFIFO.</p> <p>1) If a Model 10AFIFO is <i>not</i> connected to the DataPAC's COMPUTER INTERFACE PORT, reads the currently effective END-OF-TRANSMISSION TERMINATOR for the COMPUTER INTERFACE PORT; returns \$.</p> <p>2) If a Model 10AFIFO is connected to the DataPAC's COMPUTER INTERFACE PORT (Model 10ACP100), reads the currently effective END-OF-TRANSMISSION TERMINATOR for the FIFO COMPUTER PORT; can be issued to the 10AFIFO <i>only</i> through the FIFO COMPUTER PORT; returns \$.</p>			
ESC ESCAPE				Data	1.H.1;	10ACP100	1.0
ESC [CR]				Trans- mission	1.H.2(d); 3.B.5(d.1)	10BCP100 10KU 10BACI	1.0 1.0 1.0
				Halts any transmission from the COMPUTER INTERFACE PORT; clears any partial command that may have been previously entered. May be entered by pressing the keyboard's Esc key, or by transmitting the [ESC] character to the DataPAC via the COMPUTER INTERFACE PORT.			
EXM EXECUTE MODE				Automatic Command Execution	2.K.2(e)	10BCP100	10.0
EXM = D [CR]	E			Prevents triggering of system EXECUTE (EXU) sequences during the first 15 seconds after powerup. AVAILABLE IN 10BCP100 SOFTWARE ONLY.			
EXM = E [CR]	E			Cancels EXECUTE powerup "delay"; triggering of EXU sequences can begin immediately upon powerup. Available in 10BCP100 and 10KU software only.			
EXM [CR]				Reads current EXECUTE MODE; returns DISABLED or ENABLED .			
EXU EXECUTE				Automatic Command Execution	2.H.3; 2.K.1; 2.K.2; 2.M.1; 3.B.3(b.8); 3.B.4(e.2)	10ACP100 10BCP100 10KU	8.0 8.0 8.0
EXU r = \$ [CR]	E			Specifies one or more commands to be executed upon transition of LOGIC BIT r from <i>Logic 0 to Logic 1</i> (\$ is an ASCII string of up to 32 characters; command delimiter is colon (:)).			
EXU /r = \$ [CR]	E			Specifies one or more commands to be executed upon transition of LOGIC BIT r from <i>Logic 1 to Logic 0</i> .			
EXU r = N/A [CR]	E			Cancels existing EXU command applying to the <i>Logic 0 to Logic 1</i> transition of LOGIC BIT r.			
EXU /r = N/A [CR]	E			Cancels existing EXU command applying to the <i>Logic 1 to Logic 0</i> transition of LOGIC BIT r.			
EXU r [CR]		R		Reads the command(s) to be executed upon the <i>Logic 0 to Logic 1</i> transition of LOGIC BIT r; returns \$ or N/A .			
EXU /r [CR]		R		Reads the command(s) to be executed upon the <i>Logic 1 to Logic 0</i> transition of LOGIC BIT r; returns \$ or N/A .			

COMMAND	E P R O M	R A N G E	I M P L E M E N T A T I O N	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
FCH FRAME CHANNELS				10BACIA Setup	3.B.5 Suppl. 1	10BACIA 10BACI-422 10BACI-488	
FCH = x, y [CR]	E			Instructs the 10BACIA, 10BACI-422, or 10BACI-488 to load Channels x through y into an output buffer at the end of every complete scan cycle, thus allowing a time-coherent "frame" of data.			
FCH [CR]				Reads current "frame" range for the 10BACIA, 10BACI-422, or 10BACI-488 to which the command is directed; returns x, y.			
FCL FIFO CLEAR				FIFO Buffer Operation	3.A.8(c.5)	10AFIFO	1.0
FCL [CR]				Clears Model 10AFIFO memory; uses a physical overwrite technique to destroy all stored contents, which <i>cannot</i> be reaccessed via REACCESS FIFO MEMORY (RFM) command. Can be entered only through the FIFO COMPUTER PORT.			
FDM FLOATING POINT DUMP				"10BACI" Floating Point Option	3.B.5 Suppl. 4	10BACI-488	
FDM [CR]				Instructs a 10BACI-488 card equipped with the "FP" Option to output data for all scanned channels, once only and in the floating-point format specified by the last-entered FLOATING POINT FORMAT (FPF) command.			
FDM x TO y [CR]				Instructs a 10BACI-488 card equipped with the "FP" Option to output data for all channels from Chn. x through y, once only and in the floating-point format specified by the last-entered FLOATING POINT FORMAT (FPF) command.			
FIL FILTER				Analog Channel Setup	2.G.2; 3.B.3(c.1)	10ACP100 10BCP100 10KU	1.0 1.0 1.0
FIL x = f [CR]	E	R	I	Sets digital filtering constant f for Chn. x (-1 f 9; -1 = no filtering; 0 = only enough filtering to mask intrinsic system noise; 9 = maximum filtering).			
FIL x [CR]		R	I	Reads current digital filtering constant for Chn. x; returns f.			
FPF FLOATING POINT FORMAT				"10BACI" Floating Point Option	3.B.5 Suppl. 4	10BACI-488	
FPF = IEEE [CR]	E			Specifies IEEE format for the floating-point output of a 10BACI-488 card equipped with the "FP" Option (see also FLOATING POINT DUMP (FDM) command).			
FPF = DEC [CR]	E			Specifies DEC format for the floating-point output of a 10BACI-488 card equipped with the "FP" Option (see also FLOATING POINT DUMP (FDM) command).			
FPF [CR]				Reads current IEEE format specification for the floating-point output of a 10BACI-488 card equipped with the "FP" Option; returns IEEE or DEC .			
FRC FORCE				Analog Channel Setup	1.G.5; 1.G.6; 3.B.3(c.1)	10ACP100 10BCP100 10KU	1.0 1.0 1.0
FRC x = z [CR]	E	R	I	Scales Chn. x so that its data reading for the existing input equals the value z; calculates and stores in EEPROM the SCALING FACTOR m for Chn. x. Also sets desired precision (decimal-point location) for Chn. x. When used to calibrate Chn. x, must be preceded by ZERO (ZRO) command.			

COMMAND	E P R O M	R A N G E	I M P L E M E N T A T I O N	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
FRC x [CR]		R	I				
FRQ FREQUENCY CALIBRATION				Analog Channel Setup	1.G.4(a); 3.B.3(c.1)	10ACP100 10BCP100 10KU	1.0 1.0 1.0
FRQ x = i, u [CR]	E	R	I				
FRQ x [CR]		R	I				
FRZ FREEZE				History Card Operation	3.B.4(e.8)	10BDR64	5.0
FRZ n = s STEP z [CR]		R					
FRZ n = N/A [CR]		R					
FRZ n [CR]		R					
GBL GLOBAL				Satellite Network Operation	3.B.3(c.4)	10BD4 10BD1	2.6 2.6
GBL = OFF [CR]							
GBL = ON [CR]							
GBL [CR]							
GCL GRAPH CLEAR				LCD Graphics Operation	2.Q.2(a)	10ACP100G	3.0
GCL [CR]							

COMMAND	E P R O M	R A N G E	I M P L A D R	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
GRX GRAPH RANGE X				LCD Graphics Setup	2.Q.1(b.2); 2.Q.1(c.3)	10ACP100G	3.0
GRX p = l, h [CR]	E	R		Sets full-scale display range for the "x" channel of "XY" or "STRIP-CHART" LCD VIDEO PAGE p, where 1 ≤ p ≤ 40; l = range minimum; h = range maximum; -32768 ≤ l < h ≤ 32768.			
GRX p [CR]			R	Reads current display range for the "x" channel of "XY" or "STRIP-CHART" LCD VIDEO PAGE p; returns l,h or N/A (the latter appears if Page p is a "DATA" LCD VIDEO PAGE—see PAGE TYPE (PGT) command).			
GRY GRAPH RANGE Y				LCD Graphics Setup	2.Q.1(b.2); 2.Q.1(c.3)	10ACP100G	3.0
GRY p = l, h [CR]	E	R		Sets full-scale display range for the "y" channel of "XY" or "STRIP-CHART" LCD VIDEO PAGE p, where 1 ≤ p ≤ 40; for l and h, see the GRX command, above.			
GRY p [CR]			R	Reads current display range for the "y" channel of "XY" or "STRIP-CHART" LCD VIDEO PAGE p; returns l,h or N/A (the latter appears if Page p is a "DATA" LCD VIDEO PAGE—see PAGE TYPE (PGT) command).			
GRZ GRAPH RANGE Z				LCD Graphics Setup	2.Q.1(c.3)	10ACP100G	4.0
GRZ p = l, h [CR]	E	R		Sets full-scale display range for the "z" channel of "STRIP-CHART" LCD VIDEO PAGE p, where 1 ≤ p ≤ 40; for l and h, see the GRX command, above.			
GRZ p [CR]			R	Reads current display range for the "z" channel of "STRIP-CHART" LCD VIDEO PAGE p; returns l,h or N/A (the latter appears if Page p is either a "DATA" or an "XY" LCD VIDEO PAGE—see PAGE TYPE (PGT) command).			
GZL GRAPH ZERO LEFT				LCD Graphics Operation	2.Q.1(c.6); 2.Q.2(f)	10ACP100G	4.0
GZL [CR]	Initiates "ZERO LEFT" MODE for all "STRIP-CHART" LCD VIDEO PAGES. Each displayed time scale—as defined by the INTERVAL (INT) command—will scroll continuously to the left with each new recording, the numbers on the scale indicating <i>elapsed time</i> since recording began (i.e., since the RECORDER START (RES) command was last applied or DataPAC power last recycled). For subsequent manual scrolling of the displayed page via keyboard "arrow" keys, see Section 2.Q.2(f). In GZL mode, the LCD STRIP-CHART RECORDER will <i>stop</i> when it reaches its maximum DEPTH, and can only be restarted by application of an REC command or by recycling power. This mode is in effect, by default, on DataPAC powerup (see also GZR command, below).						
GZR GRAPH ZERO RIGHT				LCD Graphics Operation	2.Q.1(c.6)	10ACP100G	4.0
GZR [CR]	Initiates "ZERO RIGHT" MODE for all "STRIP-CHART" LCD VIDEO PAGES. Each display will include a <i>nonscrolling time scale</i> from right to left—as defined by the INTERVAL (INT) command—where the initial right-hand extreme ("0") is "now" (the present time). Manual scrolling of the display is not possible in this mode. In GZR mode, the LCD STRIP-CHART RECORDER will <i>not</i> stop when its maximum DEPTH is reached, but will continue to record, overwriting the oldest recording in memory with each new recording. On DataPAC powerup, all "STRIP-CHART"						

COMMAND	E P R O M	R A N G E	I M P L A D R	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
				displays will revert to "ZERO LEFT" MODE, by default (see GZL command, above).			
HCL HISTORY CLEAR HCL n [CR]			R	History Card Operation	3.B.4(b.4)	10BDR64	6.0
				Clears the "history memory" of Model 10BDR64 Recorder No. n. For "true erasure" of history memory, see NONVOLATILE HISTORY (NVH) command.			
HCY HARD COPY HCY [CR] HCY x [CR] HCY x TO y [CR]				Data Trans- mission	1.H.1; 1.H.2(e) ; 3.B.5(d.1)	10ACP100 10BCP100 10KU 10BACI	1.0 1.0 1.0 1.0
				Transmits current data for all scanned DATA CHANNELS, including Chns. 998 (TIME) and 999 (DATE), from COMPUTER INTERFACE PORT, once only; outputs x,w,z per channel, where x = Channel No.; w = data value (see CHARACTERS PER CHANNEL (CPC) command); z = LIMIT-ZONE Indicator No. (optional—see LIMITS (LIM) command. Output also includes specified HEADER and/or TAILER (see HEADER (HDR) and TAILER (TLR) commands).			
				Transmits current data, once only, for Chn. x only, along with specified HEADER and/or TAILER.			
				Transmits current data, once only, for Chns. x through y, only, along with specified HEADER and/or TAILER (y x).			
HDP HALT DEPTH HDP n = q [CR] HDP n [CR]			E R R	History Card Setup	3.B.4(d.7)	10BDR64	1.0
				Sets HALT DEPTH of q for Model 10BDR64 Recorder n—i.e., delays halting of Recorder n until q FRAMES have been recorded following occurrence of halt-triggering condition (0 q 32767).			
				Reads current HALT DEPTH setting for Recorder n; returns q .			
HDR HEADER HDR = "\$" [CR] HDR = N/A [CR] HDR [CR]			E E	Formatting of Data Transmissions	1.H.3(c) ; 3.B.5(c.5); 3.B.5(d.1)	10ACP100 10BCP100 10KU 10BACI	1.0 1.0 1.0 1.0
				Specifies character string \$ to be transmitted at the beginning of each data set transmitted from the COMPUTER INTERFACE PORT in response to a STREAM (STR) or HARD COPY (HCY) command (\$ is an ASCII string of up to 80 characters, enclosed in quotation marks (" "); every ASCII CONTROL CHARACTER must be entered as a hexadecimal word in brackets, within the quotation marks—see Table 1.H.2).			
				Cancels current HEADER string.			
				Reads current HEADER string; can only be entered via COMPUTER INTERFACE PORT, and outputs \$ or N/A .			
HDU HISTORY DUMP HDU n = f [CR]				History Card Operation	3.B.4(e.3); 3.B.4(e.7)	10BDR64	1.0
				Transmits from COMPUTER INTERFACE PORT a specific FRAME f of the Model 10BDR64 Recorder n; output format is determined by OUTPUT IMAGE (IMA) command.			

COMMAND	E P R O M	R A N G E	I M P L A D D R	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE
HDU n = f TO g [CR]				Transmits all FRAMES from f through g of Recorder n—or that portion of the "f TO g" range that exists (g - f).			
HEX HEXADECIMAL				System Logic Bits	2.H.2(c); 3.B.2(e.1); 3.B.2(e.2)	10ACP100 10BCP100 10KU 10BACI	8.0 8.0 8.0 1.0
HEX k = h [CR]		R		Sets the 16 bits of BIT GROUP k such that their configuration represents the four-character hexadecimal word h (see Table 2.H.2); overrides any other bit-control sources for the bits of BIT GROUP k.			
HEX k [CR]		R		Reads the hexadecimal word represented by the existing configuration of BIT GROUP k; returns h .			
HIL HIGH LIMIT				Analog Channel Setup	2.F.1; 2.F.2; 3.B.3(c.1)	10ACP100 10BCP100 10KU	1.0 1.0 1.0
HIL x = h [CR]	E	R	I	Sets high-limit value for Chn. x equal to the fixed value h, where -32768 ≤ h ≤ 32768; precision (decimal-point location) of h should match that of Chn. x's data reading.			
HIL x = CHN z [CR]	E	R	I	Sets high-limit value for Chn. x equal to the current reading of DATA CHANNEL z; Channels x and z should be set to the same precision.			
HIL x [CR]		R	I	Returns h, the fixed high-limit value for Chn. x—unless a command of HIL x = CHN z [CR] has been entered, in which case it returns CHNz .			
HLT HALT				History Card Setup	3.B.4(d.6)	10BDR64	1.0
HLT n = B [CR]	E			Specifies the logical combination of conditions that will cause the Model 10BDR64 Recorder n to halt the recording of data (B is a Boolean expression of up to 16 MNEMONIC terms and up to 15 OPERATORS—see STORE (STO) command, Section 3.B.4(d.5).			
HLT n = N/A [CR]	E			Cancels existing halt conditions for Recorder n.			
HLT n [CR]				Reads existing halt conditions for Recorder n; returns B or N/A .			
ICD INTERCHARACTER DELAY				Formatted Output Card Setup	3.C.3(b.3)	10VFO132	1.0
ICD = s [CR]	E			Sets time delay between successive character transmissions from Model 10VFO132 PRINTER INTERFACE PORT; for values of s, see Table 3.C.3.1.			
ICD [CR]				Reads current setting for 10VFO132 intercharacter delay; returns s .			
IMA OUTPUT IMAGE				History Card Setup	3.B.4(d.10)	10BDR64	1.0
IMA n = v₁, v₂, . . . , v_n [CR]	E			Specifies variables to appear in each line of output for Model 10BDR64 Recorder n, and the order in which they are to be transmitted; for "v" mnemonics, see Section 3.B.3(d.10).			
IMA n [CR]				Reads current "output image" for 10BDR64 Recorder n; returns v₁, v₂, . . . , v_n .			

COMMAND	E P R O M	R A N G E	I M P L A D R	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE
INC INCREMENT				Internal Counter Functions; Counter/ Timer Card Operation	2.M.1 ; 3.A.1(c.1); 3.A.1(d.3); 3.B.3(c.1); 3.B.5(c.7)	10ACP100 10BCP100 10KU 10BACI	8.1 8.1 8.1 1.0
INC x [CR]		(R)	I	Increments by "1" the current data value of Chn. x, where Chn. x is <i>either</i> a DOWNLOAD PSEUDOCHANNEL or a "COUNTER" Channel of a Model 10ACT01 or 10ACC-4. The range form of the INC command does not apply to 10ACT01- or 10ACC-4-dedicated channels.			
INT INTERVAL				LCD Graphics Setup	2.Q.1(c.5)	10ACP100G	4.0
INT = t [CR]		E		Sets recording interval for the DataPAC's STRIP-CHART RECORDER and the time scale to be displayed on every "STRIP-CHART" LCD VIDEO PAGE; 1 t 16; for interval codes ("t") and corresponding full-scale time periods, see Table 2.Q.1.			
INT = S [CR]		E		Instructs the DataPAC's STRIP-CHART RECORDER to record at the current <i>scan rate</i> , with 200 recordings per "STRIP-CHART" LCD VIDEO PAGE.			
INT [CR]				Reads the recording time interval currently in effect for the DataPAC's STRIP-CHART RECORDER; returns t or S .			
ITR COMPUTER INTERRUPT				Communi- cations Setup	2.B.6(b) ; 3.B.5(c.6); 3.B.5(d.1)	10ACP100 10BCP100 10KU	8.0 8.0 8.0
ITR = "\$" [CR]		E		Defines character string \$ to be transmitted from COMPUTER INTERFACE PORT upon receipt of a command of ITR [CR] (\$ is an ASCII string of up to 32 characters, enclosed in quotation marks (" "); every ASCII CONTROL CHARACTER must be entered as a hexadecimal word in brackets, within the quotation marks—see Table 1.H.2). Does not work with the "auxiliary" computer interface supplied by a Model 10BACI.			
ITR = N/A [CR]		E		Cancels existing "interrupt" designation.			
ITR [CR]				Causes predefined "interrupt" string to be transmitted from COMPUTER INTERFACE PORT at the first opportunity following completion of any transmission in progress; can only be entered via COMPUTER INTERFACE PORT, and outputs \$ or N/A .			
KEY				Keyboard Setup	2.I	10ACP100 10BCP100 10KU	8.1 8.1 8.1
KEY k = XXX [CR]		E		Programs plug-in Operator's Keyboard (or older Extended Keyboard version) such that the pressing of Prompt key, followed by numeral key k, is equivalent to the entry of the standard three-letter command MNEMONIC XXX (0 k 4).			
KEY k = N/A [CR]		E		Cancels current "prompting" assignment for keyboard numeral key k.			
KEY k [CR]				Reads command MNEMONIC currently assigned to the "prompting" function of keyboard numeral key k; returns XXX or N/A .			

COMMAND	E M	R A N G E	I M P L E M E N T S	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE VERSION
LBT "BETWEEN" LOGIC				Analog Channel Setup	2.F.1; 2.F.4 ; 2.H.2(a); 3.B.3(c.1)	10ACP100 10BCP100 10KU1.0	1.0 1.0
LBT x = r [CR]	E	R	I	Sets LOGIC BIT <i>r</i> to <i>Logic 1</i> when the data for Chn. <i>x</i> is greater than or equal to that channel's preset low limit and less than or equal to its preset high limit (see LOW LIMIT (LOL) and HIGH LIMIT (HIL) commands).			
LBT x = N/A [CR]	E	R	I	Cancels existing "BETWEEN" LOGIC assignment for Chn. <i>x</i> .			
LBT x [CR]		R	I	Reads existing "BETWEEN" LOGIC assignment for Chn. <i>x</i> ; returns <i>r</i> or N/A .			
LCT LOCATE				Analog Channel Setup; Satellite Network Setup; Aux. Comp Interface	1.G.1 ; 3.A.2(b.2); 3.B.3(b.5); 3.B.3(c.2); 3.B.3(c.1); 3.B.5(c.7); Appendix C	10ACP100 10BCP100 10KU 10BACI	1.0 1.0 1.0 1.0
LCT x = s [CR]	E	R	I	Sets the "location" of Chn. <i>x</i> ; <i>s</i> is a number from one to four digits that informs the DataPAC's CENTRAL PROCESSOR of the <i>local physical origin</i> of the channel. Chn. <i>x</i> may be an ANALOG INPUT, ANALOG OUTPUT, or VOLATILE DOWNLOAD PSEUDOCHANNEL. If Chn. <i>x</i> is an ANALOG INPUT or OUTPUT being "located" with respect to an A SLOT of an "A-sized" DataPAC, the number <i>s</i> consists of Chn. <i>x</i> 's SLOT No. and SUBCHANNEL No. (in that order); if the DataPAC is "B-sized," <i>s</i> consists of Chn. <i>x</i> 's DECK No., A SLOT No., and SUBCHANNEL No. (in that order). In either case the "typing" of Chn. <i>x</i> via the TYPE (TYP) command should <i>precede</i> the A-SLOT "locating" of that channel. If Chn. <i>x</i> is a VOLATILE DOWNLOAD PSEUDOCHANNEL being "located" with respect to a B SLOT occupied by a Model 10BACI Auxiliary Computer Interface Card, the corresponding one- or two-digit B SLOT No. should be entered for <i>s</i> . In this case, the LCT command also assigns a "type" code of "DA" to PSEUDOCHANNEL <i>x</i> ; this "typing" can be cancelled only by a RESET (RST) command applying to Chn. <i>x</i> .			
LCT x = s [CR]	E	R	I	When applied to a "B-sized" DataPAC SATELLITE, "locates" GLOBAL DATA CHANNEL <i>x</i> to the Model 10BD1 Satellite Slave Card occupying the SATELLITE'S B SLOT <i>s</i> . Does <i>not</i> specify the actual "local physical origin" of Chn. <i>x</i> within the SATELLITE NETWORK, but does allow the "B-sized" SATELLITE to which it is applied to "hear" Chn. <i>x</i> when that channel has not been dedicated to the SATELLITE via the SATELLITE (SAT) command; can be cancelled only by a RESET (RST) command applying to Chn. <i>x</i> . When a channel's 10BD1 "location" is returned in response to a LCT x [CR] interrogation, the 10BD1's B-SLOT No. (" <i>s</i> ") will be prefixed by "S" (see below).			
LCT x [CR]		R	I	Reads current "location" assignment for Chn. <i>x</i> : 1) If the interrogated DataPAC is <i>not</i> a member of a SATELLITE NETWORK, returns one of the following answers: s (a one-to-four-digit A- or B-SLOT "location" number, as described above); BINK (if Chn. <i>x</i> has been "typed" by a CHN x = BIN k [CR] command); BCDk (if Chn. <i>x</i> has been "typed" by a CHN x = BCD k [CR] command); or N/A (if Chn. <i>x</i> is either a "CONVERSION" CHANNEL or a PSEUDOCHANNEL <i>other than</i> a VOLATILE DOWNLOAD PSEUDOCHANNEL that has been "located" to B SLOT <i>s</i>). 2) If the interrogated DataPAC is a member ("NODE") of a SATELLITE NETWORK, four basic responses to the LCT x [CR] interrogation are possible: a) "LOCAL" LOCATION: s , BINK , BCDk , or N/A (as above). Returned by an "A-sized" or "B-sized" NODE when Chn. <i>x</i> is <i>dedicated to that NODE</i> via the SATELLITE (SAT) command, so that the NODE serves as the local "data origin" for Chn. <i>x</i> . Also possible, however, if the NODE is an "A-sized"			

COMMAND	E P R O M	R A N G E	I M P L A D R	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE VERSION
				<p>SATELLITE or a "B-sized" NODE where the GBL = OFF [CR] command is in effect, and where Chn. x is neither dedicated to that NODE nor "located" to the NODE'S Model 10BD1 Satellite Slave Card (as in the case of an "A-sized" SATELLITE where a "local location" of N/A is returned for nonlocal channels that have been typed "D4" in order that they may be "heard" by the SATELLITE (see DOWNLOAD CHANNELS (DLC) command); in other cases, a "local" answer may be returned which in no way reflects the true <i>physical origin</i> of Chn. x within the network).</p> <p>b) "GLOBAL" LOCATION: n,s; n,BINk; n,BCDk; or n,N/A. Returned when Chn. x has not been dedicated to the interrogated NODE via the SATELLITE (SAT) command and when the LCT x [CR] interrogation has been communicated to that NODE as an "implicitly addressed" command from some other ("B-sized") NODE. The number "n" in the response is the SATELLITE No. of the NODE to which Chn. x has been dedicated.</p> <p>c) "10BD1" LOCATION: Ss. Returned by a "B-sized" NODE (only) when 1) the GBL = OFF [CR] command is in effect at that NODE; 2) Chn. x is a channel not dedicated to that NODE but which has been "located" to the Model 10BD1 occupying the NODE'S B SLOT s; and 3) the LCT x [CR] interrogation has been "explicitly" communicated to that NODE (i.e., via an OPEN (OPN) or NODE (NOD) command, or via the NODE's own keyboard, COMPUTER INTERFACE PORT, or AUXILIARY COMPUTER INTERFACE PORT).</p> <p>d) NO RESPONSE. Returned by a "B- sized" NODE (only) when 1) the GBL = ON [CR] command is in effect at that NODE; 2) Chn. x has been "located" to the NODE'S Model 10BD1; and 3) the LCT x [CR] interrogation has been communicated to that NODE via an OPEN (OPN) or NODE (NOD) command.</p>			
LEG LEGEND				LCD/VFD Display Setup	"On the Air" Book Sec. 5 2.Q.1(b.3); 2.Q.1(c.4)	10ACP100 10ACP100G	8.9 1.0
LEG x = L [CR]		E	R	Specifies unit legend L to appear with every display of Chn. x on the DataPAC's LCD/VFD display (L can be up to four alphanumeric characters, including spaces).			
LEG x [CR]			R	Reads current unit legend for LCD/VFD display of Chn. x; returns L.			
LGO LOGO				LCD/VFD and CRT Display Setup	"On the Air" Book Sec. 5 2.C.4(a)	10ACP100 10BCP100 10KU 10CON/CCON	1.0 1.0 1.0 1.0
LGO = \$ [CR]			E	Specifies "logo" heading \$ to be displayed in the LCD/VFD or CRT display BILLBOARD whenever the BILLBOARD is not called upon to display other material (\$ is a string of up to 27 characters, including spaces).			
LGO [CR]				Reads existing "logo" entry; returns \$.			
LGT "GREATER THAN" LOGIC				Analog Channel Setup	2.F.1; 2.F.4; 2.H.2(a); 3.B.3(c.1)	10ACP100 10BCP100 10KU	1.0 1.0 1.0
LGT x = r [CR]		E	R	I	Sets LOGIC BIT r to Logic 1 when the data for Chn. x is greater than both of the channel's preset limit values (see LOW LIMIT (LOL) and HIGH LIMIT (HIL) commands).		
LGT x = N/A [CR]		E	R	I	Cancels existing "GREATER THAN" LOGIC assignment for Chn. x.		
LGT x [CR]			R	I	Reads existing "GREATER THAN" LOGIC assignment for Chn. x; returns r or N/A .		

COMMAND	E P R O M	R A N G E	I M P L A D D R	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE VERSION
LIM LIMITS				Formatting of Data Transmissions	1.H.3(b); 2.F.3; 3.B.5(c.5); 3.B.5(d.1)	10ACP100 10BCP100 10KU 10BACI	8.0 8.0 8.0 1.0
LIM [CR]				Includes LIMIT-ZONE Indicator No. z for every channel in all CHANNEL (CHN) , DUMP (DMP) , STREAM (STR) , HARD COPY (HCY) , and SNAPSHOT (SNP) transmissions from COMPUTER INTERFACE PORT (see LIMIT ZONE (LZN) command); does not affect the displayed answer to a keyboard-entered CHN x [CR] interrogation. Cancelled by NO LIMITS (NOL) command, which is in effect, by default, on powerup.			
LIN LINEARIZE				Analog Channel Setup	2.L.2	10ACP100 "L" 10BCP100 "L" 10KU "L"	8.1 8.1 8.1
LIN x = Fn(CHN x) [CR]	E			Sets up "REAL" LINEARIZATION CHANNEL No. x by applying prestored Linearization Table (or "Function") No. n <i>to that channel itself</i> (0 n 8); retypes Chn. x as "EA."			
LIN y = Fn(CHN x) [CR]	E			Sets up "PSEUDOCHANNEL" LINEARIZATION CHANNEL No. y by applying prestored Linearization Table (or "Function") No. n <i>to a different channel</i> (Chn. x) (0 n 8); retypes Chn. y as "EA."			
LIN z [CR]			R	Reads linearization function for Chn. z ("REAL" or "PSEUDOCHANNEL"); returns Fn(CHNx) —where z equals x (if "REAL") or is different from x (if "PSEUDOCHANNEL")—or N/A (the latter appears if a "WRITE" form of the LIN command has not been applied to Chn. z or if Chn. z has been reset via a RESET (RST) command).			
LLT "LESS THAN" LOGIC				Analog Channel Setup	2.F.1; 2.F.4; 2.H.2(a); 3.B.3(c.1)	10ACP100 10BCP100 10KU	1.0 1.0 1.0
LLT x = r [CR]	E	R	I	Sets LOGIC BIT r to <i>Logic 1</i> when the data for Chn. x is less than both of the channel's preset limit values (see LOW LIMIT (LOL) and HIGH LIMIT (HIL) commands).			
LLT x = N/A [CR]	E	R	I	Cancels existing "LESS THAN" LOGIC assignment for Chn. x.			
LLT x [CR]			R	Reads existing "LESS THAN" LOGIC assignment for Chn. x; returns r or N/A .			
LNE LINE				CRT Video Operation	2.C.11(e)	10BVT60 10CON/CCON	7.0 1.0
LNE n = hw <c> \$ [CR]				NOTE: Both "WRITE" ("Input") and "READ" ("Output") forms of LNE are present in 10BVT60 Versions 7.0 up to 9.0; the "READ" form was removed in Version 9.0, and restored in Version 10.0. Changes current format of Line No. n of the VIDEO PAGE on display (h = desired line height; w = desired line width; c = desired color or intensity code, entered in angle brackets (see Table 2.C.2); \$ = ASCII character string representing desired contents of Line n, including CHANNEL DISPLAY FIELDS, and color/intensity changes within the line—see Section 2.C.11(e) for details). Changes only the <i>display</i> of Line No. n. Cannot be entered via the keyboard; cannot be used to enter a BARGRAPH FIELD into a line.			
LNE n [CR]				Transmits from the COMPUTER INTERFACE PORT the format of Line No. n of the VIDEO PAGE on display, unless the page contains BARGRAPH FIELDS; outputs hw<c>\$ (unless n is a single-width line of more than 40 characters, in which case it outputs h1<c>\$1 followed by *1<c>\$2). If Line No. n is <i>any</i> line of a VIDEO PAGE containing one or more BARGRAPH FIELDS generated by a Model			

COMMAND	E P R O M	R A N G E	I M P L E M E N T	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE
				10VGM500 (see Section 3.C.4), then the LNE n [CR] command will be answered by N/A . Cannot be entered via the keyboard.			
LOK LOCK				General System Operation	2.E.1; 3.A.5(c.4); 3.A.6(c.2); 3.B.5(d.1)	10ACP100 10BCP100 10KU 10BACI	1.0 1.0 1.0 1.0
LOK [CR]				Inhibits automatic updating of the DATA RAM, instantly "locking" all DATA CHANNELS, including Nos. 998 (TIME) and 999 (DATE); cancelled by UNLOCK (UNL) command of the form UNL [CR] .			
LOK x [CR]				"Locks" Chn. x only; cancelled by UNL x [CR] command.			
LOK x TO y [CR]				"Locks" Chns. x through y only (y > x); cancelled by UNL x TO y [CR] command.			
LOL LOW LIMIT				Analog Channel Setup	2.F.1; 2.F.2; 3.B.3(c.1)	10ACP100 10BCP100 10KU	1.0 1.0 1.0
LOL x = I [CR]	E	R	I	Sets low-limit value for Chn. x equal to the fixed value I, where -32768 ≤ I ≤ 32768; precision (decimal-point location) of I should match that of Chn. x's data reading.			
LOL x = CHN z [CR]	E	R	I	Sets low-limit value for Chn. x equal to the current reading of DATA CHANNEL z; Channels x and z should be set to the same precision.			
LOL x [CR]		R	I	Returns I , the fixed low-limit value for Chn. x—unless a command of LOL x = CHN z [CR] has been entered, in which case it returns CHNz .			
LST LIST				History Card and LCD Graphics Setup	2.Q.1(c.1); 3.B.4(b.4); 3.B.4(d.3)	10BDR64 10ACP100G	1.0 4.0
LST n = CHN x₁, x₂,..., SBG k₁, k₂,..., DTE [CR]	E			Enters "list" of variables for Model 10BDR64 Recorder n. The "list" expression can have up to 80 characters when entered via keyboard, or up to 126 characters when entered via COMPUTER INTERFACE PORT; x ₁ , x ₂ , etc., are Channel Numbers or Channel-Number ranges of the form "x TO y" (single numbers and ranges may be mixed as desired; Channel Nos. 998 (TIME) and 999 (DATE) may not be entered); k ₁ , k ₂ , etc., are BIT-GROUP Numbers or ranges of the form "k TO l" (numbers and ranges may again be mixed); the sequence of channels and/or channel ranges must be in ascending order, as must the sequence of BIT GROUPS and/or BIT-GROUP ranges; the mnemonic DTE (DATE) is optional—see Section 3.B.4(d.3). Also <i>clears</i> Recorder n and all higher-numbered recorders.			
LST n [CR]				Reads current "list" of variables for 10BDR64 Recorder n; returns CHNx₁,x₂,..., SBGk₁,k₂,... or CHNx₁,x₂,...,SBGk₁,k₂,...,DTE .			
LST = x₁, x₂,..., x_n [CR]	E			Enters "list" of DATA CHANNELS for the DataPAC's STRIP-CHART RECORDER. The "list" expression can have up to 78 characters; x ₁ , x ₂ , etc., are Channel Numbers or Channel-Number ranges of the form "x TO y" (single numbers and ranges may be mixed as desired; Channel Nos. 998 (TIME) and 999 (DATE) may not be entered); the sequence of channels and/or channel ranges must be in ascending order. Should be entered before all PAGE LIST (PGL) commands that refer to "STRIP-CHART" pages.			
LST [CR]				Reads current channel "list" for the DataPAC's STRIP-CHART RECORDER; returns x₁,x₂, ...,x_n or N/A (the latter appears if the "WRITE" form of the LST command has not yet been entered).			

COMMAND	E P R O M	R A N G E	I M P L A D D R	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
LZN LIMIT ZONE				Data Trans- mission	1.H.1; 1.H.2(f) ; 2.F.3; 3.B.5(d.1)	10ACP100 10BCP100 10KU 10BACI	8.0 8.0 8.0 1.0
LZN x [CR]				When entered through COMPUTER INTERFACE PORT, outputs a number indicating the LIMIT ZONE in which the data for Chn. x currently lies (1 for LESS THAN zone, 2 for BETWEEN zone, or 3 for GREATER THAN zone). When entered through keyboard, displays "BELOW LIMIT," "BETWEEN LIMIT," or "ABOVE LIMIT."			
LZN x TO y [CR]				When entered through COMPUTER INTERFACE PORT, outputs current LIMIT-ZONE Indicator No. for each channel in the range from Chn. x through Chn. y (y x). When entered through keyboard, displays current limit status of Chn. x only.			
MEM MEMORY				History Card Operation	3.B.4(b.5)	10BDR64	4.6
MEM [CR]				Returns a hexadecimal number representing the total number of scaled data readings the history "system" is capable of storing; the answer also indicates whether the history memory is currently <i>volatile</i> or <i>non-volatile</i> (see Section 3.B.4(b.5) for details).			
MES MESSAGE				CRT Video Operation	2.C.12(d)	10BVT60 10CON/CCON	6.0 1.0
MES m = s, \$ [CR]				Defines alphanumeric text \$ to appear in the displayed MESSAGE FIELD of system MESSAGE No. m (1 m 16), and specifies the VISUAL EFFECTS for that display; s is a "STATUS" code—see Table 2.C.3; \$ is a string of up to 15 characters, including spaces). On powerup, every MESSAGE text reverts to "blank," and every MESSAGE "STATUS" to "green on black" ("GB") or "half intensity on black" ("10"), by default.			
MES m = s [CR]				Changes to s the "STATUS" code of an existing MESSAGE m.			
MES m [CR]				Reads current definition of MESSAGE m; returns s, "\$" (quotation marks are shown enclosing the text string in every response to the MES m [CR] interrogation; these are not part of the actual MESSAGE).			
MOD MODE				FIFO Buffer Operation	3.A.8(c.6)	10AFIFO	1.0
MOD [CR]				Reads current "INPUT" and "OUTPUT" MODES for the Model 10AFIFO; can be entered only through the FIFO COMPUTER PORT; returns i,o: i = DDI (DESTRUCTIVE DATA INPUT) or NDI (NONDESTRUCTIVE DATA INPUT); o = XEN ("OPEN" OUTPUT) or XDS ("GATED" OUTPUT). See the DDI , NDI , XEN , and XDS commands.			
MTC MASTER TIMING CLOCK				General System Setup	3.B.5 Suppl. 2	10BCP200; 10BACI-422	
MTC = ON [CR]	E			Effective only if directed to a Model 10BACI-422 in a DataPAC with a 10BCP200 Central Processor. Synchronizes the system time-of-day clock to the externally sourced timing pulse received from the 10BACI-422 to which the command is directed. Should be applied to one and only one 10BACI-422 in the system. In order for the command to be effective, the CLK = ON [CR] command must also be in effect, and <i>power must be cycled</i> .			
MTC = OFF [CR]	E			Cancels synchronization of time-of-day clock to the externally sourced timing pulse received from the 10BACI-422 to which the command is directed.			

COMMAND	E P R O M	R A N G E	I M P L A D D R	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
MTC [CR]				Reads current MASTER TIMING CLOCK setting; returns ON or OFF .			
MVV MILLIVOLT/VOLT CALIBRATION				Analog Channel Setup	1.G.4(b); 3.B.3(c.4)	10ACP100 10BCP100 10KU	1.0 1.0 1.0
MVV x = i, u [CR]	E	R	I	Calibrates Strain Gage Conditioner Chn. x (i = transducer rating in "mV/V, full scale"; u = nominal full-scale rating in desired engineering units (factored as necessary, in some cases, for different excitation levels—see individual conditioner sheet in Section 1.E.2). The entered "u" value sets the precision for Chn. x.			
MVV x [CR]		R	I	Reads current calibration constants for Strain Gage Conditioner Chn. x; returns i,u or N/A (the latter appears if Chn. x has been improperly "typed").			
NCH NO CHANNEL				Formatting of Data Transmissions	1.H.3(a); 3.B.5(c.5); 3.B.5(d.1)	10ACP100 10BCP100 10KU 10BACI	1.0 1.0 1.0 1.0
NCH [CR]				Cancels ECHO (ECO) command, removing Channel Numbers from all transmissions issued from COMPUTER INTERFACE PORT in response to a CHANNEL (CHN) , DUMP (DMP) , or SNAPSHOT (SNP) command.			
NDI NONDESTRUCTIVE DATA INPUT				FIFO Buffer Setup	3.A.8(b.5)	10AFIFO	1.0
NDI [CR]	E			Places the Model 10AFIFO in "FILL" INPUT MODE; the 10AFIFO's main memory will receive and store consecutive DATA RECORDS from the DataPAC's COMPUTER INTERFACE PORT (Model 10ACP100) <i>until the memory is full</i> , after which it will receive and store a DATA RECORD from the 10ACP100 only when the required memory space becomes available. Requires the "FIFO bypass" to be OFF (see BYPASS (BYP) command). Enabling of the 10AFIFO EEPROM must precede entry of the command (see SET BIT (BIT) command). Can be entered only through the FIFO COMPUTER PORT; see also MODE (MOD) command.			
NDO NONDESTRUCTIVE DATA OUTPUT				FIFO Buffer Operation	3.A.8(c.1)	10AFIFO	1.0
NDO [CR]				Causes the Model 10AFIFO to output through the FIFO COMPUTER PORT the DATA RECORD currently in the 10AFIFO's <i>output buffer</i> , one time only; this DATA RECORD is retained in the output buffer and may be retransmitted by subsequent applications of the NDO command. Only effective when the 10AFIFO is in "GATED" OUTPUT MODE (see TRANSMISSION DISABLE (XDS) command) or when the "FIFO bypass" is ON (see BYPASS (BYP) command); can be entered only through the FIFO COMPUTER PORT.			
NOB NO BITS				System Logic Bits	2.H.5; 2.K.2(f); 3.B.3(b.6)	10ACP100 10BCP100 10KU	8.0 8.0 8.0
NOB [CR]				Disables the reading of system LOGIC BITS with each scan cycle; cancelled by BITS (BTS) command. May be used to disable system EXECUTE (EXU) functions (see Section 2.K.2(e)). Does not affect the reading of system CONDITIONAL BITS (Section 2.K.3), but may affect the <i>triggering</i> of such bits if they are dependent on system LOGIC-BIT states.			

COMMAND	E P R O M	R A N G E	I M P L A D D R	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
NOD NODE				Satellite Network Operation	3.B.3(c.5)	10ACP100 10BD4 10BD1 10BACI 10CON/CCON	1.0 2.6 2.6 1.0 1.0
NOD n, \$ [CR]				Routes a single standard MNEMONIC COMMAND \$ to the network NODE (HOST or SATELLITE) of SATELLITE No. n, one time only (0 n 99; \$ can be up to 80 ASCII characters, literally stating the command to be routed). May be entered at any DataPAC NODE, via local keyboard, COMPUTER INTERFACE, or AUXILIARY COMPUTER INTERFACE PORT; will not work with OPERATOR CONSOLE SATELLITES. Requires OPN = LOC [CR] to be in effect at the NODE where the NOD command is entered.			
NOL NO LIMITS				Formatting of Data Transmissions	1.H.3(b); 2.F.3; 3.B.5(c.5); 3.B.5(d.1)	10ACP100 10BCP100 10KU 10BACI	8.0 8.0 8.0 1.0
NOL [CR]				Cancels LIMITS (LIM) command, removing LIMIT-ZONE indication from all transmissions from COMPUTER INTERFACE PORT in response to a CHANNEL (CHN) , DUMP (DMP) , STREAM (STR) , HARD COPY (HCY) , or SNAPSHOT (SNP) command; in effect, by default, on powerup.			
NVH NONVOLATILE HISTORY				History Card Setup	3.B.4(b.3); 3.B.4(b.4)	10BDR64	3.0
NVH [CR]			E	Activates nonvolatile "history" memory of any and all installed History Memory Option Cards (including the Model 10BSPC), <i>physically erasing all current memory</i> and making inaccessible for storage of subsequent recordings the original 32K readings of the Model 10BDR64 History Card.			
NVH = N/A [CR]			E	Reverts to volatile "history" memory, including the Model 10BDR64's original 32K readings.			
OPN OPEN				Satellite Network Operation	3.B.3(c.5)	10ACP100 10BD4 10BD1 10BACI 10CON/CCON	10.0 2.6 2.6 1.0 1.0
OPN = n [CR]				"Opens" an "explicit" command route between a local command source (keyboard, COMPUTER INTERFACE PORT, or AUXILIARY COMPUTER INTERFACE PORT) of a given network NODE and any other NODE in the network. Designates the network NODE (HOST or SATELLITE) of SATELLITE No. n to be the only member of the network to receive any and all commands subsequently entered at the NODE to which the OPN command was applied <i>via the local command source by which this command was applied</i> (0 n 99). Cancels any previous OPN command applied to that command source.			
OPN = LOC [CR]				Returns to "local" operation the NODE command source (keyboard, COMPUTER INTERFACE PORT, or AUXILIARY COMPUTER INTERFACE PORT) through which this command is entered; cancels the "explicit" routing of commands from the NODE in question to another NODE, as specified by a previous OPN = n [CR] command.			
OPN [CR]				Returns n , the SATELLITE No. of the network NODE currently "opened" to the command source (keyboard, COMPUTER INTERFACE PORT, or AUXILIARY COMPUTER INTERFACE PORT) through which the OPN [CR] command is entered—unless this command source is currently in "local" operation, in which case LOC is returned.			

COMMAND	E P R O M	R A N D O M	I M P L E M E N T A T I O N	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
OPT OUTPUT TERMINATOR				Formatting of Data	1.H.3(f); 2.B.4(b);	10ACP100 10BCP100	8.0 8.0
OPT = \$ [CR]	E			Transmissions	3.A.8(b.3); 3.A.8(b.4); 3.B.5(c.5); 3.B.5(d.1)	10KU 10BACI 10AFIFO	8.0 1.0 1.0
OPT [CR]					1) If a Model 10AFIFO is <i>not</i> connected to the DataPAC's COMPUTER INTERFACE PORT, specifies one or two characters to be transmitted from the COMPUTER INTERFACE PORT at the end of every <i>line</i> of output from that port (\$ is a string of one or two ASCII CONTROL CHARACTERS entered as hexadecimal word(s) in brackets—see Table 1.H.2). Also sets to \$ the END-OF-TRANSMISSION TERMINATOR for the COMPUTER INTERFACE PORT (see END OF TRANSMISSION TERMINATOR (EOT) command). 2) If a Model 10AFIFO is connected to the DataPAC's COMPUTER INTERFACE PORT (Model 10ACP100), specifies an OUTPUT (END-OF- LINE) TERMINATOR for the FIFO COMPUTER PORT. Can be issued to the 10AFIFO <i>only</i> through the FIFO COMPUTER PORT; enabling of the 10AFIFO EEPROM must precede entry of the command (see SET BIT (BIT) command). Also sets to \$ the END-OF-TRANSMISSION TERMINATOR for the FIFO COMPUTER PORT (see END OF TRANSMISSION TERMINATOR (EOT) command). Does not affect the current OUTPUT TERMINATOR and END-OF-TRANSMISSION TERMINATOR for the 10ACP100, which are <i>fixed</i> at LINE FEED ("[0A]") and CARRIAGE RETURN ("[0D]"), respectively, as long as the 10ACP100 is connected to the 10AFIFO.		
PAG PAGE				LCD/VFD and CRT Display Operation	"On the Air" Book Sec. 5 2.C.3; 2.Q.1(a)	10ACP100 10ACP100G 10BVT60 10CON/CCON	8.9 1.0 1.0 1.0
PAG p [CR]							Calls any existing DATA DISPLAY PAGE No. p to display (1 p 100 for CRT VIDEO display; 1 p 40 for LCD/VFD display). The mnemonic PAG may also be entered by pressing the keyboard's Page key.
PAG [CR]							Reads the Page Number of the DATA DISPLAY PAGE currently being displayed; returns p .
PAG p? [CR]							Reads the number of "blocks" of video memory currently used by an existing CRT VIDEO PAGE No. p (1 p 100); can only be entered via COMPUTER INTERFACE PORT, and outputs an integral number from 0 through 32 (an answer of "0" indicates that Page p does not exist in EEPROM storage).
PBR PRINTER BAUD RATE				Formatted Output Card Setup	3.C.3(b.2)	10VFO132	1.0
PBR = b, d, s, p [CR]	E						Sets Baud rate and other RS-232-C protocols for Model 10VFO132 PRINTER INTERFACE PORT: b = Baud rate (see table in Section 3.C.3(b.2)); d = No. of Data Bits: 7 or 8; s = No. of Stop Bits: 1 or 2; p = Parity: 0 = NONE, 1 = ODD, 2 = EVEN
PBR [CR]							Reads current protocol values for 10VFO132 PRINTER INTERFACE PORT; returns b,d,s,p .

COMMAND	E P R O M	R A N G E	I M P L A D R	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE
PEN				LCD Graphics Operation	2.Q.2(b)	10ACP100G	4.0
PEN = UP [CR]				If an "XY" LCD VIDEO PAGE is currently on display, "raises" the "pen" (i.e., discontinues plotting of x versus y data points). If a "STRIP-CHART" LCD VIDEO PAGE is on display, "raises" all three "pens" (i.e., discontinues plotting of data for all three channels—"x," "y," and "z"). Each form of the PEN command will work only when an "XY" or "STRIP-CHART" page is actually on display.			
PEN = DOWN [CR]				If an "XY" LCD VIDEO PAGE is currently on display, "lowers" the "pen" (i.e., resumes plotting of x versus y data points from current values). If a "STRIP-CHART" LCD VIDEO PAGE is on display, "lowers" all three "pens" (i.e., resumes plotting of data for all three channels—"x," "y," and "z"—from current values). In effect, by default, on powerup.			
PEN n = UP [CR]				"Raises" only <i>one</i> of the three "pens" of the "STRIP-CHART" LCD VIDEO PAGE currently on display (for "n," enter either X, Y, or Z, corresponding to the channel whose plot is to be discontinued).			
PEN n = DOWN [CR]				"Lowers" only <i>one</i> of the three "pens" of the "STRIP-CHART" LCD VIDEO PAGE currently on display (for "n," enter either X, Y, or Z, corresponding to the channel whose plot is to be resumed); in effect for all pens, by default, on powerup.			
PEN [CR]				Reads the "pen" status for the "XY" LCD VIDEO PAGE currently on display; returns UP or DOWN . If a "STRIP-CHART" page is on display, an interrogation of PEN [CR] will be interpreted as PEN X [CR] (see the following command form).			
PEN n [CR]				Reads the "pen" status for <i>one</i> of the three channels of the "STRIP-CHART" LCD VIDEO PAGE currently on display, where n = X, Y, or Z; returns UP or DOWN .			
PGL PAGE LIST				LCD/VFD Display Setup; LCD Graphics Setup	"On the Air" Book Sec. 5 2.Q.1(b.1); 2.Q.1(c.2)	10ACP100 10ACP100G	8.9 3.0
PGL p = x₁, x₂, . . . , x₁₂ [CR]	E	R		Specifies up to 12 DATA CHANNELS to be displayed on LCD/VFD DATA DISPLAY PAGE p (1 ≤ p ≤ 40); entered Channel Nos. (x ₁ , x ₂ , etc.) need not be in order, and may include, if applicable, Nos. 998 (TIME) and 999 (DATE). If fewer than 12 channels are entered, the remaining display fields will be dedicated to corresponding Channel Numbers "native" to Page p. All LCD pages are initially set to the "DATA" type (see PAGE TYPE (PGT) command).			
PGL p = x, y [CR]	E	R		Specifies the two DATA CHANNELS on which the plot displayed by "XY" LCD VIDEO PAGE p is to be based (1 ≤ p ≤ 40). Chn. x takes the horizontal axis; Chn. y, the vertical axis. Channel Nos. 998 (TIME) and 999 (DATE) may not be entered. Page p should be set to "XY" type via the PAGE TYPE (PGT) command, <i>before</i> the PGL command is applied.			
PGL p = x [CR] = x, y [CR] = x, y, z [CR]	E	R	E	Specifies the one, two or three DATA CHANNELS to be plotted versus time on "STRIP-CHART" LCD VIDEO PAGE p (1 ≤ p ≤ 40). Channel Nos. 998 (TIME) and 999 (DATE) may not be entered. Page p should be set to "STRIP" type via the PAGE TYPE (PGT) command, <i>before</i> the PGL command is applied. Also, the LIST (LST) command should be entered for the DataPAC's STRIP-CHART RECORDER, <i>before</i> the PGL command is applied to individual "STRIP-CHART" pages.			
PGL p [CR]			R	Reads current "page list" for LCD/VFD PAGE p; returns x₁,x₂,...,x₁₂; x,y; or x,y,z .			

COMMAND	E P R O M	R A N G E	I M P L E M E N T A R Y	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE VERSION
PGT PAGE TYPE				LCD Graphics Setup	2.Q.1(a)	10ACP100G	3.0
PGT p = v [CR]	E	R		Sets "page type" for LCD VIDEO PAGE p, where 1 ≤ p ≤ 40; v is "page type" code: v = DATA ("normal" DATA-CHANNEL format); XY ("x versus y" plotting); or STRIP (3-pen "strip-chart" plotting). When a page is <i>reset</i> to "DATA" type, its LIST will be reset to initial ("cold-boot") values (see PAGE LIST (PGL) command). All LCD pages are initially set to "DATA" type.			
PGT p [CR]		R		Reads "page type" for LCD VIDEO PAGE p; returns v.			
PLA PLAYBACK				History Card Setup	3.B.4(d.8); 3.B.4(d.9); 3.B.4(e.8)	10BDR64 10BSPC	6.0 1.0
PLA x = REC n, CHN y (-f) [CR]	E			Sets up "NORMAL" or VIDEO PLAYBACK PSEUDOCHANNEL x to represent the data value for Chn. y that was recorded by Model 10BDR64 Recorder n a specific number of FRAMES in the past (1 ≤ x ≤ 997 for "NORMAL" PLAYBACK; 1000 ≤ x ≤ 1299 for VIDEO PLAYBACK); f = SEARCH DEPTH, i.e., the no. of FRAMES "ago" at which the data for Chn. y is to be reviewed; 1 ≤ f ≤ 32767, provided that it does not exceed the total DEPTH of the recorder). The command types Chn. x as "D9." The SEARCH FRAME indicator "(-f)" may be omitted, in which case a default value of "(-1)" is assumed; the playback will in this case refer to the <i>last recording</i> made by Recorder n.			
PLA x = REC n, SER (-f) [CR]	E			Sets up VIDEO PLAYBACK PSEUDOCHANNEL x to represent the SERIAL NUMBER of the FRAME recorded by 10BDR64 Recorder n a specific number (f) of FRAMES in the past; 1000 ≤ x ≤ 1299; 1 ≤ f ≤ 32767. Types Chn. x as "D9." If "(-f)" is omitted, a value of (-1) is assumed (see above).			
PLA x = REC n, TME (-f) [CR]	E			Sets up VIDEO PLAYBACK PSEUDOCHANNEL x to represent the <i>integral time</i> of recording of the FRAME recorded by 10BDR64 Recorder n a specific number (f) of FRAMES in the past (Chn. x will read the time to the nearest second); 1000 ≤ x ≤ 1299; 1 ≤ f ≤ 32767. Types Chn. x as "D9." If "(-f)" is omitted, a value of (-1) is assumed (see above).			
PLA x = REC n, TMF (-f) [CR]	E			Sets up VIDEO PLAYBACK PSEUDOCHANNEL x to represent the <i>fractional time</i> of recording of the FRAME recorded by 10BDR64 Recorder n a specific number (f) of FRAMES in the past (Chn. x will read the time to the nearest hundredth of a second); 1000 ≤ x ≤ 1299; 1 ≤ f ≤ 32767. Types Chn. x as "D9." If "(-f)" is omitted, a value of (-1) is assumed (see above).			
PLA x = REC n, DTE (-f) [CR]	E			Sets up VIDEO PLAYBACK PSEUDOCHANNEL x to represent the date of recording of the FRAME recorded by 10BDR64 Recorder n a specific number (f) of FRAMES in the past; 1000 ≤ x ≤ 1299; 1 ≤ f ≤ 32767. Types Chn. x as "D9." If "(-f)" is omitted, a value of (-1) is assumed (see above). For the "DATE" PLAYBACK to be effective, the DTE mnemonic must be included in the LIST (LST) expression for Recorder n.			
PLA x = REC n, AV y (-f) [CR]	E			Sets up "NORMAL" or VIDEO STATISTICAL PLAYBACK PSEUDOCHANNEL No. x to report the <i>continuous average value</i> experienced by Chn. y over the last "f" recordings of Recorder n (1 ≤ x ≤ 997 for "NORMAL" PLAYBACK; 1000 ≤ x ≤ 1299 for VIDEO PLAYBACK; 1 ≤ f ≤ 10000). Types Chn. x as "D9." Requires installation of Model 10BSPC History SPC Option Card.			
PLA x = REC n, LO y (-f) [CR]	E			Sets up "NORMAL" or VIDEO STATISTICAL PLAYBACK PSEUDOCHANNEL No. x to report the <i>lowest value</i> experienced by Chn. y over the last "f" recordings of Recorder n (1 ≤ x ≤ 997 for "NORMAL" PLAYBACK; 1000 ≤ x ≤ 1299 for VIDEO PLAYBACK; 1 ≤ f ≤ 10000). Types Chn. x as "D9." Requires installation of Model 10BSPC History SPC Option Card.			
PLA x = REC n, HI y (-f) [CR]	E			Sets up "NORMAL" or VIDEO STATISTICAL PLAYBACK PSEUDOCHANNEL No. x to report the <i>highest value</i> experienced by Chn. y over the last "f" recordings of Recorder n (1 ≤ x ≤ 997 for "NORMAL" PLAYBACK; 1000 ≤ x ≤ 1299 for VIDEO			

COMMAND	E P R O M	R A N G E	I M P L A D R	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE
PLA x = REC n, XBR y (-f) [CR]	E						
PLA x = REC n, R y (-f) [CR]	E						
PLA x = N/A [CR]	E	R					
PLA x [CR]			R				
PRI PRINT PAGE				Formatted Output Card Operation	3.C.3(c.2); 3.C.4(g)	10VFO132	1.0
PRI p [CR]			R				
PRI 0 [CR]							
PRI [CR]							
PRT PRINT CHANNEL DATA				Formatted Output Card Operation	3.C.3(e); 3.C.3(f)	10VFO132	7.0
PRT PAG h, x, PAG t [CR]							
PRT PAG h, x TO y, PAG t [CR]							
PRT [CR]							
PRT x [CR]							

COMMAND	E P R O M	R A N G E	I M P L A D D R	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
PRT x TO y [CR]				Transmits from the 10VFO132 PRINTER INTERFACE PORT the data for Chns. x through y only, along with current <i>DEFAULT</i> HEADER and TAILER pages (see DEFAULT HEADER/TAILER (DHT) command).			
PSB PERIPHERAL STATUS BIT				Automatic Command Execution	2.H.2(d); 2.K.2(d)	10ACP100 10BCP100 10KU	8.1 8.1 8.1
PSB = r [CR]	E			Assigns "special bit" LOGIC SOURCE to LOGIC BIT r: r will be at Logic 1 only when the PERIPHERAL COMMAND QUEUE is empty.			
PSB = N/A [CR]	E			Cancels current PERIPHERAL STATUS BIT assignment.			
PSB [CR]				Reads current PERIPHERAL STATUS BIT assignment; returns r or N/A .			
PTY PRINTER TYPE				Formatted Output Card Setup	3.C.3(b.4); 3.C.4(d)	10VFO132	9.1
PTY = n [CR]	E			Sets Model 10VFO132 for "printer type" of n, where n = 0 indicates any conventional RS-232-C printer that is not <i>Epson</i> or <i>Epson-compatible</i> ; n = 1 indicates an <i>Epson</i> or <i>Epson-compatible</i> printer (recommended for printout of BARGRAPH PAGES).			
PTY [CR]				Reads current 10VFO132 "printer type" setting; returns n .			
RCL RECALL				CRT Video Operation	2.C.6	10BVT60 10CON/CCON	1.0 1.0
RCL [CR]				"Recalls" to display (from temporary buffer storage) the last VIDEO PAGE to have been composed or edited (on powerup, the buffer contains the SIGN-ON PAGE).			
REC RECORDER CLEAR				LCD Graphics Operation	2.Q.2(d)	10ACP100G	4.0
REC [CR]				Clears the DataPAC's LCD STRIP-CHART RECORDER; the next recording will have a DEPTH of "1" (i.e., will be the first recording to be entered in the recorder's "cleared" memory). In "ZERO LEFT" MODE, resets time-scale to "zero" (see GRAPH ZERO LEFT (GZL) command).			
REF REFRESH				CRT Video Setup	2.C.1(c)	10BVT60 10CON/CCON	1.0 1.0
REF = n [CR]	E			Selects desired refresh rate for the CRT display (1 n 60; the actual screen refresh rate, in Hz, is equal to 60/n).			
REF [CR]				Reads current "refresh constant" for CRT display; returns n .			
REH RECORDER HALT				LCD Graphics Operation	2.Q.2(d)	10ACP100G	4.0
REH [CR]				Halts the DataPAC's LCD STRIP-CHART RECORDER until application of a RECORDER START (RES) or recycling of power; freezes the displayed plot and time scale (if scrolling) for all "STRIP-CHART" LCD VIDEO PAGES.			

COMMAND	E P R O M	R A N G E	I M P L E M E N T A T I O N	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
RES RECORDER START RES [CR]				LCD Graphics Operation	2.Q.2(d)	10ACP100G	4.0
				Restarts an LCD STRIP-CHART RECORDER that has been halted by a RECORDER HALT (REH) command, <i>from the point where it was halted</i> .			
REL RESET ERROR LOG REL [CR] REL n [CR]				Satellite Network Operation	3.B.3(c.6)	10BD4	2.2
				Resets to zero all "ERROR-LOG" entries for all SATELLITES (see SATELLITE ERROR LOG (SEL) command).			
		R		Resets to zero all "ERROR-LOG" entries for SATELLITE No. n.			
RFM REACCESS FIFO MEMORY RFM [CR]				FIFO Buffer Operation	3.A.8(c.4)	10AFIFO	1.0
				Restores access to all data records currently contained in the Model 10AFIFO; can be entered only through the FIFO COMPUTER PORT.			
RHM REACCESS HISTORY MEMORY RHM n [CR] RHM n = r [CR]				History Card Operation	3.B.4(e.6)	10BDR64	5.2
		R		Restores access to all recorded FRAMES currently contained in the Model 10BDR64 Recorder n, regardless of any and all EMPTY (EMP) commands previously applied to this recorder.			
		R		Restores access only to the last "r" FRAMES recorded by 10BDR64 Recorder n prior to the last EMPTY (EMP) command to have been applied to this recorder.			
RLS RELEASE RLS r [CR]				System Logic Bits	2.H.4	10ACP100 10BCP100 10KU	1.0 1.0 1.0
		R		Releases the LATCH of system LOGIC BIT r.			
RMD RECORD MODE RMD [CR]				History Card Operation	3.B.4(e.2)	10BDR64	1.0
				Causes Model 10BDR64 History Card to exit SETUP MODE, making each of the four recorders ready to record data and inhibiting further entry or modification of setup values (see SETUP MODE (SMD) command). When history memory is in NONVOLATILE MODE, this command must be entered following every powerup, in order to activate the system's current playbacks (see PLAYBACK (PLA) command).			
RNG RANGE RNG x = n [CR] RNG x = 00h [CR]				Encoder Cond. Card Setup; Counter/Timer Card Setup	1.E.2.10A35(3.a); 3.A.1(b.2); 3.A.1(d.2)	10ACP100 10BCP100 10KU	8.0 8.0 8.0
		E	R	Selects a specific combination of range and resolution for Model 10ACT01 or 10ACC-4 Chn. x; for values of n, see Tables 3.A.1.3 - 3.A.1.6 and Table 3.A.1.9).			
		R		Selects a count predivision by any integer from 1 through 256 for the Model 10A35 using Chn. x (the decimal value of the two-character hexadecimal number h is to be one less than the value of the integral divisor by which the 10A35 count is to be			

COMMAND	E E P R O M	R A N G E	I M P L E M E N T A T I O N	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE
RNG x = 80h [CR]		R					
		R					
RNG x [CR]		R					
RPL REPLAY				History Card Operation	3.B.4(e.9)	10BDR64	5.0
RPL n = INT t [CR]		R		Initiates a <i>single</i> "history replay" for all "NON-STATISTICAL" PLAYBACK PSEUDOCHANNELS set up for the Model 10BDR64 Recorder n, where t is a number from 0 through 15 indicating the clock-time <i>interval</i> at which the replay is to step "forward," starting with the "oldest" FRAME in memory (for time-interval coding, see Section 3.B.4(e.9)). For continuous monitoring of "replay" SEARCH DEPTH, the ZUM n [CR] interrogation may be used.			
RPL n = INT t, R [CR]		R		Initiates <i>repeated</i> "history replays" for all "NON-STATISTICAL" PLAYBACK PSEUDOCHANNELS set up for 10BDR64 Recorder n.			
RPL n = N/A [CR]		R		Terminates any "history replay" (single or repeated) currently in progress for 10BDR64 Recorder n.			
RSM RESUME				Analog Channel Setup	1.G.6	10ACP100 10BCP100 10KU	8.1 8.1 8.1
RSM [CR]				Resumes normal measurement by unlatching any and all latched calibration conditions that may exist on any measurement channels (see SHUNT CALIBRATE (SHP/SHN) commands).			
RSM x [CR]		R		Unlatches any latched calibration condition for Chn. x only.			
RSN RESET SERIAL NUMBER				History Card Operation	3.B.4(e.3)	10BDR64	1.0
RSN n [CR]		R		Resets to zero the SERIAL NUMBER of the FRAME to be next recorded by the Model 10BDR64 Recorder n.			
RSN n = s [CR]		R		Resets to s the SERIAL NUMBER of the FRAME to be next recorded by 10BDR64 Recorder n (0 s 99999999).			
RSP RESET STATISTICAL PLAYBACK				History Card Operation	3.B.4(d.8)	10BDR64 10BSPC	6.0 1.0
RSP n [CR]		R		Resets all "X-BAR" and "RANGE" PLAYBACK PSEUDOCHANNELS for Recorder n; returns each playback to its initial state ("NO RECORDINGS YET") with a data reading of zero.			

COMMAND	E P R O M	R A N G E	I M P L E M E N T S	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE VERSION
RST RESET				Analog Channel Setup	2.D.2; 2.J.4; 2.L.3; 3.A.2(b.3); 3.B.2(e.1); 3.B.3(b.5); 3.B.3(c.1); 3.B.3(Appendix); 3.B.4(d.8); 3.B.5(c.7); Appendix C	10ACP100 10BCP100 10KU 10BACI	6.5 6.5 1.0 1.0
RST x [CR]	E	R					NOTE: In 10ACP100/10BCP100 versions prior to "6.5," the RST command retypes <i>all</i> channels, including PSEUDOCHANNELS, to "55." If Chn. x is a "REAL" ANALOG INPUT CHANNEL, retypes Chn. x as "55" (this is a direct millivolt reading of the DataPAC's internal "Called Signal Bus"); resets the SCALING FACTOR ("m") for Chn. x to 5000; resets the ZERO OFFSET ("b") for Chn. x to 0 (zero). If Chn. x is a "CONVERSION" CHANNEL, an ANALOG OUTPUT CHANNEL, or a PSEUDOCHANNEL of any kind, retypes the channel to "D0" (i.e., VOLATILE DOWNLOAD PSEUDOCHANNEL); if the PSEUDOCHANNEL has a "location" or "origin" on a COPROCESSOR CARD (Model 10BD1 Satellite Slave Card, Model 10BACI Auxiliary Computer Interface Card, Model 10BDR64 History Card, etc.), releases the COPROCESSOR from that channel. RST x [CR] is <i>not</i> an "implicitly addressed" command. See also the TYPE (TYP) command.
SAT SATELLITE				Satellite Network Setup	3.B.3(b.5)	10BD4	1.0
SAT n = x, y [CR]	E						Designates SATELLITE No. n to be the sole "data origin" for GLOBAL DATA CHANNELS x through y (1 < x < y < 998; Chn. 1 is always dedicated to the HOST; Chns. 998 (TIME) and 999 (DATE) are always "local"). Here, n > 0; all channels below the lowest-numbered channel dedicated to any SATELLITE will be automatically dedicated to the HOST. The command must be applied <i>to the HOST</i> ; both the HOST EEPROM Switch and that of SATELLITE No. n must be ON. The LCT x [CR] interrogation may be used to determine the SATELLITE to which a given channel has been dedicated (see Section 3.B.3(c.2)).
SAT n = x [CR]	E						Designates SATELLITE No. n to be the sole "data origin" for GLOBAL DATA CHANNEL x only (1 < x < 998; n > 0).
SAT n = CON [CR]	E						Tells the HOST that SATELLITE No. n is an OPERATOR CONSOLE SATELLITE.
SAT n = N/A [CR]	E						Cancels existing dedication of GLOBAL DATA CHANNEL(S) to SATELLITE No. n, thus causing the SATELLITE to stop communicating locally acquired analog data to the HOST'S 10BD4. Subsequent interrogation <i>from a NODE other than SATELLITE No. n</i> for the "type" or "location" of a channel whose dedication to SATELLITE No. n was cancelled by this command will yield D0 or N/A , respectively (see TYPE (TYP) and LOCATE (LCT) commands).
SAT n [CR]							Reads GLOBAL DATA CHANNEL(S) currently dedicated to SATELLITE No. n, where n > 0; returns x,y ; x ; CON ; or N/A . An interrogation of SAT 0 [CR] is not presently effective.
SAV SAVE				CRT Video Setup	2.C.7	10BVT60 10CON/CCON	1.0 1.0
SAV n [CR]	E						Stores in EEPROM the currently displayed VIDEO PAGE as Page No. n. This command may require special confirmation, and can only be entered through the keyboard.

COMMAND	E P R O M	R A N G E	I M P L E M E N T A T I O N	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
SBC SYSTEM BASE CHANNEL				General System Setup	1.F.1		
SBC = x [CR]	E			Sets the current SYSTEM BASE CHANNEL to Channel No. x (where "x" is any Channel Number from "1" through the number that would result in a <i>highest</i> channel at the system limit of "997").			
SBC [CR]				Reads the current SYSTEM BASE CHANNEL; returns x .			
SBL SHOW BUTTON LOCATIONS				Touchscreen Video Operation	3.C.5(d.2)	10BVT65	1.0
SBL [CR]				Highlights all BUTTONS on the displayed VIDEO PAGE with the color/intensity specified by the last-entered BUTTON FIELD COLOR (BFC) command; overrides any and all other color-controlling factors; cancelled by pressing any keyboard key.			
SCN SCAN				General System Operaion	1.F.2(b)	10ACP100 10BCP100 10KU	8.0 8.0 8.0
SCN = x, y [CR]	(E)			If the EEPROM Switch is OFF, specifies x and y to be the first and last channels, respectively, of the system's "temporary" SCAN RANGE (y x); on powerup, the SCAN RANGE will default to that defined by the last-entered TERMINATOR (TER) command. If the EEPROM Switch is ON, specifies a <i>default</i> (powerup) SCAN RANGE from Chn. x through Chn. y, regardless of the TER command currently in effect.			
SCN [CR]				Reads first and last channels of the currently effective SCAN RANGE; returns x,y .			
SEL SATELLITE ERROR LOG				Satellite Network Operation	3.B.3(c.6)	10BD4	2.2
SEL [CR]				Reads "ERROR LOG" for all SATELLITES; returns, for every SATELLITE, A,B,C,D,E : A = no. of TIMEOUT ERRORS detected since last RESET ERROR LOG (REL) command; B = no. of CHECKSUM ERRORS since last REL ; C = 0 (THIS COUNTER NOT USED AT PRESENT); D = "SLOW CYCLE COUNTER" (total no. of 10BD4 scan cycles that have taken place since last REL , divided by 30000); E = "CYCLE COUNTER" (total no. of 10BD4 scan cycles that have taken place since last REL , counted by "1's"). Cannot be entered via keyboard.			
SEL n [CR]		R		Reads "ERROR LOG" for SATELLITE No. n; returns A,B,C,D,E .			
SEN SENSITIVITY				Counter/ Timer Card Setup	3.A.1(b.2)	10ACP100 10BCP100 10KU	8.0 8.0 8.0
SEN x = g [CR]	E			Sets input-amplifier sensitivity of Model 10ACT01 Chn. x, independent of the "type" designation of this channel; the selected gain factor g (1 g 5) sets the 10ACT01's analog-input voltage range, as given in Table 3.A.1.7).			
SEN x [CR]				Reads current gain setting for 10ACT01 Chn. x; returns g .			
SHN SHUNT CAL.–NEGATIVE				Analog Channel Setup	1.G.6; 3.B.3(c.4)	10ACP100 10BCP100 10KU	8.9 8.9 8.9
SHN x [CR]		R	I	Closes and latches Shunt Calibration Switch of Strain Gage Chn. x for a <i>negative</i> up-scale reading; switch is unlatched by RESUME (RSM) command.			

COMMAND	E P R O M	R A N G E	I M P L E M E N T A T I O N	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
SHO SHOW				Automatic Command Execution	2.C.2(c); 2.K.3(c)	10BVT60 10CON/CCON	7.0 1.0
SHO [CR]				Calls to display the CONDITIONAL DIRECTORY for CONDITIONAL BITS 1 through 5.			
SHO2 [CR]				Calls to display the CONDITIONAL DIRECTORY for CONDITIONAL BITS 6 through 10.			
SHP SHUNT CAL.-POSITIVE				Analog Channel Setup	1.G.6; 3.B.3(c.4)	10ACP100 10BCP100 10KU	8.9 8.9 8.9
SHP x [CR]		R	I	Closes and latches Shunt Calibration Switch of Strain Gage Chn. x for a <i>positive</i> up-scale reading; switch is unlatched by RESUME (RSM) command.			
SMD SETUP MODE				History Card Setup	3.B.4(d.2)	10BDR64	1.0
SMD [CR]				Causes Model 10BDR64 to enter SETUP MODE, stopping any recording in process, and allowing entry of recorder parameters and/or conditions (see also RECORD MODE (RMD) command).			
SND SEND				Communi- cations	2.B.6(c); 3.B.5(c.6); 3.B.5(d.1)	10ACP100 10BCP100 10KU 10BACI	8.0 8.0 8.0 1.0
SND \$ [CR]				Causes ASCII character string \$ to be transmitted from COMPUTER INTERFACE PORT (\$ is a string of up to 32 characters; every ASCII CONTROL CHARACTER must be entered as a hexadecimal word in brackets—see Table 1.H.2).			
SND @ \$ [CR]				Sends the single MNEMONIC COMMAND \$ to the Daytronic Model PC-EGU Enhanced Graphics Card installed in an IBM or IBM-compatible computer connected to the DataPAC's COMPUTER INTERFACE PORT (if an "A-sized" DataPAC) or AUXILIARY COMPUTER INTERFACE PORT (if a "B-sized" DataPAC). In the former case, the SND command must be entered via the DataPAC's keyboard; in the latter case, it must be routed to the B SLOT occupied by the Model 10BACI Auxiliary Computer Interface Card in question, using an ATTACH (ATT) or VIA (VIA) command.			
SNP SNAPSHOT				Data Trans- mission	1.H.1; 1.H.2(c); 2.E.1; 3.B.5(d.1)	10ACP100 10BCP100 10KU 10BACI	1.0 1.0 1.0 1.0
SNP [CR]				Transmits time-coherent "snapshot" of all scanned DATA CHANNELS, including Chns. 998 (TIME) and 999 (DATE), from COMPUTER INTERFACE PORT, once only; outputs x,w,z per channel, where x = Channel No. (optional—see ECHO (ECO) command); w = data value; z = LIMIT-ZONE Indicator No. (optional—see LIMITS (LIM) command).			
SNP x TO y [CR]				Transmits time-coherent "snapshot" of data, once only, for Chns. x through y only (y \geq x).			
SOP SIGN-ON PAGE				CRT Video Setup	2.C.9	10BVT60	1.0
SOP = p [CR]	E			Specifies existing CRT VIDEO PAGE p to be displayed upon system powerup; does not apply to LCD/VFD displays.			

COMMAND	E P R O M	R A N D O M	I M P L E M E N T A T I O N	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
SOP [CR]				Reads current SIGN-ON PAGE assignment; returns p .			
SRC LOGIC SOURCE				Logic Bit Setup;	2.F.4; 2.H.1;	10ACP100 10BCP100	1.0 1.0
				Logic I/O Setup;	2.H.2 ; 2.H.3;	10KU 10BACI	1.0 1.0
				Satellite Network Setup;	3.A.3(c.2); 3.B.2(c.2); 3.B.3(b.6);		
				Aux. Comp Interface	3.B.3(c.1); 3.B.3(c.3); 3.B.5(c.7)		
SRC r = s [CR]	E	R	I	<p>Specifies a local LOGIC SOURCE for LOGIC BIT r; s is one of the following LOGIC-SOURCE codes (for LOGIC SOURCES that permit either LATCHING or NONLATCHING MODE, see also RELEASE (RLS) command):</p> <ul style="list-style-type: none"> s = LIM, LAT (internal LIMITS, latching) = LIM, NON (internal LIMITS, nonlatching) = LIM (internal LIMITS; previously specified LATCH MODE remains in effect) = INP, LAT (LOGIC INPUT, latching) = INP, NON (LOGIC INPUT, nonlatching) = INP (LOGIC INPUT; previously specified LATCH MODE remains in effect) = Bs (designates as the local LOGIC SOURCE of LOGIC BIT r the Model 10BACI Auxiliary Computer Interface Card occupying the DataPAC's B SLOT s; a bit sourced to a 10BACI can only be set "externally," by means of a SET BIT (BIT), BINARY (BIN), BINARY CODED DECIMAL (BCD), or HEXADECIMAL (HEX) command directed to the 10BACI; cancelled by SRC r = EXT [CR] command (see below)) = SAT (for "A-sized" DataPAC SATELLITE ("S" Version) only—designates as the local LOGIC SOURCE of GLOBAL LOGIC BIT r the corresponding bit within the GLOBAL BIT GROUP(S) downloaded to all "A-sized" DataPAC SATELLITES with each 10BD4 scan cycle (see DOWNLOAD BITS (DLB) command); allows the SATELLITE to "hear" Bit r when that bit has <i>not</i> been dedicated to the SATELLITE via the SATELLITE SYSTEM BITS (SSB) command; cancelled by SRC r = EXT [CR] command (see below)) = EXT (cancels any previous "SRC=" command applying to Bit r; confers control of the bit solely to subsequent SET BIT (BIT), BINARY (BIN), BINARY CODED DECIMAL (BCD), and/or HEXADECIMAL (HEX) commands. If Bit r is a GLOBAL LOGIC BIT sourced either to a BIT GROUP downloaded by the 10BD4 or to a Model 10BD1 Satellite Slave Card (see below), discontinues the "hearing" of Bit r by the SATELLITE in question. If Bit r is sourced to a Model 10BACI, returns "external" control of the bit (via BIT, BIN, BCD, or HEX) to the DataPAC's CENTRAL PROCESSOR.) 			
SRC r = Bs [CR]	E	R	I	<p>When applied to a "B-sized" DataPAC SATELLITE, "sources" GLOBAL LOGIC BIT r to the Model 10BD1 Satellite Slave Card occupying the SATELLITE'S B SLOT s; does <i>not</i> specify an actual LOGIC SOURCE for the bit, but does allow the SATELLITE to "hear" Bit r when that bit has not been dedicated to the SATELLITE via the SATELLITE SYSTEM BITS (SSB) command; cancelled by SRC r = EXT [CR] command (see above).</p>			
SRC r [CR]			R	<p>Reads current local LOGIC-SOURCE assignment for Bit r:</p> <ol style="list-style-type: none"> 1) If the interrogated DataPAC is <i>not</i> a member of a SATELLITE NETWORK, returns one of the forms of the LOGIC-SOURCE code s given above, except for SAT (if Bit r is presently sourced to EXTERNAL control, an answer of EXT,NON will be returned). 2) If the interrogated DataPAC is a member ("NODE") of a SATELLITE NETWORK, four basic responses to the SRC r [CR] interrogation are possible: 			

COMMAND	E P R O M	R A N G E	I M P L E M E N T A R Y	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST	
				CATEGORY	SECTION(S)		SOFTWARE VERSION	
								<p>a) "LOCAL" LOGIC SOURCE: s (as above). Returned by an "A-sized" or "B-sized" NODE when Bit r is <i>dedicated to that NODE</i> via the SATELLITE SYSTEM BITS (SSB) command, so that the NODE serves as the local "data origin" for Bit r. Also possible, however, if the NODE is an "A-sized" SATELLITE or a "B-sized" NODE where the GBL = OFF [CR] command is in effect, and where Bit r is neither dedicated to that NODE nor "sourced" to the NODE'S Model 10BD1 Satellite Slave Card (in such cases, a "local" answer may be returned which in no way reflects the true LOGIC SOURCE of Bit r within the network).</p> <p>b) "GLOBAL" LOGIC SOURCE: n,s. Returned when Bit r has not been dedicated to the interrogated NODE via the SATELLITE SYSTEM BITS (SSB) command and when the SRC r [CR] interrogation has been communicated to that NODE as an "implicitly addressed" command from some other ("B-sized") NODE. The number "n" in the response is the SATELLITE No. of the NODE to which Bit r has been dedicated.</p> <p>c) "10BD1" LOGIC SOURCE: Bs. Returned by a "B-sized" NODE (only) when 1) the GBL = OFF [CR] command is in effect at that NODE; 2) Bit r is a bit <i>not</i> dedicated to that NODE but which has been "sourced" to the Model 10BD1 occupying the NODE'S B SLOT s; and 3) the SRC r [CR] interrogation has been "explicitly" communicated to that NODE (i.e., via an OPEN (OPN) or NODE (NOD) command, or via the NODE'S keyboard, COMPUTER INTERFACE PORT, or AUXILIARY COMPUTER INTERFACE PORT.</p> <p>d) NO RESPONSE. Returned by a "B-sized" NODE (only) when 1) the GBL = ON [CR] command is in effect at that NODE; 2) Bit r has been "sourced" to the NODE'S Model 10BD1; and 3) the SRC r [CR] interrogation has been communicated to that NODE via an OPEN (OPN) or NODE (NOD) command.</p>
SSB SATELLITE SYSTEM BITS SSB n = k [CR] SSB n = k, l [CR] SSB n = N/A [CR] SSB n [CR]				Satellite Network Setup	3.B.3(b.6)	10BD4	1.0	<p>Designates SATELLITE No. n to be the sole "data origin" for GLOBAL BIT GROUP k. Here, n > 0 (IT SHOULD NEVER BE "0"); all BIT GROUPS below the lowest-numbered BIT GROUP dedicated to any SATELLITE will be automatically dedicated to the HOST. The command must be applied <i>to the HOST</i>; both the HOST EEPROM Switch and that of SATELLITE No. n must be ON. The SRC r [CR] interrogation may be used to determine the SATELLITE to which a given LOGIC BIT (but <i>not</i> BIT GROUP) has been dedicated (see Section 3.B.3(c.3)).</p> <p>Designates SATELLITE No. n to be the sole "data origin" for GLOBAL BIT GROUPS k through l (l > k; n > 0).</p> <p>Cancels existing dedication of GLOBAL BIT GROUP(S) to SATELLITE No. n, thus causing the SATELLITE to stop communicating locally acquired logic data to the HOST'S 10BD4. Subsequent interrogation <i>from a NODE other than SATELLITE No. n</i> for the LOGIC SOURCE of a bit whose dedication to SATELLITE No. n was cancelled by this command will yield EXT,NON (see LOGIC SOURCE (SRC) command).</p> <p>Reads GLOBAL BIT GROUP(S) currently dedicated to SATELLITE No. n, where n > 0; returns k; k,l; or N/A. An interrogation of SSB 0 [CR] is not presently effective.</p>
STH START FROM HALT STH n [CR]				History Card Operation	3.B.4(e.5)	10BDR64	1.0	Restarts halted Model 10BDR64 Recorder n.

COMMAND	E P R O M	R A N G E	I M P L O R D R	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE VERSION
STO STORE				History Card Setup	3.B.4(d.5)	10BDR64	1.0
STO n = B [CR]	E			Specifies the logical combination of conditions that will cause the Model 10BDR64 Recorder n to record and store a FRAME of data for all DATA CHANNELS and SYSTEM BIT GROUPS in its predefined "list" (B is a Boolean expression of up to 15 MNEMONIC terms and up to 14 OPERATORS—see Section 3.B.4(d.5) for details).			
STO n = N/A [CR]	E			Cancels existing store conditions for Recorder n.			
STO n [CR]				Reads existing store conditions for Recorder n; returns B or N/A .			
STR STREAM				Data	1.H.1;	10ACP100	1.0
				Trans- mission	1.H.2(d); 3.B.5(d.1)	10BCP100 10KU 10BACI	1.0 1.0 1.0
STR [CR]				Continuously repeats transmission from COMPUTER INTERFACE PORT of current data for all scanned DATA CHANNELS, including Chns. 998 (TIME) and 999 (DATE), until terminated by ESCAPE (ESC) command or keyboard ESC key; outputs x,w,z per channel, where x = Channel No.; w = data value (see CHARACTERS PER CHANNEL (CPC) command); z = LIMIT-ZONE Indicator No. (optional—see LIMITS (LIM) command). Output also includes specified HEADER and/or TAILER (see HEADER (HDR) and TAILER (TLR) commands).			
STR x [CR]				Continuously repeats transmission of current data for Chn. x only, along with specified HEADER and/or TAILER, until terminated by ESCAPE (ESC) command.			
STR x TO y [CR]				Continuously repeats transmission of current data for Chn. x through y only, along with specified HEADER and/or TAILER, until terminated by ESCAPE (ESC) command (y - x).			
STS STATUS				CRT Video Operation	2.C.12(b); 2.C.12(e)	10BVT60 10CON/CCON	1.0 1.0
STS x = s [CR]	R			Specifies VISUAL EFFECTS to be exhibited by the DATA FIELD or VIDEO PLAYBACK FIELD assigned to Chn. x, and by any FIXED TEXT "associated" with that field; s is a "STATUS" code—see Table 2.C.3. Temporarily overrides "BIT CONTROL" STATUS (VBC) , "GREATER THAN" STATUS (VGT) , "BETWEEN" STATUS (VBT) , and "LESS THAN" STATUS (VLT) commands currently applying to Chn. x.			
STS x = INT [CR]	R			Returns control of VISUAL EFFECTS for display of Chn. x to the last-entered VBC , VGT , VBT , and VLT commands applying to that channel; automatically in effect on powerup.			
STS x [CR]	R			Reads STS entry in effect for Chn. x. If a command of STS x = s [CR] is currently in control of VISUAL EFFECTS for Chn. x, returns s ; if not, returns INT .			
TAR TARE				General System Operation	2.G.3; 3.B.3(c.4)	10ACP100 10BCP100 10KU	1.0 1.0 1.0
TAR x [CR]	R	I		Zeros Chn. x and stores offset value in volatile RAM memory (see also ZERO (ZRO) command).			

COMMAND	E P R O M	R A N G E	I M P L E M E N T A T I O N	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE
TBT TIMER BIT				General System Setup	2.M.3	10ACP100 (11.1)	
TBT m = r [CR]	E	R		Assigns LOGIC BIT r to A-Sized DataPAC's TIMER No. m (0 m 23), so that Bit r is set to <i>Logic 1</i> for a period of one complete scan cycle when Timer m registers the time value to which it has been set by an appropriate TIMER (TMR) command.			
TBT m = N/A [CR]	E	R		Cancels current logic-bit assignment of TIMER No. m.			
TBT m [CR]				Reads current logic-bit assignment of TIMER No. m; returns m or N/A .			
TER TERMINATOR				General System Setup	1.F.2(a); 3.B.3(b.1)	10ACP100 10BCP100 10KU	1.0 1.0 1.0
TER = x [CR]	E			Designates Chn. x as DataPAC TERMINATOR CHANNEL—i.e., the final channel of the default SCAN RANGE, which is Chn. 1 to and including Chn. x. Note that the TER command can be overridden by a SCAN (SCN) command that has been entered with the EEPROM Switch ON.			
TER [CR]				Reads current TERMINATOR CHANNEL; returns x .			
THC TRACK HOLD CONTROL				General System Setup	1.E.2.10A74-4	10BCP200	
THC = s [CR]	E			Informs the DataPAC of the slot location "s" of the particular Model 10A1 Control Signal Card that is to be synchronized to the DataPAC's scan cycle; s is a four-digit number consisting of the DECK No., SLOT No., and SUBCHANNEL No. of the selected 10A1 card.			
THC [CR]				Reads location of currently designated "master" 10A1 card; returns s .			
TLR TAILER				Formatting of Data Transmissions	1.H.3(c); 3.B.5(c.5); 3.B.5(d.1)	10ACP100 10BCP100 10KU 10BACI	1.0 1.0 1.0 1.0
TLR = "\$" [CR]	E			Specifies character string \$ to be transmitted at the end of each data set transmitted from the COMPUTER INTERFACE PORT in response to a STREAM (STR) or HARD COPY (HCY) command (\$ is an ASCII string of up to 80 characters, enclosed in quotation marks (" "); every ASCII CONTROL CHARACTER must be entered as a hexadecimal word in brackets, within the quotation marks—see Table 1.H.2).			
TLR = N/A [CR]	E			Cancels current TAILER string.			
TLR [CR]				Reads current TAILER string; can only be entered via COMPUTER INTERFACE PORT, and outputs \$ or N/A .			
TME TIME				General System Setup	1.F.3	10ACP100 10BCP100 10KU 10CON/CCON	1.0 1.0 1.0 1.0
TME = t [CR]	E			Sets DataPAC's internal clock-time (t is a 5- or 6-digit number: hour-minute-second, to be displayed with separating colons (:)).			
TME [CR]				Reads current time value; returns t .			

COMMAND	E P R O M	R A N G E	I M P L E M E N T A T I O N	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
TMO TIMEOUT				Communi- cations Setup	2.B.6(a); 2.H.2(d)	10ACP100 10BCP100 10KU	8.0 8.0 8.0
TMO = r, s [CR]	E			Assigns "special bit" LOGIC SOURCE to LOGIC BIT r: r will be set to Logic 1 if no recognizable character has been received at the COMPUTER INTERFACE PORT for a period of s seconds (1 ≤ s ≤ 60), and will be reset to <i>Logic 0</i> upon subsequent receipt of a recognizable character at that port.			
TMO = N/A [CR]	E			Cancels current TIMEOUT BIT assignment.			
TMO [CR]				Reads current TIMEOUT BIT assignment; returns r,s or N/A .			
TMP TEMPLATE				Formatted Output Card Setup	3.C.3(f.2)	10VFO132	7.0
TMP = T [CR]	E			Creates format "template" for channel data transmitted from Model 10VFO132 PRINTER INTERFACE PORT in response to a PRINT CHANNEL DATA (PRT) command; the template expression T is a combination, in any desired order, of FIXED TEXT and VARIABLE DATA FIELDS (for Channel No., data, and LIMIT-ZONE Indicator No.)—see Section 3.C.3(f.2) for details.			
TMP [CR]				Reads current template expression for Model 10VFO132 channel-data transmissions; returns T .			
TMR TIMER				General System Setup	2.M.3	10ACP100 (11.1)	
TMR m = T [CR]	E	R		Sets A-Sized DataPAC's TIMER No. m to the time value "T"; 0 ≤ m ≤ 23; T is a six-digit number expressing any legal time-of-day reading (hour/minute/second) from "000000" (= midnight) to "235959" (= one second until midnight).			
TMR m = N/A [CR]	E			Disables TIMER No. m <i>plus all timers of a number greater than m</i> .			
TMR m [CR]				Reads current time-value setting of TIMER No. m; returns T or N/A .			
TST TOUCHSCREEN TYPE				Touchscreen Video Setup	3.C.5(b.1)	10BVT65	1.0
TST = 1 [CR]	E			Informs the DataPAC of the "type" of touchscreen to be used; the only operative "type" is currently that employed by the Models 10VCM14T and 10VCM19TA Color Monitors (i.e., "Type 1").			
TST [CR]				Reads current touchscreen "type" setting; currently returns only 1 .			
TYP TYPE				System Channel Setup	1.G.1; 2.D.2; 2.M.2; 3.A.4(b.4); 3.B.3(b.5); 3.B.3(c.1); Appendix C	10ACP100 10BCP100 10KU	1.0 1.0 1.0
TYP x = v [CR]	E	R	I	Sets the local "type" designation for Chn. x, where v is a two-character hexadecimal code number specifying "special treatment" factors for the channel (see Appendix C for a complete list of channel "type" codes). Chn. x may be a "REAL" (ANALOG INPUT) CHANNEL, a "CONVERSION" CHANNEL, or a PSEUDO-CHANNEL that is not "autotyping" (e.g., a DOWNLOAD or TIMER PSEUDO-CHANNEL). "Autotyping" PSEUDOCHANNELS include CALCULATE, LINEARIZATION, and PLAYBACK PSEUDOCHANNELS; the "WRITE" form of the TYP			

COMMAND	E P R O M	R A N G E	I M P L E M E N T S	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE VERSION
TYP x [CR]			R I				
				command will have no effect on such channels, or on ANALOG OUTPUT CHANNELS. See also RESET (RST) command.			
				Reads current local "type" designation for Chn. x, which may be a "REAL" (ANALOG INPUT) CHANNEL, a "CONVERSION" CHANNEL, a PSEUDO-CHANNEL of any kind, or an ANALOG OUTPUT CHANNEL; returns v.			
UNL UNLOCK				General	2.E.2;	10ACP100	1.0
				System	3.A.5(c.4);	10BCP100	1.0
				Operation	3.A.6(c.2);	10KU	1.0
					3.B.5(d.1)	10BACI	1.0
UNL [CR]				Cancels LOK [CR] command; "unlocks" the DATA RAM, resuming automatic updating of all scanned DATA CHANNELS, including Nos. 998 (TIME) and 999 (DATE).			
UNL x [CR]				Cancels LOK x [CR] command; "unlocks" Chn. x only.			
UNL x TO y [CR]				Cancels LOK x TO y [CR] command; "unlocks" Chns. x through y only (y x).			
VBC "BIT CONTROL" STATUS				CRT Video	2.C.12(b)	10BVT65	1.0
				Setup		10CON/CCON	1.0
				NOTE: The VBC command will not work for any version of the Model 10BVT60 Video Text Card. It will work, however, for any version of the Model 10BVT65 "Touchscreen" Video Text Card (see Section 3.C.5).			
VBC x = s ON BIT q [CR]			E R	Specifies VISUAL EFFECTS to be exhibited by the DATA FIELD assigned to Chn. x, and by any FIXED TEXT "associated" with that field, when the state of LOGIC BIT q is Logic 1; s is a "STATUS" code—see Table 2.C.3. Can be temporarily overridden by a STATUS (STS) command applying to Chn. x.			
VBC x = N/A [CR]			E R	Cancels existing "BIT CONTROL" STATUS assignment for Chn. x.			
VBC x [CR]			R	Reads existing "BIT CONTROL" STATUS assignment for Chn. x; returns s ON BIT q or N/A .			
VBT "BETWEEN" STATUS				CRT Video	2.C.12(b);	10BVT60	1.0
				Setup	2.F.1	10CON/CCON	1.0
VBT x = s [CR]			E R	Specifies VISUAL EFFECTS to be exhibited by the DATA FIELD assigned to Chn. x, and by any FIXED TEXT "associated" with that field, when the data for Chn. x lies in the "BETWEEN" LIMIT ZONE; s is a "STATUS" code—see Table 2.C.3. Can be overridden by a "BIT CONTROL" STATUS (VBC) command, when Bit q is at <i>Logic 1</i> , or (temporarily) by a STATUS (STS) command applying to Chn. x.			
VBT 998 = s [CR]			E	Sets VISUAL EFFECTS for display of system TIME (Chn. 998)—for "STATUS" code s see Table 2.C.3.			
VBT 999 = s [CR]			E	Sets VISUAL EFFECTS for display of system DATE (Chn. 999)—for "STATUS" code s see Table 2.C.3.			
VBT x [CR]			R	Reads existing "BETWEEN" STATUS setting for Chn. x; returns s .			
VDL VIDEO DOWNLOAD				CRT Video	2.C.11(c);	10BVT60	9.0
				Operation	2.P.4	10CON/CCON	1.0
VDL n = \$_n [CR]			(E)	Downloads to DataPAC video memory, via the COMPUTER INTERFACE PORT, the contents (\$ _n) of SECTION No. n of the VIDEO PAGE being transmitted to the DataPAC (n 64); cannot be entered via keyboard. If you want the DataPAC only to display the page being transmitted, without storing it, the EEPROM Switch need not be on. See also VIDEO UPLOAD (VUL) and VIDEO ERROR LOG (VEL) commands.			

COMMAND	E P R O M	R A N G E	I M P L A D D R	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST	
				CATEGORY	SECTION(S)		SOFTWARE VERSION	
VDL 99 = p, c [CR]	(E)							Terminates the VIDEO DOWNLOAD (VDL) series for transmission to a DataPAC of the VIDEO PAGE to be stored as Page No. p (1 p 100); p = 0 indicates that the page is only to be displayed, not stored; c is a CHECKSUM number (positive or negative) for the page contents just transmitted. Overwrites any Page p already existing in EEPROM storage; cannot be entered via keyboard.
VDU VIDEO DISPLAY UNIT VDU = n, f [CR] VDU [CR]	E			CRT Video Setup	2.C.1(a); 2.N.2	10BVT60 10CON/CCON	6.0 1.0	Specifies video format and frame rate for all system CRT's, internal and external; n = C (color) or M (monochrome); f = 50 or 60 (Hz). Reads current video format and frame rate; returns n,f .
VEL VIDEO ERROR LOG VEL [CR]				CRT Video Operation	2.C.11(d)	10BVT60 10CON/CCON	9.0 1.0	Requests the last error to have occurred during transfer of a VIDEO PAGE initiated by either the VIDEO UPLOAD (VUL) or VIDEO DOWNLOAD (VDL) command; cannot be entered via keyboard. Four responses are presently possible, available only at COMPUTER INTERFACE PORT: ERROR 0 = no error detected; ERROR 3 = last error was a CHECKSUM error; ERROR 4 = EEPROM Switch was OFF; ERROR 5 = insufficient "free" video memory to save received page.
VGT "GREATER THAN" STATUS VGT x = s [CR] VGT x [CR]	E	R		CRT Video Setup	2.C.12(b); 2.F.1	10BVT60 10CON/CCON	1.0 1.0	Specifies VISUAL EFFECTS to be exhibited by the DATA FIELD assigned to Chn. x, and by any FIXED TEXT "associated" with that field, when the data for Chn. x lies in the "GREATER THAN" LIMIT ZONE; s is a "STATUS" code—see Table 2.C.3. Can be overridden by a " BIT CONTROL " STATUS (VBC) command, when Bit q is at <i>Logic 1</i> , or (temporarily) by a STATUS (STS) command applying to Chn. x. Reads existing "GREATER THAN" STATUS setting for Chn. x; returns s .
VIA VIA s, \$ [CR]				General System Operation; Aux. Comp. Interface	3.B.1; 3.B.5(a); 3.B.5(d.2)	10BCP100	9.0	Routes a single MNEMONIC COMMAND \$ to the B CARD occupying B SLOT s; the ATTACH (ATT) command need not be entered prior to VIA .
VID VIDEO MODE VID = v [CR] VID [CR]				CRT Video Setup	2.C.1(b); 2.N.2	10BVT60 10CON/CCON	7.0 1.0	Selects desired video display mode; v = INT (internal) or EXT (external); at powerup, INTERNAL mode will always be in effect. The keyboard's Ctrl (CONTROL) and System Config (SYSTEM CONFIGURATION) keys can also be used to toggle back and forth between INTERNAL and EXTERNAL displays. Reads current video display mode; returns v .
VLT "LESS THAN" STATUS VLT x = s [CR]	E	R		CRT Video Setup	2.C.12(b); 2.F.1	10BVT60 10CON/CCON	1.0 1.0	Specifies VISUAL EFFECTS to be exhibited by the DATA FIELD assigned to Chn. x, and by any FIXED TEXT "associated" with that field, when the data for Chn. x

COMMAND	E P R O M	R A N G E	I M P L A D D R	GENERAL	GUIDEBOOK	PRODUCT(S)	FIRST
				CATEGORY	SECTION(S)		SOFTWARE VERSION
VLT x [CR]			R	lies in the "LESS THAN" LIMIT ZONE; s is a "STATUS" code—see Table 2.C.3. Can be overridden by a " BIT CONTROL STATUS (VBC) " command, when Bit q is at <i>Logic 1</i> , or (temporarily) by a STATUS (STS) command applying to Chn. x.			
				Reads existing "LESS THAN" STATUS setting for Chn. x; returns s .			
VSS VIDEO SCAN SYMBOL				General System Setup; CRT Video Setup	1.F.2(c); 2.C.1(d)	10BVT60 10CON/CCON	8.1 1.0
VSS = 1 [CR]			E	Adds ampersand (&) flag to the display of any and all DATA CHANNELS outside the current SCAN RANGE.			
VSS = 0 [CR]			E	Cancels ampersand flagging of out-of-scan channels.			
VSS [CR]				Reads current "video scan symbol" status; returns 1 or 0 .			
VUL VIDEO UPLOAD				CRT Video Operation	2.C.11(b); 2.P.4	10BVT60 10CON/CCON	9.0 1.0
VUL = p [CR]				Transmits existing Page p from COMPUTER INTERFACE PORT (1 p 100); outputs VUL₁=\$1, VUL₂=\$2, . . . , VUL_n=\$n, VUL99=p,c ; cannot be entered via keyboard. Each line of transmission corresponds to a SECTION of Page p, starting with SECTION No. 1, up to SECTION No. n, where n ≤ 64. \$ ₁ is an ASCII string for the contents of SECTION No. 1; \$ ₂ for the contents of SECTION No. 2, etc. Terminating line ("SECTION No. 99") contains Page No. (p) and CHECKSUM number (c) for the page contents just transmitted. See also VIDEO DOWNLOAD (VDL) and VIDEO ERROR LOG (VEL) commands.			
VUL = 0 [CR]				Transmits from COMPUTER INTERFACE PORT the VIDEO PAGE currently on display; if the page has not been stored in EEPROM, a Page No. of 0 will be transmitted in the terminating line; cannot be entered via keyboard.			
XBG EXECUTE BASE GROUP				Automatic Command Execution; Satellite Network Setup	2.K.2(c); 3.B.3(b.8)	10ACP100 10BCP100 10KU	8.9 8.9 8.9
XBG 1 = k₁ [CR]			E	Specifies SYSTEM BIT GROUP k ₁ as the first of any two BIT GROUPS to be used for EXECUTE (EXU) functions.			
XBG 2 = k₂ [CR]			E	Specifies SYSTEM BIT GROUP k ₂ as the second of any two BIT GROUPS to be used for EXECUTE (EXU) functions.			
XBG 1 [CR]				Reads the first EXECUTE (EXU) BIT GROUP; returns k₁ .			
XBG 2 [CR]				Reads the second EXECUTE (EXU) BIT GROUP; returns k₂ .			
XDS TRANSMISSION DISABLE				FIFO Buffer Operation	3.A.8(b.6)	10AFIFO	1.0
XDS [CR]				Places the Model 10AFIFO in "GATED" OUTPUT MODE; the 10AFIFO will subsequently transmit its oldest "main-memory" contents or the contents of its output buffer only when so instructed by a DESTRUCTIVE DATA OUTPUT (DDO) or NONDESTRUCTIVE DATA OUTPUT (NDO) command, respectively (if a DATA RECORD is being transmitted when the XDS command is entered, that DATA RECORD will be transmitted in full). In effect, by default, on powerup. Requires the "FIFO bypass" to be OFF (see BYPASS (BYP) command). Can be entered only through the FIFO COMPUTER PORT; see also MODE (MOD) command.			

COMMAND	E P R O M	R A N G E	I M P L A D D R	GENERAL CATEGORY	GUIDEBOOK SECTION(S)	PRODUCT(S)	FIRST SOFTWARE VERSION
XEN TRANSMISSION ENABLE XEN [CR]				FIFO Buffer Operation	3.A.8(b.6)	10AFIFO	1.0
Places the Model 10AFIFO in "OPEN" OUTPUT MODE; the 10AFIFO will continuously output the oldest contents of its main memory via the output buffer; the DESTRUCTIVE DATA OUTPUT (DDO) or NONDESTRUCTIVE DATA OUTPUT (NDO) command will have no effect. Requires the "FIFO bypass" to be OFF (see BYPASS (BYP) command). Can be entered only through the FIFO COMPUTER PORT; see also MODE (MOD) command.							
ZRO ZERO ZRO x [CR]	(E)	R	I	Analog Channel Setup	1.G.5(c); 1.G.6; 3.B.3(c.1)	10ACP100 10BCP100 10KU	1.0 1.0 1.0
ZRO x = z [CR]	E	R	I	Zeros Chn. x and stores in nonvolatile EEPROM the ZERO OFFSET ("b" term) for that channel. With EEPROM Switch OFF, this command is equivalent to the TAR x [CR] command.			
ZRO x [CR]		R	I	Sets the ZERO OFFSET ("b" term) for Chn. x to a value that causes the channel's existing (nonzero) input to yield a reading of "z."			
ZRO x [CR]				Returns a number used internally for channel offsetting, or N/A (the latter appears if Chn. x is not a "REAL" channel).			
ZUM ZOOM ZUM n = s STEP z [CR]			R	History Card Operation	3.B.4(e.8); 3.B.4(e.9)	10BDR64	5.0
ZUM n = N/A [CR]			R	Increases SEARCH DEPTH of every "NON-STATISTICAL" PLAYBACK PSEUDO-CHANNEL assigned to Model 10BDR64 Recorder n by s FRAMES, and specifies an INCREMENT of z for further keyboard-controlled alteration of the SEARCH DEPTH (see also FREEZE (FRZ) command; ZUM and FRZ are mutually exclusive). The " STEP z " term is optional; if not entered, the DEPTH INCREMENT defaults to "1."			
ZUM n [CR]			R	Cancels the SEARCH-DEPTH OFFSET and DEPTH INCREMENT specified by the last ZUM command applied to Recorder n.			
				Reads current SEARCH-DEPTH OFFSET and DEPTH INCREMENT for Recorder n; returns s, s(STEPz), or N/A . If a REPLAY (RPL) command is in effect, returns the current replay SEARCH DEPTH.			

PLEASE NOTE the following section- and figure-reference corrections for **Section 3** of this Guidebook:

When you are told to refer to:

You should actually refer to:

Section 1.B

Section 1.A.3

Section 1.C

Section 4 of the appropriate
"On the Air" Booklet

Section 1.D

Section 5 of the appropriate
"On the Air" Booklet

Fig. 1.E.1 (Section 1.E.1)

Fig. 1.5 (Section 1.E.1)

Fig. 1.E.2 (Section 1.E.1)

Fig. 1.6 (Section 1.E.1)

Section 1.F.1

Section 1.F.2

Section 1.F.2

Section 1.F.3

Section 1.G.2

Section 1.G.1

Section 1.G.7

Section 1.G.6

Appendix B

Section 1.B

Section 3.C

Special "V-Card" Functions

The following sections contain instructions for the setup and operation of optional System 10 "V Cards."

——— PLEASE NOTE ———

If you plan to install any optional V CARDS by yourself, be sure to study Section 2.C.1 before you do so.

Section 3.C.1

Installation of Optional "V Cards"

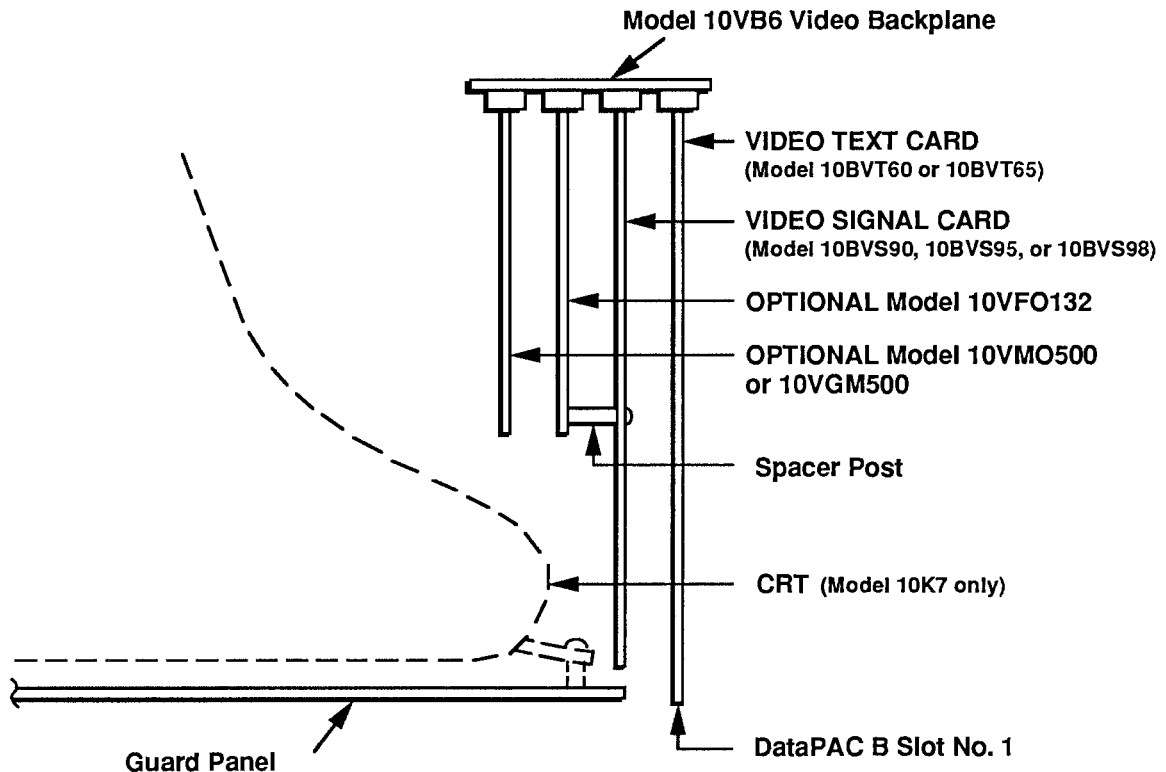


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All "B-sized" DataPACs with "video capability" will be equipped with appropriate SLOT CONNECTORS for TWO optional **Video ("V") Cards** whenever such cards are specified at the time of order. Located on the DataPAC's internal **VIDEO BACKPLANE**, these connections are immediately to the left of the DataPAC's VIDEO SIGNAL CARD, as viewed from the front of the unit (see the figures below).

a. DATAPAC MODELS 10K3, 10K6, AND 10K7*

FIG. 3.C.1.1 Video Backplane Slots for DataPAC Models 10K3, 10K6, and 10K7, as viewed from the top (drawing not to scale)



The DataPAC's VIDEO TEXT CARD (Model 10BVT60 or 10BVT65) will always occupy the right-most "V SLOT." Note that for the Models 10K6 and 10K7, this is also the DataPAC's "B SLOT" No. 1, and is accessible from the front of the unit.

To the immediate left of the Video Text Card will always be the DataPAC's VIDEO SIGNAL CARD (Model 10BVS90, 10BVS95, or 10BVS98). To access this card—and any optional V Card(s) installed to its left—you must first remove the DataPAC's front VIDEO GUARD PANEL. In the Model 10K6, this is simply a blank panel covering the left side of the B-Card rack. In the Model 10K7, the guard panel is attached to the CRT housing, which must also be removed in order to access any installed cards left of the Video Text Card.

If an optional **Model 10VFO132 Formatted Output Card** is present, it *must* be installed in the V Slot to the immediate left of the Video Signal Card, its component side facing leftward. **NO OTHER V CARD MAY OCCUPY THIS SLOT.**

* Or the corresponding "System 10/2000" models: 10KN3, 10KN6, and 10KN7.

3.C.1

INSTALLATION OF OPTIONAL "V CARDS"

If an optional **Model 10VMO500 Extended Video Option Card** or **Model 10VGM500 Video Graphics Memory Card** is present, it *must* be installed in the *second* V Slot to the left of the VIDEO SIGNAL CARD, its component side facing leftward. NO OTHER V CARD MAY OCCUPY THIS SLOT. (The Model 10VGM500 requires the Model 10BVS95 GRAPHICS VIDEO SIGNAL CARD.)

—IMPORTANT—

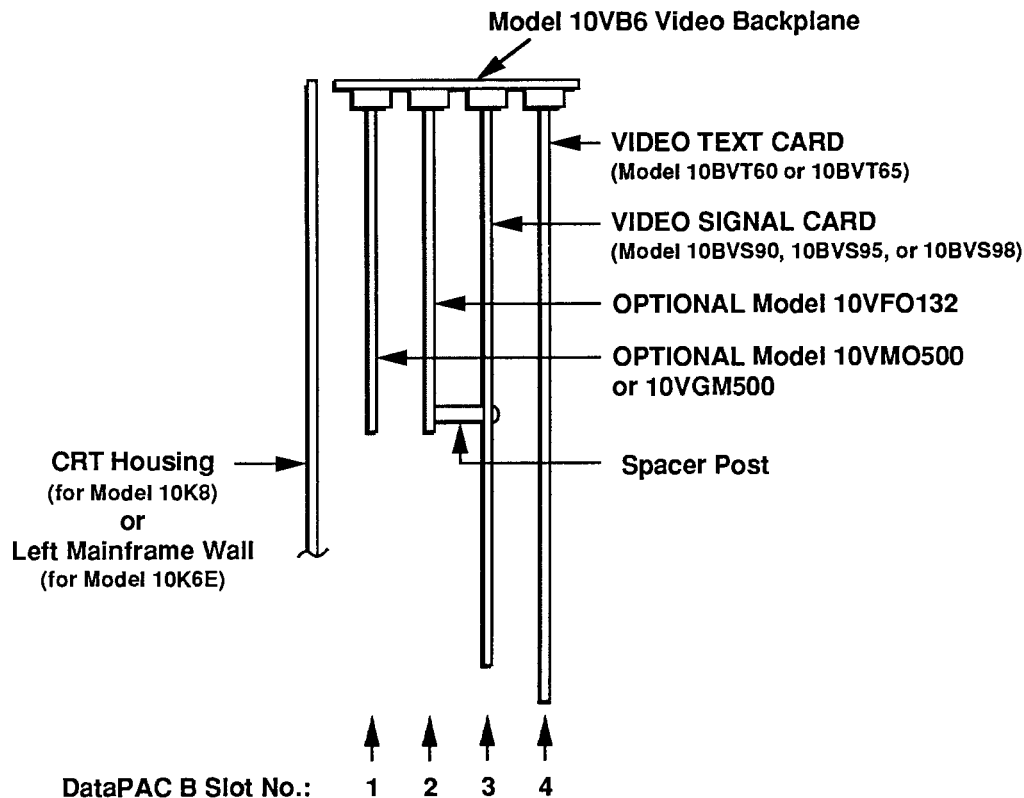
If installing a Model 10VMO500 or 10VGM500 by yourself, you should turn ON the DataPAC's EEPROM WRITE PROTECT SWITCH *before* turning on the power—but only the *first* time after installing the card.

The two remaining V SLOTS to the left of the 10VMO500 or 10VGM500 are for additional "video" cards.

b. DATAPAC MODELS 10K6E AND 10K8*

The above remarks apply equally to all versions of the Model 10K6E and 10K8 DataPACs, except that *all* V SLOTS are accessible from the front of the DataPAC, and *each* corresponds to a "B SLOT." For the Models 10K6E and 10K8, the VIDEO SIGNAL CARD will always take B SLOT No. 3; and the VIDEO TEXT CARD, B SLOT No. 4.

FIG. 3.C.1.2 Video Backplane Slots for DataPAC Models 10K6E and 10K8, as viewed from the top (drawing not to scale)



* Or the corresponding "System 10/2000" models: 10KN6(E) and 10KN8.

Section 3.C.2

Extended Video Memory
(Without Bargraph):
Model 10VMO500 Extended
Video Option Card



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As explained in Section 2.C.2 of this Guidebook, the Model 10VMO500 Extended Video Option increases your DataPAC's "video memory" to a total of 661 "blocks" of 64 bytes each.

The 10VMO500 *must* be installed in the *second* V SLOT to the left of the DataPAC's VIDEO SIGNAL CARD (see Section 3.C.1). It requires no other setup.

For the way in which the presence of a Model 10VMO500 affects the DataPAC's PAGE DIRECTORY, see Section 2.C.2(b). Fig. 2.C.2 shows how the DIRECTORY distinguishes between the DataPAC's original ("standard") video memory and the "extended" memory provided by the 10VMO500.

Section 3.C.3

Formattable Printer Output:

Model 10VFO132

Formatted Output Card



System 10 Guidebook

The **Model 10VFO132 Formatted Output Card** provides a special RS-232-C PRINTER INTERFACE PORT for instant hard-copy reproduction of any VIDEO PAGE FORMAT on display or in storage (including the DataPAC's standard PAGE DIRECTORY), with all appropriate "live" DATA VALUES, BIT-STATES, MESSAGES, and VIDEO PLAYBACKS. It can also transmit to a printer, in sequence, all existing VIDEO PAGE FORMATS within a specified Page-Number range. When dedicated by means of the **PRINTER TYPE (PTY)** command to an Epson or Epson-compatible printer, the 10VFO132 lets you print video pages containing *horizontal bargraphs* generated by an optional Model 10VGM500 Video Graphics Memory Card (see Section 3.C.4). Unused lines at the bottom of transmitted VIDEO PAGES can be suppressed, if desired.

In addition, the 10VFO132 permits the printing of "live" data for one, all, or a selected range of system DATA CHANNELS, along with specified "HEADER" and "TAILER" texts. These "HEADERS" and "TAILERS" are separate, precomposed VIDEO PAGE FORMATS. Via the **EOL** or **EOP** command, respectively, you can specify up to eight standard printer CONTROL CHARACTERS to be automatically transmitted at the end of each line or page of output.

The **TEMPLATE (TMP)** command lets you create a unique format "template" for the presentation of transmitted channel data. This template is a combination of variable DATA FIELDS and one or more portions of user-entered FIXED TEXT, in any desired order. Any DATA FIELD may contain Channel Number and/or LIMIT-ZONE Indicator Number ("1," "2," or "3"). The inclusion of terminating spaces in the template allows *columnar formatting* of printed data.

THE MODEL 10VFO132 MUST BE INSTALLED IN THE V SLOT TO THE IMMEDIATE LEFT OF THE DATAPAC'S VIDEO SIGNAL CARD (see Section 3.C.1).

----- PLEASE NOTE -----

The Model 10VFO132 requires special software when used with the **Model 10BVT65 (TOUCHSCREEN) Video Text Card**. If your system was shipped from the factory with both the 10VFO132 and 10BVT65 cards installed, then you need not concern yourself with compatibility problems. If you are adding a 10VFO132 to an existing system that contains a 10BVT65, CONTACT THE FACTORY FOR COMPLETE INSTRUCTIONS.

3.C.3.b

PRINTER INTERFACE SETUP

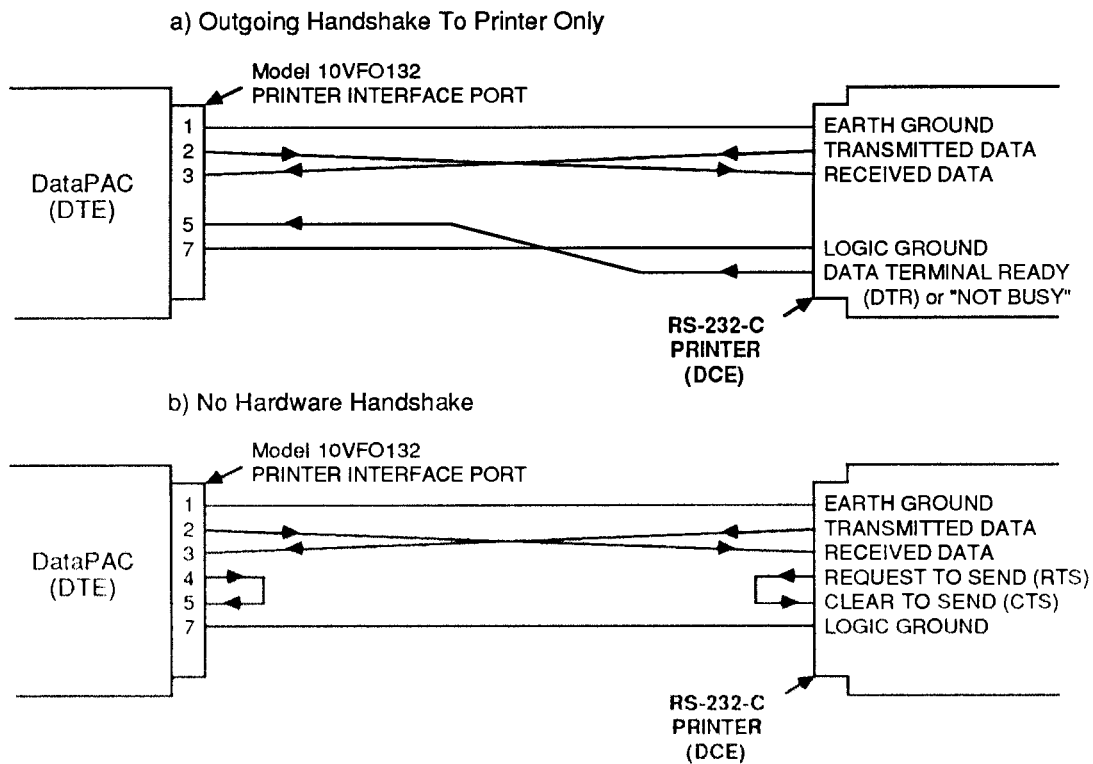
1. CONNECTIONS

The 10VFO132's PRINTER INTERFACE PORT employs the same 25-pin RS-232-C connector as the DataPAC'S COMPUTER INTERFACE PORT. The location of this connector in the rear of the DataPAC is shown in the appropriate figure in Section 1.A.2 of this Guidebook.

For general comments on RS-232-C cables and connections, see Section 2.B.2(a) of this Guidebook.

Suggested cabling between a 10VFO132-equipped DataPAC and a conventional RS-232-C printer or recorder is shown in Fig. 3.C.3.1, below—for both "outgoing handshake" and "no handshake" situations. Since different printers may assign the same I/O pin number to different interface functions, Fig. 3.C.3.1 shows the *functions* only. For corresponding pin numbers, consult the literature accompanying your specific receiving device.

Fig. 3.C.3.1 Suggested Connections for the Model 10VFO132 PRINTER INTERFACE PORT



2. SETTING RS-232-C INTERFACE PROTOCOL: PBR COMMAND

FOR PROPER DATA TRANSFER TO OCCUR BETWEEN THE 10VFO132 AND THE CONNECTED RECEIVING DEVICE, THE 10VFO132'S PRINTER INTERFACE PORT MUST BE SET TO CONFORM EXACTLY WITH THE PROTOCOL STIPULATED BY THE CONNECTED DEVICE. For an explanation of data-transfer "protocol," see Section 2.B.2(b) of this Guidebook.

ALSO, IF YOU ARE USING AN *EPSON* OR *EPSON-COMPATIBLE* PRINTER, YOU SHOULD MAKE SURE THAT THE 10VFO132 IS SET FOR A PRINTER "TYPE" OF "1" (see Section b.4, below).

You will use the **PRINTER BAUD RATE (PBR)** command to set the RS-232-C Baud rate and other data-link protocol values for the 10VFO132. The command has this form:

$$\mathbf{PBR = b, d, s, p [CR] *}$$

where

b is the BAUD-RATE selection code:

0 =	50	8 =	1800
1 =	75	9 =	2000
2 =	110	10 =	2400
3 =	134.5	11 =	3600
4 =	150	12 =	4800
5 =	300	13 =	7200
6 =	600	14 =	9600
7 =	1200	15 =	19.2K

d is the NUMBER OF DATA BITS (7 or 8)

s is the NUMBER OF STOP BITS (1 or 2)

p is the PARITY selection code:

0 = NONE; 1 = ODD; 2 = EVEN

3. SETTING INTERCHARACTER DELAY: ICD COMMAND

The characteristics of your receiving device may dictate that you set a *time delay* between successive *character* transmissions from the 10VFO132'S PRINTER INTERFACE PORT. To do so, apply the **INTERCHARACTER DELAY (ICD)** command:

$$\mathbf{ICD = s [CR] *}$$

where "s" is the selected delay period, as given in the following table. Note that these are approximate delay values only. "s" is initially set at "0" (no delay).

3.C.3.b

PRINTER INTERFACE SETUP

Table 3.C.3.1. Model 10VFO132 Intercharacter Delay Periods

"s" Value	Intercharacter Delay
0	0 microseconds
1	100 microseconds
2	240 microseconds
3	580 microseconds
4	1.4 milliseconds
5	3.4 milliseconds
6	8.2 milliseconds
7	20 milliseconds

4. SETTING PRINTER TYPE: PTY COMMAND

The **PRINTER TYPE (PTY)** command becomes especially important when you wish to use the Model 10VFO132 to print VIDEO PAGES containing HORIZONTAL BARGRAPHS generated via the optional **Model 10VGM500 Video Graphics Memory Card** (Section 3.C.4 of this Guidebook).

The form of the command is

PTY = n [CR] *

where "n" is a single-digit number greater than or equal to zero, corresponding to the "type" of printer you wish to use.

Possible values for "n" are presently as follows:

"n" = 0 : indicates any conventional serial printer (RS-232-C, ASCII) that is not an *Epson* or *Epson-compatible*;

"n" = 1 : indicates an *Epson* or *Epson-compatible* printer.

The 10VFO132 is initially set for a printer of "Type 0." A PRINTER OF "TYPE 1" IS RECOMMENDED FOR THE PRINTOUT OF BARGRAPH PAGES, AS EXPLAINED IN SECTION 3.C.4(d) OF THIS GUIDEBOOK.

1. PRINTING THE PAGE DIRECTORY: **CAT** COMMAND

To transmit from the 10VFO132's PRINTER INTERFACE PORT the DataPAC's PAGE DIRECTORY, enter a **CATALOG (CAT)** command:

CAT [CR]

The PAGE DIRECTORY is described in Section 2.C.2(b) of this Guidebook. It shows which of the DataPAC's 100 potential VIDEO PAGE FORMATS have already been formatted and entered into EEPROM storage.

2. THE **PRINT PAGE (PRI)** COMMAND

a. PRINTING A SELECTED VIDEO PAGE OR RANGE OF PAGES

You may transmit from the 10VFO132's PRINTER INTERFACE PORT any VIDEO PAGE No. *p* currently in EEPROM storage—with any and all appropriate "live" data values, bit states, MESSAGES, and VIDEO PLAYBACKS—by entering a **PRINT PAGE (PRI)** command of

PRI p [CR]

For this command to be effective, the specified VIDEO PAGE FORMAT must be an *existing* page whose Page Number *p* lies within the "legal" range of 1 through 100 (see Section 2.C.3 of this Guidebook).

A command of the form

PRI p TO q [CR]

will transmit from the PRINTER INTERFACE PORT, in sequence, all *existing* pages within the range from Page No. *p* to and including Page No. *q*. If this range contains Page Numbers to which no VIDEO PAGE FORMATS have been assigned, they will be ignored in the transmission sequence. Thus, simply by commanding

PRI 1 TO 100 [CR]

you can "dump" to the printer *all* formats currently contained in the VIDEO EEPROM, regardless of how many there actually are or of how they are numbered.

b. PRINTING THE CURRENTLY DISPLAYED VIDEO PAGE

To transmit from the 10VFO132's PRINTER INTERFACE PORT the VIDEO PAGE *currently on display*—with any and all appropriate "live" data values, bit states, MESSAGES, and VIDEO PLAYBACKS—command

PRI 0 [CR]

c. TRANSMITTING A CARRIAGE RETURN

To transmit a single CARRIAGE RETURN ([CR]) from the 10VFO132's PRINTER INTERFACE PORT, command

PRI [CR]

This command may be used for *vertical formatting* of printouts (see Section d, below).

3. CLEARING A "QUEUE" OF VIDEO PAGES: **CLQ** COMMAND

To clear a "queue" of pages *yet to be transmitted* by the 10VFO132, enter a **CLEAR QUEUE (CLQ)** command:

CLQ [CR]

The effect of this command is to terminate printing immediately, abrogating any and all unexecuted **PRINT PAGE (PRI)** commands in storage. A stored series of such commands might be the result, say, of triggering an **EXECUTE (EXU)** or **COMMAND (CMD)** sequence (see Section 2.K of this Guidebook).

1. SPECIFYING "END OF LINE" CONTROL CHARACTER(S): EOL COMMAND

The **END OF LINE (EOL)** command lets you specify one or more printer CONTROL CHARACTERS to be transmitted by the 10VFO132 at the end of each *line* of output produced in response to a **PRINT PAGE (PRI)** or **PRINT CHANNEL DATA (PRT)** command (PRT is discussed in Section e, below). The command has this form:

EOL = \$ [CR] *

where "\$" is a string of up to *eight* ASCII CONTROL CHARACTERS, which may include CARRIAGE RETURN ([CR]), LINE FEED ([LF]), FORM FEED ([FF]), etc. Each CONTROL CHARACTER must be represented in the "\$" string by a *hexadecimal word in brackets*. If two or more characters are entered, they should be within the same pair of brackets, with adjacent characters separated by a comma, as in the example below. Two-character hexadecimal equivalents for standard ASCII CONTROL CHARACTERS are given in Table 1.H.2, Section 1.H.3 of this Guidebook.

Thus, for example, a command of

EOL = [0D,0A] [CR] *

specifies an "end-of-line" termination of CARRIAGE RETURN, LINE FEED. The 10VFO132 is initially set for an "EOL" of "[0D,0A]" (i.e., [CR][LF]).

2. SPECIFYING "END OF PAGE" CONTROL CHARACTER(S): EOP COMMAND

The **END OF PAGE (EOP)** command lets you specify one or more printer CONTROL CHARACTERS to be transmitted by the 10VFO132 at the end of each *page* of output produced in response to a **PRINT PAGE (PRI)** or **PRINT CHANNEL DATA (PRT)** command (PRT is discussed in Section e, below). The command has this form:

EOP = \$ [CR] *

For "\$," see the **END OF LINE (EOL)** command, above.

Thus, for example, a command of

EOP = [0C,0A,0A,0D] [CR] *

specifies an "end-of-page" termination of FORM FEED, LINE FEED, LINE FEED, CARRIAGE RETURN.

The 10VFO132 is initially set for an "EOP" of "[0D,0A]" (i.e., [CR][LF]).

3. SUPPRESSION OF BLANK LINES: BLS COMMAND

To cause any VIDEO PAGE specified by a **PRINT PAGE (PRI)** command, above, to automatically suppress *all unused lines at the bottom of the page*, apply the following **BLANK LINE SUPPRESS (BLS)** command:

BLS = 1 [CR]

To *disable* the suppression of blank lines, command

BLS = 0 [CR]

1. THE PRINT CHANNEL DATA (PRT) COMMAND

You can use the following form of the **PRINT CHANNEL DATA (PRT)** command to transmit from the Model 10VFO132's PRINTER INTERFACE PORT the current data for system DATA CHANNEL No. x, along with specific "HEADER" and "TAILER" pages:

PRT PAG h, x, PAG t [CR]

Current channel "data" may include CHANNEL NUMBER and LIMIT-ZONE INDICATOR NUMBER (see the **TEMPLATE (TMP)** command, Section f.2, below). In the above command, "h" is the *Page Number* of the stored VIDEO PAGE to be used as a HEADER to the channel-data printout; "t" is the number of the page to be used as a TAILER. Both "h" and "t" must be *existing* pages, within the "legal" page-number range of 1 to 100.

Note that BLANK LINE SUPPRESSION (see above) is in effect automatically for all **PRT** outputs.

———— IMPORTANT ————

When composing HEADER and TAILER PAGES, bear in mind that every *single printed line* of a VIDEO PAGE transmitted in response to a **PRINT CHANNEL DATA (PRT)** command will represent *two* successive lines from the CRT display of that page. Suppose, for example, that the *display* of HEADER PAGE No. h includes these two successive lines of FIXED TEXT:

ABC CORP PRODUCT TEST DATA—RUN NO. 567
[4 SPACES]OPERATOR: JOHN SMITH

When *printed* in response to a **PRT** command, this text will appear as only *one* line:

ABC CORP PRODUCT TEST DATA—RUN NO. 567 OPERATOR: JOHN SMITH

REMEMBER: EVERY PAIR OF SUCCESSIVE LINES OF A DISPLAYED HEADER OR TAILER PAGE WILL CONSTITUTE ONLY *ONE* LINE OF THE PRINTED VERSION OF THAT PAGE. You will have to be careful, therefore, to compose line pairs whose *coupled line width* is less than or equal to the maximum line width specified for your particular printer.

To transmit the data for all scanned channels from Channel No. x to and including Channel No. y, along with specific HEADER and TAILER PAGES, command

PRT PAG h, x TO y, PAG t [CR] *

The **DEFAULT HEADER/TAILER (DHT)** command (given in Section e.2) lets you specify "DEFAULT" HEADER and TAILER PAGES to be printed when no other such pages are entered in the **PRT** command.

Thus, to transmit the data either for Channel No. x or for Channel Nos. x through y, along with the currently effective *DEFAULT* HEADER and TAILER PAGES, you need only command, respectively,

PRT x [CR] or **PRT x TO y [CR]**

If your DataPAC was shipped with the 10VFO132 installed, its *initial* and "*cold-boot*" *DEFAULT* PAGES are Page Nos. 98 (HEADER) and 99 (TAILER). Page No. 98 contains in its first line the reading of current system TIME (Channel No. 998) and DATE (Channel No. 999); Page No. 99's first

line contains the reading of current system TIME (Channel No. 999) only. The remainder of each page is blank. You can recompose these initial DEFAULT HEADER and TAILER PAGES, if desired, using the video formatting procedures given in Section 2.C.5.

If you want to transmit the data for *all scanned channels*—with the exception of Channel Nos. 998 (TIME) and 999 (DATE)—along with the currently effective *DEFAULT* HEADER and TAILER PAGES, simply command

PRT [CR]

Note that all printouts generated by any form of the **PRINT CHANNEL DATA (PRT)** command will incorporate the END-OF-LINE and END-OF-PAGE characters specified by the last-entered **EOL** and **EOP** commands (described in Sections d.1 and d.2, above). Note also that the **CHANNELS PER LINE (CPL)** and **TEMPLATE (TMP)** commands, discussed in Section f, below, allow precise formatting of the channel-data presentation for all forms of the **PRINT CHANNEL DATA (PRT)** command. Assuming a one-channel-per-line transmission format, the basic printout sequence will be

```

[HEADER PAGE]
[FIRST LINE OF CHANNEL DATA] [END-OF-LINE TERMINATOR]
[SECOND LINE OF CHANNEL DATA] [END-OF-LINE TERMINATOR]
.
.
.
[LAST LINE OF CHANNEL DATA] [END-OF-LINE TERMINATOR]
[TAILER PAGE]
[END-OF-PAGE TERMINATOR]
```

For specific examples, see the **TEMPLATE (TMP)** command, Section f.2.

2. SPECIFYING DEFAULT HEADER AND TAILER PAGES: DHT COMMAND

To specify "DEFAULT" HEADER and TAILER PAGES for the **PRINT CHANNEL DATA (PRT)** command *other than Page Nos. 98 and 99, respectively* (see above), enter the **DEFAULT HEADER/TAILER (DHT)** command:

DHT = h, t [CR] *

where "h" and "t" are the numbers of existing, "legal" VIDEO PAGE FORMATS.

3.C.3.f

FORMATTING OF CHANNEL-DATA PRINTOUTS

1. SETTING CHANNELS PER LINE: **CPL** COMMAND

To indicate the *maximum number of channels* to be included in each line of output produced by the 10VFO132 in response to a **PRINT CHANNEL DATA (PRT)** command (see above), you may enter a **CHANNELS PER LINE (CPL)** command during setup:

CPL = n [CR] *

where "n" (the maximum number of channels per line) may be any integer from 1 through 25 (it is initially set at 3).

2. DEFINING FORMAT "TEMPLATE": **TMP** COMMAND

By means of the **TEMPLATE (TMP)** command, you can create a format "template" for the presentation of channel data transmitted by the Model 10VFO132 in response to a **PRINT CHANNEL DATA (PRT)** command (see above). This command has a general form of

TMP = T [CR] *

The "template" expression "T" is a combination of FIXED TEXT and VARIABLE FIELDS, in *any desired order*. The FIXED TEXT may consist of any ASCII characters, *except double quotation marks (")*—these are not allowed in the actual *text* of the template expression.

The VARIABLE FIELDS are represented by *multiple entries* of the letters C, D, and L:

- You may enter a group of *up to three "C's,"* to indicate the position of a CHANNEL NUMBER within the data presentation.
- You may enter a group of *up to seven "D's,"* to indicate the position of a DATA FIELD.
- The letter "L" may be entered *once* to indicate the position of a LIMIT-ZONE INDICATOR NUMBER ("1" for data LESS THAN both limit values; "2" for data BETWEEN both limit values; "3" for data GREATER THAN both limit values—see the **LIMIT ZONE (LZN)** command, Section 1.H.2 of this Guidebook).

The total number of characters in the "template" expression "T" may not exceed 32. This maximum, however, may be further limited by other parameters—particularly the current "channels per line" (**CPL**) setting.

You should also keep in mind that any FIXED TEXT which contains a letter C, D, or L *must* be enclosed in *quotation marks* (to prevent the DataPAC from interpreting the letter as a VARIABLE FIELD indicator). See the second example, below.

In the following examples, assume that these 10VFO132 setup commands have already been applied (see Sections d.1 and d.2, above):

1. END-OF-LINE TERMINATOR: **EOL = [0D,0A]** (that is, [CR][LF])

2. END-OF-PAGE TERMINATOR: **EOP = [0A,0A]** (that is, [LF][LF])

Suppose, too, that *three channels per line* have been specified via the **CPL** command (see above). If we want each channel's data transmission to consist of

CHANNEL NUMBER (up to three digits)
 COMMA AND SPACE
 DATA FIELD (up to four characters)
 COMMA AND SPACE
 LIMIT-ZONE INDICATOR NUMBER (one digit)
 FOUR SPACES

then the following **TEMPLATE (TMP)** command should be entered:

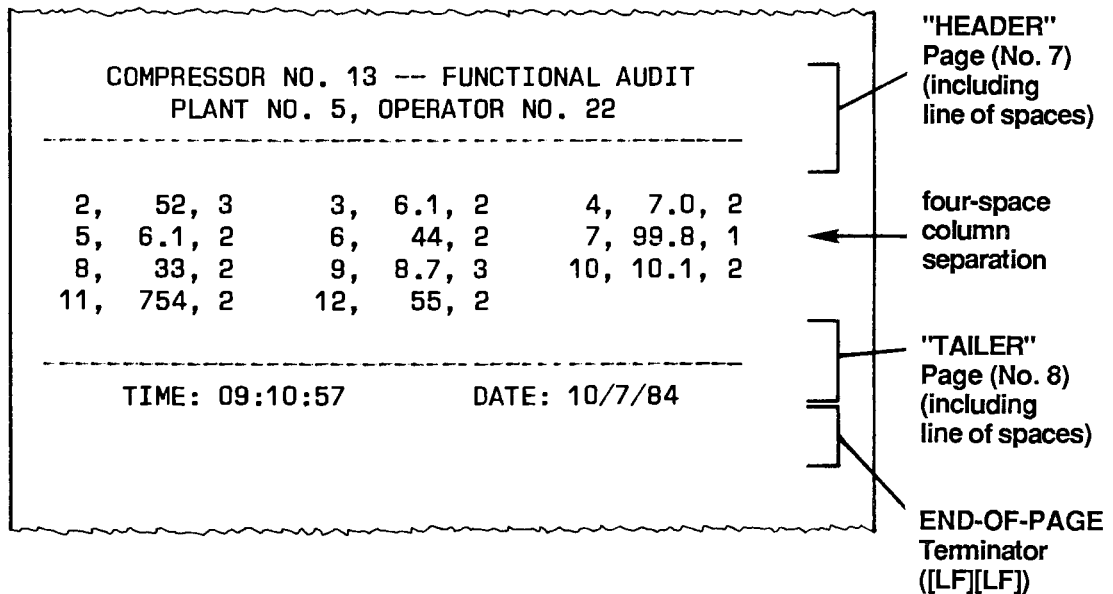
TMP = CCC,xDDDD,xLxxxx[CR] *

where "x" here represents entry of a *space character*. Upon application of

PRT PAG 7, 2 TO 12, PAG 8 [CR]

a printout like that shown in Fig. 3.C.3.2 will be generated. Typical **HEADER** and **TAILER** PAGES are included on the printout (these are Page Nos. 7 and 8, respectively).

Fig. 3.C.3.2



This example shows how the inclusion of *terminating spaces* in the **TMP** statement allows *columnar formatting* of printed data. Note, too, that **DATA FIELD** contents are always *right-justified* (leading zeros suppressed).

3.C.3.f

FORMATTING OF CHANNEL-DATA PRINTOUTS

As a second example, suppose that only *one* channel per line is specified via the **CPL** command. The following **TEMPLATE (TMP)** command is then entered:

```
TMP = "CHAN."xNO.xCC:xDDDxxxZONE:xL[CR] *
```

where, again, "x" represents a *space character*.

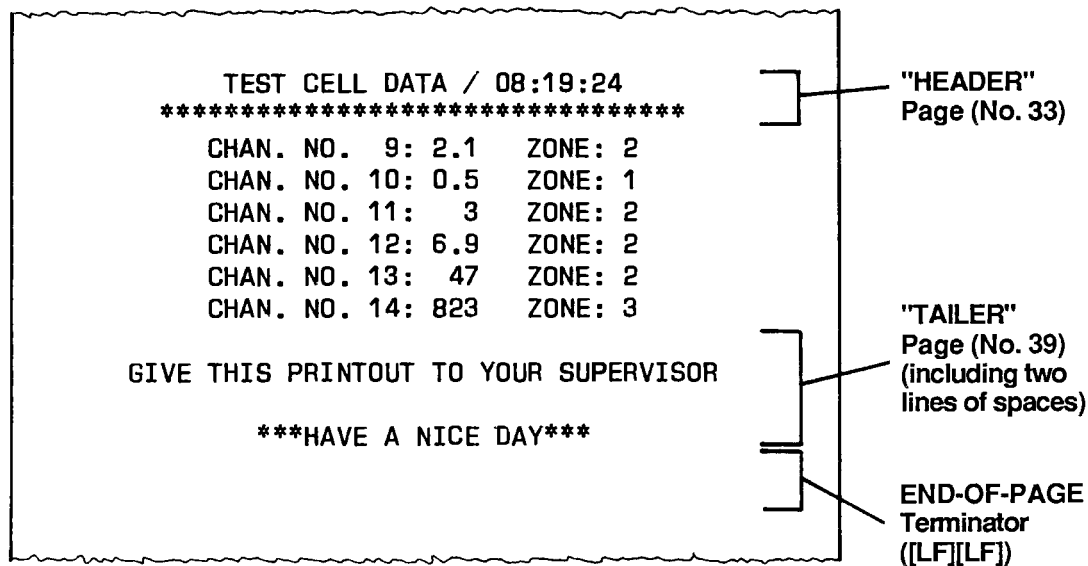
The word **CHAN.** in the template's FIXED TEXT must be entered in quotation marks, since it includes the letter **C** (which would otherwise be interpreted as a VARIABLE FIELD indicator). The word **ZONE:** need not be entered in quotes.

Upon application of

```
PRT PAG 33, 9 TO 14, PAG 39 [CR]
```

a printout of this form will be generated:

Fig. 3.C.3.3



Section 3.C.4

Video Bargraph Display: Model 10VGM500 Video Graphics Memory Card



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The Model 10VGM500 Video Graphics Memory Card has two main functions:

1. It provides the "memory extension" function of the Model 10VMO500 Extended Video Option Card, thus increasing the DataPAC's total video memory to 661 "blocks" of 64 bytes each.
2. It lets the user incorporate *horizontal bargraphs*, individually dedicated to selected system DATA CHANNELS, in any standard VIDEO PAGE FORMAT composed and stored via the keyboard operations discussed in Section 2.C of this Guidebook. There are six basic BARGRAPH types:
 - a. SOLID BAR WITH SCALE
 - b. SOLID BAR WITHOUT SCALE
 - c. UPWARD POINTER WITH SCALE
 - d. UPWARD POINTER WITHOUT SCALE
 - e. DOWNWARD POINTER WITH SCALE
 - f. DOWNWARD POINTER WITHOUT SCALE

For the first of the 10VGM500's two functions, see the discussion of the Model 10VMO500 in Section 2.C.2 of this Guidebook. The present section will only treat the BARGRAPH function of the 10VGM500. Note that we will be talking strictly of COLOR BARGRAPHS in this section; however, you may also use the 10VGM500 in a DataPAC with MONOCHROME display (such as the Model 10K7), in which case "colors" are replaced by corresponding "intensities" (see Section 2.C.5(d) for the color/intensity relationship).

Each 10VGM500-generated BARGRAPH is configured via simple keyboard commands during composition of the VIDEO PAGE in which it is to appear, just like any standard CHANNEL DISPLAY FIELD (DATA, BIT-STATE, MESSAGE, or VIDEO PLAYBACK). When the display is in "LIVE DATA" mode, each BARGRAPH will appear as an actual "bar" of color—or as an upward- or downward-directed "pointer"—moving against a background field of different color.

For each BARGRAPH you will first specify its size, its position on the page, and the individual DATA CHANNEL it is to represent. To specify BARGRAPH size, you will enter the desired *height* of the display line to contain the BARGRAPH and the desired *width* of each character in that line. The *length* of the BARGRAPH FIELD entered within the line must be greater than *nine* character spaces.

Prompted by a menu on the DataPAC display, you will then enter the BARGRAPH'S "type" (bar, upward pointer, downward pointer—with or without scale) and *range* ("data zero" and "data top"). If a BARGRAPH *with scale* is selected, you may further indicate the desired spacing of the graduation marks for that scale.

Like that of any standard DATA, BIT-STATE, or MESSAGE FIELD, the background/foreground color or intensity combination of each BARGRAPH will be continuously controlled by "STATUS"-defining commands entered by the user **STATUS (STS)**, **"BIT CONTROL" STATUS (VBC)**, **"GREATER THAN" STATUS (VGT)**, etc.). By this means, the BARGRAPH can be made to exhibit special *event-triggered visual effects*, including instant color changes, blinking, and "flashing."

When the DataPAC contains an optional **Model 10VFO132 Formatted Output Card** (Section 3.C.3), hard-copy printout of any BARGRAPH display is possible on any Epson or Epson-compatible printer.

———— NOTE ————

The Model 10VGM500 requires that the DataPAC contain the **Model 10BVS95 Graphics Video Signal Card**, which is an enhanced version of the Model 10BVS90. THE MODEL 10VGM500 MUST BE INSTALLED IN THE *SECOND V SLOT TO THE LEFT OF THE 10BVS95* (see Section 2.C.1 of this Guidebook).

3.C.4.b

SETTING "BVS" NUMBER: BVS COMMAND

To make certain that your system is set to accommodate the Model 10BVS95 Graphics Video Signal Card, you should initially enter a **B VIDEO SIGNAL (BVS)** command of

BVS = 95 [CR] *

(Similarly, a command of **BVS = 90 [CR] *** sets the system to accommodate the Model 10BVS90 Video Signal Card.)

PLEASE NOTE

Never establish more than *80* BARGRAPHS on any one VIDEO PAGE FORMAT. If you attempt to print a page containing more than 80 BARGRAPHS by means of the **Model 10VFO132 Formatted Output Card** (as explained in Section 3.C.4.d), the system may crash and need to be rebooted, in which case the printer setup may be lost.

You should think of each BARGRAPH as a special kind of "DATA FIELD," to be entered into the VIDEO PAGE FORMAT now being composed through a procedure similar to that for the entry of actual DATA FIELDS. See Section 2.C.5(e) of this manual for full details on DATA-FIELD entry.

REMEMBER THAT BEFORE ANY PAGE CAN BE COMPOSED, THE DATAPAC MUST FIRST BE PLACED IN THE "TEXT EDITOR" MODE BY PRESSING THE **Video Formt (VIDEO FORMAT)** KEY. TO EXIT "TEXT EDITOR" MODE AFTER A PAGE HAS BEEN SATISFACTORILY COMPOSED, PRESS THE **Exit** KEY (see Sections 2.C.5(b) and 2.C.5(j)).

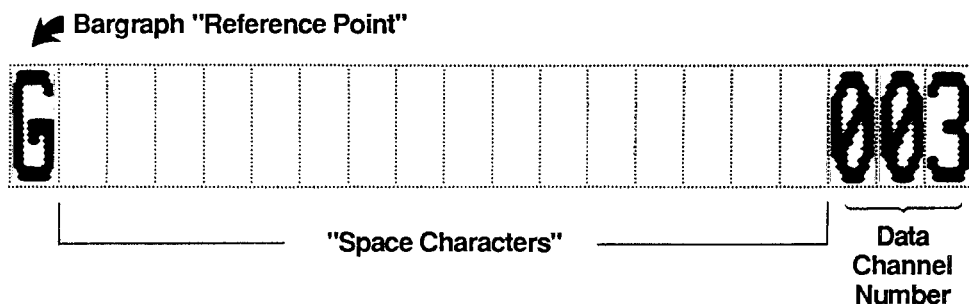
The procedure for establishing a BARGRAPH while in TEXT EDITOR MODE is as follows:

1. Move the cursor to the extreme left edge of the screen, at the vertical position of the display line that is to contain the BARGRAPH.
2. Set the *height* of the display line that is to contain the BARGRAPH, and the *width* of each character in that line, using the **Height** and **Width** keys, respectively, as explained in Section 2.C.5(c).
3. If any FIXED TEXT is to precede the BARGRAPH on this line, type in that text (for setting text color within a line, see Section 2.C.5(d)). If one or more CHANNEL DISPLAY FIELD(S) are to precede the BARGRAPH on this line, enter them via the appropriate procedure(s) given in Section 2.C.5.
4. Press the **Caps Lock** key. The key's red indicator light will go on when the keyboard is "locked" for CAPITAL LETTERS. The Model 10BVS95 GRAPHICS VIDEO SIGNAL CARD supports lower-case letters. It is necessary, however, to enter CAPITAL letters when defining a BARGRAPH.
5. Position the cursor at the "REFERENCE POINT" of the BARGRAPH to be entered. FOR A HORIZONTAL BARGRAPH, THE "REFERENCE POINT" IS THE *LEFT-MOST SPACE* OF THE BARGRAPH FIELD (see Fig. 3.C.4.1).
6. Press the **Begin Data** key.
7. Enter a CAPITAL letter "G." (Unless the **Caps Lock** key has been pressed, you will have to press **Shift** and hold it down as you press **G**).
8. Using the SPACE BAR, enter *spaces* to represent the BARGRAPH FIELD, but *three spaces fewer* than the total number you want for the field (see Fig. 3.C.4.1). THE TOTAL NUMBER OF SPACES FOR A BARGRAPH FIELD CANNOT BE FEWER THAN *NINE*.

Note that, while the DataPAC is in TEXT EDITOR MODE, the letter "G" will appear in the first space of the BARGRAPH FIELD (i.e., at the field's "REFERENCE POINT").

Note too that, while the DataPAC is in TEXT EDITOR MODE, each BARGRAPH will normally appear as *blue characters on a green background*, regardless of the command currently governing the "VISUAL EFFECTS" of the channel represented by the BARGRAPH.*

Fig. 3.C.4.1 Sample 20-Space Bargraph



* The "TEXT EDITOR" BARGRAPH FIELD color or intensity can be modified by means of the **DATA FIELD COLOR (DFC)** command.

3.C.4.c

ESTABLISHING A BARGRAPH IN A VIDEO PAGE FORMAT

9. Type in the three-digit Channel Number (001 through 997) of the system DATA CHANNEL to be represented by the BARGRAPH (Channel Nos. 998 and 999 are dedicated to system TIME and DATE, respectively, and cannot be represented by BARGRAPHS).

For example, if, as in Fig. 3.C.4.1, you need a *20-space* BARGRAPH to represent the data for system Channel No. 3, you should hit the SPACE BAR *seventeen* times and then type **003**. (Actually, the leading zeros are not necessary, and you can use one- or two-digit Channel Numbers if you wish, since $003 = 03 = 3$. THE IMPORTANT THING TO REMEMBER IS THAT REGARDLESS OF HOW MANY DIGITS IT CONTAINS, THE CHANNEL-NUMBER ENTRY MUST BE **RIGHT-JUSTIFIED**; THAT IS, ITS LAST DIGIT MUST OCCUPY THE LAST SPACE OF THE BARGRAPH FIELD. For this reason it is convenient to regard a Channel Number as a *three-digit* number, and to gauge the length of the BARGRAPH accordingly, as given in Step 8, above.)

10. Press the **End Data** key. The first BARGRAPH parameter ("DATA TOP") will now appear on the display BILLBOARD.
11. "DATA TOP" refers to the *upper data value of the desired range*—that is, the data reading you wish to correspond to the *right edge* of the BARGRAPH FIELD. The default value for this parameter, which will initially appear when **End Data** is pressed, will reflect a one-to-one relationship with the present *length* of the BARGRAPH. If, for example, the bar is 20 characters (= 160 pixels) long, its default DATA TOP will be "160."

Type in the desired DATA TOP for the BARGRAPH (6 digits maximum, plus decimal point and polarity sign; 8 digits maximum if no decimal point or sign). The entered value should reflect the engineering-unit scaling of the channel being represented by the BARGRAPH, and should match the *precision* of the channel's data reading.

To enter the DATA TOP value presently shown in the BILLBOARD, press CARRIAGE RETURN. The second BARGRAPH parameter ("DATA ZERO") will now appear in the BILLBOARD—unless the present difference between DATA TOP and DATA ZERO for the BARGRAPH is too small (see NOTE, below).

12. "DATA ZERO" refers to the *lower data value of the desired range*—that is, the data reading you wish to correspond to the *left edge* of the BARGRAPH FIELD. The default value for this parameter, which will initially appear when **End Data** is pressed, is "0."

Type in the desired DATA ZERO for the BARGRAPH (6 digits maximum, plus decimal point and polarity sign; 8 digits maximum if no decimal point or sign). The entered value should reflect the engineering-unit scaling of the channel being represented by the BARGRAPH, and should match the *precision* of the channel's data reading.

To enter the DATA ZERO value presently shown in the BILLBOARD, press CARRIAGE RETURN. The third and final BARGRAPH parameter ("TYPE") will now appear in the BILLBOARD—unless the present difference between DATA TOP and DATA ZERO for the BARGRAPH is too small.

———— NOTE ————

The *difference* between the DATA TOP and DATA ZERO of a BARGRAPH must be sufficiently large to allow calculation of data increments per pixel. If such is not the case, a message will appear on the display BILLBOARD, and the parameter you have attempted to enter will not be accepted.

13. For the "TYPE" entry, you will enter either a single CAPITAL letter ("A" through "F") or a CAPITAL letter ("A" through "F") *plus* an integral number from 0 through 80.

The following table shows the letter to be entered for each basic BARGRAPH "type."

Table 3.C.4.1.

Model 10VGM500 BARGRAPH "Types"	
BARGRAPH "Type"	"Type" Letter
UPWARD POINTER WITHOUT SCALE	A
SOLID BAR WITHOUT SCALE	B
SOLID BAR WITH SCALE	C
DOWNWARD POINTER WITHOUT SCALE	D
DOWNWARD POINTER WITH SCALE	E
UPWARD POINTER WITH SCALE	F

If you select a BARGRAPH *with scale*—i.e., a BARGRAPH with a "type" letter of "C," "E," or "F"—you may further indicate the desired spacing of the graduation marks for the scale by entering a number from 0 through 80 immediately after the letter designating the "type." This number will indicate the *number of characters separating adjacent marks* on the scale. Note that "0" and "1" are here equivalent; an entry of either "E0" or "E1," for example, designates a DOWNWARD POINTER WITH SCALE with a graduation mark every character. "F2" designates an UPWARD POINTER WITH SCALE with a mark every other character, and "C5" designates a SOLID BAR WITH SCALE with a mark every fifth character.

REMEMBER THAT THE GRADUATION INDICATOR NUMBER APPLIES ONLY TO BARGRAPHS OF "TYPE" LETTER "C," "E," OR "F." If no number is entered for such a BARGRAPH, a "0" is assumed, and the scale will have a graduation mark every character.

A BARGRAPH'S scale will always assume the same color as its "foreground" bar or pointer (see Section d.3, below). If the BARGRAPH is an UPWARD POINTER, the scale will be at the top of the bar; if a DOWNWARD POINTER, it will be at the bottom.

(Note that you can also create a BARGRAPH scale of any desired graduation and any desired (unchanging) color by entering it as FIXED TEXT in the line just above or below the BARGRAPH, representing each mark by a character such as the letter "I," a single quotation mark, a double quotation mark, etc.)

After you have typed in the letter (or letter-plus-number) corresponding to the desired BARGRAPH "type" (or "type"-plus-scale), finalize the entry by pressing CARRIAGE RETURN.

After a BARGRAPH "type" has been entered, the BILLBOARD will again display the first parameter (DATA TOP), with the last-entered value for this parameter. IF YOU WISH TO CHANGE THE PRESENTLY SPECIFIED DATA TOP, YOU MAY NOW DO SO. IF YOU WISH TO CHANGE EITHER OF THE OTHER TWO PARAMETERS (DATA ZERO AND "TYPE"), YOU MAY STEP TO THE NEXT PARAMETER IN THE SEQUENCE BY PRESSING CARRIAGE RETURN.

3.C.4.c

ESTABLISHING A BARGRAPH IN A VIDEO PAGE FORMAT

———— NOTE ————

IF AT ANY TIME DURING THE ENTRY OF BARGRAPH PARAMETERS YOU DECIDE NOT TO COMPLETE THE BARGRAPH DEFINITION PROCEDURE, YOU MAY ABORT THE DEFINITION SEQUENCE BY PRESSING THE **Ctrl (CONTROL)** KEY AND HOLDING IT DOWN AS YOU PRESS THE **End Data** KEY. Be sure to keep the **Ctrl** key down; pressing *only* the **End Data** key will have the effect of enacting the current definition (see Step 14, below).

Ctrl / End Data will NOT remove from the screen the BARGRAPH whose parameters you had been defining. It will simply bring you back to where you were before you pressed the **End Data** key the first time (Step 10, above)—i.e., the screen cursor at the last space of the BARGRAPH FIELD. To *delete* the BARGRAPH altogether, see the procedure in Section d.2, below.

14. Once you are satisfied with all BARGRAPH parameter assignments, press the **End Data** key.
15. You may now release the **Caps Lock** and enter any further FIXED TEXT or CHANNEL DISPLAY FIELDS to be contained in this line of display.

1. VIEWING AND MODIFYING BARGRAPH PARAMETERS

To review the defining parameters for an existing BARGRAPH, you should

- a. Enter TEXT EDITOR MODE by pressing the **Video Formt (VIDEO FORMAT)** key.
- b. Move the cursor to the "REFERENCE POINT" of the BARGRAPH in question (i.e., over the letter "G" that appears in the first space of the BARGRAPH FIELD).
- c. Press the **Begin Data** key. The first BARGRAPH parameter ("DATA TOP") will appear in the BILLBOARD.
- d. Proceed as in Section c, Steps 11, 12, and 13 (above), stepping through the parameter sequence by pressing CARRIAGE RETURN, and at the same time modifying any or all parameters as desired.
- e. Once you are satisfied with all BARGRAPH parameter assignments, press the **End Data** key.

2. DELETING A BARGRAPH

To delete a BARGRAPH from the currently displayed VIDEO PAGE FORMAT, you should

- a. Enter TEXT EDITOR MODE by pressing the **Video Formt (VIDEO FORMAT)** key.
- b. Move the cursor to the "REFERENCE POINT" of the BARGRAPH in question (i.e., over the letter "G" that appears in the first space of the BARGRAPH FIELD).
- c. Press the **End Data** key.

3. SETTING VISUAL EFFECTS FOR A BARGRAPH

See Section 2.C.12(b) of this manual. All comments made there concerning the control of "VISUAL EFFECTS" for a DATA FIELD apply equally to BARGRAPHS.

Note that if a BARGRAPH has a *scale*, the color of that scale will always be the same as that of the "foreground" bar or pointer (while the DataPAC is in "LIVE DATA" mode).

4. PRINTOUT OF BARGRAPH PAGES: PTY AND PRI COMMANDS

Printout of VIDEO PAGES (with or without BARGRAPH FIELDS) requires the **Model 10VFO132 Formatted Output Card**, which is treated in Section 3.C.3 of this Guidebook. To print a page that contains BARGRAPHS, you will use the **PRINT PAGE (PRI)** command, just as you would to print any VIDEO PAGE currently on display or in EEPROM storage (see Section 3.C.3(c) for details). The form of the printout, however, will depend on the "printer type" for which the 10VFO132 has been set via the **PRINTER TYPE (PTY)** command (Section 3.C.3(b.4)).

FOR PRINTOUT OF BARGRAPH PAGES, A PRINTER OF "TYPE 1"—THAT IS, AN *EPSON* OR *EPSON-COMPATIBLE* PRINTER—IS RECOMMENDED. Such a printer will yield exact hard-copy reproduction of HORIZONTAL BARGRAPHS of any of the six basic "types," just as they appear when displayed—except that printed bars will be proportionally shorter than displayed bars because of a necessary reduction of pixel-per-character width. A *line* will be printed either below or above each BAR or POINTER to indicate the *total length* of the BARGRAPH FIELD. Graduation marks will appear on this line when the BARGRAPH is a type "WITH SCALE." A "Type 1" printer also allows the printing of the following "special characters," which are not available with a "Type 0" printer: Δ (delta), $^{\circ}$ (degree), and \angle (angle).

3.C.4.d

OTHER BARGRAPH OPERATIONS

Note that a printer of "Type 0" (i.e., a conventional non-Epson serial ASCII printer) *may* be used for printout of BARGRAPHS. In this case, however, you should note the following:

- a. Each BAR in the printout will be represented by a series of *asterisks* (*), each of which corresponds to a "whole" screen character (8 pixels wide). A *number* will be printed at the end of a bar to indicate that at that point there are insufficient pixels to make another asterisk; the printed number indicates the number of pixels remaining over the last integral multiple of eight.
- b. POINTERS and SCALES will *not* be printed (a graph of the "POINTER" type will be represented by asterisks).
- c. The total length of the BARGRAPH FIELD will not be directly indicated on the printout.

Section 3.C.5

Video Touchscreen Operation: Model 10BVT65 Video Text Card

PLEASE NOTE

This manual section applies only to older "T" versions of the **Model 10KN6 Mainframe** (10KN6T, 10KN6-2T, 10KN6-3T, and 10KN6-4T).



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3.C.5.a

INTRODUCTION: BVT COMMAND

When installed in any version of the **Model 10K6TA or 10KN6T DataPAC**, the **Model 10BVT65 Video Text Card** permits TOUCHSCREEN OPERATION with regard to the display of the DataPAC's "RGB" or RS-170 VIDEO OUTPUT by a **Model 10VCM14T, 10VCMN14T, 10VCM19TA, or 10VCM19TV Color Monitor** (for VIDEO OUTPUT connections, see Section 2.N of this Guidebook).

THE MODEL 10BVT65 REQUIRES A **MODEL 10BVS95 VIDEO SIGNAL CARD**; IT WILL NOT WORK WITH A MODEL 10BVS90.

What "touchscreen operation" means is that you can make an operator-interactive "BUTTON" out of any DATA FIELD*, BIT-STATE FIELD, MESSAGE FIELD, or VIDEO PLAYBACK FIELD displayed on a given VIDEO PAGE.** To do so, you will specify—either during the initial *field-defining* procedure or subsequently, as a *field-editing* procedure—one or two "conditional" command strings, along with the specific system "conditions" under which each command string is to be "executable." Consisting of one or more standard MNEMONIC COMMANDS, each command string will be automatically executed whenever

- 1) THE BUTTON IN QUESTION IS TOUCHED (OR "PRESSED"), *AND AT THE SAME TIME*
- 2) THE SPECIFIED "CONDITION" FOR EXECUTION OF THAT COMMAND STRING IS OCCURRING.

By indicating a "condition" of "ANY," you can cause a given command string to be executed whenever its BUTTON is "pressed," regardless of current system conditions.

When establishing a given DISPLAY-FIELD "BUTTON," you will also specify the desired DURATION OF CONTACT for the BUTTON—i.e., the period of time the BUTTON must be continuously "pressed" before evaluation of present system conditions and execution of command(s) (if allowed by these conditions) will take place. Expressed in tenths of a second, the contact period can be as short as "zero" seconds and as long as 5 seconds.

NOTE: The **BVT (BVT)** command lets you ask your DataPAC whether or not a Model 10BVT65 is present. If the DataPAC contains a 10BVT65, it will reply to an interrogation of

BVT [CR]

with an answer of **65**; if the Model 10BVT60 is present, NO answer will be returned.

* Including any HORIZONTAL BARGRAPH generated by an optional Model 10VGM500 Video Graphics Memory Card (see Section 3.C.4).

** **NOTE:** IF THE DATA FIELD, BIT-STATE FIELD, MESSAGE FIELD, OR VIDEO PLAYBACK FIELD HAS ONE OR TWO REGIONS OF "ASSOCIATED FIXED TEXT" (see Section 2.C.5(i)), THIS TEXT WILL BE PART OF THE COMPLETE "BUTTON." This feature lets you create a BUTTON labelled by a word or words, which can be "associated" to, say, a blank MESSAGE FIELD.

----- ALSO NOTE -----

The **Model 10VFO132 Formatted Output Card** (Section 3.C.3) requires special software when used with the Model 10BVT65. If your system was shipped from the factory with both the 10VFO132 and 10BVT65 cards installed, then you need not concern yourself with compatibility problems. If you are adding a 10BVT65 to an existing system that contains a 10VFO132, CONTACT THE FACTORY FOR COMPLETE INSTRUCTIONS.

1. SETTING TOUCHSCREEN TYPE: **TST** COMMAND

The purpose of the **TOUCHSCREEN TYPE (TST)** command is to inform the DataPAC of the "type" of touchscreen to be used. At present, the only operative touchscreen "type" is that employed by the Models 10VCM14T, 10VCMN14T, 10VCM19TA, and 10VCM19TV Color Monitors. This is designated as "Type "1." The only effective form of this SETUP COMMAND, at present, is thus

TST = 1 [CR] *

2. ENABLING THE TOUCHSCREEN: **BON** AND **BOF** COMMANDS

To enable the touchscreen, enter a **BUTTONS ON (BON)** command of

BON [CR]

THIS COMMAND IS IN EFFECT, BY DEFAULT, ON DATAPAC POWERUP.

To disable the touchscreen—if, for example, you did not wish the operator to be able to activate any **BUTTONS**—enter a **BUTTONS OFF (BOF)** command of

BOF [CR]

3. RECALIBRATING THE TOUCHSCREEN: **CAL** COMMAND

Every 10VCM14T and 10VCM19TA touchscreen will have been precalibrated, at the factory, prior to shipment. If at any point you observe that a **BUTTON'S** area of activation fails to coincide with its displayed field, you can very simply *recalibrate* the entire screen by applying the **CALIBRATE (CAL)** command:

CAL [CR] *

NOTE THAT *THE DATAPAC'S EEPROM MUST BE ENABLED* IN ORDER TO STORE THE NEWLY ESTABLISHED CALIBRATION COEFFICIENTS.

The **CAL** command will initiate the calibration sequence by temporarily replacing the VIDEO PAGE on display with the TOUCHSCREEN CALIBRATION PAGE. IF AT ANY POINT YOU WISH TO ABORT THE CALIBRATION PROCEDURE, SIMPLY PRESS ANY KEY ON THE DATAPAC'S PLUG-IN KEYBOARD.

The CALIBRATION PAGE will instruct you to "TOUCH CURSOR UNTIL BLINKING STOPS." By touching each of the nine CURSOR spaces as they sequentially appear on the display, you will define the four quadrants of the screen. As instructed, continue to touch each space until it stops blinking and the next space in the sequence appears. TO REDUCE PARALLAX DEVIATIONS, BE SURE THAT YOU ARE VIEWING THE SCREEN FROM APPROXIMATELY THE SAME ANGLE AS THAT FROM WHICH IT IS "NORMALLY" VIEWED. ALSO, TOUCH EACH CURSOR SPACE AS SQUARELY AND PRECISELY AS YOU CAN, KEEPING YOUR FINGER PERPENDICULAR TO THE SCREEN TO MINIMIZE THE ACTUAL FINGERTIP CONTACT AREA.

When all nine calibration points have been touched, the previously displayed VIDEO PAGE will reappear.

For instructions on the entering of DATA FIELDS, BIT-STATE FIELDS, MESSAGE FIELDS, and VIDEO PLAYBACK FIELDS, and on the setting of appropriate VISUAL EFFECTS for these fields, see Sections 2.C.5 (e through h) and 2.C.12 (b through e) of this Guidebook. *Duplication* of a given line of display by means of the *tilde* ("~") key is discussed in Section 2.C.4(h) of this Guidebook. Note here that if the line to be duplicated contains one or more BUTTONS, you must press the **Ctrl (CONTROL)** key and hold it down as you press "~," in order to duplicate the line's BUTTON(S) along with its other contents.

NOTE ALSO: NO MORE THAN 40 BUTTONS MAY BE PUT ON ANY GIVEN VIDEO PAGE.

1. SETTING BUTTON "DURATION" PERIOD

As explained in Section 2.C.5, the last step in defining a DISPLAY FIELD of any type is to press the **End Data** key. Once you have done so, "**DUR N/A**" will appear in the BILLBOARD.

IF YOU DO NOT WANT THE NEWLY ESTABLISHED DISPLAY FIELD TO FUNCTION AS A COMMAND-EXECUTING "BUTTON," YOU NEED ONLY PRESS **End Data** ONCE AGAIN TO RETURN TO "TEXT EDITOR" MODE.

IF YOU WANT THE FIELD TO BE A BUTTON, you must enter its DURATION definition, which has two parts. First enter via the keyboard a number from 0 through 50, indicating the multiple of *tenths of a second* that is to constitute the BUTTON'S "DURATION" PERIOD, FOLLOWED BY A COMMA. The second part of the DURATION definition is the specification of a BUTTON "TOUCH ACKNOWLEDGMENT" VISUAL EFFECT. For this, enter a conventional two-or-three-character "STATUS" code, as given in Table 2.C.3 of Section 2.C.12(a), indicating the foreground/background color or intensity combination—plus optional "blinking" or "flashing"—to be in effect for the BUTTON field as long as it is actually "pressed."

For example, if the BUTTON is to "pressed" for 2 seconds before evaluation of its "conditionals" occurs, and if you also want a TOUCH ACKNOWLEDGEMENT of *flashing red on blue*, enter a "DUR" value of **20,RBF**, followed by CARRIAGE RETURN ([CR]). Once the terminating [CR] is entered, the first "conditional" prompt will appear in the BILLBOARD, and the actual DISPLAY FIELD will change to the foreground/background color or intensity combination specified by the last **BUTTON FIELD COLOR (BFC)** command (Section 3.C.5(d.1), below). If there is to be no effective delay between "pressing" and evaluation, you would enter **0** for the first part of the "DUR" value.

----- IMPORTANT -----

When a BUTTON's color changes to the specified "ACKNOWLEDGEMENT" color, it means only that the BUTTON has been "pressed," and NOT that the specified command or commands have been executed. *The BUTTON's "conditionals" will not be evaluated until the DURATION period has fully elapsed.* Therefore, if you remove your finger from the BUTTON before the end of the DURATION period, the conditionals will not be evaluated at all, and the corresponding commands will not be executed.

A DataPAC CRT's *refresh rate* may be set by means of the **REFRESH (REF)** command, as explained in Section 1.G.5(b) of this Guidebook. Keep in mind that this rate can affect the appearance of a BUTTON'S "TOUCH ACKNOWLEDGMENT" VISUAL EFFECT. If a relatively long refresh rate is in effect and only a short DURATION is required, you may in fact not even see the acknowledgment before the BUTTON'S function or functions are executed.

To establish a 10VGM500-generated BARGRAPH FIELD as a BUTTON:

- a. If you are creating a new BARGRAPH, follow the procedure given in Section 3.C.4.c of this Guidebook, beginning by pressing the **Begin Data** key and ending by pressing the **End Data** key. Then press **Begin Data** once again.
 If you are making a BUTTON out of an existing BARGRAPH, move the cursor *to the first space to the immediate right of the BARGRAPH* and press **Begin Data**.
- b. Set the BUTTON'S "DURATION" period, "CONDITIONALS," and "EXECUTES" as explained in this section.
- c. Establish the BUTTON by pressing **End Data**.

2. SETTING BUTTON "CONDITIONALS"

For each BUTTON you can define two "conditionals," each of which takes an "IF . . . , THEN . . ." form. This lets you set up alternative command-string executions for typical bistate system situations (e.g., **IF BIT NO. 314 IS AT LOGIC 1 WHEN THE BUTTON IS PRESSED, THEN SET LOGIC OUTPUT PORT NO. 10 AT LOGIC 1; IF BIT NO 314 IS AT LOGIC 0 WHEN THE BUTTON IS PRESSED, THEN SET LOGIC OUTPUT PORT NO. 12 AT LOGIC 1 AND CAUSE MESSAGE NO. 3 TO READ "WARNING!"**).

After the "DURATION" value has been set, the BILLBOARD will display "**1** IF N/A" (the "N/A" indicates that no "**1** IF" statement is currently in effect for the BUTTON). Here you will enter the BUTTON's first "IF" statement as a Boolean expression of up to 32 characters, employing the following MNEMONICS and the operators "*" (AND) and "+" (OR):

To specify the condition that:	Use MNEMONIC:
A bit is HIGH (at a Logic 1 state)	BIT
A bit is LOW (at a Logic 0 state)	/BIT
A channel's data is in the " GREATER THAN " LIMIT ZONE	ZGT
A channel's data is NOT in the " GREATER THAN " LIMIT ZONE	/ZGT
A channel's data is in the " LESS THAN " LIMIT ZONE	ZLT
A channel's data is NOT in the " LESS THAN " LIMIT ZONE	/ZLT
A channel's data is in either ZONE OF VIOLATION (i.e., <i>outside</i> the "BETWEEN" LIMIT ZONE)	ZVO
A channel's data is NOT in either ZONE OF VIOLATION	/ZVO
[NO CONDITION]	ANY

For example, the term **BIT 66** means "when Bit No. 66 is high"; **ZGT 201** means "when data for Channel No. 201 is in the 'GREATER THAN' LIMIT ZONE"; **/ZVO 8** means "when Channel No. 8 does NOT lie in either the 'GREATER THAN' or 'LESS THAN' LIMIT ZONE."

Entering "**ANY**" for "**1** IF" means that the command(s) you will enter for "**1** THEN" (below), will be "unconditionally" executed whenever the BUTTON is pressed—i.e., regardless of the present state of the system.

Here are a few typical "IF" statements:

ZLT 10 + ZLT 11

3.C.5.c

ESTABLISHING DISPLAY BUTTONS

(= IF data for EITHER Channel No. 10 OR Channel No. 11 is in the respective "LESS THAN" LIMIT ZONE. NOTE THAT IN THIS CASE, WHERE SUCCESSIVE TERMS IN THE BOOLEAN EXPRESSION HAVE THE SAME MNEMONIC ("ZLT"), YOU NEED ONLY WRITE A SINGLE MNEMONIC WITH MULTIPLE ARGUMENTS:

ZLT 10 + 11

In fact, the DataPAC will condense such expressions for you automatically, so that **BIT 0 * BIT 1 * BIT 4**, for example, will appear in the BILLBOARD as **BIT 0 * 1 * 4**;

BIT 689 * ZVO 72

(=IF Bit No. 689 is at *Logic 1* AND a limit violation is occurring for Channel No. 72);

BIT 689 + /BIT 101 * /ZVO 72

(=IF EITHER Bit No. 689 is at *Logic 1* OR Bit No. 101 is at *Logic 0* AND at the same time data for Channel No. 72 lies in the "BETWEEN" LIMIT ZONE).

NOTE: TO FINALIZE ENTRY OF THE "1) IF" STATEMENT, YOU NEED TO PRESS CARRIAGE RETURN ([CR] TWICE. PRESSING [CR] THE FIRST TIME ALLOWS YOU TO GO BACK AND EDIT THE EXPRESSION YOU HAVE JUST TYPED IN (USE THE **Back Space** or **Left ARROW** KEY TO MOVE THE CURSOR TO THE LEFT; USE THE **Right ARROW** KEY TO MOVE IT TO THE RIGHT); PRESSING [CR] THE SECOND TIME "ENTERS" THE EXPRESSION. The BILLBOARD will now display "1) THEN N/A."

3. SETTING BUTTON "EXECUTES"

You should now enter the command or commands you wish to be executed when the BUTTON is touched AND the statement "1) IF" is then evaluated as "true" (REMEMBER: A CONDITION OF "ANY" IS ALWAYS TRUE). The "1) THEN" complement to the "1) IF" statement is identical in form to the command string you would enter in an **EXECUTE (EXU)** command (see Section 2.K.2). It is a string of up to 32 ASCII characters, literally stating any command or commands that the DataPAC can recognize, with adjacent commands separated by a *colon* (:).

If, for example, by "pressing" the BUTTON you want to release the "latch" of Bit No. 97 and also to increment by "1" the number reported by DOWNLOAD PSEUDOCANNEL No. 233—given that the corresponding statement "1) IF" is "true"—you should enter for "1) THEN"

RLS 97 : INC 233

Again, you will have to press CARRIAGE RETURN *twice* to enter the command(s) you type in at the "1) THEN" prompt.

You will then see in the BILLBOARD the "2) IF N/A" prompt, for the BUTTON'S second conditional. IF YOU DO NOT WISH TO USE THE SECOND "IF . . . , THEN . . ." FUNCTION, JUST PRESS THE **End Data** KEY TO RETURN TO "TEXT EDITOR" MODE. Otherwise, enter the desired "2) IF" statement and its "2) THEN" command-string complement, just as you did above for the first conditional.

If you need to modify a previous entry, you can cycle through the series of existing "1) IF," "1) THEN," "2) IF," and "2) THEN" entries by repeatedly pressing CARRIAGE RETURN (the **Back**

Space key will move you backwards through the series). When all entries are satisfactory, press the **End Data** key to establish the BUTTON and return to "TEXT EDITOR" MODE.

You can subsequently *edit* an established BUTTON'S "DURATION" setting and any of its "IF" and "THEN" statements by entering "TEXT EDITOR" MODE, moving the cursor to the *leftmost* space of the DISPLAY FIELD in question, pressing **Begin Data**, and using CARRIAGE RETURN to step through the series, while making any desired changes via the keyboard (use the **Back Space** or **Left ARROW** key to move the cursor to the left; use the **Right ARROW** key to move it to the right). To *cancel* any given entry, change it to "N/A." Note, however, that a "DUR" setting of "N/A" cancels the BUTTON function altogether, and that a "THEN" statement with a corresponding "IF" of "N/A" is not meaningful, and will not be executed.

NOTE TOO THAT WHEN A BUTTON IS "PRESSED"—AND THE SPECIFIED "DURATION," IF ANY, HAS ELAPSED—THE DATAPAC WILL EVALUATE *BOTH* CONDITIONALS FOR "TRUE-NESS" OR "FALSENESS" *BEFORE EXECUTING ANY COMMANDS*. You can not therefore "chain" the two conditionals such that the execution of "1) THEN" affects the evaluation of "2) IF," since the evaluation in every case precedes the execution.

3.C.5.d

HIGHLIGHTING & DISABLING BUTTONS ON A PAGE

1. SETTING BUTTON HIGHLIGHT COLOR: **BFC** COMMAND

To specify a foreground/background color or intensity combination for the display of every **BUTTON** on the current **VIDEO PAGE** either upon application of a **SHOW BUTTON LOCATIONS (SBL)** command (see below) or upon entry of "TEXT EDITOR" MODE, you can use the **BUTTON FIELD COLOR (BFC)** command. This is a **SETUP COMMAND** of the form

BFC = c [CR] *

where "c" is a two-character **COLOR/INTENSITY** code, as given in Table 2.C.2, Section 2.C.11, of this Guidebook.

2. HIGHLIGHTING PAGE BUTTONS: **SBL** COMMAND

The **SHOW BUTTON LOCATIONS (SBL)*** command is a **RUN-TIME COMMAND** that allows you to see, at any time, which **DISPLAY FIELDS** of the **VIDEO PAGE** on display are presently functioning as **BUTTONS**. Thus, when a command of

SBL [CR]

is entered, all **BUTTONS** on the displayed page will assume the color/intensity specified by the last-entered **BUTTON FIELD COLOR (BFC)** command (above), overriding any and all other color-controlling factors for their respective **DISPLAY FIELDS** (**LIMIT LOGIC**, etc.).

To *cancel* **BUTTON** highlighting, simply press any key on the **DataPAC's** plug-in keyboard.

3. DISABLING PAGE BUTTONS: **CLS** COMMAND**

By entering a **CLEAN SCREEN (CLS)** command of

CLS = n [CR]

you can temporarily disable all active **BUTTONS** on the currently displayed **VIDEO PAGE** for "n" seconds ($1 \leq n \leq 60$), so that you may clean the **CRT** screen with no danger of inadvertently "pressing" a **BUTTON**. During the **CLS** period, the **BILLBOARD** will display the time remaining before all **BUTTONS** are automatically re-enabled.

* In 10BVT65 software versions earlier than 11.3, this command was called **SHOW BUTTONS (SBS)**.

** Not present in 10BVT65 software versions earlier than 11.3.

PLEASE NOTE the following section- and figure-reference corrections for **Section 3** of this Guidebook:

When you are told to refer to:

You should actually refer to:

Section 1.B

Section 1.A.3

Section 1.C

Section 4 of the appropriate
"On the Air" Booklet

Section 1.D

Section 5 of the appropriate
"On the Air" Booklet

Fig. 1.E.1 (Section 1.E.1)

Fig. 1.5 (Section 1.E.1)

Fig. 1.E.2 (Section 1.E.1)

Fig. 1.6 (Section 1.E.1)

Section 1.F.1

Section 1.F.2

Section 1.F.2

Section 1.F.3

Section 1.G.2

Section 1.G.1

Section 1.G.7

Section 1.G.6

Appendix B

Section 1.B

Section 3.B

Special "B-Card" Functions

The following sections contain instructions for the setup and operation of optional System 10 "B Cards."

Section 3.B.1

"Attaching" a DataPAC
Command Source to a
Specific B Card: **ATT**, **DET**,
and **VIA** Commands



System 10 Guidebook

"ATTACHING" A DATAPAC COMMAND SOURCE TO A SPECIFIC B CARD: ATT, DET, AND VIA COMMANDS

3.B.1

The **ATTACH (ATT)** command lets you communicate one or a series of mnemonic commands *exclusively* to a single specified B CARD.

Directly "attaching" one of the DataPAC's two standard "command sources" (i.e., plug-in keyboard or COMPUTER INTERFACE PORT) to an INTERFACE PORT associated with a given B CARD, **ATTACH (ATT)** is principally used during setup of an AUXILIARY COMPUTER INTERFACE furnished by the Model 10BACI. See Section 3.B.5(c) for specific details and examples.

The *general* form of the **ATTACH (ATT)** command is

ATT = s [CR]

where "s" is the number of the SLOT occupied by the B CARD to be "attached" either to the DataPAC's keyboard or to its COMPUTER INTERFACE PORT.

If the above command is entered via the DataPAC's plug-in keyboard, then the card in B SLOT No. s will be exclusively "attached" to the keyboard. That is, all subsequent keyboard-entered MNEMONIC COMMANDS will be received only by this card, and will be ignored by all other cards. Commands entered via the COMPUTER INTERFACE PORT, however, will in this case continue to be received by all cards.

If the above command is entered via the COMPUTER INTERFACE PORT, then the card in B SLOT No. s will be exclusively "attached" to the COMPUTER INTERFACE PORT. Commands entered via the keyboard, however, will in this case continue to be received by all cards.

Note that **ATTACH (ATT)** is a "RUN-TIME" COMMAND, and may therefore be applied at any time during normal operation.

The **DETACH (DET)** command serves to cancel the **ATTACH (ATT)** command. Thus, to "detach" the B CARD presently "attached" to either the DataPAC's plug-in keyboard or its COMPUTER INTERFACE PORT, command, *via the keyboard or COMPUTER INTERFACE PORT, respectively*

DET [CR]

Prior to the first **ATT** command—or following a **DET** command—an interrogation of **ATT [CR]** will return an answer of "0" (zero), indicating that no B SLOT is currently "attached" to the command source from which the interrogation originates.

The **VIA (VIA)** command serves as a "one-line" **ATTACH (ATT)** command. Thus, by commanding

VIA s, \$ [CR]

you can route a *single* standard MNEMONIC COMMAND "\$" directly and exclusively to the B CARD occupying B SLOT No. s, without having first to "attach" that SLOT to the keyboard or COMPUTER INTERFACE PORT by means of an **ATTACH (ATT)** command. **VIA** is used principally to route individual commands to an AUXILIARY COMPUTER INTERFACE PORT (see Section 3.B.5(d.2)).

Section 3.B.2

Logic and Digital I/O: Model 10BIO-16 Universal Logic I/O Card



System 10 Guidebook

The **Model 10BIO-16 Universal Logic I/O Card** provides sixteen optically isolated LOGIC I/O PORTS. Each LOGIC I/O PORT can be designated as either INPUT or OUTPUT. INPUT and OUTPUT ports may be intermixed as desired.

Logic INPUTS are accepted by the 10BIO-16 directly from dry contacts (switches, relays, etc.). INPUTS and OUTPUTS are compatible with TTL and other solid-state logic systems. Note that all OUTPUT levels are *negative true* (i.e., GROUND when at *Logic 1* ("VCC"); +5 V-DC when at *Logic 0*).

Logic I/O Interface Specifications:

General: Optically isolated logic; isolated +5 V Reference Power Supply provided; maximum current is 200 mA, total; external reference supply may be used; allowable VCC range is +5 to +15 V

As Input: CMOS-device input with internal 100-kilohm pull-up to VCC ("Logic 1"); may be driven by TTL, LSTTL, CMOS (+5 V), or through dry contacts to Isolated Common

As Output: Open-collector current sink with internal 100-kilohm pull-up to VCC; maximum sink current is 50 mA per output

3.B.2.b

10BIO-16 CONNECTIONS

The Model 10BIO-16 uses the 18-terminal LOGIC I/O CONNECTOR shown in Fig. 3.B.2.1(a) (this is Daytronic Connector No. 65284.1). It provides screw terminals for direct connection to process logic devices.

Above the terminal block are two pins which, when connected by a jumper supplied with the 10BIO-16, cause the card's INTERNAL ISOLATED 5-VOLT DC supply to be applied to the "VCC" input. When the jumper is absent, you must supply your own EXTERNAL POWER SUPPLY (+5 to +24 V-DC) to the "VCC" terminal.

Typical logic connections are shown in Fig. 3.B.2.1(b).

Note that ALL *UNUSED* LOGIC INPUTS SHOULD BE "DESENSITIZED" BY TYING THEM ALL TO COMMON (GROUND). Otherwise, the logic-activity indicator lights for these lines could blink during normal operation, from pickup of stray voltages.

Fig. 3.B.2.1(a) 18-Terminal Logic I/O Connector (No. 65284.1)

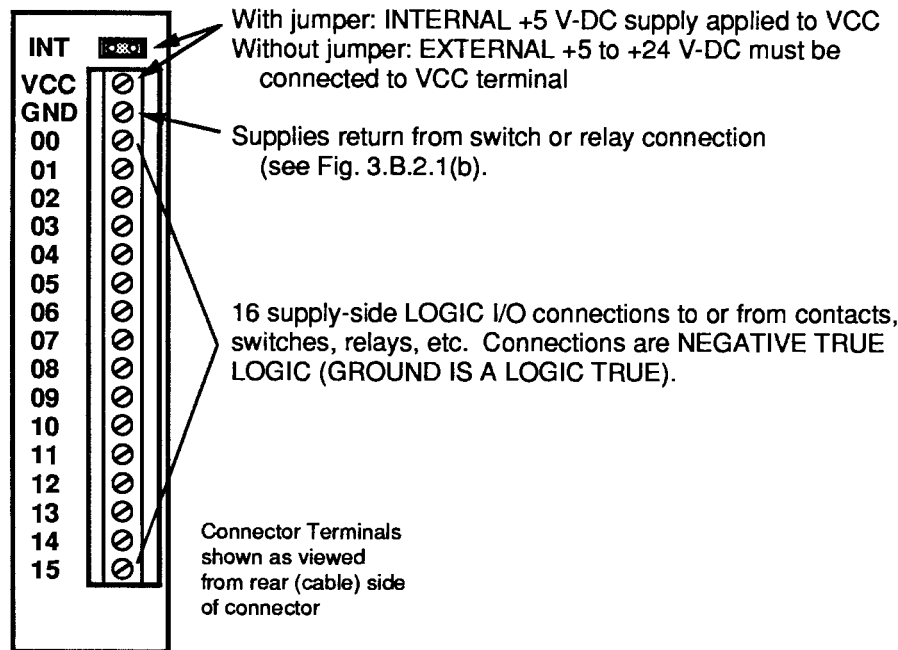
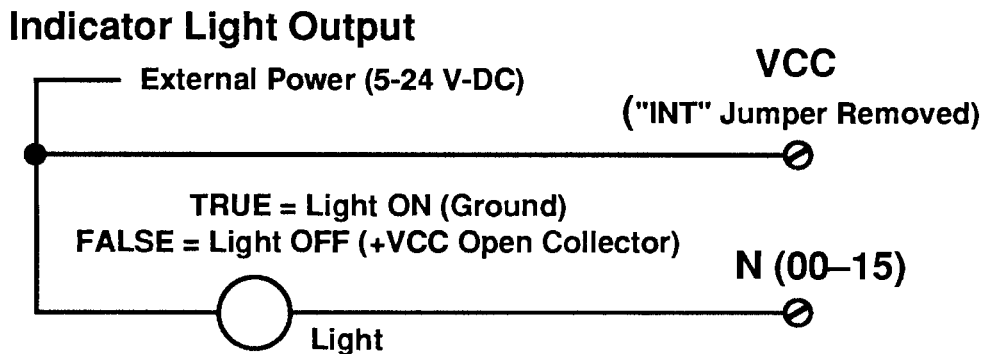
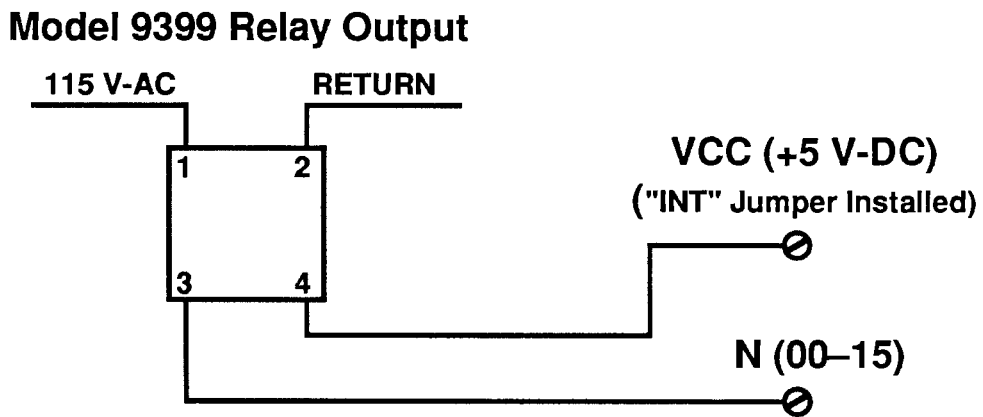
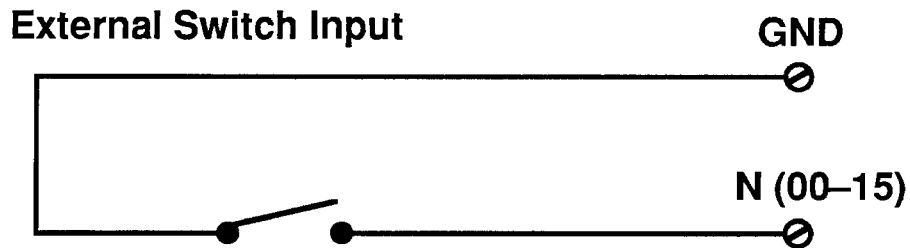


Fig. 3.B.2.1(b) Typical 10BIO-16 Logic Connections



3.B.2.c

SETUP OF LOGIC I/O PORTS

1. 10BIO-16 INITIALIZATION: BSL COMMAND

Before you can specify which of the 10BIO-16's LOGIC I/O PORTS are to be INPUTS and which are to be OUTPUTS, you must first "initialize" the 10BIO-16 Card. You will use the **B SLOT (BSL)** command to establish a *one-to-one correspondence* between the 10BIO-16's sixteen LOGIC I/O PORTS and the sixteen members of a particular system BIT GROUP (for an explanation of BIT GROUPS and their "RANK" numbers, see Section 2.H.1).

The general form of the **BSL** command is

$$\mathbf{BSL\ s = 1, k\ [CR]\ ^*}$$

The effect of this command is to assign to the Model 10BIO-16 occupying B SLOT No. "s" both a B-CARD "TYPE" code of "1" and the sixteen bits of the BIT GROUP of RANK No. "k." (All B CARDS other than the Model 10BIO-16 are automatically "typed" by the system.)

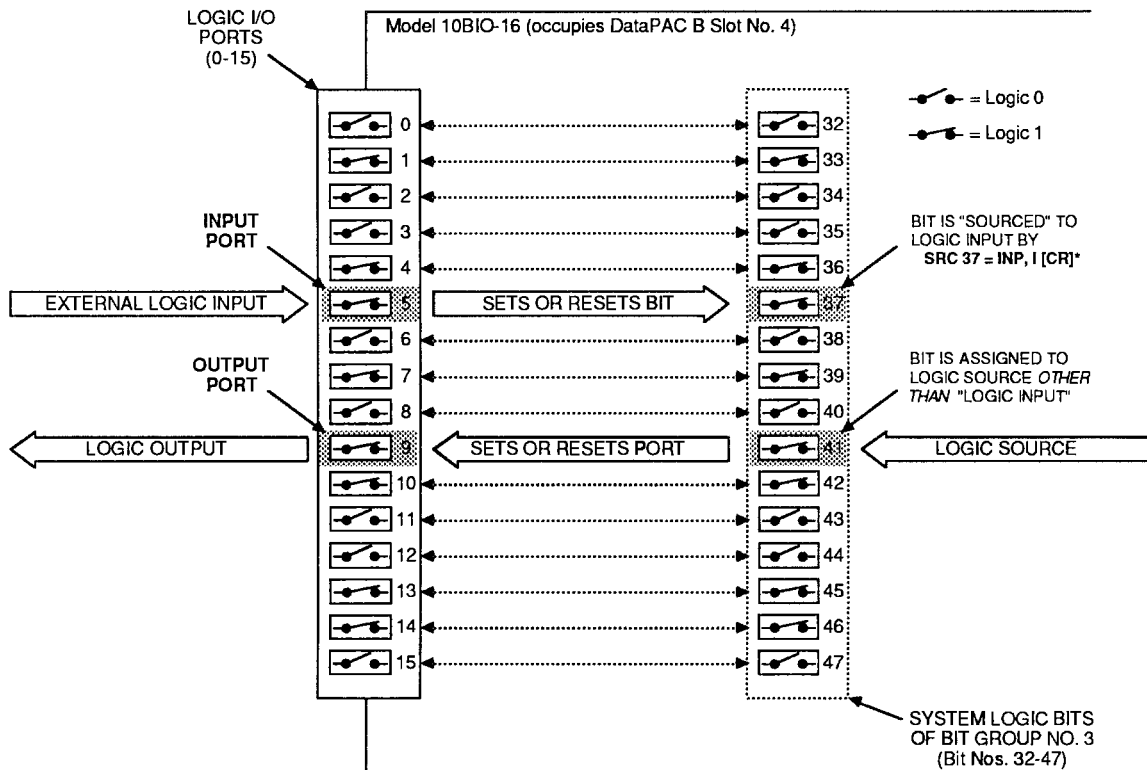
For example, to assign BIT GROUP No. 3 (i.e., Bit Nos. 32 through 47) to the LOGIC I/O PORTS of the 10BIO-16 occupying B SLOT No. 4, you would command

$$\mathbf{BSL\ 4 = 1, 3\ [CR]\ ^*}$$

Bit No. 32 will now correspond to the 10BIO-16's LOGIC I/O PORT No. 0, Bit No. 33 to Port No. 1, Bit No. 34 to Port No. 2, etc. The situation is illustrated in Fig. 3.B.2.2. Note that in this figure the 10BIO-16's LOGIC I/O PORTS are numbered 0 through 15. These are not necessarily the numbers which appear on the 10BIO-16's LED indicator film. The card's front-edge indicator numbers will in most cases correspond to the 16 internal LOGIC BITS assigned to the card (see Section d, below).

Note also that if two or more Model 10BIO-16 Cards are present, they need *not* be assigned to contiguous BIT GROUPS. That is, one card might have a RANK of "1" (Bit Nos. 0-15), while a second might be ranked "4" (Bit Nos. 48-63), and a third be ranked "10" (Bit Nos. 144-159).

Fig. 3.B.2.2 Correspondence of Logic I/O Ports and System Bits



To *cancel* the current BIT-GROUP assignment for the 10BIO-16 occupying B SLOT No. s, command

BSL x = 255 [CR] *

2. SPECIFYING LOGIC INPUTS: SRC COMMAND

When a given LOGIC I/O PORT is designated to be a logic *input*, its existing logic state will at all times directly control the state of the system LOGIC BIT that corresponds to that port—so long as no other (overriding) LOGIC SOURCE is currently in effect for that bit. See, for example, Port No. 5 in Fig. 3.B.2.2. The assignment of LOGIC SOURCES is explained in detail in Section 2.H.

To designate as a logic *input* the LOGIC I/O PORT corresponding to Bit No. r, thereby placing Bit No. r under direct control of any external logic signal *received* at that port, command

SRC r = INP, I [CR] *

where "I" is a three-letter mnemonic indicating the desired "LATCH MODE" for Bit No. r: either **LAT** (for *latching*) or **NON** (for *nonlatching*).

To designate as logic inputs the LOGIC I/O PORTS corresponding to Bit Nos. r through q, command

SRC r TO q = INP, I [CR] *

Returning to the example illustrated in Fig. 3.B.2.2, if a command of

SRC 37 = INP, NON [CR] *

has been entered, then the state of Bit No. 37 will be continuously determined by the external *logic input* received at LOGIC I/O PORT No. 5. If, however, the command is

SRC 37 = INP, LAT [CR] *

then, following the receipt of a *Logic 1* at Port No. 5, Bit No. 37 will remain "latched" at *Logic 1* until "unlatched" by a **RELEASE (RLS)** command (see Section 2.H.4)—regardless of the subsequent activity of Port No. 5.

3. SPECIFYING LOGIC OUTPUTS

When a given LOGIC I/O PORT is designated to be a logic *output*, its logic state (and consequently the logic level it transmits to an external device) is at any time directly controlled by the existing state of the system LOGIC BIT that corresponds to that port. See, for example, Port No. 9 in Fig. 3.B.2.2.

THERE IS NO SPECIFIC COMMAND FOR DESIGNATING A LOGIC OUTPUT. ANY LOGIC I/O PORT TO WHOSE CORRESPONDING SYSTEM LOGIC BIT A COMMAND OF

SRC r = INP, I [CR] *

HAS NOT BEEN APPLIED WILL BE AUTOMATICALLY DESIGNATED AS AN *OUTPUT* PORT.

Returning again to the example shown in Fig. 3.B.2.2, we see that if Bit No. 41 has been assigned any LOGIC SOURCE *other than "LOGIC INPUT,"* then its corresponding LOGIC I/O PORT (No. 9) will produce a logic *output* that continuously reflects the state of Bit No. 41, regardless of the actual LOGIC SOURCE presently in control of that bit.

3.B.2.c

SETUP OF LOGIC I/O PORTS

———— IMPORTANT ————

REMEMBER THAT ALL LOGIC OUTPUTS ARE *NEGATIVE TRUE* (*Logic 1* = GROUND; *Logic 0* = +5 V-DC). Always check connections to the logic device receiving each output, to make sure that the correct polarity is observed.

On the front edge of the Model 10BIO-16 is an LED logic-state indicator for each of the card's sixteen LOGIC I/O PORTS. This indicator will light to indicate a *Logic 1* level at the respective port.

NOTE: Before a Model 10BIO-16 is shipped, a film strip is usually mounted on the indicator array, in order to number the indicators in terms of the sixteen bits of the specific system BIT GROUP associated with that card. Thus, if the 10BIO-16 LOGIC I/O PORTS are to correspond to the BIT GROUP of "RANK" No. 1, its indicators will be numbered 0 through 15; if the ports are to correspond to the BIT GROUP No. 2, the indicators will be numbered 16 through 31; etc.

PROCEDURES DISCUSSED IN THIS SECTION APPLY EQUALLY TO BOTH THE MODEL 10AIO-16 AND 10BIO-16 UNIVERSAL LOGIC I/O CARDS.

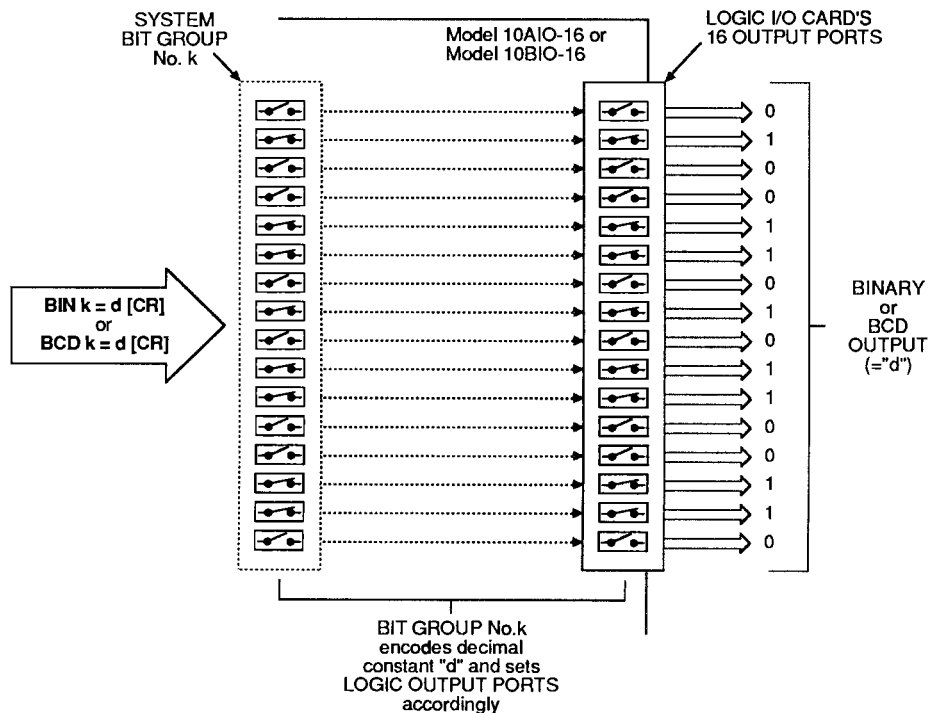
1. BINARY OUTPUT: BIN, HEX, AND CCH COMMANDS

To arrange for a Universal Logic I/O Card to output in *BINARY* form either a constant numerical value or the current (analog) data value of a given system DATA CHANNEL No. x, you should first

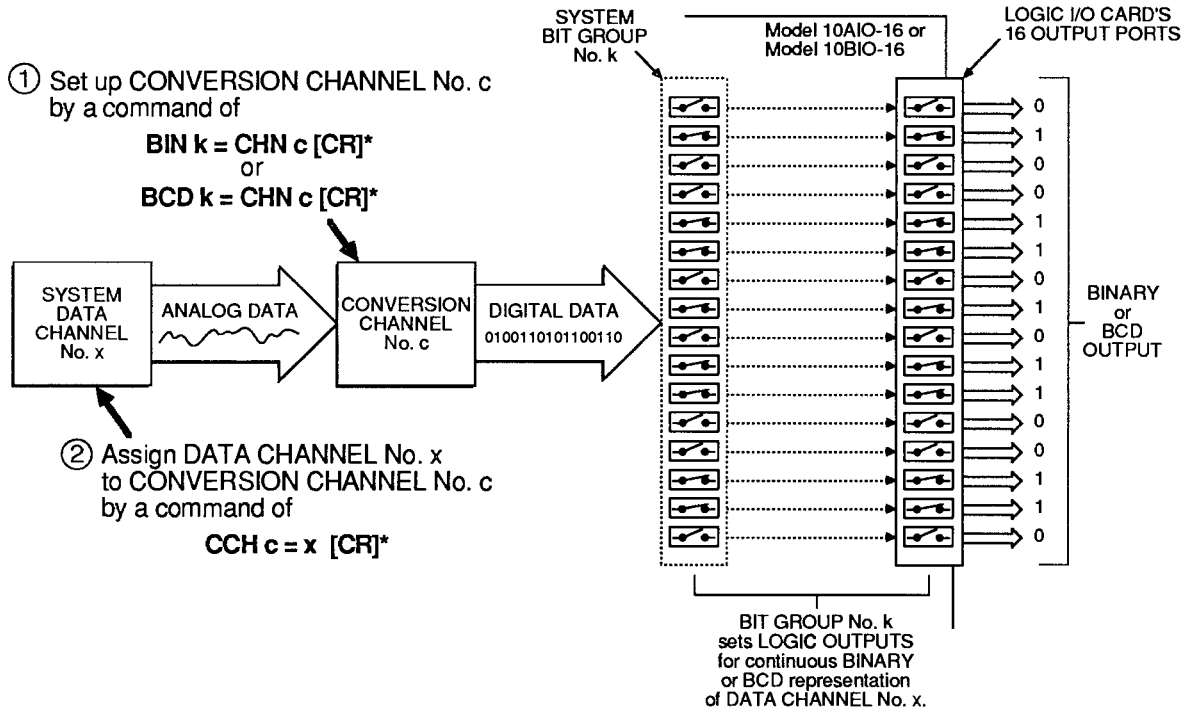
- MAKE SURE THAT THE CARD HAS BEEN PROPERLY "INITIALIZED"—THAT IS, THAT A ONE-TO-ONE CORRESPONDENCE HAS BEEN ESTABLISHED BETWEEN ITS SIXTEEN LOGIC I/O PORTS AND THE SIXTEEN MEMBERS OF A SPECIFIC SYSTEM BIT GROUP OF RANK NO. "k" (see Section c.1, above)—AND ALSO
- MAKE SURE THAT EACH OF THE CARD'S SIXTEEN LOGIC I/O PORTS HAS BEEN SPECIFIED TO BE A LOGIC OUTPUT (see Section c.3, above).

Fig. 3.B.2.3 BINARY or BCD Output from a Logic I/O Card

a) Output to Represent a Fixed Decimal Value



b) Output to Represent Variable Analog Data Via Analog-to-Digital Conversion Channel



a. BINARY OUTPUT TO REPRESENT A FIXED DECIMAL VALUE

If you wish the Logic I/O Card dedicated to BIT GROUP No. "k" to output in BINARY form a *fixed decimal value* "d," you may enter a **BINARY (BIN)** command of the form

$$BIN\ k = d\ [CR]$$

where "d" is a decimal integer from -32000 to 32000. This "RUN-TIME" COMMAND configures BIT GROUP No. "k" to represent, in BINARY form, the entered decimal value "d"—a configuration which is reflected, in turn, by the Logic I/O Card's sixteen *output* ports. See Fig. 3.B.2.3(a).

NOTE: Following a command of the above form, an interrogation of **BIN k [CR]** will yield the fixed decimal value "d" to which BIT GROUP No. k has been set.

b. BINARY OUTPUT TO REPRESENT A FIXED HEXADECIMAL VALUE

Similarly, to represent a *fixed hexadecimal value* "h" by the output configuration of the Logic I/O Card dedicated to BIT GROUP No. "k," you may enter a **HEXADECIMAL (HEX)** command of the form

$$HEX\ k = h\ [CR]$$

where "h" is any four-character hexadecimal word. See Table 2.H.2, Section 2.H.2, for "Binary-Hexadecimal Equivalents." Like **BINARY (BIN)**, the **HEX** command is a "RUN-TIME" COMMAND.

c. BINARY OUTPUT TO REPRESENT THE VALUE OF A DATA CHANNEL

If you wish the Logic I/O Card dedicated to BIT GROUP No. "k" to output in BINARY form the *current analog data reading of a given system DATA CHANNEL*, you should do the following (Fig. 3.B.2.3(b) summarizes the procedure):

1. SET UP CONVERSION CHANNEL FOR ANALOG-TO-DIGITAL TRANSLATION

A "CONVERSION CHANNEL" is a special system DATA CHANNEL used to mediate the translation of internal analog data into BINARY or BINARY CODED DECIMAL (BCD) *output*.

To set up a CONVERSION CHANNEL No. "c" for BINARY translation of internal analog data, you must first enter a **BINARY (BIN)** command of

BIN k = CHN c [CR] *

The number "c" can be any presently unused Channel Number in the system. This command assigns Channel No. c a "TYPE" code of **B1** and causes BIT GROUP No. k to receive digitally converted data from that CONVERSION CHANNEL.

2. ESTABLISH CHANNEL NO. x AS THE "DATA SOURCE" FOR CONVERSION CHANNEL NO. c

Enter a **CONVERSION CHANNEL (CCH)** command of

CCH c = x [CR] *

Channel No. x may be any DATA CHANNEL ("REAL" or "PSEUDO"). This step is required in order that Channel No. x's analog data be continuously available to the system *during the time taken for analog-to-digital translation*.

Note that if you wish to *cancel* the above **CCH** command, you should enter a **RESET (RST)** command of

RST c [CR] *

This will reset the "TYPE" code for Channel No. c to "D0" (VOLATILE DOWNLOAD PSEUDOCHANNEL). A subsequent interrogation of **CCH c [CR]** will receive an answer of **N/A**.

As illustrated in Fig. 2.B.2.3(b), the effect of the above **BIN** and **CCH** commands is to set the *output* configuration of the Logic I/O Card assigned to BIT GROUP No. k to represent, in BINARY form, the current value of DATA CHANNEL No. x. NOTE, HOWEVER, THAT ANY DECIMAL POINT IN THE DATA READING FOR CHANNEL NO. x WILL BE IGNORED.

ALSO NOTE: Following a **BIN** command of the above form, an interrogation of **BIN k [CR]** will *not* yield a decimal value corresponding to the present binary configuration of BIT GROUP k, but rather the "path of conversion" presently applying to that BIT GROUP—i.e., **CHN c**.

d. CANCELLING THE BIN COMMAND: BIT COMMAND

Either form of the **BINARY (BIN)** command has the effect of assigning to every member of BIT GROUP No. k a LOGIC SOURCE of "EXTERNAL CONTROL" (for a complete discussion of LOGIC SOURCES, see Section 2.H of this Guidebook). The **BIN** command will therefore override any existing LOGIC-SOURCE designation for each and every bit in the BIT GROUP.

To *cancel* a **BINARY (BIN)** command, you will have to enter a **SET BIT (BIT)** command that returns the 16 bits in question to their former (EEPROM-stored) LOGIC SOURCE assignments. This command will have the form

BIT r TO q = INT [CR] *

where "r TO q" defines the range of bits comprising the BIT GROUP to which the **BIN** command was applied (for "Returning to Previous Logic Source," see Section 2.H.2(c.2)).

2. BINARY INPUT: "CHN=" AND HEX COMMANDS

To arrange for a Universal Logic I/O Card to read a *BINARY input* received at its LOGIC I/O PORTS, you should first

- MAKE SURE THAT THE CARD HAS BEEN PROPERLY "INITIALIZED"—THAT IS, THAT A ONE-TO-ONE CORRESPONDENCE HAS BEEN ESTABLISHED BETWEEN ITS SIXTEEN LOGIC I/O PORTS AND THE SIXTEEN MEMBERS OF A SPECIFIC SYSTEM BIT GROUP OF RANK NO. "k" (see Section c.1, above)—AND ALSO
- MAKE SURE THAT EACH OF THE CARD'S SIXTEEN LOGIC I/O PORTS HAS BEEN SPECIFIED TO BE A **NONLATCHING LOGIC INPUT** BY A COMMAND OF

SRC r TO q = INP, NON [CR] *

where "r TO q" defines the range of bits comprising BIT GROUP No. k (see Section c.2, above).

a. READING THE DECIMAL VALUE OF A BINARY INPUT

1. SET UP A "REAL" DATA CHANNEL FOR DIGITAL-TO-ANALOG TRANSLATION

To establish a "REAL" CHANNEL No. x for reading the *BINARY input* received by the Logic I/O Card corresponding to the system BIT GROUP of RANK No. "k," enter the following **CHANNEL (CHN)** command:

CHN x = BIN k [CR] *

Application of this command automatically assigns to Channel No. x a "TYPE" code of **B4** and a "LOCATION" designation of **BIN k**. It is a "SETUP" COMMAND, requiring that the EEPROM Switch be ON.

2. INTERROGATE FOR DIGITAL-INPUT CHANNEL READING

You may now use the "READ" form of the **CHANNEL (CHN)** command (see Section 1.H.2) to interrogate for the current reading of Channel No. x. This reading is the *decimal* equivalent of the *BINARY* value represented by the present configuration of BIT GROUP No. k—a configuration that reflects the *BINARY input* received by the Logic I/O Card associated with that BIT GROUP (see Fig. 3.B.2.4). Thus, depending on its mode of entry, a command of

CHN x [CR]

will produce either an output of this decimal value from the DataPAC's COMPUTER INTERFACE PORT or its display on the BILLBOARD; it will *not* return an answer of **BIN k**.

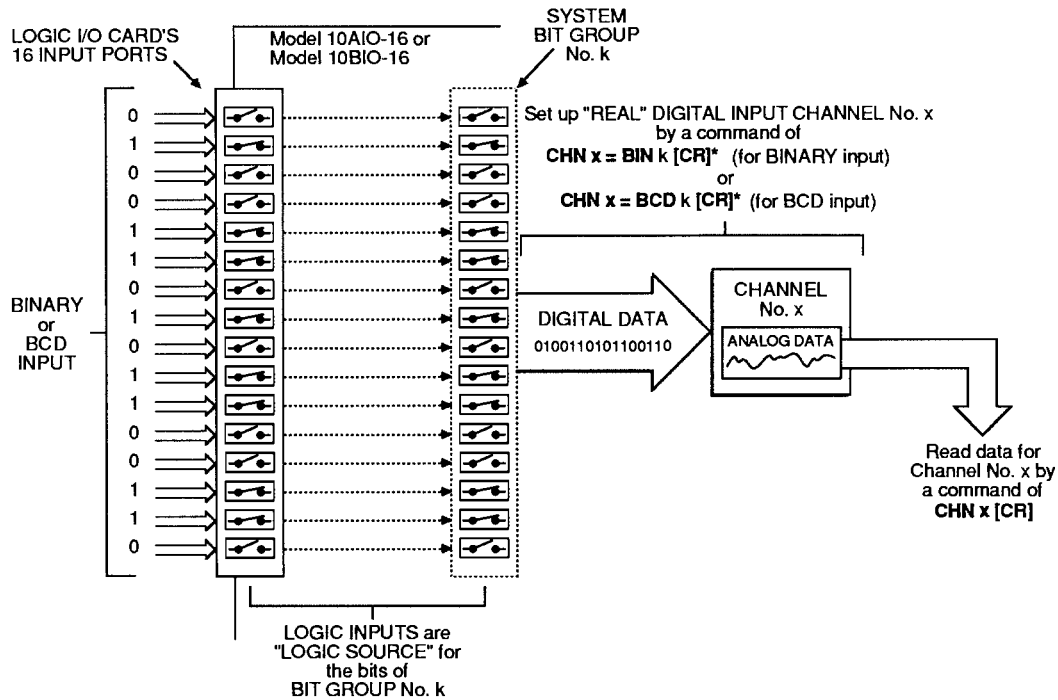
b. READING THE HEXADECIMAL VALUE OF A BINARY INPUT

A command of

HEX k [CR]

lets you read the hexadecimal value currently represented by the configuration of BIT GROUP No. "k"—a configuration that reflects the *HEXADECIMAL* value of the *BINARY input* received by the Logic I/O Card associated with that BIT GROUP. Depending on its mode of entry, this command will produce either an output of the appropriate four-character hexadecimal value "h" from the DataPAC's COMPUTER INTERFACE PORT or its display on the BILLBOARD (see also Section 2.H.2(c)).

Fig. 3.B.2.4 Binary or BCD Input



3. BCD OUTPUT: BCD AND CCH COMMANDS

See the procedures for the setting up of fixed and variable BINARY output, Sections e.1(a) and e.1(c), above. The procedures for the setting up of *output in BCD form* from a Universal Logic I/O Card is strictly analogous, except that here you will use the **BINARY CODED DECIMAL (BCD)** command instead of the **BINARY (BIN)** command.

a. BCD OUTPUT TO REPRESENT A FIXED DECIMAL VALUE

Here you will enter a command of

$$BCD\ k = d\ [CR]$$

where the entered *decimal* value "d" is an integer from -7999 to 7999.

b. BCD OUTPUT TO REPRESENT THE VALUE OF A DATA CHANNEL

1. SET UP CONVERSION CHANNEL FOR ANALOG-TO-DIGITAL TRANSLATION

To set up a CONVERSION CHANNEL No. "c" for BCD translation of internal analog data, you must enter a **BINARY CODED DECIMAL (BCD)** command of

$$BCD\ k = CHN\ c\ [CR]^*$$

The command assigns Channel No. c a "TYPE" code of B2 and causes BIT GROUP No. k to receive digitally converted data from that CONVERSION CHANNEL.

2. ESTABLISH DATA CHANNEL NO. x AS THE "DATA SOURCE" FOR CONVERSION CHANNEL NO. c

As with BINARY output (Section e.1), you will enter a **CONVERSION CHANNEL (CCH)** command of

$$\text{CCH } c = x \text{ [CR] } *$$

Again as with BINARY output, ANY DECIMAL POINT IN THE DATA READING FOR CHANNEL NO. x WILL BE IGNORED.

C. CANCELLING THE BCD COMMAND: BIT COMMAND

You will use a **SET BIT (BIT)** command of

$$\text{BIT } r \text{ TO } q = \text{INT [CR] } *$$

as explained in Section e.1(d), above.

4. BCD INPUT: "CHN=" COMMAND

See the procedure for the reading of BINARY input, Section e.2(a), above. The procedure for the reading of a *BCD input* received by a Universal Logic I/O Card is strictly analogous.

a. SET UP A "REAL" DATA CHANNEL FOR DIGITAL-TO-ANALOG TRANSLATION

To establish a "REAL" CHANNEL No. x for reading the BCD input received by the Logic I/O Card corresponding to the system BIT GROUP of RANK No. "k," command

$$\text{CHN } x = \text{BCD } k \text{ [CR] } *$$

Application of this "SETUP" COMMAND automatically assigns to Channel No. x a "TYPE" code of **B3** and a "LOCATION" designation of **BCD k**.

b. INTERROGATE FOR DIGITAL-INPUT CHANNEL READING

As with BINARY input (Section e.2(a)), you may use a command of

$$\text{CHN } x \text{ [CR]}$$

to interrogate for the *decimal* equivalent of the BCD value represented by the present configuration of BIT GROUP No. k—a configuration that reflects the BCD input received by the Logic I/O Card associated with that BIT GROUP (see again Fig. 3.B.2.4). Note that the above interrogation will *not* return an answer of **BCD k**.

Section 3.B.3

Satellite Network Systems:

Model 10BD4

Satellite Interface Card and

Model 10BD1

Satellite Slave Card



System 10 Guidebook

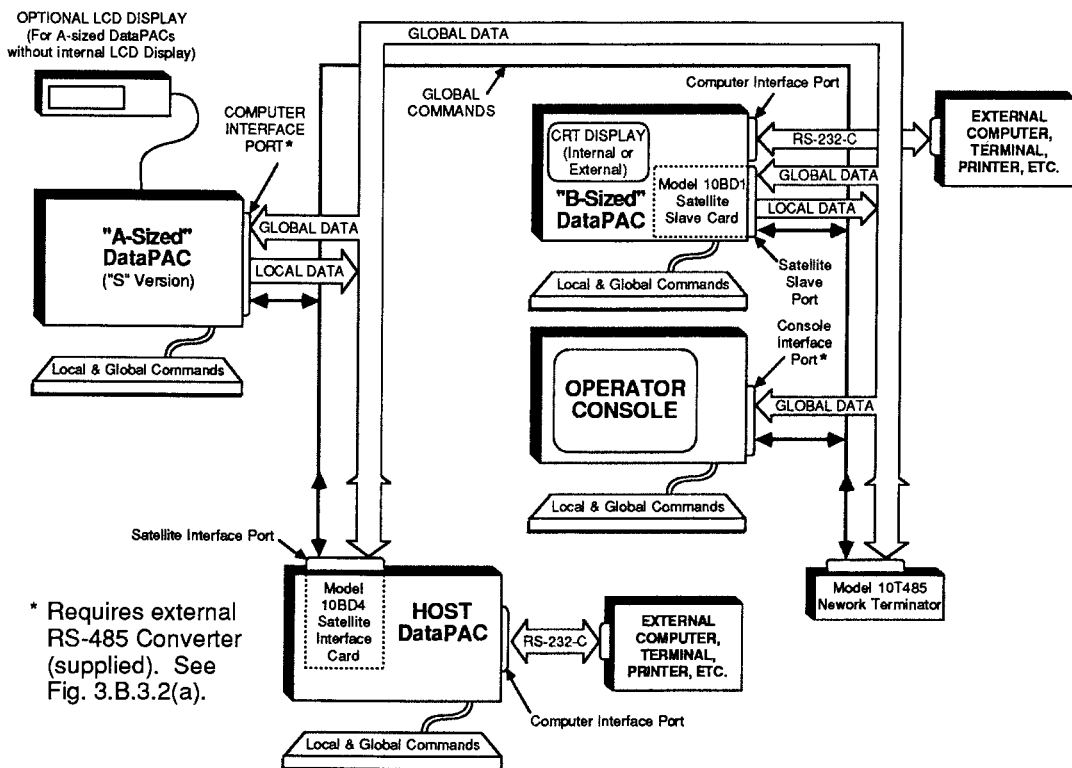
1. THE SATELLITE NETWORK

When equipped with an optional **Model 10BD4 Satellite Interface Card**, any "B-sized" DataPAC can become a central "master" or "HOST" unit for a Local Area Network consisting of one or more Daytronic "SATELLITE" units. Any "B-sized" DataPAC may function as a SATELLITE (Model 10K6, 10K7, 10K8, etc.). An "A-sized" DataPAC may function as a SATELLITE *only if it is a special "S" version of that DataPAC model* (i.e., Model 10KUS, 10K1S, 10K2S, 10K4S, 10K4DS, etc.). A **Model 10CON or 10CCON Operator Console** can also serve as a SATELLITE unit. All in all, such SATELLITES can provide complete *remote-site data acquisition, data display, process control, or entry of "GLOBAL" system commands*.

While responding instantly and "transparently" to interrogation by the HOST DataPAC, each SATELLITE DataPAC remains independently responsible for all data collection, control, and/or display functions relating to those DATA CHANNELS and LOGIC BITS for which it serves as a unique "local" origin. These functions may include cross-channel calculations, analog peak capture, logic and analog control I/O, automatic command "executes," maintenance of "live" LCD or CRT display, digital "history" recording, etc.

Fig. 3.B.3.1 shows a generalized SATELLITE system. Specific connections are described in Section b.3, below. HOST-SATELLITE and SATELLITE-SATELLITE interchanges are achieved via RS-485 serial interface of fixed protocol, which allows *up to 31 SATELLITES* on a twisted-pair ring of *up to 1 km (3279 ft.)* in total length. Note, however, that optional provisions are available for handling up to 99 SATELLITES in all.

Fig. 3.B.3.1 Generalized Satellite Network



The Daytronic SATELLITE NETWORK is a form of "packet network." This means that it provides for the sequential delivery of discrete "data packets" from each SATELLITE to the HOST and from each SATELLITE (or HOST) to every "B-sized" SATELLITE in the network. It also provides for the sequential delivery of discrete "message packets" from each SATELLITE to the HOST. Each message packet contains any standard MNEMONIC COMMANDS that have been entered at the SATELLITE location, but which are intended for delivery to some *other* member or members of the network.

3.B.3.a

INTRODUCTION

In setting up the network, you will first assign a unique identifying SATELLITE NUMBER to each SATELLITE. You may then dedicate to the HOST DataPAC and to each DataPAC SATELLITE in the network a selected range of "GLOBAL" DATA CHANNELS and a selected range of "GLOBAL" BIT GROUPS ("global" here means that such a DATA CHANNEL or BIT GROUP may be read and/or displayed, if desired, by any member of the SATELLITE NETWORK).

Each DataPAC will now serve as the unique "data origin" for its specified channels and bits. The dedication of "GLOBAL" channels and bits to network DataPACs is done via the **SATELLITE (SAT)** and **SATELLITE SYSTEM BITS (SSB)** commands, respectively. GLOBAL DATA CHANNEL No. 1 must always be dedicated to the HOST.

PLEASE NOTE

In the "simplified" setup procedures discussed in this section, it is convenient to consider all active DATA CHANNELS and all active LOGIC BITS to be "GLOBAL," regardless of whether they originate from a SATELLITE DataPAC or from the HOST. Concerning "GLOBAL" data, you should note that

- "GLOBAL" CHANNELS AND BITS ARE SIMULTANEOUSLY AVAILABLE TO THE HOST AND TO EVERY SATELLITE IN THE NETWORK.
 - As explained in Sections b.5(b) and b.6(a), below, EACH "GLOBAL" CHANNEL OR BIT MAY BE DEDICATED TO ANY DATAPAC IN THE NETWORK (HOST OR SATELLITE)—BUT *ONLY* TO THAT SINGLE DATAPAC. IT MAY BE "READ" (OR "HEARD"), HOWEVER, BY EVERY OTHER NETWORK MEMBER (see Sections b.5(c,d) and b.6(b,c)).
-

After the network has been fully set up, the Model 10BD4 will automatically interrogate each SATELLITE in turn, *according to the predesignated SATELLITE-NUMBER sequence*, having first interrogated the HOST DataPAC. The 10BD4 operates on a scan cycle which is *independent* of that of the HOST'S CENTRAL PROCESSOR.

When interrogated, each network DataPAC (HOST or SATELLITE) will transmit a "data packet" to the Model 10BD4. That is, it will send to the 10BD4, in sequence, the numeric data values and logic states currently in its DATA RAM for all GLOBAL DATA CHANNELS and GLOBAL BIT GROUPS that have been specifically dedicated to that DataPAC. Following each data packet, the interrogated DataPAC will also transmit a "CHECKSUM" number. This is simply the numeric summation of the data that has just been transmitted. The 10BD4 will perform a similar summation for each data packet it receives, and will compare its own "CHECKSUM" with that reported by the transmitting DataPAC. This procedure allows detection of faulty data transfer from SATELLITE (or HOST) to the Model 10BD4 (for the monitoring of transmission errors, see Section c.6, below).

With each of its own scan cycles, the HOST DataPAC'S CENTRAL PROCESSOR interrogates the Model 10BD4 for all current data in the 10BD4'S DATA RAM, as collected from all DataPAC SATELLITES in the network. The HOST then updates its own DATA RAM accordingly, publishing all network-collected data to any and all of its "COPROCESSOR" CARDS (i.e., to every Model 10BDR64 History Card, Model 10BACI Auxiliary Computer Interface Card, etc., contained in the HOST DataPAC).

At the same time that it is transmitted to the Satellite Interface Card, a given data packet is transmitted to *every "B-sized" SATELLITE in the network*. This same data is further available to *every "A-sized" satellite that has been configured to receive it*, through the HOST. After receiving data from another SATELLITE or from the HOST, a SATELLITE will accordingly update the corresponding DATA CHANNELS and LOGIC BITS in its own DATA RAM, and also any "local" LCD or CRT *display* of any of these channels and bits for which it is responsible.

The network also allows any SATELLITE *to issue commands to any other SATELLITE or to the HOST*. Every interrogation by the 10BD4 for SATELLITE data will be accompanied by an interrogation for a "message packet"—i.e., for any MNEMONIC COMMANDS that may be currently awaiting delivery from the SATELLITE in question to some other member of the network. On receipt by the 10BD4, all such "GLOBAL" COMMANDS are immediately sent to the HOST'S CENTRAL PROCESSOR. From there each command is routed directly to the individual network unit to which it is "implicitly" addressed by virtue of the GLOBAL DATA CHANNEL(S) or GLOBAL LOGIC BIT(S) referred to by the command itself, or to which it has been "explicitly" addressed by means of an **OPEN (OPN)** or **NODE (NOD)** command (see Sections c.1 and c.5, below). Because of this GLOBAL COMMAND capability, the total system can accommodate *more than one observation station throughout the network*.

In contrast to a "GLOBAL" COMMAND, which may be entered through the keyboard, COMPUTER INTERFACE PORT, or optional AUXILIARY COMPUTER INTERFACE (ACI) PORT of any member of the network in order to be sent to any other member, a "LOCAL" COMMAND can only be "heard" and acted upon by the unit whose keyboard, COMPUTER INTERFACE PORT, or ACI PORT has been used to enter that command.

When interrogated by the 10BD4, each OPERATOR CONSOLE SATELLITE will only transmit its current message packet (these units do not transmit data; they only *receive* it for purposes of "local" display, printout, recording, etc.). GLOBAL COMMANDS MAY BE RECEIVED OR ISSUED BY AN OPERATOR CONSOLE SATELLITE ONLY THROUGH THE **OPEN (OPN)** COMMAND.

2. TYPES OF SATELLITES

a. "A-SIZED" DATAPAC ("S" VERSION)

TO INTERACT PROPERLY WITH THE SATELLITE NETWORK, AN "A-SIZED" DATAPAC SATELLITE MUST BE A SPECIAL "**S**" VERSION OF THAT DATAPAC MODEL.* All "S"-version DataPACs have limited bidirectionality. They are also provided with a capacity of 1000 DATA CHANNELS and with a PLUG-IN KEYBOARD CONNECTOR, thereby permitting the direct keyboard entry of MNEMONIC COMMANDS, both "LOCAL" and "GLOBAL." Such a SATELLITE cannot receive "LOCAL" COMMANDS through its COMPUTER INTERFACE PORT, which is necessarily dedicated to the network (see Fig. 3.B.3.1).

Note that with certain "A-sized" DataPAC SATELLITES, the immediate review and verification of *keyboard* command entries is not possible, because an internal LCD display is not present. "A-sized" SATELLITES without LCD display include the Models 10KUS, 10K1S, and 10K4TS. It is therefore recommended that any system employing such a SATELLITE also include a **Model 10LCD12A Display Option**, which provides a remote 12-line LCD display and a Model 10P80A Extended Keyboard.

b. "B-SIZED" DATAPAC WITH MODEL 10BD1 SATELLITE SLAVE

Every "B-sized" DataPAC SATELLITE must have a capacity of 1000 DATA CHANNELS. It also requires a **Model 10BD1 Satellite Slave Card** in order to issue its own locally acquired data to the network and to receive GLOBAL DATA from the network for local display, printout, etc. Such a SATELLITE can receive commands "locally" through its plug-in keyboard, through its COMPUTER INTERFACE PORT (which in this case is not dedicated to the network), or through the AUXILIARY COMPUTER INTERFACE PORT supplied by an optional Model 10BACI (see Section 3.B.5 of this Guidebook).

c. OPERATOR CONSOLE (MODEL 10CON OR 10CCON)

An OPERATOR CONSOLE can only *receive* GLOBAL DATA from the network.

* Note that if an existing "non-S" A-sized DataPAC is supplied with a **Model 10D485 RS-485 Satellite Interface Adapter**, that DataPAC can be made to *receive* "global" data from the network. It will not be possible, however, for the DataPAC to *transmit* its own "local" data to the network.

However, it can both issue and receive GLOBAL COMMANDS via the **OPEN (OPN)** command, just like an "A-sized" or "B-sized" DataPAC SATELLITE. Like an "A-sized" DataPAC SATELLITE, it can receive LOCAL COMMANDS through its plug-in keyboard (only). For more information on the Models 10CON and 10CCON, see Section 2.O of the Guidebook.

3. SYNOPSIS OF SATELLITE SETUP PROCEDURE

In general, the setup of a System 10 SATELLITE NETWORK will involve the following steps, in the order given. *Each step is discussed in detail in the sections that follow.*

—— PLEASE NOTE ——

In order that you may set up your SATELLITE NETWORK as quickly and easily as possible, the following procedure is offered as the simplest and most straightforward method. You should know, however, that more complicated setup techniques are possible, some of which may, under certain circumstances, increase overall system speed.

1. Make sure that each "A-sized" DataPAC SATELLITE in the system is set for a COMMAND TERMINATOR of CARRIAGE RETURN [CR].
2. Make sure that the HOST DataPAC has been assigned a SATELLITE NUMBER of "0" (zero), via an **ASSIGN SATELLITE NUMBER (ASN)** command applied to the HOST.
3. Assign a unique *nonzero* SATELLITE NUMBER to each SATELLITE in the network, via an **ASN** command applied to the SATELLITE.
4. Establish proper CABLE CONNECTIONS between adjacent SATELLITES and between the "first" SATELLITE and the HOST DataPAC's SATELLITE INTERFACE PORT.
5. Make sure that the following RS-232-C protocol is observed by every "A-sized" DataPAC SATELLITE at its COMPUTER INTERFACE PORT, by setting the DataPAC's Protocol Switches accordingly:

153.6K BAUD, 8 DATA BITS, 2 STOP BITS, ODD PARITY
6. Set the HOST DataPAC's TERMINATOR CHANNEL, via the **TERMINATOR (TER)** command, so that the HOST will scan all *active* GLOBAL DATA CHANNELS.
7. Use the **TERMINATOR (TER)** or **SCAN (SCN)** command to set for each DataPAC SATELLITE a SCAN RANGE that contains all channels to be "heard" by that SATELLITE; this includes all channels to be *dedicated* to the SATELLITE in Step 8.
8. Apply a **SATELLITE (SAT)** command to the HOST DataPAC for each DataPAC SATELLITE that is to serve as the "data origin" for one or a range of GLOBAL DATA CHANNELS.
9. If you wish an "A-sized" DataPAC SATELLITE to be able to read and/or display one or more GLOBAL DATA CHANNELS which have *not* been dedicated to that SATELLITE in Step 8, first apply a **DOWNLOAD CHANNELS (DLC)** command to the HOST DataPAC, specifying the GLOBAL DATA CHANNEL(S) to be downloaded to *every* "A-sized" DataPAC SATELLITE in the network with each 10BD4 scan cycle.
10. Then apply one or more **TYPE (TYP)** commands to the "A-sized" DataPAC in question, to assign a local "TYPE" code of "D4" to each *10BD4-downloaded channel* the DataPAC is to read and/or display.

11. If you wish a "B-sized" DataPAC SATELLITE to be able to read and/or display one or more GLOBAL DATA CHANNELS which have *not* been dedicated to that SATELLITE in Step 8, apply the special "B-SLOT" form of the **LOCATE (LCT)** command to that DataPAC to locally "locate" each such channel to the SATELLITE'S 10BD1 card.
12. Apply a **SATELLITE SYSTEM BITS (SSB)** command to the HOST DataPAC for each DataPAC SATELLITE that is to serve as the "data origin" for one or a range of GLOBAL BIT GROUPS.
13. If you wish an "A-sized" DataPAC SATELLITE to be able to read one or more GLOBAL LOGIC BITS which have *not* been dedicated to that SATELLITE in Step 12, first apply a **DOWNLOAD BITS (DLB)** command to the HOST DataPAC, specifying the GLOBAL BIT GROUP(S) to be downloaded to *every* "A-sized" DataPAC SATELLITE in the network with each 10BD4 scan cycle.
14. Then apply one or more **LOGIC SOURCE (SRC)** commands to the "A-sized" DataPAC in question, to assign a local LOGIC SOURCE of "SAT" to each *10BD4-downloaded bit* the DataPAC is to read.
15. If you wish a "B-sized" DataPAC SATELLITE to be able to read and/or display one or more GLOBAL LOGIC BITS which have *not* been dedicated to that SATELLITE in Step 12, apply the special "B-SLOT" form of the **LOGIC SOURCE (SRC)** command to that DataPAC to locally "source" each such bit to the SATELLITE'S 10BD1 card.
16. Using the standard procedures given in Sections 1 and 2 of this Guidebook, set up the DATA CHANNELS of each DataPAC SATELLITE that are to be used for the "local" acquisition of numeric data—i.e., that have been specifically dedicated to that SATELLITE via a **SATELLITE (SAT)** command applied to the HOST (Step 8). Also set up all HOST channels that are to be so used.
17. Again using standard procedures, set up the BIT GROUPS of each DataPAC SATELLITE that have been specifically dedicated to that SATELLITE via a **SATELLITE SYSTEM BITS (SSB)** command applied to the HOST (Step 12). Also set up all HOST BIT GROUPS that are to be so used.
18. Apply a command of **SAT n = CON [CR]*** to the HOST DataPAC for each OPERATOR CONSOLE SATELLITE (No. "n") in the network.
19. Perform all necessary VIDEO SETUP for each SATELLITE with LCD or CRT "video capability," and also for the HOST DataPAC.
20. Use the **EXECUTE BASE GROUP (XBG)** command to set appropriate EXECUTE BASE GROUPS for any SATELLITES to be loaded with **EXECUTE (EXU)** statements.

For "Considerations for Altering an Existing Satellite Network,"
see the Appendix at the end of this Guidebook section.

4. SATELLITE CARD STATUS INDICATORS

The Satellite Card has nine front-panel STATUS INDICATORS. The top four lights are red, to indicate "ERROR" or "ALERT" conditions. The remaining lights are green.

DTR

When this light is ON, it means that the 10BD4 is *not* asserting **DATA TERMINAL READY**. The 10BD4 input buffer is full, and it is therefore NOT READY TO RECEIVE DATA from the network.

RTS

When this light is ON, it means that the 10BD4 is prevented from transmitting to the SATELLITE network because one or more SATELLITES are *not* asserting "DATA TERMINAL READY."

TMOE

When this light is ON, it means that a **TIMEOUT ERROR** has been detected—that is, that a SATELLITE is *not answering* an interrogation by the 10BD4. For the "logging" of TIMEOUT ERRORS, see the **SATELLITE ERROR LOG (SEL)** command, Section c.6(a), below. "TMOE" indication is not exercised on the Model 10BD1 Satellite Slave Card.

CSUM

When this light is ON, it indicates a **CHECKSUM ERROR** with respect to a SATELLITE'S data transmission to the 10BD4. Again, see the **SEL** command, Section c.6(a). "CSUM" indication is not exercised on the Model 10BD1 Satellite Slave Card.

CHR

When this light is ON, it means that the 10BD4 has received a valid ASCII **CHARACTER**.

MNE

When this light is ON, it means that the HOST DataPAC has received through its COMPUTER INTERFACE PORT a valid **MNEMONIC COMMAND** relating to the Satellite Interface Card.

RET

When this light is ON, it means that the last character received by the 10BD4 was a **CARRIAGE RETURN** ([CR]).

XMT

When this light is ON, it means that there is presently some activity on the 10BD4's *data-transmission* line.

RCV

When this light is ON, it means that there is presently some activity on the 10BD4's *data-reception* line.

1. SETTING COMMAND TERMINATOR FOR "A-SIZED" DATAPAC SATELLITES: **CMT** COMMAND

Every "A-sized" DataPAC SATELLITE must be set to recognize a "standard" COMMAND TERMINATOR of *CARRIAGE RETURN* ([CR]).

Note that the HOST DataPAC, all "B-SIZED" DataPAC SATELLITES, and all OPERATOR CONSOLE SATELLITES are preset to recognize this COMMAND TERMINATOR at the respective ports through which they interface with the network. FOR EACH SUCH UNIT, THE *COMPUTER INTERFACE PORT* NEED NOT BE SET TO RECOGNIZE A COMMAND TERMINATOR OF [CR].

Unless otherwise specified, every "A-sized" DataPAC will have been factory-set, prior to shipment, to recognize a "standard" command termination of [CR]. If for some reason a different COMMAND TERMINATOR has been previously designated for the DataPAC, then it will have to be *reset* by turning ON the DataPAC's EEPROM Write Protect Switch and entering a command of the form

CMT = [0D] [CR] *

via the DataPAC's keyboard. For full details on the **COMMAND TERMINATOR (CMT)** command, see Section 2.B.5 of this Guidebook.

2. ASSIGNING SATELLITE NUMBERS: **ASN** COMMAND

a. ASSIGNING SATELLITE NUMBER TO THE HOST

IN ORDER FOR IT TO OPERATE AS THE NETWORK "MASTER" UNIT, THE HOST DATAPAC MUST BE ASSIGNED A "SATELLITE NUMBER" OF "0" (ZERO). Note that *all* DataPACs are factory-set, prior to shipment, to this SATELLITE NUMBER.

To make sure, however, that your HOST is properly set, turn ON its EEPROM Write Protect Switch and enter the following **ASSIGN SATELLITE NUMBER (ASN)** command, via the HOST'S plug-in keyboard:

ASN = 0 [CR] *

The effect of this command is to place the HOST DataPAC's CENTRAL PROCESSOR in the "master" mode.

b. ASSIGNING SATELLITE NUMBERS TO SATELLITES

EVERY SATELLITE IN THE SYSTEM MUST BE ASSIGNED A *UNIQUE, NONZERO "SATELLITE NUMBER."* Without this identifying number, no data or command interchanges can take place between the HOST and the SATELLITE or between the SATELLITE and other SATELLITES.

———— NOTE ————

IT IS RECOMMENDED THAT, IF POSSIBLE, YOU ASSIGN TO EACH SATELLITE ITS RESPECTIVE SATELLITE NUMBER *BEFORE CONNECTING THAT SATELLITE TO THE NETWORK.*

The following **ASSIGN SATELLITE NUMBER (ASN)** command should be issued directly to each SATELLITE via that SATELLITE'S own keyboard, *after the SATELLITE'S EEPROM Write Protect Switch has been turned ON:*

ASN = n [CR] *

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SATELLITE NETWORK SETUP

where "n" is the unique SATELLITE NUMBER whereby the given SATELLITE (alone) is to be identified ($1 \leq n \leq 99$).

The effect of this command is to place the SATELLITE'S CENTRAL PROCESSOR in the "slave" mode and to give it a unique "address" within the network.*

3. NETWORK INTERCONNECTIONS

Consisting of three shielded twisted pairs wired *pin-to-pin* between identical 9-pin connectors, the network's "RS-485" linkage allows the daisy-chaining of SATELLITES in a ring of up to 1 km (3279 ft.) in total length. A single Model 10BD4 Satellite Interface Card can normally accommodate up to 31 SATELLITES, although optional provisions permit the linkage of up to 99 SATELLITE units to a single HOST DataPAC (contact the factory for details).

The 10BD4's SATELLITE INTERFACE PORT furnishes two separate 9-pin RS-485 SATELLITE INTERFACE CONNECTORS. For convenience, you may use either or both of these connectors in constructing your network, depending on the physical placement of the HOST with respect to other network members.

Fig. 3.B.3.2(a) shows a ring of three SATELLITES, corresponding to the three basic types of SATELLITES discussed in Section a.2, above. In this case, only one of the 10BD4's 9-pin SATELLITE INTERFACE CONNECTORS is used.

In Fig. 3.B.3.2(b), both of the 10BD4's 9-pin connectors are used, since the HOST is situated midway between the extreme members of the network. NOTE THAT ALTHOUGH TWO SEPARATE SATELLITE CHAINS ARE HERE SHOWN, EACH WITH ITS OWN NETWORK TERMINATOR, THERE IS STILL ONLY ONE BASIC SATELLITE NETWORK.

* Another important effect of the **ASN = n [CR]*** command is to automatically set to CARRIAGE RETURN ([0D]) the SATELLITE'S current **OUTPUT TERMINATOR (OPT)** and **END OF TRANSMISSION TERMINATOR (EOT)**—see Section 1.H.3(g) for these parameters.

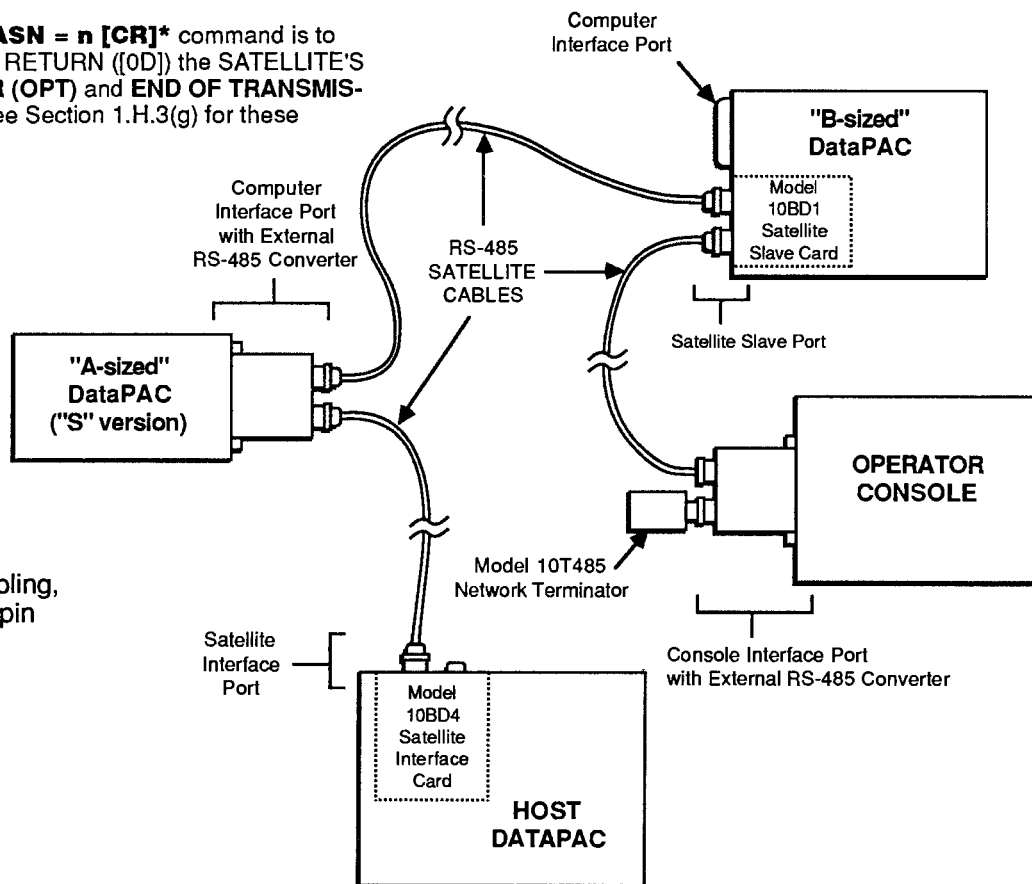
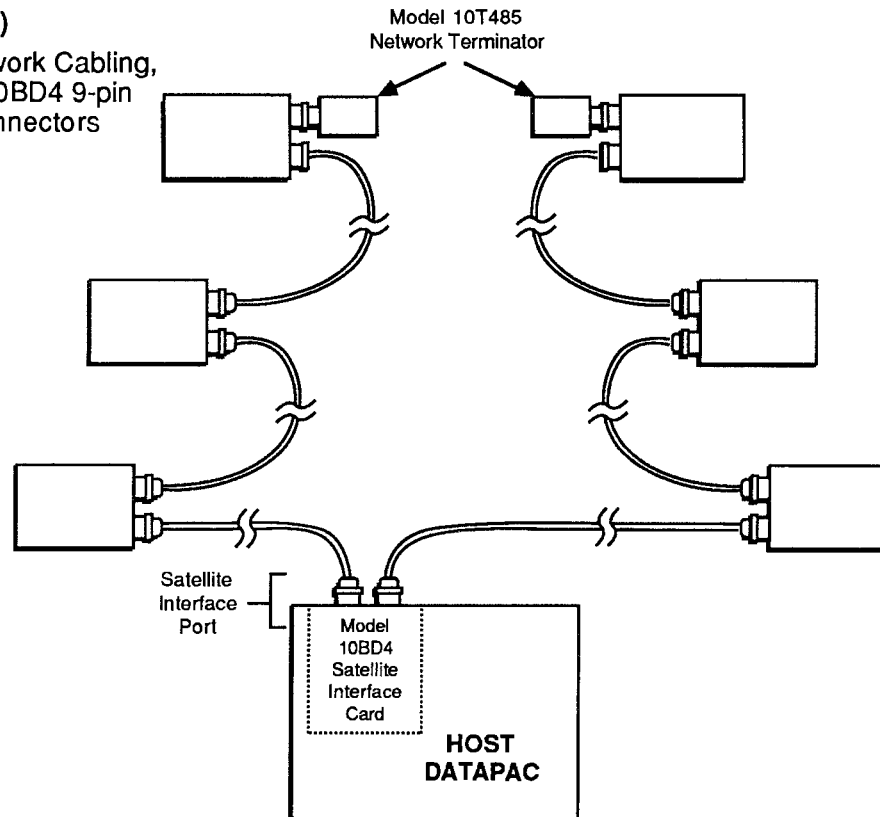


Fig. 3.B.3.2(a)
Satellite Network Cabling,
Using One 10BD4 9-pin
Interface Connector

Fig. 3.B.3.2(b)

Satellite Network Cabling,
Using Both 10BD4 9-pin
Interface Connectors



A sufficient number of **RS-485 SATELLITE CABLES** are supplied with every ordered SATELLITE NETWORK system. These cables establish all network data and command interchanges by connecting consecutive network members in daisy-chain fashion. Each individual SATELLITE CABLE may be of indefinite length, so long as the total length of the SATELLITE ring does not exceed 1 km (3279 ft.).

As shown in Fig. 3.B.3.2(a), an external RS-485 converter connector is mounted on the rear panel of every "A-sized" DataPAC SATELLITE. This is required to convert the standard RS-232-C line configuration of the DataPAC's COMPUTER INTERFACE PORT to the *pin-to-pin RS-485 configuration* shown in Fig. 3.B.3.3. Attaching directly to the DataPAC's 25-pin COMPUTER INTERFACE CONNECTOR, the converter furnishes two 9-pin RS-485 connectors for connection either of two SATELLITE CABLES or of one SATELLITE CABLE and one NETWORK TERMINATOR.

For a "B-sized" DataPAC SATELLITE, a **Model 10BD1 Satellite Slave Card** is always used *in place of the DataPAC's COMPUTER INTERFACE PORT* to link the DataPAC to the network. This frees the COMPUTER INTERFACE PORT for connection to a computer, printer, or other external RS-232-C device. Like the 10BD4, the Model 10BD1 supplies two 9-pin RS-485 connectors for connection either of two SATELLITE CABLES or of one SATELLITE CABLE and one NETWORK TERMINATOR.

For an OPERATOR CONSOLE SATELLITE, the CONSOLE INTERFACE PORT is used to link the CONSOLE to the network. A "video" RS-485 converter connector is mounted on the rear of each Model 10CON or 10CCON. Attaching directly to the 25-pin CONSOLE INTERFACE PORT, this converter also furnishes two 9-pin SATELLITE INTERFACE CONNECTORS.

As shown in Fig. 3.B.3.2, a **Model 10T485 Network Terminator** should only be attached to one of the 9-pin connectors of the *last* SATELLITE INTERFACE in a given SATELLITE chain.

3.B.3.b

SATELLITE NETWORK SETUP

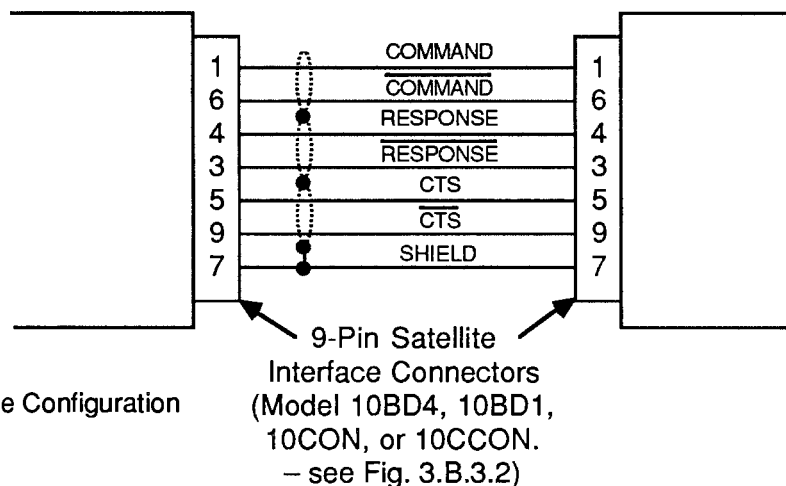


Fig. 3.B.3.3 RS-485 Satellite Cable Configuration

4. SETTING INTERFACE PROTOCOL FOR "A-SIZED" DATAPAC SATELLITES

The SATELLITE INTERFACE PORT furnished by the HOST DataPAC's Model 10BD4 is *preset* at the factory to recognize the following serial-ASCII interface protocol values, for both transmission and reception of data:

153.6K BAUD, 8 DATA BITS, 2 STOP BITS, ODD PARITY

(for an explanation of data-transfer "protocol," see Section 2.B.2 of this Guidebook).

Every SATELLITE SLAVE PORT (Model 10BD1) and CONSOLE INTERFACE PORT (Model 10CON or 10CCON) is also preset to recognize these same protocol values.

However, since every "A-SIZED" DataPAC SATELLITE connects to the network via its *COMPUTER INTERFACE PORT*, YOU MUST MAKE SURE THAT EACH SUCH INTERFACE IS SET TO RECOGNIZE THE ABOVE PROTOCOL VALUES. THIS IS ABSOLUTELY NECESSARY IN ORDER FOR PROPER DATA AND COMMAND INTERCHANGES BETWEEN THE DATAPAC AND THE SATELLITE NETWORK TO OCCUR.

You must therefore set the "A-sized" DataPAC's PROTOCOL SWITCHES to match the above (required) protocol. Consult Section 2.B.2(b) of this Guidebook for full instructions (remember that the **BAUD RATE (BAU)** command WILL NOT WORK WITH "A-SIZED" DATAPACS).

----- PLEASE NOTE -----

As explained in the *Appendix* to this Guidebook section, it is not an easy matter to change the network GLOBAL-CHANNEL and/or GLOBAL-BIT-GROUP assignments once these have been originally set up. In fact, the channel-range procedure involves the *COMPLETE RECONFIGURATION (INCLUDING RECALIBRATION) OF ALL ORIGINALLY ASSIGNED DATA CHANNELS FOR THE HOST DATAPAC AND ALL "B-SIZED" DATAPAC SATELLITES*. CAREFUL PLANNING PRIOR TO SETUP OF THE SATELLITE NETWORK CAN REDUCE THE PROBABILITY THAT A CHANGE OF THIS TYPE WILL BE NEEDED.

In particular, you may wish, during initial setup, to *add a number of DOWNLOAD PSEUDOCHANNELS ("TYPE D0") to the end of each SATELLITE SCAN RANGE*. This will allow for future expansion within each SATELLITE DataPAC and will reduce the likelihood of losing vital system calibration due to reconfiguration.

5. SETTING UP "GLOBAL" DATA CHANNELS

a. SETTING HOST AND SATELLITE SCAN RANGES: TER AND SCN COMMANDS

———— PLEASE NOTE ————

As mentioned in Section a.3, above, the procedures here given have been somewhat simplified for the sake of ease of setup. MORE COMPLEX TECHNIQUES INVOLVING RUN-TIME MODIFICATION OF SATELLITE SCAN RANGES FOR THE PURPOSE OF SPEED ENHANCEMENT ARE GIVEN IN APPENDIX K OF THIS GUIDEBOOK.

NOTE ALSO THAT OPERATOR CONSOLE SATELLITES DO NOT REQUIRE SCAN RANGE SETTINGS.

1. SETTING HOST SCAN RANGE

Set the HOST DataPAC to scan *all active GLOBAL DATA CHANNELS* by turning ON its EEPROM Switch and applying a **TERMINATOR (TER)** command of

TER = x [CR] *

where "x" is a Channel Number equal to that of the highest-numbered GLOBAL DATA CHANNEL to be dedicated to *any* DataPAC SATELLITE in the network. This command specifies a *powerup-default* SCAN RANGE from Channel No. 1 to and including Channel No. x.

For the simple network shown in Fig. 3.B.3.4, for example, you would set the HOST'S SCAN RANGE by designating Channel No. 320 (the network's highest *active* GLOBAL DATA CHANNEL) to be the TERMINATOR CHANNEL, via a command of

TER = 320 [CR] *

2. SETTING THE SCAN RANGE FOR EACH DATAPAC SATELLITE

For each DataPAC SATELLITE in the network, you should set a SCAN RANGE that contains all GLOBAL DATA CHANNELS to be "heard" by that SATELLITE—i.e., all channels you wish the SATELLITE to be able to read and/or display. For an "A-sized" DataPAC SATELLITE, this normally includes all channels dedicated to the SATELLITE via the **SATELLITE (SAT)** command (Section b.5(b), below), plus all 10BD4-downloaded channels that have been given a local "TYPE" code of "D4" (see Section b.5(c)). For a "B-sized" DataPAC SATELLITE, it normally includes all channels dedicated to the SATELLITE via the **SAT** command, plus all channels that have been locally "located" to the SATELLITE'S Model 10BD1 Satellite Slave Card (see Section b.5(d)).

If the lowest-numbered GLOBAL DATA CHANNEL to be "heard" by the SATELLITE in question is GLOBAL DATA CHANNEL No. 1, you may set the SATELLITE'S SCAN RANGE by means of the **TERMINATOR (TER)** command (see above). In this case, the specified TERMINATOR CHANNEL *for the SATELLITE* will be the highest-numbered GLOBAL DATA CHANNEL to be "heard" by the SATELLITE.

If the lowest-numbered GLOBAL DATA CHANNEL to be "heard" by the SATELLITE in question is higher than GLOBAL DATA CHANNEL No. 1, you may use the following **SCAN (SCN)** command, *having first turned ON the SATELLITE's EEPROM Switch* (though the **SCAN (SCN)** command is normally used as a "RUN-TIME" COMMAND, it may also be used,

3.B.3.b

SATELLITE NETWORK SETUP

as in the present case, to define a "default" SCAN RANGE for the DataPAC, when the DataPAC's EEPROM is enabled (see Section 1.F.1 of this Guidebook for full details)):

SCN = x, y [CR] *

where Channel No. x is the lowest-numbered GLOBAL DATA CHANNEL to be "heard" by the SATELLITE and Channel No. y is the highest.

b. DEDICATING GLOBAL CHANNELS TO DATAPAC SATELLITES AND TO THE HOST: **SAT** COMMAND

The **SATELLITE (SAT)** command lets you designate any DataPAC SATELLITE to be the exclusive "data origin" for a specific GLOBAL DATA CHANNEL or range of GLOBAL DATA CHANNELS. Whenever interrogated by the Model 10BD4, this DataPAC SATELLITE will communicate all "locally" acquired data for its "dedicated" channel(s) both to the 10BD4 itself and to all other members of the network.

You may use the "READ" form of the **LOCATE (LCT)** command at any time to learn the network member to which a given GLOBAL DATA CHANNEL has been dedicated, as well as the "local LOCATION" currently assigned to that channel (see Section c.2, below, for details).

———— IMPORTANT ————

The **SATELLITE (SAT)** command is always applied to the *HOST DataPAC*. In order for it to be effective, the HOST'S EEPROM Write Protect Switch must be ON. THE EEPROM SWITCH OF THE DATAPAC SATELLITE TO WHICH ONE OR MORE CHANNELS ARE BEING DEDICATED MUST ALSO BE ON.

The general form of the **SATELLITE (SAT)** command is

SAT n = x, y [CR] *

where $2 \leq x < y \leq 997$. This command designates SATELLITE No. n to be the sole "data origin" for GLOBAL DATA CHANNEL Nos. x through y. Specifically, it informs the 10BD4 that each channel within SATELLITE No. n's "LOCAL"-CHANNEL range of x through y will now serve as the sole data origin for the *like-numbered* "GLOBAL" CHANNEL.

Note that the lowest-numbered channel that can be dedicated to a SATELLITE is Channel No. 2; CHANNEL NO. 1 MUST ALWAYS BE DEDICATED TO THE HOST. Channel Nos. 998 and 999 are "LOCAL" CHANNELS only, and are always dedicated, respectively, to TIME and DATE.

A single-channel form of the **SAT** command is also possible:

SAT n = x [CR] *

where $2 \leq x \leq 997$. This form, however, will rarely be used.

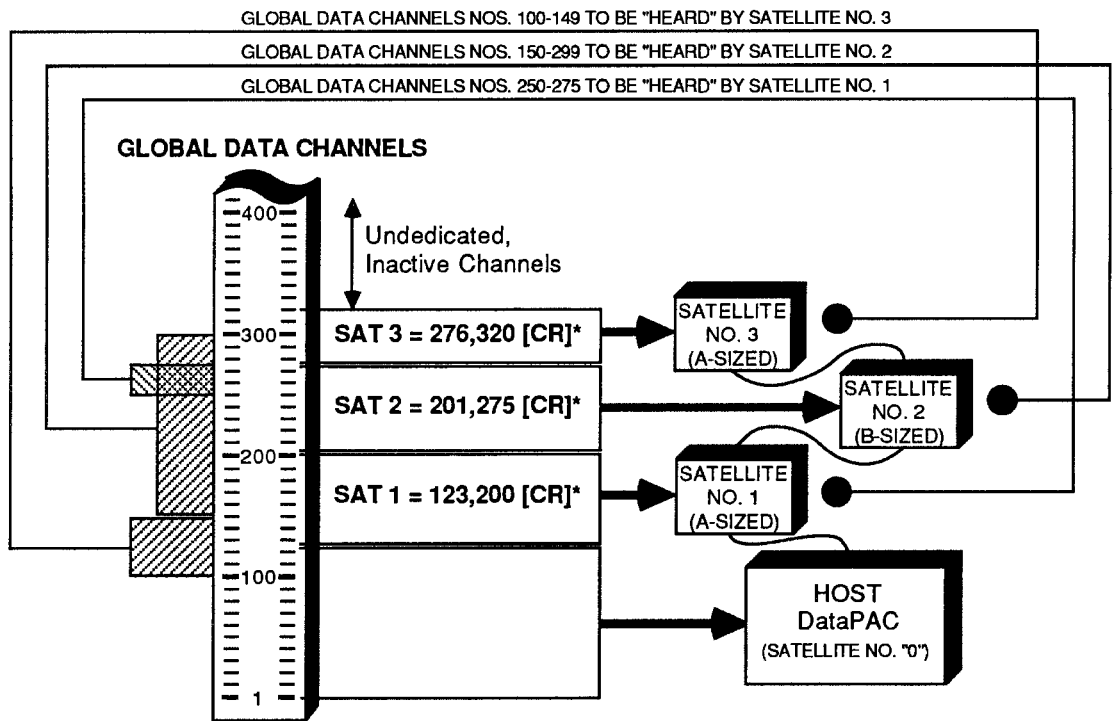
With reference to the **SAT** command, you should note that

- ANY AND ALL GLOBAL DATA CHANNELS *BELOW* THE LOWEST-NUMBERED CHANNEL DEDICATED TO ANY DATAPAC SATELLITE IN THE NETWORK WILL BE AUTOMATICALLY DEDICATED TO THE HOST. Since, as mentioned above, the lowest-numbered channel that can be dedicated to a SATELLITE is Channel No. 2, Channel No. 1 will *always* be dedicated to the HOST.

Note, however, that an interrogation of **SAT 0 [CR]** is not presently effective; it will not return the channel(s) currently dedicated to the HOST.

- ANY AND ALL GLOBAL DATA CHANNELS ABOVE THE HIGHEST-NUMBERED CHANNEL DEDICATED TO ANY DATAPAC SATELLITE WILL REMAIN INACTIVE AND WILL NOT BE USED BY THE SYSTEM.
- AS A GENERAL RULE, YOU SHOULD NOT LEAVE AN *UNDEDICATED*—AND THEREFORE *INACTIVE*—CHANNEL OR CHANNELS BETWEEN DEDICATED CHANNELS OR CHANNEL RANGES. That is, the total range of dedicated channels should be a *continuous* range, as in the example below.

Fig. 3.B.3.4 Setup of Global Data Channels



Consider, for example, the system shown in Fig. 3.B.3.4. In setting up the network, three **SATELLITE (SAT)** commands are communicated to the HOST:

SAT 1 = 123, 200 [CR] *

SAT 2 = 201, 275 [CR] *

SAT 3 = 276, 320 [CR] *

The first command designates SATELLITE No. 1 to be the "data origin" for GLOBAL CHANNEL Nos. 123 through 200; the second assigns GLOBAL CHANNEL Nos. 201 through 275 to SATELLITE No. 2; and the third assigns GLOBAL CHANNEL Nos. 276 through 320 to SATELLITE No. 3.

3.B.3.b

SATELLITE NETWORK SETUP

Since Channel No. 123 is the *lowest-numbered* channel dedicated to *any* SATELLITE, all channels below No. 123 (i.e., Nos. 1 through 122) are automatically dedicated to the HOST. And since Channel No. 320 is the *highest-numbered* channel dedicated to *any* SATELLITE, all channels above No. 320 remain inactive. Finally, the total range of dedicated channels is a *continuous* range, consisting as it does of three immediately adjacent subranges (123 to 200, 201 to 275, 276 to 320). It would have been inadvisable, for instance, to have dedicated Channel Nos. 123 through 174 to SATELLITE No. 1 and Channel Nos. 201 through 275 to SATELLITE No. 2, thus leaving Channel Nos. 175 through 200 as a range of *undedicated* channels between two successive dedicated ranges (see, however, Appendix K of this manual for exceptions to this rule).

———— NOTE ————

After one of a SATELLITE'S "LOCAL" DATA CHANNELS has been designated to be the sole "data origin" for the like-numbered "GLOBAL" CHANNEL, the existing setup characteristics of that local channel (TYPE, LOCATION, FILTER, LIMIT VALUES, etc.) *will be automatically assumed by the corresponding GLOBAL CHANNEL.*

THEREFORE, ANY MEMBER OF THE NETWORK (SATELLITE OR HOST) CAN NOW BE INTERROGATED FOR THESE SETUP VALUES. ALSO, ANY OF THESE VALUES CAN NOW BE *MODIFIED*, IF DESIRED, THROUGH AN APPROPRIATE SETUP COMMAND (**TYP**, **LCT**, **FIL**, **HIL**, **LOL**, etc.) ENTERED THROUGH ANY MEMBER OF THE NETWORK (SATELLITE OR HOST). See Sections c.1 through c.5, below, for the "global" routing of INTERROGATIVE and SETUP COMMANDS.

To *cancel* a **SAT** assignment, thus instructing SATELLITE No. n to stop communicating "locally acquired" analog data to the Model 10BD4, you may apply *to the HOST* a command of

SAT n = N/A [CR] *

———— NOTE ————

The above command serves to *disconnect* SATELLITE No. n from the network as an analog "data origin." It will have the effect of "*globally*" *resetting* all channels formerly dedicated to SATELLITE No. n by a previous **SAT** command. It will reset these channels, that is, *from the network's point of view (only)*. IT WILL NOT AFFECT THE EXISTING SETUP CHARACTERISTICS OF ANY OF SATELLITE NO. n'S OWN "LOCAL" CHANNELS. ONLY THE CORRESPONDING "GLOBAL" CHANNELS ARE RESET.

Thus, if you were to ask any member of the network for the "TYPE" or "LOCATION" of a GLOBAL DATA CHANNEL that has been reset via a **SAT n = N/A [CR] *** command applied to some *other* SATELLITE, you will get an answer of **DO** or **N/A**, respectively. However, if you follow a **SAT n = N/A [CR] *** command with an inquiry of **TYP x [CR]** or **LCT x [CR]** entered *at SATELLITE No. n itself*, you will be answered with the *local* "TYPE" or "LOCATION" designation still in effect for that SATELLITE'S Channel No. x. (This channel is now no longer "global"; it no longer serves as "data origin" for the network's like-numbered GLOBAL DATA CHANNEL, since the SATELLITE in which it resides has been effectively disconnected from the network. See Appendix K of this Guidebook for a consideration of "NONGLOBAL" SATELLITE DATA CHANNELS.)

C. SETTING AN "A-SIZED" DATAPAC SATELLITE TO "HEAR" GLOBAL CHANNELS NOT DEDICATED TO THAT SATELLITE: **DLC AND **TYP** COMMANDS**

To arrange for an "A-sized" DataPAC SATELLITE to be able to read and/or display one or more GLOBAL DATA CHANNELS that *have not been dedicated to that SATELLITE itself via an appropriate **SATELLITE (SAT)** command*, you should

1. SPECIFY GLOBAL CHANNELS TO BE DOWNLOADED TO ALL "A-SIZED" SATELLITES BY THE 10BD4

A **DOWNLOAD CHANNELS (DLC)** command should be applied to the *HOST DataPAC*, designating the GLOBAL DATA CHANNEL or range of GLOBAL DATA CHANNELS to be downloaded—with each 10BD4 scan cycle—to *every* "A-sized" DataPAC SATELLITE in the network. To so designate all GLOBAL DATA CHANNELS from Channel No. x to and including Channel No. y, command

DLC = x, y [CR] *

Here, Channel No. x is the lowest-numbered GLOBAL DATA CHANNEL to be "heard" by *any* "A-sized" DataPAC SATELLITE to which it has not been dedicated, while Channel No. y is the highest.

———— **NOTE** ————

Since the automatic downloading of channels by the 10BD4 slows down its overall scan speed, the **DLC** range should be kept *as short as possible*. It should only include those GLOBAL DATA CHANNELS which are to be "heard" by one or more "A-sized" DataPAC SATELLITES.

Like the **SAT** command, the **DLC** command also has a single-channel form, which is rarely used:

DLC = x [CR] *

You may *cancel* the 10BD4's automatic downloading of GLOBAL DATA CHANNELS to all "A-sized" SATELLITES by applying to the HOST a command of

DLC = N/A [CR] *

2. CHECK SATELLITE SCAN RANGE

Make sure that the "A-sized" DataPAC SATELLITE in question has been set to scan all of the 10BD4-downloaded GLOBAL DATA CHANNELS you want it to be able to read and/or display (see Section b.5(a), above). TO MAXIMIZE ITS OWN SCAN RATE, IT SHOULD NOT BE MADE TO SCAN CHANNELS IT DOES NOT NEED TO "HEAR."

3. RETYPE AS "D4" ALL DOWNLOADED CHANNELS TO BE "HEARD" BY THE SATELLITE

Apply one or more **TYPE (TYP)** commands to the "A-sized" DataPAC SATELLITE, in order to assign a local "TYPE" code of "D4" to each 10BD4-downloaded GLOBAL DATA CHANNEL which is to be "heard" by the SATELLITE and which has not been dedicated to the SATELLITE via the **SAT** command (see the example below). Be sure to turn ON the SATELLITE'S EEPROM Switch before entering the necessary **TYPE (TYP)** command(s).

3.B.3.b

SATELLITE NETWORK SETUP

REMEMBER THAT ANY GLOBAL DATA CHANNEL OR CHANNELS FOR WHICH THE "A-SIZED" DATAPAC SATELLITE IS ITSELF THE UNIQUE "DATA ORIGIN" SHOULD *NOT* BE GIVEN A LOCAL "TYPE" CODE OF "D4." SUCH CHANNELS ALREADY HAVE THEIR OWN LOCAL **TYP** ASSIGNMENTS AND ARE ALREADY "HEARD" BY THE SATELLITE.

For example, suppose that SATELLITE Nos. 1 and 3 in Fig. 3.B.3.4 are both "A-sized" DataPACs. Suppose too that, in addition to its "dedicated" range of Channel Nos. 123 through 200, you want SATELLITE No. 1 to be able to read Channel Nos. 250 through 275, and that you want SATELLITE No. 3 to be able to read Channel Nos. 100 through 149, in addition to its "dedicated" range of Channel Nos. 276 through 320.

You will first apply to the HOST DataPAC a command of

DLC = 100, 275 [CR] *

This defines the range of GLOBAL DATA CHANNELS to be downloaded with each 10BD4 scan cycle to *both* "A-sized" SATELLITES (since the lowest channel to be "heard" by an "A-sized" SATELLITE to which it has not been dedicated is No. 100, and the highest is No. 275). You should now make sure that each SATELLITE is set to scan all channels you want it to be able to read (including, of course, those which have been dedicated to it via the **SAT** command). Thus, for SATELLITE No. 1, the SCAN RANGE should be (at least) from Channel No. 123 through No. 275, and for SATELLITE No. 3, from Channel No. 100 through No. 320. Then apply to SATELLITE No. 1 a command of

TYP 250 TO 275 = D4 [CR] *

and to SATELLITE No. 3 a command of

TYP 100 TO 149 = D4 [CR] *

d. SETTING A "B-SIZED" DATAPAC SATELLITE TO "HEAR" GLOBAL DATA CHANNELS NOT DEDICATED TO THAT SATELLITE: **LCT** AND **RST** COMMANDS

Every OPERATOR CONSOLE SATELLITE will always "hear" all GLOBAL DATA CHANNELS—that is, it will always be able to *read* any GLOBAL CHANNEL when so interrogated or to *display* any GLOBAL CHANNEL when a "local" VIDEO PAGE FORMAT has been composed that contains a DATA FIELD for that channel.

Like an OPERATOR CONSOLE SATELLITE, a "B-sized" DataPAC SATELLITE will always be *in receipt* of all GLOBAL DATA. However, to arrange for the SATELLITE to be able to actually read and/or display one or more GLOBAL DATA CHANNELS that *have not been dedicated to that SATELLITE itself via an appropriate **SAT** command*, you should

1. "RELOCATE" ALL UNDEDICATED CHANNELS TO THE SATELLITE'S MODEL 10BD1

A special form of the **LOCATE (LCT)** command lets you "LOCATE" to the SATELLITE'S **Model 10BD1 Satellite Slave Card** a GLOBAL DATA CHANNEL or range of GLOBAL DATA CHANNELS *outside* the range of channels dedicated to the SATELLITE itself. The 10BD1 becomes the *local* "LOCATION" for each such channel—that is, its apparent physical origin *from the SATELLITE'S point of view (only)*. With each of its own scan cycles, the SATELLITE'S CENTRAL PROCESSOR will thus be referred to the 10BD1 for the channel's current data value. Note that we do *not* thereby specify an actual "local physical origin" for the channel at the SATELLITE in question; this origin continues to reside in the particular network member to which the channel has been dedicated via the **SATELLITE (SAT)** command.

If the Model 10BD1 occupies the SATELLITE'S B SLOT No. *s*, then to "LOCATE" to the 10BD1 all GLOBAL DATA CHANNELS from Channel No. *x* through Channel No. *y*, you would apply the following command *to the SATELLITE itself*, after turning ON its EEPROM Switch:

LCT x TO y = s [CR] *

Like the **SAT** and **DLC** commands, the **LCT** command also has a single-channel form, which is rarely used in this application:

LCT x = s [CR] *

REMEMBER THAT ANY GLOBAL DATA CHANNEL OR CHANNELS FOR WHICH THE "B-SIZED" DATAPAC SATELLITE IS ITSELF THE UNIQUE "DATA ORIGIN" SHOULD *NOT* BE LOCALLY "LOCATED" TO THE SATELLITE'S MODEL 10BD1 CARD. SUCH CHANNELS ALREADY HAVE THEIR OWN LOCAL **LCT** ASSIGNMENTS AND ARE ALREADY "HEARD" BY THE SATELLITE.

Because for each "B-sized" DataPAC SATELLITE there will almost always be a range of GLOBAL DATA CHANNELS dedicated to the SATELLITE itself via the **SAT** command, the multichannel "B-SLOT **LCT**" command will in most cases have to be applied *twice*: once with reference to all GLOBAL DATA CHANNELS *below the lowest-numbered channel* dedicated to the SATELLITE, and the second time with reference to all GLOBAL DATA CHANNELS *above the highest-numbered channel* dedicated to the SATELLITE. As in the example below, the second **LCT** command may include *inactive* GLOBAL DATA CHANNELS—i.e., those above the total range of dedicated channels—without detriment to system speed or operation.

2. CHECK SATELLITE SCAN RANGE

Make sure that the "B-sized" DataPAC SATELLITE in question has been set to scan all GLOBAL DATA CHANNELS you want it to be able to read and/or display (see Section b.5(a), above).

Refer again to Fig. 3.B.3.4. GLOBAL DATA CHANNEL Nos. 201 through 275 have been dedicated to SATELLITE No. 2 via the second **SATELLITE (SAT)** command. Suppose that this SATELLITE is a "B-sized" DataPAC whose Model 10BD1 occupies B SLOT No. 4. Suppose too that you want the SATELLITE to be able to read and display all GLOBAL DATA CHANNELS from Channel No. 150 through Channel No. 299. Two **LOCATE (LCT)** commands should first be applied to SATELLITE No. 2:

LCT 1 TO 200 = 4 [CR] * and **LCT 276 TO 997 = 4 [CR] ***

This "locates" to the 10BD1 *all* GLOBAL DATA CHANNELS outside the range of channels dedicated to the SATELLITE itself (Nos. 201 through 275). You should then set the SATELLITE'S SCAN RANGE to include all channels you want it to be able to read and display (including, of course, those which have been dedicated to it via the **SAT** command). In the present example, this SCAN RANGE should be (at least) from Channel No. 150 through No. 299.

To *discontinue* the reading of a given channel or range of channels by a "B-sized" DataPAC SATELLITE, you may change the SATELLITE'S current SCAN RANGE, if possible, to exclude the channel(s) in question. Or you may issue *to the SATELLITE itself* a **RESET (RST)** command of either

RST x [CR] * or **RST x TO y [CR] ***

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———— NOTE ————

A **RESET (RST)** COMMAND IS NECESSARY IF YOU WISH TO ASSIGN A NEW LOCAL "LOCATION" TO ANY CHANNEL CURRENTLY "LOCATED" TO A SATELLITE'S MODEL 10BD1 SATELLITE SLAVE CARD. Since it is not "implicitly addressed" (Section c.1), **RST** will only reset the "local" characteristics of the channel or channels to which it applies; IT WILL NOT RESET THE CHANNEL OR CHANNELS "GLOBALLY."

6. SETTING UP "GLOBAL" LOGIC BITS

———— NOTE ————

The procedures in this section are largely analogous to those given in Section b.5, above, for dedicating GLOBAL DATA CHANNELS to network members, and for setting an "A-" or "B-sized" DataPAC SATELLITE to "hear" GLOBAL DATA CHANNELS that are not dedicated to it. NOTE, HOWEVER, THAT WHEN LOGIC BITS ARE INVOLVED, YOU NEED NOT WORRY ABOUT "SCAN RANGE." YOU MUST, HOWEVER, BE SURE THAT THE **BITS (BTS)** COMMAND IS IN EFFECT FOR BOTH THE HOST DATAPAC AND THE DATAPAC SATELLITE IN QUESTION (see Section 2.H.5 of this Guidebook). **BTS** is in effect, by default, on DataPAC powerup.

Note too that any DataPAC SATELLITE may be loaded with **EXECUTE (EXU)** command strings, each of which will be automatically triggered on perception *by the SATELLITE* of the logic-state transition of a specified GLOBAL LOGIC BIT (see Section 2.K. of this Guidebook for a full description of the **EXECUTE (EXU)** command). Obviously, the DataPAC SATELLITE must be capable of *reading* any and all "trigger bits" assigned to its individual **EXU** function(s). See also Section b.8, below, for the setup of a SATELLITE'S "EXECUTE BASE GROUPS."

a. DEDICATING GLOBAL BIT GROUPS TO DATAPAC SATELLITES AND TO THE HOST: **SSB COMMAND**

———— NOTE ————

YOU CANNOT ASSIGN A LOCAL "DATA ORIGIN" TO AN *INDIVIDUAL* GLOBAL LOGIC BIT. YOU CAN ONLY DEDICATE GLOBAL LOGIC BITS TO PARTICULAR SATELLITES IN TERMS OF 16-MEMBER **BIT GROUPS**.

ALSO, DO NOT CONFUSE THE ASSIGNING OF A UNIQUE "DATA ORIGIN" (SATELLITE) TO A GIVEN GLOBAL BIT GROUP WITH THE ASSIGNING OF A UNIQUE LOCAL "LOGIC SOURCE" TO EACH BIT WITHIN THAT GROUP (see Section 2.H of this Guidebook for a full discussion of BIT GROUPS and LOGIC SOURCES).

The **SATELLITE SYSTEM BITS (SSB)** command lets you designate any DataPAC SATELLITE to be the exclusive "data origin" for a specific GLOBAL BIT GROUP or range of GLOBAL BIT GROUPS.

You may use the "READ" form of the **LOGIC SOURCE (SRC)** command at any time to learn the network member to which a given GLOBAL LOGIC BIT (*not* BIT GROUP) has been dedicated, and also the *local* LOGIC SOURCE currently assigned to that bit (see Section c.3, below, for details).

———— IMPORTANT ————

As with the **SATELLITE (SAT)** command, the **SATELLITE SYSTEM BITS (SSB)** command is always applied *to the HOST DataPAC*. In order for it to be effective, the HOST'S EEPROM Write Protect Switch must be ON. THE EEPROM SWITCH OF THE SATELLITE TO WHICH ONE OR MORE BIT GROUPS ARE BEING DEDICATED MUST *ALSO* BE ON.

The general form of the **SATELLITE SYSTEM BITS (SSB)** command is either

or	SSB n = k [CR] *	NOTE: The number "n" should be from 1 through 99; it should NEVER be "0."
	SSB n = k, l [CR] *	

depending on whether you wish to dedicate to DataPAC SATELLITE No. n a single GLOBAL BIT GROUP (No. k) or a continuous range of GLOBAL BIT GROUPS (Nos. k through l).

For example, a command of

SSB 10 = 2, 4 [CR] *

establishes each LOGIC BIT within SATELLITE No. 10's BIT GROUP Nos. 2, 3, and 4 as the sole "data origin" for the corresponding (*like-numbered*) GLOBAL BIT.

With reference to the **SSB** command, you should note that

- ANY AND ALL GLOBAL BIT GROUPS *BELOW* THE LOWEST-NUMBERED BIT GROUP DEDICATED TO ANY DATAPAC SATELLITE IN THE NETWORK WILL BE AUTOMATICALLY DEDICATED *TO THE HOST*. Note, however, that an interrogation of **SSB 0 [CR]** is not presently effective; it will not return the BIT GROUP(S) currently dedicated to the HOST.
- ANY AND ALL GLOBAL BIT GROUPS *ABOVE* THE HIGHEST-NUMBERED BIT GROUP DEDICATED TO ANY DATAPAC SATELLITE WILL REMAIN INACTIVE AND WILL NOT BE USED BY THE SYSTEM.
- THE TOTAL RANGE OF DEDICATED BIT GROUPS NEED *NOT* BE A CONTINUOUS RANGE.

———— NOTE ————

After one of a SATELLITE'S "LOCAL" BIT GROUPS has been designated to be the sole "data origin" for the like-numbered "GLOBAL" BIT GROUP, the existing LOGIC-SOURCE assignment for each bit in the local BIT GROUP *will be automatically assumed by the corresponding GLOBAL BIT*.

THEREFORE, ANY MEMBER OF THE NETWORK (SATELLITE OR HOST) CAN NOW BE INTERROGATED FOR THE LOGIC SOURCE OF ANY BIT WITHIN THIS BIT GROUP. ALSO, THIS LOGIC-SOURCE ASSIGNMENT CAN NOW BE *MODIFIED*, IF DESIRED, THROUGH AN APPROPRIATE **LOGIC SOURCE (SRC)** COMMAND ENTERED THROUGH ANY MEMBER OF THE NETWORK (SATELLITE OR HOST). See Sections c.1 through c.5, below, for the "global" routing of INTERROGATIVE and SETUP COMMANDS.

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To *cancel* an **SSB** assignment, thus instructing SATELLITE No. n to stop communicating "locally acquired" logic data to the Model 10BD4, you may apply to the *HOST* a command of

SSB n = N/A [CR] *

———— NOTE ————

The above command serves to *disconnect* SATELLITE No. n from the network as a logic "data origin." It will have the effect of "*globally*" *re-sourcing* all bits formerly dedicated to SATELLITE No. n by a previous **SSB** command. It will re-source these bits, that is, *from the network's point of view (only)*. IT WILL NOT AFFECT THE EXISTING LOGIC-SOURCE ASSIGNMENTS OF ANY OF SATELLITE NO. n'S OWN "LOCAL" BITS. ONLY THE CORRESPONDING "GLOBAL" LOGIC BITS ARE RE-SOURCED.

Thus, if you were to ask any member of the network for the LOGIC SOURCE of a GLOBAL LOGIC BIT that has been re-sourced via an **SSB n = N/A [CR] *** command applied to some *other* SATELLITE, you will get an answer of **EXT, NON**. However, if you follow an **SSB n = N/A [CR] *** command with an inquiry of **SRC r [CR]** entered at SATELLITE No. n itself, you will be answered with the *local* LOGIC-SOURCE still in effect for that SATELLITE'S Bit No. r. (This bit is now no longer "global"; it no longer serves as "data origin" for the network's like-numbered GLOBAL LOGIC BIT, since the SATELLITE in which it resides has been effectively disconnected from the network. See Appendix K of this Guidebook for a consideration of "NONGLOBAL" SATELLITE DATA CHANNELS.)

b. SETTING AN "A-SIZED" DATAPAC SATELLITE TO "HEAR" GLOBAL LOGIC BITS NOT DEDICATED TO THAT SATELLITE: **DLB** AND **SRC** COMMANDS

1. SPECIFY GLOBAL BIT GROUPS TO BE DOWNLOADED TO ALL "A-SIZED" SATELLITES BY THE 10BD4

A **DOWNLOAD BITS (DLB)** command should be applied to the *HOST DataPAC*, designating the GLOBAL BIT GROUP or range of GLOBAL BIT GROUPS to be downloaded—with each 10BD4 scan cycle—to *every* "A-sized" DataPAC SATELLITE in the network. Command, respectively,

DLB = k [CR] * or **DLB = k, l [CR] ***

This command is analogous to the **DOWNLOAD CHANNELS (DLC)** command discussed in Section b.5(c), above (see this section for details and example).

———— NOTE ————

Since the automatic downloading of BIT GROUPS by the 10BD4 slows down its overall scan speed, the **DLB** range should be kept *as short as possible*. It should include only those GLOBAL BIT GROUPS to be "heard" by one or more "A-sized" DataPACs.

To *cancel* the 10BD4's automatic downloading of GLOBAL BIT GROUPS to all "A-sized" SATELLITES, apply to the *HOST* a command of

DLB = N/A [CR] *

2. RE-SOURCE AS "SAT" ALL DOWNLOADED BITS TO BE "HEARD" BY THE SATELLITE

Apply to the "A-sized" DataPAC one or more **LOGIC SOURCE (SRC)** commands of the single-bit or range form—

SRC r = SAT [CR] * or **SRC r TO q = SAT [CR] ***

respectively—in order to assign a local LOGIC SOURCE of "SAT" to each GLOBAL LOGIC BIT within the GLOBAL BIT GROUP(S) specified by the **DLB** command, above, which is to be "heard" by the SATELLITE and which has not been dedicated to the SATELLITE via the **SSB** command.

REMEMBER THAT ANY GLOBAL LOGIC BIT CONTAINED IN A BIT GROUP FOR WHICH THE "A-SIZED" DATAPAC SATELLITE IS ITSELF THE UNIQUE "DATA ORIGIN" SHOULD NOT BE GIVEN A LOCAL LOGIC SOURCE OF "SAT." SUCH BITS ALREADY HAVE THEIR OWN LOCAL **SRC** ASSIGNMENTS AND ARE ALREADY "HEARD" BY THE SATELLITE (ASSUMING THE **BTS** COMMAND IS IN EFFECT).

C. SETTING A "B-SIZED" DATAPAC SATELLITE TO "HEAR" GLOBAL LOGIC BITS NOT DEDICATED TO THAT SATELLITE: SRC AND NOB COMMANDS

A special form of the **LOGIC SOURCE (SRC)** command lets you "source" to the SATELLITE'S **Model 10BD1 Satellite Slave Card** a GLOBAL LOGIC BIT or range of GLOBAL LOGIC BITS *outside* the range of BIT GROUPS dedicated to the SATELLITE itself. The 10BD1 becomes the *local* LOGIC SOURCE for each such bit—that is, its apparent bit-state determinant *from the SATELLITE'S point of view (only)*. With each of its own scan cycles, the SATELLITE'S CENTRAL PROCESSOR will thus be referred to the 10BD1 for the bit's current state. Note that we do *not* thereby specify an actual "LOGIC SOURCE" for the bit at the SATELLITE in question; this continues to reside in the particular network member to which the bit has been dedicated via the **SATELLITE SYSTEM BITS (SSB)** command.

If the Model 10BD1 occupies the SATELLITE'S B SLOT No. *s*, then to "source" to the 10BD1 all GLOBAL LOGIC BITS from Bit No. *r* through Bit. No. *q*, you would apply the following command *to the SATELLITE itself*, after turning ON its EEPROM Switch:

SRC r TO q = Bs [CR] *

In this command, the letter "B" must immediately precede the B-SLOT No. "*s*."

The **SRC** command also has a single-bit form, which is rarely used in this application:

SRC r = Bs [CR] *

Note that, unlike the **SATELLITE SYSTEM BITS (SSB)** and **DOWNLOAD BITS (DLB)** commands, above, the **LOGIC SOURCE (SRC)** command refers to one or a range of *individual LOGIC BITS*, and not to one or a range of BIT GROUPS.

REMEMBER TOO THAT ANY GLOBAL BIT CONTAINED IN A BIT GROUP FOR WHICH THE "B-SIZED" DATAPAC IS ITSELF THE UNIQUE "DATA ORIGIN" SHOULD NOT BE LOCALLY "SOURCED" TO THE SATELLITE'S MODEL 10BD1. SUCH BITS ALREADY HAVE THEIR OWN LOCAL **SRC** ASSIGNMENTS AND ARE ALREADY "HEARD" BY THE SATELLITE (ASSUMING THE **BTS** COMMAND IS IN EFFECT).

The "range" form of the "B-SLOT **SRC**" command will in almost all cases have to be applied *twice*: once with reference to all GLOBAL LOGIC BITS below the lowest-numbered bit of the lowest-numbered BIT GROUP dedicated to the SATELLITE, and the second time with reference to all GLOBAL LOGIC BITS above the highest-numbered bit of the highest-numbered BIT GROUP dedicated to the SATELLITE. The second **SRC** command may include

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inactive GLOBAL LOGIC BITS—i.e., those above the total range of dedicated BIT GROUPS—without detriment to system speed or operation.

For example, suppose that a given "B-sized" DataPAC SATELLITE has been made the "data origin" for GLOBAL BIT GROUP Nos. 3 through 5 (total system GLOBAL LOGIC-BIT capacity is always 1000). The LOGIC-BIT range that corresponds to this BIT-GROUP range is Bit No. 32 through Bit No. 79. The SATELLITE'S Model 10BD1 Satellite Slave Card occupies B SLOT No. 2. In setting up this SATELLITE, you would therefore issue to it the following **SRC** commands:

SRC 0 TO 31 = B2 [CR] * and **SRC 80 TO 999 = B2 [CR] ***

To discontinue the "hearing" of *all* LOGIC BITS by a "B-sized" DataPAC SATELLITE (including those that have been dedicated to it via the **SSB** command), you can instruct the SATELLITE'S CENTRAL PROCESSOR to stop the scanning of bits by applying to the SATELLITE a **NO BITS (NOB)** command:

NOB [CR]

(see Section 2.H.5 of this Guidebook—this command will also disable all **EXECUTE (EXU)** functions for the SATELLITE).

To discontinue the "hearing" of a given *range* of GLOBAL LOGIC BITS (Nos. *r* through *q*) that have been locally "sourced" to the SATELLITE'S Model 10BD1, you can "re-source" them to "EXTERNAL" by applying to the SATELLITE a command of

SRC r TO q = EXT [CR] *

7. SETTING HOST AND SATELLITES FOR LOCAL DATA ACQUISITION AND FOR DISPLAY OF GLOBAL DATA

FOR EVERY OPERATOR CONSOLE SATELLITE IN THE NETWORK, apply to the HOST DataPAC a command of

SAT n = CON [CR] *

where "n" is the respective SATELLITE NUMBER.

Each member of the network should now be set up with regard to *its own independent data-acquisition, process-control, and/or data-display functions.*

You are here referred to the relevant sections of this Guidebook. See the Table of Contents. Among the most important "local" setup procedures are

- a. DataPAC POWERUP and KEYBOARD CONNECTION (Sections 1.B and 1.C)
- b. CABLING OF ANALOG INPUTS (Section 1.E)
- c. CRT VIDEO SETUP of "B-sized" DataPACs and OPERATOR CONSOLES (Sections 1.D.2 and 2.C); LCD VIDEO SETUP of certain "A-sized" DataPAC SATELLITES (Sections 1.D.1 and 2.Q)
- d. DataPAC "REAL"-CHANNEL CONFIGURATION and CALIBRATION (Section 1.G)
- e. DATA-CHANNEL LIMIT SETUP (Section 2.F)
- f. PSEUDOCCHANNEL SETUP (Sections 2.D, 2.J, 2.L, 2.M, 3.B.4(d.8), etc.)
- g. SETUP OF LOGIC BITS (Section 2.H)

- h. SETUP OF LOGIC I/O for optional Model 10AIO-16 or 10BIO-16 (Section 3.A.3 or 3.B.2)
- i. CABLING AND SETUP OF "B-SIZED" DATAPAC'S COMPUTER INTERFACE PORT AND OPTIONAL AUXILIARY COMPUTER INTERFACE PORT (ACI) (Sections 2.B and 3.B.5)
- j. SETUP OF **EXECUTE (EXU)** and **COMMAND (CMD)** FUNCTIONS (the latter for "B-sized" DataPACs only—Section 2.K and also Section b.8, below)

Note that since most DATA-CHANNEL SETUP COMMANDS are "implicitly addressed," they will be automatically routed to the specific network members to which they apply, when entered either at the HOST or at any "B-sized" DataPAC SATELLITE where the **GBL = ON [CR]** command is in effect (see Section c.1, below). Note too that *any* SETUP COMMAND can be "explicitly" routed to any given network member from any other network member, using the **OPEN (OPN)** or **NODE (NOD)** command (see Section c.5).

"Implicit" or "explicit" routing of SETUP COMMANDS can only be done, of course, after the SATELLITES involved have been assigned their respective SATELLITE NUMBERS (via the **ASN** command) and the required network interface has been fully established. In order for a "routed" SETUP COMMAND to be effective, the recipient SATELLITE'S EEPROM Write Protect Switch must be ON.

8. SETTING SATELLITE "EXECUTE BASE GROUPS": **XBG** COMMAND

In a SATELLITE NETWORK, each DataPAC SATELLITE can have its own group of 32 **EXECUTE (EXU)** strings, independent of all other SATELLITES. Each **EXU** string contained in a DataPAC SATELLITE may be triggered by any GLOBAL LOGIC BIT which is "heard" by that SATELLITE (see Section b.6, above).

The two BIT GROUPS used by a DataPAC to trigger **EXECUTE (EXU)** command strings constitute the DataPAC's "EXECUTE BASE GROUP." Normally a DataPAC is initially set to use its first two BIT GROUPS (i.e., Bit Nos. 0 through 31) for this purpose.

It will usually be desirable to assign to every DataPAC SATELLITE which is to be loaded with its own **EXECUTE (EXU)** strings an EXECUTE BASE GROUP *different* from that of any other DataPAC in the system, including the HOST. (This would not be case, however, if you ever wanted two or more DataPACs to simultaneously execute individual command strings on the logic-state transition of one single GLOBAL BIT.)

By means of the **EXECUTE BASE GROUP (XBG)** command, you can assign a DataPAC's **EXECUTE (EXU)** statements to the bits of *any two* BIT GROUPS, which need not be contiguous. The application of the **XBG** command is fully discussed in Section 2.K.2(c) of this manual.

Suppose, for example, that you want the HOST DataPAC to continue to use the first two GLOBAL BIT GROUPS for its **EXU** functions, while GLOBAL BIT GROUP Nos. 3 and 4 (i.e., GLOBAL BIT Nos. 32 through 63) are to be assigned to the **EXU** functions of a given DataPAC SATELLITE. You should then issue the following commands *to the DataPAC SATELLITE*, after turning ON its EEPROM Switch:

XBG 1 = 3 [CR] * and XBG 2 = 4 [CR] *

If the SATELLITE has no keyboard (Model 10KU, 10K1, 10K4, etc.), you can send the **XBG** commands to the SATELLITE *via the HOST'S keyboard*, using the **OPEN (OPN)** or **NODE (NOD)** command, as explained in Section c.5, below, once a SATELLITE NUMBER has been assigned to the SATELLITE.

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1. INTRODUCTION: GLOBAL COMMANDS

———— NOTE ————

For convenience in discussing the following "RUN-TIME" operations, we will call any member of the network (HOST or SATELLITE) a "NODE." Individual NODES, including the HOST DataPAC, are distinguished by their respective "SATELLITE NUMBERS" (see Section b.2, above). The SATELLITE NUMBER of the HOST is always "0."

A "GLOBAL COMMAND" is a command intended for a network NODE other than the one at which the command is actually entered. Such a command is said to be "IMPLICITLY ADDRESSED" if, having been entered at any "B- sized" DataPAC NODE where the **GBL = ON [CR]** command is in effect (see below), it is then automatically routed to the one specific "A-" or "B-sized" DataPAC NODE to which it applies. By virtue of the GLOBAL DATA CHANNEL(S) or GLOBAL LOGIC BIT(S) contained in the command itself, the HOST DataPAC's CENTRAL PROCESSOR knows immediately to which DataPAC NODE an implicitly addressed command is to be sent. It therefore needs no other ("explicit") instructions—such as an **OPEN (OPN)** or **NODE (NOD)** command—to direct the command to the proper DataPAC NODE.

For example, when entered at a "B-sized" NODE where the **GBL = ON [CR]** command is in effect, the HOST DataPAC knows immediately that a command of

HIL 593 [CR]

is meant for the DataPAC SATELLITE to which GLOBAL DATA CHANNEL No. 593 has been dedicated; or that a command of

SRC 21 = INP, NON [CR] *

is meant for the DataPAC SATELLITE to which GLOBAL BIT GROUP No. 2 (Bit Nos. 16 through 31) has been dedicated. Each of these commands contains its own "implicit address."

Implicitly addressed CHANNEL-related commands are as follows (except for **CHN**, both "WRITE" and "READ" forms are included):

**ANO, BEE, "CHN=", CLC, CON, DEC, EMM, FIL, FRC, FRQ, HIL, INC,
LBT, LCT, LGT, LLT, LOL, MVV, SHN, SHP, TAR, TYP, ZRO**

Note that while the "WRITE" form of the **CHANNEL (CHN)** command is implicitly addressed, the "READ" form is *not*. Thus, to an interrogation of the form **CHN x [CR]**, the "local" channel value will always be returned.

Note too that the **RESET (RST)** command is not in the above list; though it contains a specific DATA-CHANNEL argument, a GLOBAL **RST** command *must be "explicitly" routed* to be effective.

The only implicitly addressed BIT-related command (both "WRITE" and "READ") is **LOGIC SOURCE (SRC)**.

IF A GIVEN COMMAND IS *NOT* IMPLICITLY ADDRESSED, THEN IN ORDER TO BE SENT FROM ONE NODE TO ANOTHER, IT MUST BE "EXPLICITLY" ADDRESSED BY MEANS OF THE **OPEN (OPN)** OR **NODE (NOD)** COMMAND, AS EXPLAINED IN SECTION c.5, BELOW.

The **GLOBAL (GBL)** command, discussed in Section c.4, below, may be used to disable the transmission of implicitly addressed commands from a given "B-sized" DataPAC NODE. To be effective, any GLOBAL COMMAND entered at a NODE at which the **GBL = OFF [CR]** command is in effect must be "explicitly addressed."

———— NOTE ————

GLOBAL COMMANDS CAN NOT BE "IMPLICITLY" ROUTED FROM AN "A-SIZED" DATAPAC SATELLITE OR FROM AN OPERATOR CONSOLE SATELLITE, FOR BOTH OF WHICH THE **GBL = OFF [CR]** CONDITION IS ALWAYS IN EFFECT. While such a SATELLITE may always *receive* "implicitly addressed" commands, any GLOBAL COMMAND to be *issued by* an "A-sized" DataPAC or OPERATOR CONSOLE SATELLITE must be "explicitly" routed via the **OPEN (OPN)** or **NODE (NOD)** command, as explained in Section c.5, below.

Because it is implicitly addressed, a **LOCATE (LCT)** or **LOGIC SOURCE (SRC)** interrogation referring to any GLOBAL DATA CHANNEL or GLOBAL LOGIC BIT can be entered at any "B-sized" NODE where the **GBL = ON [CR]** command is in effect. See Sections c.2 and c.3, below. It is also possible to enter at any such NODE the "range" forms of these commands (i.e., the **LCT x TO y** and **SRC r TO q** forms)—or of any other implicitly addressed "READ" or "WRITE" COMMAND.

When so doing, however, please note that IN ANY ONE GLOBAL COMMAND OF THE "RANGE" FORM, THE SPECIFIED RANGE CANNOT EXCEED THE RANGE OF CHANNELS OR BITS DEDICATED TO A SINGLE SATELLITE, OR "OVERLAP" BETWEEN DIFFERENT SATELLITES. THIS RULE ONLY APPLIES TO GLOBAL SETUP AND INTERROGATION COMMANDS THAT ARE "IMPLICITLY ADDRESSED."

For example, suppose that Channel Nos. 100 through 149 have been dedicated to one SATELLITE DataPAC, and Channel Nos. 150 through 199 to another. A GLOBAL COMMAND (entered, say, at the HOST DataPAC) of

HIL 125 TO 175 [CR]

would not be permitted, since it "crosses SATELLITE boundaries." Instead, you must respect the fact that two separately dedicated channel ranges are here involved by entering two different GLOBAL COMMANDS:

HIL 125 TO 149 [CR] and **HIL 150 TO 175 [CR]**

Note, however, that an interrogation of **HIL 125 TO 175 [CR]** may be legitimately entered as a LOCAL COMMAND to any given network DataPAC (SATELLITE or HOST) or may be "explicitly" routed to any given DataPAC via an **OPEN (OPN)** or **NODE (NOD)** command. A COMMAND OF THE "RANGE" FORM NEED OBSERVE SATELLITE BOUNDARIES ONLY WHEN IT IS ENTERED AS AN *IMPLICITLY ADDRESSED GLOBAL COMMAND*.

2. REQUESTING THE "LOCATION" OF A GLOBAL DATA CHANNEL FROM ANY "B-SIZED" DATAPAC NODE: LCT COMMAND

If at any time during normal operation you need to know the network DataPAC (SATELLITE or HOST) to which a given GLOBAL DATA CHANNEL No. x has been dedicated via the **SATELLITE (SAT)** command—and/or the true local "LOCATION" of Channel No. x—you may enter the following **LOCATE (LCT)** interrogation at any "B-sized" NODE where the **GBL = ON [CR]** command is in effect:

LCT x [CR]

The interrogated "B-sized" NODE will return an answer of

LCT x = n, s

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where "n" is the SATELLITE NUMBER of the network DataPAC to which Channel No. x has been dedicated, and where "s" is the channel's "LOCATION" with respect to that DataPAC. The variable "s" is a standard "LOCATION" designation (see Sections 1.G.2 and 3.B.5(c.7) of this Guidebook, and also the listing of "s" values under the **LCT** mnemonic, Section 4.B).

If, however, **LCT x [CR]** is asked of the DataPAC NODE *to which Channel No. x has been dedicated via the **SAT** command*, the reply will *not* contain the SATELLITE NUMBER "n" of that NODE, but will only give the channel's local "LOCATION" ("s").

This NONGLOBAL ("s" only) response is also possible if the interrogated NODE is an "A-sized" DataPAC SATELLITE or a "B-sized" DataPAC NODE where the **GBL = OFF [CR]** command is in effect (see Section c.4, below) and where Channel No. x is neither dedicated to that NODE nor "located" to the NODE'S Model 10BD1 Satellite Slave Card. YOU SHOULD BE AWARE THAT, IN THE LATTER CASE, A "LOCAL" ANSWER MAY BE RETURNED FOR THE **LCT x [CR]** INTERROGATION WHICH IN NO WAY REFLECTS THE *TRUE PHYSICAL ORIGIN* OF GLOBAL DATA CHANNEL NO. x WITHIN THE NETWORK (see Appendix K for details).

REMEMBER

THE "GLOBAL" ("n, s") RESPONSE TO THE **LCT x [CR]** INTERROGATION IS POSSIBLE ONLY WHEN THE COMMAND IS "IMPLICITLY" ROUTED FROM THE INTERROGATED "B-SIZED" DATAPAC.

If the **LCT x [CR]** interrogation is "explicitly" communicated to a given "B-sized" NODE—via an **OPEN (OPN)** or **NODE (NOD)** command, or via the NODE'S own keyboard, COMPUTER INTERFACE PORT, or AUXILIARY COMPUTER INTERFACE PORT—and if Channel No. x is a channel not dedicated to that NODE but which has been "located" to its Model 10BD1 Satellite Slave Card (as explained in Section b.5(d), above), then two other responses are possible:

- a. **Ss**, where "s" is the number of the B SLOT occupied by the 10BD1 (representing the "local LOCATION" of Channel No. x, this answer is given when the **GBL = OFF [CR]** command is in effect at the interrogated "B-sized" NODE); or
- b. **NO RESPONSE**, when the **GBL = ON [CR]** command is in effect (this is because, as mentioned in Section c.5, below, the "explicit" and "implicit" addressing of a given command are mutually exclusive; therefore,, you cannot "explicitly" request a given NODE to originate an "implicitly addressed" GLOBAL INTERROGATION of **LCT x [CR]**).

3. REQUESTING THE "LOGIC SOURCE" OF A GLOBAL LOGIC BIT FROM ANY "B-SIZED" DATAPAC NODE: **SRC** COMMAND

If at any time during normal operation you need to know the network DataPAC (SATELLITE or HOST) to which a given GLOBAL LOGIC BIT No. r has been dedicated via the **SATELLITE SYSTEM BITS (SSB)** command—and/or the true local LOGIC SOURCE of Bit No. r—you may enter the following **LOGIC SOURCE (SRC)** interrogation at any "B-sized" NODE where the **GBL = ON [CR]** command is in effect:

SRC r [CR]

The interrogated "B-sized" NODE will return an answer of

SRC r = n, s

where "n" is the SATELLITE NUMBER of the network DataPAC to which the BIT GROUP containing Bit No. r has been dedicated, and "s" is the bit's LOGIC SOURCE with respect to that DataPAC. The variable "s" is a standard LOGIC-SOURCE designation (see Section 2.H.2 of this Guidebook and also the listing of "s" values under the **SRC** mnemonic, Section 4.B).

If, however, **SRC r [CR]** is asked of the DataPAC NODE *to which the BIT GROUP containing Bit No. r has been dedicated via the **SSB** command*, the reply will *not* contain the SATELLITE NUMBER "n" of that NODE, but will only give the bit's local LOGIC SOURCE ("s").

This NONGLOBAL ("s" only) response is also possible if the interrogated NODE is an "A-sized" DataPAC SATELLITE or a "B-sized" DataPAC NODE where the **GBL = OFF [CR]** is in effect (see Section c.4, below) and where Bit No. r is neither dedicated to that NODE nor "sourced" to the NODE's Model 10BD1 Satellite Slave Card. YOU SHOULD BE AWARE THAT, IN THE LATTER CASE, A "LOCAL" ANSWER MAY BE RETURNED FOR THE **SRC r [CR]** INTERROGATION WHICH IN NO WAY REFLECTS THE TRUE LOGIC SOURCE OF GLOBAL BIT No. r WITHIN THE NETWORK (see Appendix K for details).

———— REMEMBER ————

THE "GLOBAL" ("n, s") RESPONSE TO THE **SRC r [CR]** INTERROGATION IS POSSIBLE ONLY WHEN THE COMMAND IS "IMPLICITLY" ROUTED FROM THE INTERROGATED "B-SIZED" DATAPAC.

If the **SRC r [CR]** interrogation is "explicitly" communicated to a given "B-sized" NODE—via an **OPEN (OPN)** or **NODE (NOD)** command, or via the NODE'S own keyboard, COMPUTER INTERFACE PORT, or AUXILIARY COMPUTER INTERFACE PORT—and if Bit No. r is a bit not dedicated to that NODE but which has been "sourced" to its Model 10BD1 Satellite Slave Card (as explained in Section b.6(c), above), then two other responses are possible:

- a. **Bs**, where "s" is the number of the B SLOT occupied by the 10BD1 (representing the local LOGIC SOURCE of Bit No. r, this answer is given when the **GBL = OFF [CR]** command is in effect at the interrogated "B-sized" NODE); or
- b. **NO RESPONSE**, when the **GBL = ON [CR]** command is in effect (because you cannot "explicitly" request a given NODE to originate an "implicitly addressed" GLOBAL INTERROGATION of **SRC r [CR]**).

4. DISABLING THE "IMPLICIT" ROUTING OF GLOBAL COMMANDS FROM A "B-SIZED" DATAPAC NODE: **GBL** COMMAND

The **GLOBAL (GBL)** command may be used to isolate any "B-sized" DataPAC NODE from the GLOBAL COMMAND network, with respect to the "implicit" routing of commands. This serves to increase the NODE'S *local* communications speed by ensuring fully "stand-alone" operation in response to any and all commands there received. It also enhances local system security, since an erroneous operator entry will in this case affect only the NODE at which it was entered.

Thus, by applying a command of

GBL = OFF [CR]

to the "B-sized" DataPAC NODE in question, you will disable the transmission from that NODE of any and all "implicitly addressed" commands entered there via keyboard, COMPUTER INTERFACE PORT, or AUXILIARY COMPUTER INTERFACE PORT. AS A RESULT, EVERY COMMAND SUBSEQUENTLY RECEIVED BY THAT NODE WILL BE TREATED STRICTLY AS A *LOCAL COMMAND*.

Note that

- a. AS MENTIONED ABOVE, THE **GLOBAL (GBL)** COMMAND APPLIES ONLY TO "B-SIZED" DATAPAC NODES. ALL "A-SIZED" SATELLITES AND ALL OPERATOR CONSOLE SATELLITES ARE ALWAYS IN THE **GBL = OFF [CR]** CONDITION.
- b. THE **GBL** COMMAND DOES NOT AFFECT THE "EXPLICIT" ROUTING OF GLOBAL COMMANDS TO OR FROM THE NODE TO WHICH IT IS APPLIED (see Section c.5, below).

To re-enable the "implicit" routing of GLOBAL COMMANDS from a "B-sized" DataPAC NODE, command

GBL = ON [CR]

This command is in effect, by default, on SATELLITE powerup.

5. "EXPLICIT" ROUTING OF GLOBAL COMMANDS

- a. "OPENING" A DIRECT COMMAND ROUTE BETWEEN ANY TWO NETWORK NODES: **OPN** COMMAND

By means of the **OPEN (OPN)** command, you can cause any and all standard MNEMONIC COMMANDS entered at a given "A-" or "B-sized" NODE to be ignored by that NODE itself and to be passed directly and exclusively to any other "A-" or "B-sized" NODE in the network. Specifically, it "opens" an "explicit" command route between one of a given NODE'S *local command sources* (keyboard, COMPUTER INTERFACE PORT, or optional AUXILIARY COMPUTER INTERFACE PORT) and any other NODE in the network.

Thus, when applied to any NODE (HOST or SATELLITE), a *keyboard-entered* command of

OPN = n [CR]

designates the single "remote" NODE of SATELLITE NUMBER *n* to be the *only* member of the network to receive any and all commands subsequently entered *via keyboard* at the NODE to which the **OPN** command is applied.

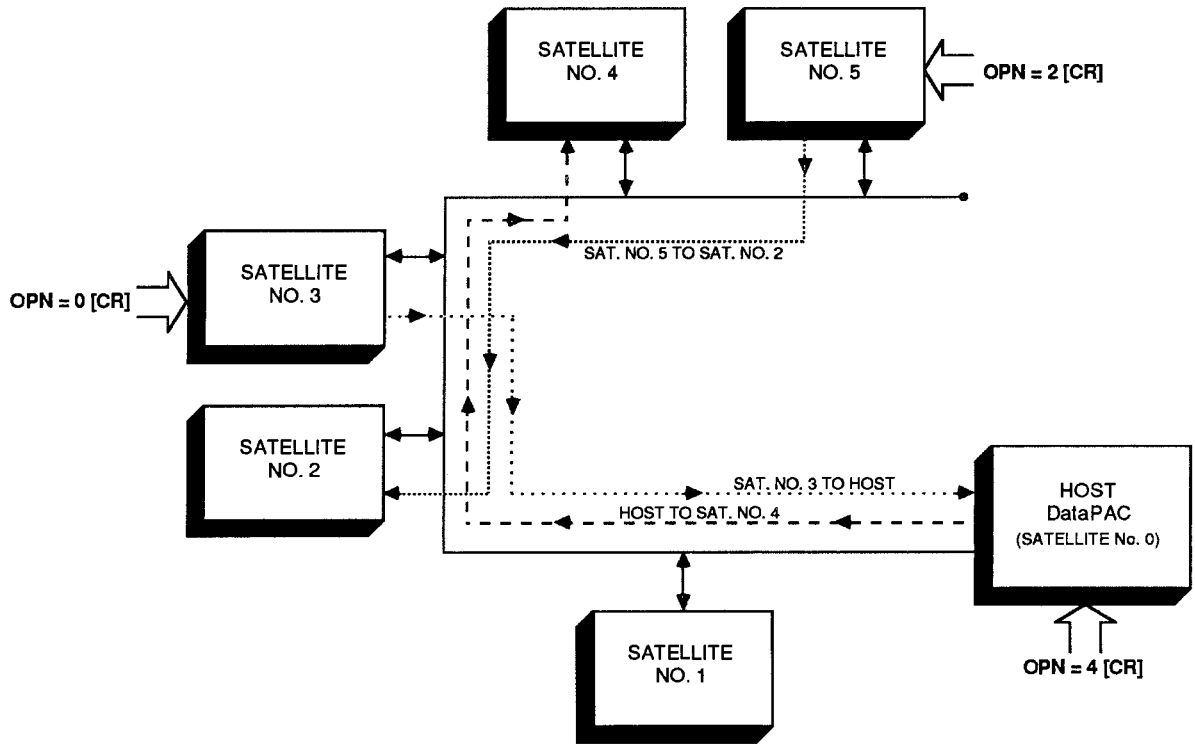
If the above command had been issued to a NODE through that NODE'S COMPUTER INTERFACE PORT or optional AUXILIARY COMPUTER INTERFACE (ACI) PORT, then it would have specified the single NODE ("n") to receive any and all commands subsequently entered *via COMPUTER INTERFACE or ACI PORT, respectively*, at the NODE to which the **OPN** command was applied.

See, for example, Fig. 3.B.3.5. By entering a command of

OPN = 4 [CR]

via the keyboard of the HOST DataPAC (NODE No. 0), you will arrange for NODE No. 4 (a SATELLITE) to receive any and all commands subsequently entered via the HOST'S keyboard. Similarly, by entering a command of **OPN = 2 [CR]** via the COMPUTER INTERFACE PORT of NODE No. 5 (a "B-sized" SATELLITE), you will arrange for NODE No. 2 (another SATELLITE) to receive any and all commands entered through NODE No. 5's COMPUTER INTERFACE PORT.

Fig. 3.B.3.5 "Opening" of "Explicit" Global-Command Routes Between Network Nodes



Finally, by entering a command of **OPN = 0 [CR]** via the keyboard of NODE No. 3 (a SATELLITE), you will arrange for NODE No. 0 (the HOST) to receive all commands entered at NODE No. 3's keyboard. ALL OF THESE VARIOUS **OPEN (OPN)** COMMANDS CAN BE IN EFFECT AT THE SAME TIME.

Regarding the **OPN** command, please note the following restrictions:

1. **OPN** does not apply to "special key" functions of the keyboard (e.g., **STEP**, **PROMPT**, etc.).
2. **OPN** does not apply to the **OPN** command itself. That is, an **OPN** command applied to a given NODE automatically *cancel*s any previous **OPN** command in effect for that NODE.
3. THE "IMPLICIT" AND "EXPLICIT" ROUTING OF A GIVEN COMMAND ARE MUTUALLY EXCLUSIVE. Thus, every command routed "explicitly" by means of an **OPN** command will be treated by the receiving NODE strictly as a LOCAL COMMAND—even if it is one of the "implicitly addressed" commands listed in Section c.1, above, and even if the **GBL = ON [CR]** command is in effect at the receiving NODE. If, for example, a command of **LCT x [CR]** is "explicitly" routed to a NODE to which GLOBAL CHANNEL No. x is *not* dedicated or to whose Model 10BD1 Satellite Slave Card that channel has not been "located," then NO RESPONSE WILL BE RETURNED TO THIS INTERROGATION.

———— **ALSO NOTE** ————

In the response to an interrogation of the "range" ("x TO y") form which has been issued to a given DataPAC SATELLITE via an **OPEN (OPN)** command entered at the COMPUTER INTERFACE PORT of some other NODE, each per-channel answer will be terminated by the SATELLITE'S current **END-OF-TRANSMISSION TERMINATOR (EOT)**, and *not* by its **OUTPUT TERMINATOR (OPT)** (in many cases, however, a DataPAC's EOT and OPT will be the same—see Section 1.H.3(g) of this Guidebook).

3.B.3.c

SATELLITE NETWORK OPERATION

You will normally use the **OPEN (OPN)** command when you want to communicate *more than one* standard MNEMONIC COMMAND from a given NODE to another, "remotely" located NODE. When you need to communicate only one command to a "remote" DataPAC NODE (HOST or SATELLITE), you can use the the **NODE (NOD)** command, without first having to "open" a command route (see below).

If, after you have "opened" a command route between two NODES by an **OPN = n [CR]** command, you wish to *return the command source in question (keyboard, COMPUTER INTERFACE PORT, or ACI PORT) to "local" operation*, you should command

OPN = LOC [CR]

The effect is to cancel the "explicit" routing of GLOBAL COMMANDS specified by the previous **OPN = n [CR]** command.

By asking

OPN [CR]

of a given NODE, you can learn the SATELLITE NUMBER of the NODE to which GLOBAL COMMANDS are currently being routed from the command source through which this interrogation is entered. If no command route has been "opened" from the original NODE, the response to this interrogation will be **LOC**.

b. ROUTING A SINGLE COMMAND BETWEEN ANY TWO DATAPAC NODES: **NOD** COMMAND

The **NODE (NOD)** command serves as a "one-line" **OPEN (OPN)** command. It lets you route a *single* MNEMONIC COMMAND directly between any two DataPAC NODES, *once only*, without having first to "open" the command route in question by means of an **OPEN (OPN)** command (above). IT DOES NOT WORK WITH OPERATOR CONSOLE SATELLITES.

Thus, to cause DataPAC NODE No. n to receive the MNEMONIC COMMAND represented by the ASCII STRING "\$," at any time during normal operation, you need only enter the following command *at any other DataPAC NODE, via keyboard, COMPUTER INTERFACE PORT, or optional AUXILIARY COMPUTER INTERFACE PORT*:

NOD n, \$ [CR]

"\$" can consist of up to 80 ASCII characters, literally stating the single command to be transmitted to NODE No. n. (If the command "\$" is a SETUP COMMAND, then NODE No. n's EEPROM Switch must, of course, be ON in order for the command to be effective.)

NOTE THAT THE RESTRICTIONS GIVEN ABOVE WITH REGARD TO THE **OPEN (OPN)** COMMAND APPLY IN GENERAL TO THE **NODE (NOD)** COMMAND.

——ALSO NOTE——

The **OPN = LOC [CR]** command must be in effect at the DataPAC NODE where the **NODE (NOD)** command is entered (see Section 5.a, above). That is, if a DataPAC NODE is presently "opened" to another network NODE, a **NOD** command applied to that DataPAC will have no effect.

6. COMMUNICATIONS DIAGNOSIS

a. REQUESTING ERROR LOG: SEL COMMAND

To request the "ERROR LOG" kept by the Model 10BD4 for any given SATELLITE No. n, you can apply the following **SATELLITE ERROR LOG (SEL)** command *to the HOST*, via the HOST's COMPUTER INTERFACE PORT or optional AUXILIARY COMPUTER INTERFACE PORT (it cannot be entered through the keyboard):

SEL n [CR]

A SATELLITE'S "ERROR LOG" consists of five numbers, and so the response to the above **SEL** command will be an output of

A, B, C, D, E

where

"A" is the number of TIMEOUT ERRORS detected for the SATELLITE since the last application of the **RESET ERROR LOG (REL)** command (below). A TIMEOUT ERROR occurs when a SATELLITE is *not answering* an interrogation by the 10BD4.

"B" is the number of "CHECKSUM" ERRORS detected by the 10BD4 since the last **REL** command (see Section a.1, above, for a brief description of the "CHECKSUM" procedure).

"C" will always read "0" (ZERO); THIS COUNTER IS NOT USED AT PRESENT.

"D" is the "SLOW CYCLE COUNTER." It represents the total number of 10BD4 scan cycles that have taken place since the last **REL** command, *divided by 30,000*.

"E" is the "CYCLE COUNTER." It represents the total number of 10BD4 scan cycles that have taken place since the last **REL** command, counted by "1's."

To request the "ERROR LOG" for ALL SATELLITES, command

SEL [CR]

To request the "ERROR LOG" for SATELLITE No. n *only*, command

SEL n [CR]

–and to request it for all SATELLITES from SATELLITE No. n to and including SATELLITE No. m, command

SEL n TO m [CR]

b. RESETING ERROR LOG: REL COMMAND

To *reset to zero* all "ERROR-LOG" entries in the Model 10BD4 (for ALL SATELLITES), apply the following **RESET ERROR LOG (REL)** command *to the HOST*:

REL [CR]

To reset to zero all "ERROR-LOG" entries for SATELLITE No. n *only*, command

REL n [CR]

3.B.3.c

SATELLITE NETWORK OPERATION

–and to do so for all SATELLITES from SATELLITE No. n to and including SATELLITE No. m,
command

REL n TO m [CR]

TO ADD ONE OR MORE DATAPACS AT THE END OF AN EXISTING NETWORK CHAIN, you need only assign the next available SATELLITE NUMBER(S) in sequence, via the **ASSIGN SATELLITE NUMBER (ASN)** command (Section b.2), and follow the other DataPAC SATELLITE setup procedures given in Section b.

HOWEVER, IN ORDER TO CHANGE A DATAPAC SATELLITE'S or the HOST'S DataPAC's "GLOBAL CHANNEL RANGE" (defined by the corresponding **SATELLITE (SAT)** command, Section b.5.b) you must proceed as follows:

----- **CAUTION !** -----

ALL RELEVANT CHANNEL CALIBRATION IS LOST WHEN THE FOLLOWING PROCEDURE IS PERFORMED. THEREFORE, **CHANGES OF THIS TYPE ARE NOT RECOMMENDED**. Careful planning prior to setup of the SATELLITE NETWORK can reduce the probability that a change of this type will be required.

In particular, you may wish, during initial setup, to *add a number of DOWNLOAD PSEUDOCHANNELS ("TYPE D0") to the end of each SATELLITE SCAN RANGE*. This will allow for future expansion within each SATELLITE DataPAC and will reduce the likelihood of losing system calibration due to reconfiguration.

1. Apply a command of **SAT n = N/A [CR] *** to the HOST DataPAC for every SATELLITE in the network.
2. Reset all channels in the HOST DATAPAC's *original* "**SAT**-defined" range (Channel Nos. x through y) by applying a command of **RST x TO y [CR] *** to the HOST.
3. Reset all channels of each "**B-SIZED**" DataPAC SATELLITE'S *original* "**SAT**-defined" range (Channel Nos. x through y) by applying a command of **RST x TO y [CR] *** to that SATELLITE.
4. "Retype" to "55" all channels in the HOST DATAPAC's *original* "**SAT**-defined" range (Channel Nos. x through y) by applying a command of **TYP x TO y = 55 [CR] *** to the HOST.
5. "Retype" to "55" all channels of each "**B-SIZED**" DataPAC SATELLITE'S *original* "**SAT**-defined" range (Channel Nos. x through y) by applying a command of **TYP x TO y = 55 [CR] *** to that SATELLITE.
6. For the HOST DataPAC and every "**B-SIZED**" DataPAC SATELLITE, reconfigure and, if necessary, recalibrate all "local" channels that were reset by the above steps.
7. Repeat the relevant "SATELLITE NETWORK SETUP" procedures given in Section 3.B.3.b., entering the new **SAT** ranges.

Similarly, TO CHANGE A DATAPAC SATELLITE'S or the HOST'S DataPAC's "GLOBAL BIT-GROUP RANGE" (defined by the corresponding **SATELLITE SYSTEM BITS (SSB)** command, Section b.6.a), you must

1. Apply a command of **SSB n = N/A [CR] *** to the HOST DataPAC for every SATELLITE in the network.
2. "Resource" the bits of all "local" BIT GROUPS that were reset by the above step.
3. Repeat the relevant "SATELLITE NETWORK SETUP" procedures given in Section 3.B.3.b., entering the new **SSB** ranges.

Section 3.B.4

Digital “History” Recording and Playback: Model 10BDR64 “History” Card and Accessories



System 10 Guidebook

PLEASE NOTE

1. The new Models **10BHM128A**, **10BHM256A**, **10BHM384A**, and **10BSPCA** are functionally identical to the Models 10BHM128, 10BHM256, 10BHM384, and 10BSPC, respectively. Everything said in this manual about these older models applies equally to the corresponding new "A" versions.
2. The new **Model 10BHDM384 High Density History Memory Card** or **Model 10BSPC384 High Density History SPC Option Card** may be used alone with the 10BDR64 History Card to provide nonvolatile (battery-backed) storage for up to 384K individual data recordings. With these high-density cards, it is no longer necessary to also install the models 10BHM128(A) and 10BHM256(A) to obtain this amount of memory. The 10BSPC384 performs all the statistical analysis functions described in this manual for the 10BSPC.

1. THE HISTORY CARD

The purpose of the **Model 10BDR64 History Card** is to make, store, and output digital recordings of numerical and logic data acquired by a "B-sized" DataPAC (10K6, 10K7, 10K8, etc.).

You can instruct any one of the History Card's four independent RAM recorders to automatically record a predefined list of randomly selected DATA CHANNELS and LOGIC BITS. Recording can be at preset time intervals, or can be triggered by a specific combination of system *logic*, *limit*, and/or *time-interval* conditions. Similar conditions can also be specified for halting and restarting each recorder.

Special outputting commands let you transmit to an external computer, printer, or CRT display—*via the DataPAC's COMPUTER INTERFACE PORT*—all or part of the data recordings made by one of the four recorders since it was last interrogated, or an expandable "history window" consisting of a selected range of recordings made, if desired, both *before* and *after* occurrence of a halt-triggering condition. The latter capability lets you review the specific "data history" associated with, say, a critical limit violation or process shut-down. You can select variables to appear in a recorder's output (such as *time*, *date*, *serial number*, etc.), and the order in which these variables are to be transmitted.

The History Card lets you play back as a *live data channel* the data last recorded for any given system channel or the data recorded for that channel at a specified time in the past. When a **Model 10BSPC History SPC Option Card** is present, you can also play back the *lowest and highest values* recorded for a given DATA CHANNEL since a given recording in the past, and the *continuous average value* for the data reported by the channel over the same time period. "Statistical" playback functions provided by the Model 10BSPC also include *X-BAR* and *RANGE*, automatically calculated over successive "sampling" periods for a given channel. These and other playback features discussed in Section d.8, below, greatly facilitate rate-of-change computations, statistical display of process data, and other operations involving rapid analysis of "historical" data sets. You can, for example, easily arrange for simultaneous video display, on the same CRT page, of a set of "playback channels" and of the corresponding "live" data values.

Through a special "time search" function, it is possible to quickly review the values recorded by a given 10BDR64 recorder for one or a set of DATA CHANNELS over a period of time. You can also "replay" *all data* for a given recorder's "playback" channels, from the "oldest" to the "newest," using a *variable time scale*. This permits "slow motion" playback of all data recorded during a fast event, or a fast review of all data recorded for a test or process of long duration.

Playback of system BIT GROUPS is also possible, using specially set up BINARY "CONVERSION" CHANNELS.

2. "FRAMES" AND "DEPTH"

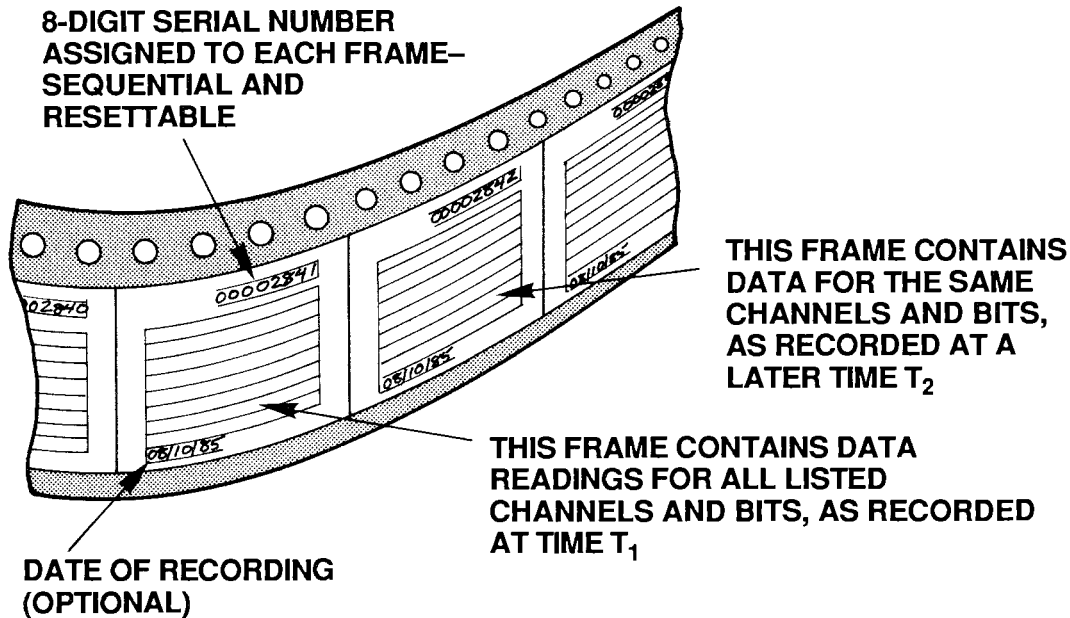
All of the DATA-CHANNEL and LOGIC-BIT readings recorded by one of the History Card's recorders *at a given instant of time* constitute a **FRAME** within that recorder's "history" memory. In other words, each FRAME corresponds to a single, instantaneous RECORDING OF DATA for all channels and bits that have been entered in the given recorder's LIST. Every FRAME can also include the *date of recording*, if so specified by the initial **LIST (LST)** command, as explained in Section d.3, below.

A sequence of FRAMES within a given recorder thus corresponds to a time-correlated sequence of separate recordings of the *same* set of selected process variables (channels and bits). A useful analogy, as shown in Fig. 3.B.4.1, is that of a strip of movie film, each FRAME of which depicts an instantaneous state of the *same* continuously changing scene.

3.B.4.a

INTRODUCTION

Fig. 3.B.4.1. "Frames" of Recorded Data (for a Given History Card Recorder)



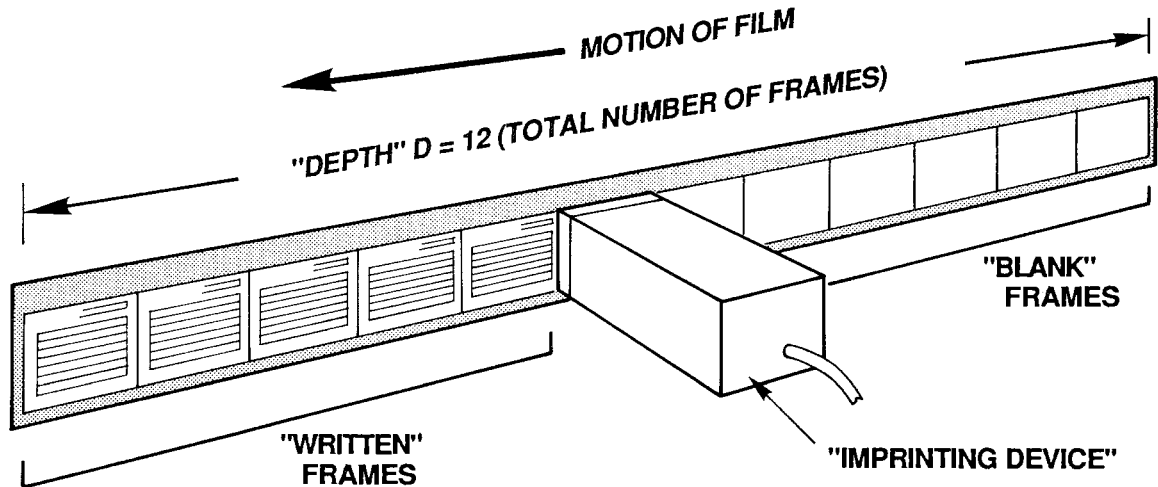
One important difference, however, between the sequence of FRAMES for a History Card recorder and for a movie film is that the *time increment* between successive movie FRAMES is constant, whereas the time that separates any two successive History Card FRAMES in a sequence may or may not be constant, depending on how you have set up the recording process. Thus, for example, you can instruct a History Card recorder to make recordings at precisely regular time intervals, or you can make it record only upon occurrence of a prespecified combination of system logic, limit, and/or time-interval conditions (this is explained under the **STORE (STO)** command, Section d.5, below).

Every FRAME of data within a recorder's memory has an 8-digit **SERIAL NUMBER**, for the purpose of relating it chronologically to other FRAMES in the recorder. This number provides a means of verifying not only the precise *sequence* of multiple recordings (FRAMES), but also the *completeness* of such a sequence. It can be used to correlate a given FRAME with an actual measured entity, like an individual part on production line or a measured process at a particular moment of time. *SERIAL-NUMBER resetting* is discussed in Section e.3, below.

The **DEPTH** of a given recorder refers to its FRAME capacity; the number of FRAMES of data it can hold is its "depth of storage." This is a variable quantity for each recorder and is defined by the user via the **DEPTH (DPT)** command, described in Section d.4. In terms of the movie-film analogy, the **DEPTH** is simply the number of FRAMES on the film strip, which is of course proportional to the total *length* of the strip.

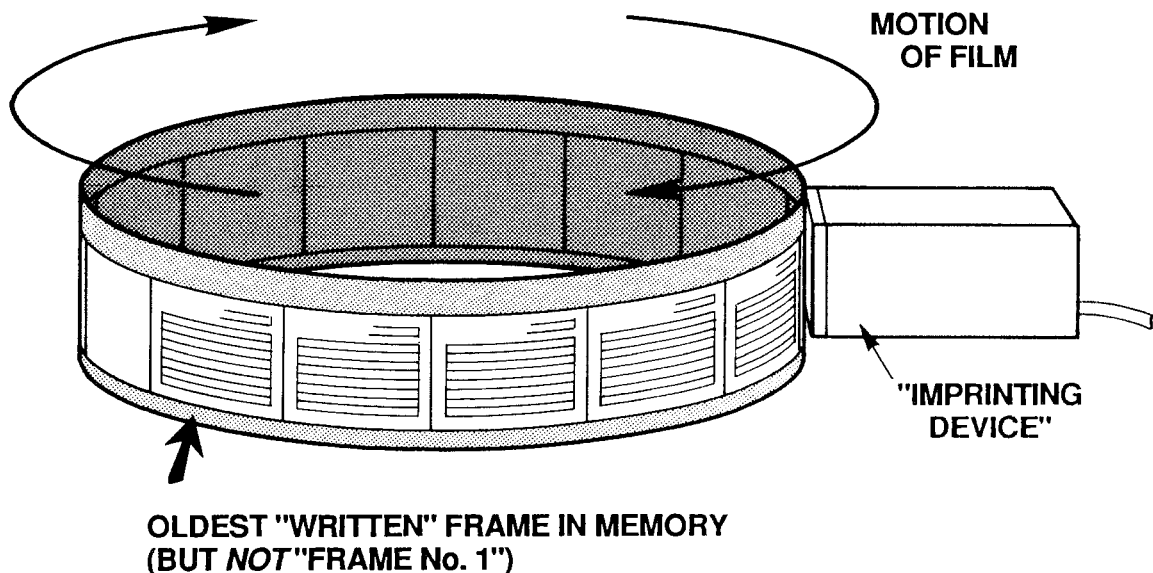
To better conceptualize the situation, however, we need to add to our analogy an element that represents the actual recording process. Let us therefore suppose that our movie film consists *initially* of "blank" FRAMES. As the film is advanced (at either a constant or variable rate), each blank FRAME will successively pass in front of some kind of "imprinting device." This device will "write" upon that FRAME the data readings reported by all listed channels and bits *at that instant of time*. The situation is illustrated in Fig. 3.B.4.2. Note that the farther a particular "written" FRAME is from the imprinting device, the *older in time* is the data it contains.

Fig. 3.B.4.2. "Writing" of Data on Recorder Frames



When all of the initially blank FRAMES have been "written" upon—that is, when the recorder's total DEPTH has been reached—then any subsequent recording of data automatically overwrites the *oldest* FRAME in that recorder's memory. To complete our picture, therefore, we must join the first and final FRAMES of our film, to create a circular band of FRAMES, continuously revolving in time. Now, each time a "written" FRAME passes by the imprinting device, it will be erased and then "rewritten" with up-to-date values for all of its listed channels and bits. See Fig. 3.B.4.3.

Fig. 3.B.4.3. Circular "Film" Allows "Rewriting" of Frames



Keep in mind that we cannot now speak of an absolutely "first" or "last" FRAME in the recorder's memory (as we will see in Section e.7, below, when we assign actual "Frame Numbers," these numbers will always be relative to a predefined "halt-triggering" event). We *can* meaningfully speak, however, of the *oldest* ("written") FRAME in memory, since each FRAME corresponds to a particular time of recording.

3. HISTORY CARD STATUS INDICATORS

The History Card has eight front-panel STATUS INDICATORS. The top two are red; the lower six are green.

RAM ERROR

When this light is ON (and the **CONFIG ERROR** light is OFF), it means that the routine automatic self-diagnosis performed by the system on every powerup has failed to find adequate working RAM, or that a nonrecoverable hardware condition exists that prevents normal working operation of the History Card. If the indicator continues to light up as you recycle power several times, your only course of action is to replace your present History Card with another one.

CONFIG ERROR

When this light is ON, it means that the current total "history memory" is not sufficient for the present configuration of the History Card's four recorders (see Section b, below). This will occur when failure of the RAM itself has been detected during the routine automatic self-diagnosis performed by the system on every powerup, or, more likely, when a portion of the total history memory has somehow been removed since the last recorder configuration was established (e.g., a Model 10BHM128, 10BHM256, or 10BHM384 History Memory Option Card has been disconnected).

SET UP MODE

When this light is ON, it means that the History Card is in SETUP MODE. It will go OFF when the card is placed in RECORD MODE.

MNE

When this light is ON, it means that the DataPAC has received through its keyboard or COMPUTER INTERFACE PORT a valid MNEMONIC COMMAND relating to the History Card, or that an **EXECUTE (EXU)** or **COMMAND (CMD)** sequence has been triggered that contains such a command (see Section 2.K of this Guidebook).

REC 1, REC 2, REC 3, REC 4

Each recorder's individual **REC** indicator will light when that recorder first begins recording. It will remain lit to indicate that a recording *has been made* by that recorder. It will go OFF when recording stops because a **HALT (HLT)** condition has occurred, or whenever the recorder's memory is cleared upon entry of a **HISTORY CLEAR (HCL)**, **NONVOLATILE HISTORY (NVH)**, **LIST (LST)**, or **DEPTH (DPT)** command (see Section b.4, below).

PLEASE NOTE

On powerup of the DataPAC, the History Card's Status Indicators *may or may not* go on momentarily. If they fail to light on powerup, it should *not* be taken as an indication that the card is malfunctioning. What *should* be observed on powerup is the **SETUP MODE** indicator blinking at a rate of approximately 1 second for every 10K of system "history memory," which is all memory resident on the History Card and on any and all installed History Memory Option Cards (Models 10BHM128, 10BHM256, and 10BHM384)—see Section 3.B.4.b.

1. CALCULATING RECORDER MEMORY VOLUME

The History Card's normal capacity is 32000 *scaled data readings*. The portion of this total "history memory" that will be allocated to each of the card's four RAM recorders is dependent on the size of that recorder's specified **LIST** of variables to be included in each **FRAME** of data, multiplied by the specified **DEPTH** (the total number of **FRAMES** to be recorded).

To determine a given recorder's "LIST size" (L),

- a. Add the **NUMBER OF "LISTED" CHANNELS** and the **NUMBER OF "LISTED" SYSTEM BIT GROUPS** (see Section d.3 for details on **LIST (LST)** variables).
- b. Add to this sum either "4" (if the **DATE** is *not* included in the **LIST**) or "6" (if the **DATE** is included).
- c. Round *up* the resultant sum to the *next integral multiple of 8*.

To obtain the recorder's required memory volume (V), multiply the recorder's **LIST size** (L) by its **DEPTH** (D):

$$V = L \times D$$

For example, suppose that the **LIST** you have entered for Recorder No. 1 includes 28 selected **DATA CHANNELS** and 3 selected **SYSTEM BIT GROUPS**, and also specifies the recording of the system date. Then the **LIST size L** for this recorder equals 28 + 3 + 6, or 37, rounded to the next *higher* multiple of 8, which is 40. If the **DEPTH** of Recorder No. 1 has been set at, say, 150, then the memory required by the recorder (in its presently specified **LIST/DEPTH** configuration) is 40 x 150 = 6000 readings.

Naturally, the sum of the four individual recorder memories cannot exceed the total "history memory" of the system (this is 32K readings, if the History Card is used without the optional memory extension discussed in the next section). If it happens that a recorder does not have sufficient memory to make as many recordings of a specified **LIST** as are called for by its specified **DEPTH**, then *the system will automatically adjust the DEPTH of the recorder in question and also the DEPTH of every higher-numbered recorder*, in order to produce an allowable recorder memory volume sufficient for the entered **LIST**. Lower-numbered recorders are thus given priority for memory "space."

———— NOTE ————

If a given recorder is not being used, its **DEPTH** should be set to "0" via the **DEPTH (DPT)** command (see Section d.4, below). This will allow allocation of its history memory to the remaining active recorders.

2. OPTIONAL EXTENSION OF HISTORY MEMORY: MODELS 10BHM128, 10BHM256, 10BHM384, AND 10BSPC

When the sum of the required individual recorder memories exceeds 32K readings, you may expand your total history memory by means of one or more **Model "10BHM" History Memory Option Cards** (10BHM128, 10BHM256, and 10BHM384). Each card provides additional history memory of up to 128K readings, according to the following sequence:

- a. For up to 128K readings in addition to the History Card—or for a total *nonvolatile* memory of 128K readings (see below)—the **Model 10BHM128** is required.

3.B.4.b

HISTORY MEMORY AND TIME CONSIDERATIONS

- b. For up to **256K** readings in addition to the History Card—or for a total *nonvolatile* memory of 256K readings—both the **Model 10BHM128** and the **Model 10BHM256** are required.
- c. For up to **384K** readings in addition to the History Card—or for a total *nonvolatile* memory of 384K readings—all three "10BHM" Cards are required: **Model 10BHM128**, **10BHM256**, and **10BHM384**.*

NOTE: The **Model 10BSPC History SPC Option Card** (discussed in Section d.8(d), below) also acts as a Model 10BHM128 History Memory Option Card. Thus, if a total additional or nonvolatile memory of 128K readings is desired, a Model 10BSPC alone will suffice; if up to 256K additional or nonvolatile readings are desired, a Model 10BHM256 can be used along with the 10BSPC; if up to 384K additional or nonvolatile readings are desired, both the Model 10BHM256 and the Model 10BHM384 can be used with the 10BSPC.*

All additional memory, as well as the History Card's original 32K readings will remain *volatile* as long as the **NONVOLATILE HISTORY (NVH)** command is not in effect (see below). The contents of such memory will be lost upon loss of system primary power. For installation of "History Option" Cards, see Section c, below.

3. INITIATING NONVOLATILE HISTORY MEMORY: NVH COMMAND

The **Model "10BHM" History Memory Option Cards** and/or **Model 10BSPC History SPC Option Card** also permit nonvolatile (*battery-backed-up*) storage of all system history recordings. When "nonvolatile history" is in effect, however, the History Card's original 32K memory is *no longer available* to the system.

To activate the nonvolatile history memory of any and all installed "History Option" Cards, you must be in SETUP MODE (as explained in Section d.2, below), and command

NVH [CR] *

The application of this command *physically erases all current history memory in the system*, as explained in the following section. All subsequent data recordings will be stored in nonvolatile memory on the installed Model "10BHM" and/or 10BSPC Card(s) only.

Note also that the **NVH [CR] *** command must be applied whenever a Model "10BHM" or 10BSPC Card is added to or removed from the system.

To revert to *volatile* history memory, including the History Card's original 32K readings, enter SETUP MODE and command

NVH = N/A [CR] *

4. "CLEARING" AND "ERASING" HISTORY MEMORY

a. THE HISTORY CLEAR (HCL) COMMAND

The **HISTORY CLEAR (HCL)** command may be used to "clear" all recordings contained in a given recorder or range of recorders, without affecting any other recorder parameters. Being a

* The new **Model 10BHDM384 High Density History Memory Card** or **Model 10BSPC384 High Density History SPC Option Card** may be used alone with the 10BDR64 History Card to provide nonvolatile (battery-backed) storage for up to 384K individual data recordings. With these high-density cards, it is no longer necessary to also install the models 10BHM128(A) and 10BHM256(A) to obtain this amount of memory.

"RUN-TIME" COMMAND, it may be applied at any time during normal operation (i.e., while the History Card is in RECORD MODE), without having to turn on the EEPROM Switch. Its effect is to make *inaccessible* all current data recordings for the specified recorder(s), but not to physically *erase* this data.

Thus, to clear the history memory of Recorder No. n only, simply command

HCL n [CR]

—and to clear Recorder Nos. n through m, command

HCL n TO m [CR]

b. OTHER MEMORY-CLEARING COMMANDS: LST AND DPT COMMANDS

The **LIST (LST)** and **DEPTH (DPT)** commands will also have the effect of "clearing" one, some, or all History Card recorders—but *only when the History Card is in SETUP MODE* (see Section d.2, below) and the EEPROM Switch is ON.

Thus, by specifying a new **LIST (LST)** or **DEPTH (DPT)** for Recorder No. n (see Sections d.3 and d.4, respectively), you will clear not only Recorder No. n, but also *all higher-numbered recorders*. If, for example, you modify the LIST statement for Recorder No. 2, then Recorder Nos. 2, 3, and 4 will be completely cleared.

C. "TRUE ERASURE" OF HISTORY MEMORY: NVH COMMAND

In accordance with high-security requirements, the "true erasure" of history-memory contents is also possible. The means of "true erasure" will depend on whether your DataPAC's history "system" is in VOLATILE or NONVOLATILE MODE.

1. "TRUE ERASURE" OF VOLATILE HISTORY MEMORY

The history "system" will be in VOLATILE MODE as long as the

NVH = N/A [CR] *

command is in effect (see Section b.3, above). When in VOLATILE MODE, all data recordings will be *automatically and "truly" erased on every powerup* (but *not* powerdown). Therefore, to ensure "true erasure" of all history memory in this mode, simply *recycle DataPAC power*.

2. "TRUE ERASURE" OF NONVOLATILE HISTORY MEMORY

The history "system" will be in NONVOLATILE MODE when the

NVH [CR] *

command is in effect. In this mode, only the history memory residing on any and all optional Model "10BHM" and/or 10BSPC cards is available for storage of history recordings.

When in NONVOLATILE MODE, you can ensure "true erasure" of all history memory by simply *re-entering* a command of **NVH [CR] ***.

Concerning this command, please note that

- a. Although it is a "SETUP" COMMAND and requires that the DataPAC's EEPROM Switch be ON, it does not actually write to the EEPROM, and may therefore be applied any number of times without subjecting the EEPROM to excessive write cycles.

3.B.4.b

HISTORY MEMORY AND TIME CONSIDERATIONS

- b. As mentioned above, if the **NVH [CR]** * command is entered *through the DataPAC's keyboard*, it is necessary to recycle power in order to make the command effective.

5. REQUESTING TOTAL HISTORY MEMORY: **MEM** COMMAND

A **MEMORY (MEM)** command of

MEM [CR]

will yield a hexadecimal number representing the total number of scaled data readings your history "system" (History Card plus any and all "History Option" Cards) is capable of storing. The answer will also indicate whether the memory is currently VOLATILE or NONVOLATILE. The possible responses to the **MEM [CR]** interrogation are as follows:

- (**MEM** =) 10000H (indicates 32,000 VOLATILE readings, max.)
50000H (indicates 160,000 VOLATILE readings, max.)
90000H (indicates 288,000 VOLATILE readings, max.)
D0000H (indicates 416,000 VOLATILE readings, max.)

3FE00H (indicates 128,000 NONVOLATILE readings, max.)
7FE00H (indicates 256,000 NONVOLATILE readings, max.)
BFE00H (indicates 384,000 NONVOLATILE readings, max.)

ONCE A MODEL 10BDR64 HISTORY CARD HAS BEEN INSERTED IN A PARTICULAR B SLOT AND HAS BEEN SET UP BY MEANS OF THE COMMANDS GIVEN IN SECTION d, BELOW, THEN THAT CARD *SHOULD NOT BE MOVED TO A DIFFERENT B SLOT AT ANY LATER TIME.*

Therefore, be sure to choose a B SLOT you can *permanently* dedicate to a History Card, before setting up that card's recording and playback functions. Also, if you ever remove a History Card for some reason, be sure to return it to its original slot location.

If your system also contains one or more "History Option" Cards—i.e., a **Model 10BSPC History SPC Option Card** and/or one or more **Model "10BHM" History Memory Option Cards**—then you will require a special HISTORY BACKPLANE to establish the necessary connections between the History Card and the installed "History Option" Card(s). All cards will plug directly into the HISTORY BACKPLANE. There are three backplane versions, depending on whether one, two, or three "History Option" Cards are to be present (see Section b.2, above). The History Card will always occupy the *right-most* backplane slot, as viewed from the front of the unit; a History SPC Option Card and any and all History Memory Option Cards will be located to its immediate left (on the backplane).

When a History Card and one or more "History Option" Cards are ordered with a DataPAC, the HISTORY BACKPLANE will be installed at the factory. If you order one or more "History Option" Cards for an existing DataPAC, an appropriate HISTORY BACKPLANE will be shipped with the card(s). This you may easily install in the field (contact the factory for specific instructions). In this case, remember that the History Card should retain its original B-SLOT position, as explained above, and that a History SPC Option Card and any and all History Memory Option Cards should be located to the immediate *left* of the History Card (on the HISTORY BACKPLANE).

3.B.4.d

HISTORY CARD SETUP

1. INTRODUCTION

Of the setup procedures discussed in this section, these four are always required:

- a. ENTER SETUP MODE (Section d.2)
- b. LIST VARIABLES TO BE RECORDED for each recorder (Section d.3)
- c. SET RECORDER DEPTH for each recorder, if it is to be other than the factory-set value of "500" (Section d.4)
- d. SPECIFY "STORE" CONDITIONS for each recorder (Section d.5)

The other procedures given below may or may not be performed, depending on the your particular recording application.

When you receive your History Card, it will have been set at the factory for the following *initial* setup values:

- a LIST (for all recorders) of "CHN 1 TO 10, SBG 1 TO 2"
- a DEPTH (for all recorders) of "500"
- a STORE CONDITION (for Recorder No. 1) of "INT 3"
- a STORE CONDITION (for Recorder No. 2) of "INT 6"
- a STORE CONDITION (for Recorder No. 3) of "INT 9"
- a STORE CONDITION (for Recorder No. 4) of "INT 11"
- a HALT CONDITION (for all recorders) of "N/A"
- a HALT DEPTH (for all recorders) of "1"
- an OUTPUT IMAGE (for all recorders) of "FR, DN, FT, SN"

You will modify these initial assignments as your requirements demand, using the commands discussed below.

Note that all setup commands have respective *interrogative* forms, whereby you can ask the system at any time for the current value of a given setup parameter (for further explanation, see Sections 1.A.3(d) and 4.B of this Guidebook).

Your first setup steps will always be

- TURN ON THE DATAPAC'S EEPROM WRITE PROTECT SWITCH.
- PLACE THE HISTORY CARD IN "SETUP MODE."

2. ENTERING SETUP MODE: **SMD** COMMAND

NONE OF THE COMMANDS DISCUSSED IN THIS SECTION WILL BE EFFECTIVE UNLESS THE HISTORY CARD HAS FIRST BEEN PLACED IN **SETUP MODE**. To do this, simply command

SMD [CR]

This command immediately stops any recording in process. The History Card's front-panel **SMD** indicator will light while the card is in **SETUP MODE**.

3. LISTING VARIABLES TO BE RECORDED: **LST** COMMAND

To enter the LIST of DATA CHANNELS and LOGIC BITS for Recorder No. *n*, command

LST n = CHN *x*₁, *x*₂, ... , SBG *k*₁, *k*₂, ... , DTE [CR] *

where

"n" is the recorder number (1-4);

"x" is either a single channel number or a range of channel numbers expressed in the form **x TO y** (where $y > x$); and

"k" is the RANK number of a single SYSTEM BIT GROUP (SBG) or a range of RANK numbers expressed in the form **k TO l** (where $l > k$).

Please note that

1. A RECORDER'S "LIST," AS DEFINED BY THE ABOVE **LST** COMMAND, CAN TAKE UP TO 78 CHARACTERS, INCLUDING COMMAS.
2. THE SEQUENCE OF DATA CHANNELS AND/OR CHANNEL RANGES (x1, x2, etc.) MUST BE ENTERED *IN ASCENDING ORDER*, AS MUST THE SEQUENCE OF SYSTEM BIT GROUPS AND/OR BIT-GROUP RANGES (see the example below).
3. Channel Nos. 998 (TIME) and 999 (DATE) may not be entered in the **LST** expression.
4. The mnemonic **DTE** is optional. If it is present, the current *system date* will be automatically included in each recorded FRAME. Note that it is necessary to include **DTE** in the recorder's **LST** expression if you want the date to be included in the recorder's *output* (see Section d.10, below), or if you want to set up one or more "DATE" PLAYBACK PSEUDOCHANNELS for the recorder (Section d.8(c)).

NOTE: If in changing a recorder's current LIST, you *exclude* one or more PLAYBACK PSEUDOCHANNELS that were included in that recorder's previous LIST, a "PSEUDO-CHANNEL ERROR" will be invoked for any of these PLAYBACKS. For *cancelling* PLAYBACK PSEUDOCHANNEL assignments, see Section 3.B.4.d.

As an example of the **LIST (LST)** command, suppose that you want each of the recordings (or FRAMES) produced by Recorder No. 3 to contain readings for DATA CHANNEL Nos. 1, 22, 37, 38, 39, 40, 66, and 111, and for SYSTEM BIT GROUP Nos. 2, 4, and 5—plus the current system date for each recording. You will enter this command:

LST 3 = CHN 1, 22, 37 TO 40, 66, 111, SBG 2, 4 TO 5, DTE [CR] *

4. SETTING RECORDER DEPTH: DPT

To enter the desired DEPTH for Recorder No. n, command

DPT n = d [CR] *

where "d" is an integer from 0 through 32,767. (A recorder set to a DEPTH of "0" will not record. Such a setting can therefore be used to *disable* a given recorder, if it is not required, thereby allocating its history memory to the remaining active recorders.)

If you want to set a *range* of recorders (No. n through No. m) to the same DEPTH value, you can command

DPT n TO m = d [CR] *

Thus, if you want to set all four recorders to a DEPTH of, say, 999, you would command

DPT 1 TO 4 = 999 [CR] *

Remember that the maximum DEPTH to which a recorder can be set will depend on the LIST that has been entered for that recorder, and on the portion of total system "history memory" available to it (see Section b.1, above).

3.B.4.d

HISTORY CARD SETUP

5. SPECIFYING "STORE" CONDITIONS: **STO** COMMAND

a. THE **STORE (STO)** COMMAND

You will use the **STORE (STO)** command to specify the condition or logical combination of conditions the occurrence of which will cause Recorder No. n to instantly record and store a FRAME of data. These conditions may include

- the *limit status* of selected system DATA CHANNELS
- the *logic states* of selected system LOGIC BITS
- the occurrence of *logic-state transitions* for selected system LOGIC BITS
- the passage of a specific *time interval*, as registered by the system clock

The general form of the **STORE (STO)** command is

STO n = B [CR] *

where "n" is the Recorder Number and "B" is a string of characters representing a *Boolean algebraic expression* of the general form

[MNEMONIC plus CHANNEL, BIT, or INTERVAL NUMBER] [OPERATOR]
[MNEMONIC plus CHANNEL, BIT, or INTERVAL NUMBER] [OPERATOR] ...

The expression "B" may contain up to 15 MNEMONIC terms and up to 14 OPERATORS. The allowable MNEMONICS are given below. The allowable OPERATORS are "*" ("AND") and "+" ("OR").

b. **STO** MNEMONICS

Each "MNEMONIC plus CHANNEL, BIT, or INTERVAL NUMBER" term in the **STO** expression refers directly to a possible "condition" of an actual system DATA CHANNEL, LOGIC BIT, or TIME INTERVAL, as follows:

1. DATA-CHANNEL LIMIT STATUS: ZGT, ZLT, AND ZVO

To specify the condition that:	Use MNEMONIC:
A channel's data is in "GREATER THAN" LIMIT ZONE	ZGT
A channel's data is NOT in "GREATER THAN" LIMIT ZONE	/ZGT
A channel's data is in "LESS THAN" LIMIT ZONE	ZLT
A channel's data is NOT in "LESS THAN" LIMIT ZONE	/ZLT
A channel's data is in either ZONE OF VIOLATION (i.e., outside the "BETWEEN" LIMIT ZONE)	ZVO
A channel's data is NOT in either ZONE OF VIOLATION	/ZVO

For example, the term **ZGT 201** means "when data for Channel No. 201 is in the 'GREATER THAN' LIMIT ZONE"; **/ZVO 8** means "when Channel No. 8 does NOT lie in either the 'GREATER THAN' or 'LESS THAN' LIMIT ZONE."

Each of these MNEMONICS may refer to any "legal" DATA CHANNEL. Remember, however, that data for any channel above the TERMINATOR CHANNEL or otherwise outside the specified SCAN RANGE *may not contain currently valid data* (see Section 1.F of this Guidebook).

2. LOGIC STATE OF SYSTEM BIT: BIT

To specify the condition that:

Use MNEMONIC:

A bit is HIGH (at a *Logic 1* state)

BIT

A bit is NOT HIGH (i.e., it is at *Logic 0*)

/BIT

For example, the term **BIT 66** means "when Bit No. 66 is high"; **/BIT 45** means "when Bit No. 45 is low." These MNEMONICS may refer to any system LOGIC BIT (No. 0 through 999).

3. LOGIC-STATE TRANSITION OF SYSTEM BIT: BGL AND BGH

To specify the condition that:

Use MNEMONIC:

A bit is GOING LOW (transition from *Logic 1* to *Logic 0*)

BGL

A bit is GOING HIGH (transition from *Logic 0* to *Logic 1*)

BGH

For example, the term **BGL 134** means "when Bit No. 134 is going low"; **BGH 9** means "when Bit No. 9 is going high." The MNEMONICS may refer to any system LOGIC BIT (No. 0 through 999).

4. TIME INTERVAL: INT

To specify the condition that:

Use MNEMONIC:

The system time-of-day clock is registering passage of a specific time interval

INT

The allowable system "clock-time" intervals are numbered as follows:

0 = 10 millisec	6 = 1 sec	11 = 1 min
1 = 20 millisec	7 = 2 sec	12 = 2 min
2 = 50 millisec	8 = 5 sec	13 = 5 min
3 = 0.1 sec	9 = 10 sec	14 = 10 min
4 = 0.2 sec	10 = 20 sec	15 = 20 min
5 = 0.5 sec		

For example, the term **INT 9** is a condition that occurs every 10 seconds; technically, it means "when the system clock reads **XX:XX:X0.00** (hours : minutes : integral seconds . hundredths of a second; "X" is any digit)."

3.B.4.d

HISTORY CARD SETUP

———— NOTE ————

NO MORE THAN ONE "INT" TERM CAN BE INCLUDED IN A **STORE (STO)** EXPRESSION.

ALSO NOTE: If you need to record data at intervals *longer than 20 minutes*, you can make recording dependent on the transition of a given system LOGIC BIT (using the BGL or BGH MNEMONIC, above). This "trigger bit" can in turn be automatically set or reset at intervals of up to 24 hours, by including an appropriate **SET BIT (BIT)** command in a **COMMAND (CMD)** statement (see Section 2.K.3 for details).

C. EXAMPLES OF THE **STORE (STO)** COMMAND

———— REMEMBER ————

What the command **STO n = B [CR] *** actually asserts is that Recorder No. n will produce a record of all its listed channels and bits when and only when the existing states of the system conditions indicated by the MNEMONIC terms of the expression "B" are such that their *logical combination*, as given by the OPERATORS of that expression, yields a total "truth value" of "1."

For example, here are a few typical **STORE (STO)** commands:

STO 1 = ZLT 10 + ZLT 11 [CR] *

(Recorder No. 1 will record and store a FRAME when data for *EITHER* Channel No. 10 *OR* Channel No. 11 is in the "LESS THAN" LIMIT ZONE.)

STO 3 = BGH 689 * ZVO 72 [CR] *

(Recorder No. 3 will record and store a FRAME when Bit No. 689 goes high *AND* a limit violation is occurring for Channel No. 72.)

STO 4 = BGL 689 + BGH 101 * /ZVO 72 [CR] *

(Recorder No. 4 will record and store a FRAME *EITHER* when Bit No. 689 goes low *OR* when Bit No. 101 goes high and at the same time data for Channel No. 72 lies in the "BETWEEN" LIMIT ZONE.)

STO 1 = INT 5 [CR] *

(Recorder No. 1 will record and store a FRAME every half second.)

STO 2 = BIT 32 * INT 6 + /BIT 32 * INT 11 [CR] *

(Recorder No. 2 will record and store a FRAME every second when Bit No. 32 is high, *OR* every minute when this bit is low.)

To *cancel* the existing **STO** condition(s) for Recorder No. n, command

STO n = N/A [CR] *

6. SPECIFYING "HALT" CONDITIONS: **HLT** COMMAND

To specify the condition or logical combination of conditions the occurrence of which will cause Recorder No. n to *halt* the recording of data, command

HLT n = B [CR] *

Syntax for the expression "B" is the same as for the **STORE (STO)** command, above.

To *cancel* the existing halt condition(s) for Recorder No. n, command

HLT n = N/A [CR] *

———— IMPORTANT ————

IF *NONVOLATILE HISTORY MEMORY* IS IN EFFECT (Section b.3, above), THEN A HALTED RECORDER WILL REMAIN HALTED—EVEN UPON CYCLING OF DATAPAC POWER—UNTIL APPLICATION TO THAT RECORDER OF A **START FROM HALT (STH)** COMMAND (see Section e.5, below).

7. SETTING HALT DEPTH: **HDP** COMMAND

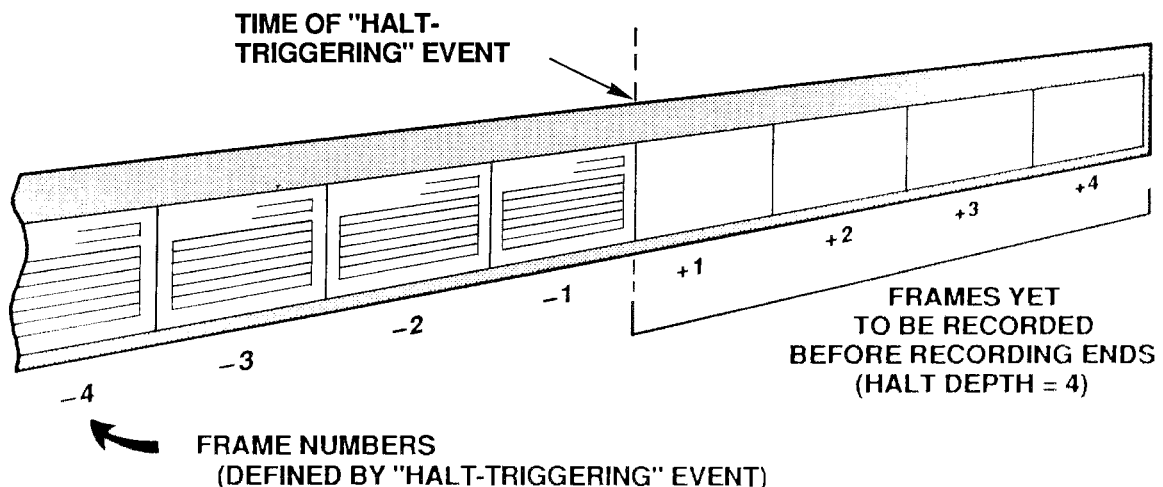
You may sometimes want to record a specific number of FRAMES *after* a "halt-triggering event" has occurred. To arrange for the actual halting of Recorder No. n to be *delayed* accordingly, command

HDP n = q [CR] *

where "q" is the recorder's **HALT DEPTH** (i.e., the number of FRAMES that will be recorded following occurrence of the "halt-triggering" condition). It may be any integer from 0 through 32767. See Fig. 3.B.4.4.

"Frame Numbers" will be discussed under the **HISTORY DUMP (HDU)** command, Section e.7(b), below. See also the **CURRENT HALT STATUS (CHS)** command (Section e.4), which lets you ask for the number of FRAMES that have been recorded *so far* since occurrence of the "halt-triggering" condition. For restarting a halted recorder, see Section e.5.

Fig. 3.B.4.4. Assignment of Frame Numbers



8. DEFINING PLAYBACK PSEUDOCHANNELS: PLA COMMAND

a. INTRODUCTION: "NORMAL" AND "VIDEO" PLAYBACK PSEUDOCHANNELS

The History Card's playback function makes available for direct *interrogation* or *video display* all of the readings recorded for a given system DATA CHANNEL that are currently in history memory.

The playback setup procedure involves the assignment of a PLAYBACK PSEUDOCHANNEL to every DATA CHANNEL whose past readings, as recorded by a given recorder, you wish to review. Depending on the channel number you assign it, a PLAYBACK PSEUDOCHANNEL can be either

- a "NORMAL" PLAYBACK PSEUDOCHANNEL (which can have any Channel Number from 1 through 997), or
- a VIDEO PLAYBACK PSEUDOCHANNEL (which must have a Channel Number from 1000 through 1299)

The main difference between these two types of PSEUDOCHANNELS is that, unlike "NORMAL" PSEUDOCHANNELS, VIDEO PSEUDOCHANNELS are read only by the system's video cards. *They are not included in the normal scanning of system channels, and therefore the system does not "spend time" in handling them.*

"NORMAL" PLAYBACK PSEUDOCHANNELS are used primarily when you wish to *interrogate* the system for recorded data values by means of the **CHANNEL (CHN)** command, or to provide *limit-monitoring* or *analog output* for playback channels.

VIDEO PLAYBACK PSEUDOCHANNELS are *not* interrogatable via the **CHANNEL (CHN)** command, but are strictly intended for CRT display of recorded data. Like all other DATA CHANNELS, they allow for the exhibition of CRT VISUAL EFFECTS. In the case of VIDEO PLAYBACK PSEUDOCHANNELS, however, such effects may be controlled only by the **STATUS (STS)** command (see Section 2.C.12(e)). As explained in Section c, below, a VIDEO PLAYBACK PSEUDOCHANNEL can also be set up to display a recorded FRAME's SERIAL NUMBER, TIME, or DATE.

Every VIDEO PLAYBACK PSEUDOCHANNEL will be displayed on the CRT screen within a VIDEO PLAYBACK FIELD. This variable field is to be entered in the process of composing the respective VIDEO PAGE FORMAT, as explained in Section 2.C.5(h) of this Guidebook. (The procedure for entering a VIDEO PLAYBACK FIELD is identical to that for entering a DATA FIELD, *except* that the channel-number entry, which is now any number from 1000 through 1299, must be preceded by an *asterisk* (*).)

———— NOTE ————

- The total number of "NORMAL" PLAYBACK PSEUDOCHANNELS that can be set up for a given History Card is *29 channels per recorder*.
- The total number of VIDEO PLAYBACK PSEUDOCHANNELS that can be set up for a given History Card is *300 channels, regardless of the recorder(s) to which they are assigned*.
- The total number of "STATISTICAL" PLAYBACKS ("NORMAL" or "VIDEO") that can be set up for a given History Card is *25 channels per recorder* (these are discussed in Section d.8(d), below).

—— ALSO NOTE ——

WHEN YOUR SYSTEM'S HISTORY MEMORY IS IN *NONVOLATILE* MODE—I.E., WHEN THE **NVH [CR]** * COMMAND IS IN EFFECT (Section 3.B.4(b.3)—YOU MUST APPLY A **RECORD MODE (RMD)** COMMAND TO THE DATAPAC FOLLOWING EVERY POWERUP, IN ORDER TO ACTIVATE THE SYSTEM'S CURRENT PLAYBACKS (see Section 3.B.4(e.2), below, for details).

b. **THE PLAYBACK (PLA) COMMAND AND RELATED "RUN-TIME" COMMANDS (ZUM, FRZ, RPL)**

Like CALCULATE PSEUDOCHANNELS, PLAYBACK PSEUDOCHANNELS are automatically "configured" as soon as they are defined. Thus, each of the **PLAYBACK (PLA)** commands given below and in the following sections will have the effect of assigning a TYPE code of **D9** to the channel being set up (Channel No. x).

To set up a PLAYBACK PSEUDOCHANNEL No. x to represent the data value for DATA CHANNEL No. y that was *last recorded* by Recorder No. n, command

PLA x = REC n, CHN y [CR] *

In this and the following **PLA** command, the channel number "x" can be from 1 through 997 if you are setting up a "NORMAL" PLAYBACK PSEUDOCHANNEL, or from 1000 through 1299 if it is to be a VIDEO PLAYBACK PSEUDOCHANNEL.

To set up a PLAYBACK PSEUDOCHANNEL No. x to represent the data value for DATA CHANNEL No. y that was recorded by Recorder No. n *a specific number of FRAMES in the past*, command

PLA x = REC n, CHN y (-f) [CR] *

Here, "f" is the **SEARCH DEPTH** for PLAYBACK PSEUDOCHANNEL No. x. This is the number of FRAMES "ago" at which the **SEARCH FRAME** is located. It is thus a measure of the "pastness" in time of the FRAME within the recorder's memory that contains the data reading of interest (see Fig. 3.B.4.5). The allowable SEARCH DEPTH (f) can be from 1 through 32767, provided that it does not exceed the total DEPTH predesignated for Recorder No. n via the **DEPTH (DPT)** command.

Note that, as time goes on and new recordings continue to be made, the SEARCH FRAME will "advance" accordingly, since the SEARCH DEPTH (the "pastness" of the SEARCH FRAME) will always remain *constant*, unless a **ZOOM (ZUM)**, **FREEZE (FRZ)**, or **REPLAY (RPL)** command is in effect.

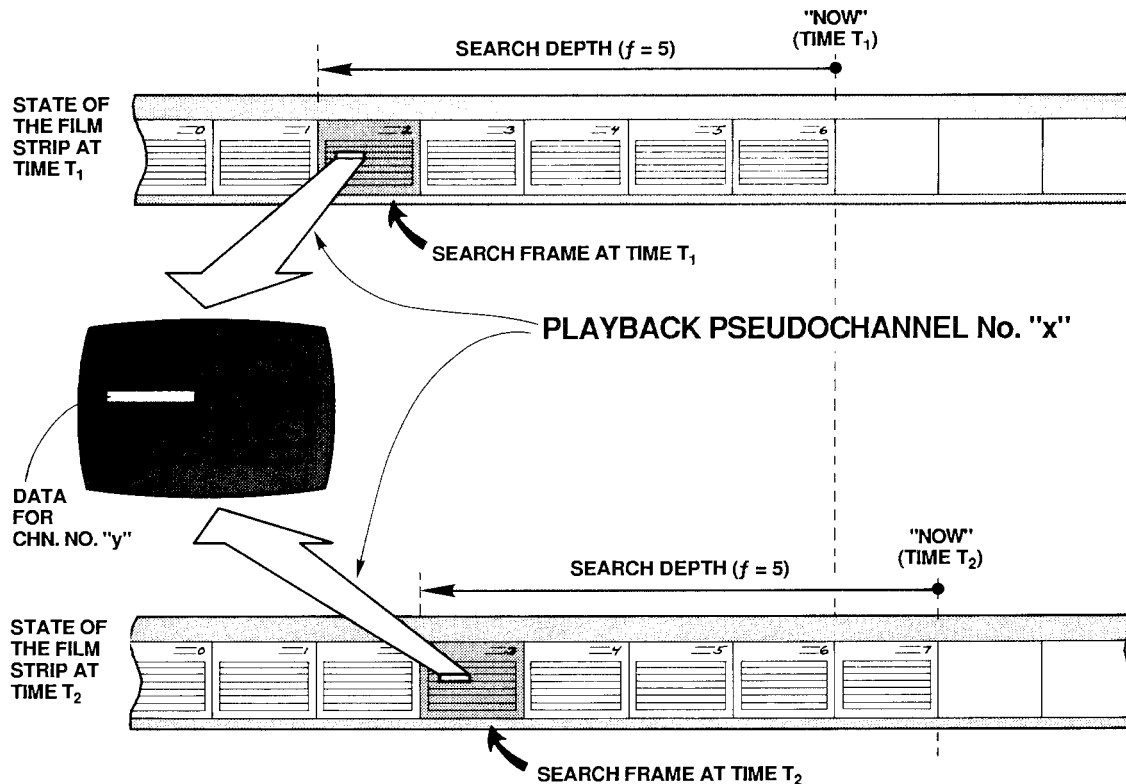
The situation is illustrated in Fig. 3.B.4.5. The upper picture represents the state of a recorder "film strip" at a given time; the lower picture shows the same strip at a later time, *after* another recording has been made. With the recording of the FRAME with the SERIAL NUMBER of "7," the SEARCH FRAME automatically moves from "2" to "3," and the data reading reported by the PLAYBACK PSEUDOCHANNEL changes accordingly. The SEARCH DEPTH, however, remains a constant *five* FRAMES.

Several very useful "RUN-TIME" COMMANDS relate to the playback of "historical" data. By means of the **ZOOM (ZUM)** command you can readily alter the magnitude of the SEARCH DEPTH (and hence the current position of the SEARCH FRAME). The **FREEZE (FRZ)** command lets you "zoom" to a SEARCH FRAME that *does not change* with ongoing recordings. The **REPLAY (RPL)** command allows *the automatic FRAME-by-FRAME reduction* of a recorder's SEARCH DEPTH at a specified rate. These commands are discussed in detail in Sections e.8 and e.9, below.

3.B.4.d

HISTORY CARD SETUP

Fig. 3.B.4.5. Specification of Playback "SEARCH DEPTH"



The **ZOOM (ZUM)** command can be applied even while recording is in process, in order to rapidly review the values that have been reported by one or more DATA CHANNELS over an "historical" period of time. Specifically, you can use it to observe how all or part of the DATA CHANNELS contained in a given recorder's LIST have evolved *together* in time. Such "time-coherent zooming" of a whole set of channels is discussed in detail in Section e.8. For setup purposes, however, you should note here that it is useful in such cases to set up a PLAYBACK PSEUDOCHANNEL that lets you identify the current SEARCH FRAME in terms of either its SERIAL NUMBER or TIME of recording, as explained in the following section.

You can assign to the *same* DATA CHANNEL (No. y) more than one PLAYBACK PSEUDOCHANNEL, each with a different SEARCH DEPTH " f ." This lets you display simultaneously and on the same CRT page the data values reported by Channel No. y at different times "ago." Note, however, that it is generally not a good idea to mix a channel's "live" (i.e., current) data reading with "playbacks" of its past readings on the same VIDEO PAGE FORMAT, if you intend to use the **ZOOM (ZUM)** command for "time search" purposes (see Section e.8).

PLEASE NOTE

The **ZUM**, **FRZ**, and **RPL** commands do not apply to the "STATISTICAL" PLAYBACK PSEUDOCHANNELS described in Section d.8(d), below. The application of **ZUM** to a given recorder or recorders will not affect any such playbacks set up for that recorder or recorders, while the application of either **FRZ** or **RPL** will actually *disable* any and all "STATISTICAL" PLAYBACKS for the recorder(s) in question as long as the command is in effect.

C. SPECIAL VIDEO PLAYBACKS: SERIAL NUMBER, TIME, AND DATE

To set up a VIDEO PLAYBACK PSEUDOCHANNEL to display the **SERIAL NUMBER** of the SEARCH FRAME, command

PLA x = REC n, SER (-f) [CR] *

where $1000 \leq x \leq 1299$ and $1 \leq f \leq 32767$.

To set up a VIDEO PLAYBACK PSEUDOCHANNEL to display the **TIME** of the SEARCH FRAME, *to the nearest second* or *to the nearest hundredth of a second*, command, respectively

PLA x = REC n, TME (-f) [CR] *

or

PLA x = REC n, TMF (-f) [CR] *

To set up a VIDEO PLAYBACK PSEUDOCHANNEL to display the **DATE** of the SEARCH FRAME, command

PLA x = REC n, DTE (-f) [CR] *

Note that in order for the "DATE" PLAYBACK to be effective, it is necessary that the **DTE** mnemonic be included in the **LIST (LST)** expression for Recorder No. n (see Section d.3, above).

If the SEARCH FRAME indicator "(-f)" is omitted from any of the above four **PLA** commands, a default value of "-1" will be assumed. That is, the playback of SERIAL NUMBER, TIME, or DATE will refer to the *last recording* made by Recorder No. n.

d. STATISTICAL PLAYBACKS: Model 10BSPC

The main function of the **Model 10BSPC History SPC Option Card** is to perform statistical analysis of data recorded by the Model 10BDR64 History Card. Enhancing the History Card's basic playback capabilities, while relieving the DataPAC's CENTRAL PROCESSOR of the required computational tasks, it is an important tool for on-line **Statistical Process Control (SPC)**.

As explained in Section b.2, above, the 10BSPC also acts as a Model 10BHM128 History Memory Option Card, providing 128K scaled readings in addition to those of the History Card, or allowing conversion to a *nonvolatile* history memory of up to 128K readings. For installation of the 10BSPC, see Section c, above.

Specifically, the Model 10BSPC makes possible several special forms of the **PLAYBACK (PLA)** command, which may be used to set up "STATISTICAL" PLAYBACK PSEUDOCHANNELS. Such playbacks may be either "NORMAL" or "VIDEO." *No more than 25 "STATISTICAL" PLAYBACK PSEUDOCHANNELS may be set up for a given recorder.*

NOTE ALSO THAT ALL VALUES REPORTED BY "STATISTICAL" PLAYBACK PSEUDOCHANNELS ARE ROUNDED DOWN TO THE NEAREST INTEGER.

———— IMPORTANT ————

You should not set up both "STATISTICAL" and "NON-STATISTICAL" PLAYBACKS for the same recorder if you wish to apply the **FREEZE (FRZ)** or **REPLAY (RPL)** commands to that recorder. This is because the application of either of these commands to a given recorder WILL *DISABLE ANY AND ALL* "STATISTICAL" PLAYBACKS SET UP FOR THAT RECORDER AS LONG AS THE COMMAND IS IN EFFECT.

Application of a **ZOOM (ZUM)** command to a given recorder will *not* disable any "STATISTICAL" PLAYBACKS set up for that recorder; however, it will not affect them either. That is, it will not change the existing SEARCH DEPTH setting for any of these playbacks.

1. "CONTINUOUS" STATISTICAL PLAYBACKS: AVERAGE, MAXIMUM, AND MINIMUM

A command of

PLA x = REC n, AV y (-f) [CR] *

will set up a PLAYBACK PSEUDOCHANNEL No. x to report the *continuous average value* experienced by DATA CHANNEL No. y over the last "f" recordings of Recorder No. n. For this and the two following **PLA** commands, $1 \leq x \leq 997$ ("NORMAL" PLAYBACK) or $1000 \leq x \leq 1299$ ("VIDEO" PLAYBACK), and $1 \leq f \leq 10000$.

Similarly, you can arrange for the playback of the *lowest* or *highest* value experienced by Channel No. y over the last "f" recordings of Recorder No. n by commanding, respectively,

PLA x = REC n, LO y (-f) [CR] *

or

PLA x = REC n, HI y (-f) [CR] *

———— NOTE ————

For all "AVERAGE," "MAXIMUM," AND "MINIMUM" PLAYBACKS, the SEARCH DEPTH ("f")—i.e., the *number* of recorded FRAMES over which the average, maximum, or minimum of Channel No. y is continuously reported—will always remain the same. Thus, with each new recording made by Recorder No. n, the newly recorded FRAME will be added to each playback's "statistical base," while the oldest FRAME will be dropped. As mentioned above, application of the **ZOOM (ZUM)** command (which is normally used to modify a playback's SEARCH DEPTH while in RECORD MODE) *will have no effect on any "STATISTICAL" PLAYBACK.*

2. "INDUSTRY STANDARD" STATISTICAL PLAYBACKS: X-BAR AND RANGE

Unlike the above "STATISTICAL" PLAYBACKS, the "X-BAR" and "RANGE" PLAYBACKS do not operate "continuously," but on the basis of successive "sampling periods," each of which consists of the same fixed number of data recordings (1 through 25).

To set up an "X-BAR" PLAYBACK PSEUDOCHANNEL, command

PLA x = REC n, XBR y (-f) [CR] *

where "f" here defines the number of recorded FRAMES per "sampling period" ($1 \leq f \leq 25$).

Assume, for example, that we have entered an "f" of "10." As Recorder No. n is making its first ten recordings, Channel No. x will read a data value of "0." However, as soon as the recorder begins its 11th recording, Channel No. x will report the *average value* for Channel No. y's data over the *first* "sampling period" (the first 10 recordings). Channel No. x will continue to report this value until the next sampling period is finished—that is, until the next ten recordings have been made. It will then report the average for Channel No. y as computed over the *second* sampling period (the 11th through 20th recordings), a value which will be held until the *third* sampling period is finished, and so on.

The "RANGE" PLAYBACK operates in a similar fashion. It is set up by a command of

PLA x = REC n, R y (-f) [CR] *

Channel No. x will now read *the absolute value of the difference between the highest and lowest values of Channel No. y* over the previous sampling period (reading "0" up until the "fth" recording is finished). The maximum value that can be reported by a "RANGE" PLAYBACK PSEUDOCHANNEL is 32767. Again, $1 \leq f \leq 25$.

"X-BAR" and "RANGE" PLAYBACKS may be *reset* at any time by means of the **RSP** command, as described in the following section.

e. RESETTING "X-BAR" AND "RANGE" PLAYBACKS: RSP COMMAND

The **RESET STATISTICAL PLAYBACK (RSP)** command serves to reset all "X-BAR" and "RANGE" PLAYBACK PSEUDOCHANNELS for a given recorder or range of recorders—if, for example, a test needs to be restarted while recording is still in process.

Thus, to reset all "X-BAR" and "RANGE" PLAYBACK PSEUDOCHANNELS for Recorder No. n, command

RSP n [CR]

To reset all "X-BAR" and "RANGE" PLAYBACK PSEUDOCHANNELS for Recorder Nos. n through m, command

RSP n TO m [CR]

The effect of the **RSP** command is to return each playback in question to its *initial* state ("NO RECORDINGS YET") with a data reading of "0" (zero).

f. CANCELLING PLAYBACK ASSIGNMENTS: PLA AND RST COMMANDS

To *release* Channel No. x from its PLAYBACK PSEUDOCHANNEL assignment (either "NORMAL" or VIDEO), in order that it may be reconfigured for some other use, command

PLA x = N/A [CR] *

This command will automatically "retype" Channel No. x as "D0."

To cancel the playback assignments of all channels from Channel No. x through Channel No. y, "retyping" them all as "D0," command

PLA x TO y = N/A [CR] *

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HISTORY CARD SETUP

If the History Card is absent, you may use a **RESET (RST)** command of

RST x [CR] * or **RST x TO y [CR] ***

to cancel one or a range of playbacks, "retyping" them to "D0."

Note that the "WRITE" form of the **TYPE (TYP)** command will never affect a PLAYBACK PSEUDOCHANNEL.

9. SETTING UP PLAYBACK OF SYSTEM BIT GROUPS: **CHN**, **PLA**, **CCH**, AND **BIN** COMMAND

Suppose that you wish to playback the state of a given BIT GROUP No. k that was recorded by Recorder No. n "f" FRAMES ago. To do so, you may use the **BINARY (BIN)** command, as explained in the following procedure. For a complete discussion of the **BIN** command, see Section 3.B.2(e) of this Guidebook.

- a. You must first establish a "REAL" DATA CHANNEL (No. y) to read the BINARY value represented by the 16 bits of BIT GROUP No. k. Enter a **CHANNEL (CHN)** command of the form

CHN y = BIN k [CR] *

where "y" is any unused system Channel Number (0 through 997).

- b. You must make sure that Channel No. y is included in the "LIST" of variables to be recorded by Recorder No. n—along with the BIT GROUP in question (No. k). See the **LIST (LST)** command, Section d.3, above. Also make sure that Channel No. y is within the DataPAC's current SCAN RANGE.

- c. Now set up a "NORMAL" PLAYBACK PSEUDOCHANNEL (No. x) to represent the data value for Channel No. y that was recorded by Recorder No. n "f" FRAMES in the past. As explained in Section d.8, above, you would enter a **PLAYBACK (PLA)** command of

PLA x = REC n, CHN y (-f) [CR] *

- d. You must now establish a CONVERSION CHANNEL (No. c), in order to convert the decimal value reported by PLAYBACK PSEUDOCHANNEL No. x back to a BINARY representation. Enter a **BINARY (BIN)** command of

BIN j = CHN c [CR] *

where "j" is any BIT GROUP other than "k." BIT GROUP No. j will now be continuously configured by the digitally converted data it receives from CONVERSION CHANNEL No. c.

- e. Finally, assign PLAYBACK PSEUDOCHANNEL No. x to be the "source" for CONVERSION CHANNEL No. c by entering a **CONVERSION CHANNEL (CCH)** command of

CCH c = x [CR] *

As a result of the above steps, BIT GROUP No. j will continuously reflect the logic-state configuration of BIT GROUP No. k that existed "f" FRAMES ago, and may be interrogated by a **SET BIT (BIT)** or **HEXADECIMAL (HEX)** command (see Section 2.H.2(c) of this Guidebook). The playback "time search" and "replay" features described in Sections e.8 and e.9, below, may also be employed with regard to the "BIT GROUP" PLAYBACK PSEUDOCHANNEL No. x.

10. FORMATTING RECORDER OUTPUTS: IMA COMMAND

The **OUTPUT IMAGE (IMA)** command lets you select the variables you want to appear in each *line* of output produced by Recorder No. *n* in response to an **EMPTY (EMP)** or **HISTORY DUMP (HDU)** command, and the order in which these variables are to be transmitted. Each line of output corresponds to a FRAME of recorded data. The **EMP** and **HDU** commands are treated in detail in Sections e.6 and e.7, below.

The **IMA** command has this general form:

$$\mathbf{IMA\ n = v_1, v_2, \dots, v_n [CR] *}$$

The successive "v" terms are MNEMONICS for selected output variables from the following list:

FR	FRAME NUMBER (see Section e.7(a), below). In the output, all frames will be preceded by FRA .
DN	DATA NUMBER (either <i>Channel No.</i> or <i>System Bit Group No.</i>), followed by appropriate DATA. Thus, each DATA CHANNEL included in the recorder's initial LIST will be transmitted as [CHN. NO.][DATA] . Each listed SYSTEM BIT GROUP (SBG) will be transmitted as [SBG NO.][DATA] , with the symbol # preceding the Bit Group Number. DATA for each listed BIT GROUP will be represented by a 4-character HEXADECIMAL WORD, followed by the letter H.
DV	DATA ONLY (no Channel No. or System Bit Group No. "echo").
DT	DATE on which the FRAME was recorded, with a format of XXXXXX (month, day, and year). See Note d, below.
FT	<i>FRACTIONAL</i> TIME at which the FRAME was recorded, with a format of XXXXXX.XX (hours, minutes, and seconds—as determined by the TME = t [CR]* command—plus <i>hundredths of a second</i> , not settable by the user).
TM	<i>INTEGRAL</i> TIME at which the FRAME was recorded, with a format of XXXXXX (hours, minutes, and seconds—as determined by the TME = t [CR]* command).
SN	SERIAL NUMBER of the FRAME.

Concerning the above MNEMONICS, you should note the following:

- a. MNEMONICS may not be repeated in the **IMA** expression.
- b. MNEMONICS may be entered in *any desired order* in the **IMA** expression.
- c. **DN** and **DV** are mutually exclusive, as are **FT** and **TM**. Thus, you can select only one output format for DATA and only one format for TIME.
- d. **DT** will not be included in the recorder's output unless **DTE** is also present in the recorder's LIST (see Section d.3, above).
- e. If any of the above MNEMONICS is omitted from the **IMA** expression, the corresponding variable will not appear in the output.
- f. Your History Card has been factory-set for an initial "image" of **FR, DN, FT, SN**.

3.B.4.d

HISTORY CARD SETUP

As an example of the **OUTPUT IMAGE (IMA)** command, suppose that you want to indicate for Recorder No. 2 a line-output "image" that looks, in general, like this:

```
[SERIAL NO.],[INTEGRAL TIME],[DATE],[CHN. NO.],[DATA],[CHN. NO.],  
[DATA],...,[SBG NO.],[DATA],[SBG NO.],[DATA],...[CR][LF]
```

The appropriate command would be

IMA 2 = SN,TM,DT,DN [CR] *

Fig. 3.B.4.6 represents an actual printout of seven FRAMES of data, recorded at 30-second intervals, as formatted by the above **IMA** command. In this case, the recorder's LIST consists of Channel Nos. 1, 3, 4, and 5; System Bit Group Nos. 7 and 8; and DATE—as specified by a command of

LST 2 = CHN 1, 3 TO 5, SBG 7 TO 8, DTE [CR] *

Fig. 3.B.4.6.

Serial Number	Integral Time	Date	Channel No.	Channel Data	SBG No.	SBG Data
50829	,055830	,81084	,1	,57 .3,3,9 .34,4,715,5,0 .21	,#7,54F7H	,#8,A2C7H
50830	,055900	,81084	,1	,57 .1,3,9 .30,4,722,5,0 .20	,#7,54F7H	,#8,B2C6H
50831	,055930	,81084	,1	,56 .9,3,10 .59,4,723,5,1 .01	,#7,64E7H	,#8,B2C6H
50832	,060000	,81084	,1	,57 .0,3,10 .03,4,719,5,0 .89	,#7,65E7H	,#8,B2C5H
50833	,060030	,81084	,1	,57 .3,3,9 .99,4,720,5,0 .94	,#7,54F7H	,#8,B8C5H
50834	,060100	,81084	,1	,57 .8,3,10 .01,4,717,5,0 .45	,#7,55F7H	,#8,B0C5H
50835	,060130	,81084	,1	,57 .6,3,9 .98,4,721,5,1 .10	,#7,56F7H	,#8,A0C6H

Or suppose you want an output line for Recorder No. 2 of the general form

```
[DATA],[DATA],[DATA],...,[FRACTIONAL TIME],[FRAME NO.][CR][LF]
```

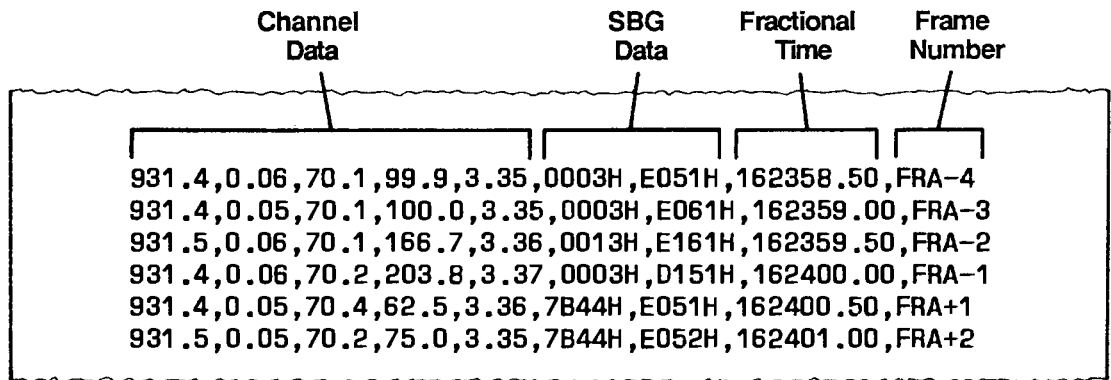
You would then command

IMA 2 = DV,FT,FR [CR] *

Fig. 3.B.4.7 shows a printout of six FRAMES (Nos. -4 through (+)2), recorded at half-second intervals, as formatted by this **IMA** command. Here, the recorder's LIST consists of five DATA CHANNELS and two BIT GROUPS.

Note that an OUTPUT TERMINATOR of **[CR][LF]** has been assumed in these examples. To designate different END-OF-LINE terminating characters, you may use the **OUTPUT TERMINATOR (OPT)** command (see Section 1.H.3(g) of this Guidebook).

Fig. 3.B.4.7



3.B.4.e

HISTORY CARD OPERATION

1. INTRODUCTION

The commands discussed in this section are "RUN-TIME" interrogative or imperative commands, and may therefore be applied, when appropriate, *during* the History Card's normal recording and playback operation.

As soon as you have completed all setup procedures dictated by your History Card's specific application, you should

- TURN OFF THE DATAPAC'S EEPROM WRITE PROTECT SWITCH.
- PLACE THE HISTORY CARD IN "RECORD MODE."

2. ENTERING RECORD MODE: **RMD** COMMAND

a. THE **RECORD MODE (RMD)** COMMAND

To exit SETUP MODE, thus making each of the History Card's recorders *ready to record data*, command

RMD [CR]

This command inhibits further entry or modification of recorder setup values. If you need to change setup values at any later time, you must re-enter SETUP MODE via the **SMD** command (Section d.2, above).

PLEASE NOTE: If the DataPAC's Channel 998 ("TIME") has been "locked" by means of a **LOK [CR]** command either before or after the History Card was placed in SETUP MODE, then the History Card WILL NOT GO INTO RECORD MODE UPON ENTRY OF THE **RMD** COMMAND. THE TIME CHANNEL MUST BE "UNLOCKED" IN ORDER FOR THE HISTORY CARD TO ENTER RECORD MODE.

b. **AUTOMATIC ENTRY OF RMD FOLLOWING POWERUP IN "NONVOLATILE HISTORY" MODE**

The two following procedures show how you can arrange to enter the **RMD** command *automatically*, in the event that DataPAC power is recycled during unattended operation. The method you choose will depend on your available system resources.

1. USE OF THE **CONDITIONAL (CDL)** AND **COMMAND (CMD)** COMMANDS

(For a full discussion of the **CDL** and **CMD** commands, see Section 2.K.3 of this Guidebook.)

- a. Turn ON the DataPAC's EEPROM Switch and enter a command of

CDL q = /BIT r • INT 6 [CR] *

where "q" is any currently unused CONDITIONAL BIT and "r" is any currently unused LOGIC BIT (Bit No. r should have a LOGIC SOURCE of "EXT, NON"—see Section 2.H.2).

- b. Then enter a command of

CMD q = RMD : BIT r = 1 [CR] *

As a result of these commands, the **RMD** command will be applied automatically *fifteen seconds after every powerup* (**CDL**-triggered sequences are always delayed by fifteen seconds after powerup).

2. USE OF THE EXECUTE (EXU) COMMAND

(For a full discussion of the **EXU** command, see Section 2.K.2 of this Guidebook.)

- a. Select a currently unused Channel No. *x* which is *included in the DataPAC's present SCAN RANGE*.
- b. Assign a "TYPE" code of "D2" (INCREMENTAL TIMER PSEUDOCHANNEL) to Channel No. *x* by turning ON the DataPAC's EEPROM Switch and entering a command of

TYP x = D2 [CR] *

- c. Set a high limit value of "15" for Channel No. *x* by commanding

HIL x = 15 [CR] *

- d. Specify any currently unused Logic Bit No. *r* to be set to *Logic 1* when Channel No. *x* exceeds its high limit value by commanding

LGT x = r [CR] *

- e. Then enter the following **EXECUTE (EXU)** command:

EXU r = RMD [CR] *

As a result of these steps, the **RMD** command will be applied automatically *fifteen seconds after powerup* (regardless of the "EXECUTE MODE" currently in effect—see Section 2.K.2(d)).

3. RESETTING SERIAL NUMBER: RSN COMMAND

a. RESETTING NEXT FRAME TO ZERO

When you want to reset to *zero* the SERIAL NUMBER of the FRAME to be next recorded by Recorder Number *n*, command

RSN n [CR]

The FRAME following in sequence that which is next to be recorded will bear a SERIAL NUMBER of "0000001"; the FRAME after that one will be "0000002"; etc.

To reset to zero the SERIAL NUMBERS of all FRAMES to be next recorded by Recorder Nos. *n* through *m*, command

RSN n TO m [CR]

b. RESETTING NEXT FRAME TO AN INTEGRAL NUMBER

To set the SERIAL NUMBER of the FRAME to be next recorded by Recorder No. *n* to a specific integral value "*s*," command

RSN n = s [CR]

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HISTORY CARD OPERATION

where $0 \leq s \leq 99999999$. At powerup, the SERIAL NUMBER for the next FRAME to be recorded will default to *zero* for each recorder, unless the **NONVOLATILE HISTORY (NVH)** command has been applied (see Section b.3, above).

To set to the same value *s* the SERIAL NUMBERS of all FRAMES to be next recorded by Recorder Nos. *n* through *m*, command

RSN n TO m = s [CR]

———— NOTE ————

If the total number of *recorded* FRAMES now stored in a given recorder is "F," and if the SERIAL-NUMBER sequence was not changed during the recording of these frames, then the full range of SERIAL NUMBERS in the recorder will be, at any time,

FROM (N-(F-1)) THROUGH N

where "N" is the SERIAL NUMBER of the most recently recorded FRAME. If the recorder happens to be "full"—that is, if with every new recording it is replacing with a new FRAME the oldest FRAME in storage—then "F" will be equal to the recorder's DEPTH.

To prevent the possibility of there being more than one FRAME in the recorder with the *same* SERIAL NUMBER, you should make sure that any new SERIAL NUMBER to which you reset the recorder *does not lie within the above range*. For example, if the most recently recorded FRAME has a SERIAL NUMBER of 3285, and is the 150th FRAME in storage, then the *lowest* SERIAL NUMBER in the recorder is presently $(3285-149) = 3136$. (We are here assuming that the recorder's SERIAL NUMBER has not been reset during the recording of the 150 FRAMES.) If you now reset the SERIAL NUMBER, make sure that the new number does not lie within the range of 3136 through 3285.

———— ALSO NOTE ————

If a command of **RSN n = s [CR]** is applied when the History Card is in RECORD MODE, and the FRAME of SERIAL NUMBER "s" is subsequently contained within the range of FRAMES to be transmitted by Recorder No. *n* in response to an **EMPTY (EMP)** or **HISTORY DUMP (HDU)** command (Sections e.6 and e.7, below), then the **EMP** or **HDU** process WILL BE ABORTED WHEN THAT FRAME IS REACHED. That is, if an entire range of FRAMES is to be successfully "emptied" or "dumped," the corresponding SERIAL-NUMBER sequence must be *continuous*. In the event that such a transmission is aborted because a discontinuity in SERIAL NUMBERS is perceived by the recorder, the **EMP** or **HDU** command should be reapplied.

4. REQUESTING CURRENT HALT STATUS: CHS COMMAND

If, following the occurrence of a "halt-triggering" condition for Recorder No. *n*, you want to find out how many FRAMES the recorder has stored so far *since the occurrence of that condition*, you can command

CHS n [CR]

The DataPAC's response will take the format **r, q**, where "r" is the number of FRAMES that have been recorded following the "halt-triggering" event, and "q" is the total HALT DEPTH of the recorder, as specified during setup by the **HALT DEPTH (HDP)** command.

For example, a response of **4, 9** to a **CHS** interrogation means that four FRAMES have been recorded since the "halt-triggering" condition occurred, and that five more FRAMES are yet to be recorded before the full HALT DEPTH of "9" is reached (and the recorder finally stops recording).

5. RESTARTING A HALTED RECORDER: **STH** COMMAND

To restart a halted Recorder No. n, command

STH n [CR]

The recorder is now ready to record data when its specified "store" condition next occurs.

Note that the restarting of a halted recorder can be made dependent on one or a combination of system conditions by including the **STH** command in an **EXECUTE (EXU)** or **COMMAND (CMD)** statement (see Section 2.K of this Guidebook).

To restart all halted recorders from No. n through No. m, command

STH n TO m [CR]

6. "EMPTYING" AND "REACCESSING" HISTORY MEMORY

a. THE "**EMPTY (EMP)**" COMMAND

In general, you will use the **EMPTY (EMP)** command, in either of its two forms, *while recording is in process*. The command allows you to learn *what has happened since the last such interrogation*.

A command of

EMP n [CR]

will output from the DataPAC's COMPUTER INTERFACE PORT all FRAMES of Recorder No. n, in sequence, that have been recorded since the last **EMP** command was applied to the recorder.

A command of

EMP n = f [CR]

will output in sequence a *selected number of FRAMES* that have been recorded since the last **EMP** command, provided that the SERIAL-NUMBER sequence for these FRAMES is *continuous* (see Section e.3, above). Here, "f" is the number of FRAMES to be "emptied," starting from the oldest frame not "emptied" by a prior **EMPTY (EMP)** command.

See, for example, Fig. 3.B.4.8. Here, five recorded FRAMES separate the applications of two successive **EMPTY (EMP)** commands (i.e., **EMP'** and **EMP**). FRAME "f₁" is the oldest FRAME *not* "emptied" by the command **EMP'**. Thus, a present command of

EMP n = 3 [CR]

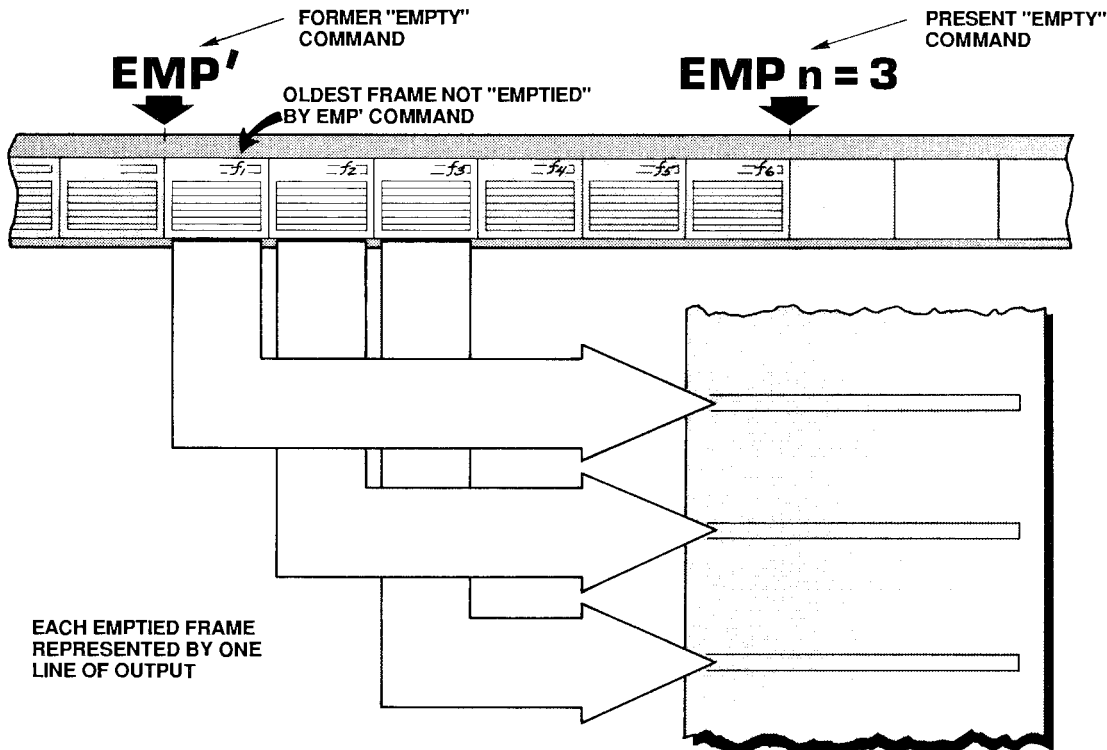
will "empty" FRAMES "f₁," "f₂," and "f₃" from this recorder (No. n).

3.B.4.e

HISTORY CARD OPERATION

The contents of each "emptied" FRAME will constitute a *line* of output. The number of output lines transmitted by the DataPAC in response to an **EMPTY (EMP)** command will therefore equal the number of FRAMES recorded or requested, whichever is smaller. The precise *format* for each line of output will depend on the last **OUTPUT IMAGE (IMA)** command to have been applied to the recorder in question (see Section d.10, above).

Fig. 3.B.4.8. "Emptying" of Recorder Frames



b. THE "REACCESS HISTORY MEMORY (RHM)" COMMAND

Despite its name, the **EMPTY (EMP)** command does not literally "empty" a recorder's FRAMES. Until the recorder's DEPTH is reached, all recorded FRAMES will *remain* in its memory, regardless of any and all **EMPTY (EMP)** commands that may have been applied. (After its DEPTH has been filled, of course, the oldest FRAME in the recorder's memory will be lost with each subsequent recording.) By applying the **REACCESS HISTORY MEMORY (RHM)** command, you can restore access to all FRAMES still in storage that have been previously "emptied," or to the last "r" FRAMES recorded prior to the last application of the **EMPTY (EMP)** command.

The following command restores access to—i.e., allows "re-emptying" of—all recorded FRAMES of data in Recorder No. n that have been previously "emptied":

RHM n [CR]

A command of the form

RHM n TO m [CR]

reaccesses all previously "emptied" FRAMES contained in Recorder Nos. n through m.

If you want to reaccess only the last "r" FRAMES recorded prior to the last **EMPTY (EMP)** command, then command

RHM n = r [CR]

For example, if the film strip shown in Fig. 3.B.4.8 represents Recorder No. 2, then a command of

RHM 2 = 3 [CR]

applied *after* the command **EMP** (and before any subsequent **EMPTY (EMP)** commands) will restore for future "re-emptying" FRAMES "f₄," "f₅," and "f₆." The **RHM n = r [CR]** command also has an "n TO m" form.

7. "DUMPING" HISTORY MEMORY: HDU COMMAND

a. FRAME NUMBERING

"Frame Numbers" are used only with regard to the **HISTORY DUMP (HDU)** command. Relating recorded FRAMES chronologically to a "halt-triggering" event, these numbers enable you to "dump" a specified number of FRAMES that were recorded *before* the event and a specified number recorded *after* the event (up to the predefined HALT DEPTH of the recorder).

As shown in Fig. 3.B.4.4 (Section d.7), all FRAMES recorded *before* a "halt-triggering" event are designated by *negative* numbers. The larger the negative number, the older the FRAME. Thus, the *last* FRAME to be recorded prior to a "halt-triggering" event is always given a Frame Number of "-1."

FRAMES recorded *after* a "halt-triggering" event (up to the number of FRAMES defined by the HALT DEPTH) are given by *positive* numbers. The smaller the positive number, the older the FRAME. Thus, the *first* FRAME to be recorded following the event is given a Frame Number of "(+)1."

———— REMEMBER ————

- Frame Numbers are used only in connection with the **HISTORY DUMP (HDU)** command, and are meaningful *only after the occurrence of a "halt-triggering" condition*.
- The *magnitude* of the number assigned to a given FRAME indicates the FRAME'S "distance" in time from the "halt-triggering" event.
- The *polarity* of the number assigned to a given FRAME indicates whether the FRAME was recorded before or after the "halt-triggering" event.

b. THE "HISTORY DUMP (HDU)" COMMAND

In general, you will use the **HISTORY DUMP (HDU)** command, in either of its two forms, *after recording has stopped*. As shown in Fig. 3.B.4.9, **HDU** serves to define a flexible "history window" that lets you review a specified period of data history. All recorded FRAMES "seen" through the window are "dumped" as output from the DataPAC's COMPUTER INTERFACE PORT. Regions of a recorder's history record can be dumped at any time; such dumping is not affected by any previously applied **EMPTY (EMP)** command(s).

3.B.4.e

HISTORY CARD OPERATION

When you want to transmit from the DataPAC's COMPUTER INTERFACE PORT the contents of a specific Frame No. *f* from Recorder No. *n*, command

HDU n = f [CR]

When you want to dump a *sequence of FRAMES* from Recorder No. *n*, command

HDU n = f TO g [CR]

where "*f*" and "*g*" are the Frame Numbers that define the sequence. Even if a portion of the specified "*f TO g*" sequence does not exist, that portion which *does* exist will be "dumped" in its entirety. As with the **EMPTY (EMP)** command, the SERIAL-NUMBER sequence for the range of FRAMES to be transmitted must be *continuous* (see Section e.3, above).

As an example of a **HISTORY DUMP (HDU)** command, suppose that recordings are taken by the History Card's Recorder No. 3 at 5-second intervals, as specified by an initial **STORE (STO)** command of

STO 3 = INT 8 [CR] *

Suppose also that a HALT DEPTH of "4" has been specified for the recorder by a command of

HDP 3 = 4 [CR] *

The *Frame Numbers* associated with the sequence of recordings will be determined by the time at which the predefined "halt-triggering" condition is detected. In this example, the "halt-triggering" event occurs between times XX:XX:30 and XX:XX:35, and so the Frame-Number sequence will be as shown in Fig. 3.B.4.9. Note that four recordings have been made *following* the "halt-triggering" event, because a HALT DEPTH of "4" had been indicated for this recorder.

To dump three FRAMES *prior to* the "halt-triggering" event and two FRAMES *following* it, command

HDU 3 = -3 TO 2 [CR]

The five FRAMES recorded from XX:XX:20 through XX:XX:40 will consequently be transmitted from the COMPUTER INTERFACE PORT.

As with the **EMPTY (EMP)** command, each output *line* will correspond to a single FRAME, and the precise output *format* will be determined by the last **OUTPUT IMAGE (IMA)** command to have been applied (see Section d.10).

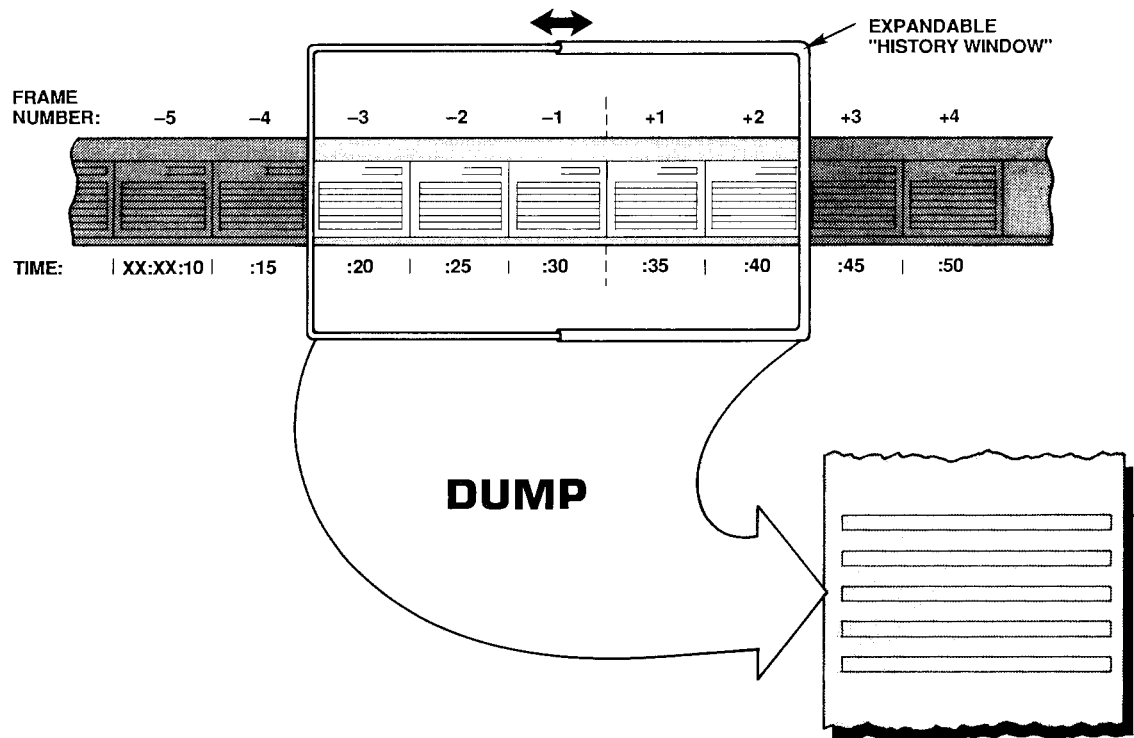
8. PLAYBACK TIME SEARCH

a. THE "ZOOM (ZUM)" COMMAND

Recall from Section d.8 that for every "NON-STATISTICAL" PLAYBACK PSEUDOCCHANNEL ("NORMAL" or "VIDEO"), you will specify a **SEARCH DEPTH** ("*f*"). This number simply defines the "pastness" of the SEARCH FRAME, which is the FRAME in history memory that contains the data of interest. A SEARCH DEPTH of "*f*" identifies the current SEARCH FRAME as the FRAME which was recorded "*f*" FRAMES "ago" (review Fig. 3.B.4.5).

The **ZOOM (ZUM)** command is a "RUN-TIME" COMMAND that lets you modify the SEARCH DEPTH of *every* "NON-STATISTICAL" PLAYBACK PSEUDOCCHANNEL assigned to a given recorder by the *same number of FRAMES*. The **ZUM** command has no effect on "STATISTICAL" PLAYBACKS (Section d.8(d)).

Fig. 3.B.4.9. "Dumping" of Recorder Frames



Thus, by commanding

ZUM n = s [CR]

you will increase by "s" FRAMES the SEARCH DEPTH for *every* "NON-STATISTICAL" PLAYBACK PSEUDOCHANNEL of Recorder No. n. The effect is thus to displace all of the recorder's "NON-STATISTICAL" PLAYBACK PSEUDOCHANNELS *backwards in time* by the same number of FRAMES ("s"). This SEARCH DEPTH "offset" is limited by the total DEPTH (D) of the recorder; "s" cannot have a value such that "f" + "s" > D.

Further "run-time" alteration of the SEARCH DEPTH is possible by this form of the command:

ZUM n = s STEP z [CR]

Here, "s" is, as before, the SEARCH DEPTH offset; "z" is the magnitude of a DEPTH *increment*, expressed as a *number of FRAMES*. Once you have specified a particular value of "z," you can then use your DataPAC's keyboard to move the SEARCH FRAMES for all "NON-STATISTICAL" PLAYBACK PSEUDOCHANNELS of Recorder No. n either *forward* or *backward* in time, synchronously:

- To move all SEARCH FRAMES *backward in time* by an increment of "z" FRAMES, press the keyboard's **Back Space** key.
- To move all SEARCH FRAMES *forward in time* by an increment of "z" FRAMES, press the keyboard's **Step** key. You will be able to move forward by any number of FRAMES *up to "s,"* but no further.

3.B.4.e

HISTORY CARD OPERATION

Moving of the SEARCH FRAME for each PLAYBACK PSEUDOCHANNEL will start from the SEARCH DEPTH defined by the offset "s," when added to the SEARCH DEPTH "f" originally specified for that channel. If no "STEP" term is entered in the **ZOOM (ZUM)** command, the DEPTH increment "z" will automatically default to "1."

The same **ZUM** command can be applied to Recorder Nos. n through m at the same time by commanding

ZUM n TO m = s [CR] or ZUM n TO m = s STEP z [CR]

The effects of the **ZOOM (ZUM)** command are illustrated in Fig. 3.B.4.10. Here, an initial SEARCH DEPTH of "5" has been specified for one or more PLAYBACK PSEUDOCHANNELS assigned to Recorder No. n by one or more commands of the form

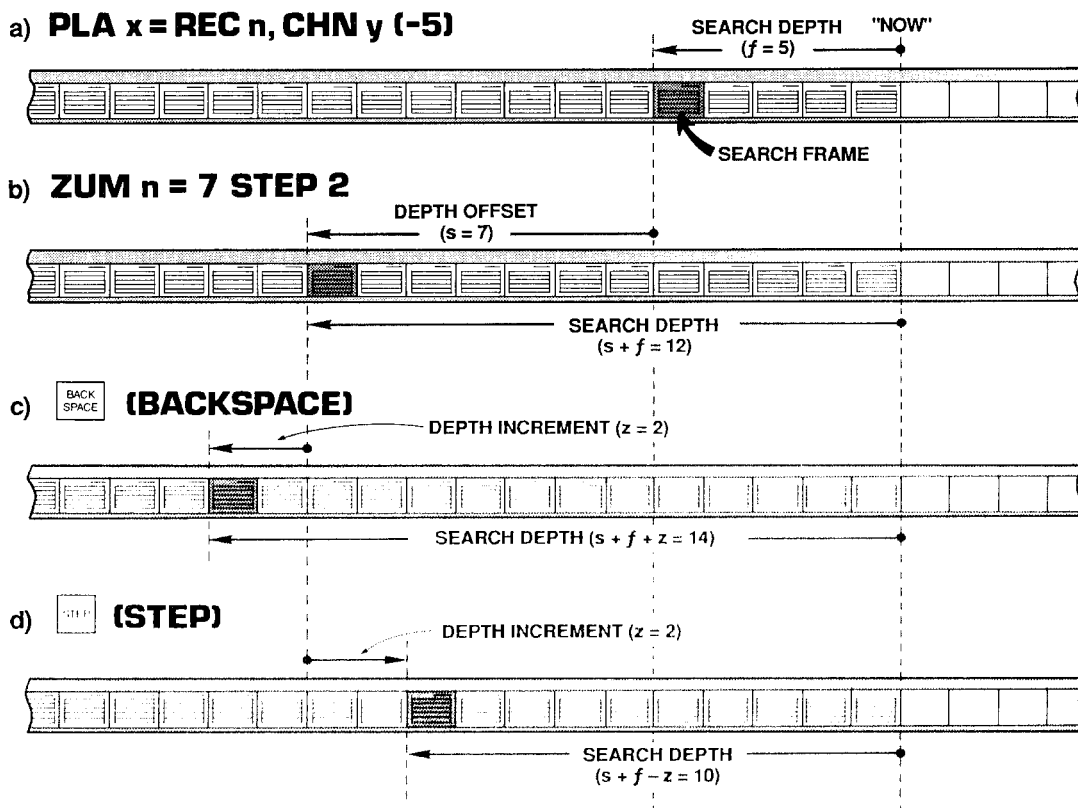
PLA x = REC n, CHN y (-5) [CR] *

Upon application of the following command, the SEARCH DEPTH for ALL PLAYBACK PSEUDOCHANNELS assigned to Recorder No. n will increase by 7 FRAMES, and a DEPTH increment of 2 FRAMES will be specified for further (keyboard) modification of the SEARCH DEPTH:

ZUM n = 7 STEP 2 [CR]

Pressing the **Back Space** key will now increase the SEARCH DEPTH by two FRAMES, thus moving the SEARCH FRAME *backwards* in time. Pressing the **Step** key will reduce the SEARCH DEPTH by two FRAMES, moving the SEARCH FRAME *forward* in time.

Fig. 3.B.4.10. "Zooming" a Playback Pseudochannel



To cancel the DEPTH offset now in effect for Recorder No. *n* or for Recorder Nos. *n* through *m*, command, respectively,

ZUM *n* = N/A [CR] or ZUM *n* TO *m* = N/A [CR]

The SEARCH DEPTH for each playback will now revert to the value "1" specified by that playback's original **PLAYBACK (PLA)** command.

b. "ZOOMING" A DATA SET

Suppose that Recorder No. 3's LIST includes Data Channel Nos. 1 through 15, and that you wish to observe how the values reported by these channels have changed *together* in time. In other words, you wish to be able to display on the same CRT page the readings that all of these channels reported at a given time in the past.

1. SET UP PLAYBACK "SET"

Your first step would be to set up fifteen VIDEO PLAYBACK PSEUDOCHANNELS, assuming that you have already composed a PAGE FORMAT for their display (see Section d.8, above). Let us call these PLAYBACK PSEUDOCHANNELS Nos. 1001 through 1015. In order to achieve "time coherence" for the entire set of DATA-CHANNEL readings, you will have to specify the *same* SEARCH DEPTH for all fifteen playbacks. Since you want maximum "zoomability" for your playbacks, you should set an initial SEARCH DEPTH of only "1." Your playback setup commands would therefore take this form:

PLA 1001 = REC 3, CHN 1 (-1) [CR] *
PLA 1002 = REC 3, CHN 2 (-1) [CR] *
 .
 .
 .
PLA 1015 = REC 3, CHN 15 (-1) [CR] *

With no further alteration of the SEARCH DEPTH, the display of these PLAYBACK PSEUDOCHANNELS will show the values reported by the corresponding DATA CHANNELS at the *last* recording to have been made—that is, *one* FRAME "ago."

2. SEARCH FRAME INDICATION

You will want to include on the same CRT display a means of identifying the current SEARCH FRAME—that is, the FRAME in memory from which the displayed data set is currently being taken. You can identify the SEARCH FRAME by its SERIAL NUMBER, in which case you will set up an additional PLAYBACK PSEUDOCHANNEL for display on the same video page:

PLA 1016 = REC 3, SER (-1) [CR] *

Or you can use FRAME TIME (integral or fractional) for purposes of identifying the current SEARCH FRAME:

PLA 1016 = REC 3, TME (-1) [CR] *
PLA 1016 = REC 3, TMF (-1) [CR] *

Or you may set up playbacks for simultaneous display of *both* SERIAL NUMBER *and* TIME.

The important thing is, of course, that ALL PLAYBACK PSEUDOCHANNELS, including SEARCH FRAME indicator(s), be set at the *same* initial FRAME DEPTH ("1").

3. "ZOOM" TO EARLIER SEARCH FRAME

Suppose you now want to look at the state of this data set that existed *ten FRAMES ago*, and then to be able to move the SEARCH FRAME either backwards or forwards *three FRAMES* at a time, by means of the **Back Space** or **Step** key, respectively. You would enter a command of

ZUM 3 = 9 STEP 3 [CR]

which would cause the displayed data for all fifteen channels (plus the SEARCH FRAME indicator) to move "coherently" backwards in time.

C. "FREEZING" THE SEARCH FRAME: FRZ COMMAND

In Section d.8 it was explained that a playback's SEARCH FRAME will normally *advance*, FRAME by FRAME, as each new recording is made. This is illustrated in Fig. 3.B.4.5. The **FREEZE (FRZ)** command, however, lets you specify a SEARCH FRAME that will *not* be affected by continued recordings.

The **FRZ** command is very similar to the **ZOOM (ZUM)** command. With it, you will specify a DEPTH offset "s" and (optionally) a DEPTH increment "z":

FRZ n = s STEP z [CR]

Thus, a command of

FRZ 3 = 25 STEP 5 [CR]

will increase the present SEARCH DEPTH for every playback assigned to Recorder No. 3 by 25 FRAMES, and will provide for further keyboard modification of the SEARCH DEPTH by individual increments of 5 FRAMES, backward or forward. This time, however, the SEARCH FRAME will continue to be the FRAME specified by the above command, *even as subsequent recordings are made* by Recorder No. 3 (in this case, it is the SEARCH DEPTH itself that increases by one FRAME with each new recording). As stated in Section d.8(d), above, the application of a **FRZ** command to a given recorder WILL DISABLE ANY AND ALL "STATISTICAL" PLAYBACKS SET UP FOR THAT RECORDER AS LONG AS THE COMMAND IS IN EFFECT.

The same **FRZ** command can be applied to Recorder Nos. n through m at the same time by commanding

FRZ n TO m = s [CR] or FRZ n TO m = s STEP z [CR]

To cancel the DEPTH offset provided by the last **FREEZE (FRZ)** command applied to Recorder No. n or to Recorder Nos. n through m, command, respectively,

FRZ n = N/A [CR] or FRZ n TO m = N/A [CR]

Note that when the SEARCH DEPTH (which, again, increases with every new recording) becomes equal to the recorder's overall DEPTH, this "N/A" condition will automatically go into effect. Note also that the **ZOOM (ZUM)** and **FREEZE (FRZ)** commands are mutually exclusive; application of one command to a given recorder will supersede any prior application of the other command to the same recorder.

9. HISTORY REPLAY: RPL COMMAND

a. INITIATING AND TERMINATING REPLAYS

The **REPLAY (RPL)** command is normally applied after recording has stopped. It lets you review—at a selected "replay rate"—ALL stored FRAMES for any and all "NON-STATISTICAL" PLAYBACK PSEUDOCHANNELS assigned to a given recorder. The effect of the **RPL** command is to make the recorder's *initial* SEARCH FRAME the "oldest" FRAME in memory, and then to successively decrease the current SEARCH DEPTH one FRAME at a time, until the "newest" FRAME (the last to have been recorded) is reached. You will specify the *time interval* at which the replay is to step "forward" in time toward the latest recorded FRAME as the SEARCH DEPTH is continuously decreased.

Thus, the "replay" function permits "slow motion" playback of all data recorded during a fast event, or a fast review of all data recorded for a test or process of long duration.

If desired, the entire replay process may be indefinitely *repeated*. That is, after the SEARCH DEPTH has been reduced to only "1"—and the current SEARCH FRAME is therefore the last FRAME to have been recorded—passage of the specified time interval will cause the SEARCH FRAME to return to the "oldest" FRAME in memory.

To initiate a *single* "history replay" for all "NON-STATISTICAL" PLAYBACK PSEUDOCHANNELS set up for Recorder No. n, command

RPL n = INT t [CR]

where "t" is a number from 0 through 15 indicating the desired "clock-time" interval at which the replay is to step "forward":

0 = 10 milliseC	6 = 1 sec	11 = 1 min
1 = 20 milliseC	7 = 2 sec	12 = 2 min
2 = 50 milliseC	8 = 5 sec	13 = 5 min
3 = 0.1 sec	9 = 10 sec	14 = 10 min
4 = 0.2 sec	10 = 20 sec	15 = 20 min
5 = 0.5 sec		

As stated in Section d.8(d), above, the application of a **RPL** command to a given recorder WILL DISABLE ANY AND ALL "STATISTICAL" PLAYBACKS SET UP FOR THAT RECORDER AS LONG AS THE COMMAND IS IN EFFECT.

To initiate *repeated* "history replays" for all "NON-STATISTICAL" PLAYBACK PSEUDOCHANNELS set up for Recorder No. n, command

RPL n = INT t, R [CR]

To *terminate* the replay currently in progress—either single or repeated—command

RPL n = N/A [CR]

Note that each of the above **REPLAY (RPL)** commands can be applied to Recorder Nos. n through m at the same time, by entering the corresponding "range" form of the command:

RPL n TO m = INT t [CR]
RPL n TO m = INT t, R [CR]
RPL n TO m = N/A [CR]

3.B.4.e

HISTORY CARD OPERATION

b. MONITORING REPLAYS: ZUM COMMAND

Continuous monitoring of the current replay SEARCH DEPTH is possible by means of the "READ" form of the **ZOOM (ZUM)** command, described in Section e.8. Thus, by typing an interrogation of

ZUM [CR]

on the keyboard, while a replay is in progress, you can invoke a BILLBOARD display of the number of FRAMES yet to be replayed (until the "newest" FRAME is reached). Until the **ZUM** command is cancelled or another keyboard command subsequently entered, this replay SEARCH DEPTH, which decreases by "1" with every replayed FRAME, will remain on display.

Section 3.B.5

Auxiliary Computer Interface: Model 10BACIA Auxiliary Computer Interface Card



System 10 Guidebook

**PLEASE NOTE THE FOLLOWING
NEW "BACI" PRODUCTS:**

1. Model **10BACIA** Auxiliary Computer Interface Card

The Model 10BACIA replaces the Model 10BACI discussed in this section. Note, however, that everything said in this section concerning the 10BACI applies equally to the 10BACIA. The primary functional difference between these two versions is that, by virtue of the **FRAME CHANNELS (FCH)** command, the 10BACIA allows *the transmission of a prespecified "frame" of time-coherent channel data*. This is treated in **3.B.5 Supplement No. 1 (Model 10BACIA New Features)**. Also, the 10BACIA can be readily converted to a Model 10BACI-422 by addition of the optional Model 10422BP RS-422 Backplane (see below).

2. Model **10BACI-422** RS-422 Auxiliary Computer Interface Card

The Model 10BACI-422 is equivalent to a Model 10BACIA with an integral *RS-422 hardware interface* on a 9-pin D subminiature female socket (in place of the 10BACIA's standard RS-232-C interface). The RS-422 interface includes an extra pair of wires for communication of an external *synchronizing pulse*. Thus, the addition of RS-422 interface hardware to the 10BACIA allows *timed synchronous data collection*, controlled by a master timing pulse, when the 10BACI-422 is used in a "System 10/2000" DataPAC. Use of the 10BACI-422—particularly in conjunction with the **Model 10K488 Data Concentrator**—is treated in **3.B.5 Supplement No. 2 (Model 10BACI-422)**.

3. Model **10BACI-488** IEEE-488 Auxiliary Computer Interface Card

The Model 10BACI-488 is equivalent to a Model 10BACIA with a 24-pin parallel port for standard TALKER/LISTENER communications with an IEEE-488 bus (in place of the 10BACIA's standard RS-232-C interface). Setup and use of the 10BACI-488 is treated in **3.B.5 Supplement No. 3 (Model 10BACI-488)**.

4. **FP (Floating Point)** Option

THIS OPTION APPLIES ONLY TO THE **MODEL 10BACI-488 IEEE-488 AUXILIARY COMPUTER INTERFACE CARD**, AND IS AVAILABLE ONLY ON SPECIAL REQUEST. It allows the 10BACI-488 to issue data for all scanned channels or for a specified range of channels in either IEEE or DEC FLOATING-POINT FORMAT. Setup and use of the FP Option is treated in **3.B.5 Supplement No. 4 (10BACI "Floating Point" Option)**.

5. Model **10422BP** RS-422 Backplane

By replacing the standard RS-232 backplane of a Model 10BACIA with the mainframe-mounted Model 10422BP, you can convert the 10BACIA to a Model 10BACI-422 (see above). Note that the 10422BP may also be used with an older Model 10BACI, but in this case the synchronization features of the 10BACIA and 10BACI-422 will not be available.

Every **Model 10BACI Auxiliary Computer Interface Card** provides the DataPAC in which it is installed with an "auxiliary" full-duplex RS-232-C interface (hereafter referred to as an "ACI"). *As seen by a connected external RS-232-C device—computer, terminal, printer, recorder, etc.—every ACI behaves identically to the DataPAC's standard COMPUTER INTERFACE PORT ("CIP").* That is, a standard MNEMONIC COMMAND issued to an ACI by an RS-232-C device connected to that ACI will invoke from the ACI a response *identical in form* to the response the CIP would produce to the same command. For example, a **DUMP (DMP)** command issued to an ACI will cause it to "dump" data; a **SEND (SND)** command issued to an ACI will cause it to "send" the specified message; a **COLUMNS (CLM)** command will establish columnar format for subsequent **STREAM (STR)** and **HARDCOPY (HCY)** outputs from the ACI; and so on. In addition, the ACI will produce appropriate responses to all standard "READ" COMMANDS recognized by the CIP.

The number of ACI's a DataPAC can have is limited only by the number of available B SLOTS.

As stated above, the activity of a given ACI can be directly controlled by the external RS-232-C device to which it is connected. IT CAN ALSO BE CONTROLLED BY MNEMONIC COMMANDS ENTERED THROUGH THE DATAPAC'S *EXTENDED KEYBOARD OR COMPUTER INTERFACE PORT (CIP)*. AS EXPLAINED IN THE FOLLOWING SECTIONS, KEYBOARD OR CIP CONTROL OF AN ACI CAN BE EFFECTED BY ONE OF THREE "RUN-TIME" COMMANDS: **ATTACH (ATT)**, **VIA (VIA)**, OR **COMMUNICATIONS (COM)**.

The **ATTACH (ATT)** command lets you establish a direct and exclusive "command route" between a given command source (KEYBOARD or CIP) and the Model 10BACI occupying a given DataPAC B SLOT. It is used primarily for *setup* of the ACI in question or for subsequent *interrogation* of the ACI for its own setup parameters. It is cancelled by the **DETACH (DET)** command.

The **VIA (VIA)** command serves as a "one-line" **ATTACH (ATT)** command. By prefixing **VIA** to any standard MNEMONIC COMMAND, you can route that command directly and exclusively to the Model 10BACI occupying a given DataPAC B SLOT, without having first to "attach" that SLOT to the keyboard or CIP.

The **COMMUNICATIONS (COM)** command lets you designate a "DEFAULT COMMUNICATIONS PORT" (DCP) for the DataPAC. The DCP is the single system RS-232-C INTERFACE PORT which will respond to all subsequent *port-related IMPERATIVE and SETUP COMMANDS* received by the DataPAC from the keyboard or executed as a result of an **EXECUTE (EXU)** or **COMMAND (CMD)** command. Port-related IMPERATIVE COMMANDS include **DUMP (DMP)**, **STREAM (STR)**, **SEND (SND)**, **LOCK (LOK)**, etc.; port-related SETUP COMMANDS include **BAUD RATE (BAU)**, **DELAY (DLY)**, **HEADER (HDR)**, and **OUTPUT TERMINATOR (OPT)**. A full list of **COM**-affected commands is given in Section d.1, below). The DCP behaves exactly like the DataPAC's COMPUTER INTERFACE PORT (CIP), *as seen from a connected external RS-232-C device*. In the absence of any ACI's, the DCP is the CIP. As explained in Section d, below, **ATTACH (ATT)** and **VIA (VIA)** will both override the current **COM** assignment, as will commands received by an ACI from its connected RS-232-C device.

The Model 10BACI is to be regarded as a system "COPROCESSOR." Thus, in addition to an "auxiliary" RS-232-C interface, every ACI also provides an onboard DATA RAM. As explained in Section c.7, below, *externally acquired* numeric and logic data can thus be downloaded from the connected RS-232-C device to the ACI itself. With each internal scan cycle, this data will be "locally" updated (at the ACI), to be read from there by the DataPAC's CENTRAL PROCESSOR. Such local handling of downloaded data by the ACI helps preserve the DataPAC's high scan speed when a large number of inputs is involved.

3.B.5.b

MODEL 10BACI SYSTEM STATUS INDICATORS

The Model 10BACI has ten front-panel STATUS INDICATORS. The top four lights are red, to indicate "error" or "alert" conditions. The remaining lights are green.

The **DTR**, **RTS**, **ERR**, **CHR**, **MNE**, **RET**, **XMT**, and **RCV** lights are identical in function to the corresponding indicators on the DataPAC's INTERFACE CARD, except that they now refer to line activity at the respective ACI. See Section 1.A.4 of this Guidebook for an explanation of these indicators. The **OFF** indicator is not presently used.

The **COM** indicator will light when the ACI in question has been designated to be the DataPAC's single DEFAULT COMMUNICATIONS PORT (DCP) by a **COMMUNICATIONS (COM)** command (Section d.1, below). When no ACI's **COM** light is on, it means that the DCP is the COMPUTER INTERFACE PORT (CIP).

Before entering any SETUP COMMANDS for a given ACI, you should first turn ON the DataPAC's EEPROM Switch (the ACI has no EEPROM Switch of its own, since it reads the CENTRAL PROCESSOR'S EEPROM Switch).

1. THE "ATTACH (ATT)" AND "DETACH (DET)" COMMANDS

"Attach" the given ACI either to the DataPAC's EXTENDED KEYBOARD or to the COMPUTER INTERFACE PORT (CIP), whichever command source you wish to use (setup procedures are usually performed through the keyboard).

Thus, if you want to "attach" the ACI of the Model 10BACI card occupying B SLOT No. s to the DataPAC's keyboard, enter the following command, *via the keyboard*:

ATT = s [CR]

All subsequent keyboard-entered MNEMONIC COMMANDS will now be "heard" ONLY by the Model 10BACI in question; they will be ignored by all other cards in the system. Commands entered via the CIP, however, will in this case continue to be received by all cards.

If the above **ATT** command is entered *via the COMPUTER INTERFACE PORT*, then the 10BACI in B SLOT No. s will be exclusively "attached" to the CIP. Commands entered via the keyboard, however, will in this case continue to be received by all cards.

The **DETACH (DET)** command serves to cancel the **ATTACH (ATT)** command. Thus, to "detach" the 10BACI presently "attached" to either the DataPAC's keyboard or CIP, command, *via the keyboard or CIP, respectively*,

DET [CR]

Note that **ATTACH (ATT)** and **DETACH (DET)** are "RUN-TIME" COMMANDS, and may therefore be applied at any time during normal operation.

Note too that the **VIA (VIA)** command (Section d.2, below) permits momentary "attachment" of a 10BACI for the purpose of directing a single MNEMONIC COMMAND to that 10BACI without prior application of an **ATTACH (ATT)** command.

You may now issue SETUP COMMANDS directly to the 10BACI in question via the command source you have "attached" to it (keyboard or CIP).

2. ACI CABLING

For general RS-232-C Interface Cabling, see Section 2.B.2 of this Guidebook. The remarks made there concerning COMPUTER INTERFACE PORT connections apply equally to every "AUXILIARY" COMPUTER INTERFACE.

3. SETTING ACI PROTOCOL: **BAU** COMMAND

FOR PROPER DATA INTERCHANGE BETWEEN AN ACI AND A CONNECTED RS-232-C DEVICE TO OCCUR, THE ACI MUST BE SET TO CONFORM EXACTLY WITH THE PROTOCOL STIPULATED BY THE CONNECTED DEVICE.

For an explanation of RS-232-C "protocol" characteristics, see Section 2.B.2 of this Guidebook.

3.B.5.c

SETUP OF THE AUXILIARY COMPUTER INTERFACE

———— NOTE ————

IN ORDER TO SET OR RESET THE PROTOCOL VALUES FOR AN ACI, YOU MUST USE THE **BAUD RATE (BAU)** COMMAND. Unlike the DataPAC's INTERFACE CARD, the 10BACI has no Protocol Switches, and is not affected by the "MENU" Setup Program discussed in Section 2.B.2.

After "attaching" the ACI in question to the DataPAC's keyboard or CIP (as above), enter via the keyboard or CIP, respectively,

BAU = b, d, s, p [CR] *

where

b is the BAUD-RATE selection code:

2 = 1200	6 = 19.2K
3 = 2400	7 = 153.6K
4 = 4800	8 = 38.4K
5 = 9600	9 = 76.8K

(Note that a Baud rate of 300 is not available for the 10BACI. However, rates of 38.4K and 76.8K are available, which are not offered by the DataPAC's CIP.)

d is the NUMBER OF DATA BITS (7 or 8)

s is the NUMBER OF STOP BITS (1 or 2)

p is the PARITY selection code:

0 = NONE; 1 = ODD; 2 = EVEN

4. SETTING ACI COMMAND TERMINATOR: **CMT** COMMAND

Prior to shipment, every ACI is factory-set for a COMMAND TERMINATOR of CARRIAGE RETURN ([CR]). If you intend to issue commands to an ACI from an external RS-232-C device that normally terminates its transmissions with a character other than [CR], you will have to apply a **COMMAND TERMINATOR (CMT)** command to that ACI, having first "attached" the ACI to the respective command source (keyboard or CIP). Enter a command of

CMT = c [CR] *

where "c" is any single ASCII character, with the exception of [ESC], which will never be recognized by the ACI as a COMMAND TERMINATOR. If the specified terminator is an ASCII CONTROL CHARACTER—such as [CR], [LF], [FF], etc.—it must be entered as a *hexadecimal word in brackets*. Two-character hexadecimal equivalents for standard ASCII CONTROL CHARACTERS are given in Table 1.H.2, Section 1.H.3 of this Guidebook.

5. ACI OUTPUT FORMATTING

ALL MNEMONIC COMMANDS THAT RELATE TO THE FORMATTING OF TRANSMISSIONS FROM THE DATAPAC'S COMPUTER INTERFACE PORT MAY BE USED TO FORMAT TRANSMISSIONS FROM AN ACI, AFTER THE ACI HAS BEEN "ATTACHED" TO THE RESPECTIVE COMMAND SOURCE (KEYBOARD OR CIP). IN ALL CASES, THE COMMAND SYNTAX IS THE SAME.

Formatting commands (described in Section 1.H.3 of this Guidebook) include

ECHO (ECO)	to include Channel-Number "echo" in CHN , DMP , or SNP outputs
NO CHANNEL (NCH)	to cancel ECO
LIMITS (LIM)	to include LIMIT-ZONE indication in CHN , DMP , or or SNP outputs
NO LIMITS (NOL)	to cancel LIM
HEADER (HDR)	to specify HEADER string for STR and HCY outputs
TAILER (TLR)	to specify TAILER string for STR and HCY outputs
CHARACTERS PER CHANNEL (CPC)	to specify number of DATA-FIELD spaces for STR and HCY outputs
COLUMNS (CLM)	to set columnar format for STR and HCY outputs
OUTPUT TERMINATOR (OPT)	to set OUTPUT ("END-OF-LINE") TERMINATOR
END OF TRANSMISSION (EOT)	to set END-OF-TRANSMISSION TERMINATOR different from OUTPUT ("END-OF-LINE") TERMINATOR
DELAY (DLY)	to set intertransmission delay time for DMP , STR , HCY , SNP , and LZN outputs

6. SETTING OTHER ACI COMMUNICATIONS FEATURES

CERTAIN MNEMONIC COMMANDS THAT RELATE TO SPECIAL COMMUNICATIONS FEATURES OF THE DATAPAC'S COMPUTER INTERFACE PORT MAY ALSO BE APPLIED TO AN ACI, AFTER THE ACI HAS BEEN "ATTACHED" TO THE RESPECTIVE COMMAND SOURCE (KEYBOARD OR CIP). IN ALL CASES, THE COMMAND SYNTAX IS THE SAME.

Such commands (described in Section 2.B.6 of this Guidebook) include

SEND (SND)to cause the ACI to transmit a specified ASCII string

7. ACI "LOCAL" CHANNELS AND BITS

a. LOCATING "OFF-BOARD" VOLATILE DOWNLOAD PSEUDOCHANNELS TO THE 10BACI: **LCT** AND **RST** COMMANDS

To arrange for an ACI to be responsible for updating the RAM-stored data value of a given VOLATILE DOWNLOAD PSEUDOCHANNEL No. x, you can use the **LOCATE (LCT)** command:

LCT x = s [CR] *

where "s" is the number of the B SLOT occupied by the Model 10BACI in question. Note that system "REAL" CHANNELS, CONVERSION CHANNELS, and NONVOLATILE ("KEEP-ALIVE") PSEUDOCHANNELS may not be "located" to an ACI.

3.B.5.c

SETUP OF THE AUXILIARY COMPUTER INTERFACE

APPLICATION OF THE ABOVE COMMAND WILL AUTOMATICALLY ASSIGN A "TYPE" DESIGNATION OF DA TO CHANNEL NO. x.

Although Channel No. x is now "off-board" *from the CENTRAL PROCESSOR's point of view*, it may be subsequently interrogated or transmitted just like any other system DATA CHANNEL through an appropriate command communicated to the DataPAC through the keyboard or CIP (**CHANNEL (CHN)**, **DUMP (DMP)**, **STREAM (STR)**, etc.)—or by such a command communicated directly to the ACI by the external RS-232-C device to which it is connected. Channel No. x's current data value may also be incremented or decremented, just like that of any other DOWNLOAD PSEUDOCANNEL, by means of an **INCREMENT (INC)** or **DECREMENT (DEC)** command applied to the DataPAC or directly to the ACI (see Section 2.M.1 of this Guidebook). As mentioned above, such "local" control of downloaded numeric data helps preserve the DataPAC's high internal scan rate.

The above **LOCATE (LCT)** command can only be cancelled by applying a **RESET (RST)** command of

RST x [CR] *

This command will return the responsibility of updating Channel No. x to the DataPAC's CENTRAL PROCESSOR, and will "retype" the channel as **D0** (for channel "reconfiguration," see Appendix C of this Guidebook). The "WRITE" form of the **TYPE (TYP)** command will have no effect on Channel x.

b. SOURCING LOGIC BITS TO THE 10BACI: **SRC** COMMAND

As a system "COPROCESSOR," a Model 10BACI can serve as the immediate "LOGIC SOURCE" of one or more system LOGIC BITS, *from the CENTRAL PROCESSOR's point of view* (for "Logic Sourcing," see Section 2.H.2 of this Guidebook). A LOGIC BIT sourced to an ACI can only be set or reset by means of an *external bit-setting command* directed to the ACI (**SET BIT (BIT)**, **HEXADECIMAL (HEX)**, **BINARY (BIN)**, or **BINARY CODED DECIMAL (BCD)**).

Thus, to "source" a given Bit No. r to the 10BACI occupying B SLOT No. s, enter the following **LOGIC SOURCE (SRC)** command:

SRC r = Bs [CR] *

Note that the Slot-Number entry must be preceded by the letter "B."

To return "EXTERNAL" control of Bit No. r to the CENTRAL PROCESSOR, command

SRC r = EXT [CR] *

—— IMPORTANT ——

MAKE SURE THE DATAPAC'S EEPROM SWITCH IS ON WHEN YOU ENTER THIS COMMAND.

See Sections 2.H.2 and 4.B for a full treatment of the **LOGIC SOURCE (SRC)** command.

1. DESIGNATING THE DEFAULT COMMUNICATIONS PORT: **COM** COMMAND

The **COMMUNICATIONS (COM)** command lets you designate the DEFAULT COMMUNICATIONS PORT (DCP) for the DataPAC. The DCP is the single RS-232-C INTERFACE PORT which *alone* will, by default, receive and respond to every subsequent *port-related IMPERATIVE or SETUP COMMAND* applied to the DataPAC via the *keyboard* or via an **EXECUTE (EXU)** or **COMMAND (CMD)** function. Any command received by a specific port (ACI or CIP) from an RS-232-C device directly connected to that port or from a command source directly "attached" to that port by means of an **ATTACH (ATT)** or **VIA (VIA)** command will be answered *only at that port*, whether or not it is the DataPAC's current DCP.

COM-affected commands presently include the following:

**BAU, CLM, CMT, CPC, DLY, DMP, ECO, EOT, ESC, HCY, HDR,
LIM, LOK, NCH, NOL, OPT, SND, SNP, STR, TLR, UNL**

Note that neither the **CHANNEL (CHN)** command nor the **LIMIT ZONE (LZN)** command is listed among the above "**COM**-affected" commands. This is because, although **CHN** (in its **CHN [CR]** form) and **LZN** are included among the standard "Data Transmission" commands described in Section 1.H.2 of this Guidebook, they are both actually "READ" commands, the "location of response" to which will always depend on the "location of entry" (see Section 1.A.3(d) for "Read Commands and Responses").

To designate as the DCP the ACI provided by the Model 10BACI card installed in B SLOT No. *s*, command

COM = s [CR] *

Note that this is a SETUP COMMAND and requires that the DataPAC's EEPROM Switch be ON. Its effect will be to write into the CENTRAL PROCESSOR'S EEPROM the "port address" to which any of the above commands is now to be exclusively routed, unless this command is otherwise directed to a specific port by an **ATTACH (ATT)** or **VIA (VIA)** command, or by a connected RS-232-C device.

YOU MAY, HOWEVER, "TEMPORARILY" REASSIGN TO ANOTHER ACI THE FUNCTION OF DCP, DURING NORMAL OPERATION, WITHOUT HAVING TO TURN ON THE EEPROM SWITCH, BY COMMANDING

COM = s₁ [CR]

where "s₁" is a B-SLOT Number different from the original "s." Upon recycling of system power, the **COM** assignment will return to the port specified while the EEPROM was enabled.

To return to the DataPAC's COMPUTER INTERFACE PORT the function of DCP, command

COM = 26 [CR] *

Concerning the **COM** command, you should note the following:

- a. Although the **COMMUNICATIONS (COM)** command has a "RUN-TIME" form, you are advised *not* to change the DEFAULT COMMUNICATIONS PORT assignment while the system is in operation, unless you are sure that
 1. no output is currently in progress as a result of the present **COM** assignment, and
 2. the rerouting of automatic or semi-automatic data gathering functions (e.g., external computer interrogation or **EXECUTE**-driven commands) will not result in error.

3.B.5.d

OPERATION OF THE "AUXILIARY" COMPUTER INTERFACE

Remember that **COM** is essentially a *system setup* command; a change in DCP assignment will generally entail a change in the overall functioning of the system.

- b. By changing the current DEFAULT COMMUNICATIONS PORT from one system port to another, YOU DO NOT THEREBY TRANSFER THE EXISTING SETUP CHARACTERISTICS OF THE ONE PORT TO THE OTHER. Every system port must be *individually* set up by appropriate commands (**BAU**, **CMT**, **OPT**, **EOT**, **HDR**, **DLY**, etc.) issued directly to that port by a connected RS-232-C device or—when that port is the system DEFAULT COMMUNICATIONS PORT—by keyboard.
- c. Be careful not to confuse the **ATTACH (ATT)** and **COMMUNICATIONS (COM)** commands.

ATTACH (ATT) is a general command used to "attach" a DataPAC command source (KEYBOARD or COMPUTER) to the card occupying a specific B SLOT, usually for purposes of *setting up* the card or of *interrogating* it for its own specific setup parameters. Remember, however, that ANY standard MNEMONIC COMMAND may be routed to a specific B CARD after that card has been "attached" to the keyboard or CIP. By this means—as well as by the **VIA (VIA)** command, below—port-specific imperatives such as **DMP**, **STR**, **SND**, **LOK**, etc., can be issued to an ACI that is *not* the currently specified DEFAULT COMMUNICATIONS PORT.

COMMUNICATIONS (COM), on the other hand, is used to specify a particular RS-232-C INTERFACE PORT to be the only port that will "hear" and respond to subsequent keyboard-entered or automatically executed commands that relate to the activity of such a port (usually these will be *transmission-initiating* imperatives like **DMP**, **STR**, **HCY**, **SND**, etc.). THE **COM** COMMAND WILL NOT—AND SHOULD NOT—NORMALLY BE USED TO SET UP AN ACI OR TO INTERROGATE AN ACI FOR ITS SETUP PARAMETERS.

- d. If the DataPAC's COMPUTER INTERFACE PORT is *not* the present DEFAULT COMMUNICATIONS PORT (i.e., if **COM = 26 [CR]** is not in effect), a **PAGE (PAG)** command contained in an **EXECUTE (EXU)** string will not work (for **PAG**, see Section 2.C.3; for **EXU**, see Section 2.K.2). You will have to prefix the PAG command with

VIA 26

to properly route it to the Video Card Set (see below).

2. ROUTING SINGLE COMMANDS TO AN ACI: VIA COMMAND

The **VIA (VIA)** command serves as a "one-line" **ATTACH (ATT)** command, allowing you to route a *single* MNEMONIC COMMAND directly and exclusively to a given Model 10BACI, without having first to "attach" that SLOT to the keyboard or CIP by an **ATTACH (ATT)** command or to designate the ACI in question to be the DEFAULT COMMUNICATIONS PORT by a **COMMUNICATIONS (COM)** command.

Thus, to issue to the 10BACI occupying B SLOT No. *s* the MNEMONIC COMMAND represented by the ASCII STRING "\$," at any time during normal operation, command

VIA *s*, \$ [CR]

where "\$" can consist of up to 80 ASCII characters, literally stating the command to be routed to the 10BACI occupying B SLOT No. *s*.

Section 3.B.5 Supplement No. 1: Model 10BACIA New Features

The Model 10BACIA Auxiliary Computer Interface Card is identical to the Model 10BACI discussed in Section 3.B.5, *except that*

- it needs to be told by means of the **BCP (BCP)** command whether it is working with a 10BCP100(A) or 10BCP200 ("System 10/2000") Central Processor
- it responds to the **FRAME CHANNELS (FCH)** and **MASTER TIMING CLOCK (MTC)** commands as explained below
- its response to the **DUMP SYSTEM DATA (DSD)** command differs from that of the 10BACI
- it can be converted to a Model 10BACI-422 by addition of the Model 10422BP RS-422 Backplane.

1. Ensuring 10BACIA / Central Processor Compatibility: **BCP** Command

To ensure proper operation of the **FRAME CHANNELS (FCH)** command, it is necessary for every 10BACIA to know which type of CENTRAL PROCESSOR card is in the DataPAC—a Model 10BCP100/10BCP100A or a Model 10BCP200 (which is used in all "System 10/2000" DataPACs). To inform all 10BACIA's in the DataPAC that they are being used with a 10BCP100 or 10BCP100A, you should make sure that a command of

BCP = 100 [CR] *

is in effect; to inform all 10BACIA's that the DataPAC has a 10BCP200, make sure that

BCP = 200 [CR] *

is in effect.

2. Transmitting a Time-Coherent Data "Frame": **FCH** Command

The 10BACIA can be instructed to load Channels x through y into an output buffer *at the end of every complete scan cycle*. To do so, you should direct to the 10BACIA a **FRAME CHANNELS** command of

FCH = x, y [CR] *

This command allows a *time-coherent "frame" of data* (i.e., the data for Channels x through y) to be transferred to the 10BACIA's output buffer as soon as this data set has been fully scanned and posted. During loading of the buffer, the 10BACIA will delay responding to a request for output until the loading has been completed (about 5 milliseconds). If the 10BACIA is in the process of transmitting data at the end of the scan cycle, loading is suspended. The currently loaded "buffer frame" of data can be subsequently transmitted from the 10BACIA via any of the standard channel-outputting commands (**DMP**, **STR**, **HCY**, **SNP**, **DSD**, **DSF**, etc.).

NOTE: The **FCH** command requires that the EEPROM Write Protect Switch be ON. It does not require the presence of the Model 10BCP200 CENTRAL PROCESSOR. It may be applied to any system 10BACIA card, or to any Model 10BACI-422 or 10BACI-488. It can be sent directly to the 10BACIA via the 10BACIA's RS-232-C port, the DataPAC's keyboard or standard Computer Interface, or an **EXECUTE (EXU)** or **COMMAND (CMD)** function (see Section 3.B.5.d).

3. The **MTC** Command

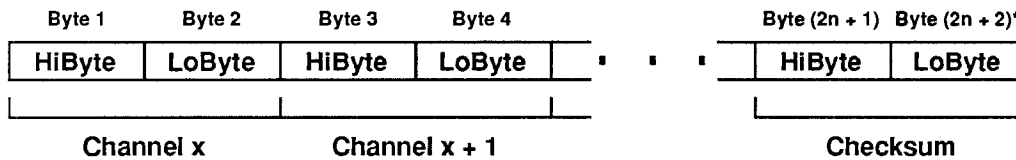
When a Model 10BACIA has been converted to a Model 10BACI-422 and is used in a "System 10/2000" DataPAC (i.e., a DataPAC with the Model 10BCP200 CENTRAL PROCESSOR), a **MASTER TIMING CLOCK (MTC)** command of **MTC = ON [CR]** can be applied in conjunction with a **CLOCK** command of **CLK = ON [CR]** to synchronize the DataPAC's time-of-day clock with an external timing pulse communicated to the 10BCP200 by the 10BACI-422. See **Section 3.B.5 Supplement No. 2 (Model 10BACI-422)** for details concerning the **MTC** command.

NOTE HERE THAT FOR A MODEL 10BACI ITSELF—*WITHOUT RS-422 INTERFACE HARDWARE*—THE **MTC = OFF [CR]** COMMAND SHOULD ALWAYS BE IN EFFECT; THE **MTC = ON [CR]** COMMAND SHOULD *NEVER* BE APPLIED TO A MODEL 10BACIA.

4. Response to **DSD** Command

The format of the output produced by the Model 10BACIA in response to a **DUMP SYSTEM DATA (DSD)** command is different from that produced by the 10BACI. This output is shown in Fig. 1, below. See the latest version of Appendix L.1 ("Binary Transmission Mnemonics") for complete details.

Fig. 1 Transmission Format for **DSD** Command (10BACIA, 10BACI-422, and 10BACI-488)



* Where n = the number of channels in the transmitted range (x TO y).

Section 3.B.5 Supplement No. 2: Model 10BACI-422

1. Introduction

The Model **10BACI-422** Auxiliary Computer Interface Card allows direct transmission of data acquired by a "B-Sized" DataPAC to an external device with RS-422 I/O capability, without the need for an external RS-232 to RS-422 adaptor (such as the Model 10E422). It is equivalent to a Model 10BACIA with an integral RS-422 hardware interface on a 9-pin D subminiature female socket (in place of the 10BACIA's standard RS-232-C interface). The RS-422 interface contains an extra pair of wires for communication of an externally sourced *synchronizing pulse*. This allows *timed synchronous data collection*, controlled by the external pulse, when the 10BACI-422 is used in a "System 10/2000" DataPAC (i.e., with a Model 10BCP200 CENTRAL PROCESSOR CARD)—as explained in Section 4, below.

While the 10BACI-422 may communicate with any external RS-422 device, it was designed primarily to allow direct data transfer between a "B-Sized" DataPAC and an individual **Model 10A422 Communication Buffer Card** within a **Model 10K488 Data Concentrator**, while also allowing the timing pulse generated by the 10K488 to synchronize the collection of data for all connected DataPACs. For use of the 10BACI-422 within a complete 10K488-based data collection system, you should consult the *Model 10K488 Instruction Manual*.

2. Ensuring 10BACI-422 / Central Processor Compatibility: **BCP** Command

To ensure proper operation of the **FRAME CHANNELS (FCH)** command, it is necessary for every 10BACI-422 to know which type of CENTRAL PROCESSOR card is in the DataPAC—a Model 10BCP100/10BCP100A or a Model 10BCP200 (which is used in all "System 10/2000" DataPACs). To inform all 10BACI-422's in the DataPAC that they are being used with a 10BCP100 or 10BCP100A, you should make sure that a command of

BCP = 100 [CR] *

is in effect; to inform all 10BACI-422's that the DataPAC has a 10BCP200, make sure that

BCP = 200 [CR] *

is in effect.

3. Setup of the RS-422 Auxiliary Computer Interface

Pin assignments for the 10BACI-422's 9-pin RS-422 Connector are as follows:

Pin	Function
1	COMMAND
6	COMMAND
4	RESPONSE
3	RESPONSE
5	CLEAR TO SEND
9	CLEAR TO SEND
7	SYNC
8	SYNC
2	COMMON

Note that Pins 7 and 8 are dedicated to the externally sourced synchronizing pulse ("SYNC"). If the device to which the 10BACI-422 is connected does not supply such a signal, these pins should be left unconnected (for cabling between a 10BACI-422 and a Model 10A422 Communication Buffer Card, see the *Model 10K488 Instruction Manual*.)

In the cable connecting the 10BACI-422 and the external RS-422 device, the SHIELD for each "twisted pair" should be connected to "COMMON" (Pin 2). Use BELDEN 9728 DATALENE 100 Ω or equivalent cable.

FOR PROPER DATA INTERCHANGES TO OCCUR BETWEEN THE 10BACI-422 AND AN EXTERNAL RS-422 DEVICE, THE 10BACI-422 MUST BE SET TO CONFORM EXACTLY WITH THE INTERFACE PROTOCOL STIPULATED BY THE CONNECTED DEVICE. For setup of the 10BACI-422 interface protocol using the **ATTACH (ATT)** and **BAUD RATE (BAU)** commands, see Section 3.B.5.c.

4. Transmitting a Time-Coherent Data "Frame": **FCH** Command

SEE 3.B.5 SUPPLEMENT NO. 1 (NEW 10BACIA FEATURES) FOR A DISCUSSION OF THE **FRAME CHANNELS (FCH)** COMMAND, WHICH APPLIES EQUALLY TO THE MODEL 10BACI-422.

5. Setting Up the Master Timing Clock: **CLK** and **MTC** Commands

When an external synchronizing pulse signal is available through the RS-422 interface—as it is when the 10BACI-422 is communicating with a Model 10K488 Data Concentrator—then you will need to enter a **CLOCK (CLK)** command and a **MASTER TIMING CLOCK (MTC)** command in order to "slave" the DataPAC's scan cycle to this "master" pulse signal. These commands are effective only when the DataPAC contains a Model 10BCP200 CENTRAL PROCESSOR CARD (as do all "System 10/2000" DataPACs). NOTE TOO THAT THE EXTERNAL SYNC PULSES MUST BE AT A RATE OF 1 SECOND \pm 0.05%.

The purpose of the **CLOCK (CLK)** command is to synchronize the scanning of data channels to the DataPAC's time-of-day clock. When a command of

CLK = OFF [CR] *

is in effect, there will be no delay between successive scan cycles; each scan will begin as soon as the last one has finished. When, however, a command of

CLK = ON [CR] *

is in effect, data conversion will be paused at the end of each scan until the time-of-day clock registers its next *tenth of a second*. Thus, a scan will be initiated exactly ten times a second—assuming that a small enough number of channels is being scanned. The **CLK** command is a SETUP command and requires that the EEPROM Write Protect Switch be ON.

The purpose of the **MASTER TIMING CLOCK (MTC)** command is to synchronize the DataPAC's time-of-day clock to the externally sourced timing pulse, to within ± 2 milliseconds. The synchronized millisecond clock is then used to trigger successive scans at 0.1-second intervals, as directed by the **CLK = ON [CR]** command. Thus, when a command of

MTC = ON [CR] *

is in effect, the 10BCP200 will expect regular timing pulses to be received FROM THE SINGLE 10BACI-422 TO WHICH THIS COMMAND WAS DIRECTED.* This command should be applied to *one and only one* Model 10BACI-422 in the system, since it in effect tells the 10BCP200 which 10BACI-422 to "listen" to for each successive sync pulse. It can be sent directly to the 10BACI-422 via the RS-422 port or through the DataPAC's keyboard or standard Computer Interface (see Section 3.B.5.d).

Concerning the **MTC** command, note also that

* While **MTC = ON [CR]** is in effect, a watchdog timer ensures that loss of the master timing signal will not "hang up" normal processor functions.

- This is a SETUP command and requires that the EEPROM Write Protect Switch be ON.
- Setting up the clock synchronization is done at system "bootup." POWER MUST THEREFORE BE CYCLED FOR THE **MTC** COMMAND TO BE EFFECTIVE.
- In order for the **MTC = ON [CR]** command to be effective, the **CLK = ON [CR]** command must be in effect.
- To cancel the "slaving" of the time-of-day clock to the external sync pulse, you can send a command of

MTC = OFF [CR] *

to the 10BACI-422 to which the original **MTC = ON [CR]** was applied.

- The **MTC = ON [CR]** command should NEVER be applied to a Model 10BACIA Auxiliary Computer Interface Card unless it is equipped with a Model 10422BP RS-422 Backplane connected to an appropriate master timing source.

6. Response to **DSD** Command

For the format of the output produced by the Model 10BACI-422 in response to a **DUMP SYSTEM DATA (DSD)** command, see 3.B.5 Supplement No. 1 (Model 10BACIA New Features).

Section 3.B.5 Supplement No. 3: Model 10BACI-488

1. Introduction

The **Model 10BACI-488** allows direct connection of a "B-sized" DataPAC to an IEEE-488 bus, thus eliminating the need for an external RS-232 to IEEE-488 adaptor such as the Model 10CIF488A. It is equivalent to a Model 10BACIA with a 24-pin parallel port for standard IEEE-488 TALKER/LISTENER communications (in place of the 10BACIA's standard RS-232-C interface).

NOTE: While the 10BACI-488 conforms to the *hardware* protocol of IEEE-488, it does not adhere to the *software* protocol contained in IEEE-488.2. In addition, the data transfer rate is limited by the rate at which data can be received from the System 10 database (typically 2000 to 3000 channels per second). As a result, the 10BACI-488 transfer rate will be about 15,000 to 17,000 bytes per second.

Note too that the rear connector supplied with the 10BACI-488 covers two "B" SLOTS. The slot at which the card is "located" is the right-hand slot; the left-hand slot is empty.

Everything that is said in Section 3.B.5 (Version SB.3 or higher) about the Model 10BACI Auxiliary Computer Interface Card applies equally to the Model 10BACI-488, *EXCEPT THAT*

- a. Unlike the 10BACI, the 10BACI-488 DOES NOT SUPPORT SERIAL COMMUNICATIONS; therefore, all references to "RS-232-C" interface connections and protocols should be ignored. The 10BACI-488 provides a 24-PIN PARALLEL PORT CONNECTOR (only), as described below.
- b. The 10BACI-488 card has on-board DIP switches for assigning a specific bus address to the System 10.
- c. The **ADDRESS (ADD)** and **END OR IDENTIFY (EOI)** commands have been developed for use with the 10BACI-488. These are given in Section 4, below. In addition, the response of the 10BACI-488 to the **FRAME CHANNELS (FCH)** and **DUMP SYSTEM DATA (DSD)** commands is identical to that of the Model 10BACIA (see **3.B.5 Supplement No. 1**).
- d. The 10BACI's **RTS** and **DTS** front-panel STATUS INDICATORS have been replaced by **LAD** ("Listener Active Device") and **TAD** ("Talker Active Device"), to indicate the System 10's current bus role.

2. Ensuring 10BACI-488 / Central Processor Compatibility: **BCP** Command

To ensure proper operation of the **FRAME CHANNELS (FCH)** command, it is necessary for every 10BACI-488 to know which type of CENTRAL PROCESSOR card is in the DataPAC—a Model 10BCP100/10BCP100A or a Model 10BCP200 (which is used in all "System 10/2000" DataPACs). To inform all 10BACI-488's in the DataPAC that they are being used with a 10BCP100 or 10BCP100A, you should make sure that a command of

BCP = 100 [CR] *

is in effect; to inform all 10BACI-488's that the DataPAC has a 10BCP200, make sure that

BCP = 200 [CR] *

is in effect.

3. Connections

The 10BACI-488's 24-pin PARALLEL PORT connects directly to the IEEE-488 bus, via a cable supplied by the user and conforming to recommended IEEE-488 cable practice. Standard IEEE-488 pinout is employed for this port, as follows:

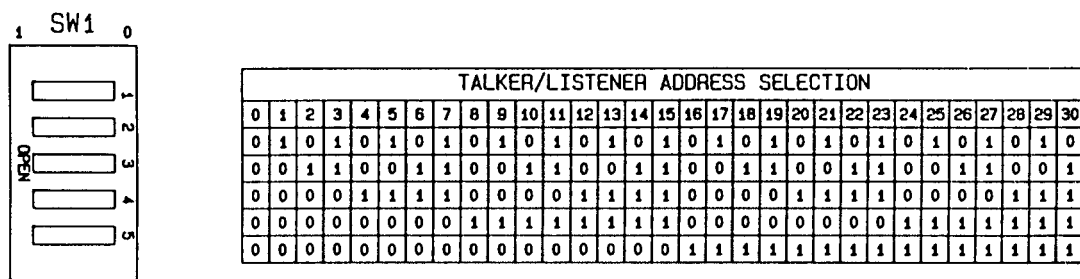
Pin No.	Signal Line	Pin No.	Signal Line
1	DI01 (Data Line)	13	DI05 (Data Line)
2	DI02 (Data Line)	14	DI06 (Data Line)
3	DI03 (Data Line)	15	DI07 (Data Line)
4	DI04 (Data Line)	16	DI08 (Data Line)
5	\overline{EOI} (End or Identify)	17	\overline{REN} (Remote Enable)
6	\overline{DAV} (Data Valid)	18	Ground
7	\overline{NRFD} (Not Ready For Data)	19	Ground
8	\overline{NDAC} (Not Data Accepted)	20	Ground
9	\overline{IFC} (Interface Clear)	21	Ground
10	\overline{SRQ} (Service Request Line)	22	Ground
11	ATN (Attention)	23	Ground
12	Shield		

4. Setting System 10 IEEE-488 Bus Address

With reference to IEEE-488 bus structure, a System 10 connected via a 10BACI-488 is a "TALKER/LISTENER" device, to which you must assign a specific bus address (any integer from 0 through 30). To do so,

1. Turn OFF mainframe power and remove the 10BACI-488 card from its slot (see Appendix B for card insertion and removal).
2. Locate the ADDRESS SELECTION SWITCHES on the 10BACI-488 card (see Fig. 1, below). Set these five switches as shown in the table to encode, in binary form, the value of the desired bus address. The address can be any integer from 1 through 30 (address "0" is reserved for the controller, and should not be used). For example, to select an address of "21," set Switches 1 through 5 to form a sequential pattern of "10101" (switch depressed to the left for "1"; to the right for "0"). At any time you may use the **ADDRESS (ADD)** command, described in the following section, to check the current setting of the ADDRESS SELECTION SWITCHES.
3. Return the 10BACI-488 card to its slot, and reactivate the mainframe.

Note that, upon system powerup, the System 10 will be at null (i.e., inactive on the bus) until it is told by the bus controller to be a TALKER or LISTENER.



TALKER/LISTENER
ADDRESS SELECTION

Fig. 1 10BACI-488 Address Selection Switches

5. 10BACI-488 Mnemonic Commands

The following two special commands have been developed for use with the 10BACI-488. They can be sent directly to the 10BACI-488 from the IEEE-488 bus or through the DataPAC's keyboard or standard Computer Interface (see Section 3.B.5.d).

ADDRESS (ADD)

To read the current bus address setting, enter

ADD [CR]

The current decimal address value (0 through 30) will be returned.

END OR IDENTIFY (EOI)

By means of the **EOI** command, you can arrange for the IEEE-488 "END OR IDENTIFY" function to be invoked at the end of each output line and/or at the end of each complete output transmission. Note that when large blocks of data are being routinely placed on the bus—as would happen, for instance, in response to a **DUMP (DMP)** command—it would optimize speed to have EOI occur only at the end of every complete transmission, and not at the end of every output line.

The general form of the **EOI** command is

$$\mathbf{EOI = OPT \left\{ \begin{array}{l} \mathbf{ON} \\ \mathbf{OFF} \end{array} \right\} , EOT \left\{ \begin{array}{l} \mathbf{ON} \\ \mathbf{OFF} \end{array} \right\} [CR] *}$$

Thus, if you indicate **OPT = ON**, the last byte of the OUTPUT TERMINATOR will be accompanied by an invocation of the EOI; and if you indicate **EOT = ON**, the last byte of the END-OF-TRANSMISSION TERMINATOR will likewise invoke the EOI. NOTE: This is a SETUP COMMAND, and requires that the EEPROM Write Protect Switch be ON.

6. "FP" (Floating Point) Commands: **FPF** and **FDM**

If the 10BACI-488 is equipped with the "FP" (Floating Point) Option, the **FLOATING POINT FORMAT (FPF)** and **FLOATING POINT DUMP (FDM)** commands are also valid (see 3.B.5 Supplement No. 4 for a description of these commands).

Section 3.B.5 Supplement No. 4: 10BACI "Floating Point" Option

1. Introduction

NOTE: The "FP" or "Floating-Point" Option applies ONLY to the **Model 10BACI-488 IEEE-488 Auxiliary Computer Interface Card**, and is available only on special request. It allows the 10BACI-488 to issue data for all scanned channels or for a specified range of channels in either *IEEE* or *DEC FLOATING-POINT FORMAT*.

2. Setting the Floating-Point Format

You will use the **FLOATING POINT FORMAT (FPF)** command to tell the 10BACI-488 what floating-point format you want. Thus, to specify IEEE format, enter a command of

FPF = IEEE [CR] *

—or to specify DEC format, enter

FPF = DEC [CR] *

Note that **FPF** is a SETUP command, and requires that the Write Protect Switch be ON.

The difference between the two floating-point formats lies in the interpretation of the 8 bits representing the *exponent* for each transmitted channel data value (see Section 4, below).

3. Initiating a Floating-Point Output

A run-time **FLOATING POINT DUMP (FDM)** command lets a 10BACI-488 card output selected channel data *once only* in the floating-point format specified by the last-entered **FPF** command. The **FDM** command should be sent directly to the 10BACI-488 card either through its "external" interface port or through the DataPAC's keyboard or standard Computer Interface (see Section 3.B.5.d).

To initiate from the 10BACI-488 the floating-point "dump" of the data presently reported by *all scanned channels*, command

FDM [CR]

To initiate the floating-point "dump" of the *continuous range of channels* from Channel No. x to and including Channel No. y (where $x \leq y$), command

FDM x TO y [CR]

4. Floating-Point Output Formats

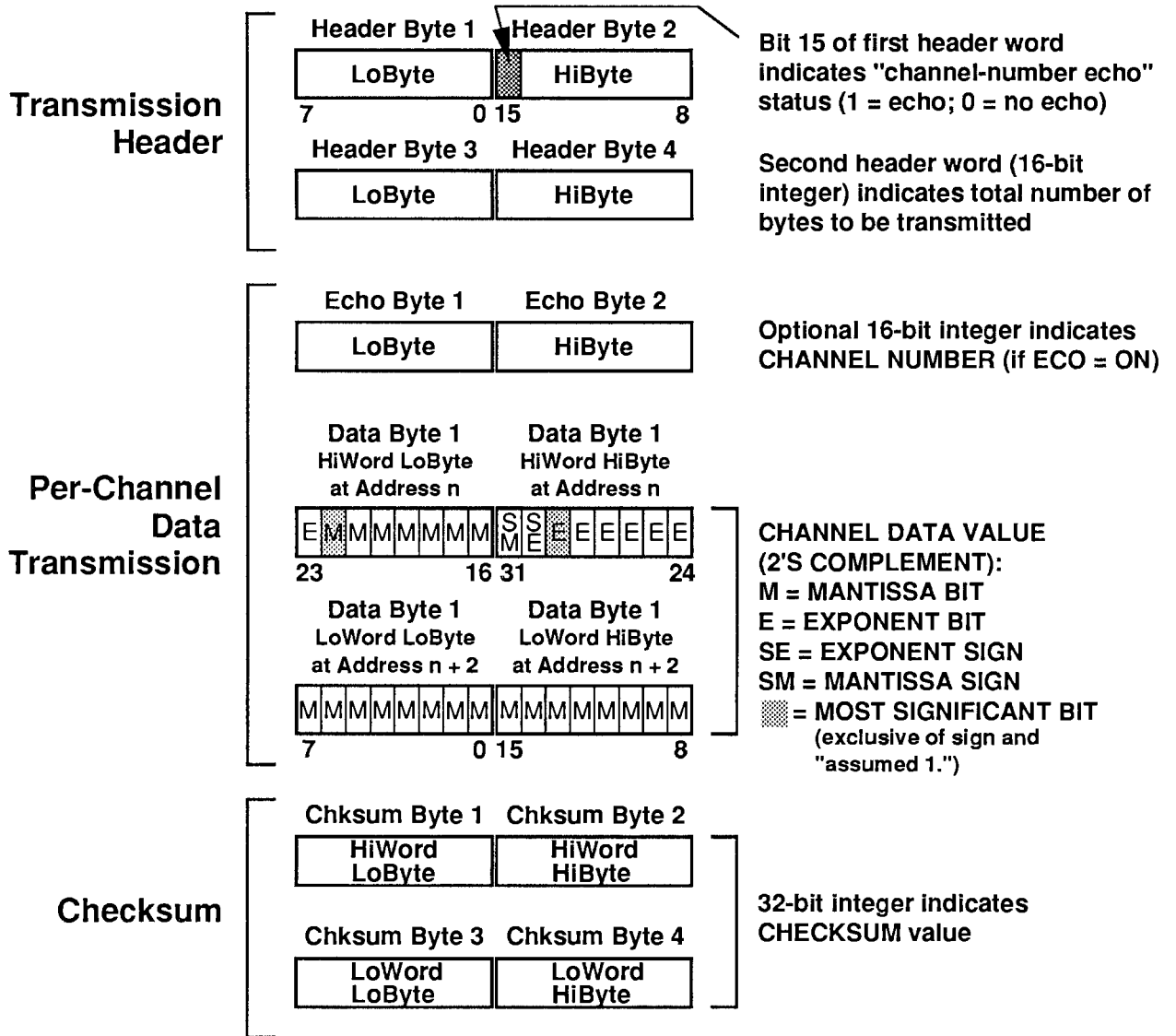
The output produced by a 10BACI-488 card in response to either form of the **FDM** command will consist of (in order of transmission)

- a **TRANSMISSION HEADER** composed of two sixteen-bit "words"
 - The first header word indicates whether or not the "channel-number echo" is currently in effect. Thus, Bit 15 of this word will be "1" when and only when the **ECHO (ECO)** command is in effect; Bit 15 will be "0" when and only when the **NO CHANNEL (NCH)** command is in effect. See Section 1.H.3 for details on the **ECO** and **NCH** commands.
 - The second header word contains a 16-bit integer representing the *total number of bytes* to be transmitted (including the checksum and the header itself). If the **ECO** command is in effect, this number will be $(n \times 6) + 8$, where "n" is the total number of channels to be "dumped"; if **NCH** is in effect, the total number of bytes to be transmitted will be $(n \times 4) + 8$.

- the actual **DATA TRANSMISSION** for all or a specific range of system channels (depending on the form of the **FDM** command—see above)
 - If the **ECO** command is in effect, the data transmission for *each channel* will be preceded by a 16-bit integer indicating the appropriate CHANNEL NUMBER.
 - The "live" data value for each channel is represented by 32 bits (two 16-bit words), with both the *mantissa* and the *exponent* represented in "2's COMPLEMENT" form. Fig. 1 shows the order of these 32 bits for both IEEE and DEC FLOATING-POINT FORMAT.
- a trailing **CHECKSUM** value represented as a 32-bit integer
 - The final checksum number is the modulo-32 summation of (1) the two header words, (2) each channel-number "echo" (if present)*, and (3) each transmitted data value. Its value should be compared to that of the same summation as performed by the receiving device, to determine whether the transmission was successful.

* Note that when the **ECO** command is in effect, a *leading 16-bit word of "0"* will be used with the channel-number "echo" for purposes of the checksum summation.

Fig. 1 10BACI Floating-Point Output



PLEASE NOTE the following section- and figure-reference corrections for **Section 3** of this Guidebook:

When you are told to refer to:

You should actually refer to:

Section 1.B

Section 1.A.3

Section 1.C

Section 4 of the appropriate
"On the Air" Booklet

Section 1.D

Section 5 of the appropriate
"On the Air" Booklet

Fig. 1.E.1 (Section 1.E.1)

Fig. 1.5 (Section 1.E.1)

Fig. 1.E.2 (Section 1.E.1)

Fig. 1.6 (Section 1.E.1)

Section 1.F.1

Section 1.F.2

Section 1.F.2

Section 1.F.3

Section 1.G.2

Section 1.G.1

Section 1.G.7

Section 1.G.6

Appendix B

Section 1.B

Section 3.A

Special "A-Card" Functions

The following sections contain instructions for the setup and operation of optional System 10 "A Cards" dedicated to functions *other than signal conditioning or diagnostic testing*. For Conditioner Card setup and operation, see Section 1.E.2.

Section 3.A.1

Counter/Timer Functions:

Model 10ACT01

Counter/Timer Card and

Model 10ACC-4

Four-Channel Totalizer Card



System 10 Guidebook

———— HANDLING CAUTION! ————

DO NOT LAY THE MODEL 10ACT01 BOARD ON ANY METAL OR OTHER CONDUCTIVE SURFACE. SHORT-CIRCUITING OF THE LITHIUM BATTERY COULD OCCUR, WITH POSSIBLE SEVERE DAMAGE TO THE INSTRUMENT.

By means of the **TYPE (TYP)** command, the **Model 10ACT01 Counter/Timer Card** can be made to function in any of the four modes of operation described below.

In all but the TIMER mode, the "events" being counted by the 10ACT01 are *waveform pulses*, AC or unipolar, delivered to the 10ACT01's rear I/O CONNECTOR by an external *pulse transformer transducer* with two-wire isolated windings (turbine flowmeter, tachometer pickup, etc.), by a *transistor or logic-circuit driver*, or by a similar signal source.

The **Model 10ACC-4 Totalizer Card** can accept up to *four* independent TTL pulse inputs, and functions only in the COUNTER (or TOTALIZER) mode. It is particularly useful in assembly-line applications that require the accurate counting of large numbers of parts.

1. FREQUENCY MODE

In this mode, the 10ACT01 counts *events per unit time*, and can thus be used for direct *frequency or rpm measurement*. As explained in Section b.2(b), below, the **RANGE (RNG)** command lets you select the desired *full-scale frequency range* (with corresponding *resolution*), plus the specific *time base* during which "events" (pulses) are to be counted.

2. PERIOD MODE

In this mode, the 10ACT01 calculates the *average time period* required for the occurrence of 1, 10, 60, 100, or 120 pulse "events" (cycles). Such measurements are particularly useful when dealing with relatively low *flow or speed* signals, where a conventional frequency-to-voltage conversion is impractical. The *full-scale reading* (along with corresponding *resolution* and *minimum frequency input*) is selectable via the **RANGE (RNG)** command, as explained in Section b.2(b), below.

3. COUNTER (TOTALIZER) MODE

In this mode, the 10ACT01 or 10ACC-4 counts *all* perceived "events" (pulses) by an increment of 1, 10, or 100 (with a respective *full-scale count reading* of 32767, 327670, or 3276700), selectable via the **RANGE (RNG)** command (see Sections b.2(b) and d.2(a), below).

Special MNEMONIC COMMANDS, described in Section c.2, below, allow the operator or computer to *increment* the counter at any time, to disconnect or reconnect the external input, to *hold* the existing displayed count, to instantly *update* ("release") the displayed count, to *reset* the counter to zero, and to *clear* the counter (to resume normal counting from zero).

You can also use specific *logic inputs* to the 10ACT01's or 10ACC-4's I/O CONNECTOR to initiate a "hold," "release," "resetting," or "clearing" of the counter. In addition, the 10ACT01 lets you disable and re-enable the external input via logic-signal command, when the card is in COUNTER mode.

4. TIMER MODE

In this mode, the Model 10ACT01 provides *precision timing* by counting pulses generated by its own internal clock. As explained in Section b.2(b), resolution is selectable via the **RANGE (RNG)** command from 10 microseconds to 10 minutes, with corresponding *full-scale readings* from 0.32767 second to 327670 minutes.

3.A.1.a

INTRODUCTION: COUNTER/TIMER MODES OF OPERATION

Special MNEMONIC COMMANDS, described in Section c.2, below, allow the operator or computer to *disconnect or reconnect the external input*, to *hold* the displayed time value, to *update* ("release") the displayed time value, to *reset* the timer to zero, and to *clear* the time (to resume normal timing operation from zero). You can also use *logic inputs* to the 10ACT01's I/O CONNECTOR to disable and re-enable the external input, or to initiate a "hold," "release," "resetting," or "clearing" of the timer.

1. 10ACT01 CONNECTIONS

a. GENERAL CONSIDERATIONS

The Model 10ACT01's 20-pin I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322 (shown in Fig. 1.E.1). Pin functions are given in Table 3.A.1.1. Cabling is shown in Fig. 3.A.1.2 for three different types of input:

1. a nonexcited low-level frequency or rpm signal (0 to 100 kHz);
2. a TTL-level pulse or square-wave signal (0 to 3200 kHz);
3. output from a zero-velocity speed sensor with excitation of nominal +5 V-DC.

For low-level and zero-velocity inputs, connections are shown for both FREQUENCY/PERIOD and COUNTER/TIMER operation of the 10ACT01.

Specifications for the input pulse signal are identical to those given for the **Model 10A40 Frequency Input Conditioner Card**. The analog-input *voltage* range may be set, independent of the "mode of operation," via the **SENSITIVITY (SEN)** command (see Section b.2(c)).

Note that the 10ACT01's **Pin B** may have either of two functions, depending on the nature of the input signal:

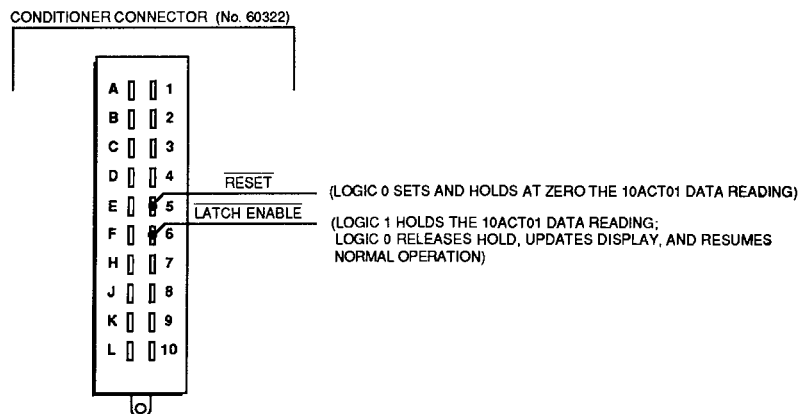
- When the input is *low-level* (0 to 100 kHz), Pin B serves as a negative-true *enabling* pin. That is, the +SIGNAL input, which should be connected to Pin 3, will be enabled only when Pin B is at a *Logic 0* level. Therefore, Pin B *must be tied to COMMON (Pin 2)* in order for the 10ACT01 to operate.

When the 10ACT01 is in COUNTER or TIMER mode, Pin B may serve as a controllable gate, to enable and disable the external input as desired. To be so used, however, it *must also be tied to the LATCH ENABLE input (Pin 6)*. See Section c.3, below.

- When the input is *TTL-level* (100 to 3200 kHz), it should be *received* at Pin B. In this case, the +SIGNAL (Pin 3) should be tied to COMMON (Pin 2), and the -SIGNAL (Pin C) should be tied to the -5 V-DC EXCITATION (Pin A).

The 10ACT01's Pins 5 and 6 provide negative-true *logic inputs* for the remote control of COUNTER and TIMER operation (see Fig. 3.A.1.1). These logic commands may be "ORed" with corresponding MNEMONIC COMMANDS, as explained in Section c.2, below.

Fig. 3.A.1.1 Model 10ACT01 Logic Inputs for Counter/Timer Control



3.A.1.b

MODEL 10ACT01 SETUP

b. SUPPRESSION OF NOISE IN LOW-FREQUENCY INPUT

False triggering can sometimes occur, especially at the *low-frequency input range*, because of stray pickup of frequencies outside the common-mode range. Capacitive coupling of the frequency input to ground can in such cases serve to suppress unwanted signal noise.

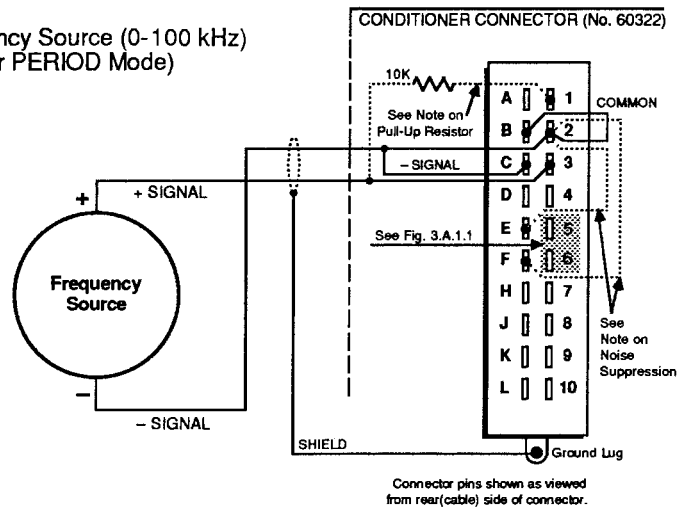
If you find your frequency reading to be unacceptably unstable or "noisy," you should connect either Pin E or Pin F to SIGNAL COMMON (Pin 2). Pin E provides 0.1-microfarad capacitance; Pin F provides 10-microfarad capacitance. Note that connection of Pin E is *recommended* for zero-velocity sensors (see Fig. 3.A.1.2(d,e)).

C. PULL-UP RESISTOR

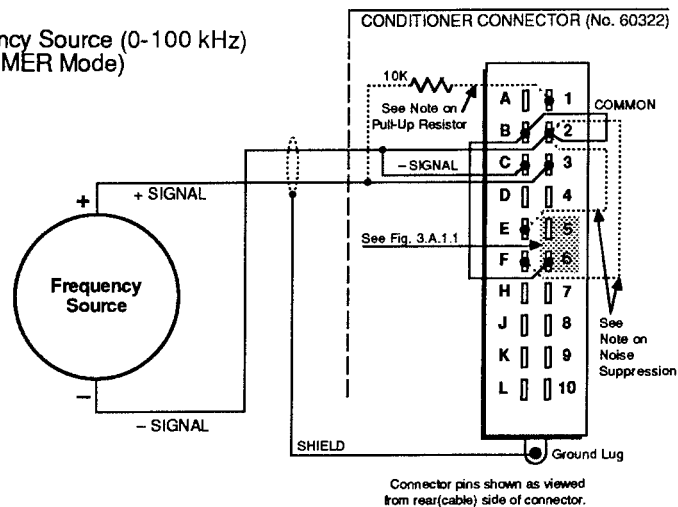
When used with an *open-collector* type sensor, the Model 10ACT01 requires a pull-up resistor (typically *10 kilohms*) between the +SIGNAL and the +5 V-DC EXCITATION (Pin 1).

Fig. 3.A.1.2 Model 10ACT01 Cabling

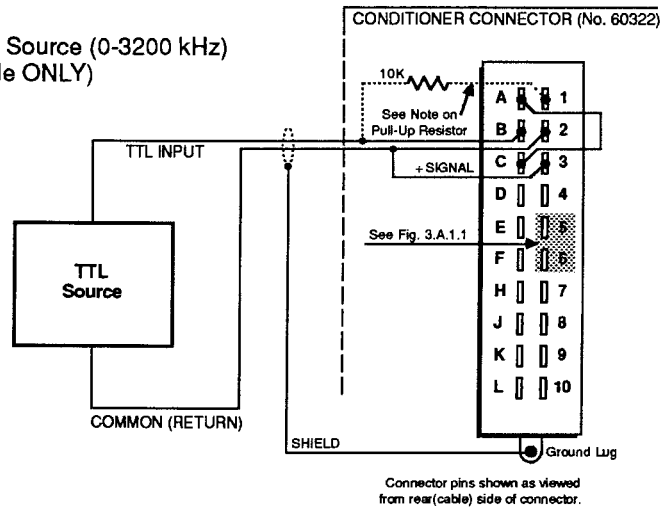
a) Input from Low-Level Frequency Source (0-100 kHz)
(10ACT01 in FREQUENCY or PERIOD Mode)



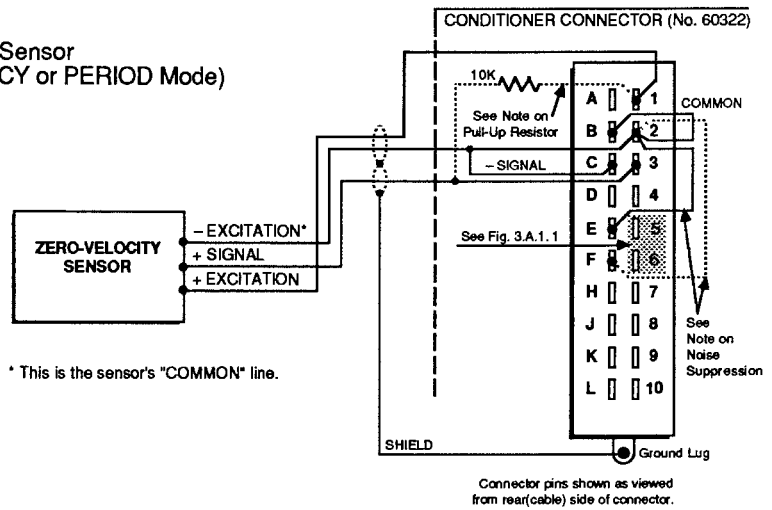
b) Input from Low-Level Frequency Source (0-100 kHz)
(10ACT01 in COUNTER or TIMER Mode)



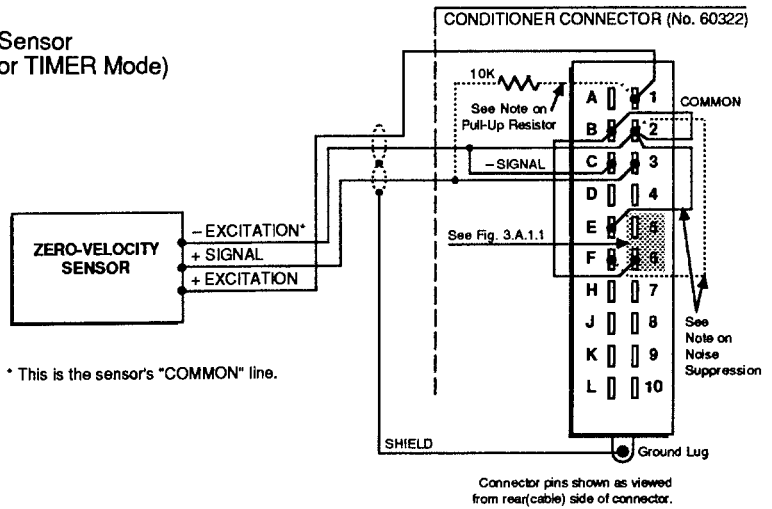
c) Input from TTL-Level Frequency Source (0-3200 kHz)
(10ACT01 in FREQUENCY Mode ONLY)



d) Input from Zero-Velocity Sensor
(10ACT01 in FREQUENCY or PERIOD Mode)



e) Input from Zero-Velocity Sensor
(10ACT01 in COUNTER or TIMER Mode)



3.A.1.b

MODEL 10ACT01 SETUP

Table 3.A.1.1

Model 10ACT01 Pin Assignments

I/O CONNECTOR Pin No.	Line Function
1	+EXCITATION (+ 5 V-DC)
A	-EXCITATION (- 5 V-DC)
2	COMMON
B	(1) INPUT ENABLE (2) TTL-LEVEL INPUT
3	+SIGNAL (LOW-LEVEL)
C	-SIGNAL
4,D	N/C
5	RESET
E	0.1-MICROFD COUPLING
6	LATCH ENABLE
F	10-MICROFD COUPLING
7-L	N/C

2. 10ACT01 CONFIGURATION

a. SETTING 10ACT01 MODE: **TYP** COMMAND

To select the desired mode of operation for the Model 10ACT01 that uses DATA CHANNEL No. x, turn ON the DataPAC's EEPROM Write Protect Switch and enter a **TYPE (TYP)** command of the general form

TYP x = v [CR] *

where "v" is the appropriate two-character (hexadecimal) TYPE code, as given in the following table:

Table 3.A.1.2

10ACT01 Mode of Operation	Channel Type Code
FREQUENCY MODE (EVENTS PER UNIT TIME)	C0
PERIOD MODE	C1
COUNTER (TOTALIZER) MODE	C2
TIMER MODE	C3

b. SETTING RANGE AND RESOLUTION: **RNG** COMMAND

———— NOTE ————

You will normally NOT have to "locate" the 10ACT01 DATA CHANNEL via the **LOCATE (LCT)** command, unless you are "reconfiguring" the channel or are installing the 10ACT01 card yourself—in which case see Appendix C.

To select the desired combination of *range* and *resolution* for the Model 10ACT01 that uses DATA CHANNEL No. x, you should enter a **RANGE (RNG)** command of the general form

$$\mathbf{RNG\ x = n\ [CR]\ *}$$

Allowable values for the number "n" will depend on the particular mode of operation selected for your 10ACT01 via the **TYPE (TYP)** command, above. Note that a *default* value for "n" exists for each of the four modes. The default range will be in effect until the first application of the **RNG** command.

1. FREQUENCY MODE (TYPE "C0")

When using your 10ACT01 for frequency or rpm measurement, you will select the appropriate *full-scale frequency range*, with corresponding *resolution*, and also the desired *time base* of the measurement. Enter in the above **RNG** command the "n" value for the range configuration you have selected.

Table 3.A.1.3.

10ACT01 Ranges for FREQUENCY MODE

Full-Scale Range	Resolution	Time Base	"n" Value
3.2 kHz	0.1 Hz	10 sec	1
32 kHz	1 Hz	1 sec	2*
32 kHz	1 Hz	10 sec	4
320 kHz**	10 Hz	0.1 sec	3
320 kHz**	10 Hz	1 sec	5
320 kHz**	10 Hz	10 sec	7
3.2 mHz**	100 Hz	0.1 sec	6
3.2 mHz**	100 Hz	1 sec	8

* Default range.

** This range exceeds the 100-kHz capability of the 10ACT01's *low-level* frequency input. In such cases, the *TTL INPUT* (Pin B) should be used (see Section b.1 for details).

2. PERIOD MODE (TYPE "C1")

When using your 10ACT01 for period measurement, you will select the appropriate *full-scale reading*, with corresponding *minimum frequency input* and *resolution*, and also the *number of input cycles over which an average period value is to be calculated*. Enter in the **RNG** command the "n" value for the range configuration you have selected.

3.A.1.b

MODEL 10ACT01 SETUP

Table 3.A.1.4.

10ACT01 Ranges for PERIOD MODE

Full-Scale Reading (millisec)	No. of Cycles Averaged	Minimum Input Frequency	Resolution	"n" Value
32767	1	0.032 Hz	1 millisec	1
32767	10	0.032 Hz	1 millisec	2
32767	100	0.032 Hz	1 millisec	3
27305	120	0.037 Hz	1 millisec	4
5461	60	0.183 Hz	1 millisec	5
3276.7	1	0.32 Hz	100 microsec	6
3276.7	10	0.32 Hz	100 microsec	7
3276.7	100	0.32 Hz	100 microsec	8
2730.5	120	0.37 Hz	100 microsec	9
546.1	60	1.83 Hz	100 microsec	10
327.67	1	3.2 Hz	10 microsec	11*
327.67	10	3.2 Hz	10 microsec	12
327.67	100	3.2 Hz	10 microsec	13
273.05	120	3.7 Hz	10 microsec	14
54.61	60	18.3 Hz	10 microsec	15
32.767	1	32 Hz	1 microsec	16
32.767	10	32 Hz	1 microsec	17
32.767	100	32 Hz	1 microsec	18
27.305	120	37 Hz	1 microsec	19
5.461	60	183 Hz	1 microsec	20
3.2767	10	320 Hz	100 microsec	21
3.2767	100	320 Hz	100 microsec	22
2.7305	120	370 Hz	100 microsec	23
0.5461	60	1832 Hz	100 microsec	24
0.32767	100	3200 Hz	10 microsec	25

* Default range.

NOTE

When selecting a suitable range for period measurement, keep in mind that the *update interval* for the scanned period reading will be equal to

$$\frac{\text{No. of Cycles Averaged}}{\text{Frequency Input}}$$

For example, if you apply a command of

RNG 48 = 17 [CR] *

for the 10ACT01 using Channel No. 48, and the applied frequency input is, say, 1 kHz, then your period measurement will be up- dated every hundredth of a second, since

$$\frac{10}{1000 \text{ Hz}} = 0.01 \text{ sec}$$

3. COUNTER MODE (TYPE "C2")

When using your 10ACT01 as an "event" counter (or "totalizer"), you will select an appropriate *full-scale count*, with corresponding *count increment*. Enter in the **RNG** command the "n" value for the range configuration you have selected.

Table 3.A.1.5.

10ACT01 Ranges for COUNTER MODE

Full-Scale Count	Count Increment	"n" Value
32767	1	1*
327670	10	2
3276700	100	3

* Default range.

4. TIMER MODE (TYPE "C3")

When using your 10ACT01 as a timer, you will select an appropriate *full-scale reading*, with corresponding *resolution*. Enter in the **RNG** command the "n" value for the range configuration you have selected.

Table 3.A.1.6.

10ACT01 Ranges for TIMER MODE

Full-Scale Reading	Resolution	"n" Value
0.32767 sec	10 microsec	1
3.2767 sec	100 microsec	2
32.767 sec	1 millisec	3
327.67 sec	10 millisec	4
3276.7 sec	100 millisec	5
32767 sec	1 sec	6*
327670 sec	10 sec	7
3276700 sec	100 sec	8
32767 min	1 min	9
327670 min	10 min	10

* Default range.

3.A.1.b

MODEL 10ACT01 SETUP

C. SETTING 10ACT01 INPUT-AMPLIFIER SENSITIVITY: **SEN** COMMAND

You can set the input-amplifier *sensitivity* of the Model 10ACT01 that uses DATA CHANNEL No. x by applying the **SENSITIVITY (SEN)** command:

$$\mathbf{SEN\ x = g\ [CR] *}$$

where the value of "g" ("gain") to be entered is independent of the mode of operation selected via the **TYPE (TYP)** command, above. It does, however, set the 10ACT01's analog-input *voltage* range, as shown in the following table:

Table 3.A.1.7.

10ACT01 Input Levels	Sensitivity ("g") Value
10 V - 200 V	1
3 V - 60 V	2
1 V - 20 V	3
300 mV - 6 V	4
100 mV - 2 V	5

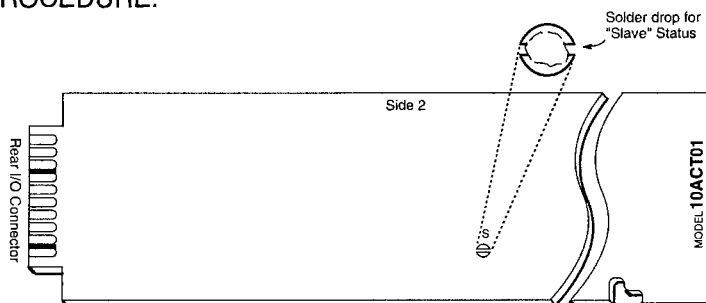
d. "SLAVING" OF MULTIPLE 10ACT01'S

NOTE: THIS PROCEDURE IS NECESSARY ONLY WHEN MULTIPLE 10ACT01'S ARE BEING USED FOR FREQUENCY MEASUREMENTS OF EQUAL TIME BASE.

When more than one 10ACT01 cards are installed in a single DataPAC, you can synchronize their 1.000000-mHz crystal frequency reference by designating one card as "MASTER" and the other(s) as "SLAVE(S)." Unless otherwise specified, all Model 10ACT01's are factory-set for "MASTER" operation. To set a 10ACT01 for "SLAVE" operation, you should

1. Make sure the EEPROM Switch is OFF, and then turn OFF DataPAC power.
2. Remove the 10ACT01 card to be "slaved" from its slot (see Appendix B).
3. Locate the programming jumper pads labelled "S" on "Side 2" of the 10ACT01 board (see Fig. 3.A.1.3).
4. Place a solder drop between the jumper pads.
5. Reinstall the card.
6. **IMPORTANT:** Before reactivating power, make sure that the DataPAC motherboard's wire-wrap "I/O #1" pin (No. 41) for each mainframe slot containing a Model 10ACT01 is hardwired to the "I/O #1" pin (No. 41) of *every other slot containing a 10ACT01 card*. All 10ACT01 "I/O #2" wire-wrap pins (No. 42) should likewise be interconnected, as should all 10ACT01 "I/O #3" wire-wrap pins (No. 43). CONTACT THE DAYTRONIC SERVICE DEPARTMENT FOR THE WIRE-WRAP PROCEDURE.

Fig. 3.a.1.3
Model 10ACT01
"Slave" Program-
ming Jumpers



1. INCREMENTING THE COUNT: **INC** COMMAND

By entering the **INCREMENT (INC)** command, you can cause a Model 10ACT01 in the COUNTER mode (only) to increase its count reading by *one increment* (1, 10, or 100, depending on the full-scale count selected via the **RANGE (RNG)** command—see Section b.2(b)).

Thus, to increase by one increment the count reading of the 10ACT01 that uses DATA CHANNEL No. x, simply command

INC x [CR]

For the application of the **INC** command to a DOWNLOAD PSEUDOCCHANNEL, see Section 2.M.1.

2. COUNTER/TIMER CONTROL

The four following commands are applicable only when the Model 10ACT01 is functioning in the COUNTER or TIMER mode.

NOTE THAT EACH COMMAND AFFECTS ONLY THE SCANNED DATA READING (WHICH, IN MOST CASES, WILL BE A *DISPLAYED* VALUE). THE 10ACT01 WILL ALWAYS CONTINUE TO ACCUMULATE COUNTS, REGARDLESS OF THE "CONTROL" COMMAND PRESENTLY IN EFFECT, AND OF THE DISPLAYED READING THAT RESULTS FROM THE APPLICATION OF THAT COMMAND.

Note also that the effects of these commands can also be obtained by the application of appropriate *logic inputs* to the 10ACT01's rear I/O CONNECTOR—but again, only when the 10ACT01 is set for COUNTER or TIMER mode.

a. HOLDING THE COUNT/TIME VALUE: **COH** COMMAND

To *inhibit updating* of the scanned data reading of the 10ACT01 that uses DATA CHANNEL No. x, apply the **COUNTER HOLD (COH)** command:

COH x [CR]

Alternatively, a *Logic 1* input at Pin 6 of the 10ACT01's rear I/O CONNECTOR will "hold" the existing scanned data reading. Such an input may be "ORed" with a **COUNTER HOLD (COH)** command (see also Section c.3, below).

b. UPDATING THE COUNT/TIME VALUE: **COU** COMMAND

To *release* the **COUNTER HOLD (COH)** command, thus instantly updating the scanned data reading of the 10ACT01 that uses DATA CHANNEL No. x, and resuming normal COUNTER or TIMER operation, apply the **COUNTER UPDATE (COU)** command:

COU x [CR]

Alternatively, a *Logic 0* input at Pin 6 of the 10ACT01's rear I/O CONNECTOR will release an existing "hold" condition, instantly updating the display and resuming normal operation. Such an input may be effectively "ORed" with a **COUNTER UPDATE (COU)** command (see also Section c.3, below).

3.A.1.c

MODEL 10ACT01 OPERATION

C. RESETTING THE COUNTER/TIMER: COR COMMAND

To *set and hold at zero* the scanned data reading of the 10ACT01 that uses DATA CHANNEL No. x, apply the **COUNTER RESET (COR)** command:

COR x [CR]

If the 10ACT01's data reading is currently being "held" at a nonzero value by a **COUNTER HOLD (COH)** command or by a *Logic 1* at Pin 6, then the application of **COUNTER RESET (COR)** will *not* produce a reading of zero. For the resetting of the 10ACT01 to be reflected in the scanned data reading, the **COUNTER UPDATE (COU)** command must be in effect, and Pin 6 must be at a *Logic 0* level.

Alternatively, a *Logic 0* input at Pin 5 of the 10ACT01's rear I/O CONNECTOR will set and hold at zero the scanned data reading, if no **COUNTER HOLD (COH)** command is presently in effect, and if Pin 6 is at a *Logic 0* level. Such an input may be "ORed" with a **COUNTER RESET (COR)** command (see also Section c.3, below).

d. CLEARING THE COUNTER/TIMER: COC COMMAND

To *release* the **COUNTER RESET (COR)** command, thereby resuming normal updating (from zero) of the scanned data reading of the 10ACT01 that uses DATA CHANNEL No. x, apply the **COUNTER CLEAR (COC)** command:

COC x [CR]

Alternatively, a *Logic 1* input at Pin 5 of the 10ACT01's rear I/O CONNECTOR will cause the Counter/Timer to resume normal updating (from zero) of the scanned data reading. Such an input may be effectively "ORed" with a **COUNTER CLEAR (COC)** command (see also Section c.3, below).

3. DISABLING AND ENABLING EXTERNAL INPUT DURING TIMER OPERATION: EID AND EIE COMMANDS

As indicated above, control of the Model 10ACT01's COUNTER or TIMER operation can be accomplished in two ways:

- by MNEMONIC COMMANDS (**COH**, **COU**, **COR**, and **COC**), or
- by appropriate *logic inputs* to the 10ACT01's rear I/O CONNECTOR.

Both methods of control may be simultaneously in effect, in a "logic-OR" fashion.

In applications where the 10ACT01 functions in the TIMER mode with "ORed" timer control, it is sometimes useful to be able to *disable the 10ACT01's external input* (including any and all logic commands received at the I/O CONNECTOR), in order to establish strictly *internal* control of the timing process (via MNEMONIC COMMANDS). You can then *re-enable* the external input whenever you wish the card to respond as well to external logic-signal commands—as, for example, when you're timing the duration of a switched process state.

To *disconnect* from the 10ACT01 that uses DATA CHANNEL No. x any and all external signals and logic commands received at its rear I/O CONNECTOR, apply the **EXTERNAL INPUT DISABLE (EID)** command:

EID x [CR]

To cancel the **EID** command, thus *reconnecting* all external signals and logic commands received at the I/O CONNECTOR of the 10ACT01 that uses Channel No. x, apply the **EXTERNAL INPUT ENABLE (EIE)** command:

EIE x [CR]

NOTE: Although the **EID** and **EIE** commands will be effective when the 10ACT01 is in either COUNTER or TIMER mode, they are, in general, only useful during 10ACT01 TIMER operation (obviously, disconnection of the external input would only disrupt normal FREQUENCY, PERIOD, or COUNTER operations). Upon application to the 10ACT01 of a **TYPE (TYP)** or **RANGE (RNG)** command (Section b.2), the **EXTERNAL INPUT ENABLE (EIE)** command is automatically in effect.

ALSO NOTE: When the 10ACT01 is in COUNTER or TIMER mode (only), an input of *Logic 1* at Pin B of the I/O CONNECTOR will also serve to *disable* the external input. A *Logic 0* at Pin B will then re-enable the external input.

3.A.1.d

MODEL 10ACC-4 SETUP AND OPERATION

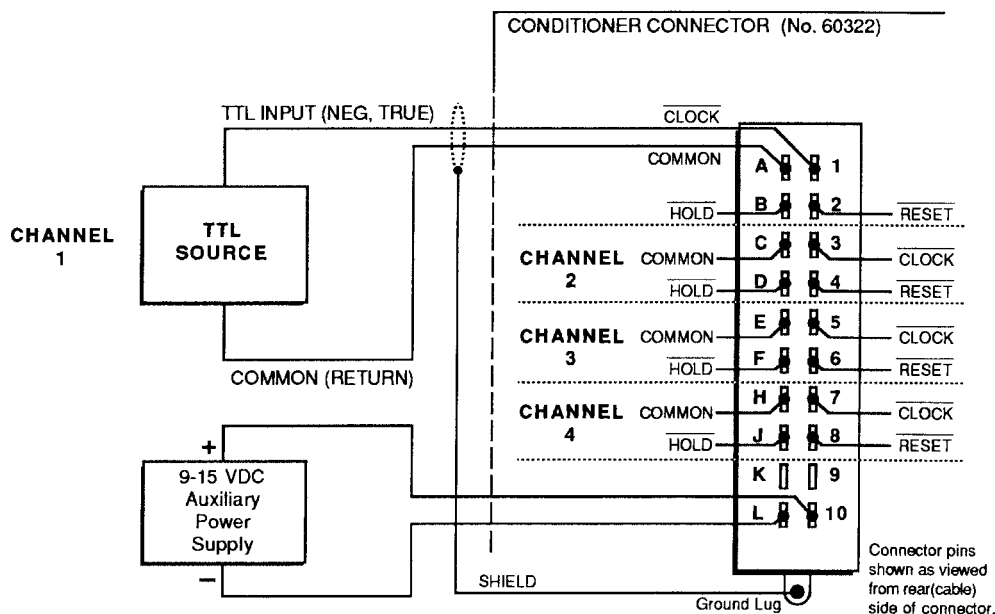
1. 10ACC-4 CONNECTIONS

The Model 10ACC-4's 20-pin I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322 (shown in Fig. 1.E.1). Pin functions are given in Table 3.A.1.8, below. Cabling is given in the following figure. Each of the 10ACC-4's independent channels may be connected to either a TTL driver or contact switch.

Concerning 10ACC-4 pin connections, you should note that

- All inputs are TTL-level (+ 5 V-DC maximum). Contact closures are *negative true to ground* (active low logic), so that a *Logic 0* at Pin 1, 3, 5, or 7 causes the "clocking" of one count for Channel 1, 2, 3, or 4, respectively.
- You may select a *debounce time* from 0.06 through 30 milliseconds for all four inputs (see Section d.2(b) for the procedure).
- Like the 10ACT01, the Model 10ACC-4 provides for the application and release of "COUNT HOLD" and "COUNT RESET" by appropriate negative-true *logic inputs* at the I/O CONNECTOR—as well as by the entry of MNEMONIC COMMANDS (see Section d.4, below). For full details on "External Logic Specifications and Interconnections," see Appendix F of this Guidebook.
- Unlike the 10ACT01, the Model 10ACC-4 has input provisions for a user-supplied *auxiliary external power supply* from 9 to 15 V-DC, which would allow you to keep each channel's count "alive" during system power shut-down (see Fig. 3.A.1.4, below).

Fig. 3.A.1.4 Model 10ACC-4 Cabling



NOTE: Upon system powerup, ALL 10ACC-4 CHANNELS COME UP IN THE "COUNT HOLD" MODE. In order for them to perform properly, you must issue a **COUNTER UPDATE (COU)** command to each channel by entering a command of **COU x [CR]** or by applying a *Logic 1* to the appropriate pin of the rear I/O CONNECTOR.

Table 3.A.1.8

Model 10ACC-4 Pin Assignments

I/O CONNECTOR Pin No.	10ACC-4 Channel No.	Line Function
1	1	CLOCK
A	1	COMMON
2	1	RESET
B	1	HOLD
3	2	CLOCK
C	2	COMMON
4	2	RESET
D	2	HOLD
5	3	CLOCK
E	3	COMMON
6	3	RESET
F	3	HOLD
7	4	CLOCK
H	4	COMMON
8	4	RESET
J	4	HOLD
9,K		N/C
10	+ 9-15 V-DC AUXILIARY EXTERNAL POWER INPUT	
L	- 9-15 V-DC AUXILIARY EXTERNAL POWER INPUT	

N/C = Not Committed.

2. 10ACC-4 CONFIGURATION

a. SETTING RANGE AND RESOLUTION: RNG COMMAND

NOTE: Prior to shipment, each 10ACC-4 channel will have been assigned a TYPE designation of "C2" (this is the code assigned to the 10ACT01's channel in "COUNTER" ("TOTALIZER") mode, as explained in Section b.2(a), above). THEREFORE, YOU NEED NOT APPLY THE **TYPE (TYP)** COMMAND WHEN CONFIGURING THE 10ACC-4. Also, you will normally NOT have to "locate" the 10ACC-4's DATA CHANNELS via the **LOCATE (LCT)** command, unless you are "reconfiguring" them or are installing the 10ACC-4 card yourself—in which case see Appendix C.

Note too that the **SENSITIVITY (SEN)** command (Section b.2(c), above) does *not* apply to the Model 10ACC-4.

Each of the 10ACC-4's channels may be independently set for an appropriate *full-scale count* (with corresponding *count increment*) by entering, for that channel, a **RANGE (RNG)** command of the form

$$\mathbf{RNG\ x = n\ [CR]\ *}$$

where "x" is the number of the channel being set, and "n" is "1," "2," or "3," as given in the following table:

3.A.1.d

MODEL 10ACC-4 SETUP AND OPERATION

Table 3.A.1.9.

10ACC-4 Ranges		
Full-Scale Count	Count Increment	"n" Value
32767	1	1
327670	10	2
3276700	100	3

Until the first application of the **RNG** command, a "default" range of 32767 will be in effect.

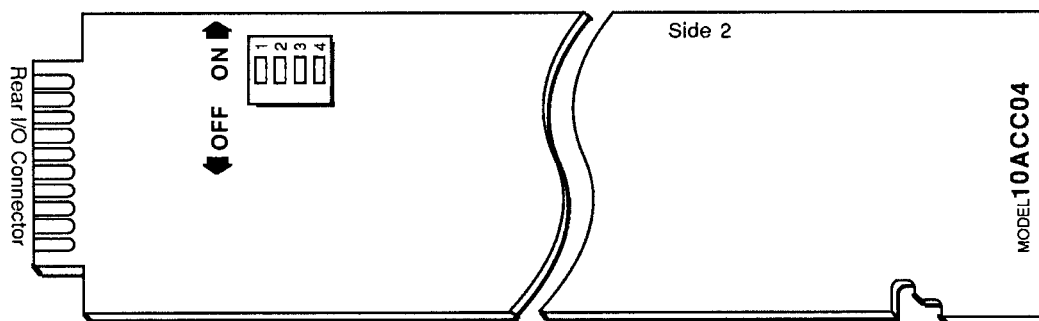
b. SETTING "DEBOUNCE" TIME

You can apply the same trigger delay (from 60 microseconds to 30 milliseconds) to all four of the 10ACC-4's input lines. This provides time for the bouncing of switch contacts to subside.

To set a "debounce" time for all four inputs:

1. Make sure the EEPROM Switch is OFF, and then turn OFF DataPAC power.
2. Remove the 10ACC-4 Card from its SLOT (see Appendix B for "Card Insertion and Removal").
3. Locate the DIP-switch block on the 10ACC-4 board. The switches are shown in Fig. 3.A.1.5, below.

Fig. 3.A.1.5. Model 10ACC-4 Debounce Switches



4. Referring to the following table, position the switches for the desired debounce time.

Table 3.A.1.10

Model 10ACC-4 Debounce Settings

Debounce Time (milliseconds)	Switch Settings
0.06	All Switches OFF ("OPEN")
1.5	Only Switch No. 1 ON ("CLOSED")
3.0	Only Switch No. 2 ON
4.5	Only Switch Nos. 1 and 2 ON
6.0	Only Switch No. 3 ON
7.5	Only Switch Nos. 1 and 3 ON
9.0	Only Switch Nos. 2 and 3 ON
10.5	Only Switch Nos. 1, 2, and 3 ON
15.0	Only Switch No. 4 ON
16.5	Only Switch Nos. 1 and 4 ON
18.0	Only Switch Nos. 2 and 4 ON
19.5	Only Switch Nos. 1, 2, and 4 ON
21.0	Only Switch Nos. 3 and 4 ON
22.5	Only Switch Nos. 1, 3, and 4 ON
28.5	Only Switch Nos. 2, 3, and 4 ON
30.0	All Switches ON

3. INCREMENTING THE COUNT: INC COMMAND

An **INCREMENT (INC)** command of the form

INC x [CR]

may be applied to any one of the 10ACC-4's channels (No. x) to increase its count reading by *one increment* (1, 10, or 100, depending on the full-scale count selected for that channel via the **RANGE (RNG)** command, above).

4. COUNTER CONTROL: COH, COU, COR, AND COC COMMANDS

These four commands are discussed in Section c.2, above, with reference to the Model 10ACT01 Counter/Timer Card in "COUNTER" or "TIMER" mode. Each command may also be used with the Model 10ACC-4, but is here applied individually to only one of the card's four counter channels.

NOTE THAT EACH COMMAND AFFECTS ONLY THE SCANNED DATA READING OF THE CHANNEL TO WHICH IT IS APPLIED (IN MOST CASES, THIS WILL BE A *DISPLAYED VALUE*). EACH 10ACC-4 CHANNEL WILL ALWAYS CONTINUE TO ACCUMULATE COUNTS, REGARDLESS OF THE "CONTROL" COMMAND PRESENTLY IN EFFECT FOR THAT CHANNEL, AND OF THE DISPLAYED READING THAT RESULTS FROM THE APPLICATION OF THAT COMMAND.

As with the Model 10ACT01, the effects of the four "COUNT CONTROL" commands can also be obtained by the application of appropriate *logic inputs* to the 10ACC-4's rear I/O CONNECTOR. Thus,

a. **TO HOLD THE COUNT VALUE** for a 10ACC-4's Channel No. x, you may apply a command of

COH x [CR]

Alternatively, a *Logic 0* at Pin B, D, F, or J of the 10ACC-4's rear I/O CONNECTOR will "hold" the existing scanned data reading for the corresponding channel, and may be "ORed" with a **COUNTER HOLD (COH)** command.

3.A.1.d

MODEL 10ACC-4 SETUP AND OPERATION

- b. TO UPDATE THE COUNT VALUE for a 10ACC-4's Channel No. x, you may apply a command of

COU x [CR]

Alternatively, a *Logic 1* at Pin B, D, F, or J of the 10ACC-4's rear I/O CONNECTOR will release an existing "hold" condition for the corresponding channel, instantly updating that channel's display and resuming its normal counting operation. Such an input may be "ORed" with a **COUNTER UPDATE (COU)** command.

- c. TO RESET THE COUNT for a 10ACC-4's "unheld" Channel No. x, you may apply a command of

COR x [CR]

Alternatively, a *Logic 0* at Pin 2, 4, 6, or 8 of the 10ACC-4's rear I/O CONNECTOR will set and hold at zero the scanned data reading for the corresponding channel, if no **COUNTER HOLD (COH)** is in effect for the channel, and if the channel's "HOLD" pin is at *Logic 1*. Such an input may be "ORed" with a **COUNTER RESET (COR)** command.

- d. TO CLEAR THE COUNT for a 10ACC-4's "unheld" Channel No. x, you may apply a command of

COC x [CR]

Alternatively, a *Logic 1* at Pin 2, 4, 6, or 8 of the 10ACC-4's rear I/O CONNECTOR will release an existing "reset" condition for the corresponding channel, causing it to resume normal updating (from zero), if no **COUNTER HOLD (COH)** is in effect for the channel, and if the channel's "HOLD" pin is at *Logic 1*. Such an input may be "ORed" with a **COUNTER CLEAR (COC)** command.

Section 3.A.2

Voltage and Current Outputs:

Model 10AAO-8 Voltage
Output Card and

Model 10CAI-8 Eight-
Channel Buffer Interface



System 10 Guidebook

3.A.2.a

INTRODUCTION

Analog voltage or current signals may be used for commanding servo loops, for driving external recorders, plotters, indicators, etc., and for many other important data acquisition and control functions.

Each optional **Model 10AAO-8 Voltage Output Card** can provide up to eight independent and individually controlled ± 5 -V ANALOG OUTPUTS. Each output is "sourced" by means of an **ANALOG OUTPUT (ANO)** command to represent either

1. a *fixed millivolt value* entered by the operator or computer, or
2. a *linear function* of the value of any system ANALOG INPUT CHANNEL (or "DATA CHANNEL").

ANALOG OUTPUT CHANNELS require "typing" and "locating," just like "REAL" DATA CHANNELS. "Located" by means of the **LOCATE (LCT)** command, an ANALOG OUTPUT is *automatically* "typed" as soon as its "source" is designated by an **ANALOG OUTPUT (ANO)** command. Like DATA CHANNELS, ANALOG OUTPUTS are updated once each scan cycle, when included in the current SCAN RANGE.

The optional **Model 10CAI-8 Eight-Channel Buffer Interface** can convert one or more of the Model 10AAO-8's eight voltage outputs to standard ISA *current signals*, either unipolar (4 to 20 mA) or bipolar ("zero-center," 4 to 12 to 20 mA). This externally mounted buffer unit can also amplify one or more of the 10AAO-8's ± 5 -V outputs to the ± 10 -V range.

Note that the MODEL 10A79-4 FOUR-CHANNEL ANALOG PEAK CAPTURE CARD can be used to provide up to four continuous, *unscaled* voltage outputs for "real-time" representation of analog signals produced by conditioner cards or other internal system elements, while the MODEL 10AAO-4 ANALOG BUFFER CARD can provide *scaled* buffering of such outputs. See Section 3.A.7 of this Guidebook.

1. MODEL 10AAO-8 CONNECTIONS

The Model 10AAO-8's 20-pin rear I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322 (shown in Fig. 1.E.1). Pin functions are given in Table 3.A.2.1, below.

As shown in Fig. 3.A.2.1, ALL ANALOG OUTPUTS ARE SINGLE-ENDED, AND RETURN TO "SYSTEM COMMON."

Fig. 3.A.2.1 Model 10AAO-8 Cabling

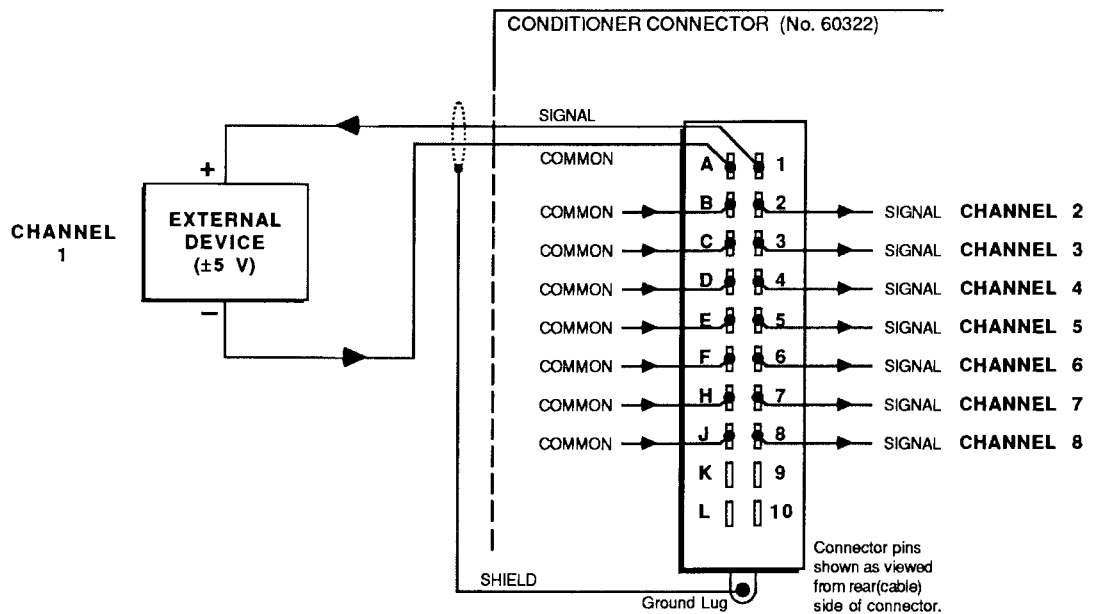


Table 3.A.2.1.

Model 10AAO-8 Pin Assignments

I/O CONNECTOR Pin No.	10AAO-8 Chan. No.	Line Function	I/O CONNECTOR Pin No.	10AAO-8 Chan. No.	Line Function
1	1	SIGNAL	5	5	SIGNAL
A	1	COMMON	E	5	COMMON
2	2	SIGNAL	6	6	SIGNAL
B	2	COMMON	F	6	COMMON
3	3	SIGNAL	7	7	SIGNAL
C	3	COMMON	H	7	COMMON
4	4	SIGNAL	8	8	SIGNAL
D	4	COMMON	J	8	COMMON

Pins 9 through L are not committed.

2. CONFIGURATION OF ANALOG OUTPUT CHANNELS

An ANALOG OUTPUT may be assigned any "legal" Channel Number (1 through 997). ANALOG OUTPUT CHANNELS and ANALOG INPUT (or "DATA") CHANNELS may be intermixed as desired in the Channel-Number sequence.

3.A.2.b

SETUP OF ± 5-VOLT OUTPUTS

Like all "REAL" DATA CHANNELS, all ANALOG OUTPUT CHANNELS must be initially "typed" and "located." For an introductory discussion of channel TYPES and LOCATIONS, see Section 1.G.2 of this Guidebook.

IF YOUR DATAPAC HAS BEEN SHIPPED WITH ONE OR MORE MODEL 10AAO-8 CARDS ALREADY INSTALLED, THE CORRESPONDING ANALOG OUTPUTS WILL HAVE BEEN CONFIGURED AT THE FACTORY, IN ACCORDANCE WITH SPECIFICATIONS GIVEN AT THE TIME OF ORDER. In this case, you need only refer to the customized "System 10 Data Sheet" in Appendix A of this Guidebook, for the TYPE and LOCATION designations presently in effect for these channels.

In the event, however, that you need to *reconfigure* an existing ANALOG OUTPUT CHANNEL, or to configure ANALOG OUTPUTS for a newly installed 10AAO-8, you should observe the following procedure:

a. SETTING CHANNEL TYPE: **ANO** COMMAND

Like certain kinds of PSEUDOCHANNELS, ANALOG OUTPUT CHANNELS are "autotyping." That is, the application of one of the two forms of the **ANALOG OUTPUT (ANO)** command will *automatically* inform the DataPAC's CENTRAL PROCESSOR of the appropriate TYPE designation for that channel:

1. The TYPE code for an ANALOG OUTPUT "sourced" by a command of **ANO x = m(CHN y) + b [CR]** * is "E0."
2. The TYPE code for an ANALOG OUTPUT "sourced" by a command of **ANO x = [CONSTANT] [CR]** * is "E1."

Besides "typing" the ANALOG OUTPUT CHANNEL in question, the **ANO** command serves to specify the "data source" for that output, and may be reapplied any number of times following initial configuration of the channel. This command is discussed in detail below. Here you need only note that when an ANALOG OUTPUT CHANNEL is being configured, the application of one of the two forms of the **ANO** command should always *precede* application of the **LOCATE (LCT)** command (below).

b. SETTING CHANNEL LOCATION: **LCT** COMMAND

Each ANALOG OUTPUT must be physically "located" with reference to an installed Model 10AAO-8 Card. The procedure is identical to that for the "locating" of system "REAL" CHANNELS. The general form of the **LOCATE (LCT)** command is

LCT x = s [CR] *

where "x" is the number of the ANALOG INPUT/OUTPUT CHANNEL being "located," and "s" is an appropriate LOCATION number: SLOT and SUBCHANNEL for "A-sized" DataPACs; DECK, SLOT, and SUBCHANNEL for "B-sized" DataPACs. See Section 1.G.2(d) and Appendix C for more details.

For example, if you wish system Channel No. 7 to be the ANALOG OUTPUT issued by Subchannel No. 4 of the Model 10AAO-8 occupying Slot No. 11 of a Model 10K6 DataPAC's A-CARD Deck No. 2, then the appropriate **LOCATE (LCT)** command would be

LCT 7 = 2114 [CR] *

NOTE: Application of one of the two forms of the **ANO** command to a given channel should always *precede* application of the **LOCATE (LCT)** command to that channel. ALSO, YOU SHOULD NEVER APPLY THE **TYPE (TYP)** COMMAND TO AN ANALOG OUTPUT CHANNEL.

3. SETTING ANALOG OUTPUT "SOURCE": **ANO** COMMAND

a. SETTING ANALOG OUTPUT EQUAL TO A FIXED MILLIVOLT VALUE

To establish a *fixed millivolt value* as the "data source" for ANALOG OUTPUT CHANNEL No. x, and to assign a TYPE code of "E1" to that channel, command

$$\mathbf{ANO\ x = e\ [CR]\ *}$$

where "e" is the desired output value in millivolts (allowable range is \pm 5000 mV).

For example, commanding

$$\mathbf{ANO\ 3 = 3500\ [CR]\ *}$$

will yield a constant output of 3.500 volts (\pm 1 mV) for ANALOG OUTPUT CHANNEL No. 3.

———— NOTE ————

The entered "e" value is automatically stored in EEPROM, and becomes, in effect, the *powerup default value* for the ANALOG OUTPUT CHANNEL in question. While you can at any time specify a *new* "source" value "e" simply by reapplying the **ANO** command, this is a SETUP operation, and requires that the EEPROM Write Protect Switch be ON.

For *temporary "RUN-TIME" modification of an existing fixed ANALOG OUTPUT value*, you can regard the ANALOG OUTPUT CHANNEL as a form of VOLATILE DOWNLOAD PSEUDOCHANNEL and use the "WRITE" form of the **CHANNEL (CHN)** command, as explained in Section 2.D.2.

Thus, returning to the above example, a "RUN-TIME" COMMAND of

$$\mathbf{CHN\ 3 = 2200\ [CR]}$$

will change the value of the voltage output of Channel No. 3 from 3.500 V (specified during "setup" by the **ANO** command) to 2.200 V. Note, however, that the original EEPROM-stored "source" value of 3500 mV will again become effective, by default, as soon as system power is cycled.

b. SETTING ANALOG OUTPUT AS A FUNCTION OF A SYSTEM DATA CHANNEL

To establish any system DATA CHANNEL No. y as the "data source" for ANALOG OUTPUT CHANNEL No. x, and to assign a TYPE code of "E0" to Channel No. x, command

$$\mathbf{ANO\ x = m(CHN\ y) + b\ [CR]}$$

where "m" and "b" are floating-point constants to convert the engineering units of Channel No. y to *millivolts*, for output by Channel No. x (allowable range is again \pm 5000 mV).

This form of the **ANO** command causes ANALOG OUTPUT CHANNEL No. x to continuously reflect the existing value of the "Source" Channel No. y.

3.A.2.b

SETUP OF \pm 5-VOLT OUTPUTS

C. INTERROGATING FOR "SOURCE" AND VALUE OF AN ANALOG OUTPUT

You may at any time request the "data source" for a given ANALOG OUTPUT CHANNEL No. x by commanding

ANO x [CR]

Depending on the nature of the **ANO** command used to initialize the channel, the DataPAC will answer with either a fixed millivolt value ("e") or a linear expression ("m(CHN y) + b").

Regardless, however, of the source from which its reading is derived, you can always request the *current millivolt value* of ANALOG OUTPUT CHANNEL No. x by simply commanding

CHN x [CR]

(For more information on the **CHANNEL (CHN)** interrogation, see Section 1.H.2.)

d. CANCELLING AN ANALOG OUTPUT: **RST** COMMAND

To cancel the current ANALOG OUTPUT assignment for Channel No. x, enter a **RESET (RST)** command of

RST x [CR] *

This will reset the "TYPE" code for Channel No. x to "D0" (VOLATILE DOWNLOAD PSEUDOCHANNEL). A subsequent interrogation of **ANO x [CR]** will receive an answer of N/A. Note that the "WRITE" form of the **TYPE (TYP)** command will have no effect on an ANALOG OUTPUT CHANNEL.

SETUP OF 4-20 mA AND ± 10 -VOLT OUTPUTS: MODEL 10CAI-8 BUFFER INTERFACE

3.A.2.c

1. 10CAI-8 CONNECTIONS

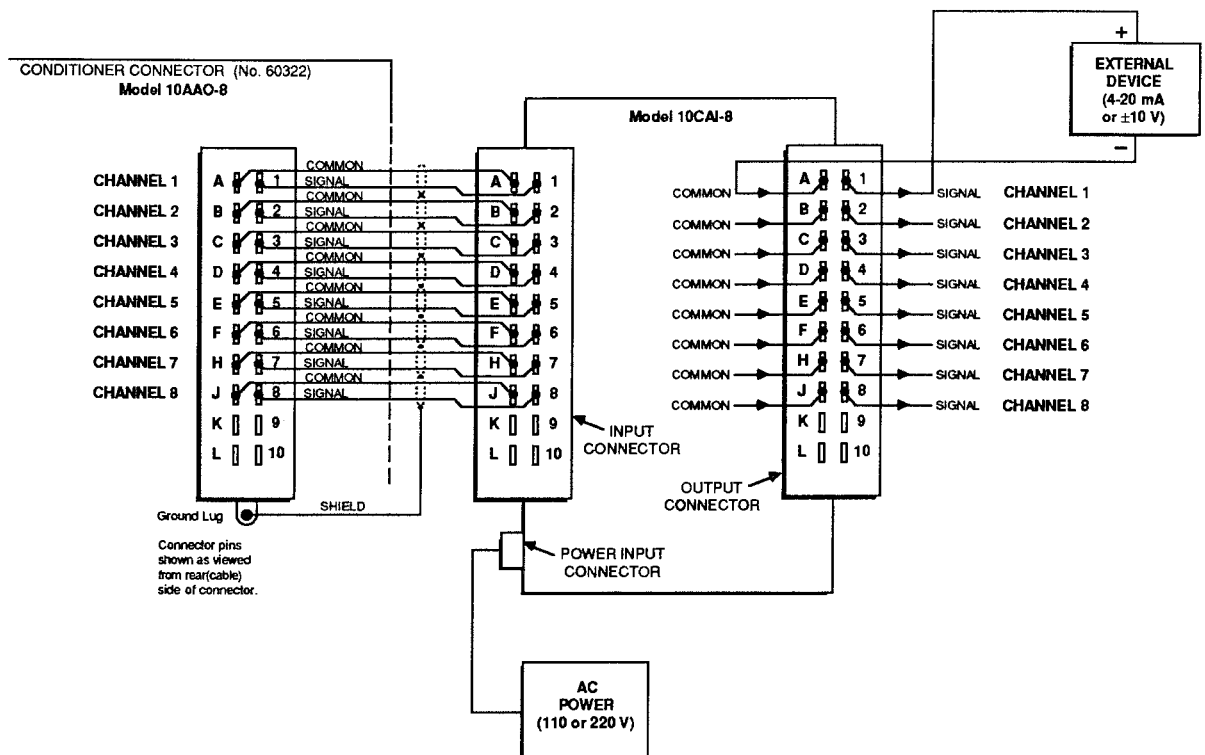
The eight channels of the Model 10CAI-8 operate individually on the eight ± 5 -volt outputs of the Model 10AAO-8 Voltage Output Card. Each 10CAI-8 channel is independently programmable for full-scale representation as

- 4 to 20 mA, corresponding to a 10AAO-8 output of 0 to +5 V-DC;
- 4 to 12 to 20 mA, corresponding to a 10AAO-8 output of -5 to +5 V-DC; or
- ± 10 V-DC, corresponding to a 10AAO-8 output of -5 to +5 V-DC.

Interconnections between the Model 10CAI-8 and the Model 10AAO-8 are shown in Fig. 3.A.2.2. Cabling between the 10AAO-8's rear I/O CONNECTOR and the 10CAI-8's "INPUT CONNECTOR" is pin-to-pin. At its "OUTPUT CONNECTOR," the 10CAI-8 provides eight *analog signals*—current or voltage—in a one-to-one correspondence to the eight outputs of the 10AAO-8. Pin assignments for the 10CAI-8's "OUTPUT CONNECTOR" are identical to those of the 10AAO-8's I/O CONNECTOR (see Table 3.A.2.2, above).

As shown in Fig. 3.A.2.2, ALL 10AAO-8 OUTPUTS ARE SINGLE-ENDED, AND RETURN TO "SYSTEM COMMON."

Fig. 3.A.2.2 10AAO-8/10CAI-8 Interconnections



Every 10CAI-8 box requires its own AC power supply. A six-foot power cord comes with every unit, with a switch-selectable transformer that may be plugged into any standard 110-VAC or 220-VAC source (60 Hz). The power cord jack fits into the hole beside the 10CAI-8's "INPUT CONNECTOR."

3.A.2.c

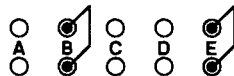
SETUP OF 4-20 mA AND \pm 10-VOLT OUTPUTS: MODEL 10CAI-8 BUFFER INTERFACE

2. PROGRAMMING OF 10CAI-8 OUTPUTS

- a. Disconnect the 10CAI-8's AC power supply.
- b. Remove the top plate of the 10CAI-8 box (4 screws in corners).
- c. Locate the double row of programming jumper pins for each of the 10CAI-8's eight channels. The Channel Number is printed to the immediate left of each pin block. Each pair of pins in each block is labelled by letter (A, B, C, D, or E).

Fig. 3.A.2.3 Jumper Configurations for 10CAI-8 Outputs
(EACH CHANNEL INDEPENDENTLY PROGRAMMABLE)

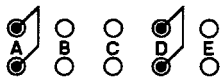
a) For 4-20 mA Output



b) For 4-12-20 mA Output



c) For \pm 10 V-DC Output



- d. To configure each channel for the desired form of output, you will connect appropriate pin pairs as shown in Fig. 3.A.2.3, by means of "mini-jumpers" or wires (four "mini-jumpers" are supplied with the 10CAI-8):

1. 4-20 mA OUTPUT

Connect pin pairs "B" and "E" for every 10CAI-8 channel you want to yield *unipolar current* output (4-20 mA).

2. 4-12-20 mA OUTPUT

Connect pin pairs "C" and "E" for every 10CAI-8 channel you want to yield *bipolar current* output (4-12-20 mA).

3. \pm 10-V OUTPUT

Connect pin pairs "A" and "D" for every 10CAI-8 channel you want to yield \pm 10-volt (DC) output.

Section 3.A.3

Logic and Digital I/O:

Model 10AIO-16

Universal Logic I/O Card



System 10 Guidebook

3.A.3.a

THE MODEL 10AIO-16 IS FOR USE WITH "A-SIZED" DATAPACS ONLY.

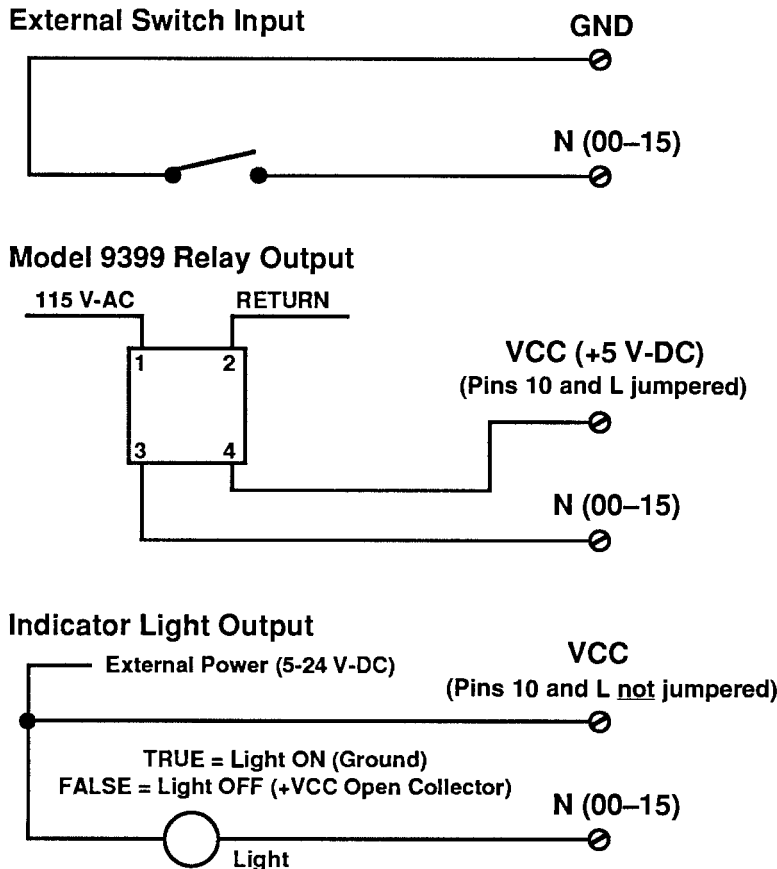
Since it is *functionally* identical to the larger-sized Model **10BIO-16** Universal Logic I/O Card, YOU SHOULD REFER TO SECTION 3.B.2 OF THIS GUIDEBOOK FOR USE OF THE MODEL 10AIO-16 WITH REGARD TO *DIGITAL I/O*.

The **Model 10AIO-16 Universal Logic I/O Card** provides sixteen optically isolated LOGIC I/O PORTS, each of which can be designated as either INPUT or OUTPUT. INPUT and OUTPUT ports may be intermixed as desired.

Logic INPUTS are accepted by the 10AIO-16 directly from dry contacts (switches, relays, etc.). INPUTS and OUTPUTS are compatible with TTL and other solid-state logic systems.

Note that all OUTPUT levels are *negative true* (i.e., GROUND when at *Logic 1* ("VCC"); +5 V-DC when at *Logic 0*).

Fig. 3.A.3.0 Typical 10AIO-16 Logic Connections



The Model 10AIO-16 uses the 20-pin rear I/O CONNECTOR shown in Fig. 1.E.1. Pin functions are given in Table 3.A.3.1, below. Typical logic connections are shown in Fig. 3.A.3.0.

----- IMPORTANT -----

IN ORDER FOR THE 10AIO-16 TO FUNCTION PROPERLY, **PIN 10** (LOGIC REFERENCE VOLTAGE TO COMMON ("VCC")) *MUST* BE TIED EITHER TO **PIN L** (INTERNAL ISOLATED +5-VOLT DC SUPPLY) OR TO THE EXTERNAL POWER SUPPLY PROVIDED BY THE USER (UP TO +24 V-DC).

ALSO, ALL *UNUSED LOGIC INPUTS* SHOULD BE "DESENSITIZED" BY TYING THEM ALL TO COMMON (PIN 9). Otherwise, the logic-activity indicator lights for these lines could blink during normal operation, from pickup of stray voltages.

Table 3.A.3.1

Model 10AIO-16 Pin Assignments

I/O CONNECTOR Pin No.	Line Function	I/O CONNECTOR Pin No.	Line Function
1	I/O No. 0	C	I/O No. 10
2	I/O No. 1	D	I/O No. 11
3	I/O No. 2	E	I/O No. 12
4	I/O No. 3	F	I/O No. 13
5	I/O No. 4	H	I/O No. 14
6	I/O No. 5	J	I/O No. 15
7	I/O No. 6	9	COM (ISO)
8	I/O No. 7	K	N/C
A	I/O No. 8	10	VCC (INPUT)
B	I/O No. 9	L	ISO +5 VDC

N/C = Not Committed

3.A.3.c

SETUP OF LOGIC I/O PORTS

1. 10AIO-16 INITIALIZATION: ASL COMMAND

Before you can specify which of the 10AIO-16's LOGIC I/O PORTS are to be INPUTS and which are to be OUTPUTS, you must first "initialize" the 10AIO-16 Card. You will use the **A SLOT (ASL)** command to establish a *one-to-one correspondence* between the 10AIO-16's sixteen LOGIC I/O PORTS and the sixteen members of a particular system BIT GROUP (for an explanation of BIT GROUPS and their "RANK" numbers, see Section 2.H.1).

The **A SLOT (ASL)** command assigns to the Model 10AIO-16 occupying a particular DataPAC "A SLOT" the sixteen bits of the BIT GROUP of a specified "RANK." Thus, to assign to the 10AIO-16 in A SLOT No. "s" the sixteen bits of the BIT GROUP of RANK No. "k," command

$$\mathbf{ASL\ s = k\ [CR]\ *}$$

The **ASL** command is recognized only by "A-sized" DataPACs.

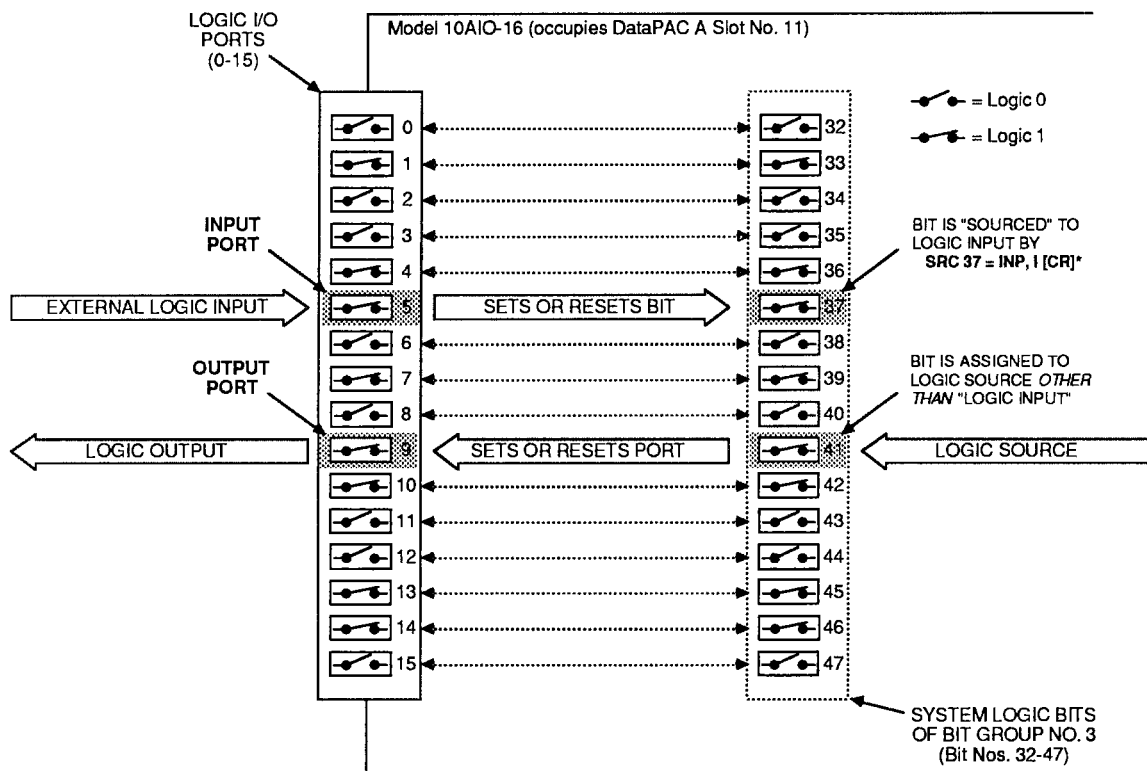
For example, to assign BIT GROUP No. 3 (i.e., Bit Nos. 32 through 47) to the LOGIC I/O PORTS of the 10AIO-16 occupying A SLOT No. 11, you would command

$$\mathbf{ASL\ 11 = 3\ [CR]\ *}$$

Bit No. 32 will now correspond to the 10AIO-16's LOGIC I/O PORT No. 0, Bit No. 33 to Port No. 1, Bit No. 34 to Port No. 2, etc. The situation is illustrated in Fig. 3.A.3.1. Note that in this figure the 10AIO-16's LOGIC I/O PORTS are numbered 0 through 15. These are not necessarily the numbers which appear on the 10AIO-16's LED indicator film. The card's front-edge indicator numbers will in most cases correspond to the 16 internal LOGIC BITS assigned to the card (see Section d, below).

Note also that if two or more Model 10AIO-16 Cards are present, they need *not* be assigned to contiguous BIT GROUPS. That is, one card might have a RANK of "1" (Bit Nos. 0-15), while a second might be ranked "4" (Bit Nos. 48-63), and a third be ranked "10" (Bit Nos. 144-159).

Fig. 3.A.3.1 Correspondence of Logic I/O Ports and System Logic Bits



To *cancel* the current BIT-GROUP assignment for the 10AIO-16 occupying A SLOT No. *s*, command

ASL *s* = N/A [CR] *

2. SPECIFYING LOGIC INPUTS: SRC COMMAND

When a given LOGIC I/O PORT is designated to be a logic *input*, its existing logic state will at all times directly control the state of the internal system LOGIC BIT that corresponds to that port—so long as no other (overriding) LOGIC SOURCE is currently in effect for that bit. See, for example, Port No. 5 in Fig. 3.A.3.1. The assignment of LOGIC SOURCES is explained in detail in Section 2.H.

To designate as a logic *input* the LOGIC I/O PORT corresponding to Bit No. *r*, thereby placing Bit No. *r* under direct control of any external logic signal *received* at that port, command

SRC *r* = INP, *I* [CR] *

where "*I*" is a three-letter mnemonic indicating the desired "LATCH MODE" for Bit No. *r*: either **LAT** (for *latching*) or **NON** (for *nonlatching*).

To designate as logic inputs the LOGIC I/O PORTS corresponding to Bit Nos. *r* through *q*, command

SRC *r* TO *q* = INP, *I* [CR] *

Returning to the example illustrated in Fig. 3.A.3.1, if a command of

SRC 37 = INP, NON [CR] *

has been entered, then the state of Bit No. 37 will be continuously determined by the external *logic input* received at LOGIC I/O PORT No. 5. If, however, the command is

SRC 37 = INP, LAT [CR] *

then, following the receipt of a *Logic 1* at Port No. 5, Bit No. 37 will remain "latched" at *Logic 1* until "unlatched" by a **RELEASE (RLS)** command (see Section 2.H.4)—regardless of the subsequent activity of Port No. 5.

3. SPECIFYING LOGIC OUTPUTS

When a given LOGIC I/O PORT is designated to be a logic *output*, its logic state (and consequently the logic level it transmits to an external device) is at all times directly controlled by the existing state of the system LOGIC BIT that corresponds to that port. See, for example, Port No. 9 in Fig. 3.A.3.1.

THERE IS NO SPECIFIC COMMAND FOR DESIGNATING A LOGIC OUTPUT. ANY LOGIC I/O PORT TO WHOSE CORRESPONDING SYSTEM LOGIC BIT A COMMAND OF

SRC *r* = INP, *I* [CR] *

HAS *NOT* BEEN APPLIED WILL BE AUTOMATICALLY DESIGNATED AS AN *OUTPUT* PORT.

Returning again to the example shown in Fig. 3.A.3.1, we see that if Bit No. 41 has been assigned any LOGIC SOURCE *other than "LOGIC INPUT,"* then its corresponding LOGIC I/O PORT (No. 9) will produce a logic *output* that continuously reflects the state of Bit No. 41, regardless of the actual LOGIC SOURCE presently in control of that bit.

3.A.3.c

SETUP OF LOGIC I/O PORTS

—— IMPORTANT ——

REMEMBER THAT ALL LOGIC OUTPUTS ARE *NEGATIVE TRUE* (*Logic 1* = GROUND; *Logic 0* = +5 V-DC). Always check connections to the logic device receiving each output, to make sure that the correct polarity is observed.

On the front edge of the Model 10AIO-16 is an LED logic-state indicator for each of the card's sixteen LOGIC I/O PORTS. This indicator will light to indicate a *Logic 1* level at the respective port.

NOTE: Before a Model 10AIO-16 is shipped, a film strip is usually mounted on the indicator array, in order to number the indicators in terms of the sixteen bits of the specific system BIT GROUP associated with that card. Thus, if the 10AIO-16 LOGIC I/O PORTS are to correspond to the BIT GROUP of "RANK" No. 1, its indicators will be numbered 0 through 15; if the ports are to correspond to the BIT GROUP No. 2, the indicators will be numbered 16 through 31; etc.

3.A.3.e

See Section 3.B.2(e) of this Guidebook. Digital I/O functions of the Model 10AIO-16 are equivalent to those of the Model 10BIO-16.

Section 3.A.4

Analog Peak Capture:

Model 10A79-4 Four-
Channel Analog Peak
Capture Card



System 10 Guidebook

This section explains the use of the Model 10A79-4 for *real-time capture of positive or negative analog-signal peaks*.

Sections 3.A.5, 3.A.6, and 3.A.7 treat other useful functions of the 10A79-4: "MAX minus MIN," "Track and Hold," and "Buffering of Analog Signals," respectively.

Fig. 3.A.4.1 Significant Per-Channel I/O for the Model 10A79-4

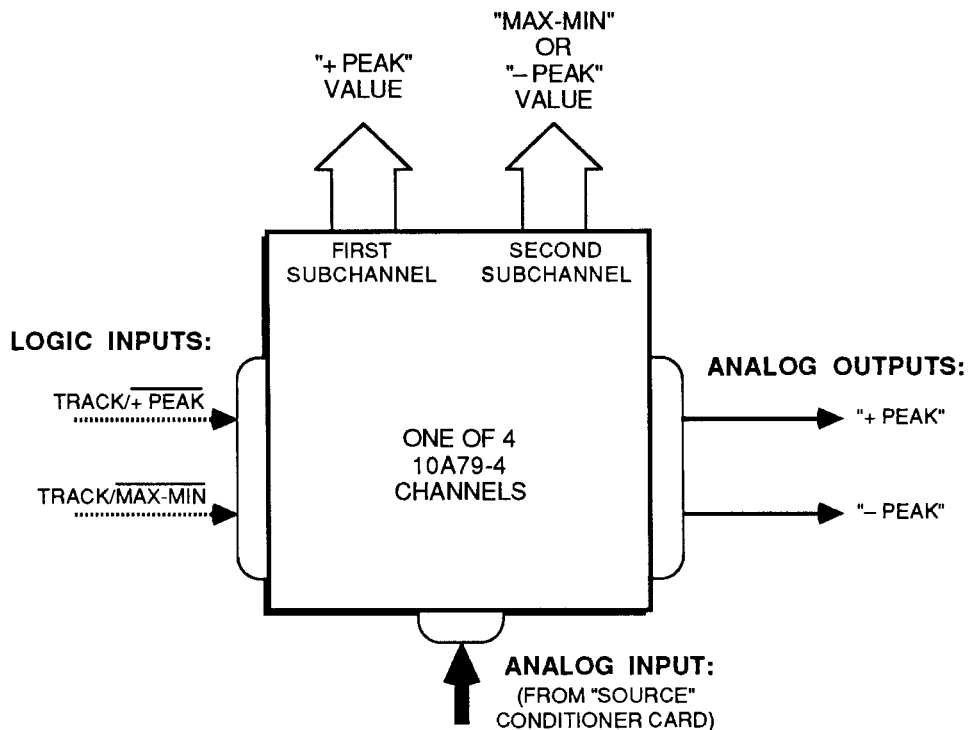


Fig. 3.A.4.1 shows significant Model 10A79-4 inputs and outputs that relate to peak-capture operation, for any *one* of the 10A79-4's four INPUT CHANNELS (specific pin assignments and SUBCHANNEL numbers are given in the following section). Specifically, *each* of the 10A79-4'S four channels has--independently of all other channels--

1. ONE ANALOG INPUT

This input signal is received by the 10A79-4 from a user-specified "source" Conditioner Card within the system, via a direct hard-wire connection on the DataPAC's "Analog Motherboard." It represents one of the Conditioner's eight possible DATA CHANNELS. A single Conditioner Card, however, can provide no more than four analog inputs to a given Model 10A79-4.

The analog signal received by each of the 10A79-4's four input channels may originate from any of the standard System 10 Analog Conditioner Cards discussed in Section 1.E.2--EXCEPT FOR *THERMOCOUPLE* and *THERMISTOR CONDITIONERS* (Models 10A9-8, 10A10-4, 10A15-8, etc.) AND CONDITIONERS WHICH DO NOT HAVE "AUXILIARY OUTPUT" TO WIRE-WRAP PINS (Models 10A35, 10A62-8, 10A64-8, 10A65-8, etc.). NONE OF THESE CARDS MAY BE USED WITH THE MODEL 10A79-4.

3.A.4.a

INTRODUCTION: 10A79-4 INPUTS AND OUTPUTS FOR ANALOG PEAK CAPTURE

2. TWO LOGIC COMMAND INPUTS

These logic signals are received at the 10A79-4's rear I/O CONNECTOR from a Model 10AIO-16 or 10BIO-16 Universal Logic I/O Card, or from an external logic source. Their function is to control the peak-capture process, as explained in Section 3.A.4(c), and as summarized in Table 3.A.4.1, below.

The "**TRACK / + PEAK**" signal controls the nature both of the "+ PEAK" analog output and of the *first* SUBCHANNEL ("+" PEAK" VALUE). It has no direct effect on the "- PEAK" analog output or the *second* SUBCHANNEL ("MAX-MIN" or "- PEAK" VALUE), unless the input channel is being used for "MAX-MIN" measurement (see Section 3.A.5).

The "**TRACK / MAX-MIN**" signal controls the nature both of the "- PEAK" analog output and of the *second* SUBCHANNEL ("MAX-MIN" or "- PEAK" VALUE). It has no direct effect on the "+ PEAK" analog output or the *first* SUBCHANNEL ("+" PEAK" VALUE).

3. TWO ANALOG OUTPUTS

These analog signals are issued from the 10A79-4's rear I/O CONNECTOR. They can be sent in turn to a strip-chart recorder or similar device, or can serve as fast "real-time" inputs to a P.I.D. servo controller.

Each output is directed by the corresponding LOGIC COMMAND INPUT either to "track" (i.e., be continuously equal to) the analog input, or to report the highest or lowest input value to have occurred since the "tracking" condition was released. See the above table.

The "+ PEAK" and "- PEAK" analog outputs are not affected by whether the corresponding input channel is set to the "MAX-MIN" or the "- PEAK" mode.

Note that the 10A79-4 has no direct "MAX minus MIN" analog output. You may, however, obtain a "differential" output based on the "+ PEAK" and "- PEAK" analog outputs, using a standard differential amplifier circuit or a special cable with the **Model 10CAI-8 Eight-Channel Buffer Interface** (see Section 3.A.2(c) and contact the factory for details).

——— ALSO NOTE ———

The 10A79-4's analog outputs are *unscaled*; they are not affected by calibration of the respective "source" Conditioner Cards. Furthermore, the actual full-scale amplitude of any given output will be a function of the "TYPE" designation of the respective analog input. Typical values are shown in Table 3.A.4.2.

Table 3.A.4.1.

**Summary of 10A79-4 Per-Channel Logic Command Inputs
(Peak Capture Operation)**

Logic Input:	Logic Level:	Effects:
TRACK / + PEAK	Logic 1	<ol style="list-style-type: none"> 1. "+ PEAK" analog output "tracks" the analog input. 2. Data value reported by the <i>first</i> SUBCHANNEL "tracks" the analog input.
	Logic 0	<ol style="list-style-type: none"> 1. "+ PEAK" analog output represents the <i>most positive</i> (or <i>least negative</i>) value experienced by the analog input since the <i>Logic 0</i> condition began. 2. Data value reported by the <i>first</i> SUBCHANNEL represents the "+ PEAK" value—i.e., the <i>most positive</i> (or <i>least negative</i>) value experienced by the analog input since the <i>Logic 0</i> condition began.
TRACK / MAX-MIN	Logic 1	<p>(REGARDLESS OF CHANNEL MODE SETTING)</p> <ol style="list-style-type: none"> 1. "- PEAK" analog output "tracks" the analog input. 2. Data value reported by the <i>second</i> SUBCHANNEL "tracks" the analog input.
	Logic 0	<p>(INPUT CHANNEL SET FOR "MAX-MIN" MODE)</p> <ol style="list-style-type: none"> 1. "- PEAK" analog output represents the <i>least positive</i> (or <i>most negative</i>) value experienced by the analog input since the <i>Logic 0</i> condition began. 2. Data value reported by the <i>second</i> SUBCHANNEL represents the "MAX-MIN" value—i.e., the present real-time <i>difference</i> between the most positive and the most negative values detected for the analog input since the <i>Logic 0</i> condition began, provided that the "TRACK / + PEAK" input is also at <i>Logic 0</i> (see Section 3.A.5 for "MAX minus MIN" operation of the 10A79-4). <p>(INPUT CHANNEL SET FOR "-PEAK" MODE)</p> <ol style="list-style-type: none"> 1. "-PEAK" analog output represents the <i>least positive</i> (or <i>most negative</i>) value experienced by the analog input since the <i>Logic 0</i> condition began. 2. Data value reported by the <i>second</i> SUBCHANNEL represents the "-PEAK" value—i.e., the <i>least positive</i> (or <i>most negative</i>) value experienced by the analog input since the <i>Logic 0</i> condition began.

3.A.4.a

INTRODUCTION: 10A79-4 INPUTS AND OUTPUTS FOR ANALOG PEAK CAPTURE

Table 3.A.4.2.

Model 10A79-4 Analog Outputs as a Function of Input-Channel "Type"

"Source" Conditioner	Input-Channel Type Designation	Analog Output (Volts, Full Scale)
10A9-8, 10A10-4	10 - 1E; 20 - 2E	NOT APPLICABLE
10A30-2	30	m / 1000 V*
10A40	40 - 47	± 5.0 V
10A43	40, 41, 42	± 5.0 V
10A45	55	± 5.0 V
10A48	40 - 43	± 5.0 V
10A60-4	5A, 5D 5B, 5E 5C, 5F	± 1.25 V ± 2.5 V ± 5.0 V
10A61-2	6C, 6D	± 5.0 V
10A62-8	6C, 6D	NOT APPLICABLE
10A63-2	61, 64, 67, 6A 60, 63, 66, 69 62, 65, 68, 6B	± 1.25 V ± 2.5 V ± 5.0 V
10A64-8	67, 66, 68	NOT APPLICABLE
10A65-8	61, 60, 62	NOT APPLICABLE
10A70-2, 10A72-2, 10A73-4, 10A78	70 71 72	± 1.25 V ± 2.5 V ± 5.0 V
10A16-4A, 10A17-2	A1 - AE	NOT APPLICABLE

* For an LVDT Conditioner channel, there is no stated full-scale range. The magnitude of the corresponding 10A79-4 analog output will therefore depend on the SCALING FACTOR ("m" constant) presently in effect for that channel. It can be determined by *ignoring any decimal point in the existing "m" value, and dividing this value by 1000.*

4. TWO SYSTEM SUBCHANNELS

These are standard system DATA CHANNELS, "callable" by the system, and requiring individual CONFIGURATION and CALIBRATION, as explained in Sections b.3 and b.4, below.

Like the two analog outputs, each of the two SUBCHANNELS is controlled by the corresponding LOGIC COMMAND INPUT, as indicated in Table 3.A.4.1, above.

Note that the value reported by the *second* SUBCHANNEL derived from each 10A79-4 input channel will depend not only on the logic state of the "TRACK / MAX-MIN" input, but also on the "mode" setting of the input channel. Thus, when the "TRACK / MAX-MIN" input is at *Logic 0*, this SUBCHANNEL will report *either*

- the present "MAX minus MIN" (if the respective input channel is set to the "MAX-MIN" mode) *or*
- the present "- PEAK" value (if the input channel is set to the "- PEAK" mode).

Standard signal-processing functions may be applied to any of the 10A79-4's SUBCHANNELS, including cross-channel calculations (Section 2.J), dual limit monitoring (Section 2.F), etc. In particular, you can use the "MAX" or "MIN" form of the **CALCULATE (CLC)** command to arrange for positive or negative peaks reported by a 10A79-4 SUBCHANNEL to be *digitally held*. The application of this command (explained in Section c.4, below) is necessary if a captured peak is to be observed for any length of time, because of inevitable leakage of the 10A79-4's analog memory.

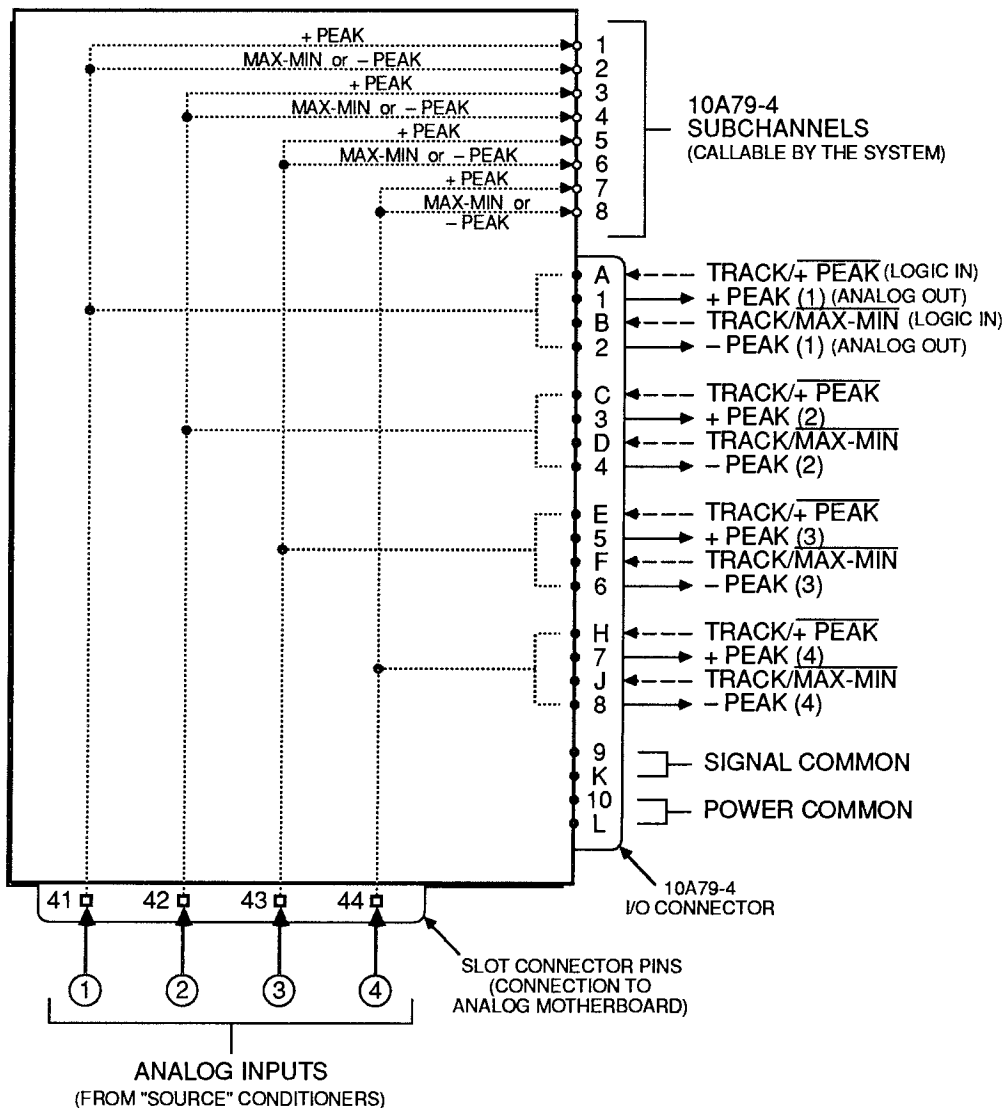
3.A.4.b

PEAK-CAPTURE SETUP

1. 10A79-4 CONNECTIONS

Full pin assignments for the Model 10A79-4 are given in Fig. 3.A.4.2, below. This figure also shows the numbering of the 10A79-4's eight SUBCHANNELS (remember that *two* separate SUBCHANNELS are derived from each of the 10A79-4's four input channels).

Fig. 3.A.4.2 Model 10A79-4 Pin Assignments



a. CONNECTION OF ANALOG INPUTS

To establish a given Conditioner DATA CHANNEL as one of the 10A79-4's four analog inputs, a wire must be installed between corresponding *wire-wrap pins* on the DataPAC's internal Analog Motherboard.

— PLEASE NOTE —

CONDITIONER/10A79-4 HARDWIRE INTERCONNECTIONS ARE NORMALLY MADE AT THE FACTORY, PRIOR TO SHIPMENT, IN ACCORDANCE WITH SPECIFICATIONS GIVEN AT THE TIME OF ORDER.

SINCE THE ANALOG MOTHERBOARD IS NOT EASILY ACCESSIBLE TO THE DATAPAC OPERATOR WITHOUT THE POTENTIAL DANGER OF HARMING SYSTEM ELEMENTS AND/OR CONFIGURATION, AND SINCE THE PROCEDURE INVOLVES ADVANCED KNOWLEDGE OF CONDITIONER CIRCUITRY, YOU ARE URGED NOT TO ATTEMPT TO MAKE SUCH INTERCONNECTIONS BY YOURSELF.

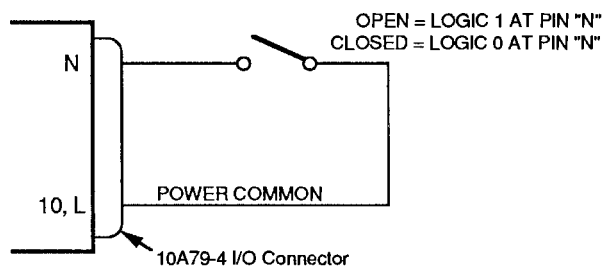
IF YOUR SYSTEM REQUIRES A MODIFICATION OF SUCH INTERCONNECTIONS—SAY, TO ACCOMMODATE THE PHYSICAL RELOCATION OF A 10A79-4 CARD, OR TO REASSIGN ITS ANALOG INPUTS—PLEASE CONTACT THE DAYTRONIC SALES STAFF OR YOUR NEAREST SALES REPRESENTATIVE OFFICE FOR DETAILED INSTRUCTIONS.

b. CONNECTION OF LOGIC INPUTS

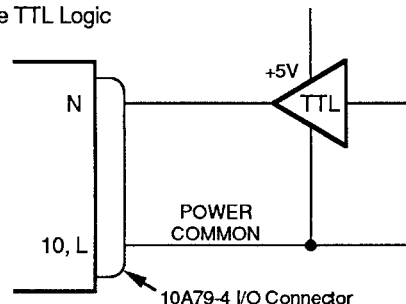
As shown in Fig. 3.A.4.2, the 10A79-4's logic command inputs are received at Pins A, B, C, D, E, F, H, and J of its 20-pin rear I/O CONNECTOR. A logic-signal input to one of these pins may be supplied by a *logic output* from a **Model 10AIO-16 or 10BIO-16 Universal Logic I/O Card**. Or it may be applied by means of an external switch or active TTL source, using the connections shown in Fig. 3.A.4.3, below.

Fig. 3.A.4.3 Logic Input to Model 10A79-4 Pin "N"

a) Switch Closure, No External Supply



b) Active TTL Logic



3.A.4.b

PEAK-CAPTURE SETUP

C. CONNECTION OF ANALOG OUTPUTS

As shown in Fig. 3.A.4.2, the 10A79-4's analog outputs are issued at Pins 1 through 8 of its 20-pin rear I/O CONNECTOR.

ALL ANALOG OUTPUTS ARE SINGLE-ENDED AND SHOULD RETURN TO "SIGNAL COMMON" (PIN 9 OR K).

2. SETTING CHANNEL MODE

Unless otherwise specified at the time of order, all four of your Model 10A79-4's input channels will have been set at the factory, prior to shipment, to the "MAX-MIN" mode. This means that, as indicated in Table 3.A.4.1, the *second* SUBCHANNEL for each of the four input channels will report the existing "MAX minus MIN" difference for the corresponding analog input, when both logic inputs for that channel are at *Logic 0*.

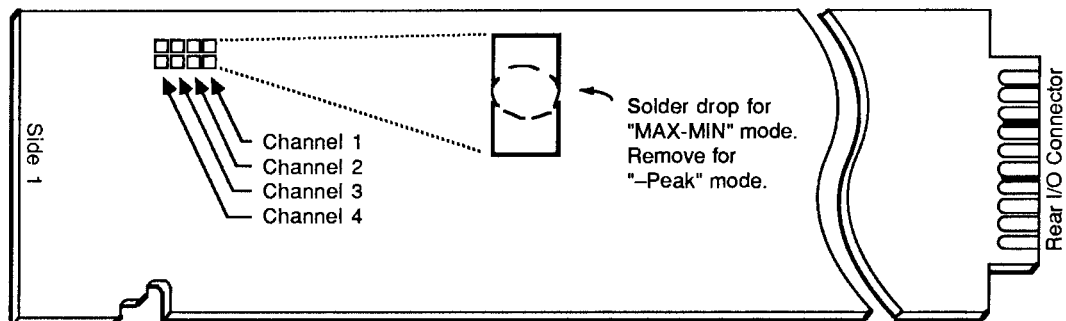
To arrange for the second SUBCHANNEL of a given input channel to report "- PEAK" data, you must reset that channel to the "- PEAK" mode, as explained below.

Remember that regardless of its "mode" setting, each input channel's *first* SUBCHANNEL will report only "+ PEAK" data, when the corresponding "TRACK / + PEAK" logic input is at a *Logic 0* level. Remember also that the channel's "mode" setting will not affect its "+ PEAK" and "- PEAK" *analog outputs*.

- a. Make sure the EEPROM Switch is OFF, and then turn off the DataPAC and remove the 10A79-4 card from its mainframe SLOT (for instructions on "Card Insertion and Removal," see Appendix B).
- b. Refer to Fig. 3.A.4.4, below, and locate the four pairs of CHANNEL MODE JUMPER PADS, one for each of the 10A79-4's four input channels, on the *bottom* (non-component) side of the board. Fig. 3.A.4.4 shows how the jumper pads are numbered to correspond to the four input channels.

If all of your 10A79-4's input channels were initially set to "MAX-MIN" mode—as is normally the case—a solder drop ("blob") will have been placed between each of the four terminal pairs.

Fig. 3.A.4.4 Model 10A79-4 Channel Mode Jumper Pads



- c. To set any one input channel to "- PEAK" mode, you must "unblob" the respective terminal pair by removing its present solder-drop interconnection. Use a fine-point solder gun to heat the solder-drop in question, until it has melted sufficiently for you to wipe it off with a clean rag. Make sure that you remove all traces of solder from the jumper pads you wish to "unblob."
- d. Reinsert the 10A79-4 card in the DataPAC and reactivate power.

3. CONFIGURING 10A79-4 SUBCHANNELS

AS WITH ALL OF YOUR SYSTEM'S INITIAL DATA CHANNELS, ALL 10A79-4 SUBCHANNELS WILL HAVE BEEN FULLY CONFIGURED AT THE FACTORY, IN ACCORDANCE WITH SPECIFICATIONS GIVEN AT THE TIME OF ORDER.

You may at some time, however, wish to *reconfigure* one or more of these SUBCHANNELS—as a result, say, of a change in source-channel "TYPE." In this case you should first study the "Data-Channel Reconfiguration" procedure given in Appendix C. With regard to the 10A79-4, note that

- a. THE "TYPE" CODE OF EACH 10A79-4 SUBCHANNEL MUST BE EITHER "E8" (see the following section) OR THE SAME "TYPE" CODE AS THAT WHICH HAS BEEN ASSIGNED TO THE "SOURCE" CONDITIONER CHANNEL SUPPLYING THE ANALOG INPUT SIGNAL FROM WHICH THE 10A79-4 SUBCHANNEL IS DERIVED.
- b. The "LOCATION" of each 10A79-4 SUBCHANNEL will be assigned in the same way as that of any other A-CARD DATA CHANNEL, but with reference to the physical A-SLOT location of the 10A79-4 Card (see also Section 1.G.2).

4. CALIBRATING 10A79-4 SUBCHANNELS: TYP AND CCH COMMANDS

The easiest way to calibrate a given 10A79-4 SUBCHANNEL No. x is to arrange for the calibration constants of the "source" conditioner channel (No. y) to be automatically loaded into Channel No. x. To do this, you can set up a special type of "CONVERSION" CHANNEL ("E8"), as follows:

- a. Make sure Channel No. x is properly "located" (see Appendix C).
- b. Set Channel No. x to be a CALIBRATION "CONVERSION" CHANNEL by commanding

TYP x = E8 [CR] *

- c. Assign to Channel No. x the "source" DATA CHANNEL No. y by entering a **CONVERSION CHANNEL (CCH)** command of

CCH x = y [CR] *

Channel No. x will now be loaded with the existing "m" and "b" values for Channel No. y. If the "source" channel (No. y) is later recalibrated, the "m" and "b" values in effect for the corresponding 10A79-4 SUBCHANNEL (No. x) will be changed accordingly.

An alternative calibration procedure for a 10A79-4 SUBCHANNEL is as follows:

- d. Make sure that the corresponding "TRACK / + PEAK" or "TRACK / MAX-MIN" input is at a *Logic 1* level.
- e. Apply to the SUBCHANNEL the *same calibration method that has been used to calibrate its "source" conditioner channel*. Thus, if calibration values have been entered for the "source" channel via commands such as **ZRO, FRC, MVV, FRQ**, etc., these same values should now be entered for the 10A79-4 SUBCHANNEL in question, via the same commands. For calibration of conditioner channels, see Section 1.G of this Guidebook.

Once properly "TYPED," "LOCATED," and CALIBRATED, a 10A79-4 SUBCHANNEL can be interrogated via the **CHANNEL (CHN)** command, examined for high and low LIMIT violations, incorporated in cross-channel calculations, and otherwise processed just like any other system "REAL" CHANNEL.

3.A.4.c

PEAK-CAPTURE OPERATION

1. "TRACKING" THE ANALOG INPUT

When a given 10A79-4 input channel's "TRACK / $\overline{+PEAK}$ " logic input is at *Logic 1*, then both the "+ PEAK" analog output for that channel and the *first* SUBCHANNEL for that channel will "track" the channel's analog input. That is, they will report a data value continuously equal to that of the analog input.

Similarly, when a given input channel's "TRACK / $\overline{MAX-MIN}$ " logic input is at *Logic 1*, then both the "- PEAK" analog output for that channel and the *second* SUBCHANNEL for that channel will "track" the channel's analog input.

2. "+ PEAK" CAPTURE

"+ PEAK" operation for any given 10A79-4 input channel is in effect when and only when the "TRACK / $\overline{+PEAK}$ " logic input for that channel is at *Logic 0*—regardless of whether the channel is set for "MAX-MIN" or "- PEAK" mode (see Section b.2, above). In effect, this logic command tells the channel to stop tracking its analog input and to begin reporting at all times the highest input value yet perceived since tracking was last halted.

Thus, when an input channel's "TRACK / $\overline{+PEAK}$ " logic input is at *Logic 0*, both the "+ PEAK" analog output for that channel and the *first* SUBCHANNEL for that channel will report the *most positive* (or *least negative*) excursion to have been experienced by the channel's analog input signal since the application of this *Logic 0* input.

Reapplication of *Logic 1* to a "TRACK / $\overline{+PEAK}$ " input amounts to a *resetting* of the corresponding "+ PEAK" analog output and SUBCHANNEL, since it returns them immediately to the "tracking" of the analog input, as shown in Fig. 3.A.4.6, below.

Multiple outputs and SUBCHANNELS may be *simultaneously reset* by tying the respective command inputs to a single logic line (see Appendix F). Also, where the system includes a Model 10AIO-16 or 10BIO-16 Universal Logic I/O Card, this common logic line can be *automatically* controlled by a selected LOGIC BIT (see Section 2.H, "System Logic Bits," and Section 2.K, "Automatic Command Execution").

Fig. 3.A.4.5 shows how the 10A79-4 may be used to capture *successively higher-valued signal maxima*, following the application of *Logic 0* to a "TRACK / $\overline{+PEAK}$ " input at time t_1 . Until time t_1 , the corresponding "+ PEAK" output and SUBCHANNEL have been continuously "tracking" the analog input, as shown. After time t_1 , they continuously report the *highest* input-signal value perceived since time t_1 . From time t_1 to time t_2 , the input is continuously rising, and so the "+ PEAK" output and SUBCHANNEL appear to be continuing to track it. At time t_2 , however, the input reaches its first maximum since time t_1 . The 10A79-4 "captures" this "positive" peak (P_1), holding it as a constant until time t_3 , when a yet *higher* input value is detected, and the "+ PEAK" output and SUBCHANNEL begin once more to track the input upwards to a yet higher peak (P_2).

Fig. 3.A.4.6 shows the "+ PEAK" capture of *successively lower-valued signal maxima*. In this case, it is necessary to *reset* the "+ PEAK" output and SUBCHANNEL—that is, to get them "back on track," so to speak—somewhere along the rise of the signal toward the second, lower peak (P_2). This is done by changing the logic level of the respective "TRACK / $\overline{+PEAK}$ " input to *Logic 1* at time t_2 , and then immediately reapplying the *Logic 0* level to this input.

As explained in Section c.4, you can hold a captured maximum *without decay* by applying the "MAX" form of the **CALCULATE (CLC)** command to the respective "+ PEAK" SUBCHANNEL.

PEAK-CAPTURE OPERATION

3.A.4.c

Fig. 3.A.4.5 + PEAK Capture (Successively Higher Peaks)

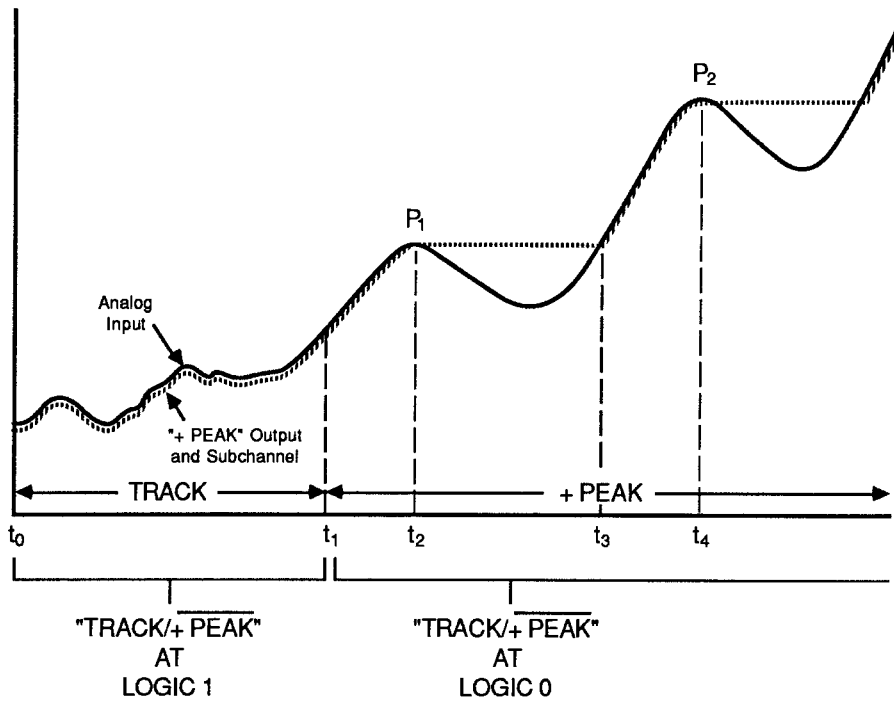
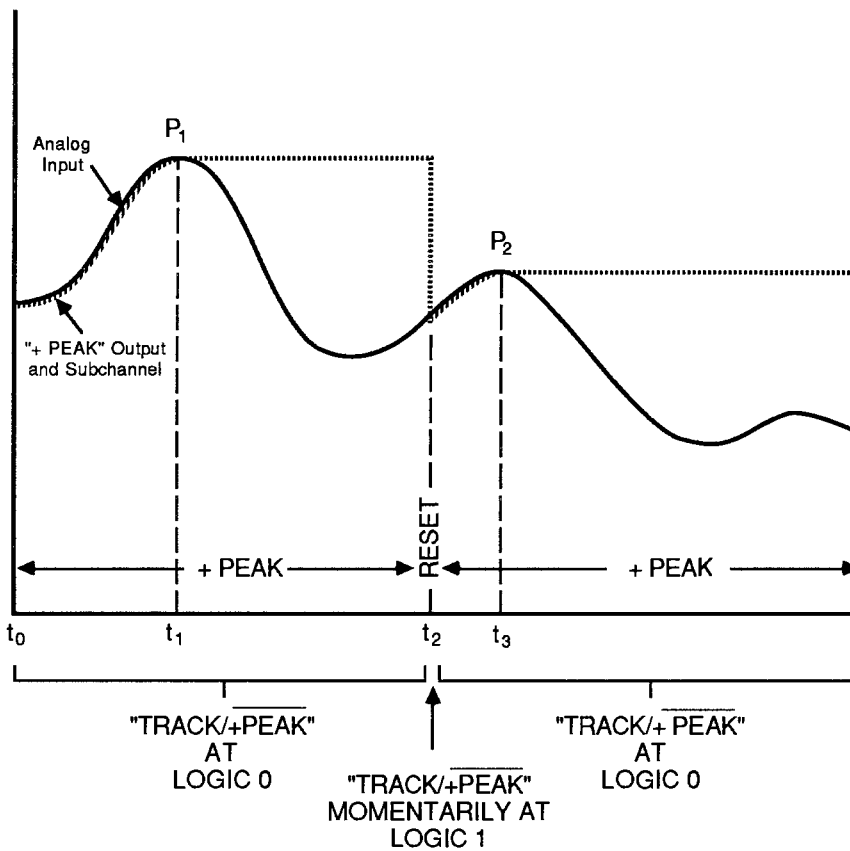


Fig. 3.A.4.6 "+ PEAK" Capture (Successively Lower Peaks)



3.A.4.c

PEAK-CAPTURE OPERATION

3. "- PEAK" CAPTURE

"- PEAK" operation for any given 10A79-4 input channel is in effect when and only when the "TRACK / $\overline{\text{MAX-MIN}}$ " logic input for that channel is at *Logic 0*. In effect, this logic command tells the channel to stop tracking its analog input and to begin reporting at all times the lowest input value yet perceived since tracking was last halted.

Thus, when an input channel's "TRACK / $\overline{\text{MAX-MIN}}$ " logic input is at *Logic 0*, the "- PEAK" analog output for that channel will represent the *most negative (or least positive)* excursion to have been experienced by the channel's analog input signal since the application of this *Logic 0* input.

NOTE: IN ORDER FOR THE CHANNEL'S SECOND SUBCHANNEL TO REPORT "- PEAK" DATA, TWO CONDITIONS ARE NECESSARY:

- a. THE CHANNEL'S "TRACK / $\overline{\text{MAX-MIN}}$ " INPUT MUST BE AT *LOGIC 0*, AND
- b. THE CHANNEL MUST HAVE BEEN SET TO THE "- PEAK" MODE, FOLLOWING THE PROCEDURE GIVEN IN SECTION b.2, ABOVE.

Reapplication of *Logic 1* to a "TRACK / $\overline{\text{MAX-MIN}}$ " input amounts to a *resetting* of the corresponding "- PEAK" analog output and of the corresponding *second* SUBCHANNEL, regardless of whether this SUBCHANNEL is reporting "- PEAK" or "MAX minus MIN" data. This action returns output and SUBCHANNEL immediately to the "tracking" of the analog input, as shown in Fig. 3.A.4.7.

Multiple outputs and SUBCHANNELS may be *simultaneously reset* by tying the respective command inputs to a single logic line (see Appendix F). Also, where the system includes a Model 10AIO-16 or 10BIO-16 Universal Logic I/O Card, this common logic line can be *automatically* controlled by a selected LOGIC BIT (see Section 2.H, "System Logic Bits," and Section 2.K, "Automatic Command Execution").

Fig. 3.A.4.7 shows how the 10A79-4 may be used to capture *successively higher-valued signal minima*, following the application of *Logic 0* to a "TRACK / $\overline{\text{MAX-MIN}}$ " input at time t_1 . Here we assume that the channel has been set to "- PEAK" mode. Until time t_1 , the corresponding "- PEAK" output and SUBCHANNEL have been continuously "tracking" the analog input, as shown. After time t_1 , and until reset at time t_3 , they continuously report the *lowest* input-signal value perceived since time t_1 . From time t_1 to time t_2 , the input is continuously falling, and so the "- PEAK" output and SUBCHANNEL appear to be continuing to track it. At time t_2 , however, the input reaches its first minimum since time t_1 . The 10A79-4 "captures" and holds as a constant value this first "negative" peak (P_1).

To capture the succeeding *higher-valued* minimum (P_2), it is necessary to *reset* the "- PEAK" output and SUBCHANNEL—that is, to get them "back on track," so to speak—somewhere along the fall of the signal toward this second minimum. This is done by changing the logic level of the respective "TRACK / $\overline{\text{MAX-MIN}}$ " input to *Logic 1* at time t_3 , and then immediately reapplying the *Logic 0* level to this input.

Fig. 3.A.4.8 shows the "-PEAK" capture of *successively lower-valued signal minima*. The *initial* signal minimum (time t_0) is held only until the input reaches a yet *lower* value at time t_1 , at which time the "-PEAK" output and SUBCHANNEL appear to track the input down to the first negative peak (P_1). This peak value will be "captured" and held until a still lower input value is detected at time t_3 , whereupon the "-PEAK" output and SUBCHANNEL will track down to the second, lower peak (P_2), etc.

As explained in the following section, you can hold a captured minimum *without decay* by applying the "MIN" form of the **CALCULATE (CLC)** command to the respective SUBCHANNEL (if it is set to "- PEAK" mode).

3.A.4 Analog Peak Capture

Fig. 3.A.4.7 "-PEAK" Capture (Successively Higher Peaks)

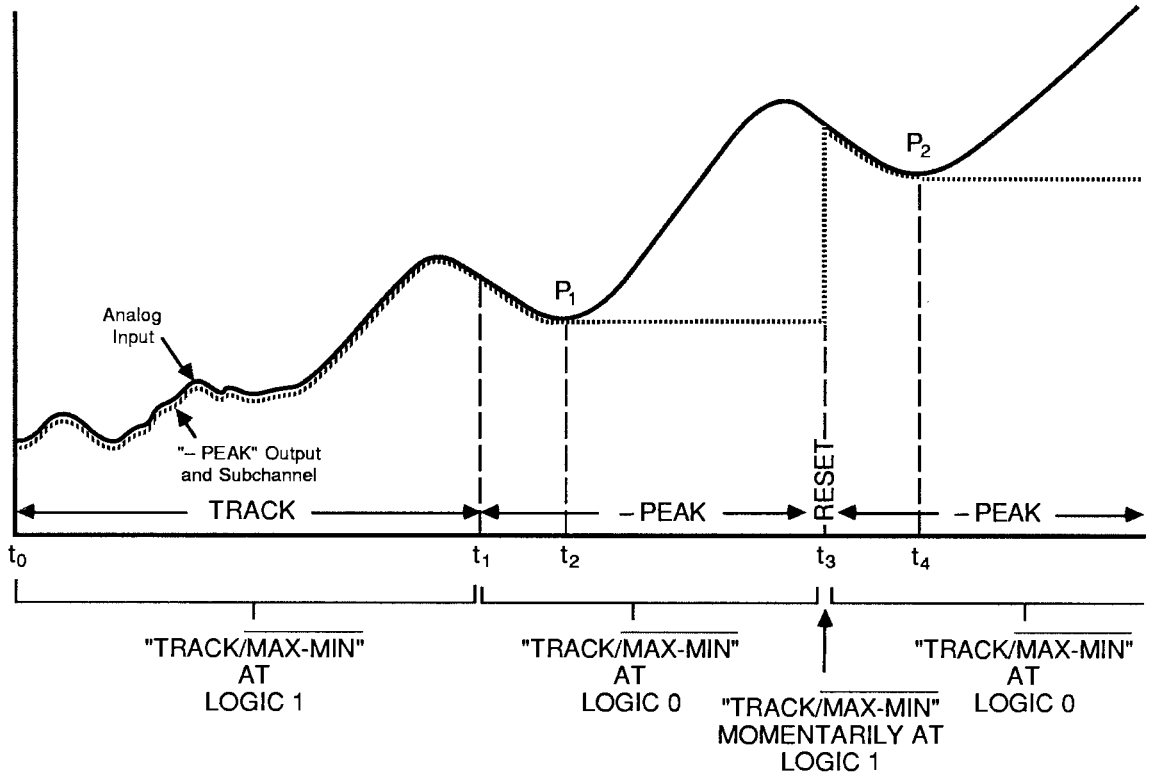
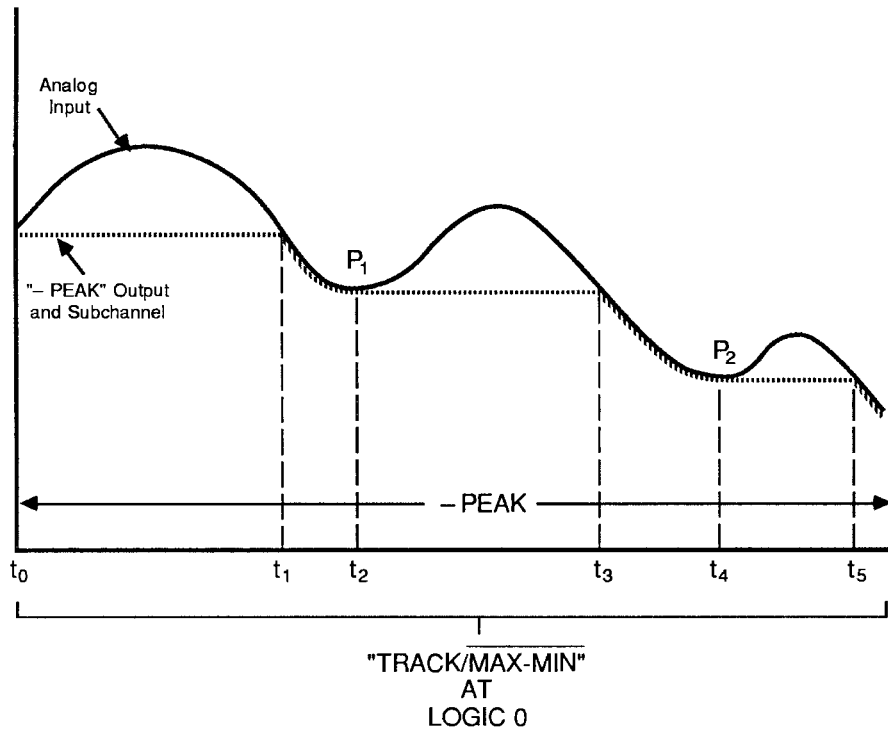


Fig. 3.A.4.8 "- PEAK" Capture (Successively Lower Peaks)



3.A.4.c

PEAK-CAPTURE OPERATION

4. HOLDING A "+ PEAK" OR "- PEAK" SUBCHANNEL WITHOUT DECAY: CLC COMMAND

The 10A79-4's capacitor memory is volatile, and entails inevitable decay of "captured" analog signal values (at a rate, however, that does not exceed 1 mV/sec).

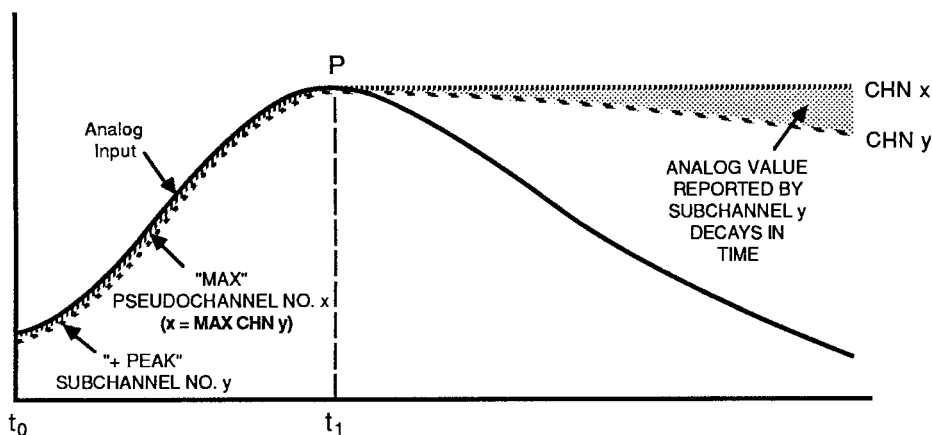
Therefore, if you need to display a maximum or minimum value reported by a 10A79-4 SUBCHANNEL for any length of time, you may wish to apply to that SUBCHANNEL a special **CALCULATE (CLC)** command that allows the captured peak value to be indefinitely (digitally) held.

If, for example, you need to observe for a relatively long time the maximum peak "P" reported by 10A79-4 SUBCHANNEL No. y (see Fig. 3.A.4.9), you may set up a system CALCULATE PSEUDOCHANNEL No. x to report this maximum *without decay* by entering a command of

$$\text{CLC } x = \text{MAX CHN } y \text{ [CR]}^*$$

This command may be applied at any time between t_0 and t_1 . As shown in Fig. 3.A.4.9, the reading of "MAX" PSEUDOCHANNEL No. x will at first *equal* that of the 10A79-4's "+ PEAK" SUBCHANNEL No. y, but only until the analog peak value held by the SUBCHANNEL begins to decay. Of course, if an input value *higher* than that of the captured peak "P" subsequently occurs, PSEUDOCHANNEL No. x will, like 10A79-4 SUBCHANNEL No. y, reflect this input behavior.

Fig. 3.A.4.9. Use of "MAX" CALCULATE PSEUDOCHANNEL for Nonvolatile Holding of Captured "+ PEAK"



Similarly, to set up a PSEUDOCHANNEL No. x to report *without decay* a minimum reported by 10A79-4 SUBCHANNEL No. y, command

$$\text{CLC } x = \text{MIN CHN } y \text{ [CR]}^*$$

For general setup and use of CALCULATE PSEUDOCHANNELS, including the "Resetting of 'MAX' and 'MIN' Channels," see Section 2.J.

Section 3.A.5

Analog "MAX minus MIN"
Function: Model 10A79-4
Four-Channel Analog Peak
Capture Card



System 10 Guidebook

This section explains the use of the Model 10A79-4 for real-time measurement of the *difference* between the highest (most positive) value and the lowest (least positive) value to have been experienced by any of up to four independent analog input signals since application of an appropriate logic command.

Sections 3.A.4, 3.A.6, and 3.A.7 treat other useful functions of the 10A79-4: "Analog Peak Capture," "Track and Hold," and "Buffering of Analog Signals," respectively.

As explained in Section 3.A.4(a), each of the 10A79-4's four input channels produces *two* SUBCHANNELS. These are standard DATA CHANNELS, "callable" by the system, and requiring individual CONFIGURATION and CALIBRATION. For numbering of 10A79-4 SUBCHANNELS, see Fig. 3.A.4.2.

The *second* of each SUBCHANNEL pair will report the existing "MAX minus MIN" value for the respective input channel when

1. the two logic inputs corresponding to that channel ("TRACK / + PEAK" and "TRACK / MAX-MIN") are *both* at a *Logic 0* level, and when
2. the channel is set to "MAX-MIN" mode.

"MAX-MIN" monitoring is especially useful when you need to know the precise range of an excursive phenomenon like the *run-out*, *wobble*, or *looseness* of a rotating part.

———— PLEASE NOTE ————

EACH "MAX-MIN" SUBCHANNEL WILL ACTUALLY REPORT AS A *NEGATIVE VALUE* THE DIFFERENCE THAT CURRENTLY EXISTS BETWEEN THE HIGHEST AND LOWEST VALUES TO HAVE BEEN YET PERCEIVED FOR THE RESPECTIVE ANALOG INPUT SIGNAL SINCE APPLICATION OF *LOGIC 0* AT THE CORRESPONDING "TRACK / MAX-MIN" INPUT. This is because the channel's differential amplifier circuitry actually performs a "MIN minus MAX" operation, i.e.,

$$(- \text{PEAK}) - (+ \text{PEAK})$$

which is equivalent to $-(\text{MAX-MIN})$, i.e.,

$$- [(+ \text{PEAK}) - (- \text{PEAK})]$$

You can easily obtain a *positive* difference reading for any "MAX-MIN" SUBCHANNEL by following the instructions given in Section c.3, below.

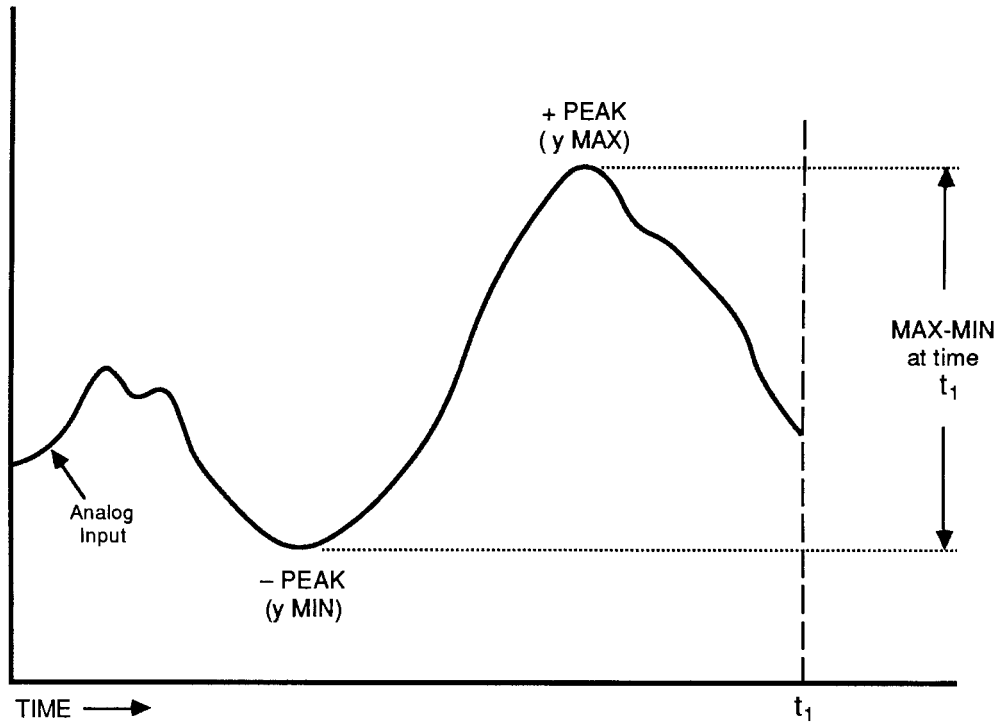
———— ALSO NOTE ————

THE 10A79-4 DOES NOT PROVIDE DIRECT "MAX-MIN" ANALOG OUTPUTS. As mentioned in Section 3.A.4(a.3), however, you may obtain a *differential* output based on the 10A79-4's "+ PEAK" and "-PEAK" ANALOG OUTPUTS, using a standard differential amplifier circuit or a special cable with the **Model 10CAI-8 Eight-Channel Buffer Interface** (see also Section 3.A.2(c) and contact factory for details).

3.A.5.a

THE 10A79-4 "MAX-MIN" SUBCHANNEL

Fig. 3.A.5.1. MAX Minus MIN Measurement



1. 10A79-4 CONNECTIONS

See Section 3.A.4(b.1). The remarks made there concerning the connection of 10A79-4 ANALOG INPUTS, LOGIC INPUTS, and ANALOG OUTPUTS apply equally to "MAX-MIN" operation.

———— IMPORTANT ————

FOR "MAX-MIN" OPERATION OF ANY OF THE 10A79-4'S FOUR INPUT CHANNELS, YOU SHOULD TIE TOGETHER THAT CHANNEL'S LOGIC COMMAND INPUTS. Thus, for the first channel, you should connect Pins A and B of the 10A79-4's rear I/O CONNECTOR (see Fig. 3.A.4.2); for the second channel, Pins C and D; for the third channel, Pins E and F; and for the fourth channel, Pins H and J.

Tying of a channel's logic-input pair will ensure that a command to initiate "MAX-MIN" reporting by the second SUBCHANNEL will not occur while the corresponding "+ PEAK" SUBCHANNEL is still "tracking" the analog input (and is therefore *not* representing the current signal maximum).

2. SETTING CHANNEL MODE

All four of your Model 10A79-4's input channels will have been set at the factory, prior to shipment, to the "MAX-MIN" mode, unless otherwise specified at the time of order or subsequently modified in the field via the procedure given in Section 3.A.4(b.2),

If you wish to use for "MAX-MIN" operation a channel that has been previously reset for "-PEAK" operation, you will have to

- a. Make sure the EEPROM Switch is OFF, and then turn off the DataPAC and remove the 10A79-4 Card from its mainframe SLOT (for instructions on "Card Insertion and Removal," see Appendix B).
- b. Refer to Fig. 3.A.4.4, Section 3.A.4, and locate the four pairs of CHANNEL-MODE JUMPER PADS, one for each of the 10A79-4's four input channels, on the *bottom* (non-component) side of the board. Fig. 3.A.4.4 shows how the jumper pads are numbered to correspond to the four input channels.
- c. To set any one input channel to "MAX-MIN" mode, you must place a solder-drop connection between the respective terminal pair.
- d. Reinsert the 10A79-4 Card in the DataPAC and reactivate power.

3. CONFIGURING AND CALIBRATING "MAX-MIN" SUBCHANNELS

See Sections 3.A.4(b.3) and 3.A.4(b.4).

3.A.5.c

"MAX-MIN" OPERATION

1. "TRACKING" THE ANALOG INPUT

When a given input channel is set to "MAX-MIN" mode, and its "TRACK / $\overline{\text{MAX-MIN}}$ " logic input is at *Logic 1*, then the "MAX-MIN" SUBCHANNEL for that channel will "track" (i.e., be continuously equal to) the channel's analog input.

2. "MAX-MIN" MEASUREMENT

In order for the *second* SUBCHANNEL of a given 10A79-4 input channel to report a true "MAX minus MIN" value for its analog input, two conditions are necessary:

- a. the two logic inputs corresponding to that channel ("TRACK / $\overline{\text{+ PEAK}}$ " and "TRACK / $\overline{\text{MAX-MIN}}$ ") must *both* be at a *Logic 0* level, and
- b. the channel must be set to "MAX-MIN" mode (see Section b.2, above).

Since the two logic inputs are tied, the first condition is met by the application of *Logic 0* to either input, whereupon

- both SUBCHANNELS will *stop tracking the analog input*;
- the *first* SUBCHANNEL, as well as the corresponding "+ PEAK" analog output, will begin to report the highest input value yet perceived since tracking was last halted (see Section 3.A.4(c.2) for "+ PEAK" capture);
- the corresponding "- PEAK" analog output will begin to report the lowest input value yet perceived since tracking was last halted (see Section 3.A.4(c.3) for "- PEAK" capture); and
- the *second* SUBCHANNEL will begin to report "Max - Min," i.e., the difference between the highest and the lowest input values yet perceived since tracking was last halted.

Reapplication of *Logic 1* to either logic input amounts to a *resetting* of both SUBCHANNELS (and of both analog outputs), since it returns them immediately to the "tracking" of the analog input. Multiple outputs and SUBCHANNELS may be simultaneously reset by tying the respective command inputs to a single logic line (see Appendix F). Also, where the system includes a Model 10AIO-16 or 10BIO-16 Universal Logic I/O Card, this common logic line can be *automatically* controlled by a selected LOGIC BIT (see Section 2.H, "System Logic Bits," and Section 2.K, "Automatic Command Execution").

3. INVERSION OF "MAX-MIN" POLARITY: EMM COMMAND

To arrange for a given "MAX-MIN" SUBCHANNEL No. *x* to report a *positive* "MAX-MIN" value

- a. Make sure that Channel No. *x* has been properly configured and calibrated.
- b. Interrogate the system for the SCALING FACTOR now being applied to Channel No. *x*. Simply command

EMM x [CR]

The answer will be a decimal number "m." This is the EEPROM-stored "slope" coefficient of the channel's linear equation " $y = mx + b$," as explained in Section 1.G.1.

- C. Turn ON the EEPROM Switch and *reenter* the SCALING FACTOR "m," but with *inverted polarity* (if it is a positive number, reenter the same number, but with negative sign; if a negative number, reenter as positive):

EMM x = -m [CR] *

4. HOLDING A "MAX-MIN" SUBCHANNEL WITHOUT DECAY: LOK AND UNL COMMANDS

The 10A79-4's capacitor memory is volatile, and entails inevitable decay of "held" analog signal values (at a rate, however, that does not exceed 1 mV/sec). You may, if you wish, apply the following **LOCK (LOK)** command to a given SUBCHANNEL No. x, if the "MAX-MIN" value represented by that SUBCHANNEL has to be displayed for any length of time:

LOK x [CR]

Discussed in Section 2.E of this Guidebook, the **LOK** command digitally "freezes" the existing data value of SUBCHANNEL No. x for an indefinite time. Note that this command will have no effect on any of the 10A79-4's *analog outputs*.

To "unlock" SUBCHANNEL No. x, thus resuming normal updating of the SUBCHANNEL, command

UNL x [CR]

Section 3.A.6

Analog "Track and Hold"
Function: Model 10A79-4
Four-Channel Analog Peak
Capture Card



System 10 Guidebook

3.A.6

ANALOG "TRACK AND HOLD" FUNCTION

This section explains the use of the Model 10A79-4 for "track and hold" of up to four analog input signals.

Sections 3.A.4, 3.A.5, and 3.A.7 treat other useful functions of the 10A79-4: "Analog Peak Capture," "MAX minus MIN," and "Buffering of Analog Signals," respectively.

a. "TRACK AND HOLD" OUTPUTS AND SUBCHANNELS

Refer to Fig. 3.A.4.1 (Section 3.A.4), which shows the I/O structure of each of the Model 10A79-4's four input channels. *Either or both* of the two analog outputs provided for each 10A79-4 input channel can easily be converted to "TRACK AND HOLD" operation. The 10A79-4 SUBCHANNEL corresponding to an output so converted will reflect the "TRACK AND HOLD" operation of that output, while the *logic input* corresponding to that analog output will now act as a "TRACK / HOLD" function.

Since any input channel to be used in "TRACK AND HOLD" operation must first be set to the "- PEAK" mode (see Section b.2, below), that channel's analog outputs—and corresponding SUBCHANNELS—can then assume one of three possible combinations:

+ PEAK and HOLD	- PEAK and HOLD	HOLD and HOLD
-----------------------	-----------------------	---------------------

b. "TRACK AND HOLD" SETUP

1. 10A79-4 CONNECTIONS

See Section 3.A.4(b.1). The remarks made there concerning the connection of 10A79-4 ANALOG INPUTS, LOGIC INPUTS, and ANALOG OUTPUTS apply equally to "TRACK AND HOLD" operation.

2. SETTING CHANNEL MODE

Unless otherwise specified at the time of order, all four of your Model 10A79-4's input channels will have been set at the factory, prior to shipment, to the "MAX-MIN" mode. BEFORE IT CAN BE USED IN "TRACK AND HOLD" OPERATION, THE INPUT CHANNEL IN QUESTION MUST FIRST BE SET TO THE "- PEAK" MODE. For the procedure involved, see Section 3.A.4(b.2).

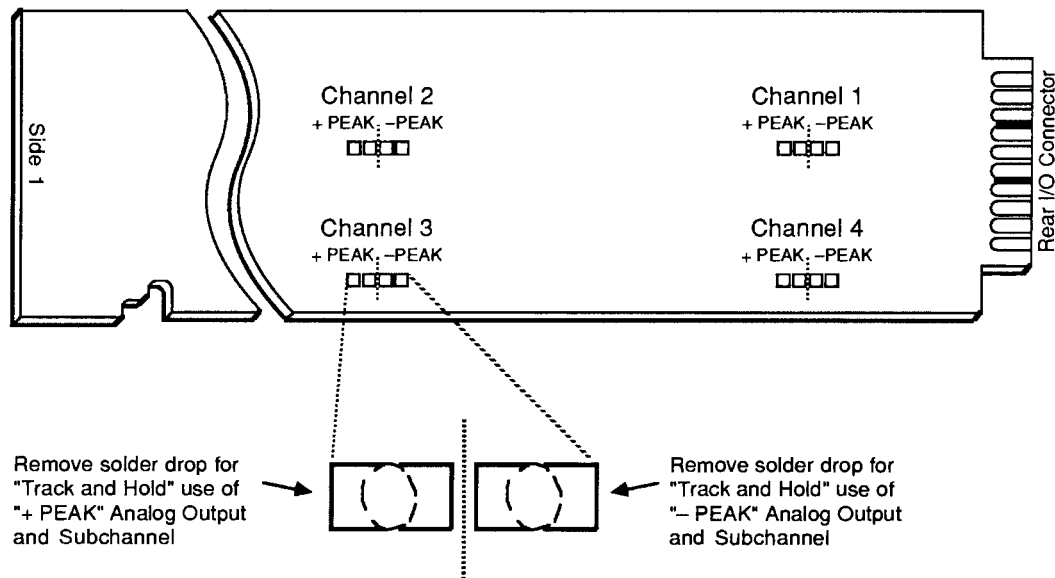
3. SETTING "TRACK AND HOLD" OUTPUTS AND SUBCHANNELS

To set one or both of an input channel's analog outputs—and the corresponding SUBCHANNEL(S)—to "TRACK AND HOLD" operation, you should

- a. Make sure the EEPROM Switch is OFF, and then turn off the DataPAC and remove the 10A79-4 Card from its mainframe SLOT (for instructions on "Card Insertion and Removal," see Appendix B).
- b. Refer to Fig. 3.A.6.1, below, and locate the "TRACK AND HOLD" JUMPER PADS for the input channel in question. There are two pairs of terminal pads for each channel: one pair for the channel's "+ PEAK" output and one for the "- PEAK" output.

- C. To convert either of the channel's outputs to "TRACK AND HOLD," you must "unblob" the respective terminal pair by removing its present solder-drop interconnection. Use a fine-point solder gun to heat the solder-drop in question, until it has melted sufficiently for you to wipe it off with a clean rag. Make sure that you remove all traces of solder from the jumper pads you wish to "unblob."
- d. Reinsert the 10A79-4 Card in the DataPAC and reactivate power.

Fig. 3.A.6.1. Model 10A79-4 "Track and Hold" Jumper Pads



4. CONFIGURING AND CALIBRATING "TRACK AND HOLD" SUBCHANNELS

See Sections 3.A.4(b.3) and 3.A.4(b.4).

C. "TRACK AND HOLD" OPERATION

1. "TRACKING" AND "HOLDING" THE ANALOG INPUT

When one of a channel's analog outputs is set to "TRACK AND HOLD," its corresponding LOGIC-INPUT pin will now represent the "TRACK / HOLD" function (see Fig. 3.A.4.2 for appropriate pin numbers).

Thus, when a *Logic 1* level exists at the logic-input pin corresponding to an analog output set to "TRACK AND HOLD" operation, that output—along with the corresponding 10A79-4 SUBCHANNEL—will "track" the channel's analog input. That is, it will represent a data value continuously equal to that of the input.

However, as soon as a *Logic 0* is received at the logic-input pin, the output—along with the corresponding SUBCHANNEL—will "hold" the analog input value that exists at that moment. This value will be held until the output is "reset" by reapplication of a *Logic 1* to the "TRACK / HOLD" pin, at which point it will again begin to "track" the analog input.

3.A.6

ANALOG "TRACK AND HOLD" FUNCTION

2. "HOLDING" A SUBCHANNEL WITHOUT DECAY: **LOK** AND **UNL** COMMANDS

The 10A79-4's capacitor memory is volatile, and entails inevitable decay of "held" analog signal values (at a rate, however, that does not exceed 1 mV/sec). You may, if you wish, apply the following **LOCK (LOK)** command to a given SUBCHANNEL No. x, if the "held" value represented by that SUBCHANNEL has to be displayed for any length of time:

LOK x [CR]

Discussed in Section 2.E of this Guidebook, the **LOK** command digitally "freezes" the existing data value of SUBCHANNEL No. x for an indefinite time. Note that this command will have no effect on any of the 10A79-4's *analog outputs*.

To "unlock" SUBCHANNEL No. x, thus resuming normal updating of the SUB-CHANNEL, command

UNL x [CR]

Section 3.A.7

Buffering of Analog Signals:

Model 10A79-4
Four-Channel Analog Peak
Capture Card
and Model 10AAO-4 Analog
Buffer Card



System 10 Guidebook

This section explains the use of the Model 10A79-4 for the buffering of up to four system analog signals with external devices.

Sections 3.A.4, 3.A.5, and 3.A.6 treat other useful functions of the 10A79-4: "Analog Peak Capture," "MAX minus MIN," and "Track and Hold," respectively.

The Model 10A79-4 can be used to buffer up to four system analog signals for continuous, real-time, *unscaled output* to oscilloscopes, strip-chart recorders, and other receiving devices.

1. Hard-wire the analog signal to be buffered to the Model 10A79-4, via the DataPAC's internal Analog Motherboard (see Section 3.A.4(b.1)). This signal will now serve as one of the 10A79-4's four ANALOG INPUTS. In almost all cases, it will originate from one of the system's Conditioner Cards that provides output to wire-wrap pins.
2. Apply a *Logic 1* level to one of the 10A79-4's two LOGIC INPUTS corresponding to this input channel (see Fig. 3.A.4.2). The ANALOG OUTPUT corresponding to this logic input will now "track" the analog input, as will the corresponding 10A79-4 SUBCHANNEL. That is, the output will represent a data value continuously equal to that of the input. No scaling will be applied; as indicated in Table 3.A.4.2, the actual full-scale amplitude of a 10A79-4 analog output will be a function of the "TYPE" designation of the respective analog input.

This tracking will not be affected by any "mode" setting of the channel in question ("+ PEAK," "-PEAK," "MAX-MIN," or "TRACK AND HOLD"), so long as the *Logic 1* level is continuously applied to the respective logic-input pin.

3. The tracking analog output may now be connected to an external monitoring or controlling device.

As shown in Fig. 3.A.4.2, the 10A79-4's analog outputs are issued at Pins 1 through 8 of its 20-pin rear I/O CONNECTOR.

ALL ANALOG OUTPUTS ARE SINGLE-ENDED AND SHOULD RETURN TO "SIGNAL COMMON" (PIN 9 OR K).

3.A.7.b

SCALED ANALOG BUFFERING WITH THE MODEL 10AAO-4

1. INTRODUCTION

The **Model 10AAO-4 Analog Buffer Card** provides buffering, filtering, and user-selectable gain for up to four individual system analog signals. Each signal may originate from any one of the system's Conditioner Cards that provides output to wire-wrap pins—with the exception of RTD Conditioners such as the Models 10A16-4A and 10A17-2.

Each of the 10AAO-4's four outputs is nominal ± 5 V (± 6 V max), with a minimum load resistance of 2000 ohms, and is factory-set for a "single-ended" configuration (i.e., output referenced to SIGNAL COMMON (GROUND)). If desired, however, all four outputs may be reconfigured as "floating," by connecting an external ± 9 V-DC supply furnished by the user. Each channel's *gain* setting will depend on the "TYPE" designation of the corresponding "source" conditioner channel (see Table 3.A.7.2, below). Each 10AAO-4 channel also has coarse ZERO and SPAN controls accessible at the front of the card, for further *calibration* or *scaling* with reference to the "source" input.

The Model 10AAO-4's 20-pin rear I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322 (shown in Fig. 1.E.1). Pin functions are given in Table 3.A.7.1, below.

Table 3.A.7.1

Model 10AAO-4 Pin Assignments

I/O CONNECTOR Pin No.	10AAO-4 Chan. No.	Line Function
1	1	SIGNAL
A	1	COMMON
2	2	SIGNAL
B	2	COMMON
3	3	SIGNAL
C	3	COMMON
4	4	SIGNAL
D	4	COMMON
9,K		+9 V
10,L		-9 V

2. SETUP OF 10AAO-4 OUTPUTS

a. CONNECTION OF ANALOG INPUTS

See "CONNECTION OF ANALOG INPUTS" for the Model 10A79-4, Section 3.A.4(b.1) of this Guidebook. All remarks apply equally to the Model 10AAO-4.

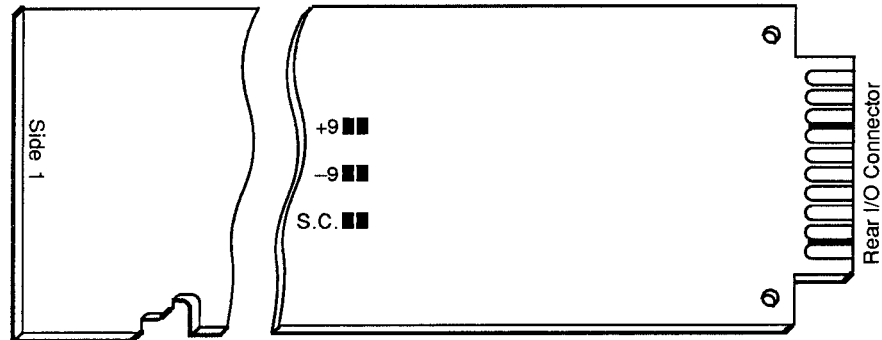
b. SETTING OUTPUT CONFIGURATION

To convert all four of the 10AAO-4's ± 5 -V outputs to "floating" configuration, you should

1. Make sure the EEPROM Switch is OFF, and then turn off the DataPAC and remove the 10AAO-4 card from its mainframe SLOT (for instructions on "Card Insertion and Removal," see Appendix B).

2. Refer to Fig. 3.A.7.1, below, and locate the three pairs of OUTPUT MODE JUMPER PADS on the bottom (non-component) side of the board (these are labelled "+9," "-9," and "S.C.," respectively). The board is usually shipped with a solder drop connecting the terminals of each pair of pads.

Fig. 3.A.7.1 Model 10AAO-4 Output Mode Jumper Pads



3. Remove the solder drop from each of the three jumper pairs. Use a fine-point solder gun to heat each solder drop, until it has melted sufficiently for you to wipe it off with a clean rag. Make sure that you remove all traces of solder from each jumper pad.
4. Reinsert the 10AAO-4 card, but DO NOT TURN ON THE DATAPAC YET.
5. Connect your external COMMON line to PIN A of the 10AAO-4's rear I/O CONNECTOR. Then connect the +9-V line of your external power supply to PIN 9 of the I/O CONNECTOR, and the -9-V line to PIN 10.
6. Reactivate DataPAC power.

C. SETTING OUTPUT GAIN VALUES

1. Make sure the EEPROM Switch is OFF, and then turn off the DataPAC and remove the 10AAO-4 card from its mainframe SLOT (for instructions on "Card Insertion and Removal," see Appendix B).
2. Refer to Table 3.A.7.2, below, for the GAIN SETTING ("1," "2," or "4") required for the "TYPE" of Conditioner supplying the input signal for each of the 10AAO-4's four channels.

3.A.7.b

SCALED ANALOG BUFFERING WITH THE MODEL 10AAO-4

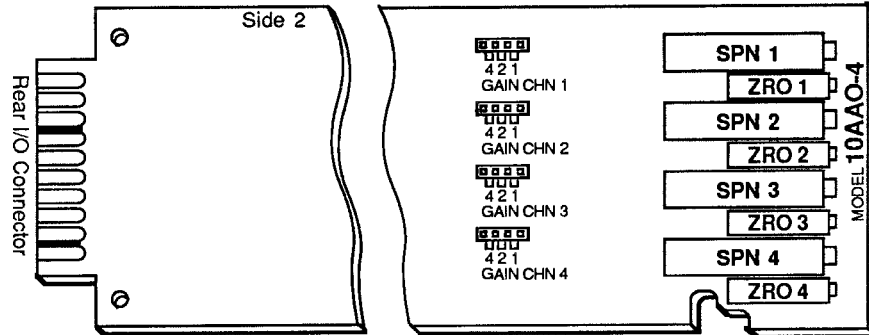
Table 3.A.7.2

Model 10AAO-4 Gain Settings as a Function of Input-Channel "Type"			
"Source" Conditioner	Bandwidth (Hz)	Input-Channel Type Designation	Gain Setting
10A30-2, 10A31-4	6	30	1
10A40	2	40-47	1
10A41-2	1.2-16	40-47	1
10A43	1.5	40, 41, 42	1
10A45	10	55	1
10A48	2	40-43	1
10A60-4	10	5A, 5D 5B, 5E 5C, 5F	4 2 1
10A61-2, 10A62-8	10	6C, 6D	1
10A63-2, 10A64-8, 10A65-8, 10A68-2, 10A69-4	5	61, 64, 67, 6A 60, 63, 66, 69 62, 65, 68, 6B	4 2 1
10A70-2, 10A73-4, 10A74-4	10	70 71 72	4 2 1
10A72-2	1000*	70 71 72	4 2 1
10A78	7.5	70 71 72	4 2 1
10A76, 10A96	10-2000	72	1

* 46 Hz when used with the Model 10AAO-4.

3. Refer to Fig. 3.A.7.2, below, and locate the row of four jumper pins for each channel, on the component side of the board. To set the GAIN for each channel, you will connect appropriate pairs of adjacent pins by means of "mini-jumpers" or wires (four "mini-jumpers" are supplied with the 10AAO-4). Thus, to set a channel for a gain of "1," connect the last two (rightmost) jumpers for that channel; to set a gain of "2," connect the two middle jumpers; and to set a gain of "4," connect the first two (leftmost) jumpers.
4. Reinsert the 10AAO-4 card and reactivate DataPAC power.

Fig. 3.A.7.2 Model 10AAO-4 Gain Jumpers and Zero/Span Controls



d. ADJUSTING OUTPUT ZERO AND SPAN

Without having to remove the 10AAO-4 from its SLOT, you can adjust the coarse ZERO and SPAN controls provided for each 10AAO-4 channel, using a small screwdriver (see again Fig. 3.A.7.2). These controls are labelled on the front edge of the card: (starting from the top) SPN1, ZRO1, SPN2, ZRO2, etc.

Thus, if you want to *calibrate* a given 10AAO-4 output to match the corresponding Conditioner Card output, you may "zero" the 10AAO-4 output when the conditioner output is zero, and "span" the 10AAO-4 output to a known up-scale reading when the conditioner output is at this value. Or you may *rescale* the 10AAO-4 output with reference to the conditioner output, if your application so requires.

Section 3.A.8

Buffer Storage of Data Outputs:
Model 10AFIFO First-In-First-Out
Buffer Memory Card



System 10 Guidebook

CAUTION!

WHENEVER YOU NEED TO CARRY THE MODEL 10AFIFO CARD OUTSIDE THE DATAPAC MAINFRAME, YOU SHOULD USE THE NONCONDUCTIVE "ANTISTAT" FOAM ENVELOPE SUPPLIED WITH THE CARD.

ALSO, YOU SHOULD NEVER LAY THE CARD ON ANY METAL OR OTHER CONDUCTIVE SURFACE.

THESE PRECAUTIONS SHOULD BE TAKEN TO PREVENT SEVERE DAMAGE TO THE CARD.

ALSO PLEASE NOTE

When the Model 10AFIFO is not powered, its RAM chips require no more than 6 μA collectively. However, the PAL (which manages write protection for data retention) requires approximately 30 μA . Because of the increased PAL current, the battery lifetime for an unpowered 10AFIFO is approximately 5000 hours.

When the 10AFIFO is powered, THERE IS NO LOAD ON THE BATTERIES. It is therefore strongly recommended that the card be installed, if possible, in a DataPAC that is continuously powered. The 5000-hour battery life would then be available for power outages, transfer of the card from system to system, etc.

Included for your convenience are three sets of spare batteries (total projected life 20,000 hours). An insulating wafer has also been installed to protect against accidental shorting of the battery and associated wiring.

— PLEASE NOTE —

The **Model 10AFIFO First-In-First-Out Buffer Memory Card** is for use in "A-sized" DataPACs only (any version of the Model 10KU, 10K1, 10K2, 10K4, etc.).

The purpose of the Model 10AFIFO is to provide *nonvolatile buffer storage* of serial-ASCII outputs issued from the DataPAC's COMPUTER INTERFACE PORT. These outputs are normally data transmissions produced in response to standard MNEMONIC COMMANDS to the DataPAC (**DUMP (DMP)**, **STREAM (STR)**, **HARD COPY (HCY)**, etc.), but may also include responses by the DataPAC's CENTRAL PROCESSOR (Model 10ACP100) to standard system *interrogations* (i.e., "READ" COMMANDS) or to special communications commands like **SEND (SND)** or **COMPUTER INTERRUPT (ITR)**.

With its *battery-backed RAM*, the 10AFIFO is ideal for applications where it's impractical to connect a computer, printer, recorder, or other receiver directly to the DataPAC while data is being acquired—as, for example, in "on-the-road" vehicle performance testing, using a DC-powered ("V"-option) DataPAC. **INTERRUPTION OF DATAPAC POWER WILL NOT AFFECT THE VALIDITY OF DATA CURRENTLY STORED IN THE 10AFIFO.** On subsequent powerup, all 10AFIFO memory contents are once more accessible to the receiving device.

Through its 20-pin FIFO COMPUTER PORT, the 10AFIFO connects *both* to the DataPAC's CENTRAL PROCESSOR (10ACP100) and to an external RS-232-C receiving device. A special dual cable is provided for these connections, as explained in Section b.2, below.

— IMPORTANT —

THE MODEL 10AFIFO RECEIVES ALL INSTRUCTIONS THROUGH ITS FIFO COMPUTER PORT ONLY. UNLIKE OTHER "SMART" A CARDS, *IT CANNOT BE COMMANDED THROUGH THE DATAPAC'S PLUG-IN KEYBOARD.* NO 10AFIFO COMMAND WILL BE EFFECTIVE WHEN SO ENTERED.

ALSO, WHEN THE 10AFIFO IS INSTALLED IN THE DATAPAC, ANY AND ALL MNEMONIC COMMANDS WHICH WOULD OTHERWISE HAVE BEEN COMMUNICATED TO THE DATAPAC THROUGH ITS COMPUTER INTERFACE PORT MUST NOW BE ENTERED VIA THE FIFO COMPUTER PORT. The 10AFIFO will automatically pass on to the DataPAC's CENTRAL PROCESSOR (10ACP100) all commands received at its FIFO COMPUTER PORT which do not relate to the 10AFIFO itself.

The **BYPASS (BYP)** command, discussed in Section c.3, below, permits responses by the 10ACP100 to *interrogation commands* entered at the FIFO COMPUTER PORT to be transferred directly to the 10AFIFO's output buffer, without having to wait for them to pass through the main FIFO memory. **ALL ANSWERS TO INTERROGATIONS WHICH RELATE TO THE 10AFIFO ITSELF—such as **CMT [CR]**, **OPT [CR]**, **EOT [CR]**, **BYP [CR]**, **MOD [CR]**, etc.—WILL BE RETURNED IMMEDIATELY FROM THE FIFO COMPUTER PORT.**

——ALSO NOTE——

If in response to a MNEMONIC COMMAND entered through the FIFO COMPUTER PORT, you receive an output of the general form

ERROR # X

(where $X \geq 1.1$), you should contact the factory SERVICE DEPARTMENT for further instructions.

10AFIFO setup parameters are written into the 10AFIFO's own EEPROM, which is enabled by the "software" setting of system LOGIC BIT No. 999 (see Section b.1, below). The commands you will use to set the 10AFIFO's INPUT and OUTPUT modes are described in Sections b.5 and b.6. In either OUTPUT MODE, the 10AFIFO can be instructed by the receiving device to halt or resume transmission (Section c.2).

In addition to the commands for I/O-MODE setup and the initiating of 10AFIFO transmissions, specific commands exist for *reaccessing* the full contents of the 10AFIFO memory at any time (see Section c.4) and for "true erasure" of memory contents, using a physical overwrite technique (Section c.5).

IMPORTANT

In order to use the Model 10AFIFO to store outputs transmitted in response to a **STREAM (STR)** or **HARD COPY (HCY)** command, you must first enter a **TAILER (TLR)** command to specify for all such outputs a "TAILER" string that *ends* in **CARRIAGE RETURN ([CR])**. That is, you must first enter a command of the form

TLR = ". . . [0D]" [CR]*

where other characters may or may not precede the TAILER-terminating "[0D]" (for full details on the **TLR** command, see Section 1.H.3 of this Guidebook). Like other DataPAC SETUP COMMANDS, the above command may be entered via the Model 10AFIFO's FIFO COMPUTER PORT.

1. SOFTWARE EEPROM ENABLE: BIT COMMAND

TO BE EFFECTIVE, EACH OF THE 10AFIFO *SETUP* COMMANDS DISCUSSED IN THE FOLLOWING SECTIONS REQUIRES THAT THE 10AFIFO EEPROM WRITE PROTECT SWITCH BE ON (this is indicated by an asterisk (*) following the command expression). THE STATE OF THE DATAPAC'S (HARDWARE) EEPROM SWITCH AT THE TIME IS IMMATERIAL.

To turn ON the 10AFIFO's EEPROM Switch, you must enter the following **SET BIT (BIT)** command *through the FIFO COMPUTER PORT* (when entered via the DataPAC's keyboard, the command will have no effect on the 10AFIFO):

BIT 999 = 1 [CR]

To turn OFF the 10AFIFO's EEPROM Switch, enter through the FIFO COMPUTER PORT a command of

BIT 999 = 0 [CR]

When setup of the 10AFIFO is complete, be sure to turn OFF the 10AFIFO EEPROM Switch.

NOTE: If the DataPAC is an "A-version" type, it will also have the "software" EEPROM-enable capability. If such is the case, a **BIT 999 = 1 [CR]** command entered at the FIFO COMPUTER PORT will turn on *both* the 10AFIFO's EEPROM Switch *and* that of the DataPAC; similarly, a command of **BIT 999 = 0 [CR]** will turn off both EEPROM Switches.

2. 10AFIFO CONNECTIONS

Fig. 3.A.8.1 shows how the 20-pin FIFO COMPUTER PORT connector on the rear of the 10AFIFO card connects both with the DataPAC's COMPUTER INTERFACE CONNECTOR and the 25-pin RS-232-C CONNECTOR of the external computer or other receiving device. For the location of your DataPAC's COMPUTER INTERFACE CONNECTOR, see Section 1.A.2 of this Guidebook.

The shielded, dual cable shown in the figure is supplied with the 10AFIFO. Its 20-pin edge-card connector attaches to the rear of the 10AFIFO board; its male 25-pin connector attaches to the DataPAC's COMPUTER INTERFACE CONNECTOR; and its female 25-pin connector attaches to the external receiver or to an interconnecting cable (normally supplied by the user) that attaches to the receiver. For a discussion of RS-232-C interfacing, see Section 2.B of this Guidebook.

3. SETUP OF 10AFIFO-10ACP100 INTERFACE

a. SETTING PROTOCOL FOR THE DATAPAC'S COMPUTER INTERFACE PORT

FOR PROPER DATA TRANSFER BETWEEN THE DATAPAC AND THE 10AFIFO TO OCCUR, THE DATAPAC'S COMPUTER INTERFACE PORT MUST BE SET TO OBSERVE THE FOLLOWING RS-232-C "PROTOCOL" CHARACTERISTICS:

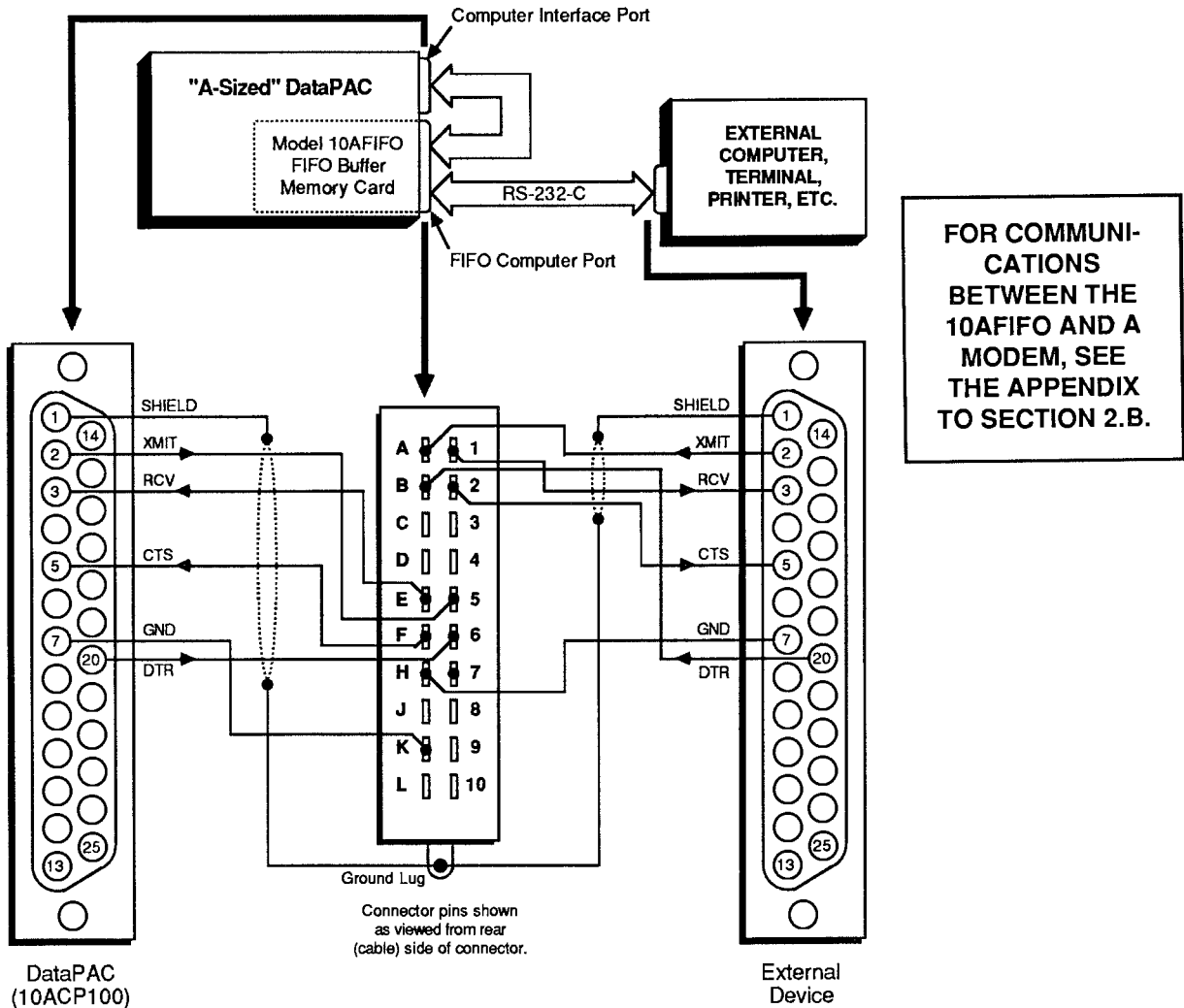
- 153.6K BAUD
- 8 DATA BITS
- 2 STOP BITS
- NO PARITY

YOU WILL SET THESE VALUES VIA THE DATAPAC'S PROTOCOL SWITCHES. These switches may be mounted either on the DataPAC's Model 10ACP100 card (Model 10K1, 10K2, etc.) or on the rear of the DataPAC itself (Model 10KU, 10K4, etc.). For full instructions, refer to Section 2.B.2 of this Guidebook.

3.A.8.b

MODEL 10AFIFO SETUP

Fig. 3.A.8.1 10AFIFO Cable Connections



FOR COMMUNICATIONS BETWEEN THE 10AFIFO AND A MODEM, SEE THE APPENDIX TO SECTION 2.B.

b. SETTING OUTPUT AND END-OF-TRANSMISSION TERMINATORS FOR THE DATAPAC'S COMPUTER INTERFACE PORT: **OPT** AND **EOT** COMMANDS

In order for proper interaction between the 10AFIFO and the DataPAC's CENTRAL PROCESSOR (Model 10ACP100) to occur, it is necessary that the DataPAC's COMPUTER INTERFACE PORT be set to issue an OUTPUT TERMINATOR of **LINE FEED** and an END-OF-TRANSMISSION TERMINATOR of **CARRIAGE RETURN**. This you may do in either of two ways:

1. Turn ON the DataPAC's EEPROM Switch. Then enter, via the plug-in keyboard, the following commands:

OPT = [0A] [CR] * and **EOT = [0D] [CR] ***

2. Or, if the DataPAC has no keyboard (10KU, 10K1, 10K4, etc.), you may simply *turn the DataPAC OFF and ON again while its EEPROM Switch is ON*, after the 10AFIFO has been connected to the 10ACP100 (Section b.2, above). The 10AFIFO will automatically set the 10ACP100 to an OUTPUT TERMINATOR of [LF] and an END-OF-TRANSMISSION TERMINATOR of [CR].

—————**IMPORTANT**—————

THE FIXED OUTPUT TERMINATOR (OPT) AND END-OF-LINE TERMINATOR (EOT) APPLYING TO THE DATAPAC'S *COMPUTER INTERFACE PORT* WHILE IT IS CONNECTED TO THE 10AFIFO SHOULD NOT BE CONFUSED WITH THE USER-SELECTABLE OPT AND EOT OF THE 10AFIFO'S *FIFO COMPUTER PORT*.

The DataPAC's OPT and EOT are required to be LINE FEED and CARRIAGE RETURN, respectively, for proper intercommunication to occur between the 10ACP100 and the 10AFIFO. ONCE THEY HAVE BEEN SET TO THESE VALUES, NO FURTHER **OPT** OR **EOT** "WRITE" COMMANDS SHOULD BE ENTERED THROUGH THE DATAPAC'S KEYBOARD.

As explained below, the 10AFIFO's OPT and EOT may be set by the operator to any values required by the RS-232-C device receiving output from the FIFO COMPUTER PORT, by means of commands entered at the FIFO COMPUTER PORT (only).

4. SETUP OF FIFO COMPUTER PORT

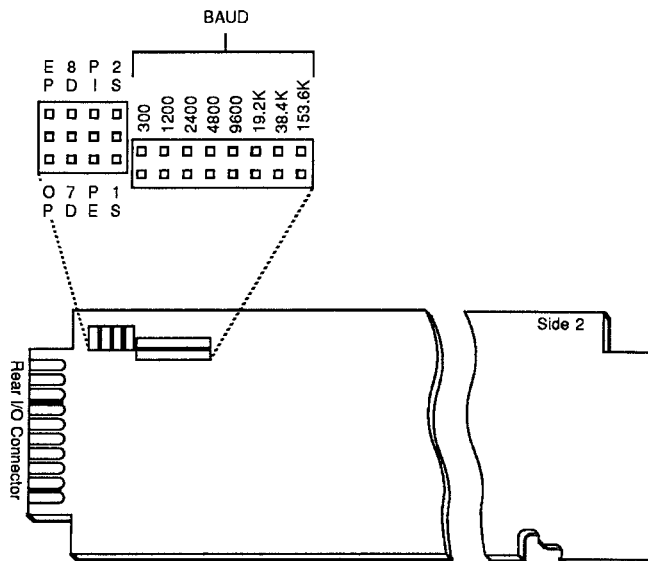
a. SETTING PROTOCOL

FOR PROPER DATA TRANSFER BETWEEN THE 10AFIFO AND THE CONNECTED RS-232-C DEVICE TO OCCUR, THE FIFO COMPUTER PORT MUST BE SET TO CONFORM EXACTLY WITH THE PROTOCOL STIPULATED BY THE CONNECTED DEVICE.

The following procedure lets you set the FIFO COMPUTER PORT'S effective "protocol":

1. Make sure the 10AFIFO EEPROM Switch and the DataPAC EEPROM Switch are both OFF (see Section b.1, above). Then turn OFF the DataPAC.
2. Remove the 10AFIFO card from its SLOT (for instructions on "Card Insertion and Removal," see Appendix B).

Fig. 3.A.8.2 10AFIFO Protocol Jumper Pins

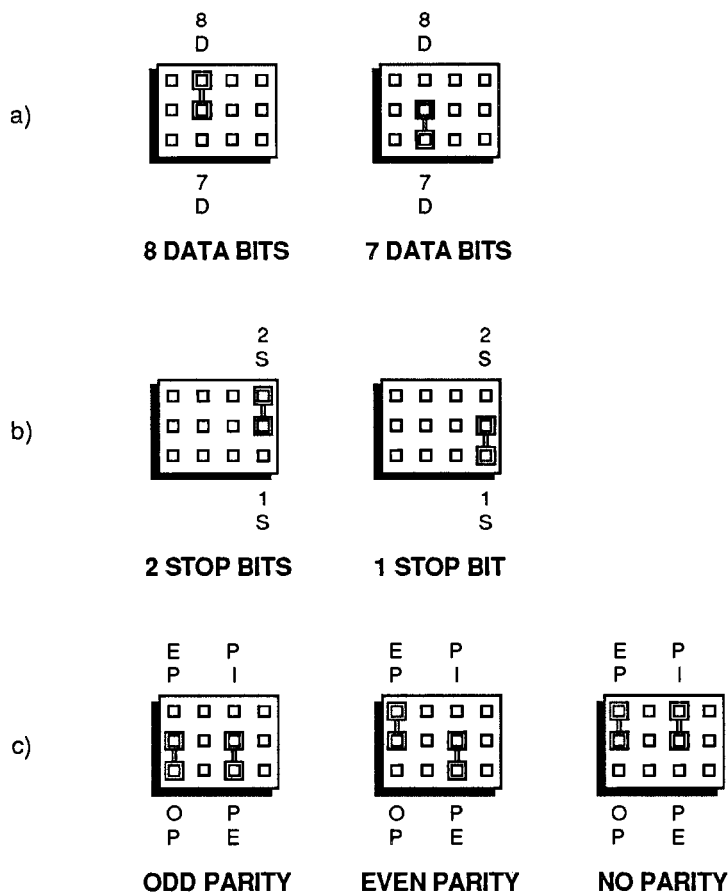


3.A.8.b

MODEL 10AFIFO SETUP

3. Refer to Fig. 3.A.8.2 and locate the two blocks of PROTOCOL JUMPER PINS on the 10AFIFO board (there are four sets of "triple-header" Berg pins and eight pairs of "double-header" Berg pins).
4. Set **BAUD RATE** for both transmission and reception of data by selecting the appropriate rate from the eight standard values shown in Fig. 3.A.8.2. Connect the corresponding pair of pins with the jumper supplied. All other Baud-rate pin pairs should be left unconnected.
5. Set **NUMBER OF DATA BITS**, **NUMBER OF STOP BITS**, and **PARITY** by connecting appropriate "triple-header" jumper pins as indicated in Fig. 3.A.8.3.
6. Reinsert the 10AFIFO card in the DataPAC and reactivate power.

Fig. 3.A.8.3 10AFIFO DATA BITS, STOP BITS, and PARITY Settings



b. SETTING COMMAND, OUTPUT, AND END-OF-TRANSMISSION TERMINATORS FOR THE FIFO COMPUTER PORT: **CMT**, **OPT**, AND **EOT** COMMANDS

————IMPORTANT————

THE COMMANDS DISCUSSED IN THIS SECTION ASSUME THAT

- THE 10AFIFO HAS BEEN CONNECTED TO THE DATAPAC'S 10ACP100 *BEFORE* THE DATAPAC IS POWERED UP; AND THAT
- THE 10AFIFO IS *NOT DISCONNECTED* FROM THE DATAPAC'S 10ACP100 WHILE THE DATAPAC IS ON.

WHILE THE 10AFIFO IS CONNECTED TO THE DATAPAC'S 10ACP100, THE "WRITE" FORM OF THE **COMMAND TERMINATOR (CMT)**, **OUTPUT TERMINATOR (OPT)**, OR **END-OF-TRANSMISSION (EOT)** COMMAND SHOULD *NOT* BE ENTERED VIA THE DATAPAC'S PLUG-IN KEYBOARD.

1. 10AFIFO COMMAND TERMINATOR

As explained in Section 2.B.5 of this Guidebook, the COMMAND TERMINATOR for the DataPAC's COMPUTER INTERFACE PORT is a single ASCII character which will be recognized by the DataPAC as the valid termination of any and all MNEMONIC COMMANDS received at that port. Prior to shipment, all DataPACs are set for a COMMAND TERMINATOR of **CARRIAGE RETURN ([CR])**.

The Model 10AFIFO also requires a COMMAND TERMINATOR, which it will recognize as the valid termination of any and all MNEMONIC COMMANDS received at its FIFO COMPUTER PORT.

ON POWERUP, THE 10AFIFO'S COMMAND TERMINATOR WILL BE AUTOMATICALLY SET TO THE EXISTING DATAPAC COMMAND TERMINATOR (assuming, again, that the 10AFIFO has been connected to the DataPAC's 10ACP100 prior to powerup). For interrogating the DataPAC for its current COMMAND TERMINATOR, see Section 2.B.5(c) of this Guidebook.

If required for proper communication with the connected RS-232-C device, you may subsequently reset *both* the 10AFIFO COMMAND TERMINATOR *and* the DATAPAC COMMAND TERMINATOR to the same ASCII CONTROL CHARACTER "c" by entering the following **COMMAND TERMINATOR (CMT)** command via the FIFO COMPUTER PORT:

CMT = c [CR] *

Note that the 10AFIFO's EEPROM Switch must be turned ON before this command is entered, via a **BIT 999 = 1** command terminated with the existing COMMAND TERMINATOR (see Section b.1, above); the DataPAC's EEPROM Switch must *also* be ON for the **CMT** command to be effective.

The specified COMMAND TERMINATOR ("c") must be a character from "[00]" through "[1F]"—i.e., it must be an ASCII CONTROL CHARACTER entered as a hexadecimal word in brackets (see Table 1.H.2, Section 1.H of this Guidebook).

Again, application of the above command will change to the same character "c" the 10AFIFO COMMAND TERMINATOR *and* the DataPAC COMMAND TERMINATOR.

3.A.8.b

MODEL 10AFIFO SETUP

You may at any time interrogate the 10AFIFO for its—and the DataPAC's—currently effective COMMAND TERMINATOR. Simply enter, via the FIFO COMPUTER PORT, a **CMT "READ"** COMMAND *terminated by CARRIAGE RETURN*:

CMT [CR]

The answer will be returned immediately from the FIFO COMPUTER PORT. Note that the terminating CARRIAGE RETURN for this command *will be recognized as such by the 10AFIFO*, regardless of the actual COMMAND TERMINATOR presently in effect.

2. 10AFIFO OUTPUT TERMINATOR

It was noted above that the Model 10AFIFO has an OUTPUT TERMINATOR independent of the DataPAC's OPT, which must be *fixed* at LINE FEED for operation with the 10AFIFO. (As explained in Section 1.H.3(g) of this Guidebook, an OUTPUT TERMINATOR for a given communications port is a string of one or two ASCII characters which will be issued from that port at the end of every *line* of output (i.e., every data transmission for a single channel)).

The 10AFIFO's OUTPUT TERMINATOR is preset, prior to shipment, at **LINE FEED, CARRIAGE RETURN ([LF][CR])**. If intercommunication with the connected RS-232-C device requires that the 10AFIFO have an OPT different from [LF][CR], you may reset it by entering the following **OUTPUT TERMINATOR (OPT)** command via the FIFO COMPUTER PORT, after the 10AFIFO EEPROM has been enabled (Section b.1):

OPT = \$ [CR] *

Any ASCII CONTROL CHARACTER in the one-or-two-character string "\$" must be entered as a hexadecimal word in brackets—see Table 1.H.2. NOTE THAT THIS COMMAND ALSO SETS TO THE SAME STRING "\$" THE 10AFIFO'S END-OF-TRANSMISSION (EOT) TERMINATOR (see the following section).

3. 10AFIFO END-OF-TRANSMISSION TERMINATOR

It was noted above that the Model 10AFIFO has an END-OF-TRANSMISSION TERMINATOR independent of the DataPAC's EOT, which must be *fixed* at CARRIAGE RETURN for operation with the 10AFIFO. (As explained in Section 1.H.3(g) of this Guidebook, the END-OF-TRANSMISSION TERMINATOR for a given communications port is a string of one to four ASCII characters which will be issued at the end of every *complete transmission* from that port, including every interrogation response.)

The 10AFIFO's END-OF-TRANSMISSION TERMINATOR is preset, prior to shipment, at **CARRIAGE RETURN, 3 LINE FEEDS ([CR][LF][LF][LF])**. If you require this EOT to be different from [CR][LF][LF][LF]—or to be different from the string "\$" specified by a previous **OUTPUT TERMINATOR (OPT)** command applied to the 10AFIFO—you may reset it by entering the following **END OF TRANSMISSION (EOT)** command via the FIFO COMPUTER PORT, after the 10AFIFO EEPROM has been enabled (Section b.1):

EOT = \$ [CR] *

As with the **OPT** command (above), any ASCII CONTROL CHARACTER in the one-to-four-character string "\$" must be entered as a hexadecimal word in brackets—see Table 1.H.2.

5. SETTING 10AFIFO INPUT MODE: **DDI** AND **NDI** COMMANDS

————NOTE————

Any "complete" (EOT-terminated) transmission from the DataPAC's COMPUTER INTERFACE PORT will be referred to in this and the following sections as a "DATA RECORD."* A given DATA RECORD may be a *response* to a DataPAC interrogation or to a special "communications" imperative such as **SND**, **ITR**, etc—or it may consist of a full "data set" of one or more per-channel output "lines" produced in response to a command of **DMP**, **STR**, **HCY**, etc.

The 10AFIFO can operate in either of two INPUT MODES:

- a. **DESTRUCTIVE DATA INPUT** ("CYCLIC") MODE: the 10AFIFO main memory receives and stores consecutive DATA RECORDS from the DataPAC's COMPUTER INTERFACE PORT *continuously*, rewriting over the oldest contents of the memory when it is full; or
- b. **NONDESTRUCTIVE DATA INPUT** ("FILL") MODE: the 10AFIFO main memory receives and stores consecutive DATA RECORDS from the DataPAC's COMPUTER INTERFACE PORT *until the memory is full*, after which it will receive and store a DATA RECORD from the 10ACP100 only when the required memory space becomes available.

To place the 10AFIFO in "CYCLIC" INPUT MODE, enter a **DESTRUCTIVE DATA INPUT (DDI)** command via the FIFO COMPUTER PORT, after the 10AFIFO EEPROM Switch has been turned ON:

DDI [CR] *

To place the 10AFIFO in "FILL" INPUT MODE, enter a **NONDESTRUCTIVE DATA INPUT (NDI)** command:

NDI [CR] *

————NOTE————

While the "FIFO bypass" is ON, the current 10AFIFO "INPUT MODE" will be suppressed, since all inputs will now bypass the main memory altogether (see Section c.3, below). Thus, the application of either **DDI** or **NDI** will have no apparent effect at this time. The command will, however, set the "INPUT MODE" that will be effective as soon as the bypass is turned OFF. For interrogation of INPUT-MODE status, see the **MODE (MOD)** command, Section c.6.

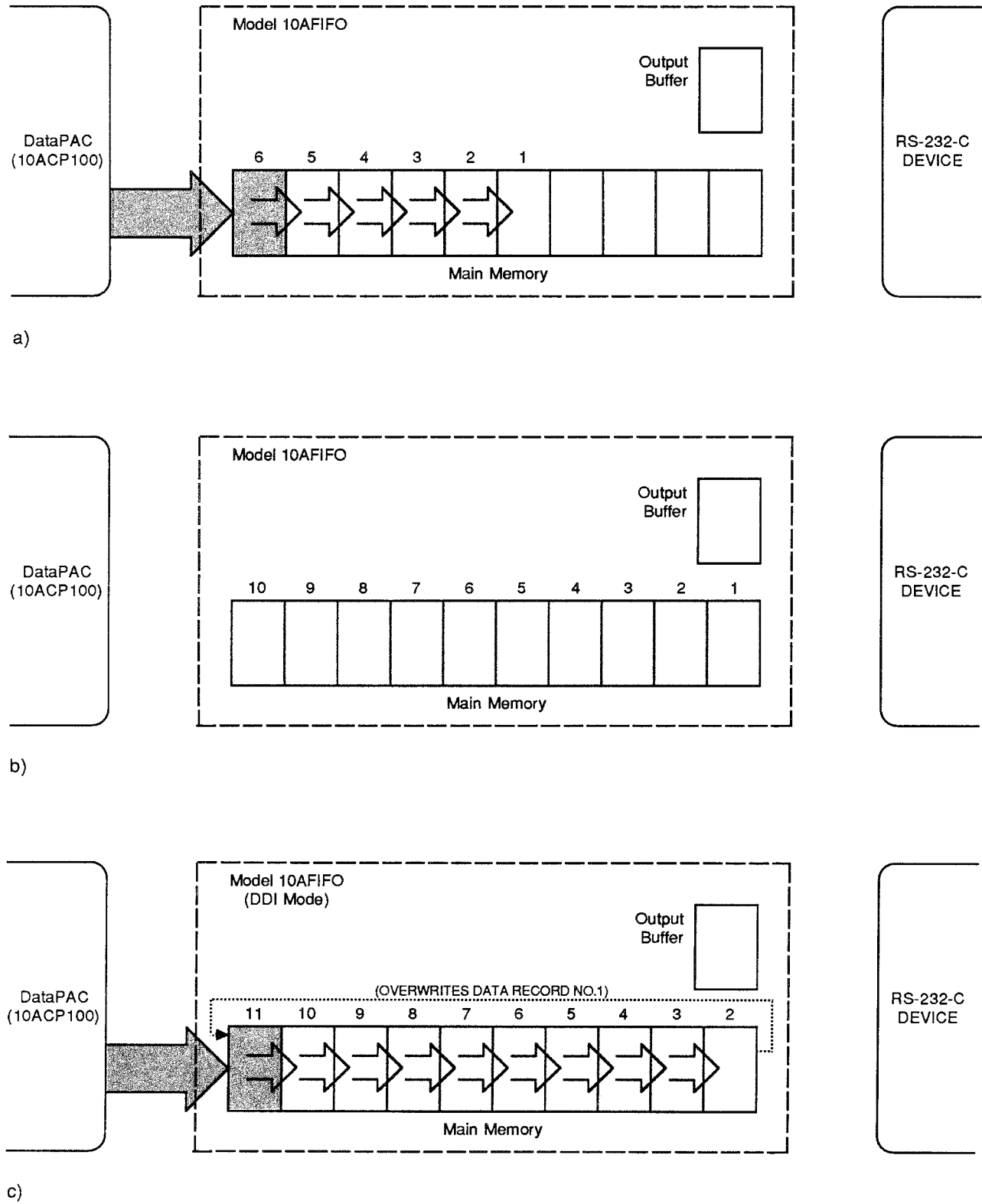
In the 10AFIFO represented by Fig. 3.A.8.4(a), the main memory presently contains six DataPAC-transmitted DATA RECORDS, the oldest ("FIRST-IN") being that which is numbered as "1." In this simplified diagram, the main memory is capable of holding four more DATA RECORDS. In Fig. 3.A.8.4(b), the memory is seen to be full. If at this point the **DDI** command is in effect, transmission of the next DATA RECORD (No. 11) from the DataPAC's COMPUTER INTERFACE PORT will cause the 10AFIFO's DATA RECORD No. 1 to be irretrievably lost (see Fig. 3.A.8.4(c)). If, however, the **NDI** command is in effect, the 10AFIFO will be unable to accept DATA RECORD No. 11 until such time as the outputting of DATA RECORD No. 1 makes room for it.

* Note that when the "FIFO bypass" is ON—i.e., when a command of **BYP = ON [CR]** is in effect (see Section 3.A.8(c.3))—a "DATA RECORD" is any transmission from the DataPAC's COMPUTER INTERFACE PORT that is terminated by *either* an EOT (END-OF-TRANSMISSION TERMINATOR) *or* an OPT (OUTPUT TERMINATOR).

3.A.8.b

MODEL 10AFIFO SETUP

Fig. 3.A.8.4 Inputting of Data Records



6. SETTING 10AFIFO OUTPUT MODE: **XEN** AND **XDS** COMMANDS

The 10AFIFO can operate in either of two OUTPUT MODES:

- a. **TRANSMISSION ENABLE** ("OPEN") MODE: the 10AFIFO will *continuously transmit* from its output buffer the oldest ("FIRST-IN") contents of its main memory; or
- b. **TRANSMISSION DISABLE** ("GATED") MODE: the 10AFIFO will transmit *only when and as instructed by one of the two following "RUN-TIME" COMMANDS: **DESTRUCTIVE DATA OUTPUT (DDO)** or **NONDESTRUCTIVE DATA OUTPUT (NDO)***. Described in Section c.1, below, each of these commands may be used to initiate the transmission of a *single DATA RECORD* only.

To place the 10AFIFO in "OPEN" OUTPUT MODE, enter a **TRANSMISSION ENABLE (XEN)** command via the FIFO COMPUTER PORT:

XEN [CR]

To place the 10AFIFO in "GATED" OUTPUT MODE, enter a **TRANSMISSION DISABLE (XDS)** command:

XDS [CR]

Both **XEN** and **XDS** are "RUN-TIME" COMMANDS and do not require the 10AFIFO's EEPROM to be enabled. The "GATED" OUTPUT MODE (**XDS**) is in effect, by default, on powerup.

——NOTE——

While the "FIFO bypass" is ON, the current 10AFIFO "OUTPUT MODE" will be suppressed (see Section c.3, below). Thus, the application of either **XEN** or **XDS** will have no apparent effect at this time. The command will, however, set the "OUTPUT MODE" that will be effective as soon as the bypass is turned OFF. For interrogation of OUTPUT-MODE status, see the **MODE (MOD)** command, Section c.6.

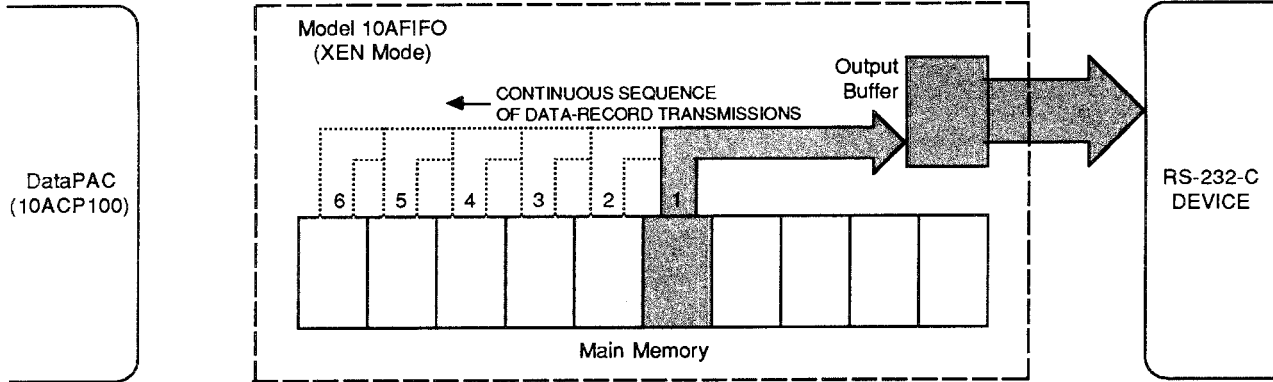
Fig. 3.A.8.5 shows a 10AFIFO that has been placed in "OPEN" OUTPUT (**XEN**) MODE. The 10AFIFO is in the process of transferring to its output buffer a copy of the oldest ("FIRST-IN") DATA RECORD in its main memory. From the output buffer, this DATA RECORD copy is immediately transmitted to the receiving device. In this mode, the transmission of a copy of DATA RECORD No. 1 will be immediately followed by the transmission of a copy of DATA RECORD No. 2, and then of No. 3, and so on. The original DATA RECORDS remain in the main memory (until the memory is full and new inputs are received), from which they may be retransmitted at any time following a **REACCESS FIFO MEMORY (RFM)** command (see Section c.4, below).

Figs. 3.A.8.6 and 3.A.8.7, below, show the effects of the **DDO** and **NDO** commands when the 10AFIFO is in "GATED" OUTPUT (**XDS**) MODE. Note that if a DATA RECORD is being transmitted when the **XDS** command is entered, that DATA RECORD will be transmitted in full.

3.A.8.b

MODEL 10AFIFO SETUP

Fig. 3.A.8.5 10AFIFO in "OPEN" Output (XEN) Mode



1. INITIATING 10AFIFO TRANSMISSIONS IN "GATED" OUTPUT MODE

a. DESTRUCTIVE DATA OUTPUT: DDO COMMAND

When the 10AFIFO is in "GATED" OUTPUT (XDS) MODE, a **DESTRUCTIVE DATA OUTPUT (DDO)** command of

DDO [CR]

—entered via the FIFO COMPUTER PORT *while the "FIFO bypass" is OFF*—will cause the 10AFIFO to output a copy of the oldest ("FIRST-IN") DATA RECORD in its main memory via the output buffer, one time only, and *to retain this DATA RECORD in the output buffer, having first destroyed the previous output-buffer contents.*

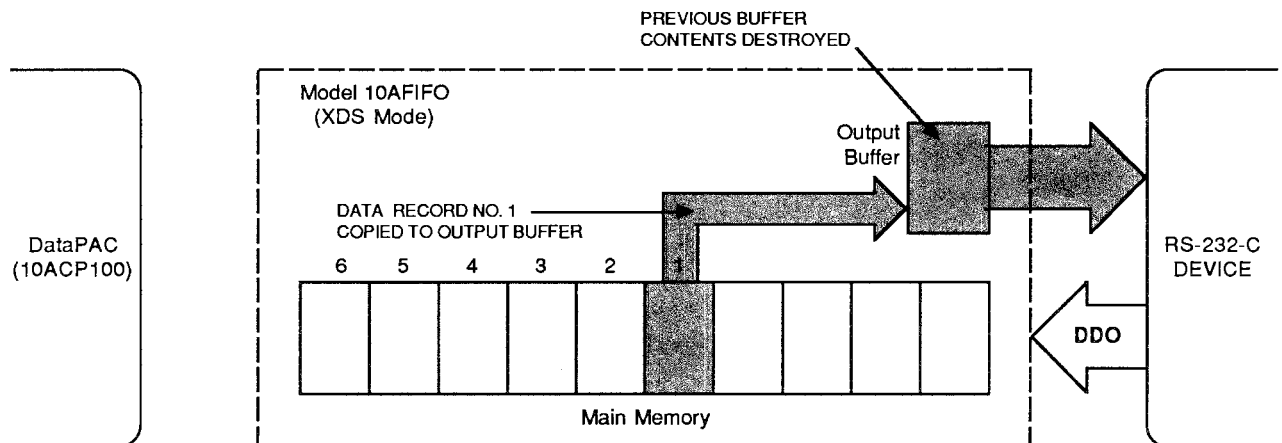
From the output buffer, the "FIRST-IN" DATA RECORD initially transmitted in response to the **DDO** command may be retransmitted one or more times via one or more **NDO** commands (below)—until another **DDO** command is entered.

—————**NOTE**—————

If **DDO** is entered *while the "FIFO bypass" is ON* (see Section c.3, below), it will have no immediate effect, but will be executed as soon as the bypass is turned OFF.

Fig. 3.A.8.6 shows the effects of the **DDO** command. A copy of the oldest DATA RECORD is transferred to the 10AFIFO output buffer, from which it is transmitted (once) and in which it is then retained. The original DATA RECORD remains in the FIFO main memory itself (until the memory is full and a new input is received), from which it may be reaccessed at any time (see the **REACCESS FIFO MEMORY (RFM)** command, Section c.4, below).

Fig. 3.A.8.6 Destructive Data Output (DDO)



3.A.8.c

MODEL 10AFIFO OPERATION

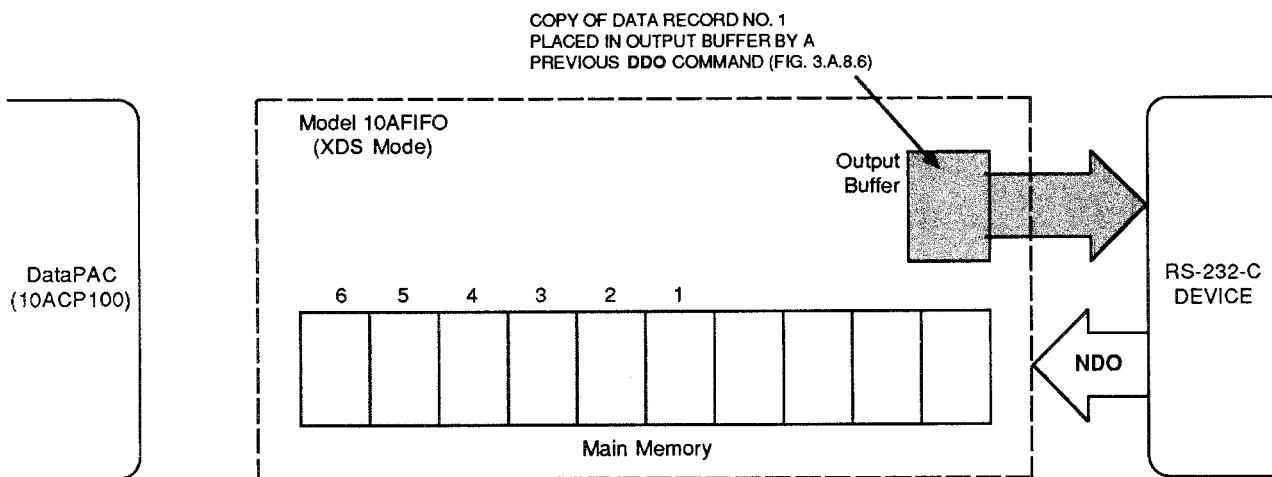
b. NONDESTRUCTIVE DATA OUTPUT: **NDO** COMMAND

When the 10AFIFO is in "GATED" OUTPUT (**XDS**) MODE, a **NONDESTRUCTIVE DATA OUTPUT (NDO)** command of

NDO [CR]

—entered at any time during normal operation via the FIFO COMPUTER PORT—will cause the 10AFIFO to output the *existing contents of the output buffer*, one time only, without destroying these contents and without affecting the contents of the 10AFIFO main memory (see Fig. 3.A.8.7). The **NDO** command may be reapplied any number of times, retransmitting the same output-buffer contents each time, until a subsequent **DDO** command replaces the existing buffer contents with a copy of the oldest DATA RECORD in the 10AFIFO main memory.

Fig. 3.A.8.7 Nondestructive Data Output (NDO)



NOTE

Unlike the **DDO** command, **NDO** will work *when the "FIFO bypass" is ON* (see Section c.3, below).

2. HALTING AND RESTARTING 10AFIFO TRANSMISSIONS

In either OUTPUT MODE (**XEN** or **XDS**), the 10AFIFO can be made to *halt* any transmission in progress—and to inhibit any further transmissions—by issuing an ASCII **DC1** character (hexadecimal **11**) to the 10AFIFO via the FIFO COMPUTER PORT (on some devices, this character can be generated by the **XOFF** key and/or **CONTROL S** key sequence).

To then *resume* 10AFIFO transmissions, you may issue an ASCII **DC3** character (hexadecimal **13**, which can be generated on some devices by **XON** and/or **CONTROL Q**).

3. BYPASSING THE 10AFIFO MAIN MEMORY: **BYP** COMMAND

As mentioned in Section a, the 10AFIFO will automatically pass on to the DataPAC all MNEMONIC COMMANDS received at the FIFO COMPUTER PORT which do not apply to the 10AFIFO itself. If any such command calls for a *response* from the DataPAC—as, for example, do all "READ" COMMANDS—that response will normally be sent to the 10AFIFO by the DataPAC, just like any other output from the DataPAC's COMPUTER INTERFACE PORT. This means that, in cases where the 10AFIFO main memory already contains previously transmitted DATA RECORDS, *the interrogation response will not be immediately available to the interrogating device*, which must wait until the requested answer "gets its turn" to be transmitted.

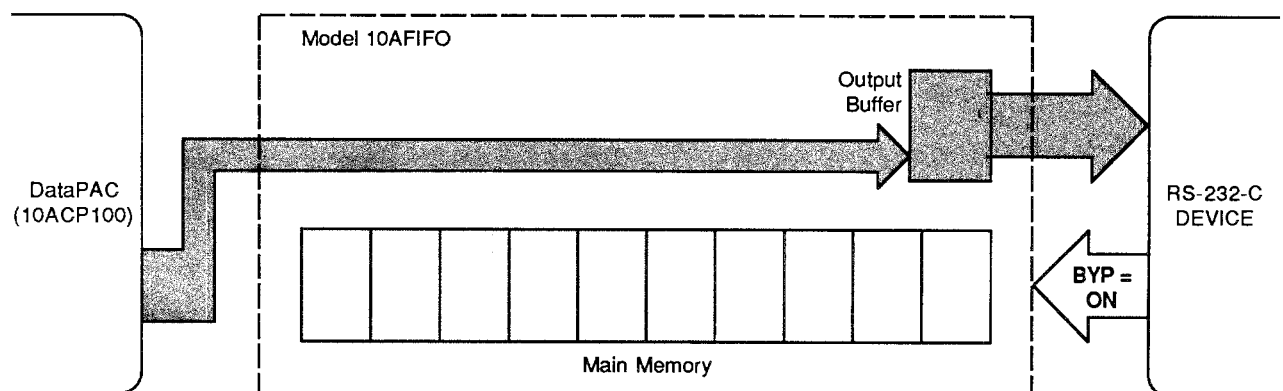
However, by means of the **BYPASS (BYP)** command, you may allow a DataPAC interrogation response to bypass the 10AFIFO's main memory altogether, as shown in Fig. 3.A.8.8. Thus, a command of

BYP = ON [CR]

entered via the FIFO COMPUTER PORT causes any and all subsequent output from the DataPAC's COMPUTER INTERFACE PORT to be transferred *directly and continuously* to the 10AFIFO's output buffer, from which it is immediately transmitted to the external device. As with the **DDO** command, the previous contents of the output buffer will be destroyed.

When the "bypassed" DataPAC output comes to an end, the last DATA RECORD in this output will be *retained in the 10AFIFO output buffer*.* This DATA RECORD may then be retransmitted by a **NONDESTRUCTIVE DATA OUTPUT (NDO)** command—until another DataPAC output is transferred to the buffer, or (if the bypass is then turned OFF) until a **DESTRUCTIVE DATA OUTPUT (DDO)** command is next applied.

Fig. 3.A.8.8 FIFO Bypass



————NOTE————

While the **BYP = ON [CR]** command is in effect, the standard 10AFIFO INPUT and OUTPUT MODES (**DDI**, **NDI**, **XEN**, and **XDS**) are suppressed. The corresponding commands, if applied at this time, will have no apparent effects, though they will in fact set the MODES that *will* be effective as soon as the bypass is turned OFF. Also, the **DESTRUCTIVE DATA OUTPUT (DDO)** command, when entered while the bypass is ON, will have no effect until the bypass is turned OFF.

* Note that when the "FIFO bypass" is ON—i.e., when a command of **BYP = ON [CR]** is in effect (see Section 3.A.8(c.3))—a "DATA RECORD" is any transmission from the DataPAC's COMPUTER INTERFACE PORT that is terminated by *either* an EOT (END-OF-TRANSMISSION TERMINATOR) *or* an OPT (OUTPUT TERMINATOR).

To cancel the "FIFO bypass," enter a command of

BYP = OFF [CR]

via the FIFO COMPUTER PORT. All DataPAC outputs are again received and stored in the 10AFIFO's main memory; all standard INPUT and OUTPUT MODES are again applicable.

4. REACCESSING 10AFIFO MEMORY: **RFM** COMMAND

Until a DATA RECORD in 10AFIFO storage has been overwritten by a newly received input from the DataPAC's 10ACP100—or until a **FIFO CLEAR (FCL)** command has been entered—that DATA RECORD can be reaccessed at any time, *even if a copy of it has already been transmitted one or more times from the 10AFIFO output buffer*. Simply enter, via the FIFO COMPUTER PORT, a **REACCESS FIFO MEMORY (RFM)** command of

RFM [CR]

If the 10AFIFO is in "OPEN" OUTPUT (**XEN**) MODE, it will retransmit all DATA RECORDS in its main memory, starting with the oldest ("FIRST IN"). If it is in "GATED" OUTPUT (**XDS**) MODE, it will retransmit the oldest DATA RECORD in memory when the **DESTRUCTIVE DATA OUTPUT (DDO)** command is next entered.

The **RFM** command allows verification of 10AFIFO transmissions, and may be re-entered any number of times to produce successive retransmissions of 10AFIFO memory contents.

5. CLEARING 10AFIFO MEMORY: **FCL** COMMAND

In accordance with high-security requirements, the **FIFO CLEAR (FCL)** command permits "true erasure" of all contents of the 10AFIFO memory (including any contents of the output buffer), by means of a physical overwrite technique. Simply enter, via the FIFO COMPUTER PORT, a command of

FCL [CR]

This command makes impossible the subsequent retransmission of 10AFIFO contents via the **REACCESS FIFO MEMORY (RFM)** command (above).

6. INTERROGATING FOR INPUT/OUTPUT MODE: **MOD** COMMAND

To read the 10AFIFO's current INPUT MODE and OUTPUT MODE, enter via the FIFO COMPUTER PORT a **MODE (MOD)** command of

MOD [CR]

This interrogation will return an answer of "i, o." Here, "i" (INPUT MODE) may be either **DDI** (DESTRUCTIVE DATA INPUT) or **NDI** (NONDESTRUCTIVE DATA INPUT)—see Section b.5, above; "o" (OUTPUT MODE) may be either **XEN** (TRANSMISSION ENABLE) or **XDS** (TRANSMISSION DISABLE)—see Section b.6.

7. CHECKING DATA INTEGRITY: CSF COMMAND

As a diagnostic tool for assurance of data integrity, the **CHECKSUM FIFO (CSF)** command can be used to perform checksum tests on (1) the 10AFIFO's 256K CODE EPROM; (2) the 8K EEPROM for working-parameter storage; and (3) the main FIFO memory and output buffer memory (6 x 256K RAM).

The checksum value of the 10AFIFO's existing EEPROM contents and the checksum value of its existing RAM contents will both be stored when you apply a command of

CSF = SUM [CR]*

Note that a checksum reference for the 10AFIFO's CODE EPROM has been prestored at the factory.

Applying a subsequent command of

CSF [CR]

will return the following three-part answer:

[Field 1], [Field 2], [Field 3] [EOT]

"Field 1" indicates the checksum status of the 10AFIFO CODE EPROM. If the checksum is equal to the prestored value, the field will contain the word "PASSED"; if not, it will contain some 4-character hexadecimal word (e.g., 1CE4). THE APPEARANCE OF AN ACTUAL HEXADECIMAL VALUE IN "FIELD 1" INDICATES A POSSIBLE HARDWARE PROBLEM. CONTACT THE DAYTRONIC CUSTOMER SUPPORT SERVICES DEPARTMENT FOR SPECIFIC INSTRUCTIONS.

"Field 2" indicates the checksum status of the 10AFIFO EEPROM. If the checksum is equal to the value stored by the last **CSF = SUM [CR]*** command, "Field 2" will contain the word "PASSED." If the EEPROM contents have changed since the last **CSF = SUM [CR]*** command, the field will contain some 4-character hexadecimal word.

"Field 3" indicates the checksum status of the 10AFIFO RAM. If the checksum is equal to the value stored by the last **CSF = SUM [CR]*** command, "Field 3" will contain the word "PASSED." If the RAM contents have changed since the last **CSF = SUM [CR]*** command, the field will contain some 4-character hexadecimal word.

Section 3.A.9

PID Loop Control:
Model 10A PID
Loop Control Card



System 10 Guidebook

3.A.9.a

INTRODUCTION

The Model 10APID operates on *process set-point* and *feedback* input signals to provide a fast, selectively damped ± 7 V-DC ERROR SIGNAL OUTPUT. This output may be used to drive a motor, pump, solenoid valve, relay, temperature controller, or other servo equipment. The set-point input is user-adjustable, while the feedback input represents the *measured process variable to be "controlled"*—temperature, pressure, position, etc. (see the basic *closed-loop* arrangement shown in Fig. 3.A.9.2, below).

In the following discussion, the 10APID's set-point input will be referred to as the **COMMAND (INPUT)** and the feedback input as the **RESPONSE (INPUT)**. The fastest loop response characteristics are obtained when COMMAND and RESPONSE inputs are both "*real-time*" *analog signals*. This permits continuous error-sensing feedback independent of the DataPAC's internal scan speed. In this case—as explained in Section c.5, below—the 10APID may receive its COMMAND and RESPONSE signals either via hardwire connection to the DataPAC's analog motherboard (when the signal source is internal to the DataPAC system) or via the card's rear 20-pin I/O CONNECTOR (when the source is external).

The COMMAND and RESPONSE inputs may also be established *digitally*, as standard system DATA CHANNELS. This permits them to be directly loaded by the operator or computer, or to represent continuous arithmetic functions of *other* system channels that report either constant or variable data. In this case, COMMAND and RESPONSE values may be easily set and/or modified by means of the **ANALOG OUTPUT (ANO)** command, as explained below. Although the overall control-loop response time is now limited by the scan rate of the DataPAC's CENTRAL PROCESSOR, this will not be a problem in most applications, since this rate is typically over 2500 channels per second.

Finally, the COMMAND and RESPONSE inputs may be *mixed*, if required (i.e., one *analog*, the other *digital*).

Regardless of their respective sources, the 10APID's COMMAND and RESPONSE inputs are continuously available as ± 5 V-DC *analog outputs* both from wirewrap pins on the DataPAC motherboard and from the 10APID's rear I/O CONNECTOR (see Fig. 3.A.9.4). They may thus be read by other signal-processing and/or display elements either internal or external to the DataPAC system.

Derived from the arithmetic *difference* between the COMMAND and RESPONSE inputs, the ERROR SIGNAL produced by the 10APID is continuously available as an analog output from the rear I/O CONNECTOR only, for direct connection to the process actuator. You can easily and precisely adjust the 10APID's **PROPORTIONAL (P)**, **INTEGRAL (I)**, and **DERIVATIVE (D)** coefficients *to tailor the characteristics of the ERROR SIGNAL to your specific control application*. This procedure, known as "tuning the loop," is detailed in Section c.8, below. In general, you will want to make the ERROR SIGNAL output react as fast to a change in the COMMAND and/or RESPONSE input as the actuator to which it is issued allows or requires.

Section c.2 describes how the "P," "I," and "D" factors actually operate upon the ERROR SIGNAL, and discusses selection of the "PROPORTIONAL (P) MODE" best suited to your application.

The COMMAND and RESPONSE inputs, as well as the INTEGRAL and DERIVATIVE coefficients, may each be "clamped" to individual *high and low limit values*, in order to protect your servomechanism—and to safeguard the process itself—in the event that the input or coefficient in question violates its normal operating range. Clamp limits are preset by the operator, using on-board potentiometer controls, and may be displayed by the DataPAC as standard DATA CHANNELS.

In addition to these "clamp" limit settings, a DataPAC with LCD or CRT video capability can, if desired, display "live" values of the 10APID's COMMAND and RESPONSE inputs; of the PROPORTIONAL, INTEGRAL, and DERIVATIVE coefficients; and of the ERROR SIGNAL output—but only when a scanned system DATA CHANNEL has been "located" to the 10APID SUBCHANNEL that corresponds to the value to be displayed (see the following section).

The Model 10APID's eight SUBCHANNELS function as follows:

Subchannel Number	Function
1	COMMAND "CLAMP" HIGH LIMIT
2 (if TYPE "E0" or "E1") (if TYPE "55")	INTEGRAL (I) COEFFICIENT (± 127 mV) RESPONSE "CLAMP" HIGH LIMIT
3 (if TYPE "E0" or "E1") (if TYPE "55")	PROPORTIONAL (P) COEFFICIENT (± 127 mV) INTEGRAL "CLAMP" HIGH LIMIT
4 (if TYPE "E0" or "E1") (if TYPE "55")	DERIVATIVE (D) COEFFICIENT (± 127 mV) DERIVATIVE "CLAMP" HIGH AND LOW LIMIT
5 (if TYPE "E0" or "E1") (if TYPE "55")	COMMAND INPUT (± 5000 mV) COMMAND "CLAMP" LOW LIMIT
6 (if TYPE "E0" or "E1") (if TYPE "55")	RESPONSE INPUT (± 5000 mV) RESPONSE "CLAMP" LOW LIMIT
7	INTEGRAL "CLAMP" LOW LIMIT
8	ERROR SIGNAL OUTPUT

Note that, except for SUBCHANNEL Nos. 1, 7, and 8, all 10APID SUBCHANNELS are "shared" between an analog *input* function (i.e., a particular "CLAMP" LIMIT) and an analog *output* function (COMMAND, RESPONSE, INTEGRAL, PROPORTIONAL, or DERIVATIVE—as defined by a corresponding ANALOG OUTPUT (ANO) command).

Thus, to each "shared" SUBCHANNEL you may "LOCATE" *two* distinct system DATA CHANNELS. These two channels will be distinguished by the DataPAC's CENTRAL PROCESSOR according to their respective "TYPE" designations.

For example, if you wish your DataPAC's Channel No. 93 to represent the 10APID's INTEGRAL (I) COEFFICIENT and Channel No. 56 to represent the RESPONSE "CLAMP" HIGH LIMIT, you will need to "LOCATE" *both* Channel No. 93 *and* Channel No. 56 to SUBCHANNEL No. 2 of the A SLOT occupied by your 10APID card (for channel "locating" via the LOCATE (LCT) command, see Section 1.G.2(d) of this Guidebook). These two channels, however, must be differently "TYPED": Channel 56 (the "CLAMP" channel) *must* have a "TYPE" designation of "55" (direct millivolt reading of the DataPAC's Called Signal Bus, with $m = 5000$ and $b = 0$), whereas Channel 93 (INTEGRAL COEFFICIENT) *must* be "typed" either "E0" (ANALOG OUTPUT as a function of another system channel) or "E1" (constant-valued ANALOG OUTPUT). The "typing" and "locating" of 10APID channels will be further discussed in the relevant setup sections below.

3.A.9.c

MODEL 10APID SETUP

1. SETTING CLAMP LIMIT VALUES

----- NOTE -----

ALL 10APID "CLAMPS" ARE PRESET AT THE FACTORY TO THE ± 5 V-DC LIMITING RANGE, WHICH IS SATISFACTORY FOR MANY CONTROL APPLICATIONS. IF YOUR SERVO EQUIPMENT IS GENERALLY COMPATIBLE WITH THIS RANGE, YOU MAY IGNORE THIS SECTION AND PROCEED TO THE SECTION ENTITLED "SETTING PROPORTIONAL (P) MODE," BELOW. IF, HOWEVER, YOUR SERVO EQUIPMENT OPERATES AT A SIGNAL RANGE CONSIDERABLY LOWER THAN ± 5 V, YOU WILL MOST LIKELY WISH TO ADJUST ONE OR MORE CLAMP LIMITS TO A VALUE OR VALUES MORE APPROPRIATE FOR YOUR APPLICATION, VIA THE FOLLOWING PROCEDURE.

Note too that the DERIVATIVE CLAMP is *zero-centered*; since high and low limits for this CLAMP are always of equal magnitude but opposite polarity, you need only specify one limit value.

- a. Turn OFF the DataPAC's EEPROM Switch. Then turn OFF the DataPAC and *remove the 10APID Card from its SLOT* (for instructions on "Card Insertion and Removal," see Appendix B). The card is removed to prevent possible saturation of the INTEGRAL amplifier while CLAMP channels are being configured.
- b. Reactivate the DataPAC and turn ON the EEPROM Switch.
- c. Select a currently unused system DATA CHANNEL to dedicate to each 10APID "CLAMP LIMIT" you wish to adjust. The channels you select need not form a continuous range. All of them must, however, be included in your DataPAC's present SCAN RANGE, *at least for the duration of the CLAMP-setting procedure*. In most cases, you will neither need nor want to continue updating these CLAMP-LIMIT channels during normal operation, as this will reduce your system's overall scan speed. You may therefore wish at this point to enlarge your current SCAN RANGE *temporarily*, in order to include at its upper end those unused channels to which the CLAMP LIMITS are to be assigned. Then, following the limit-setting procedure, you can return the SCAN RANGE to its former size, thereby excluding the CLAMP-LIMIT channels from the scan cycle (see Section 1.F.1 of this Guidebook for alteration of SCAN RANGE via the TER and SCN commands). This method lets you retain the configured CLAMP-LIMIT channels within the system, without wasting time in unnecessarily scanning them. In the event that a CLAMP later needs to be altered, the SCAN RANGE can again be temporarily expanded to include the respective channel. If you do not wish to retain the CLAMP-LIMIT channels, you may permanently "relocate" them to other system data sources after all CLAMP LIMITS have been set.
- d. Make sure that each selected CLAMP-LIMIT channel has a present "TYPE" code of "55." Enter for each such channel (No. x) or range of channels (Nos. x through y) a command, respectively, of

TYP x = 55 [CR] * or TYP x TO y = 55 [CR] *

- e. Now "locate" each CLAMP-LIMIT channel to the corresponding 10APID SUBCHANNEL, via the LOCATE (LCT) command (for SUBCHANNEL numbering, see the table in the preceding section). If, for example, you have assigned the "RESPONSE" CLAMP LOW LIMIT (10APID SUBCHANNEL No. 6) to your DataPAC's Channel No. 139, and if the Model 10APID occupies A SLOT No. 8 of the DataPAC's Deck No. 2, you would command

LCT 139 = 2086 [CR] *

(see Section 1.G.2(d) for a full explanation of the "location" number).

3.A.9 PID Loop Control

- f. Now arrange to *display* the CLAMP-LIMIT channels you have just set up (see Section 1.G.5(a)).
- g. You will now scale each CLAMP-LIMIT channel to obtain a *direct millivolt reading*. For the channel (No. x) which you have just dedicated to the 10APID's "COMMAND CLAMP" HIGH LIMIT, you should enter the following **SCALING FACTOR (EMM)** and **ZERO OFFSET (BEE)** commands:

EMM x = 5000 [CR] *

BEE x = 0 [CR] *

These same two commands should also be entered for the channel now dedicated to the "COMMAND CLAMP" LOW LIMIT and the channel dedicated to the "DERIVATIVE CLAMP" HIGH AND LOW LIMITS. For the channel (No. x) dedicated to the 10APID's "INTEGRAL CLAMP" HIGH LIMIT, you should command

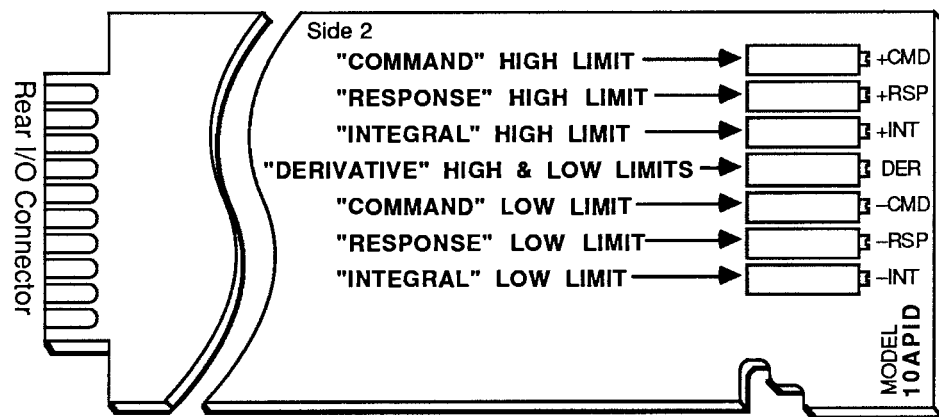
EMM x = -5000 [CR] *

BEE x = 0 [CR] *

These commands should also be entered for the channel dedicated to the "INTEGRAL CLAMP" LOW LIMIT.

- h. Again turn OFF the EEPROM Switch, and then turn OFF the DataPAC. Reinsert the Model 10APID in its SLOT, and reactivate the DataPAC.
- i. The 10APID's front-edge CLAMP-LIMIT CONTROLS are shown in Fig. 3.A.9.1, below. Use a small insulated screwdriver to turn the screw of the potentiometer control corresponding to each CLAMP LIMIT you wish to adjust, until the corresponding channel display shows a limit reading suitable for your control equipment.
- j. As mentioned above, unless for some reason you wish your effective CLAMP LIMITS to remain as "live" data, you may now wish either to exclude the CLAMP-LIMIT channels from your DataPAC's SCAN RANGE (via the TER or SCN command), or to reassign these channels to other data sources.

Fig. 3.A.9.1 10APID Clamp-Limit Controls



2. SETTING PROPORTIONAL (P) MODE

The Model 10APID can be set to either of two basic modes of operation. The mode you select will depend upon whether or not the measured process variable will respond to a given change in ERROR SIGNAL ("STIMULUS") in a relatively *predictable* way. This will be the case when the RESPONSE INPUT (i.e., the measured variable) depends on a single dominating parameter to the extent that a precise mathematical relationship may be expressed between the RESPONSE and the "stimulating" ERROR SIGNAL. If we represent the RESPONSE INPUT by the time function "r(t)" and the ERROR SIGNAL by the function "e(t)," then the dependence of r(t) on e(t) can be expressed by the function "F," such that

$$r(t) \equiv F(e(t))$$

The function F is known as the "transfer function" for the measured variable in question. If, for example, you know that the RESPONSE of your process in RPM is closely approximated by the square root of the *throttle position* (which is in turn continuously determined by the ERROR SIGNAL issued to the process), you could write the transfer function as

$$r(t) = \sqrt{e(t)}$$

This function has an "inverse" form, namely

$$e(t) = F^{-1}(r(t)) = r^2(t)$$

When the transfer function is well known and can be expressed as a mathematical function that has a natural "inverse," then your control loop can be quickly and approximately "closed" by replacing the PROPORTIONAL (P) term of the basic PID algorithm, given below, by the COMMAND INPUT c(t) as operated upon by this inverse function—that is, by "F⁻¹(c(t))." The procedure, explained in detail in Section c.4, involves the definition of the inverse function through one or more **CALCULATE (CLC)** commands. "Fine tuning" of the loop is then achieved by adjustment of the INTEGRAL (I) and DERIVATIVE (D) coefficients.

This is the "prebiased" or "VARIABLE P" mode of operation, and is set, as explained below, by disconnecting the 10APID's PROPORTIONAL amplifier from the COMMAND INPUT and connecting it to the +5-V reference (see Fig. 3.A.9.2). IN THIS MODE, YOU MUST USE THE 10APID'S DIGITAL COMMAND INPUT (see Section c.5).

Very often, however, a well-defined relationship between RESPONSE and ERROR SIGNAL will *not* be ascertainable, simply because there exist uncontrollable and often totally *unknown* variables that all contribute significantly to the behavior of the RESPONSE INPUT—variables such as ambient temperature, pressure, and humidity; random vibration or electrical noise; fluid viscosity; etc. When such is the case, you will "tune" your control loop by applying *arbitrary fixed values* of the "P," "I," and "D" coefficients, along with a constant COMMAND INPUT. Observing the resultant RESPONSE, you will then readjust the three coefficients as necessary. It is an essentially "trial and error" technique, as explained in Section c.8.

In this "FIXED P" mode of operation, the 10APID's ERROR SIGNAL OUTPUT "e(t)"—as a continuous function of the COMMAND INPUT "c(t)," the RESPONSE INPUT "r(t)," and the *fixed coefficients* "P," "I," and "D"—is given by the following equation:

$$e(t) = P \cdot c(t) + I \int [(c(t) + D \frac{dr}{dt}) - r(t)] dt$$

Here, the coefficient "P" is a *fixed percentage* of the COMMAND INPUT c(t). Representing 10APID operation in a simplified block diagram, Fig. 3.A.9.2 shows how the ERROR SIGNAL is arithmetically generated as the P, I, and D circuits act on the COMMAND and RESPONSE INPUTS.

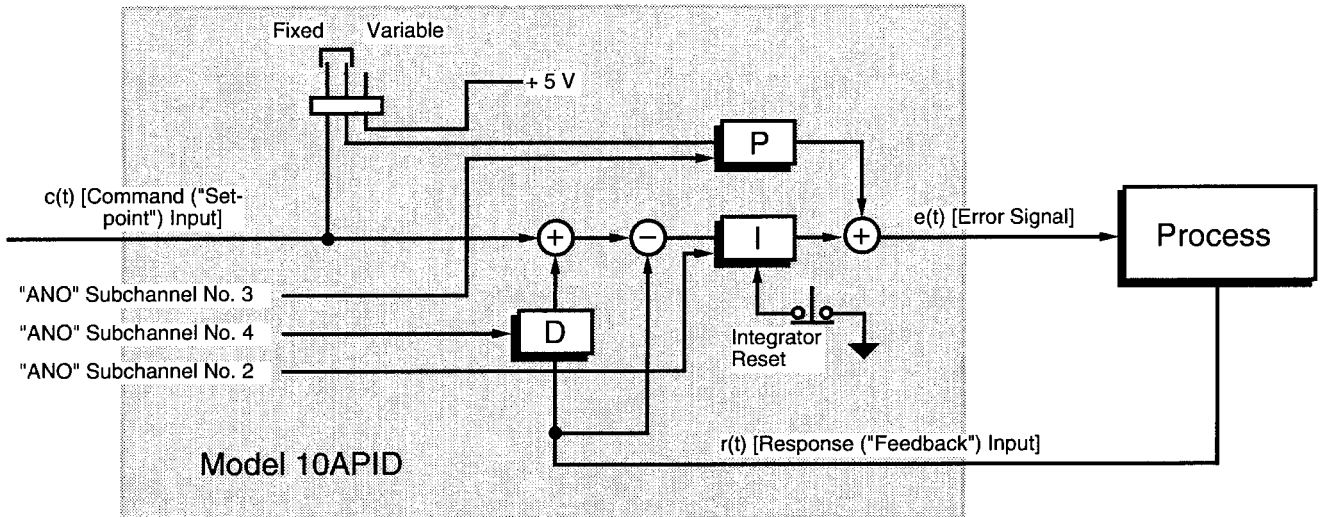


Fig. 3.A.9.2 10APID Simplified Block Diagram

----- NOTE -----

UNLESS OTHERWISE SPECIFIED, EVERY MODEL 10APID IS PRESET AT THE FACTORY FOR OPERATION IN THE "FIXED P" MODE. TO RESET THE CARD FOR "VARIABLE P" OPERATION, PERFORM THE FOLLOWING STEPS.

- a. Turn OFF the DataPAC's EEPROM Switch. Then turn OFF the DataPAC and remove the 10APID Card from its SLOT.
- b. Refer to Fig. 3.A.9.3 and locate the set of "P MODE" PROGRAMMING JUMPER PINS on the top (component) side of the card. A "minijumper" is provided for interconnecting any two adjacent jumper pins.
- c. Position the jumper as shown in Fig. 3.A.9.3 to set the 10APID to the desired "P MODE" (FIXED or VARIABLE).
- d. Reinsert the 10APID card in the DataPAC and reactivate the power.

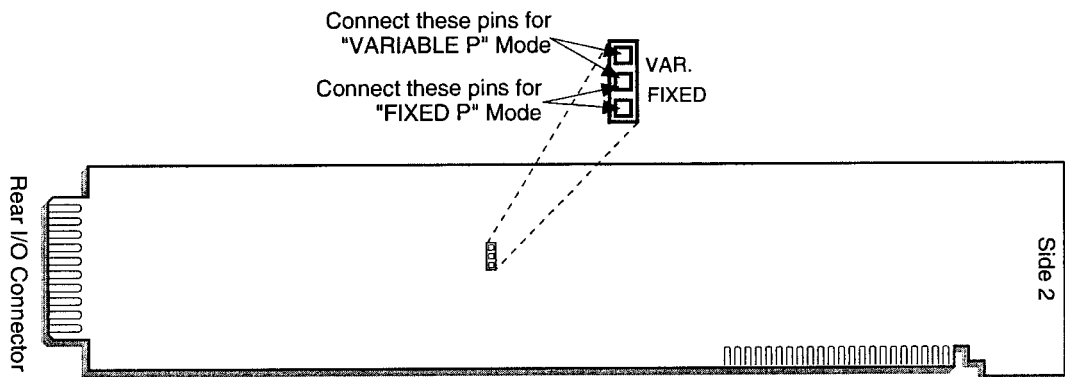


Fig. 3.A.9.3 10APID "P Mode" Jumper Pins

3.A.9.c

MODEL 10APID SETUP

----- CAUTION! -----

INITIAL "P," "I," AND "D" VALUES MUST BE ENTERED **BEFORE ANY INPUT AND OUTPUT CONNECTIONS ARE ACTUALLY MADE TO THE 10APID CARD**, REGARDLESS OF THE "P MODE" TO WHICH IT HAS BEEN SET (see the preceding section). THIS WILL PREVENT POSSIBLE SATURATION OF THE ERROR SIGNAL AND CONSEQUENT EQUIPMENT DAMAGE UPON ESTABLISHMENT OF THESE CONNECTIONS. THE PROCEDURE YOU FOLLOW, HOWEVER, *WILL* DEPEND ON THE "P MODE" YOU HAVE SELECTED.

3. SETTING INITIAL "P," "I," AND "D" VALUES FOR "FIXED P" OPERATION

- a. Select a presently unused system DATA CHANNEL No. x to dedicate to the 10APID's PROPORTIONAL (P) coefficient (SUBCHANNEL No. 3). This channel must be included in the DataPAC's present SCAN RANGE, *at least for the duration of the 10APID setup procedure*. See Step 3 under "SETTING CLAMP LIMIT VALUES," above. The remarks made there concerning temporary expansion of the SCAN RANGE to include CLAMP-LIMIT channels apply equally to "P," "I," and "D" channels in "FIXED P" MODE.

- b. Now "locate" the "P" channel to the 10APID's SUBCHANNEL No. 3, via the **LOCATE (LCT)** command. If, for example, you are assigning the "P" coefficient to system Channel No. 24, and if the Model 10APID occupies A SLOT No. 5 of the DataPAC's Deck No. 1, you would command

LCT 24 = 1053 [CR] *

(see Section 1.G.2(d) for a full explanation of the "location" number).

- c. Load the assigned "P" channel (No. x) with an *initial fixed value of zero* and assign to that channel a "TYPE" designation of "E1" by entering an **ANALOG OUTPUT (ANO)** command of the form

ANO x = 0 [CR] *

IMPORTANT: SINCE **ANO** IS AN "AUTOTYPING" COMMAND, YOU SHOULD *NOT* APPLY A SEPARATE **TYPE (TYP)** COMMAND TO CHANNEL NO. x.

- d. Select another unused channel within the current SCAN RANGE to dedicate to the 10APID's INTEGRAL (I) coefficient and "locate" this channel to the 10APID's SUBCHANNEL No. 2.

- e. Load the assigned "I" channel (No. y) with an *initial fixed value of 10* and assign it a "TYPE" code of "E1" by commanding

ANO y = 10 [CR] *

- f. Select a third channel to dedicate to the 10APID's DERIVATIVE (D) coefficient and "locate" it to SUBCHANNEL No. 4.

- g. Load the assigned "D" channel (No. z) with an *initial fixed value of zero* and assign it a "TYPE" code of "E1" by commanding

ANO z = 0 [CR] *

NOTE: You may at any time interrogate the DataPAC for the current value of any **ANO** Channel No. x that has been loaded with a *fixed (millivolt) value* by entering a "READ" command of the form

ANO x [CR]

(see also Section 3.A.2(b) of this Guidebook).

3.A.9 PID Loop Control

4. SETTING INITIAL "P," "I," AND "D" VALUES FOR "VARIABLE P" OPERATION

- a. Determine the *transfer function* of your process. As explained in Section c.2, above, this is the function "F" that relates the RESPONSE INPUT ("r(t)") to the ERROR SIGNAL ("e(t)") such that

$$r(t) \equiv F(e(t))$$

For example, suppose that the RPM response of a controlled motor is given by four times the square of the "stimulus" (ERROR SIGNAL) voltage, in mV. The transfer function could then be expressed as

$$r(t) = 4 (e^2(t))$$

- b. Now establish the *inverse* of the transfer function "F" by solving the transfer-function equation for e(t), thereby expressing the ERROR SIGNAL as a function "F⁻¹" of the RESPONSE INPUT:

$$e(t) = F^{-1}(r(t))$$

This is the function which, when applied to the system DATA CHANNEL dedicated to the COMMAND INPUT ("c(t)"), will determine the PROPORTIONAL (P) term of the operative PID algorithm. "F⁻¹" is applied to the COMMAND INPUT because the goal of this procedure is, after all, to make the RESPONSE INPUT approximately equal to the COMMAND INPUT:

$$r(t) \equiv c(t)$$

In our example, the desired "inverse" expression would be

$$e(t) = F^{-1}(r(t)) = \sqrt{1/4 r(t)} = 1/2 \sqrt{r(t)} \equiv 1/2 \sqrt{c(t)}$$

- c. Now select a presently unused system DATA CHANNEL within the SCAN RANGE and "locate" this channel to the 10APID's PROPORTIONAL (P) SUBCHANNEL (No. 3), as in Steps a and b of the preceding section. We will call this Channel No. p.
- d. Make sure that the 10APID is set for a *digital* COMMAND INPUT (refer to the following section for instructions). Note that unless otherwise specified, every 10APID is preset at the factory for a digital COMMAND INPUT and a digital RESPONSE INPUT. In "VARIABLE P" MODE, the RESPONSE INPUT may be either digital or analog.
- e. Select another unused channel within the SCAN RANGE, and "locate" it to the 10APID's COMMAND INPUT SUBCHANNEL (No. 5). We will call this Channel No. c.
- f. Select another unused channel (No. y) and enter a **CALCULATE (CLC)** command that defines this channel in terms of the "inverse" function F⁻¹ operating on Channel No. c. This command will have a *general* form of

$$\text{CLC } y = 6.50 [F^{-1}(c(t))] + 0 [\text{CR}] *$$

Note that the factor "6.50" is necessary to prevent possible saturation of the "P" SUBCHANNEL, whose effective range is only ± 127 mV. This number represents the inherent gain of the 10APID's "PROPORTIONAL" DAC, times an additional factor of "256." *As shown in the example below, it will be included in the SCALING FACTOR "m" to be entered in the actual CLC command, along with whatever constant coefficient belongs to the function F⁻¹ itself.*

For specific CLC command forms, see Section 2.J of this Guidebook. It may require more than one CLC command to define the required function, if it is relatively complex (for the sequential coupling of CLC commands, see the fifth example in Section 2.J.3).

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MODEL 10APID SETUP

In our example, suppose that Channel No. 10 has been located to the 10APID's "P" SUB-CHANNEL (No. 3), and that Channel No. 11 has been located to the 10APID's "COMMAND INPUT" SUBCHANNEL (No. 5).

Suppose also that we wish Channel No. 15 to be the "CALCULATE" PSEUDOCHANNEL (No. y) to operate on the COMMAND INPUT channel. Since the inverse function is, in this case, a square root, we would enter a CLC command of the general form

$$\text{CLC } y = m(\text{SQR CHN } c) + b \text{ [CR] } *$$

And since

$$F^{-1}(c(t)) = 1/2 \sqrt{c(t)}$$

the required "m" value would be

$$(6.50) \times (1/2) = 3.25$$

and the actual command entry would be

$$\text{CLC } 15 = 3.25(\text{SQR CHN } 11) + 0 \text{ [CR] } *$$

- g. Finally, apply an **ANALOG OUTPUT (ANO)** command to Channel No. p, in order that this channel be continuously proportional to the "CALCULATE" Channel No.y. The command should have a general form of

$$\text{ANO } p = 0.0039(\text{CHN } y) + 0 \text{ [CR] } *$$

(the coefficient "0.0039" is necessary to cancel the factor of "256" previously applied to the "P" SUBCHANNEL).

In our example, the appropriate command would then be

$$\text{ANO } 10 = 0.0039(\text{CHN } 15) + 0 \text{ [CR] } *$$

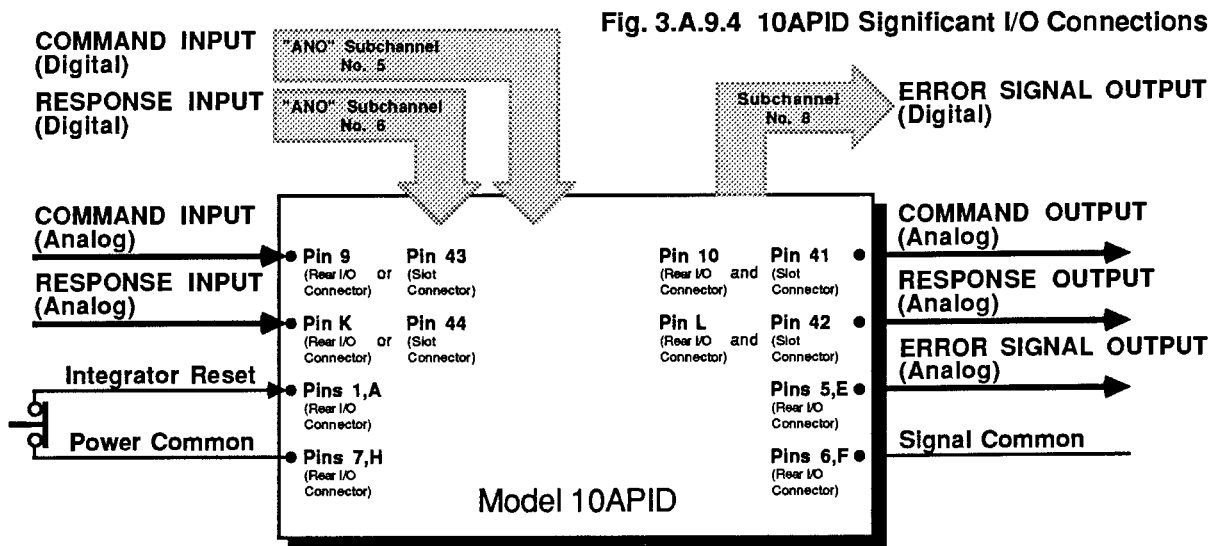
By means of this "variable" form of the **ANO** command, the above procedure has loaded the 10APID with a computed "variable P" that causes the RESPONSE INPUT to *approximate* the COMMAND INPUT—thereby minimizing the loop settling time—from the very start.

- h . To complete the loading of *initial* "P," "I," and "D" values in this mode, you should now perform Steps d through g of the preceding section. Note that the "I" and "D" coefficients thereby established will most likely be altered when it comes to "fine-tuning" the control loop in Section c.8, below.

5. SETUP OF COMMAND AND RESPONSE INPUTS

a. SETTING INPUT MODES

Fig. 3.A.9.4, below, summarizes the 10APID's significant inputs and outputs. As mentioned in the "Introduction," the COMMAND and RESPONSE INPUTS may both be either *digital* or *analog*. If analog, an input may derive from either a $\pm 7\text{-V}$ *external* source (received at the 10APID's rear I/O CONNECTOR) or a $\pm 5\text{-V}$ *internal* source (received from the DataPAC's analog motherboard via the 10APID's SLOT CONNECTOR). Specific pin assignments for these alternative analog connections are given in the figure.



As mentioned in the "Introduction," the *fastest* "real-time" loop control is achieved when COMMAND INPUT and RESPONSE INPUT are both *analog*. *Digital* inputs, on the other hand, are more easily monitored and loaded, being assigned to standard system DATA CHANNELS. Although the use of digital inputs will necessarily limit the overall loop response by the DataPAC's internal *scan rate*, it will not significantly slow down the system, if this rate is sufficiently high.

NOTE ALSO THAT, UNLESS OTHERWISE SPECIFIED, YOUR 10APID CARD HAS BEEN PRESET AT THE FACTORY FOR A *DIGITAL* COMMAND INPUT AND A *DIGITAL* RESPONSE INPUT. If you want to establish a different input configuration, you should

1. Turn OFF the DataPAC's EEPROM Switch. Then turn OFF the DataPAC and remove the 10APID Card from its SLOT.
2. Refer to Fig. 3.A.9.5, below, and locate the INPUT MODE JUMPER PINS. Two "mini-jumpers" are provided for interconnecting *one* of the three pairs of "COMMAND INPUT MODE" pins and *one* of the three pairs of "RESPONSE INPUT MODE" pins.
3. Reposition each mini-jumper as shown in Fig. 3.A.9.5 to set the desired input modes. Remember that the COMMAND INPUT and the RESPONSE INPUT need not be of the same mode, and that in "VARIABLE P" operation, a *digital* COMMAND INPUT is required.
4. Reinsert the Model 10APID in its SLOT, and reactive the DataPAC.

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MODEL 10APID SETUP

b. SETUP AND DISPLAY OF DIGITAL INPUT(S)

A *digital* input must be assigned to a particular system DATA CHANNEL that lies within the DataPAC's existing SCAN RANGE. In Section c.3 or c.4, above, you "located" selected system channels to the 10APID's "P," "I," and "D" SUBCHANNELS via the LOCATE (LCT) command, and then used the ANALOG OUTPUT (ANO) command to "type" these channels and at the same time to load them with either constant or variable values. You should follow essentially the same procedure with respect to the COMMAND INPUT (when *digital*) and the RESPONSE INPUT (when *digital*). Thus, for each digital input, you should

1. Select an unused system DATA CHANNEL No. x that lies within the present SCAN RANGE, and "locate" that channel to the respective 10APID SUBCHANNEL (No. 5 for digital COMMAND INPUT; No. 6 for digital RESPONSE INPUT), via the LCT command.
2. IF YOU WANT THE COMMAND INPUT TO BE MAINTAINED AT A CONSTANT MILLIVOLT VALUE "e," WHERE $-5000 \leq e \leq 5000$, apply an ANALOG OUTPUT (ANO) command of the form

$$\text{ANO } x = e [\text{CR}] *$$

where "x" is the number of the channel "located" to the 10APID's SUBCHANNEL No. 5. The above command automatically assigns Channel No. x a "TYPE" code of "E1" (DO NOT APPLY A TYPE (TYP) COMMAND TO THIS CHANNEL). This form of the ANO command should not be applied to the RESPONSE INPUT channel, since you would not normally want to constrain this input to a constant value.

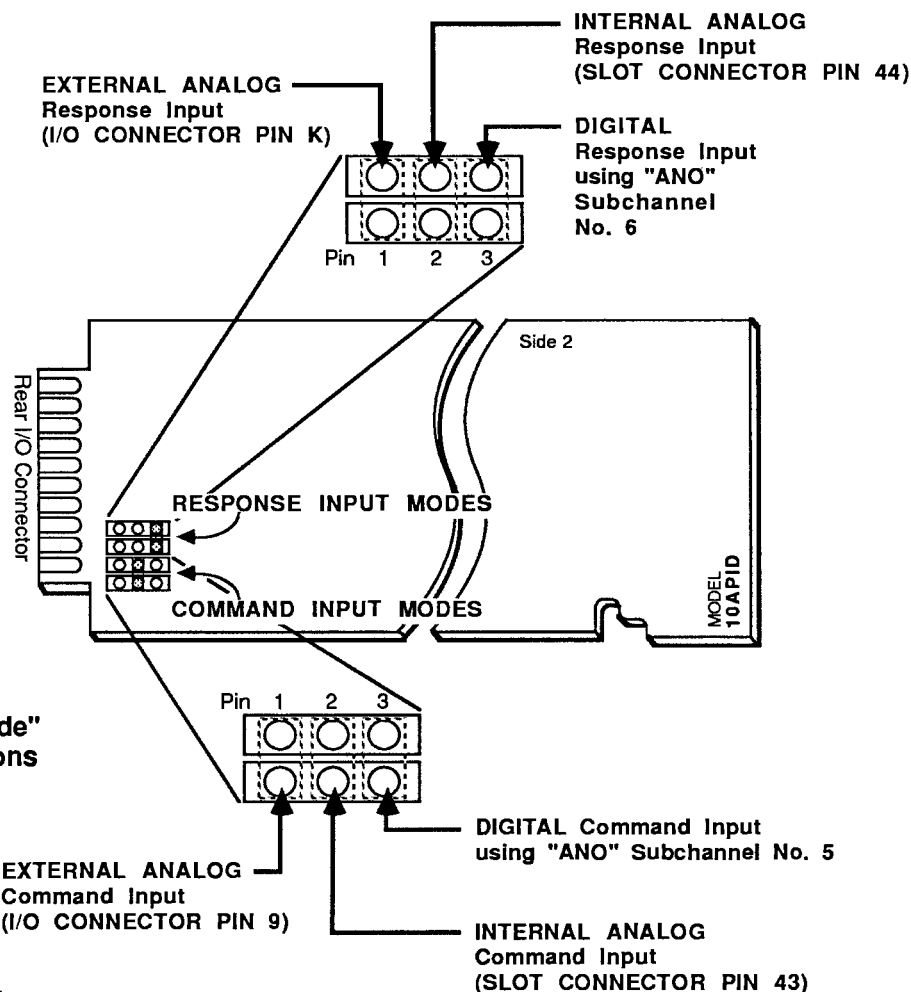


Fig. 3.A.9.5
10APID "Input Mode"
Jumper Connections

3. IF YOU WANT EITHER THE COMMAND OR THE RESPONSE INPUT TO BE CONTINUOUSLY PROPORTIONAL TO THE EXISTING VALUE OF A GIVEN "LIVE" DATA CHANNEL NO. y (as is the case, for example, in Section c.4, above), apply an **ANALOG OUTPUT (ANO)** command of the form

$$\text{ANO } x = m(\text{CHN } y) + b \text{ [CR] } *$$

where "x" is the number of the channel "located" to 10APID SUBCHANNEL No. 5 or 6, respectively, and where "m" and "b" are scaling and offset constants, respectively (see Section 3.A.2 of this Guidebook for a full discussion of the **ANO** command). The above command automatically assigns Channel No. x a "TYPE" code of "E0" (AGAIN, DO NOT APPLY A **TYP** COMMAND TO THIS CHANNEL). Remember also that the actual *millivolt range* of each digital input cannot exceed ± 5000 mV.

If you wish to *display* your 10APID's digital input(s)—perhaps for purposes of visual monitoring and/or comparison—simply arrange to display the system DATA CHANNEL(S) that have been "located" to the corresponding 10APID SUBCHANNEL(S). For DataPAC "LCD Video Setup," see Section 1.D.1 of this Guidebook; for "CRT Video Setup," see Sections 1.D.2 and 2.C (see, specifically, Sections 2.C.5(e) and 2.C.12(b) for setup of display DATA FIELDS).

----- CAUTION! -----

BEFORE ESTABLISHING ANY 10APID ANALOG INPUT OR OUTPUT CONNECTIONS, MAKE SURE THAT

1. **APPROPRIATE "CLAMP LIMITS" ARE IN EFFECT** (Section c.1, above).
2. **APPROPRIATE INITIAL "P," "I," AND "D" VALUES ARE IN EFFECT** (Section c.3 or c.4, above).
3. **THE COMMAND INPUT—WHETHER DIGITAL OR ANALOG—IS PRESENTLY ZERO (MILLIVOLTS)**. This ensures that a sudden rise in the ERROR SIGNAL will not be applied to the servo equipment when it is connected to the 10APID. For the same reason, the COMMAND INPUT should always be set to zero *before turning OFF the DataPAC*.
4. **THE DATAPAC HAS BEEN TURNED OFF**. ANALOG CONNECTIONS TO THE REAR I/O CONNECTOR SHOULD NEVER BE MADE OR BROKEN WHILE THE DATAPAC IS ON.

c. CONNECTION OF ANALOG INPUT(S)

To establish a given Conditioner Card or other *internal* system element as the source of an analog COMMAND INPUT or RESPONSE INPUT, a wire must be installed between corresponding *wire-wrap pins* on the DataPAC's internal analog motherboard.

----- PLEASE NOTE -----

SUCH INTERNAL HARDWIRE INTERCONNECTIONS ARE NORMALLY MADE AT THE FACTORY, PRIOR TO SHIPMENT, IN ACCORDANCE WITH SPECIFICATIONS GIVEN AT THE TIME OF ORDER.

SINCE THE ANALOG MOTHERBOARD IS NOT EASILY ACCESSIBLE TO THE DATAPAC OPERATOR WITHOUT THE POTENTIAL DANGER OF HARMING SYSTEM ELEMENTS

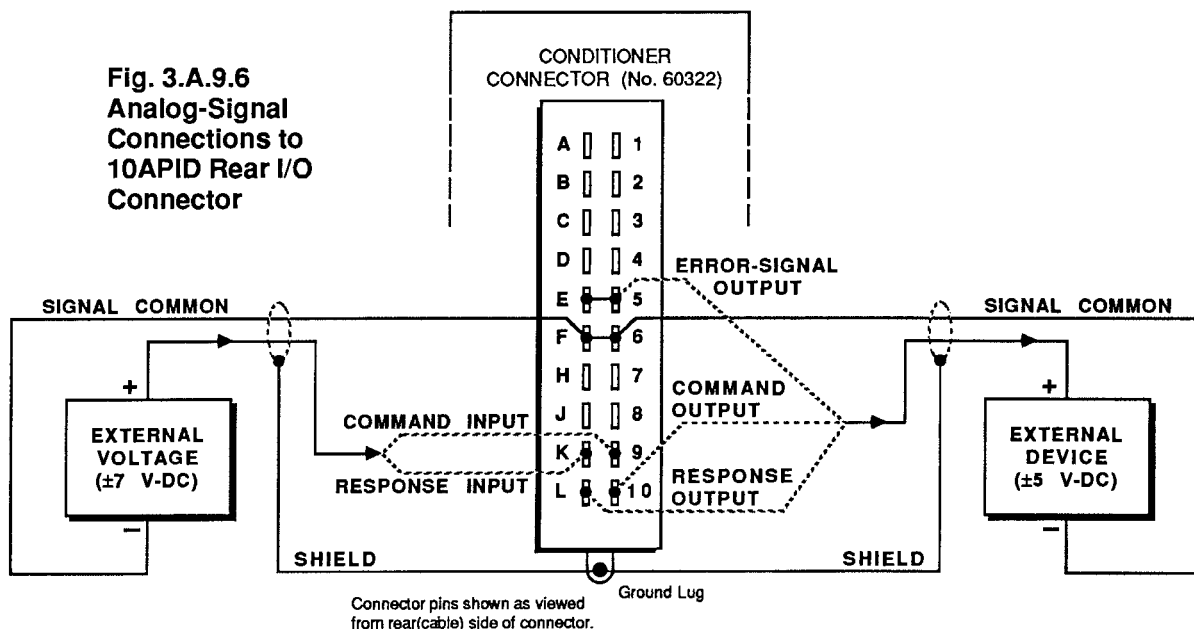
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MODEL 10APID SETUP

AND/OR CONFIGURATION, AND SINCE THE PROCEDURE INVOLVES ADVANCED KNOWLEDGE OF CONDITIONER CIRCUITRY, YOU ARE URGED NOT TO ATTEMPT TO MAKE SUCH INTERCONNECTIONS BY YOURSELF.

IF YOUR SYSTEM REQUIRES A MODIFICATION OF SUCH INTERCONNECTIONS—SAY, TO ACCOMMODATE THE PHYSICAL RELOCATION OF THE MODEL 10APID OR A GIVEN INPUT SOURCE CARD—PLEASE CONTACT THE DAYTRONIC SERVICE STAFF OR YOUR NEAREST SALES REPRESENTATIVE OFFICE FOR DETAILED INSTRUCTIONS.

If the source of an analog COMMAND INPUT or RESPONSE INPUT is *external* to the DataPAC—as it would be when these signals come directly from a voltage source within the controlled process—then appropriate connections must be made to the 10APID's rear I/O CONNECTOR, as indicated in Fig. 3.A.9.6, below. The external analog source for either input may range from -7 to +7 V-DC without damage to the 10APID. The 10APID's 20-pin I/O CONNECTOR mates with Daytronic CONDITIONER CONNECTOR No. 60322 (shown in Fig. 1.E.1 of this Guidebook). Note that each analog input must be referenced to SIGNAL COMMON (I/O CONNECTOR Pin 6 or F). Also note that, to minimize unwanted electrical noise, each input cable should be *shielded*. The "shield" wire **MUST** make contact with the DataPAC mainframe (use the L-shaped ground lug attached to the connector housing—see Section 1.E.1).



6. ENABLING THE INTEGRATOR

For normal operation, the 10APID's Integrator circuit must be continuously "enabled" by tying the INTEGRATOR RESET line of the rear I/O CONNECTOR (Pin 1 or A) to POWER COMMON (Pin 7 or H), as shown in Fig. 3.A.9.4, above.

DURING NORMAL "CLOSED LOOP" OPERATION, IT IS NOT NECESSARY TO INTERRUPT THE "INTEGRATOR ENABLE" CONNECTION. IF, HOWEVER, THE CONTROL LOOP HAS BEEN "OPENED" WHILE THE DATAPAC IS ON—EITHER BY TURNING OFF THE SERVO EQUIPMENT, BY DISCONNECTING ONE OR MORE OF THE 10APID'S ANALOG I/O CONNECTIONS, OR BY SETTING THE INTEGRAL COEFFICIENT EQUAL TO ZERO—THEN THE INTEGRATOR SHOULD BE RESET BEFORE THE LOOP IS AGAIN "CLOSED."

You can do so by *momentarily* disconnecting the INTEGRATOR RESET and POWER COMMON pins (an external single-pole, single-throw, normally closed push-button switch can be installed for

3.A.9 PID Loop Control

this purpose—see Fig. 3.A.9.4). This will discharge the Integrator capacitor of any charge accumulated while the loop was "open." Otherwise, the settling time of the loop would be abnormally long on account of the accumulated "I" offset. Discharging the Integrator also prevents possible saturation of the ERROR SIGNAL and consequent damage to the servomechanism when the loop is again "closed."

7. SETUP OF 10APID OUTPUTS

a. CONNECTION OF ANALOG COMMAND, RESPONSE, AND ERROR-SIGNAL OUTPUTS

The 10APID's available analog outputs are also shown in Fig. 3.A.9.4. Regardless of the respective "input modes," both the COMMAND INPUT and the RESPONSE INPUT are presented as ± 5 V-DC *analog outputs* at the 10APID's rear I/O CONNECTOR (for connection to an *external* device, such as a voltmeter, recorder, oscilloscope, etc.), and also at the 10APID's SLOT CONNECTOR (for connection, via the DataPAC's analog motherboard, to other *internal* system elements, such as a Model 10A79-4 Analog Peak Capture Card).

The 10APID's analog ERROR SIGNAL is available as a ± 7 V-DC analog output at the rear I/O CONNECTOR (only).

To establish a given Conditioner Card or other *internal* system element as the receiver of an analog COMMAND or RESPONSE OUTPUT, a wire must be installed between corresponding *wire-wrap pins* on the DataPAC's internal analog motherboard. IF YOU REQUIRE SUCH HARDWIRE INTERCONNECTIONS, SEE THE "NOTE" IN SECTION c.5(c), ABOVE.

If the device receiving an analog COMMAND, RESPONSE, or ERROR-SIGNAL OUTPUT is *external* to the DataPAC system, then appropriate connections must be made to the 10APID's rear I/O CONNECTOR, as indicated in Fig. 3.A.9.6, above. Note that all analog outputs are single-ended, and return to SIGNAL COMMON (I/O CONNECTOR Pin 6 or F). Also note that, to minimize unwanted electrical noise, each output cable should be *shielded*. The "shield" wire MUST make contact with the DataPAC mainframe (use the L-shaped ground lug attached to the connector housing—see Section 1.E.1).

b. SETUP AND DISPLAY OF DIGITAL ERROR-SIGNAL OUTPUT

The 10APID's SUBCHANNEL No. 8 continuously reports the "live" value of the ± 7 -V ERROR SIGNAL. If you want to monitor this value on your DataPAC's LCD or CRT display, you should

1. Select an unused system DATA CHANNEL No. x that lies within the present SCAN RANGE, and "locate" that channel to 10APID SUBCHANNEL No. 8, via the LCT command.
2. Make sure that Channel No. x has a present "TYPE" code of "55." Enter a command of
TYP x = 55 [CR] *
3. To obtain a *direct millivolt reading* for the ERROR SIGNAL channel, first enter a **SCALING FACTOR (EMM)** command of
EMM x = 10000 [CR] *
 and then a **ZERO OFFSET (BEE)** command of
BEE x = 0 [CR] *
4. Arrange to display Channel No. x. For DataPAC "LCD Video Setup," see Section 1.D.1 of this Guidebook; for "CRT Video Setup," see Sections 1.D.2 and 2.C (see, specifically, Sections 2.C.5(e) and 2.C.12(b) for setup of display DATA FIELDS).

8. TUNING THE CONTROL LOOP

In this procedure, you will use the **ANALOG OUTPUT (ANO)** command to adjust the "P," "I," and "D" coefficients—or, if you are in "VARIABLE P" mode, to adjust "I" and "D" only—until the desired ERROR-SIGNAL characteristics are obtained. The loop response will first be observed with the *initial* "P," "I," and "D" values in effect (the values you loaded in Section c.3 or c.4). These you will then modify as necessary by increments of 10 (mV)—within the allowed range of ± 127 (mV)—until the loop is satisfactorily "tuned."

The final goal is, of course, to achieve a relatively *steady-state* process, where the value of the measured variable (RESPONSE INPUT) remains as close as possible to that of the specified set-point (COMMAND INPUT), even under considerably varying process conditions, and where any *change* in either COMMAND or RESPONSE produces as fast a reaction in the ERROR SIGNAL OUTPUT as is allowed or required by the servo equipment this output is used to drive.

The millivolt value to which the **INTEGRAL (I)** coefficient is set controls the basic response time of the loop. Specifically, it determines the "rise time" of the RESPONSE. This is the time it takes for the RESPONSE to go from 10% to 90% of the existing COMMAND value. The shorter the rise time, the shorter the "settling time" (the time it takes the RESPONSE to finally "settle" into a given plus-or-minus error band about the COMMAND value—see the following figures). As explained below, in a typical "underdamped" or "critically damped" control situation, it is desirable to *minimize* the settling time. In such cases, you should apply a large enough "I" coefficient to get the RESPONSE "up to" the COMMAND value as quickly as possible.

If "I" is relatively large, however, a nonzero **PROPORTIONAL (P)** coefficient should also be applied in order to stabilize the RESPONSE, while a nonzero **DERIVATIVE (D)** coefficient should be applied to "soften" it. By slowing down ("damping") the RESPONSE as it approaches the COMMAND value, the latter function ensures that your servo equipment does not receive a potentially dangerous step impulse or oscillation. Usually, a relatively small amount of "D" is sufficient to reduce or eliminate "overshoot" and/or "undershoot" about the set-point.

Optimum weighting of the "P," "I," and "D" factors will depend on the nature of the process to be controlled. If, for example, the process is naturally slow to respond to control action (as in the case, say, of a large furnace), an *overdamped* RESPONSE with a relatively long settling time might be satisfactory (see Fig. 3.A.9.7). Such a RESPONSE would also be desirable if your servomechanism cannot tolerate overshoot of the set-point or a step impulse. If, on the other hand, a minimum settling time is required, but overshoot or undershoot about the COMMAND value is also acceptable (as, for example, in high-speed brake applications), an *underdamped* RESPONSE might work best (Fig. 3.A.9.8). Finally, if, as is most often the case, the application requires a minimum settling time with *no* overshoot, a *critically damped* RESPONSE will be called for (Fig. 3.A.9.9).

Remember that if the 10APID has been set to "FIXED P" mode (Section c.2, above), there is no known and easily definable relationship between the ERROR SIGNAL and the resultant RESPONSE, and so the tuning procedure is essentially a matter of trial and error, involving all three coefficients ("P," "I," and "D"). In "VARIABLE P" mode, however, the knowledge of such a relationship has permitted the operator to "pretune" the loop through a computed "P" function that acts as an inverse of the COMMAND INPUT (see Section c.4). In this case, it is only necessary to adjust the "I" and "D" coefficients, as shown below for the "FIXED P" mode.

- a. Check to make sure that 1) ALL NECESSARY I/O CONNECTIONS HAVE BEEN MADE (Sections c.5 and c.7); 2) THE COMMAND INPUT HAS BEEN SET TO ZERO; and 3) THE INTEGRATOR HAS BEEN ENABLED (Section c.6).
- b. Turn OFF the DataPAC's EEPROM Switch. Then turn OFF the DataPAC.

- c. Turn ON your servo equipment. Then reactivate the DataPAC and turn the EEPROM Switch back ON.
- d. Applying a constant "normal" (nonzero) value of COMMAND INPUT, observe the RESPONSE INPUT that results from the operation of the *initial* "P," "I," and "D" values you loaded in Section c.3 or c.4 (setup and display of inputs is discussed in Section c.5).
- e. Depending on the kind of "damping" you need, adjust the "P," "I," and "D" values as indicated below, until the desired RESPONSE is observed. Apply the "constant" form of the ANALOG OUTPUT (ANO) command to the respective DATA CHANNELS you have already assigned to these coefficients, just as you did in Section c.3, above.

NOTE THAT THE "P," "I," AND "D" VALUES GIVEN BELOW ARE SIMPLY RECOMMENDED "STARTING VALUES" FOR EACH DAMPING SITUATION. You will most likely have to experiment with different coefficient values (we recommend altering them by *increments of 10 (mV)*), before a satisfactory RESPONSE is generated. DO NOT EXCEED THE RANGE OF ± 127 mV FOR ANY COEFFICIENT.

Fig. 3.A.9.7 Overdamped RESPONSE

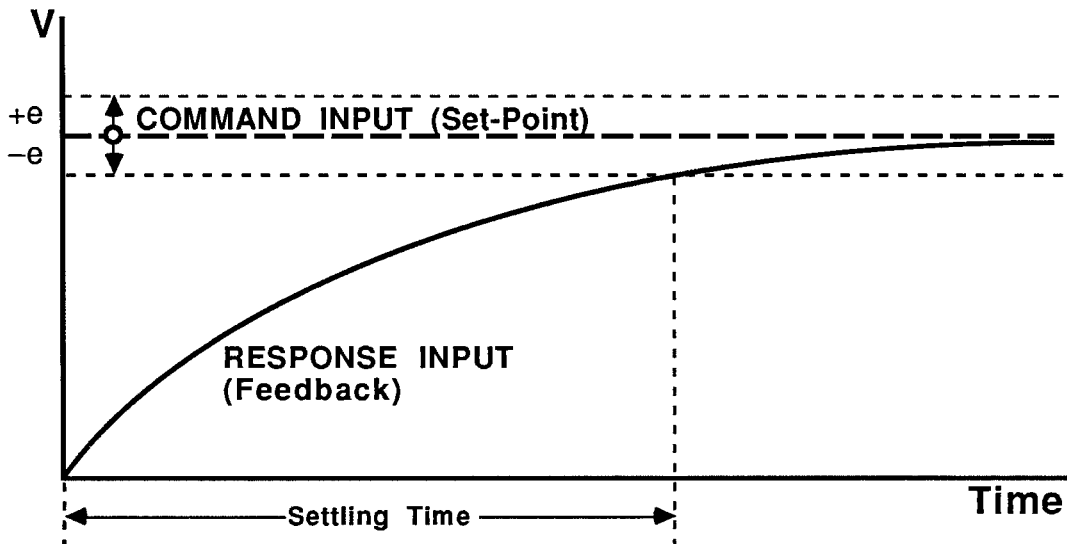
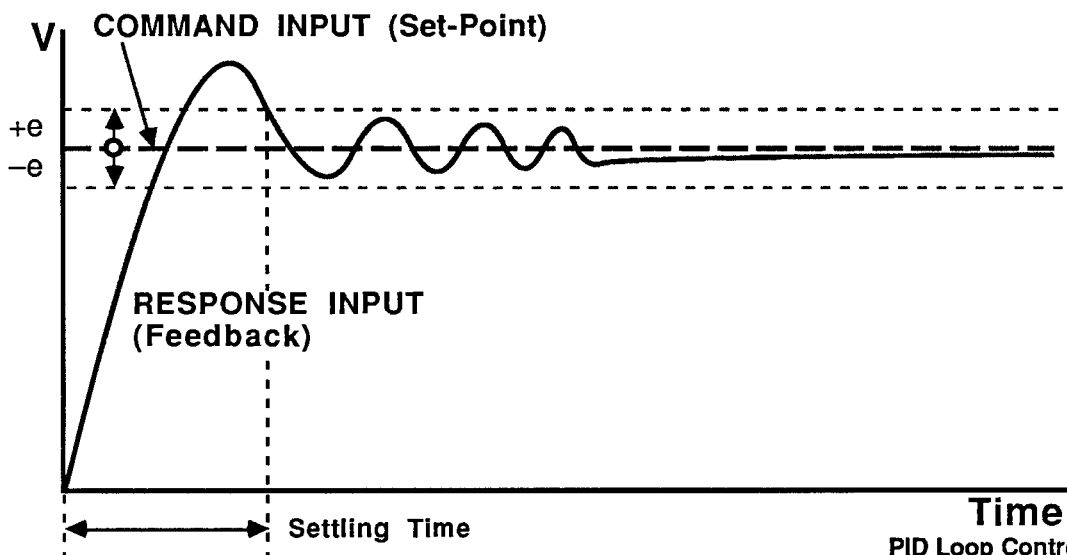


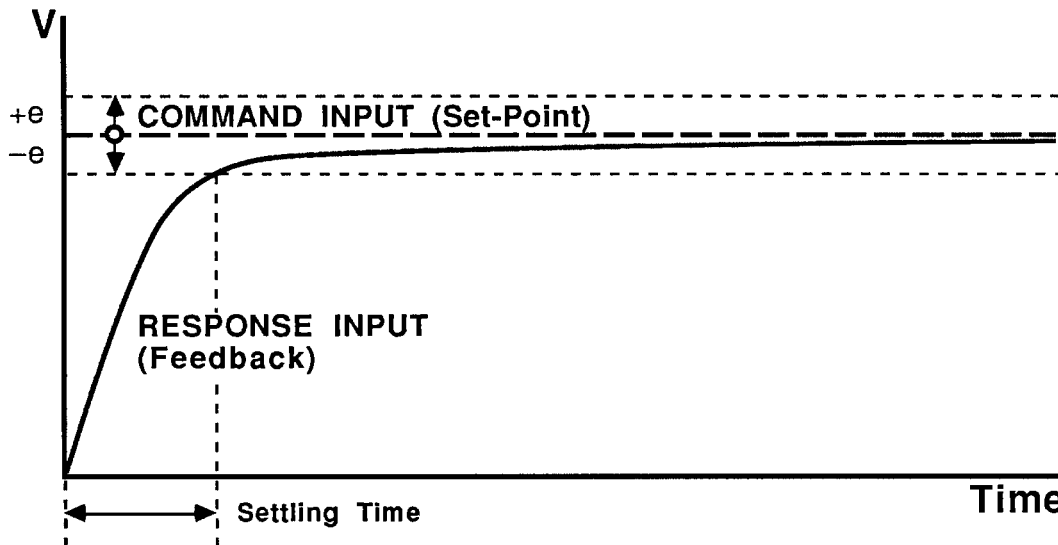
Fig. 3.A.9.8 Underdamped RESPONSE



3.A.9.c

MODEL 10APID SETUP

Fig. 3.A.9.9 Critically Damped RESPONSE



----- IMPORTANT -----

BEFORE MODIFYING THE EXISTING VALUE OF ANY COEFFICIENT, YOU SHOULD SET THE COMMAND INPUT TO ZERO. THEN PROCEED TO MODIFY THE COEFFICIENT VIA THE ANO COMMAND, AFTER WHICH YOU SHOULD RETURN THE COMMAND INPUT TO ITS FORMER "NORMAL" VALUE AND OBSERVE THE BEHAVIOR OF THE RESPONSE WITH THE NEW COEFFICIENT IN OPERATION. SETTING THE COMMAND INPUT TO ZERO BEFORE CHANGING THE "P," "I," OR "D" COEFFICIENT WILL ENSURE THAT SUDDEN VOLTAGE RISES ARE NOT APPLIED TO THE SERVO EQUIPMENT (IN "VARIABLE P" MODE, THIS APPLIES ONLY TO THE "I" AND "D" COEFFICIENTS).

Note too that it is also possible to apply the "variable" form of the ANO command to any coefficient, even when in "FIXED P" mode:

$$\text{ANO } x = m(\text{CHN } y) + b [\text{CR}] *$$

As a result of this command, the coefficient in question would depend continuously on the "live" reading of Channel No. *y*. This method of loading *variable* "P," "I," and/or "D" values is, as a rule, practical only when incorporated in an "auto-tuning" program developed by the user.

1. UNDERDAMPED RESPONSE:
FOR "P," LOAD "0" (ZERO)
FOR "I," LOAD "10"
FOR "D," LOAD "0" (ZERO)
2. OVERDAMPED RESPONSE:
FOR "P," LOAD "0" (ZERO)
FOR "I," LOAD "10"
FOR "D," LOAD "10"
3. CRITICALLY DAMPED RESPONSE:
FOR "P," LOAD "0" (ZERO)
FOR "I," LOAD "15"
FOR "D," LOAD "10"

REMEMBER:

- TO DECREASE THE SETTLING TIME OF THE RESPONSE, INCREASE "I."
- FOR LARGE "I," YOU WILL NEED SOME NONZERO "P" FOR STABILITY.
- TO MINIMIZE OSCILLATION OF THE RESPONSE ABOUT THE SET-POINT, INCREASE "D"—BUT JUST ENOUGH TO GET THE DESIRED DAMPING. AVOID LARGE AMOUNTS OF "D," SINCE THIS MAY LEAD TO AN UNSTABLE RESPONSE.
- SET THE COMMAND INPUT TEMPORARILY TO *ZERO* WHEN CHANGING AN EXISTING "P," "I," OR "D" VALUE (IN "FIXED P" MODE) OR AN EXISTING "I" OR "D" VALUE (IN "VARIABLE P" MODE), AND ALSO BEFORE TURNING OFF THE DATAPAC.
- BE SURE TO RESET THE INTEGRATOR BEFORE RECLOSING A LOOP THAT HAS BEEN OPENED WHILE THE DATAPAC WAS ON (see Section c.6).

SECTION 2

SECTION 2.L	LINEARIZATION OF DATA CHANNELS: LIN COMMAND
SECTION 2.M	INTERNAL COUNTER/TIMER FUNCTIONS
SECTION 2.N	VIDEO INPUTS AND OUTPUTS
SECTION 2.O	OPERATOR CONSOLE: MODEL 10CCONB
SECTION 2.P	BACKUP PROVISIONS
SECTION 2.Q	LCD GRAPHICS*
SECTION 2.R	FRONT-PANEL KEYPAD OPERATIONS
SECTION 2.S	OPTIONAL OPERATOR'S KEYBOARDS: MODELS 10P25A AND 10P25D

* Applies only to older LCD-display mainframes and accessories (Models 10K2C, 10K4T-D, 10LCD12A, and 10LCD12-2) equipped with the "G" Option.

PLEASE NOTE the following section- and figure-reference corrections for **Section 2** of this Guidebook:

**When you are
told to refer to:**

**You should
actually refer to:**

Section 1.B	Section 1.A.3
Section 1.C	Section 4 of the appropriate "On the Air" Booklet
Section 1.D	Section 5 of the appropriate "On the Air" Booklet
Fig. 1.E.1 (Section 1.E.1)	Fig. 1.5 (Section 1.E.1)
Fig. 1.E.2 (Section 1.E.1)	Fig. 1.6 (Section 1.E.1)
Section 1.F.1	Section 1.F.2
Section 1.F.2	Section 1.F.3
Section 1.G.2	Section 1.G.1
Section 1.G.7	Section 1.G.6
Appendix B	Section 1.B

Section 2.A

Introduction



System 10 Guidebook

That there are so many procedures included in this section of the Guidebook is a reflection of the extraordinary versatility of the Daytronic "System 10."

These are all "optional" procedures, but only technically—in the sense that none of them is absolutely required for all conceivable DataPAC operations. Obviously, with reference to your own application, some of them will not be "optional."

The procedures given here are essentially "system" procedures. For optional procedures associated with specific A, B, and V CARDS, see Section 3.

Unlike Section 1, this section of the Guidebook requires that you refer only to those subsections that deal with the setup of functions presently required by your specific application. (Although, of course, it would be profitable for you to study the entire section at the present or some future time, to familiarize yourself with DataPAC capabilities you might be unaware of right now, and which you might later wish to incorporate in your application.)

Since most applications call for some kind of *limit monitoring*, a special Limit Setup "Getting Started" Procedure is included (Section 2.F.1), similar to the training procedures of Section 1.

Section 2.B

Interfacing of Computer,
Terminal, Printer, etc.



System 10 Guidebook

2.B.1.

INTRODUCTION: THE COMPUTER INTERFACE PORT

Every DataPAC has a COMPUTER INTERFACE PORT for two-way communication with a connected computer, terminal, buffered printer, recorder, OPERATOR CONSOLE, or other external device capable of RS-232-C or IEEE-488 data interchanges. Through the DataPAC's COMPUTER INTERFACE PORT, the external device can

- ISSUE TO THE DATAPAC any MNEMONIC COMMAND in the standard System 10 command set, with the exception of **SAVE (SAV)** and **DELETE (DEL)** (which are strictly keyboard-entered commands).
- RECEIVE FROM THE DATAPAC any of the various kinds of *formatted data transmissions* discussed in Section 1.H, plus any and all *responses to interrogations that originate from the connected device* (responses to keyboard-entered interrogation commands will appear on the DataPAC BILLBOARD only).

The location of your DataPAC's 25-pin COMPUTER INTERFACE CONNECTOR is shown in the appropriate "rear connections" drawing in Section 1.A.2 of this Guidebook.

Note that, in addition to its COMPUTER INTERFACE PORT, an "A-sized" DataPAC can accommodate a LOGIC I/O PORT for the transfer of *logic and digital data* (requires the **Model 10AIO-16 Universal Logic I/O Card**—see Section 3.A.3), while a "B-sized" DataPAC can accommodate several types of optional data-communications ports, including

- a LOGIC I/O PORT for the transfer of *logic and digital data* (requires the **Model 10BIO-16 Universal Logic I/O Card**—see Section 3.B.2)
- a PRINTER INTERFACE PORT *for formattable hard-copy output* (requires the **Model 10VFO132 Formatted Output Card**—see Section 3.C.3)
- a SATELLITE INTERFACE PORT, which establishes the DataPAC as a "HOST" database to a Local Area Network (requires the **Model 10BD4 Satellite Interface Card**—see Section 3.B.3)
- a SATELLITE SLAVE PORT, which establishes the DataPAC as a "SATELLITE" unit within a Local Area Network (requires the **Model 10BD1 Satellite Slave Card**; an "A-sized" SATELLITE DataPAC will communicate with the network via its COMPUTER INTERFACE PORT—see Section 3.B.3)
- an AUXILIARY COMPUTER INTERFACE PORT, which functions essentially identically to the COMPUTER INTERFACE PORT, and which allows the DataPAC to establish simultaneous high-speed communications with more than one external device (requires the **Model 10BACI Auxiliary Computer Interface Card**—see Section 3.B.5)

----- PLEASE NOTE -----

FOR CONNECTIONS BETWEEN A DATAPAC RS-232-C INTERFACE PORT AND A MODEM, SEE THE APPENDIX AT THE END OF THIS SECTION.

a. CONNECTIONS

It is impossible to present "universal" RS-232-C cabling. The reason is that RS-232-C, while a "standard" serial-interface specification, is also a fairly broad one, with a number of options the equipment designer may or may not choose to employ. For electrical and mechanical characteristics of the interface, see the latest *EIA Standard*, published by the *Electronics Industries Association*, Washington, D.C.

THE PRECISE SETTING OF RS-232-C "PROTOCOL" VARIABLES IS ESSENTIAL FOR PROPER DATA TRANSFER. The available selection methods are explained in the following section.

RS-232-C allows the provision of special "handshake" functions. These are designed to prevent data transmitters from going too fast for their receivers. The kind of handshake you employ, if any, will depend in part on the equipment participating in the data interchange.

If you did not order a specific Daytronic *RS-232-C Interface Cable* with your DataPAC, then you will have to provide your own connection. Fig. 2.B.1(a), below, shows suggested cabling between a DataPAC and a computer, terminal, buffered printer, etc., that uses a *25-Pin RS-232-C Connector*, or between a DataPAC and a Daytronic OPERATOR CONSOLE (see Section 2.O)—for "full handshake," "incoming handshake only," and "no handshake" situations, respectively. Following RS-232-C conventions, the device at each end of the interface is seen as "DATA TERMINAL EQUIPMENT (DTE)." Fig. 2.B.1(b) shows "full-handshake" cabling between a DataPAC and a computer, terminal, printer, etc., that uses a *9-Pin D-Subminiature Connector* for its RS-232-C interface (such as an IBM PC/AT).

FOR MAXIMUM DATA-TRANSFER SPEED AND ACCURACY, A "FULL HANDSHAKE" IS GENERALLY RECOMMENDED. Relevant standard RS-232-C line functions for both connector types are described in the following table:

Table 2.B.1

Selected RS-232-C Pin Connections

(Each function is defined with respect *either to the DataPAC or to the connected RS-232-C device*, both of which are assumed to be "DTE.")

Pin No. (25-Pin Conn.)	Pin No. (9-Pin Conn.)	Mnemonic or Other Designation	Description
1	–	GND, EARTH GROUND, SHIELD	Protective Ground. Electrical equipment frame and AC power ground.
2	3	TDATA, TxD, RS232 XMIT	Transmitted Serial-ASCII Data.
3	2	RDATA, RxD, RS232 RECEIVE	Received Serial-ASCII Data.
4	7	RTS	Request To Send. A logic <i>output</i> signal which, when asserted, indicates a readiness to <i>transmit</i> data. RTS and CTS of the data transmitter or receiver may be tied, unless "full handshake" is required (see Fig. 2.B.1(a)).
5	8	CTS	Clear To Send. A logic <i>input</i> signal interpreted to mean that the connected device is ready to <i>receive</i> data. CTS and RTS of the data transmitter or receiver may be tied, unless "full handshake" is required (see Fig. 2.B.1(a)).
7	5	SGND, LOGIC GROUND	Signal Ground. Establishes common reference between the DataPAC and the connected RS-232-C device.
20	4	DTR	Data Terminal Ready. A logic <i>output</i> signal which, when asserted, indicates a readiness to <i>receive</i> data.
–	6	DSR	Data Set Ready. A logic <i>input</i> which, when asserted, indicates a readiness to communicate on the part of the connected device.

2.B.2.

RS-232-C INTERFACING

Fig. 2.B.1(a) Suggested RS-232-C Interface Connections, 25-Pin RS-232-C Connector

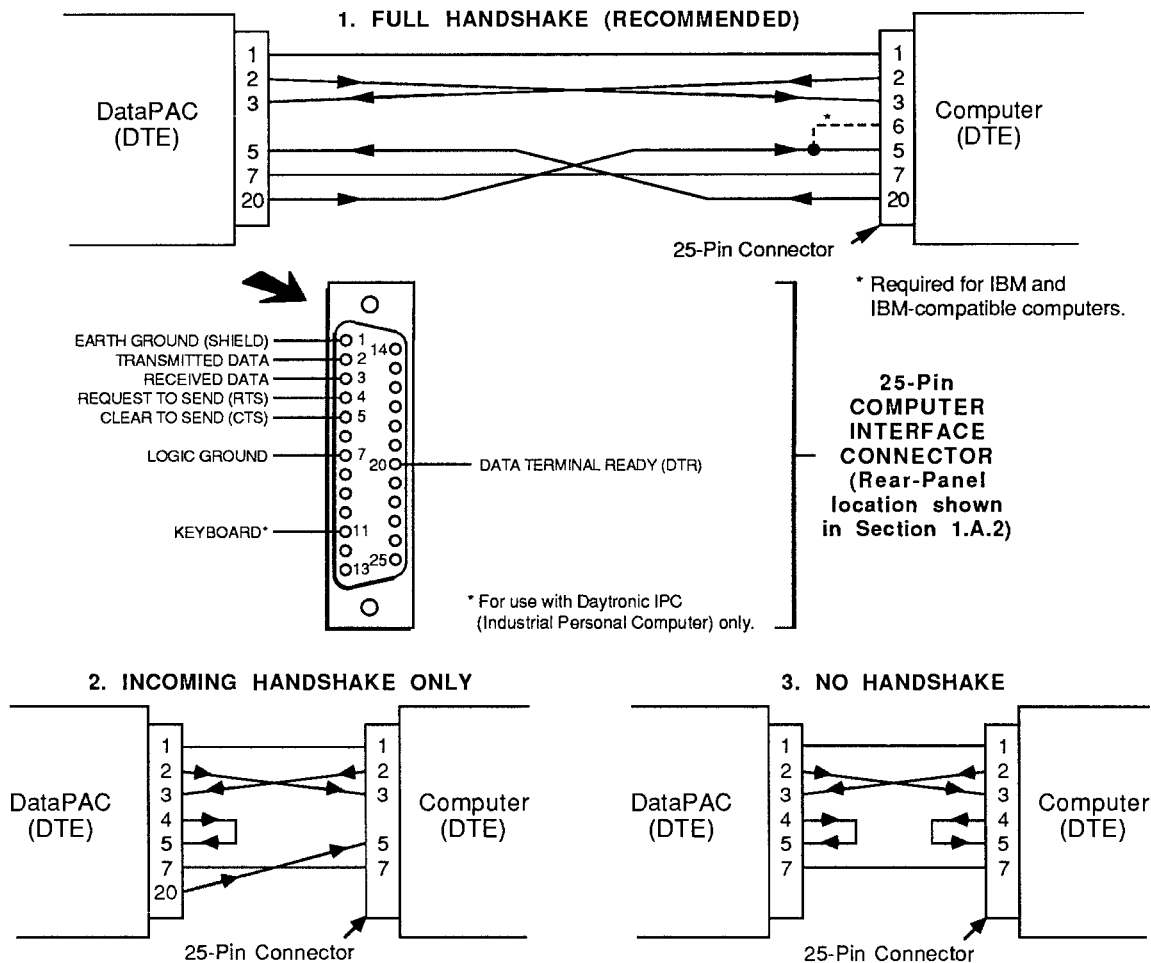
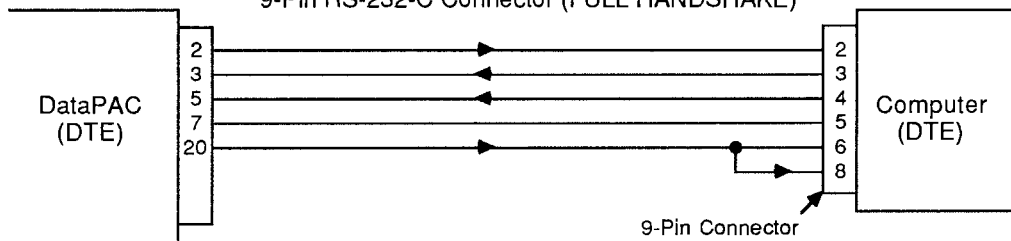


Fig. 2.B.1(b) Suggested RS-232-C Interface Connections, 9-Pin RS-232-C Connector (FULL HANDSHAKE)



Please note that the cabling in Fig. 2.B.1 is by no means "definitive." In all cases, *you should carefully study the literature accompanying the specific RS-232-C device you wish to connect to your DataPAC*, along with the definitions in the above table, to determine the cable arrangement that will create the "handshake" you need (if any).

Indeed, the idiosyncracies of your particular RS-232-C device may demand some variation of the cabling shown above. You should be aware, for instance, that the **DATA TERMINAL READY** signal issued by your device may have a different name (such as **NOT BUSY**) and may even appear on a pin other than No. 20 or No. 4. When this signal is not supplied, Pins 4 and 5 of the DataPAC's COMPUTER INTERFACE CONNECTOR *must* be jumpered together.

If you are in any doubt as to the suitability of a particular cable configuration for *your* application, feel free to contact the Daytronic SERVICE DEPARTMENT or SALES STAFF for assistance.*

----- CAUTION! -----

TO PREVENT EQUIPMENT DAMAGE, THE "OPEN CIRCUIT" VOLTAGE ACROSS THE "DATA SOURCE" END OF THE INTERFACE (WITH RESPECT TO SIGNAL GROUND) **MUST NOT EXCEED 25 VOLTS.**

b. SETTING RS-232-C INTERFACE PROTOCOL

The "protocol" applying to an RS-232-C link normally involves four basic data-transfer characteristics:

1. **BAUD RATE** (number of data bits transmitted per second).
2. **NUMBER OF DATA BITS** transmitted *per data character* (not including STOP BIT(S) and optional PARITY bit).
3. **PARITY** check: an optional feature that allows a data receiver to detect transmission errors. The transmitter may assign to an additional data-bit position either a "1" or a "0," in order to make the total number of "1's" in the transmitted character either **EVEN** or **ODD**, whichever convention has been chosen.
4. **NUMBER OF STOP BITS (1 or 2)**: allows the data receiver time to prepare for the next character transmission.

----- IMPORTANT -----

FOR PROPER DATA INTERCHANGE BETWEEN A DATAPAC AND A CONNECTED RS-232-C DEVICE TO OCCUR, THE DATAPAC'S COMPUTER INTERFACE PORT MUST BE SET TO CONFORM EXACTLY WITH THE PROTOCOL STIPULATED BY THE CONNECTED DEVICE.

You should set RS-232-C protocol characteristics in one of several ways, depending on the nature of your DataPAC. Each method is discussed in detail below.

- **IF YOUR DATAPAC HAS CRT "VIDEO CAPABILITY,"** you should set the initial interface protocol through simple keyboard responses to a built-in setup **MENU** that appears on the display.
- **IF YOUR DATAPAC DOES NOT HAVE CRT "VIDEO CAPABILITY,"** you will have to set the interface protocol by means of the DataPAC's *Protocol Switches*.

For a DataPAC *with* CRT "video capability," you may use the Protocol Switches as an alternative method to the **MENU** setup procedure, and to designate the *default* protocol to be effective on powerup. After powerup, one or more protocol characteristics for such a DataPAC may be altered at any time by a **BAUD RATE (BAU)** command, or by a subsequent **MENU** procedure—if the *DataPAC's Protocol Switches have been disabled*, as explained below.

THE **BAUD RATE (BAU)** COMMAND IS ONLY RECOGNIZED BY DATAPACS WITH CRT "VIDEO CAPABILITY."

* Small unwanted pulses on the DTR line can sometimes trigger "interrupt" routines for certain high-speed computers. If your computer experiences intermittent interruptions which you suspect to be caused by such "DTR rattle," you should install a 0.001-microfarad capacitor between Pin 7 (LOGIC GROUND) and Pin 20 (DATA TERMINAL READY) of the DataPAC's COMPUTER INTERFACE CONNECTOR.

2.B.2.

RS-232-C INTERFACING

1. VIA MENU SETUP PROGRAM

THIS PROCEDURE APPLIES ONLY TO DATAPACS WITH CRT "VIDEO CAPABILITY," AND IS EFFECTIVE ONLY WHEN THE DATAPAC'S PROTOCOL SWITCHES ARE *NOT ENABLED*.

- a. Make sure the DataPAC's EEPROM Write Protect Switch is ON.
- b. Push the **Pmpt (PROMPT)** key on the keyboard, followed by the "9" key (see Fig. 2.B.2). A video page will be displayed that asks you to

ENTER NUMBER OF INTERFACE

(When you press **Pmpt**, the DataPAC's BILLBOARD will display an "F." Unless you then press "9," nothing more will happen.)

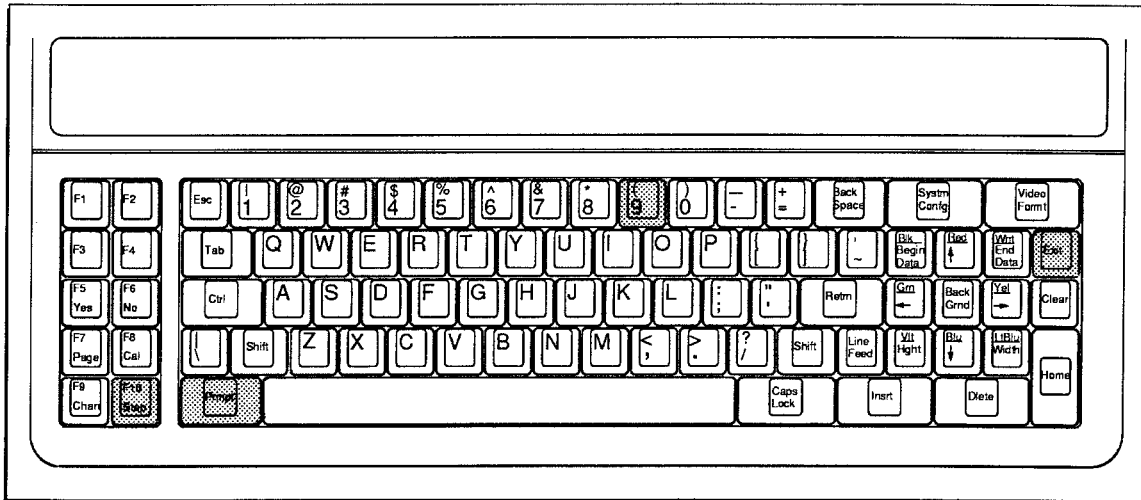


Fig. 2.B.2

- c. Type **0 [CR]**. (Typing **1 [CR]** will set the interface for IEEE-488, as explained in Section 2.B.4(b), below.)
- d. A special VIDEO PAGE will be shown which lets you select desired values of BAUD RATE, NUMBER OF DATA BITS, PARITY, and NUMBER OF STOP BITS.

Use the keyboard's **Step** key to display, in sequence, the choices available for each of the four protocol characteristics. The BILLBOARD will let you know which characteristic you are in the process of specifying (which will also be highlighted on the **MENU** page). When the desired value for this characteristic appears, press CARRIAGE RETURN. This will enter the desired value and advance you to the next characteristic to be specified.

- e. When all protocol characteristics have been appropriately specified, push the **Exit** key.

2. VIA PROTOCOL SWITCHES

THIS PROCEDURE MAY BE USED TO SET THE INTERFACE PROTOCOL FOR ANY DATAPAC.

- a. TURN OFF YOUR DATAPAC.
- b. LOCATE THE DATAPAC'S PROTOCOL SWITCHES.

For a few "A-sized" DataPAC models (10KU, 10K4T, etc.), the Protocol Switches are mounted on the mainframe's *rear panel* (see Fig. 2.B.3, below). For all other DataPACs, they are mounted on the **Interface Card**. For "A-sized" DataPACs (Models 10K1, 10K2, etc.), this is the **Model 10ACP100** (Fig. 2.B.4), and occupies the rightmost SLOT. For "B-sized" DataPACs (Models 10K6, 10K7, 10K8, etc.), it is the **Model 10BIP232** (Fig. 2.B.5), and occupies the rightmost "B SLOT."

BEFORE YOU REMOVE AN INTERFACE CARD TO SET THE PROTOCOL SWITCHES MOUNTED ON THAT CARD, YOU SHOULD FIRST TURN TO APPENDIX B OF THIS GUIDEBOOK AND CAREFULLY READ THE PROCEDURE FOR "CARD INSERTION AND REMOVAL."

NOTE: Depressing the *upward* end of the switch—i.e., toward the word "OPEN" printed on the switch block—will place it in the "OFF" position.

Note also that a blue bar will always appear on the end of the switch *opposite* to the end which is depressed. For example, in the first diagram in Fig. 2.B.6 (below), Switch 4 ("EVN") is in the "OFF" position since its *upward* end is depressed. The blue bar will therefore appear at the *downward* end of the switch.

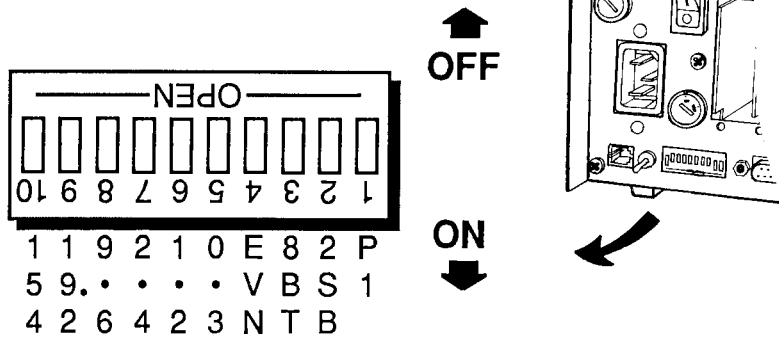


Fig. 2.B.3 Rear-Mounted Protocol Switches (Model 10KU, 10K4T, etc.)

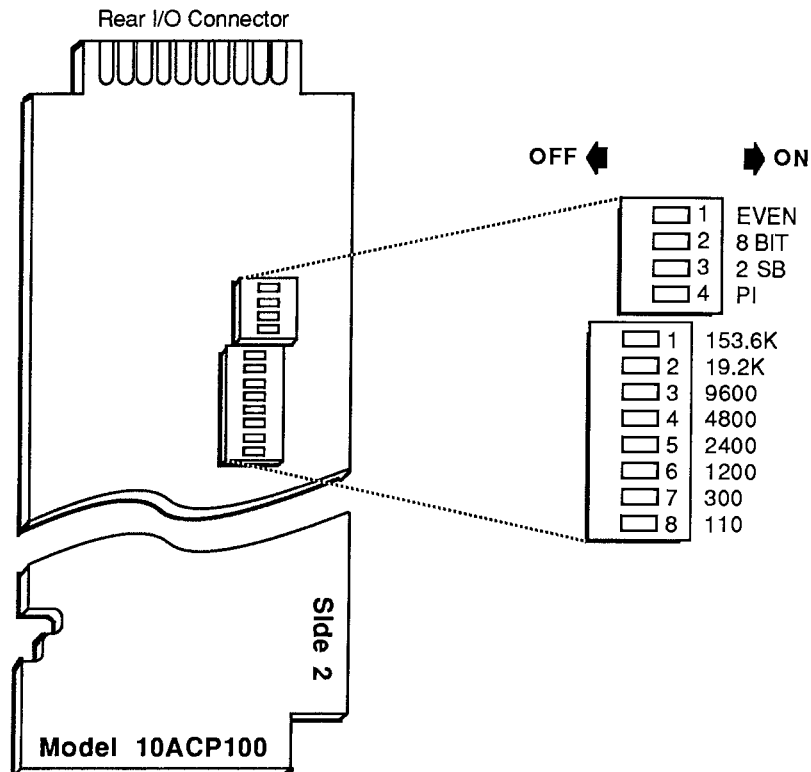


Fig. 2.B.4 Internal Protocol Switches for "A-Sized" Interface Card

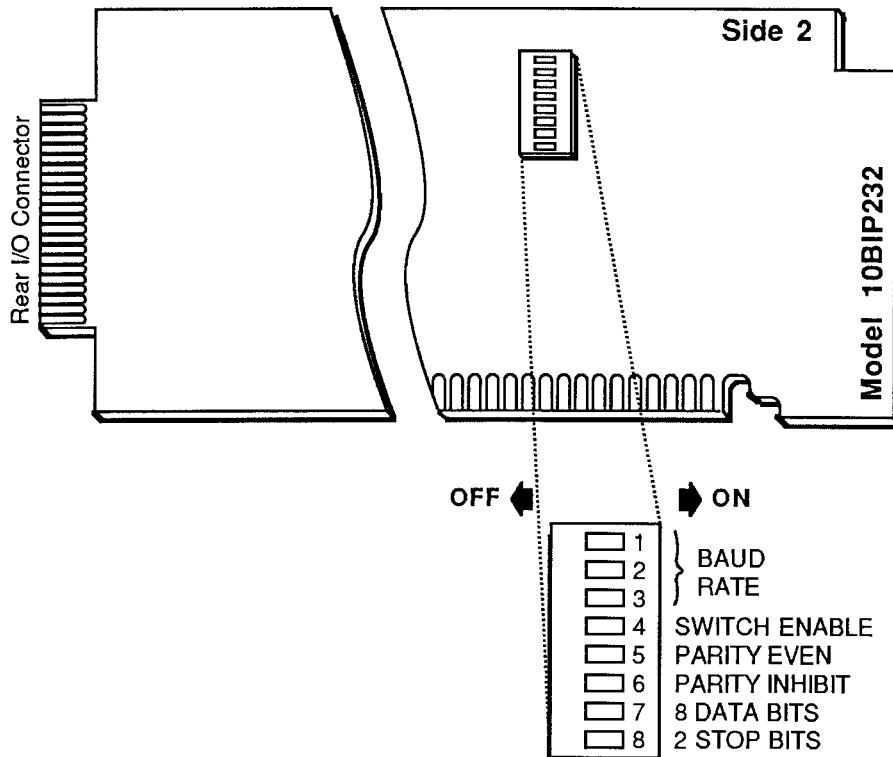


Fig. 2.B.5 Internal Protocol Switches for "B-Sized" Interface Card

C. FOR "A-SIZED" DATAPAC WITH REAR-MOUNTED PROTOCOL SWITCHES:

1. Set **BAUD RATE** for both transmission and reception of data by selecting the appropriate rate from the standard values printed below the six leftmost switches (see Fig. 2.B.3—note that the switches are labelled in *kilobaud*). Move the *one* switch corresponding to this value to the ON position. All other BAUD-RATE switches should be left OFF.
2. Set **NUMBER OF DATA BITS** for both transmission and reception of data by setting the switch labelled **8BT** as follows: OFF for 7 DATA BITS; ON for 8 DATA BITS.
3. Set **PARITY** for both transmission and reception of data by setting the switches labelled **EVN** and **PI** as shown in Fig. 2.B.6. In the case of NO PARITY, the status of Switch No. 4 (**EVN**) is immaterial.

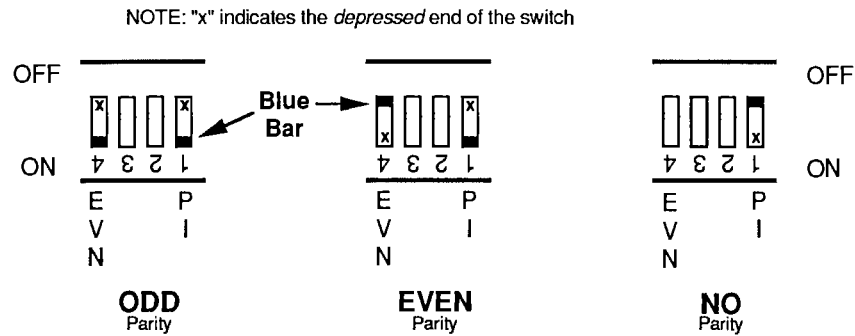


Fig. 2.B.6 PARITY Settings for Rear-Mounted Protocol Switches

4. Set **NUMBER OF STOP BITS** for both transmission and reception of data by setting the switch labelled **2SB** as follows: OFF for 1 STOP BIT; ON for 2 STOP BITS.
- d. **FOR "A-SIZED" DATAPAC WITH PROTOCOL SWITCHES ON INTERFACE CARD:**
1. Set **BAUD RATE** for both transmission and reception of data by selecting the appropriate rate from the eight standard values printed to the right of the lower switch block (see Fig. 2.B.4). Move the *one* switch corresponding to this value to the ON position (depressed to the *right*). All other BAUD-RATE switches should be left OFF.
 2. Set **NUMBER OF DATA BITS** for both transmission and reception of data by setting the switch labelled **8 BIT** as follows: OFF for 7 DATA BITS; ON for 8 DATA BITS.
 3. Set **PARITY** for both transmission and reception of data by setting the switches labelled **EVEN** and **PI** as shown in Fig. 2.B.7. In the case of NO PARITY, the status of Switch No. 1 (**EVEN**) is immaterial.

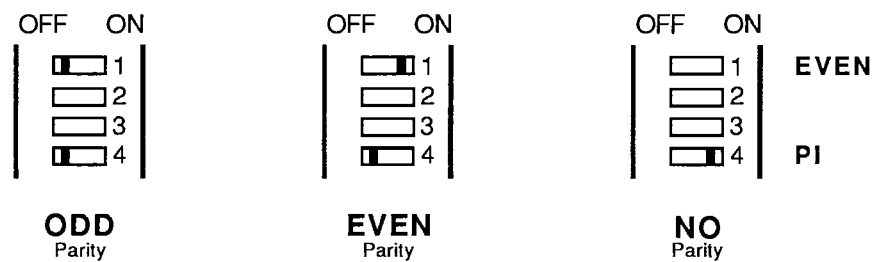


Fig. 2.B.7 PARITY Settings for "A-Sized" Interface Card (10ACP100)

4. Set **NUMBER OF STOP BITS** for both transmission and reception of data by setting the switch labelled **2 SB** as follows: OFF for 1 STOP BIT; ON for 2 STOP BITS.

2.B.2.

RS-232-C INTERFACING

e. FOR "B"-SIZED DATAPAC:

1. Set **BAUD RATE** for both transmission and reception of data by referring to Table 2.B.2, below, and setting Protocol Switches Nos. 1, 2, and 3 to encode the desired rate.

Table 2.B.2

Baud Rate Switch Settings ("B-Sized DataPAC)			
Baud Rate	1	Switch 2	3
110	OFF	OFF	OFF
300	ON	OFF	OFF
1200	OFF	ON	OFF
2400	ON	ON	OFF
4800	OFF	OFF	ON
9600	ON	OFF	ON
19.2K	OFF	ON	ON
153.6K	ON	ON	ON

2. Set **NUMBER OF DATA BITS** for both transmission and reception of data by setting Protocol Switch No. 7 OFF for 7 DATA BITS or ON for 8 DATA BITS.
3. Set **PARITY** for both transmission and reception of data by setting Protocol Switches Nos. 5 and 6 as shown in Fig. 2.B.8. In the case of NO PARITY, the status of Switch No. 5 is immaterial.

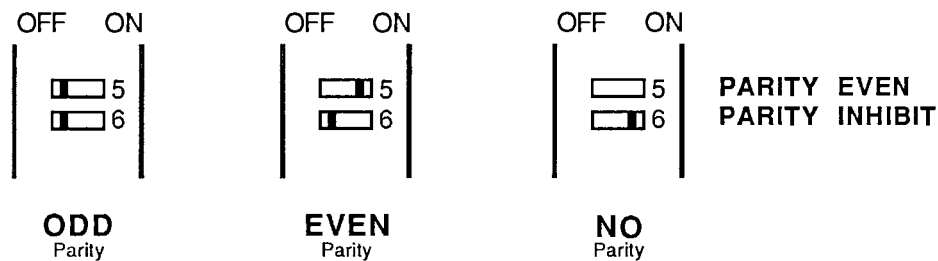


Fig. 2.B.8 PARITY Settings for "B-Sized" Interface Card (10BIP232)

4. Set **NUMBER OF STOP BITS** for both transmission and reception of data by setting Protocol Switch No. 8 OFF for 1 STOP BIT and ON for 2 STOP BITS.

f. ENABLING OF PROTOCOL SWITCHES

1. FOR "A-SIZED" DATAPAC, REGARDLESS OF SWITCH LOCATION:

The Protocol Switches are automatically enabled when set.

2. FOR "B-SIZED" DATAPAC:

WHEN A "B-SIZED" DATAPAC'S PROTOCOL SWITCHES ARE ENABLED, THE PROTOCOL CHARACTERISTICS INDICATED BY THESE SWITCHES WILL BE IN EFFECT REGARDLESS OF THE LAST **MENU** SETTINGS TO HAVE BEEN MADE OR OF THE LAST **BAUD RATE (BAU)** COMMAND TO HAVE BEEN ENTERED.

You will enable the switch settings by placing Protocol Switch No. 4 in the ON position (see Fig. 2.B.5).

After powerup, you can alter the effective protocol values by means of the **BAUD RATE (BAU)** command (see below), or by a subsequent **MENU** setup procedure – BUT ONLY IF THE PROTOCOL SWITCHES HAVE BEEN DISABLED (i.e., Switch No. 4 OFF).

3. VIA BAUD RATE (BAU) COMMAND

THIS PROCEDURE SHOULD BE USED ONLY FOR DATAPACS WITH CRT "VIDEO CAPABILITY" WHOSE PROTOCOL SWITCHES ARE NOT ENABLED; THE **BAU** COMMAND IS NOT RECOGNIZED BY DATAPACS WITHOUT CRT "VIDEO CAPABILITY."

The **BAUD RATE (BAU)** command may be applied through the EXTENDED KEYBOARD or through the DataPAC's COMPUTER INTERFACE PORT. In the latter case, obviously, it can only be used *after* the initial RS-232-C data link has been established.

To set or reset RS-232-C protocol for the COMPUTER INTERFACE PORT, simply command

BAU = b, d, s, p [CR] *

where

b is the BAUD-RATE selection code:

1 = 300	5 = 9600
2 = 1200	6 = 19.2K
3 = 2400	7 = 153.6K*
4 = 4800	

* For extending the distance for high-speed RS-232-C communications to up to one kilometer (3000 ft), see Section 2.B.7.

d is the NUMBER OF DATA BITS (7 or 8)

s is the NUMBER OF STOP BITS (1 or 2)

p is the PARITY selection code:

0 = NONE; 1 = ODD; 2 = EVEN

C. VERIFICATION OF RS-232-C INTERFACE SETUP

1. REQUESTING CURRENT PROTOCOL SETTINGS: BAU COMMAND

If your DataPAC has CRT "video capability," and if its Protocol Switches are NOT ENABLED, you can read the currently effective RS-232-C protocol characteristics by commanding

BAU [CR]

The answer

BAU = b, d, s, p

will appear on the BILLBOARD of the DataPAC's CRT display. Possible values for the variables "b" (BAUD RATE), "d" (NUMBER OF DATA BITS), "s" (NUMBER OF STOP BITS), and "p" (PARITY) are given above.

----- PLEASE NOTE -----

A DataPAC whose Protocol Switches ARE enabled (Switch No. 4 ON) will respond to an interrogation of **BAU [CR]** with the protocol values that were written into EEPROM by the last-entered **BAU = b, d, s, p [CR]** * command. These values may or may not correspond to the switch-determined protocols *currently in effect*.

To verify current protocol settings for DataPACs *without* CRT "video capability," you will have to check the Protocol Switches themselves (see above).

2. VERIFICATION OF INTERFACE

Observe your DataPAC's front-panel SYSTEM STATUS INDICATORS, as you attempt to transmit to the DataPAC an ASCII character from its standard set.

- a. The green **CHR** (CHARACTER) light should go on to indicate reception of a valid ASCII character via the COMPUTER INTERFACE PORT. This usually means that the DataPAC and the connected device are "talking" at the same BAUD RATE.
- b. The green **RCV** (RECEIVED) light will go on whenever there is activity on the RECEIVED DATA line of the interface.

The **Model 10C232NET Network Adaptor** not only serves as a *bidirectional line driver* for a DataPAC's RS-232-C linkage with a "remote" external device, but also allows data interchanges between a single DataPAC and two or more RS-232-C devices, or between a single RS-232-C device and two or more DataPACs.

The 10C232NET has three separate 25-pin INTERFACE CONNECTORS. These are labelled "J1," "J2" (or "A"), and "J3" (or "B"). In all cases, the RS-232-C cable you will use to connect any one of these INTERFACE CONNECTORS to either a DataPAC or an external RS-232-C device should be "full handshake" (see Fig. 2.B.1(a)). It may be a maximum of 1500 feet in length.

As shown in the figures, below, every 10C232NET box requires its own AC power supply. A six-foot power cord comes with every unit, with a switch-selectable transformer that may be plugged into any standard 110-VAC or 220-VAC source (60 Hz). The power-cord jack fits into the hole beside the box's "J1" connector.

NOTE THAT THE INTERRUPTION OF ANY 10C232NET'S INDIVIDUAL POWER SUPPLY WILL INTERRUPT THE FLOW OF RS-232-C DATA THROUGH THE BOX.

a. "REMOTE" RS-232-C INTERFACING

Fig. 2.B.9 shows a Model 10C232NET connecting a "remote" RS-232-C device to a DataPAC's COMPUTER INTERFACE PORT. Here, the 10C232NET acts as a bidirectional booster for all RS-232-C lines involved in "full handshake" data interchanges.

Each of the two interconnecting cables may be up to 1500 feet in length, allowing a total distance of 3000 feet between the DataPAC and the "remote" device.

In this application, the 10C232NET should be set for "AUTO MODE." Unless other specified, every 10C232NET unit is preset at the factory for this standard mode of operation.

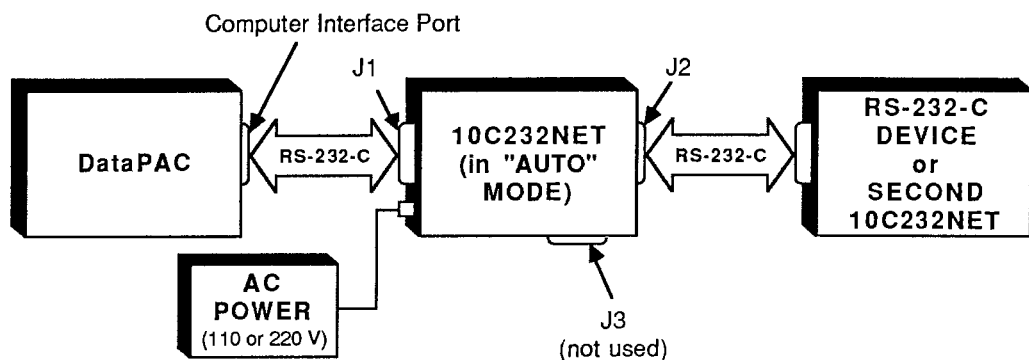


Fig. 2.B.9 "Remote" RS-232-C Interfacing Using the 10C232NET

b. "OR" CONNECTION ("DAISY-CHAINING") OF TWO RS-232-C DEVICES TO A SINGLE DATAPAC OR OF TWO DATAPACS TO A SINGLE RS-232-C DEVICE

Fig. 2.B.10 shows how the 10C232NET may be used for bidirectional logic-"OR" connection of two external RS-232-C devices to a single DataPAC, or of two DataPACs to a single RS-232-C device. Again, this application requires that the 10C232NET be set for (standard) "AUTO MODE."

In the figure, the box labelled "D" can be either a DataPAC or an external (RS-232-C) "Device." If it is a DataPAC, then the boxes numbered "1" and "2" are external RS-232-C devices—only *one* of which can "talk" to the DataPAC at any given time, even though both devices may simultaneously

2.B.3.

USES OF THE OPTIONAL MODEL 10C232NET NETWORK ADAPTOR

"listen" to the DataPAC's RS-232-C output. If, on the other hand, "D" is an external RS-232-C device—say, for example, a printer or recorder—then the numbered boxes are DataPACs, only one of which, again, can issue its RS-232-C output to the device at any given time.

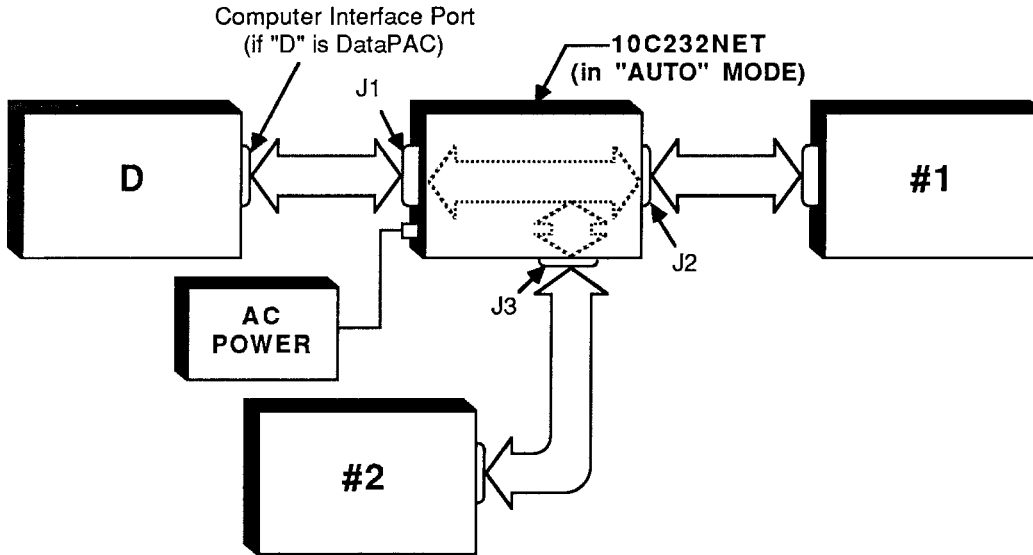


Fig. 2.B.10 Use of 10C232NET as "OR-Connector"

C. SWITCHED CONNECTION OF TWO RS-232-C DEVICES TO A SINGLE DATAPAC OR OF TWO DATAPACS TO A SINGLE RS-232-C DEVICE

Fig. 2.B.11 shows how a 10C232NET unit can be used to switch between two different RS-232-C paths. As in Fig. 2.B.10, the box labelled "D" can be either a DataPAC or an external (RS-232-C) "Device." If it is a DataPAC, then the boxes numbered "1" and "2" are external RS-232-C devices—only *one* of which can be connected to the DataPAC's COMPUTER INTERFACE PORT at any given time, depending on the setting of the 10C232NET switch. If, on the other hand, "D" is an external RS-232-C device—say, for example, a supervisory computer—then the numbered boxes are DataPACs, only one of which, again, can be connected to the device at any given time.

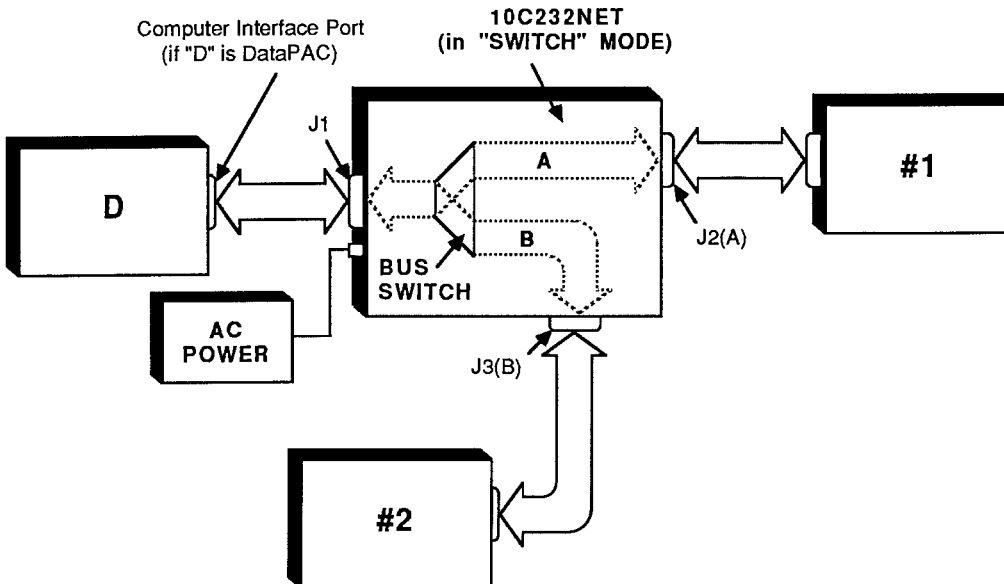


Fig. 2.B.11 Use of 10C232NET as "RS-232-C Switch"

Before it can operate as an RS-232-C switch, the 10C232NET must be set to "SWITCH MODE," as follows:

1. SETTING THE 10C232NET TO "SWITCH MODE"

- a. Disconnect the 10C232NET's AC power supply.
- b. Remove the top plate of the 10C232NET box (4 screws in corners) and locate the programming jumper pads labelled "CLOSE FOR SW" on the top side of the 10C232NET board (see Fig. 2.B.12).

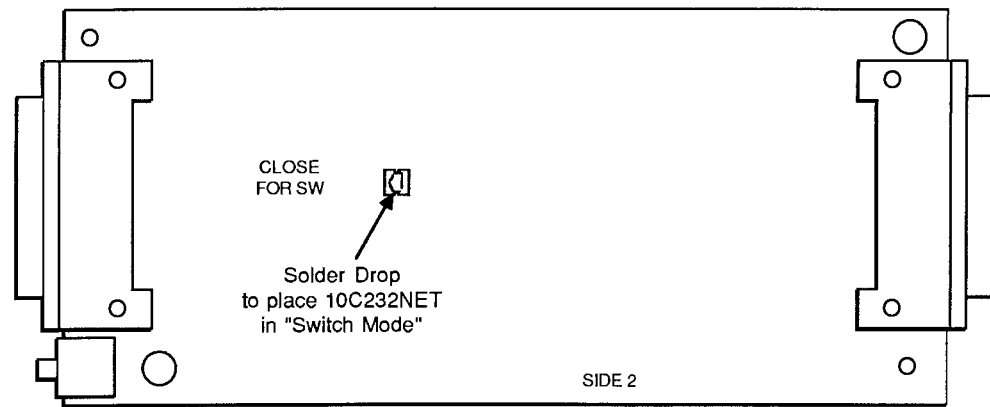


Fig. 2.B.12 10C232NET Mode Programming Jumpers

- c. Connect the two pads by means of a small solder drop. This will place the 10C232NET in "SWITCH MODE." (To return the 10C232NET to "AUTO MODE," you will have to remove the solder-drop connection.)
- d. Reassemble and reactivate the 10C232NET.

2. SELECTION OF DATA PATH

To select one of the two possible data-link paths shown in Fig. 2.B.11, you will use the logic-state activity of Pin No. 9 of *any* of the 10C232NET's three INTERFACE CONNECTORS. (Since all three "Pin 9's" are tied, the logic level of any one will represent the level of all three.)

Thus, if any Pin 9 is at a *Logic 1* state, the data path between Connector J1 and Connector J2 (Path "A") will be selected. If Box "D" in Fig. 2.B.11 is a DataPAC, this action would establish a connection between it and RS-232-C device #1.

Alternatively, if any Pin 9 is at a *Logic 0* state, the path between Connector J1 and Connector J3 (Path "B") will be selected. If "D" is an RS-232-C device, this would establish a connection between it and DataPAC #2.

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You may use your own external logic source to control the activity of Pin 9 (for "External Logic Specifications and Interconnections," see Appendix F). However, it is generally easier to dedicate a specific DataPAC *logic output* to do this, if an optional **Model 10AIO-16 or 10BIO-16 Universal Logic I/O Card** is present. (It doesn't matter which of the 10C232NET's three INTERFACE PORTS the DataPAC containing the Logic I/O Card is connected to, since the switch-control line is shared among all three ports.) In this case, you must

- a. Dedicate one of the Logic Card's sixteen I/O PORTS to the particular system LOGIC BIT you have selected to control the switch. (The state of this bit can be determined in a number of ways—see Section 2.H for full details; for instructions on the "Setup of Logic I/O Ports," see Section 3.A.3, for Model 10AIO-16, or Section 3.B.2, for Model 10BIO-16.)
- b. Then *hard-wire* the selected LOGIC I/O PORT to Pin No. 9 of the DataPAC's COMPUTER INTERFACE CONNECTOR. This pin in turn communicates the existing state of the LOGIC I/O PORT as a *logic-input command* to the 10C232NET's switch-control line (No. 9).
- c. Also hard-wire Pin No. 7 of the DataPAC's COMPUTER INTERFACE PORT (SIGNAL GROUND) to the Logic Card's "ISO COMMON" line. For the **Model 10AIO-16**, this is Pin 9. For the **Model 10BIO-16**, you may connect the interface's Pin 7 to *any* of the Logic Card's "COMMON" lines (i.e., to any even-numbered pin from No. 2 through No. 50).

d. CONNECTION OF MORE THAN TWO RS-232-C DEVICES TO A SINGLE DATAPAC, OR OF MORE THAN TWO DATAPACS TO A SINGLE RS-232-C DEVICE

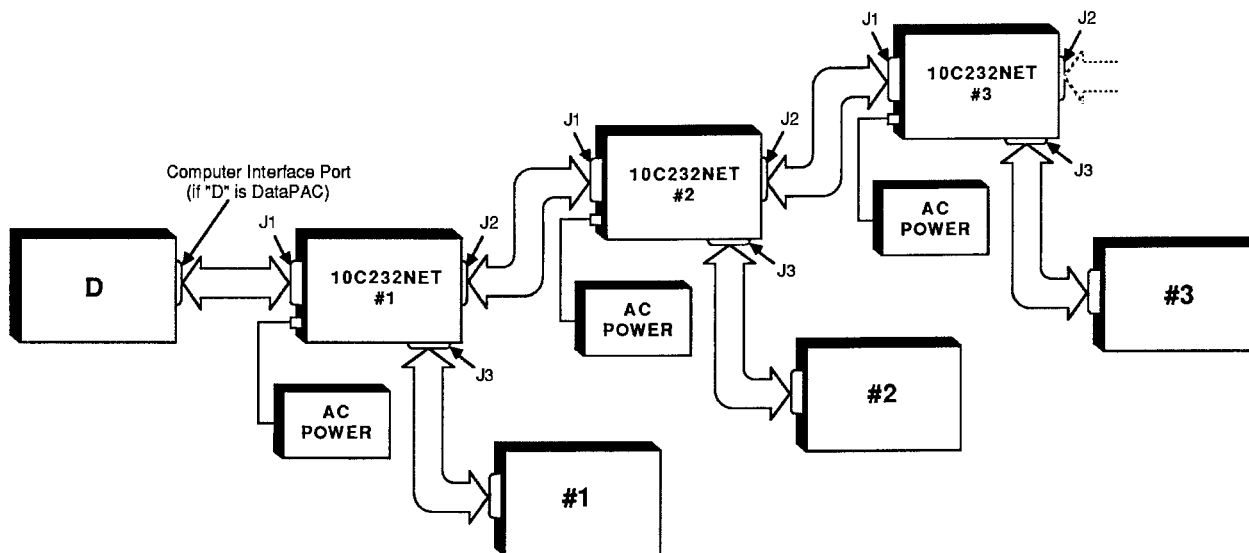


Fig. 2.B.13 Connection of Multiple Devices Using Multiple 10C232NET Units

USES OF THE OPTIONAL MODEL 10C232NET NETWORK ADAPTOR

2.B.3.

If the 10C232NET units in Fig. 2.B.13 are set to "AUTO" MODE, then they allow the OR-connection either of multiple RS-232-C devices ("#1," "#2," "#3," etc.) to a single DataPAC ("D") or of multiple DataPACs ("#1," "#2," "#3," etc.) to a single RS-232-C device ("D").

If the 10C232NET units in Fig. 2.B.13 are set to "SWITCH" MODE, then they allow a single DataPAC ("D") to be switched among multiple external RS-232-C devices ("#1," "#2," "#3," etc.)—or a single RS-232-C device ("D") to be switched among multiple DataPACs ("#1," "#2," "#3," etc.).

In the latter case, switching of the entire 10C232NET series may be controlled by an external computer or PLC, or, if the series consists of no more than six 10C232NET units, by the logic-input configuration of a single 10C232NET in the series, a configuration that includes up to five *extra logic lines* provided for each 10C232NET.

This situation is shown in Fig. 2.B.14. Here, switch-control signals dedicated to individual 10C232NETs are represented by the logic states of Pins 21 through 25 of any of the three INTERFACE PORTS of the first 10C232NET in the "cascaded" series. These logic states may in turn be determined by logic inputs from a DataPAC connected to any of the 10C232NET's three ports, as explained in the above section. Each of the five extra logic lines can pass straight through any intervening 10C232NET box(es), in order that it be tied to Pin 9 of a *different* 10C232NET in the array.

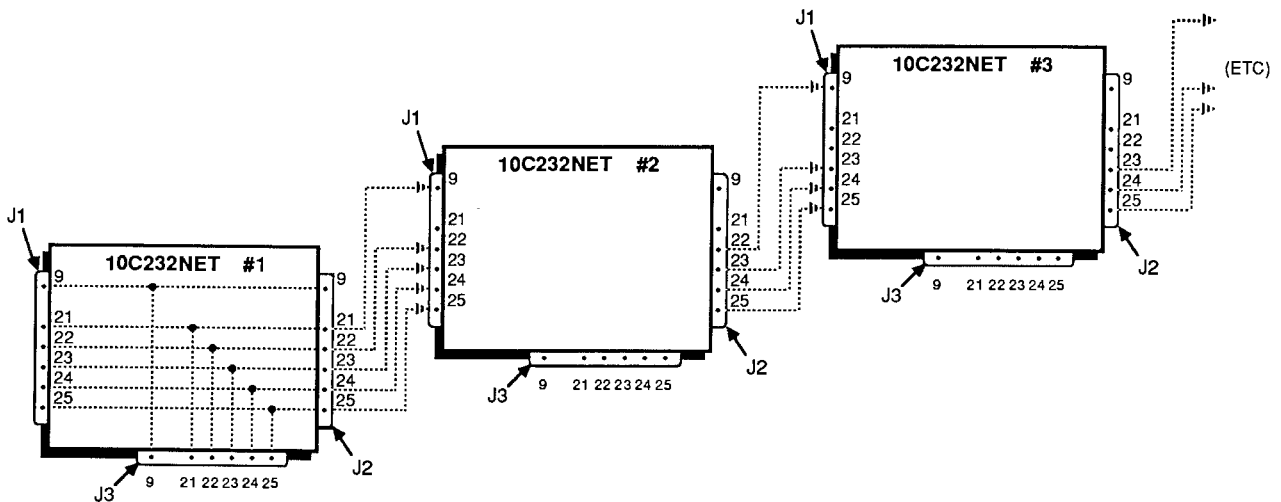


Fig. 2.B.14 Control of 10C232NET Series Using Extra Logic Lines

2.B.4.

OPTIONAL RS-422 AND IEEE-488 INTERFACING

The **Model 10CIF488A IEEE Interface Adaptor** is shown in Fig. 2.B.16, below. It consists of two separate units—the **Model 10E422 RS-232-C to RS-422 Converter** and the **Model 10CLB488 RS-422 to IEEE-488 Converter**—with an interconnecting cable supplied by the user. Refer to Section 2.B.4(b) for cabling and for instructions on configuring the 10CLB488 portion of the 10CIF488A (the 10E422 portion requires no configuration). Replacing the single-unit Model 10CIF488, the Model 10CIF488A makes possible IEEE-488 communications across significantly greater distances, at a higher data rate and with greatly enhanced noise immunity.

a. CONVERTING RS-232-C TO RS-422 VIA THE MODEL 10E422

The externally mounted **Model 10E422 RS-232-C to RS-422 Converter** lets you convert to "RS-422" standards a DataPAC's main RS-232-C COMPUTER INTERFACE or the "AUXILIARY" RS-232-C COMPUTER INTERFACE supplied by a **Model BACI Auxiliary Computer Interface Card** (see Section 3.B.5). A single 10E422 would be used to link a DataPAC either to a device with RS-422 I/O (as shown in Fig. 2.B.15) or to a **Model 10CLB488 IEEE-488 to RS-422 Converter** (see Fig. 2.B.16). BAUD RATE, NUMBER OF DATA BITS, NUMBER OF STOP BITS, and PARITY for the resulting RS-422 interface are identical to those protocol values to which the DataPAC's RS-232-C INTERFACE has been set (see Section 2.B.2(b) or 3.B.5(c)).

IMPORTANT: When connected to any "B-sized" DataPAC (10K6, 10K7, 10K8, etc.) or to a Model 10BACI of hardware version *lower than 6.0*, the Model 10E422 requires its own AC power supply. **NO EXTERNAL SUPPLY IS NEEDED WHEN THE 10E422 CONNECTS TO THE MAIN COMPUTER INTERFACE PORT OF AN "A-SIZED" DATAPAC OR TO A MODEL 10BACI OF HARDWARE VERSION 6.0 OR HIGHER.** A six-foot power cord is therefore supplied with every 10E422, with a switch-selectable transformer that may be plugged into any standard 110-VAC or 220-VAC source (60 Hz).

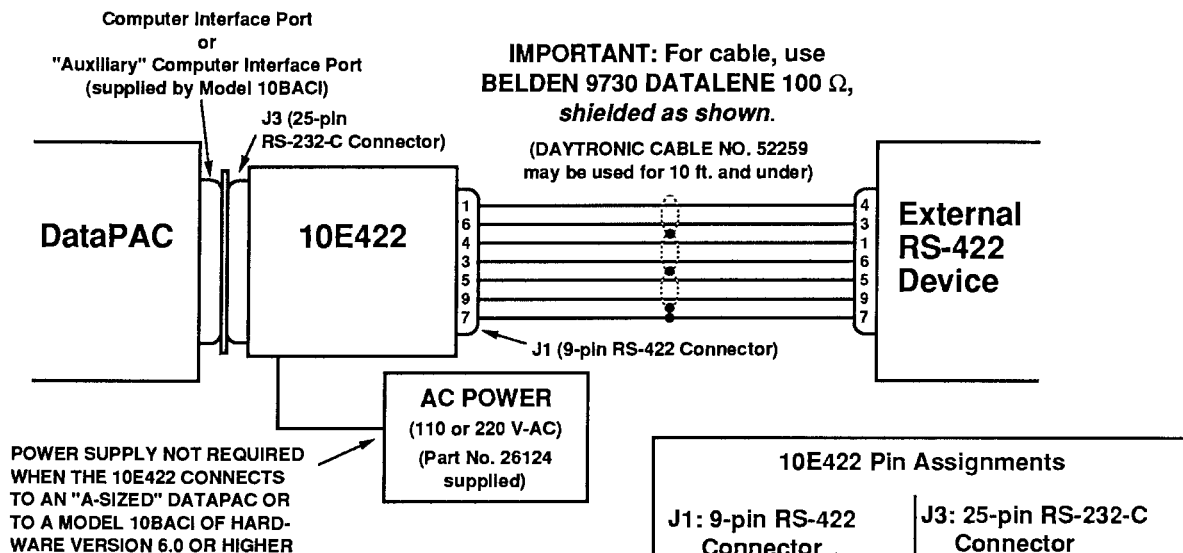
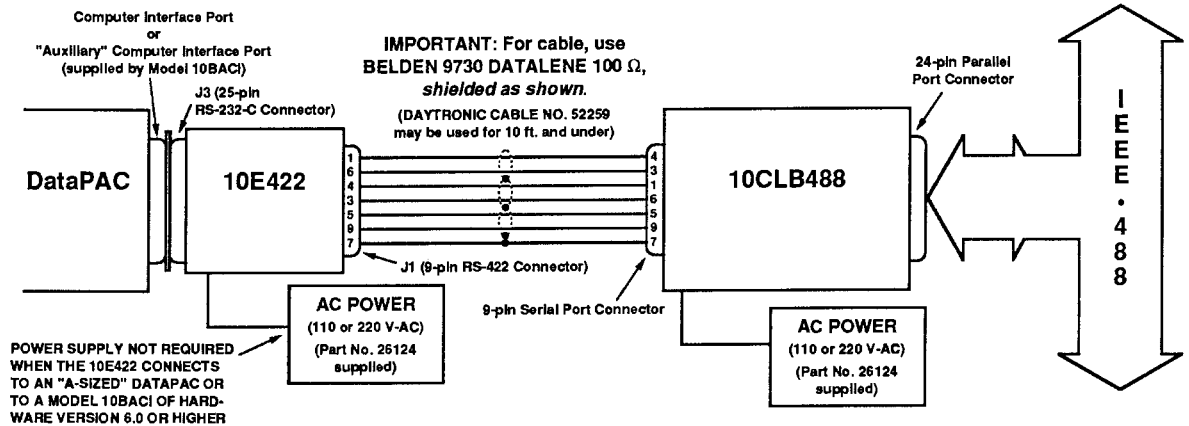


Fig. 2.B.15 Connection of Single 10E422

10E422 Pin Assignments			
J1: 9-pin RS-422 Connector		J3: 25-pin RS-232-C Connector	
Pin	Function	Pin	Function
1	COMMAND	1	SHIELD
2	POWER COM.	2	TRANSMIT DATA
3	RESPONSE	3	RECEIVE DATA
4	RESPONSE	5	CLEAR TO SEND
5	CLEAR TO SEND	7	POWER COMMON
6	COMMAND	20	DATA TERMINAL READY
7	SHIELD		
8	N/C		
9	CLEAR TO SEND		

N/C = Not Committed

Fig. 2.B.16 Connection of 10E422 AND 10CLB488 (EQUIVALENT TO MODEL 10CIF488A)



b. CONVERTING RS-422 TO IEEE-488 VIA THE MODEL 10CLB488

The MODEL 10CLB488 IEEE-488 to RS-422 Converter is a "C"-sized external unit and is used as shown in Fig. 2.B.16 to directly connect a DataPAC's 10E422-converted interface to an IEEE-488 bus.

1. CONNECTIONS

The 10CLB488's 9-pin SERIAL PORT connects directly to the 9-pin RS-422 Port of the 10E422, using the shielded cabling shown in Fig. 2.B.16.

The 10CLB488's 24-pin PARALLEL PORT connects directly to your IEEE-488 bus. Standard IEEE-488 pinout is employed for this port, as follows:

Table 2.B.3

Standard IEEE-488 Pin Assignments

Pin No.	Signal Line	Pin No.	Signal Line
1	DI01 (Data Line)	13	DI05 (Data Line)
2	DI02 (Data Line)	14	DI06 (Data Line)
3	DI03 (Data Line)	15	DI07 (Data Line)
4	DI04 (Data Line)	16	DI08 (Data Line)
5	EOI (End or Identify)	17	REN (Remote Enable)
6	DAV (Data Valid)	18	Ground
7	NRFD (Not Ready For Data)	19	Ground
8	NDAC (Not Data Accepted)	20	Ground
9	IFC (Interface Clear)	21	Ground
10	SRQ (Service Request Line)	22	Ground
11	ATN (Attention)	23	Ground
12	Shield		

NOTE: The 10CLB488 requires its own AC power supply. A six-foot power cord is therefore supplied with every unit, with a switch-selectable transformer that may be plugged into any standard 110-VAC or 220-VAC source (60 Hz).

2. SETTING IEEE-488 INTERFACE PROTOCOL

A DataPAC will be properly established as a "TALKER/LISTENER" peripheral on an IEEE-488 bus only when

2.B.4.

OPTIONAL RS-422 AND IEEE-488 INTERFACING

- Proper CABLE CONNECTIONS have been made (see Fig. 2.B.16, above).
- BOTH THE MODEL 10CLB488'S **SERIAL PORT** AND THE DATAPAC'S **COMPUTER INTERFACE PORT** HAVE BEEN SET TO THE FOLLOWING "PROTOCOL":
 - BAUD RATE (b) = 153.6K
 - NUMBER OF DATA BITS (d) = 8
 - NUMBER OF STOP BITS (s) = 2
 - PARITY (p) = 0 (NONE)
- The DataPAC has been assigned an appropriate "TALKER/LISTENER" BUS ADDRESS, as explained in the following section.

If your DataPAC has been shipped with a Model 10CLB488 IEEE Interface Adaptor, YOU NEED NOT WORRY ABOUT THE 2ND CONDITION, ABOVE. THE DATAPAC/ADAPTOR INTERFACE WILL HAVE BEEN PRESET AT THE FACTORY, AND WILL NORMALLY REQUIRE NO MODIFICATION IN THE FIELD. If for some reason, however, you need to readjust the RS-232-C protocol settings for either the DataPAC's COMPUTER INTERFACE PORT or for the 10CLB488's SERIAL PORT, you may easily do so.

a. SETTING OF PROTOCOL FOR COMPUTER INTERFACE PORT

See Section 2.B.2(b), above. When using the **MENU** setup program explained in that section, you need now only type **1 [CR]** in response to the prompt

ENTER NUMBER OF INTERFACE

to put into effect the required protocol values given above.

----- **NOTE** -----

This action will also establish an **OUTPUT** (or "END-OF-LINE") **TERMINATOR** of **EOI** (**END OR IDENTIFY**) for your DataPAC. However, when large blocks of data are being routinely placed on the bus—as would happen, for instance, in response to a **DUMP** (**DMP**) command—it would optimize speed to have **EOI** occur only at the end of every complete *transmission*, and not at the end of every output *line*. To arrange this you must

1. Follow the procedure for the specification of **RS-232-C** protocol values, as given in Section 2.B.2(b). If you are using the **MENU** setup program, type **0 [CR]** for "NUMBER OF INTERFACE," and then enter *153.6K Baud, 8 Data Bits, 2 Stop Bits, and NO Parity*.
2. Enter a command of
OPT = 0D [CR] *
3. Then enter a command of
EOT = 8D [CR] *

The **OUTPUT TERMINATOR (OPT)** command *must precede* the **END OF TRANSMISSION (EOT)** command (both commands are discussed in detail in Section 1.H.3(g)).

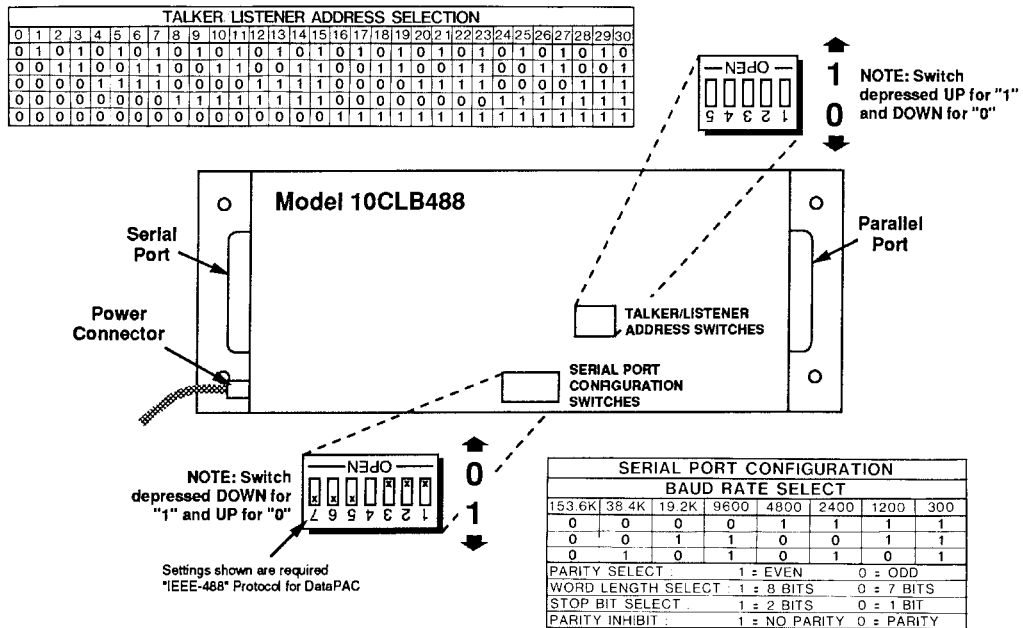


Fig. 2.B.17 Switch Settings for Model 10CLB488

b. SETTING OF PROTOCOL FOR 10CLB488 SERIAL PORT

You may set protocol values for the 10CLB488's SERIAL PORT by means of the internal switches shown in Fig. 2.B.17, above. These are accessed by removing the top plate of the 10CLB488 box (4 screws in corners).

THE SWITCH SETTINGS SHOWN IN THE DIAGRAM ARE THOSE WHICH CORRESPOND TO THE REQUIRED RS-232-C PROTOCOL VALUES GIVEN ABOVE.

c. SETTING DATAPAC IEEE-488 BUS ADDRESS

With reference to IEEE-488 bus structure, a DataPAC is a "TALKER/LISTENER" device, to which you must assign a specific bus address (any integer from 0 through 30), as follows:

1. Remove the top plate of the 10CLB488 box (4 screws in corners) and locate the ADDRESS SELECTION SWITCHES (see Fig. 2.B.17).
2. Set these five switches as shown in the table in Fig. 2.B.17 to encode, in binary form, the value of the desired bus address.

For example, to select an address of "21," set Switches 1 through 5 to form a sequential pattern of "10101" (switch depressed upward for "1"; downward for "0").

Note that, upon system powerup, the DataPAC's bus role will be that of active LISTENER, until otherwise designated by the bus controller.

d. VERIFICATION OF IEEE-488 INTERFACE SETUP

Observe your DataPAC's front-panel SYSTEM STATUS INDICATORS. The green RCV (RECEIVE) light should flash when an ASCII character is transmitted to the DataPAC from the IEEE-488 bus. See also "Requesting Current Protocol Settings: **BAU** Command," Section 2.B.2(c).

2.B.5.

SETTING COMMAND TERMINATOR: CMT COMMAND

a. THE COMMAND TERMINATOR

Prior to shipment, all DataPACs are factory-set for a COMMAND TERMINATOR of **CARRIAGE RETURN ([CR])**. All MNEMONIC COMMANDS in this Guidebook are shown with this (standard) termination.

YOU NEED CONCERN YOURSELF WITH THIS SECTION ONLY IF THE COMPUTER OR OTHER RS-232-C DEVICE TO WHICH YOU ARE CONNECTING YOUR DATAPAC NORMALLY TERMINATES ITS TRANSMISSIONS WITH A CHARACTER OTHER THAN "CARRIAGE RETURN."

When such is the case, you will have to tell the DataPAC what character it is to recognize in lieu of [CR], as a valid termination for all commands received at its COMPUTER INTERFACE PORT (*keyboard*-entered commands will *always* be terminated by [CR]). To do so, you must apply the **COMMAND TERMINATOR (CMT)** command:

CMT = c [CR] *

"c" is any single ASCII character, with the exception of [ESC], which will never be recognized by the DataPAC as a COMMAND TERMINATOR. If the specified terminator is an ASCII CONTROL CHARACTER—such as [CR], [LF], [FF], etc.—it must be entered as a *hexadecimal word in brackets*. Two-character hexadecimal equivalents for standard ASCII CONTROL CHARACTERS are given in Table 1.H.2, Section 1.H.3 of this Guidebook. Only *one* command-terminating character can be in effect at any given time.

b. SETTING COMMAND TERMINATOR FOR DATAPACS WITHOUT KEYBOARD

In order for the *initial* application of the **CMT** command to a DataPAC without keyboard to be effective, you must arrange for your external RS-232-C device to transmit this command to the DataPAC *with a terminating CARRIAGE RETURN ([CR])*.

Any subsequent **CMT** transmission will then, of course, require the COMMAND TERMINATOR specified by the last such command to have been applied.

c. INTERROGATING FOR CURRENT COMMAND TERMINATOR

To ask a DataPAC for the currently effective COMMAND TERMINATOR character, enter a command of

CMT [CR]

If this interrogation is typed on the DataPAC's keyboard—as it would normally be for DataPACs with LCD or CRT "video capability"—the answer will appear on the display BILLBOARD, with any ASCII CONTROL CHARACTER represented in hexadecimal form.

Note, however, that the above "READ" COMMAND may be entered via the DataPAC's COMPUTER INTERFACE PORT, if there is no keyboard. In this case, the terminating CARRIAGE RETURN for the **CMT** interrogation *will be recognized as such by the DataPAC*, regardless of the actual COMMAND TERMINATOR currently in effect.

a. SETTING TIMEOUT RESPONSE: TMO COMMAND

Through the **TIMEOUT (TMO)** command, you can arrange for a given system LOGIC BIT to be set to *Logic 1* whenever no recognizable character has been received at the DataPAC's COMPUTER INTERFACE PORT for a given period of time. The designated "TIMEOUT BIT" can be used to alert the system—and the operator—to a possible "down computer" or "invalid interface" condition, and to initiate whatever actions are called for by such an occurrence.

The form of the command is

TMO = r, s [CR] *

where "r" is any LOGIC BIT, and "s" is the number of *seconds* that constitute the desired "timeout" period ($1 \leq s \leq 60$).

Upon subsequent receipt of any recognizable character at the COMPUTER INTERFACE PORT, the LOGIC BIT set by this command will be automatically reset to "0." The **TIMEOUT (TMO)** command can be applied to only one system LOGIC BIT. See also Section 2.H.2(d) on the assignment of LOGIC SOURCE to a "Special Bit."

To *cancel* an existing **TIMEOUT (TMO)** command, command

TMO = N/A [CR] *

b. SETTING AND TRANSMITTING COMPUTER INTERRUPT: ITR COMMAND

1. DEFINING AN "INTERRUPT" CHARACTER STRING

You can specify a string of one or more standard ASCII characters to be transmitted from the DataPAC's COMPUTER INTERFACE PORT *upon application of the "READ" form of the INTERRUPT (ITR) command* (see below), by entering a command of the form

ITR = "\$" [CR] *

"\$" is any ASCII character or character string (32 characters maximum) which the computer can recognize as an INTERRUPT COMMAND (for example, "CONTROL C," "ESCAPE," "XON," "XOFF," etc.). IT MUST BE ENTERED WITHIN QUOTATION MARKS (" "), which are not actually transmitted. *

Every ASCII CONTROL CHARACTER to be included in the "\$" string must be entered as a *hexadecimal word in brackets*. Two-character hexadecimal equivalents for standard ASCII characters are given in Table 1.H.2, Section 1.H.3.

Only one "INTERRUPT" CHARACTER STRING can be assigned at any one time. To *cancel* the existing "INTERRUPT" designation, command

ITR = N/A [CR] *

2. INITIATING THE "INTERRUPT" TRANSMISSION

To cause the predefined "INTERRUPT" CHARACTER STRING to be transmitted to the computer from the DataPAC's COMPUTER INTERFACE PORT *at the first opportunity following completion of any transmission in progress*, command

ITR [CR]

* Note that the **INTERRUPT (ITR)** command does not work for the optional AUXILIARY COMPUTER INTERFACE PORT supplied by a Model 10BACI (see Section 3.B.5 of this Guidebook).

Obviously, the computer will have little occasion to issue this "READ" form of the **INTERRUPT (ITR)** command, which would amount to its interrupting itself! Instead, the command will normally be applied in one of two ways:

- a. manually, via the **KEYBOARD**, whereby it allows the operator a means of immediately "getting the computer's attention," or
- b. automatically, *upon detection of one or a combination of specific internal logic events, or of a specific combination of system logic, limit, and/or time-interval conditions.* Here, the **ITR** imperative must be included in a pre-entered **EXECUTE (EXU)** or **COMMAND (CMD)** command (see Section 2.K for a full discussion of "Automatic Command Execution"; see especially the second example in Section 2.K.2(b)).

NOTE: Unlike other "READ" COMMANDS, a command of **ITR [CR]** has a special "imperative" function. It will always initiate output from the **COMPUTER INTERFACE PORT**, even when it is entered via the **KEYBOARD**. The DataPAC will *not* answer a keyboard-entered **ITR [CR]** command with a **BILLBOARD** display of the current **INTERRUPT CHARACTER STRING**.

C. "SENDING" TO THE COMPUTER OR PC-EGU: **SND** COMMAND

You can instruct a DataPAC to send a given **ASCII CHARACTER STRING** to the computer via the **COMPUTER INTERFACE PORT** by commanding

SND \$ [CR]

where "\$" is any string of up to 32 **ASCII** characters. As with the **INTERRUPT (ITR)** command, above, every **ASCII CONTROL CHARACTER** in the "\$" string must be entered as a *hexadecimal word in brackets* (see Table 1.H.2, Section 1.H.3). The keyboard's **Line Feed** key may be used for direct entry of the **LINE FEED** character in the "\$" string ([LF] = hex [0A]).

Note that, unlike the **INTERRUPT (ITR)** command, the **SEND (SND)** command does *not* require that the entered character string be enclosed in quotation marks. Such marks, if present, would in fact be interpreted literally, as part of the message to be sent.

Note also that the **SEND (SND)** command *simultaneously defines and initiates* a special transmission from the DataPAC to the computer. Like the "READ" form of the **INTERRUPT (ITR)** command, it is a "RUN-TIME" COMMAND, and does not require that the DataPAC's **EEPROM Write Protect Switch** be on. Since there is no permanent storage of "sent" messages, each message ("\$\$") must be entered in full each time it is to be sent.

Like **ITR**, the **SEND (SND)** command will not, as a rule, be entered by the computer (which would thereby be sending messages to itself!), but rather

1. manually, via the **KEYBOARD**, or
2. automatically, as part of the command sequence of an **EXECUTE (EXU)** or **COMMAND (CMD)** command (see Section 2.K). In this case, the **SEND (SND)** command will define and initiate a DataPAC transmission *to be triggered by detection of one or a combination of specific internal logic events, or of a specific combination of system logic, limit, and/or time-interval conditions.*

There is a special form of the **SEND (SND)** command for issuing a single **MNEMONIC COMMAND** to a Daytronic **Model PC-EGU Enhanced Graphics Card** installed in an **IBM** or **IBM-compatible** computer. Consult your *Model PC-EGU Instruction Manual* or see Section 4 of this Guidebook, under the **SND** mnemonic.

Under optimal circumstances, the maximum cable length for valid RS-232-C interchanges at 153.6K baud is approximately 50 feet. By means of the **Model 10ESRE**, however, you can extend the distance for high-speed serial communications to approximately *one kilometer (3000 feet)*, using a BELDEN 9730 DATALENE 100 Ω cable configured and *shielded* as shown in Fig. 2.B.18. The Model 10ESRE itself consists of

- two **Model 10E422** RS-232-C to RS-422 Converters;
- a 10-foot, 9-wire, 100-ohm shielded RS-422 cable (Daytronic Cable No. 52259), intended primarily for testing purposes; and
- two plug-in AC power adapters (Part No. 96124)

Fig. 2.B.18 shows a typical 10ESRE arrangement. Here, in order to boost the 153.6K-baud link between a DataPAC and an external RS-232-C computer, printer, or PLC, one of the two 10E422 units is attached to the DataPAC (COMPUTER INTERFACE PORT or "AUXILIARY" (BACI-supplied) COMPUTER INTERFACE PORT), while the other 10E422 attaches to the RS-232-C port of the external device.

NOTE: As mentioned above, a 10E422 requires its own AC power supply when it is connected to a "B-sized" DataPAC or a Model 10BACI of hardware version *lower than 6.0*. The 10E422 that attaches to the external RS-232-C device also requires its own AC power supply, *unless* it is connected to a **Model PC-HSIC High-Speed Serial Interface Card** installed in an IBM-compatible computer (including the Daytronic **Model IPC-XT, IPC-AT, or IPC-386**). Two six-foot power cords are therefore supplied with every 10ESRE, each with a switch-selectable transformer that may be plugged into any standard 110-VAC or 220-VAC source (60 Hz).

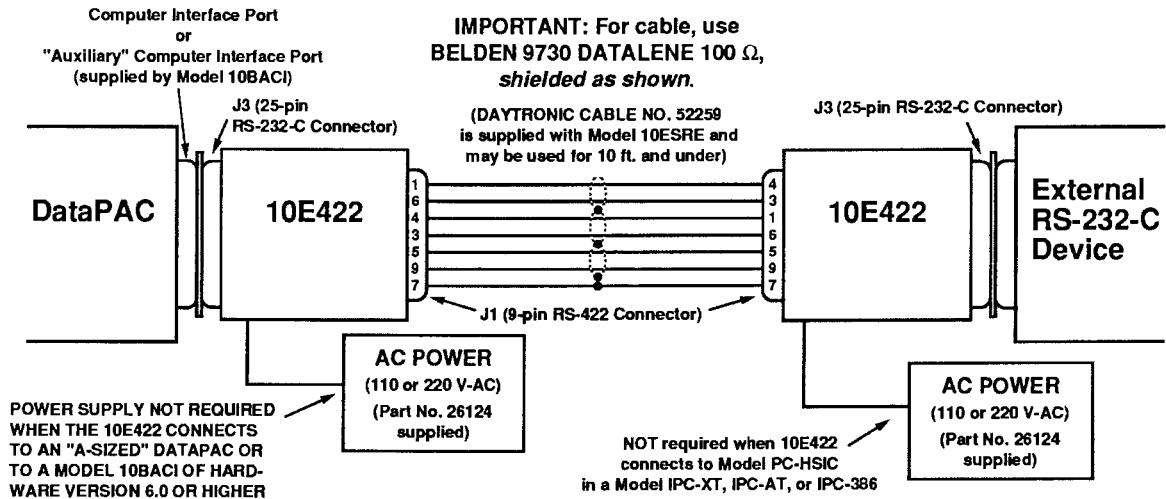


Fig. 2.B.18 Connection of Model 10ESRE

It's a simple matter to connect an external modem to any DataPAC RS-232-C Interface Port, including

- the Computer Interface Port discussed in this Guidebook section
- an Auxiliary Computer Interface Port (Section 3.B.5)
- the Printer Interface Port provided by a Model 10VFO132 (Section 3.C.3)
- the RS-232-C port provided by a Model 10AFIFO Card (Section 3.A.8).

With reference to RS-232 interfacing, a System 10 DataPAC is always to be regarded as **DATA TERMINAL EQUIPMENT (DTE)**, while a connected modem is regarded as **DATA COMMUNICATIONS EQUIPMENT (DCE)**. Therefore, the standard DTE-to-DTE interface shown Section 2.B.2 is NOT to be used for modem communications, which require a DTE-to-DCE interface.

The DTE-to-DCE interface supported by a System 10 DataPAC uses strictly PIN-TO-PIN cabling (no TXD/RXD criss-cross), where the following functions on the DataPAC (DTE) side tie directly to like-named functions on the modem (DCE) side:

- Pin 1: **EARTH GROUND (SHIELD)**
- Pin 2: **TRANSMITTED DATA (TXD)**
- Pin 3: **RECEIVED DATA (RXD)**
- Pin 4: **REQUEST TO SEND (RTS)** as an OUTPUT to indicate the DataPAC's readiness to transmit data to the attached DCE*
- Pin 5: **CLEAR TO SEND (CTS)** as an INPUT to indicate the readiness of the attached DCE to receive from the DataPAC
- Pin 7: **LOGIC GROUND**
- Pin 20: **DATA TERMINAL READY (DTR)** as an OUTPUT to indicate the DataPAC's readiness to receive data from the attached DCE

NOTE THAT THE DATAPAC IMPLEMENTS ONLY THESE WIRES FOR MODEM CONNECTIONS.

FOR PROPER DATA INTERCHANGE BETWEEN A DATAPAC AND A CONNECTED MODEM, THE DATAPAC'S INTERFACE PORT MUST BE SET TO THE SAME **BAUD RATE** AS THE MODEM. Other RS-232-C protocols—number of data bits, number of stop bits, and parity—are immaterial to the modem itself, though obviously not to the device that will be ultimately receiving data via the modem.

When used with a modem, a System 10 DataPAC will normally serve as a remote station which will be "called" periodically to report collected data to a central computer. Under certain conditions, however, it can be configured to "dial out" to an external device via the modem. For more information, contact the *Daytronic Integrated Systems Department* (513-866-3300).

* RTS is not used on all DataPAC RS-232-C ports.

Section 2.C

Complete CRT Video Setup



System 10 Guidebook

2.C

Complete CRT Video Setup

Most of the SETUP (or "WRITE") COMMANDS discussed in this section will be entered manually, by means of the DataPAC's EXTENDED KEYBOARD. Note, however, that *all* commands given here—with the exception of **SAVE (SAV)** and **DELETE (DEL)**—may be entered, if desired, through the DataPAC's COMPUTER INTERFACE PORT.

"Getting started" video procedures are presented in Section 1.D.2 of this Guidebook, in more or less simplified form.

—— NOTE ——

For *all* commands in this section to be effective, your DataPAC requires a MODEL 10BVT60 VIDEO TEXT CARD containing SOFTWARE VERSION "10.0" or higher. For the earliest software versions pertaining to individual commands, see Section 4 of this Guidebook.

a. SETTING "BVS" AND "VDU" VALUES: **BVS** AND **VDU** COMMANDS

The **B VIDEO SIGNAL (BVS)** and **VIDEO DISPLAY UNIT (VDU)** commands should be applied before any other video setup is begun. **BVS** will set the DataPAC to accommodate the specific VIDEO SIGNAL CARD with which it is equipped, while **VDU** will establish a uniform video *format* and *frame rate* for all system CRT's, internal and external.

1. IF YOUR DATAPAC CONTAINS A MODEL **10BVS90** VIDEO SIGNAL CARD, command

BVS = 90 [CR] *

2. IF YOUR DATAPAC CONTAINS A MODEL **10BVS95** GRAPHICS VIDEO SIGNAL CARD, which is required for the Model **10VGM500** Video Graphics Memory Card (Section 3.C.4), command

BVS = 95 [CR] *

3. IF YOUR SYSTEM CONTAINS AT LEAST ONE **COLOR** MONITOR, command either

VDU = C, 50 [CR] * or **VDU = C, 60 [CR] ***

depending on whether the nominal value of your local line frequency is 50 or 60 Hz, respectively.

After one of the above commands has been entered, all *intensity* values for CHANNEL DISPLAY FIELDS displayed by a system monochrome monitor will be read in terms of *color* values, as follows:

FULL INTENSITY (2) = WHITE (W)
 HALF INTENSITY (1) = GREEN (G)
 NO INTENSITY (0) = BLACK (O)

The numbers and letters in parentheses are corresponding "STATUS" codes to control VISUAL EFFECTS for displayed DATA, BIT-STATE, MESSAGE, and VIDEO PLAYBACK FIELDS (see Section 2.C.12).

4. IF YOUR SYSTEM CONTAINS ONE OR MORE **MONOCHROME** MONITORS (ONLY), command either

VDU = M, 50 [CR] * or **VDU = M, 60 [CR] ***

depending, again, on whether your local line frequency is nominally 50 or 60 Hz, respectively.

b. SELECTING VIDEO MODE: **VID** COMMAND

Every internal DataPAC CRT in your system will always be set to one of two "VIDEO MODES"—**INTERNAL** or **EXTERNAL**—depending on whether it is to display INTERNAL VIDEO PAGES currently in EEPROM storage, with "live" data, messages, etc., or an EXTERNAL VIDEO INPUT from a computer or other video-signal source. Note that the Model 10CCONB Operator Console described in Section 2.O may be similarly set for either INTERNAL or EXTERNAL display.

For complete details on System 10 VIDEO INPUTS AND OUTPUTS, see Section 2.N.

2.C.1.

SETUP OF INTERNAL CRT

1. SETTING A CRT TO DISPLAY INTERNAL VIDEO PAGES

- a. Connect the EXTENDED KEYBOARD to the DataPAC. The EEPROM Write Protect Switch need NOT be ON.
- b. Type the following **VIDEO MODE (VID)** command:

VID = INT [CR]

NOTE: At powerup, the **INTERNAL** mode will always be in effect, by default.

2. SETTING A CRT TO DISPLAY AN EXTERNAL VIDEO INPUT

- a. Connect the EXTENDED KEYBOARD to the DataPAC. The EEPROM Write Protect Switch need NOT be ON.
- b. Type

VID = EXT [CR]

----- ALSO PLEASE NOTE -----

You can use the keyboard's **Ctrl (CONTROL)** and **System Config (SYSTEM CONFIGURATION)** keys in place of the **VIDEO MODE (VID)** command, to toggle back and forth between **INTERNAL** and **EXTERNAL** displays. Simply press the **Ctrl** key and hold it down while you press the **System Config** key. The **System Config** key has a red indicator light to tell you that the DataPAC CRT is in the **EXTERNAL** mode.

C. SETTING SCREEN REFRESH RATE: REF COMMAND

Every DataPAC with CRT video capability is normally preset to update *displayed* data approximately 10 times a second. You may increase or reduce this rate, if you wish, by commanding

REF = n [CR] *

For the "refresh constant" (n), you should enter an integer from 1 through 60. This unique number is related to the actual screen "refresh rate" (R, in *Hertz*) by this equation: $60/n = R$ (Hz). The range of possible refresh rates is therefore 1 through 60 Hz. Please note that these rates are approximate only.

For example, if you enter a refresh constant of "5," data appearing on your screen will be updated approximately 12 times a second, while a value of 30 for "n" will yield a rate of only 2 times a second.

d. FLAGGING OUT-OF-SCAN CHANNELS: **VSS** COMMAND

See Section 1.F.2(c) of this Guidebook.

e. ADJUSTMENT OF CRT CONTROLS

DataPAC CRT's are factory-set prior to shipment. NORMAL USE SHOULD NECESSITATE LITTLE IF ANY READJUSTMENT OF CRT CONTROLS.

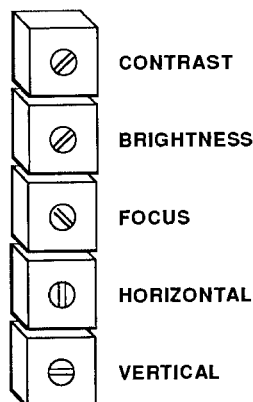
1. MONOCHROME CRT

Fig. 2.C.1, below, shows the potentiometer controls for a DataPAC MONOCHROME CRT. Slotted for screwdriver adjustment, these controls are located on the front of the CRT housing, to the immediate left of the screen. To access, simply remove the appropriate front bezel of the DataPAC. For equipment protection, always use an adjustment tool with an insulated shaft.

2. COLOR CRT

The only readily accessible control for a DataPAC COLOR CRT is the **BRIGHTNESS** knob, located just below the lower right-hand corner of the screen. To access, simply remove the front bezel. IF YOU THINK YOUR COLOR CRT REQUIRES FURTHER ADJUSTMENT, YOU SHOULD CONTACT THE DAYTRONIC FACTORY OR YOUR NEAREST AUTHORIZED SERVICE FACILITY.

Fig. 2.C.1 CRT Controls, Monochrome Monitor



a. THE NATURE OF THE "VIDEO PAGE"

Every DataPAC with CRT "video capability"—that is, which contains a VIDEO CARD SET, with or without internal CRT—allows the composition, storage, and subsequent editing of a large number of internal VIDEO PAGE FORMATS (or "VIDEO PAGES"). Each VIDEO PAGE may contain any desired combination of **FIXED TEXT** and (VARIABLE) **CHANNEL DISPLAY FIELDS** that can fit the display screen. CHANNEL DISPLAY FIELDS include

1. **DATA FIELDS** for display of "live" measured or calculated data values
2. **BIT-STATE FIELDS** for display of the states of system LOGIC BITS
3. **MESSAGE FIELDS** for display of alphanumeric MESSAGES preloaded by the operator or computer via the **MESSAGE (MES)** command
4. **VIDEO PLAYBACK FIELDS** for display of VIDEO PLAYBACK PSEUDOCHANNELS employed by an optional **Model 10BDR64 History Card**

Each VIDEO PAGE bears a *Page Number*. The PAGE DIRECTORY, described in the following section, lets you see the Page-Number assignments for all VIDEO PAGES presently in storage. You may at any time assign an *unused* Page Number to any page format appearing on the screen, thereby placing that format in nonvolatile EEPROM video memory.

It's important that you understand the distinction between a *page on display* and a *page in storage*. At any time, you can enter **TEXT EDITOR MODE** (as explained in Section 2.C.5), in order to edit or "overwrite" the *currently displayed* page format, using the EXTENDED KEYBOARD and simple "word processing" functions. A *stored* page format, however, can NOT be altered; it can only be DELETED from storage.

For example, the sample PAGE DIRECTORY in Fig. 2.C.2, below, shows a *stored* Page No. 11. It's a simple matter to "call" this page for display and to proceed to edit the *displayed* format. SUCH EDITING, HOWEVER, HAS NO EFFECT ON THE ORIGINAL "PAGE NO. 11" THAT REMAINS IN EEPROM STORAGE.

A DataPAC's video memory is much like a drawer of 100 file folders, each of which corresponds to a given *Page Number* of the PAGE DIRECTORY. The drawer itself is of fixed length (157 "blocks" of 64 bytes each is "standard" video memory; the **Model 10VMO500 Extended Video Option** or **Model 10VGM500 Video Graphics Memory Option** allows extension of this memory, as explained in the following section). The separate storage "folders," however, may vary widely in the amount of material they contain. Some, in fact, will be empty; others may be near their maximum "thickness" (32 blocks).

As explained in the following section, the PAGE DIRECTORY will give you the memory "size" of each existing VIDEO PAGE. In addition, a special form of the **PAGE (PAG)** command lets you directly interrogate the DataPAC for the memory "size" of any particular page in storage (see Section 2.C.3(c), below).

When you call a particular VIDEO PAGE for display, the contents of its "folder"—that is, of its assigned storage space in the video memory—will NOT be "removed." Instead, an editable "copy" of these contents will appear on the screen. This copy you may proceed to change as you wish, and then to store as a *new page*, *without affecting the stored original in the least*.

REMEMBER: A STORED PAGE FORMAT IS NOT ALTERED WHEN YOU ALTER ITS REPRESENTATION ON THE CRT SCREEN.

b. THE PAGE DIRECTORY: DIR COMMAND

Every DataPAC with CRT "video capability" contains a prestored PAGE DIRECTORY. To make the the PAGE DIRECTORY appear on the screen, type

DIR [CR]

A typical PAGE DIRECTORY is given in Fig. 2.C.2, below. It shows

1. which of the 100 potential VIDEO PAGES have already been formatted and entered in nonvolatile EEPROM storage, and the relative amount of video memory dedicated to each stored page. A typical VIDEO PAGE will take 5 to 7 memory "blocks" of 64 bytes each, with a nominal maximum of 32 blocks.
2. which pages, if any, are contained in the "memory extension" provided by a **Model 10VMO500 Extended Video Option** or **10VGM500 Video Graphics Memory Option**. Pages in "standard" video memory are shown *white on red* (for monochrome CRT, *white on black*), and those in optional "extended" memory, *red on white* (for monochrome CRT, *black on white*).

In the sample PAGE DIRECTORY in Fig. 2.C.2, we see that the "standard" video memory contains 9 page formats, which have been assigned Page Numbers 1, 2, 5, 25, 37, 63, 75, 99, and 100, respectively. The "extended" video memory contains 6 pages, which have been assigned Page Numbers 11, 22, 44, 55, 80, and 91, respectively. Page No. 1 takes 2 memory "blocks," Page No. 2 takes 3, Page No. 5 takes 4, etc.

3. the *"FREE" video memory* available in both "standard" video memory and optional "extended" memory, if present. "Standard" usable video memory is normally 157 "blocks" of 64 bytes each. The **Model 10VMO500** or **Model 10VGM500** can be used to increase the total capacity to 661 blocks.

Thus, on its second line the PAGE DIRECTORY displays the number of "FREE" blocks of both "standard" and "extended" memory currently at your disposal. If the "extended" memory is present, these two values will be separated by a slash, the first value being the total free "standard" memory. The PAGE DIRECTORY in Fig. 2.C.2 indicates that 110 blocks of "standard" memory and 476 blocks of "extended" memory are as yet unused. If the "extended" memory is not present, only the "standard" free memory will be shown.

4. the *total "FREE" memory* ("standard" *and* "extended") currently at your disposal. This number is shown under the word "FREE" in the lower right-hand corner of the PAGE DIRECTORY. In Fig. 2.C.2, this total is 586 blocks.

Your DataPAC will come with a number of *prestored* VIDEO PAGES, including the *initial data-display pages* described in Section 1.B.1(e), the *initial "blank" page* for use in format composition (Page No. 100), and, if your system contains a Model 10VFO132 Formatted Output Card, an initial DEFAULT "HEADER" page (No. 98) and DEFAULT "TAILER" page (No. 99), both of which are described in Section 3.C.3(e.1).

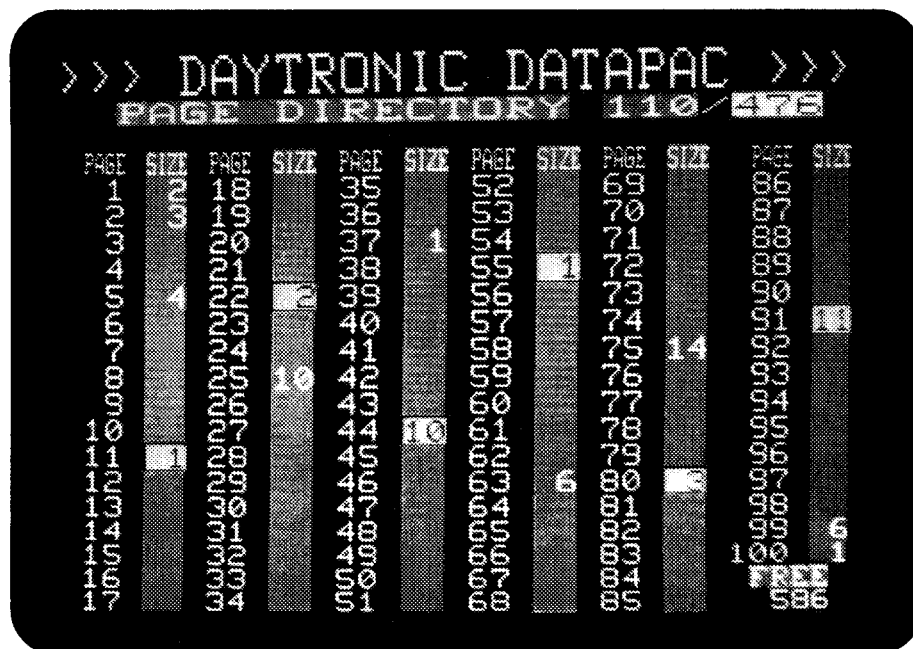


Fig. 2.C.2 Sample Page Directory

C. THE CONDITIONAL DIRECTORY: SHO COMMAND

Your DataPAC provides up to 10 user-defined **CONDITIONAL BITS**, each of which can be made directly dependent upon one or more selected *logic conditions* occurring within the measured test or process. A logic-state transition of any **CONDITIONAL BIT** can then be made to trigger the execution of one or more standard **MNEMONIC COMMANDS**, as specified by a **COMMAND (CMD)** command (for full details, see Section 2.K, "Automatic Command Execution").

To produce a full CRT display of the Boolean expressions currently defining the *first five* **CONDITIONAL BITS**, along with all **COMMAND (CMD)** statements applying to the logic-state transitions of these bits, simply command

SHO [CR]

The DataPAC will respond by displaying a special **CONDITIONAL DIRECTORY** page, similar to that shown in Fig. 2.C.3. To view **CONDITIONAL BITS** Nos. 6 through 10, along with their respective **COMMAND (CMD)** statements, command

SHO2 [CR]

—or, alternatively, press the **Step** key, having previously commanded **SHO [CR]**. (To return to the display of the first five **CONDITIONAL BITS**, press the **Step** key once again.)

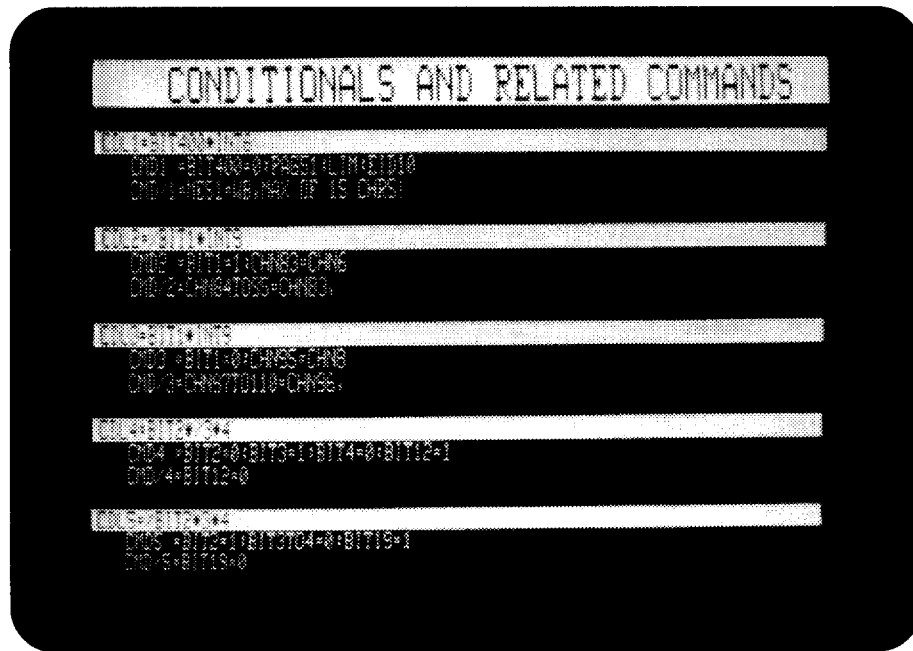


Fig. 2.C.3 Sample Conditional Directory

2.C.3.

CALLING AND INTERROGATION OF VIDEO PAGES: PAG COMMAND

a. CALLING A VIDEO PAGE FOR DISPLAY

To "call" a stored VIDEO PAGE FORMAT to the CRT screen, command

PAG p [CR]

where "p" is the Page Number of the page you wish to appear. Any integer from 1 through 100 is a "legal" value for "p," whether or not this number has actually been assigned to an existing VIDEO PAGE.

If the entered Page Number cannot be found in the PAGE DIRECTORY, or if it is outside the "legal" range of 1-100, then the **PAGE (PAG)** command will have no effect, and one of the following prompting messages will appear on the BILLBOARD:

PAGE # NOT FOUND IN DIRECTORY

(the called page is "legal" but nonexistent; check the PAGE DIRECTORY for the numbers of all pages in storage), or

ILLEGAL PAGE—MUST BE 1-100

(all pages beyond "100" are reserved for internal system use and cannot be called for display).

----- NOTE -----

You can quickly apply the **PAGE (PAG)** command by pressing the **Page** key, followed by the number of the page to be displayed and CARRIAGE RETURN. Thus, to display Page No. 37, press **Page**, followed by **37** and **[CR]**.

b. REQUESTING THE NUMBER OF THE PAGE ON DISPLAY

To ask the DataPAC for the number of the page *currently being displayed*, command

PAG [CR]

or, alternatively, press the **Page** key (only), followed by CARRIAGE RETURN. The Page Number will be displayed on the BILLBOARD. Note that if the currently displayed page has not yet been entered into EEPROM storage, via the procedure given in Section 2.C.7, the BILLBOARD response to a **PAG** interrogation will be

PAG = N/A

C. REQUESTING THE MEMORY "SIZE" OF A VIDEO PAGE

To request the number of "blocks" of video memory currently used by an existing Page No. p, you may enter, via the COMPUTER INTERFACE PORT (only), a command of

PAG p? [CR]

where, again, $1 \leq p \leq 100$. The question mark must immediately follow the number "p." The DataPAC will respond by transmitting from its COMPUTER INTERFACE PORT the number of "blocks" currently occupied by this page.

NOTE: The above command may be used in place of the DIRECTORY (DIR) command to learn *whether or not a given page exists in EEPROM storage*, since, if the designated Page No. p does not exist, a command of **PAG p? [CR]** will yield a "block-count" answer of "0" (zero).

a. SPECIFYING BILLBOARD LOGO: LGO COMMAND*

Whenever the DataPAC's CRT "BILLBOARD" is not called upon to display prompting messages, keyboard-entered commands, system responses to keyboard-entered interrogations, etc., it will contain your company's name or any other screen caption specified at the time of order.

You can *modify* this "LOGO" at any time by commanding

LGO = \$ [CR] *

where "\$" is a string of up to 27 characters, including spaces. To eliminate the LOGO display altogether, simply type in a string of SPACES for "\$."

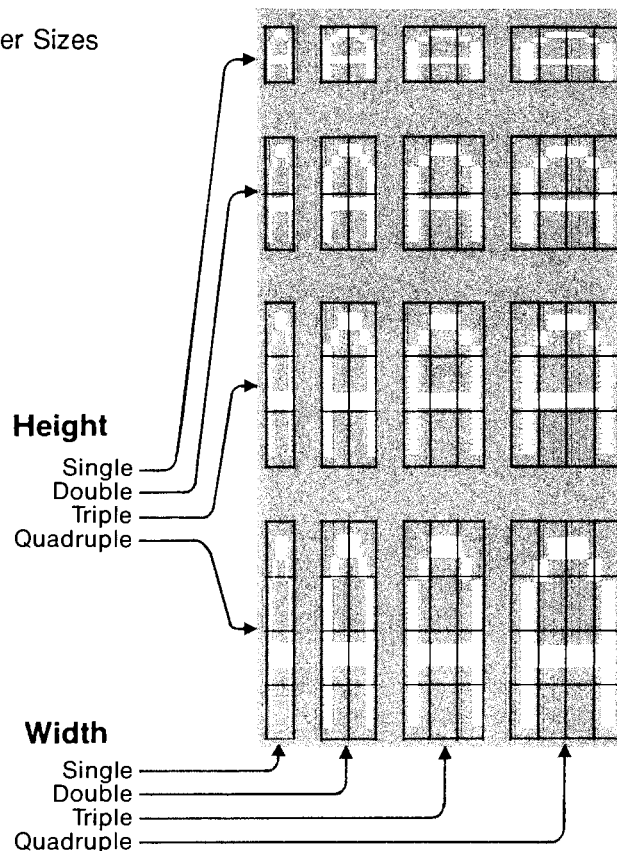
b. CHARACTER AND PAGE SIZE

1. CHARACTER SIZES

With the Model 10BVS90 VIDEO SIGNAL CARD, 16 different character sizes are possible, as shown in Fig. 2.C.4. With the Model 10BVS95 GRAPHICS VIDEO SIGNAL CARD, the same sizes are possible, *except for* the following "height x width" combinations: "2 x 1," "3 x 1," and "4 x 1." For the 10BVS95, a character *width* of "1" can only be combined with a height of "1."

ALL TEXT AND DATA CHARACTERS ON A GIVEN LINE OF THE DISPLAY WILL BE OF THE SAME SIZE (HEIGHT AND WIDTH). ("DATA characters" here means all characters, including spaces, within a DATA FIELD, BIT-STATE FIELD, MESSAGE FIELD, or VIDEO PLAYBACK FIELD.) For the setting of character size, see Section 2.C.5(c), below.

Fig. 2.C.4 Character Sizes



* The **LOGO (LGO)** command applies equally to the *front-panel LCD* "BILLBOARD" of a Model 10K2, 10K4T-D, etc. (see Section 1.D.1).

2.C.4.

GENERAL FORMATTING AND "WORD-PROCESSOR" CONSIDERATIONS

2. PAGE SIZE

The available formatting area for every CRT VIDEO PAGE consists of *up to 20 single-height lines*, with *up to 80 single-width characters per line* for a MONOCHROME display and *up to 78 characters per line* for a COLOR display.

NOTE: When monochrome and color monitors are used together, you should always specify a "COLOR" format for your system, by means of the **VIDEO DISPLAY UNIT (VDU)** command (Section 2.C.1(a), above). This ensures that no portion of a page composed on a monochrome monitor will be lost when that page is displayed on a color monitor.

As Fig. 2.C.5 shows, the above dimensions do not include the *first two single-height lines* of every displayed page, which constitute the "BILLBOARD" area in which system answers, prompting messages, warnings, company LOGO, etc., appear—as well as any and all command entries made via the keyboard (for more information on the BILLBOARD and its contents, see Section 1.A.3(c) of this Guidebook).

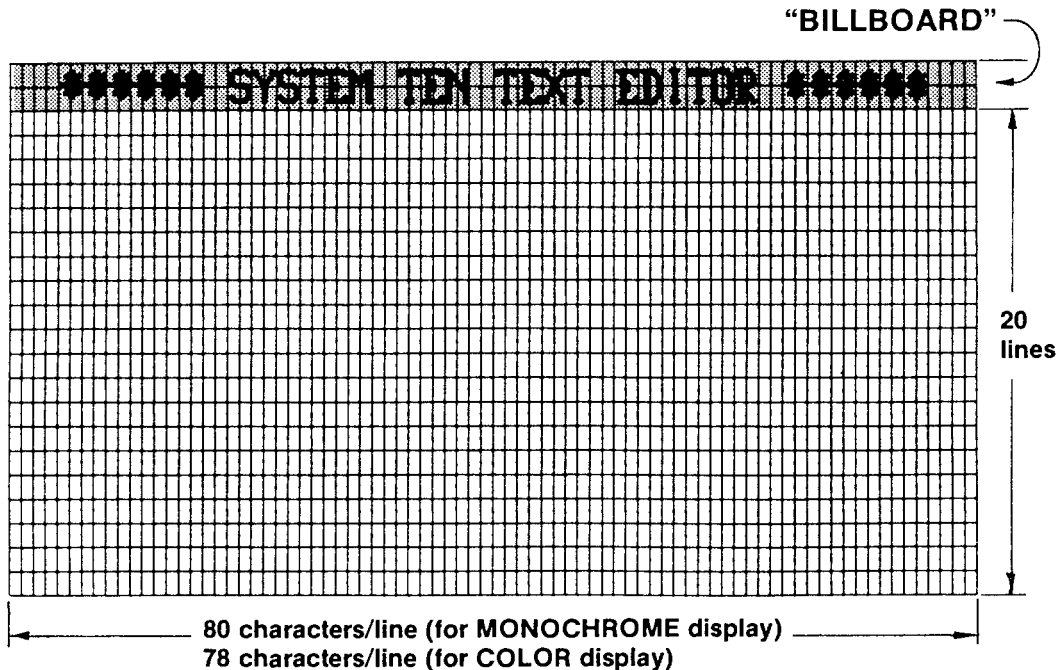


Fig. 2.C.5 Display Dimensions

C. CHANNEL DISPLAY FIELDS

The *number of spaces* you choose to represent a given CHANNEL DISPLAY FIELD will depend on the channel reading you anticipate.

1. DATA FIELD or VIDEO PLAYBACK FIELD

The size of the field should reflect both the magnitude and the precision of the measured or calculated data value you want to display. THE MAXIMUM NUMBER OF SPACES FOR A DATA FIELD OR VIDEO PLAYBACK FIELD IS *NINE*.

NOTE: A VIDEO PLAYBACK FIELD is used for the display of a VIDEO PLAYBACK PSEUDOCHANNEL. As explained in Section 3.B.4, a VIDEO PLAYBACK PSEUDOCHANNEL is a special system channel with a Channel Number from 1000 through 1299. It is used strictly for the display of *recorded "historical" data* from one of the four internal RAM recorders contained in the **Model 10BDR64 History Card**. A VIDEO PLAYBACK PSEUDOCHANNEL is set up by means of a **PLAYBACK (PLA)** command. Unlike other PSEUDOCHANNELS, it is not included in the normal scanning of system channels, and cannot be interrogated via the **CHANNEL (CHN)** command.

2. BIT-STATE FIELD

The size of the field should reflect the "DESIGNATOR PAIR" you have chosen to indicate the states of the given LOGIC BIT, as explained in Section 2.C.5(f), below. THE MAXIMUM NUMBER OF SPACES FOR A BIT-STATE FIELD IS *SEVEN*.

3. MESSAGE FIELD

The size of the field should reflect the number of characters in the text assigned to the MESSAGE in question, as explained in Section 2.C.5(g), below. THE MAXIMUM NUMBER OF SPACES FOR A MESSAGE FIELD IS *FIFTEEN*.

A single line may contain more than one CHANNEL DISPLAY FIELD of a given type, or it may contain any combination of different CHANNEL DISPLAY FIELD types permitted by the length of the line. Note, however, that adjacent CHANNEL DISPLAY FIELDS (regardless of type) *must be separated by at least one space or character of FIXED TEXT not "associated" with either field* (for "ASSOCIATED" FIXED TEXT, see Section 2.C.5(i), below).

d. CURSOR MOVEMENT: "ARROW" KEYS

The blinking cursor appears on the screen as soon as you enter TEXT EDITOR MODE. It lets you see where the next character you type will appear on the screen, and what the character's height, width, and color will be.

The cursor is moved horizontally and vertically by means of the keyboard's four "arrow" keys.

Pushing the **SPACE BAR** will move the cursor one space to the right. However, it will also enter a "space character" on the screen. Therefore, except when deliberately entering a space or spaces into the page format, you should refrain from using the **SPACE BAR**.

Pushing the **Back Space** key will move the cursor one space to the left.

Pushing the **Home** key will move the cursor to the extreme upper left corner of the screen.

e. REPEATED CHARACTER ENTRY

To continuously repeat the entry of a given character on the screen, simply hold down the respective character key.

2.C.4.

GENERAL FORMATTING AND "WORD-PROCESSOR" CONSIDERATIONS

f. INSERTION AND DELETION OF FIXED-TEXT SPACES: "INSERT" AND "DELETE" KEYS

The **Insrt** (INSERT) and **Dlete** (DELETE) keys allow *horizontal positioning* of a line of displayed text.

1. SPACE INSERTION

By pushing the **Insrt** (INSERT) key, you will insert at the position of the cursor *one space character* of FIXED TEXT, of appropriate height, width, and color. All TEXT and DATA characters in the line to the right of the cursor will be shifted one space to the right.

2. SPACE DELETION

By pushing the **Dlete** (DELETE) key, you will delete the FIXED-TEXT space occupied by the cursor. All TEXT and DATA characters in the line to the right of the cursor will be shifted one space to the left.

g. INSERTION AND DELETION OF DISPLAY LINES: "INSERT" AND "DELETE" KEYS WITH CONTROL

When used with the **Ctrl** (CONTROL) key, the **Insrt** (INSERT) and **Dlete** (DELETE) keys allow *vertical positioning* of all or a portion of the display.

1. LINE INSERTION

To insert a *full line of spaces* of appropriate height, width, and color, you must first move the cursor to the extreme *left* edge of the screen, and at the vertical position of the desired insertion. Then press the **Ctrl** key and hold it down as you press the **Insrt** key. A line of space characters will appear, over which you may now type desired FIXED TEXT, or establish desired CHANNEL DISPLAY FIELDS. The line the cursor was originally on, along with all lines of display below it, will be shifted down one space.

2. LINE DELETION

To delete an entire line of display, including all FIXED TEXT and CHANNEL DISPLAY FIELDS within the line, first move the cursor to the extreme *left* edge of the screen, at the vertical position of the line in question. Then press the **Ctrl** key and hold it down as you press the **Dlete** key. All lines of display below the deleted line will be shifted up one space.

Through successive line deletions, you can easily produce a *blank* screen for purposes, say, of composing a new page format (Section 2.C.5, below).

h. LINE DUPLICATION: "TILDE" KEY

Move the cursor to the extreme *left* edge of the screen, and one space *below* the line to be duplicated. Then press the "TILDE" key (~). An exact duplicate of the given line will be inserted immediately below it, all lines below the original line having been shifted down one space. In this way you can rapidly create a large block of background color for your display, by continuously duplicating a single line of spaces of that color.

Note that *all* contents of the given line are duplicated, including the Channel-, Bit-, or Message-Number entries of any CHANNEL DISPLAY FIELDS within the line. In almost all cases, you will want to reassign to a duplicated CHANNEL DISPLAY FIELD a number *different* from that of the original field.

a. CALLING A BLANK DISPLAY

You can always compose a new VIDEO PAGE by "recomposing" whatever page is currently on display. Suppose, for example, that you need a new page that differs only slightly from an existing Page No. 38. You can call Page No. 38 (using the **PAGE (PAG)** command, as explained above), make the required changes, and then "save" the new page, following the procedures given in Section 2.C.7. Remember that such an alteration of the *displayed* Page No. 38 leaves the *stored* Page No. 38 unchanged.

However, when composing a completely new and different page, it's often more convenient—or, at least, less distracting!—to start with a totally *blank* display, instead of having to "overwrite" an existing format. The DataPAC therefore comes with one prestored BLANK PAGE (Page No. 100).

Therefore, to produce a BLANK display for the purpose of composing a new VIDEO PAGE FORMAT, command

PAG 100 [CR]

BEFORE WRITING OR EDITING MAY BE PERFORMED ON THE SCREEN, YOU MUST ENTER THE **TEXT EDITOR MODE**, as explained in the following section.

b. ENTERING TEXT EDITOR MODE: "VIDEO FORMAT" KEY

Press the **Video Formt (VIDEO FORMAT)** key. The BILLBOARD will announce

SYSTEM 10 TEXT EDITOR

as in Fig. 2.C.5. You may now type in desired page contents, using the keyboard as a "word processor."

c. SETTING LINE SIZE: "HEIGHT" AND "WIDTH" KEYS

To set the *height* of a line of characters (including all FIXED TEXT and CHANNEL DISPLAY FIELDS in that line) and the *width* of each character in that line, use the **Height** and **Width** keys, respectively. For all possible character height/width combinations, see Fig. 2.C.4.

If, for example, you wish to set a line at *single height, double width*, you should first press the **Width** key and **2**; then press the **Height** key and **1** (ALWAYS SET THE CHARACTER WIDTH FIRST). To set a line at *quadruple height, triple width*, press, in order: **Width, 3, Height, 4**.

d. SETTING COLOR OR INTENSITY OF FIXED TEXT WITHIN A LINE: COLOR AND "BACKGROUND" KEYS WITH SHIFT

1. SETTING TEXT COLOR WITHIN A LINE OF COLOR DISPLAY

All characters in a given line of FIXED TEXT *need not be of the same color or intensity*.

You must set the desired color or intensity of a region of FIXED TEXT before you type in that text. This "region of FIXED TEXT" can be all of a line or any portion of a line; it can even be a single character.

NOTE: If your DataPAC uses a Model **10BVS90** VIDEO SIGNAL CARD along with a Model **10BVT60** VIDEO TEXT CARD of Software Version **9.0** or higher, then you must be sure that the keyboard's **Caps Lock** function is ON before entering TEXT EDITOR MODE. LOWER-CASE "TEXT EDITOR" ENTRIES WILL NOT BE CORRECTLY INTERPRETED BY THE 10BVS90 WHEN THIS 10BVT60 SOFTWARE IS BEING USED. The **Caps Lock** key has a red indicator light to tell you that it is ON.

Note that use of the Model **10BVS95** GRAPHICS VIDEO SIGNAL CARD along with 10BVT60 Software Version 9.0 or higher *does* permit the entry of lower-case letters during page composition.

2.C.5.

COMPOSING A PAGE FORMAT

To set all or part of a line's FIXED TEXT in a particular combination of **CHARACTER COLOR** and **BACKGROUND COLOR**, you need only

- a. Push the **Shift** key and hold it down.
- b. Push the key labelled with the desired CHARACTER color. The eight **COLOR** keys are

Blk (BLACK)
Wht (WHITE)
Red (RED)
Grn (GREEN)
Yel (YELLOW)
Vlt (VIOLET)
Blu (DARK BLUE)
LtBlu (LIGHT BLUE)

- c. Push the **Back Grnd (BACKGROUND)** key.
- d. Push the key labelled with the desired BACKGROUND color.
- e. Release the **Shift** key.
- f. Type the desired FIXED TEXT.

For example, if you want a certain amount of FIXED TEXT to be in *yellow* characters on a *blue* background, move the cursor to the space where you want to begin this portion of text, hold down the **Shift** key, and then press, in order, **Yel**, **Back Grnd**, **Blu**.

Note that when you're generating a line of colored FIXED TEXT, it's a good idea *not to leave the line by means of the UP or DOWN "ARROW" KEY* unless the text is complete, and you're ready to set the color of the next line. The reason is that moving the cursor vertically out of a line automatically cancels the color-setting command that has been applied to that line (or line section). You must therefore *reset the color* when you return to the line to continue typing its text. Pressing CARRIAGE RETURN at the end of the line, however, *will not change the color setting*, so that, unless reset, succeeding lines of FIXED TEXT that have been terminated by [CR] will be of the same color.

2. SETTING TEXT INTENSITY WITHIN A LINE OF MONOCHROME DISPLAY

Each "color" setting for a COLOR CRT (see above) corresponds to an "intensity" setting for a MONOCHROME CRT. "Intensity values" range from "0" (for black, or "zero intensity") to "7" (for white, or "full intensity"):

Table 2.C.1.

Monochrome "Intensity" Values	
INTENSITY VALUE OF:	CORRESPONDS TO COLOR:
0.....	BLACK
1.....	(DARK) BLUE
2.....	RED
3.....	VIOLET
4.....	GREEN
5.....	LIGHT BLUE
6.....	YELLOW
7.....	WHITE

To set CHARACTER/BACKGROUND intensity combinations for regions of FIXED TEXT of a MONOCHROME display, you will use the same procedure as given above for the setting of color for the text of a color display. Now, however, you will use the keyboard's COLOR keys to enter corresponding "intensity values."

For example, if you want a certain amount of FIXED TEXT to be in approximately *half-intensity* characters on a *black* background, move the cursor to the space you want to begin the text, hold down the Shift key, and then press, in order, **Grn**, **Back Grnd**, **Bk**.

----- ALSO PLEASE NOTE -----

WHEN DISPLAYING THE SAME PAGE FORMAT ON *BOTH* MONOCHROME AND COLOR CRT'S, you should be careful to choose CHARACTER/BACKGROUND color combinations whose corresponding "intensity values" are of sufficient contrast to yield legible characters on the monochrome display.

Specifically, for the *monochrome version of a color combination* to yield characters that may be easily distinguished from their background field, you should make sure that an "intensity-value" difference of at least "2" exists between the selected CHARACTER and BACKGROUND colors. *Yellow* characters on a *light blue* field might, for example, be adequately legible on a color monitor, but are virtually invisible on the monochrome version of the same display, the "intensity-value" difference between the two colors being only "1."

e. ENTERING AND DELETING A DATA FIELD

NOTE: Except for differences in allowable field size and in the character used to prefix the "Field Number" entry, DATA FIELDS, BIT-STATE FIELDS, MESSAGE FIELDS, and VIDEO PLAYBACK FIELDS are essentially the same with regard to format and formatting procedures. Therefore, almost all remarks in this section pertaining to the setup of DATA FIELDS apply equally to the other three types of CHANNEL DISPLAY FIELDS (which are treated separately in the three sections that follow this one).

The *color or intensity* of a CHANNEL DISPLAY FIELD—whether it be a DATA FIELD, a BIT-STATE FIELD, a MESSAGE FIELD, or a VIDEO PLAYBACK FIELD— is strictly determined by the "STATUS" commands discussed in Section 2.C.12, below. Note here that, while the DataPAC is in the TEXT EDITOR MODE, each CHANNEL DISPLAY FIELD will normally appear, for a color monitor, as *blue characters on a green background*, or, for a monochrome monitor, as *nearly black characters on a half-intensity background*— regardless of the command currently governing the channel's "VISUAL EFFECTS."

1. ENTERING A DATA FIELD WITHIN A LINE

- a. Determine the *number of spaces* you wish to constitute the DATA FIELD (maximum number of spaces is 9).
- b. Move the screen cursor to the space where you want the DATA FIELD to begin.
- c. Press the **Begin Data** key.
- d. Using the **SPACE BAR**, enter *spaces* to represent the DATA FIELD, but *three spaces fewer* than the total number you want for the field (see the example in Fig. 2.C.6).

2.C.5.

COMPOSING A PAGE FORMAT

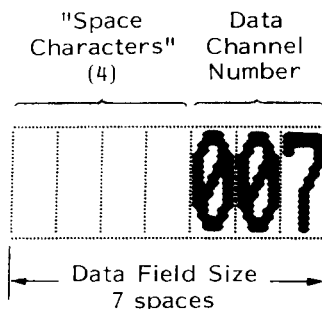


Fig. 2.C.6 Sample Data Field

- e. Then type in the three-digit Channel Number (001 through 999) of the system DATA CHANNEL supplying the value to be displayed in the DATA FIELD.

For example, if, as in Fig. 2.C.6, you need a *seven-space field* to read the data for system Channel No. 7, you should hit the **SPACE BAR** four times and then type **007**. (Actually, the leading zeros are not necessary, and you can use one- or two-digit Channel Numbers if you wish, since $007 = 07 = 7$. THE IMPORTANT THING TO REMEMBER IS THAT REGARDLESS OF HOW MANY DIGITS IT CONTAINS, THE CHANNEL-NUMBER ENTRY MUST BE **RIGHT-JUSTIFIED**; THAT IS, ITS LAST DIGIT MUST OCCUPY THE LAST CHARACTER SPACE OF THE DATA FIELD. For this reason it is convenient to regard a Channel Number as a *three-digit* number, and to gauge the size of the DATA FIELD accordingly, as given in Step d, above.)

Remember, too, that the channels for **TIME** and **DATE** are always assigned the Channel Numbers **998** and **999**, respectively.

- f. Press the **End Data** key. If the line is to contain further FIXED TEXT to the right of the DATA FIELD just entered, you may now proceed to set its color or intensity and to type it in.

Here it should be mentioned that you can use the **Insrt (INSERT)** and **Delete (DELETE)** keys to insert or delete *spaces* within a DATA FIELD—but *only while you are still in the process of establishing the field*.

ONCE YOU HAVE PRESSED **End Data**, HOWEVER, YOU CAN NO LONGER "EDIT" THE DATA FIELD, *EXCEPT* TO CHANGE THE CHANNEL-NUMBER ENTRY OR TO DELETE THE FIELD ALTOGETHER (see below). Thus, if you discover that an "established" DATA FIELD has too few or too many spaces, your only option is to *delete the entire field and re-enter it properly*.

Any attempt to insert or delete a space within an "established" DATA FIELD will invoke the following BILLBOARD announcement:

NO INSERT/DELETE IN DATA FIELD

This restriction does *not*, however, apply to any FIXED TEXT "associated" with the DATA FIELD (see Section 2.C.5(i), below).

Other formatting errors may produce other BILLBOARD messages, including any one of the following. Note that all but the last message here listed are meant to alert you to a *syntax error* which, until corrected, will prevent the pushing of the **End Data** key from having any effect, thereby "trapping" you in the DATA FIELD. The last message, on the other hand, is meant to alert you to the fact that you are now "trapped" in the DATA FIELD only because you have *neglected* to push the **End Data** key.

- **ILLEGAL DATA FIELD FORMAT**

This usually means that one or more spaces have been embedded within the Channel-Number entry, as shown:



Fig. 2.C.7

You should use the **Insrt** (**INSERT**) and **Diete** (**DELETE**) keys to remove an embedded space and reinsert it where it should go. UNTIL YOU DO SO, YOU CANNOT LEAVE THE DATA FIELD.

- **ILLEGAL KEYSTROKE IN DATA FIELD**

This message will appear after you have attempted to enter an "illegal" character in the DATA FIELD. The only "legal" CHANNEL DISPLAY FIELD characters are **SPACES**,

NUMERALS (0-9), **#**, **\$**, and ***** (the last three characters are used for creating BIT-STATE FIELDS, MESSAGE FIELDS, and VIDEO PLAYBACK FIELDS, respectively—see the following sections). Note that an "illegal" keystroke will have no effect on the DATA FIELD you are in the process of establishing; that is, the corresponding "illegal" character will not appear on the screen.

- **CHANNEL # MUST BE RIGHT JUSTIFIED**

When this message appears, it usually means that (a) you have inadvertently typed one or more DATA-FIELD spaces to the *right* of the Channel-Number entry, like this:



Fig. 2.C.8

or (b) you have somehow completely *deleted* the Channel-Number entry. As before, any improper spaces in the DATA FIELD must be deleted before you can leave the field.

- **CHANNEL # MUST BE 1-999**

You have apparently entered an "illegal" Channel Number, such as "5372" or "000." You must delete the erroneous number and enter a "legal" one, before you can leave the DATA FIELD.

- **MUST END DATA FIELD/ASSOC. TEXT TO EXIT**

Here, you have probably tried to exit the DATA FIELD (or a region of "ASSOCIATED" FIXED TEXT) by a cursor movement, the **Exit** key, or CARRIAGE RETURN—without having first pressed the **End Data** key.

2. DELETING AN "ESTABLISHED" DATA FIELD

To delete an entire DATA FIELD while in TEXT EDITOR MODE, simply move the cursor to the *first* (leftmost) space of the field, and push **End Data**.

f. ENTERING AND DELETING A BIT-STATE FIELD

A BIT-STATE FIELD is identical to a DATA FIELD (with regard to page formatting), *except that*

1. the maximum number of spaces for a BIT-STATE FIELD is 7; and
2. the Bit-Number entry must be preceded by a "pound" symbol (#).

Thus, to create a *six-space* field to display the state of SYSTEM LOGIC BIT No. 709, you should follow the procedure given in Section 2.C.5(e), above, except that in Step e you should enter



Fig. 2.C.9 Sample Bit-State Field

Again, the last digit of the Bit Number must occupy the last character space of the field. All other guidelines given above for the establishment and deletion of DATA FIELDS apply equally here.

g. ENTERING AND DELETING A MESSAGE FIELD

A MESSAGE FIELD is identical to a DATA FIELD (with regard to page formatting), *except that*

1. the maximum number of spaces for a MESSAGE FIELD is 15; and
2. the Message-Number entry must be preceded by a *dollar sign* (\$).

Thus, to create a *thirteen-space* field to display the alphanumeric text loaded into MESSAGE No. 13, you should follow the procedure given in Section 2.C.5(e), above, except that in Step e you should enter

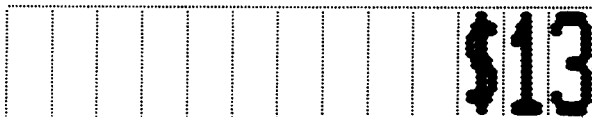


Fig. 2.C.10 Sample Message Field

Again, the last digit of the Message Number must occupy the last character space of the field. All other guidelines given above for the establishment and deletion of DATA FIELDS apply equally here.

For the entry of actual MESSAGES, see Section 2.C.12(d), below.

h. ENTERING AND DELETING A VIDEO PLAYBACK FIELD

A VIDEO PLAYBACK FIELD is identical to a DATA FIELD (with regard to page formatting), *except that*

1. it must contain a four-digit VIDEO PLAYBACK PSEUDOCHANNEL Number (1000 through 1299); and
2. this number must be preceded by an *asterisk* (*).

Thus, to create a *seven-space* field to display the state of VIDEO PLAYBACK PSEUDOCHANNEL No. 1167, you should follow the procedure given in Section 2.C.5(e), above, except that in Step e you should enter



Fig. 2.C.11 Sample Video Playback Field

Again, the last digit of the Channel Number must occupy the last character space of the field. All other guidelines given above for the establishment and deletion of DATA FIELDS apply equally here.

i. ENTERING "ASSOCIATED" FIXED TEXT

A certain amount of FIXED TEXT can be made to exhibit the same VISUAL EFFECTS that apply at any given time to a particular DATA FIELD, BIT-STATE FIELD, MESSAGE FIELD, or VIDEO PLAYBACK FIELD lying *in the same line of the display*.

In order, however, for FIXED TEXT to be thus "bracketed" or "associated" with a particular CHANNEL DISPLAY FIELD, the FIXED TEXT *must be contiguous with the field*. That is, it must be immediately adjacent, with no intervening space(s).

"ASSOCIATED" FIXED TEXT may occur to the immediate left or the immediate right of the CHANNEL DISPLAY FIELD whose variable color attributes you want it to imitate. Or the CHANNEL DISPLAY FIELD may be embedded *within* its "ASSOCIATED" FIXED TEXT. Here is an example of each situation:

2.C.5.

COMPOSING A PAGE FORMAT

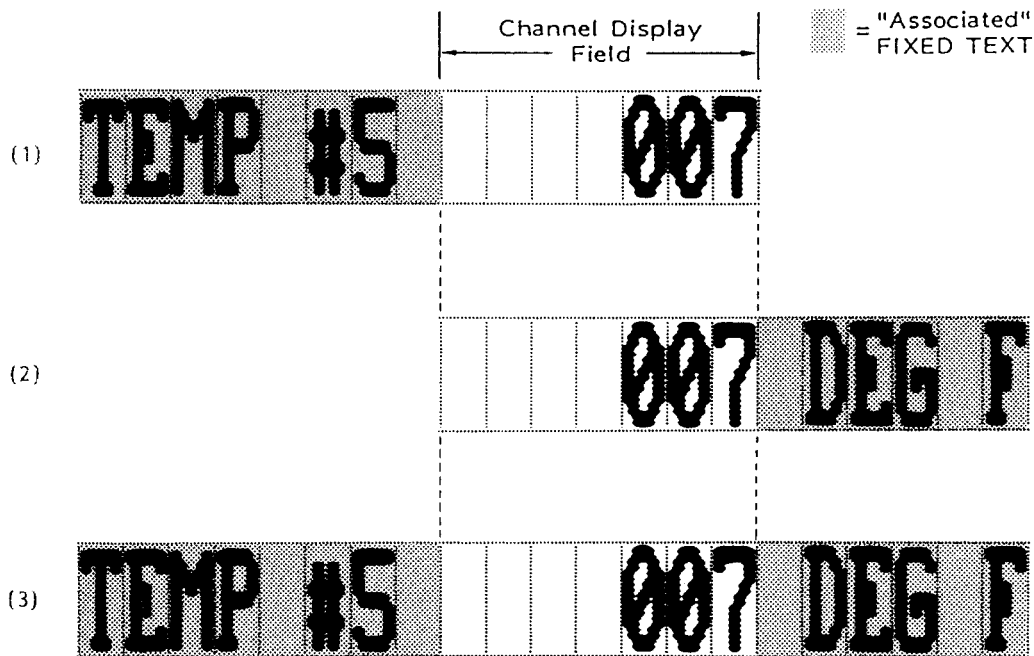


Fig. 2.C.12 "Associated" Fixed Text

To generate a line of display containing a CHANNEL DISPLAY FIELD *and* a certain amount of FIXED TEXT to be "associated" with that field, you should proceed as follows:

1. If "ASSOCIATED" FIXED TEXT is to lie to the *left* of the CHANNEL DISPLAY FIELD, as in Figs. 2.C.12(a) and (c), above, move the screen cursor to the space of FIXED TEXT where you want the "association" effect to begin.

If "ASSOCIATED" FIXED TEXT is to lie only to the *right* of the CHANNEL DISPLAY FIELD, as in Example 2, then proceed directly to Step d, below.

2. Press the **Ctrl (CONTROL)** key, hold it down, and press the **Begin Data** key.
3. Type in all desired "ASSOCIATED" FIXED TEXT to the left of the CHANNEL DISPLAY FIELD. Do *not* press **End Data**. (All "ASSOCIATED" FIXED TEXT will normally appear, while in TEXT EDITOR MODE, as *blue characters on a yellow background* for a color display, and as *characters of intensity "1" on a background of intensity "6"* for a monochrome display.)*
4. Follow the appropriate procedure to enter the desired CHANNEL DISPLAY FIELD (see Section 2.C.5(e, f, g, or h), above). As always, be sure to "bracket" the field with **Begin Data** and **End Data**.
5. If you want to enter "ASSOCIATED" FIXED TEXT to the *right* of the CHANNEL DISPLAY FIELD, press the **Ctrl (CONTROL)** key, hold it down, and press the **Begin Data** key. Then type in the desired text. End by pressing the **End Data** key.

The sequence of command keystrokes is illustrated in Fig. 2.C.13.

* The "TEXT EDITOR" color or intensity for all "ASSOCIATED" FIXED TEXT can be modified by means of the **ASSOCIATED TEXT COLOR (ATC)** command.

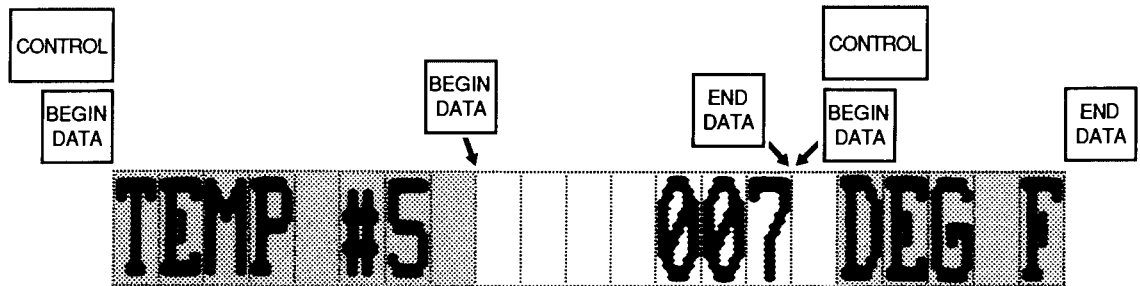


Fig. 2.C.13

If an ERROR is made in establishing "ASSOCIATED" FIXED TEXT, one of the following BILLBOARD messages may appear:

- **ILLEGAL TO END DATA HERE**

This applies only to "ASSOCIATED" FIXED TEXT entered to the *left* of the CHANNEL DISPLAY FIELD. It probably means that you have tried to end a section of "ASSOCIATED" FIXED TEXT (usually by pressing **End Data**) without providing it with a contiguous DATA FIELD, BIT-STATE FIELD, MESSAGE FIELD, or VIDEO PLAYBACK FIELD.

If, for example, you have entered

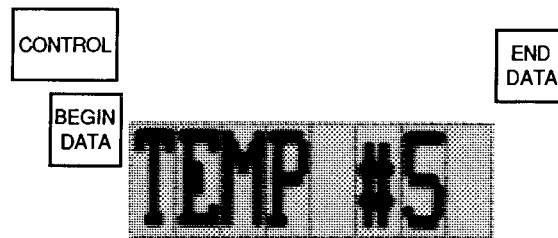


Fig. 2.C.14

the above message will appear. You needn't change the already entered FIXED TEXT—just proceed to establish the desired CHANNEL DISPLAY FIELD to its immediate right.

- **MUST END DATA FIELD/ASSOC. TEXT TO EXIT**

Here you have tried to exit the "ASSOCIATED" FIXED TEXT or its CHANNEL DISPLAY FIELD by a cursor movement, the **Exit** key, or CARRIAGE RETURN—without having first pressed **End Data**.

NOTE: It was said in Section 2.C.5(e) that you cannot insert or delete spaces within an established CHANNEL DISPLAY FIELD. This does *not* apply to an established region of "ASSOCIATED" FIXED TEXT. If, however, you wish to cancel the existing "association" of a particular region of FIXED TEXT with an adjacent or embedded CHANNEL DISPLAY FIELD, or if you wish to alter that text in any way, you have no option but to *delete* the entire region of "ASSOCIATED" FIXED TEXT, along with the CHANNEL DISPLAY FIELD, and then to reenter both as desired.

2.C.5.

COMPOSING A PAGE FORMAT

j. EXITING TEXT EDITOR MODE: "EXIT" KEY

When you are satisfied with the composition of the page on display, press the **Exit** key. The BILLBOARD will now announce

THIS PAGE IS VOLATILE; PAGE IS ___ BLKS

The blank will be filled to indicate the number of memory "blocks" used by this page (see Section 2.C.2, above).

————— **IMPORTANT!** —————

IF MAINFRAME POWER IS NOW TURNED OFF, THE PAGE FORMAT CURRENTLY ON DISPLAY WILL BE IRRETRIEVABLY LOST, UNLESS THE STEPS DESCRIBED IN SECTION 2.C.7, BELOW, ARE TAKEN TO "SAVE" IT TO NONVOLATILE EEPROM MEMORY.

A VIDEO PAGE FORMAT which has just been composed or edited is automatically placed in *temporary* buffer storage, for the duration of the "EEPROM storage" process, explained in the following section.

If at any time during page storage, you need to *recall* this page (i.e., the last to have been formatted or edited), in order to examine or reformat it, just type

RCL [CR]

You may, for instance, wish to take another look at the PAGE DIRECTORY, after you have exited TEXT EDITOR MODE, to see what pages are as yet unused. Type **DIR [CR]**, examine the PAGE DIRECTORY, and then type **RCL [CR]** to redisplay the still "volatile" page you have just composed.

Note that if you power up your DataPAC and subsequently enter a **RECALL (RCL)** command, before having entered TEXT EDITOR MODE, the current SIGN-ON PAGE will be called to display (see Section 2.C.9).

2.C.7.

STORING A PAGE FORMAT: SAV COMMAND

To save the *currently displayed page* as "Page No. n," where "n" is an integer from 1 through 100, type

SAV n [CR] *

For the **SAVE (SAV)** command to be effective, the DataPAC's EEPROM Write Protect Switch must be ON. This command can be entered *only* from the EXTENDED KEYBOARD.

After you have commanded **SAV n [CR]**, the BILLBOARD will announce

SAVING TO PAGE n

and then, upon successful page storage, it will announce

SAVED TO PAGE n, ___ BLKS, ___ FREE

(the blanks will be filled to indicate the number of memory "blocks" used by this page, and the total number of "FREE" memory blocks still available—see Section 2.C.2, above).

If the page storage process is NOT successful, it could be due to one or more of several reasons:

- a. The DataPAC's EEPROM Switch is OFF, in which case you will be told:

SWITCH OFF, TURN SWITCH ON, RESAVE PAGE

- b. YOU HAVE SPECIFIED A PAGE NUMBER ("n") ALREADY ASSIGNED TO AN EXISTING VIDEO PAGE. This existing page will now be displayed, with the announcement

PAGE ALREADY EXISTS AS SHOWN, DELETE

If you now wish to *delete* the existing Page No. n (now shown on the screen), in order to replace it in the video memory with the last page to have been formatted (now in temporary buffer storage), you should

1. Push either the **Y** or the **Yes** key. Pushing any key other than **Y** or **YES** constitutes an answer of NO. Upon your answering either YES or NO, the page you just tried to save as Page No. n will be recalled to display.
2. if you do push **Y** or **Yes**, the DataPAC will ask for confirmation:

DELETE PAGE SHOWN, CONFIRM? (Y/N)

If you now decide *not* to delete the existing Page No. n, simply push any key other than **Y** or **Yes**.

If, however, you now reply, again, **Y** or **Yes**, the page now on display (the last to have been formatted) will immediately replace the original Page No. n in EEPROM storage. The BILLBOARD will announce:

SAVING TO PAGE n

followed, as above, by

SAVED TO PAGE n, ___ BLKS, ___ FREE

- C. THERE IS INSUFFICIENT "FREE" VIDEO MEMORY TO STORE THE NEW PAGE. In this case, the BILLBOARD will announce

INADEQUATE FREE SPACE; PAGE IS ____ BLKS

The blank will be filled to indicate the "memory-block" size of the page, and thus the minimum amount of memory space that must be available in order that it be placed in storage.

You will therefore have to *delete one or more VIDEO PAGES now in EEPROM storage*, if you want to be able to save the new one. To delete an existing page, follow the procedure given in Section 2.C.10, below.

Having deleted one or more existing pages, you should now recall from buffer memory the last page to have been formatted (i.e., the page you originally tried to save as Page No. n) by typing

RCL [CR]

Then repeat the **SAV n [CR]** * command, as explained above.

----- **IMPORTANT** -----

BE SURE TO TURN OFF THE **EEPROM WRITE PROTECT SWITCH** AS SOON AS YOU HAVE COMPLETED ALL **SAVE (SAV)** AND **DELETE (DEL)** OPERATIONS FOR THE TIME BEING.

2.C.8.

EDITING AN EXISTING VIDEO PAGE

To rewrite or reposition any portion of an existing VIDEO PAGE FORMAT, first "call" the page to display, using the **PAG** command (Section 2.C.3).

Then enter TEXT EDITOR MODE by pressing the **Video Formt (VIDEO FORMAT)** key, and proceed to recompose the page as desired, following the guidelines given in Section 2.C.5, above. When all revisions are complete, exit TEXT EDITOR MODE by pressing the **Exit** key. Use the **SAVE (SAV)** command, as explained above, to assign an *unused* Page Number to the new, revised page.

Note that when editing a portion of display with FIXED TEXT of different colors or intensities, you needn't worry about resetting the color or intensity for each line you want to revise—unless, of course, you want to *change* that color or intensity. After you enter a specifically colored region of text, anything you then type in that region will assume the "native" (originally set) color.

SETTING "SIGN-ON" PAGE: SOP COMMAND

2.C.9.

To designate the VIDEO PAGE to be displayed upon system powerup, make sure that the DataPAC's EEPROM Switch is ON, and command

SOP = p [CR] *

where "p" is the appropriate Page Number (1 through 100). If the designated page *does not exist* in the EEPROM video memory, you will get a special *default* "SIGN-ON" PAGE when you next power up the DataPAC. For a description of the *initial* CRT SIGN-ON PAGE, see Section 1.B.1(e).

2.C.10.

DELETING A VIDEO PAGE FROM EEPROM MEMORY: DEL COMMAND

To delete from video memory an existing Page No. *p*, make sure that the DataPAC's EEPROM Switch is ON, and command

DEL *p* [CR] *

The **DELETE (DEL)** command can be entered only from the EXTENDED KEYBOARD. Note that it will *not* cause the page in question to be displayed.

The DataPAC will ask for confirmation:

DELETE PAGE *p*, CONFIRM? (Y/N)

If you now decide *not* to delete Page No. *p*, simply push any key other than **Y** or **Yes**. The DataPAC will tell you that it has

CANCELLED DELETE REQUEST

If, however, you press **Y** or **Yes**, you will be informed that

PAGE *p* HAS BEEN DELETED

You may easily verify page deletion by referring to the PAGE DIRECTORY (see Section 2.C.2(b)).

a. INTRODUCTION

You will use the **VIDEO UPLOAD (VUL)** command to "upload" a VIDEO PAGE FORMAT *from* a DataPAC's video memory to the memory of a connected computer, recorder, or other RS-232-C device. You will use the **VIDEO DOWNLOAD (VDL)** command to "download" *to* a DataPAC's video memory a VIDEO PAGE FORMAT from the memory of a connected computer, recorder, etc. Uploaded and downloaded pages may contain BARGRAPH FIELDS generated by a Model 10VGM500 (see Section 3.C.4).

These commands therefore permit both *backup storage* of DataPAC VIDEO PAGE FORMATS on computer disk file (in the event that video memory is accidentally or deliberately erased) and also the *duplication* ("cloning") of pages from one DataPAC to another, via an intermediary computer disk file.

As will be made clear below, the transmission of VIDEO PAGES from or to a DataPAC is a sequential "SECTION-by-SECTION" process. Here, a "SECTION" corresponds to *one half* of a "block" of EEPROM video memory (a "block," in turn, is 64 bytes; see Section 2.C.2, above). Thus, each page will consist of *twice* as many SECTIONS as the number of "blocks" it occupies in EEPROM memory, to a maximum of 64 SECTIONS (= 32 blocks). In the **VUL** and **VDL** commands, a page's SECTIONS will be sequentially *numbered*. Corresponding to each SECTION will be a string of ASCII characters encoding, in hexadecimal form, the *format contents* of that SECTION (i.e., FIXED TEXT, CHANNEL DISPLAY FIELDS, CONTROL CHARACTERS, etc.).

Each transmission will be terminated by a special "SECTION No. 99," which contains the PAGE NUMBER and a "CHECKSUM" number for that transmission. The CHECKSUM number is simply the decimal summation--positive or negative--of the data that has just been transmitted. The receiving device will perform a similar summation for each transmission received, and will compare its own CHECKSUM with that reported by the transmitting device. This procedure allows detection of faulty page transfer (see the **VIDEO ERROR LOG (VEL)** command, Section d, below).

----- PLEASE NOTE -----

THE **VUL**, **VDL**, AND **VEL** COMMANDS ARE FOR ENTRY FROM THE **COMPUTER INTERFACE PORT ONLY**; THEY WILL NOT WORK WHEN ENTERED VIA THE DATAPAC'S KEYBOARD.

b. UPLOADING A VIDEO PAGE FROM THE DATAPAC: **VUL** COMMAND

To transmit the Page No. *p* currently stored in the DataPAC's EEPROM video memory to a connected computer or other RS-232-C device, you should first insert, via the keyboard, *two FIXED-TEXT spaces* in the upper left-hand corner of the page. Then enter the following **VIDEO UPLOAD (VUL)** command, via the DataPAC's COMPUTER INTERFACE PORT:

VUL = p [CR]

where $1 \leq p \leq 100$.

To transmit from the COMPUTER INTERFACE PORT the VIDEO PAGE *currently on display*, command

VUL = 0 [CR]

Note that the DataPAC's EEPROM Switch need *not* be on for the **VUL** command to be effective.

2.C.11.

UPLOADING, DOWNLOADING, AND REVISING VIDEO PAGE FORMATS

The RESPONSE FORMAT for the page transmission initiated by either of the above commands will be

```
VUL 1 = $1 [CR] [LF]
VUL 2 = $2 [CR] [LF]
VUL 3 = $3 [CR] [LF]
      :
      :
      :
VUL n = $n [CR] [LF]
VUL 99 = p, c [CR] [LF]
```

Each line of the page transmission corresponds to a SECTION of the page, starting with SECTION No. 1 (which, again, represents the first *half* of the first "block" of video memory used by that page) and ending with SECTION No. n (where $n \leq 64$). "\$₁" signifies the ASCII STRING encoding the *format contents* of SECTION No. 1 (up to 64 ASCII characters); "\$₂" is the ASCII STRING for the contents of SECTION No. 2; etc. The terminating line (SECTION No. 99) gives the Page Number ("p"), followed by an appropriate CHECKSUM number "c." If the page being transmitted is the page *currently on display* and this page *has not been placed in EEPROM storage via the SAVE (SAV) command* (Section 2.C.7), a Page Number of "0" will be transmitted.

C. DOWNLOADING A VIDEO PAGE TO THE DATAPAC: VDL COMMAND

The **VIDEO DOWNLOAD (VDL)** command is simply the "WRITE" form of the **VIDEO UPLOAD (VUL)** command, above. Thus, to transmit a given VIDEO PAGE FORMAT to the DataPAC, via its COMPUTER INTERFACE PORT, you must arrange for your computer to issue to the DataPAC the following *series* of commands, one for each SECTION of the page, plus the special SECTION No. 99 (Page Number ("p") and CHECKSUM number ("c")).

Note that *if you wish the received page to be placed in the DataPAC's EEPROM video memory*, the DataPAC's EEPROM Switch must be ON; if, however, you wish the DataPAC simply to *display* the received page, *without storing it*, the EEPROM Switch need not be on. In the latter case, the page should be designated in the terminating **VDL** command, below, by the number "0."

```
VDL 1 = $1 [CR] *
VDL 2 = $2 [CR] *
VDL 3 = $3 [CR] *
      :
      :
      :
VDL n = $n [CR] *
VDL 99 = p, c [CR] *
```

Again, the highest SECTION Number ("n") cannot exceed 64.

The Page Number "p" entered in the terminating **VDL** command can be any number from 1 through 100 (*if the received page is to be loaded in the DataPAC's video memory*). In this case, "p" indicates the DataPAC Page Number *to be assigned to the received page*. IF PAGE NO. p ALREADY EXISTS IN THE DATAPAC'S PAGE DIRECTORY, THEN THE ABOVE **VDL** COMMANDS WILL AUTOMATICALLY OVERWRITE THIS EXISTING PAGE WITH THE ONE BEING DOWNLOADED TO THE DATAPAC. THERE WILL BE NO "CONFIRMATION OF DELETION" SEQUENCE, AS IS ENCOUNTERED WHEN USING THE **DELETE (DEL)** COMMAND (Section 2.C.10).

As mentioned above, if the received page is only to be displayed by the DataPAC, without loading it into the video memory, you may enter a "0" for the Page Number p in the terminating **VDL** command. In this case, THE RECEIVED PAGE WILL BE AUTOMATICALLY PLACED IN THE DATAPAC'S "RECALL" BUFFER, THEREBY REPLACING THE EXISTING CONTENTS OF THAT BUFFER (i.e., the last page to have been composed or edited--see Section 2.C.6). THESE CONTENTS ARE NOW IRRETRIEVABLY LOST.

d. FINDING THE LAST VIDEO UPLOADING/DOWNLOADING ERROR: **VEL** COMMAND

The **VIDEO ERROR LOG (VEL)** command lets you interrogate, via the COMPUTER INTERFACE PORT, for the *last error to have occurred for a page transfer initiated by either the **VUL** or **VDL** command.*

Thus, to an inquiry of

VEL [CR]

one of the four following responses is possible (again, these will be available only at the COMPUTER INTERFACE PORT; keyboard entry of **VEL** is not possible at present):

1. **ERROR 0** (This means that no error has been detected.)
2. **ERROR 1** (Undefined)
3. **ERROR 2** (This means that the specified page has not been found.)
4. **ERROR 3** (This means that the last error was a CHECKSUM error.)
5. **ERROR 4** (This means that the EEPROM Switch was OFF.)
6. **ERROR 5** (This means that there was insufficient "free" video memory space in the DataPAC to save the received page. This error will not be cleared until another **VDL** series is issued which does not exceed the existing "free" memory.)

e. REVISING AND TRANSMITTING FORMAT LINES: **LNE** COMMAND

The **LINE (LNE)** command enables a host computer to rapidly and automatically rewrite displayed VIDEO PAGE FORMATS, *line by line*, during the actual measurement and control process. Besides dynamic page revision, it also allows *transmission* of displayed format lines to the computer, for storage in the computer's own memory.

— NOTE —

NEITHER FORM OF THE **LINE (LNE)** COMMAND MAY BE ENTERED THROUGH THE KEYBOARD.

1. REVISING A LINE OF VIDEO PAGE FORMAT

The format of LINE No. "n" of the VIDEO PAGE *on display* can be altered by a command of this general form:

LNE n = hw <c> \$ [CR]

Note that this command changes only the *display* of Line No. n; since it does not affect the stored page, it does not require that the DataPAC's EEPROM Switch be on. To make the format change permanent, a **SAVE (SAV)** command must be reapplied to the displayed page, as explained in Section 2.C.7. Also, the command can be used to reformat display lines of a page containing BARGRAPH FIELDS generated by the Model 10VGM500 (Section 3.C.4 of this Guidebook); however, it cannot be used to *enter* a BARGRAPH FIELD into a line.

2.C.11.

UPLOADING, DOWNLOADING, AND REVISING VIDEO PAGE FORMATS

The variables employed in the **LNE** command syntax are as follows:

- n** is the *number* of the LINE whose format is to be altered, counting from the top of the page (Line No. 1 is the first line of display under the BILLBOARD). Remember that any display can have no more than 20 single-height lines.
- h** is the desired LINE HEIGHT (1, 2, 3, or 4).
- w** is the desired CHARACTER WIDTH for the line (1, 2, 3, or 4). When altering the width of the characters of an existing line, remember that a single line of color display can consist of no more than 78 single-width character spaces, and a line of mono chrome display, no more than 80 spaces.
- c** is a two-character variable entered within *angle brackets* (< >). It indicates the desired FIXED-TEXT COLOR or INTENSITY combination for the *beginning* of Line No. n (see the table below). The first character gives the desired CHARACTER color or intensity; the second gives the desired BACKGROUND color or intensity.

Table 2.C.2

Line COLOR/INTENSITY Coding

For a line of **COLOR** display, enter two of these letters to indicate the desired foreground/background color combination ("c"):

W = White
Y = Yellow
C = Cyan (Light Blue)
G = Green
V = Violet
R = Red
B = (Dark) Blue
O = OFF (Black)

For a line of **MONOCHROME** display, enter two of these numbers to indicate the desired foreground/background intensity combination ("c"):

2 = Full Intensity (White)
1 = Half Intensity
0 = OFF (Black)

For example, a "c" of **BY** (for a color display) specifies *dark blue* characters on a *yellow* background; a "c" of **12** (for a monochrome display) specifies characters of *half intensity* on a *white* background.

You may subsequently change the FIXED-TEXT color/intensity setting *within* Line No. n, if desired, by embedding another <**c**> designation within the "text string" \$ (see below).

- \$** is an ASCII CHARACTER STRING representing the desired "contents" of Line No. n. These "contents" may include

a. ONE OR MORE REGIONS OF FIXED TEXT

Note that if this text includes one or more pairs of *square or angle brackets* ([] or < >), then the text itself must be enclosed in *quotation marks* (" "). This will cause the brackets and their contents to be interpreted literally, and not as HEXADECIMAL CONTROL CHARACTERS or COLOR-CHANGE DESIGNATIONS.

b. ONE OR MORE CHANNEL DISPLAY FIELDS

Each CHANNEL DISPLAY FIELD (DATA, BIT-STATE, MESSAGE, or VIDEO PLAYBACK) should be entered as explained in Section 2.C.5, above, with "#" preceding each LOGIC BIT Number, "\$" preceding each MESSAGE Number, and "*" preceding each VIDEO PLAYBACK PSEUDOCHANNEL Number.

C. SPECIAL HEXADECIMAL CONTROL CHARACTERS

These must be entered in *square brackets* ([]). They are required for the delineation of CHANNEL DISPLAY FIELDS and "ASSOCIATED" FIXED TEXT, as follows:

1. at the BEGINNING OF A CHANNEL DISPLAY FIELD, enter [0E]
2. at the END OF A CHANNEL DISPLAY FIELD, enter [0F]
3. at the BEGINNING OF "ASSOCIATED" FIXED TEXT, enter [1C]
4. at the END OF "ASSOCIATED" FIXED TEXT, enter [0F], unless the "ASSOCIATED" FIXED TEXT is followed by a CHANNEL DISPLAY FIELD, in which case it requires no terminating CONTROL CHARACTER (see the example below).

For example, the line segment shown in Fig. 2.C.12(c) would be entered as

[1C]TEMP #5(space)[0E](4 spaces)007[0F][1C](space)DEG F[0F]



d. COLOR/INTENSITY CHANGES

You may at any point enter a *new* color/intensity setting for part of Line No. n, different from that specified for the beginning of the line by "<c>" (above). Enter, as before, with *angle brackets*: e.g., <RY> for RED ON YELLOW; <20> for WHITE ON BLACK (monochrome).

NOTE

The *maximum length* of the ASCII CHARACTER STRING "\$" is governed by the initial character-width specification "w," and by the fact that each line of monochrome display can accommodate 80 single-width characters, and each line of color display, 78 characters.

Note, however, that if you want to enter a "\$" string of *more than 40 characters* into a *single-width* line (i.e., where "w" has been set to "1"), you must do so in two steps. First enter

LNE n = h1 <c> \$₁ [CR]

and then

LNE n = *1 <c> \$₂ [CR]

The asterisk (*) in place of the HEIGHT designation in the second LNE statement is essential. "\$1" must consist of the first 40 characters of the desired line; "\$2" must begin with the 41st character.

2.C.11.

UPLOADING, DOWNLOADING, AND REVISING VIDEO PAGE FORMATS

2. TRANSMITTING A LINE OF VIDEO PAGE FORMAT

To transmit from the DataPAC's COMPUTER INTERFACE PORT the format of Line No. n of the VIDEO PAGE *currently on display*, command

LNE n [CR]

The RESPONSE FORMAT is **hw <c> \$ [CR][LF]**, unless "n" is a *single-width line of more than 40 characters*, in which case the transmission would be **h1 <c> \$₁ [CR][LF] *1 <c> \$₂ [CR][LF]** (see NOTE, above).

Note that if Line No. n is any line of a VIDEO PAGE containing one or more BARGRAPH FIELDS generated by a Model 10VGM500 (see Section 3.C.4 of this Guidebook), then the **LNE n [CR]** command will be answered by N/A.

a. "VISUAL EFFECTS" AND "STATUS"

Any displayed DATA FIELD, LOGIC-BIT FIELD, MESSAGE FIELD, or VIDEO PLAYBACK FIELD—plus any FIXED TEXT currently "associated" with that field—will at any given time exhibit certain "VISUAL EFFECTS," as follows:

1. CHARACTER COLOR/INTENSITY

All *characters* within the CHANNEL DISPLAY FIELD will be of a specific COLOR, or, for a monochrome display, of a specific INTENSITY.

2. BACKGROUND COLOR/INTENSITY

The *background* of the CHANNEL DISPLAY FIELD will likewise be of a specific COLOR or INTENSITY (necessarily different from that of the characters within the field).

3. BLINKING CHARACTERS (OPTIONAL)

The characters within the CHANNEL DISPLAY FIELD may be made to *blink* rapidly on and off against a constant background color or intensity.

4. FLASHING FIELD (OPTIONAL)

The color (or intensity) of the characters within the CHANNEL DISPLAY FIELD and the color (or intensity) of its background may be made to interchange rapidly, to produce a *flashing* effect.

At any time, the "STATUS" of a given CHANNEL DISPLAY FIELD—that is, its actual appearance on the CRT screen with reference to the above VISUAL EFFECTS—will depend on the "STATUS"-*defining command* presently in effect for that field.

There are different types of "STATUS"-defining commands for the different types of CHANNEL DISPLAY FIELDS, as will be seen in the following sections. Every such command, however, will include the designation of a coded variable ("s") which is to inform the system of the appropriate VISUAL-EFFECT "STATUS" to be assumed by the field under certain conditions.

FOR A COLOR MONITOR, the "STATUS" variable "s" consists of two letters, to which a third may be *optionally* appended:

- the first letter specifies the FOREGROUND color—that is, the color of the *characters* displayed within the CHANNEL DISPLAY FIELD—as given in Table 2.C.3, below.
- the second letter specifies the BACKGROUND color of the field.
- for the optional third letter, you may enter either a "B" (to indicate a BLINKING effect) or an "F" (to indicate a FLASHING effect).

Table 2.C.3.

"STATUS" ("s") CODING**For COLOR display:**

W = White
 Y = Yellow
 C = Cyan (Light Blue)
 G = Green
 V = Violet
 R = Red
 B = (Dark) Blue
 O = OFF (Black)

For MONOCHROME display:

2 = Full Intensity (White)
 1 = Half Intensity
 0 = OFF (Black)

B = Blink (as optional third character)
 F = Flash (as optional third character)

For example, a "STATUS" value of **GW** designates *green characters on a white background*, and a value of **RYB** designates *blinking red characters on a yellow background*. Color specifications may be entered either by *letter keys* (e.g., **W** for white, **Y** for yellow, etc.) or by the corresponding labelled "COLOR" keys (**Wht (WHITE)**, **Yel (YELLOW)**, etc.). Other examples are given in the sections that follow.

FOR A MONOCHROME MONITOR, the "STATUS" variable "s" consists of two numbers, to which, again, a "B" or "F" may be optionally appended:

- the first number specifies the FOREGROUND intensity—that is, the intensity of the *characters* displayed within the CHANNEL DISPLAY FIELD—as given in Table 2.C.3, above.
- the second number specifies the BACKGROUND intensity of the field.
- for the optional third character, you may enter either a "B" (to indicate a BLINKING effect) or an "F" (to indicate a FLASHING effect).

For example, a "STATUS" value of **01** designates *black characters on a half-intensity background*, and a value of **02F** designates a *"flashing" alternation of black characters on a full-intensity (white) background with full-intensity characters on a black background*. Other examples are given in the sections that follow.

Note that an "intensity" setting for a monochrome monitor will produce a corresponding *color* setting for a connected color monitor, as follows (see also Section 2.C.5(d) on the "color-intensity" relationship):

FULL Intensity (2) = HIGHEST color "value": **WHITE**
HALF Intensity (1) = MEDIAN color "value": **GREEN**
NO Intensity (0) = LOWEST color "value": **BLACK**

----- **NOTE** -----

When you ask *via the keyboard* for the current "STATUS" of a given CHANNEL DISPLAY FIELD (by means of the "READ" form of the appropriate "STATUS"-defining command), the DataPAC's response will appear on the BILLBOARD. The precise form of this response, however, will depend on the "video format" you selected for your system by means of the **VIDEO DISPLAY UNIT (VDU)** command (Section 2.C.1(a)). Thus, if the COLOR format was chosen, each "STATUS" value will be given as two *letters*, plus optional "B" or "F"; if the MONOCHROME format, as two *numbers*, plus optional "B" or "F."

b. SETTING VISUAL EFFECTS FOR A DATA FIELD

1. INTERNAL VS. EXTERNAL CONTROL OF DATA-FIELD "STATUS"

The VISUAL EFFECTS exhibited by a displayed DATA FIELD may be controlled either

- a. *internally*, by system events that reflect conditions existing in the monitored test or process—such as conformance of a measured value to a preset range of tolerance, or the setting of a specific LOGIC BIT—or
- b. *externally*—by an agent (operator or computer) external to the system.

Internal determination of DATA-FIELD VISUAL EFFECTS is established through four "STATUS-defining" commands: "**BIT CONTROL**" **STATUS (VBC)**, "**GREATER THAN**" **STATUS (VGT)**, "**BETWEEN**" **STATUS (VBT)**, and "**LESS THAN**" **STATUS (VLT)**. Being SETUP COMMANDS, these are all *automatically in effect, by default, upon system powerup*.

External control of DATA-FIELD VISUAL EFFECTS (by the operator or computer) can be effected through the **STATUS (STS)** command. This is a strictly "RUN-TIME" COMMAND, and gives the operator or computer the ability to override temporarily all internal "STATUS"-defining commands presently applying to a particular DATA FIELD.

In summary, there are three points you should remember concerning DATA-FIELD "STATUS" control:

- ON SYSTEM POWERUP, INTERNAL "STATUS" CONTROL OF ALL DATA FIELDS IS AUTOMATICALLY IN EFFECT, BY DEFAULT. This means that, on powerup, the VISUAL EFFECTS exhibited by each DATA FIELD will depend on the last **VBC**, **VGT**, **VBT**, and **VLT** commands to have been entered for the DATA CHANNEL associated with that field.
- THE OPERATOR OR COMPUTER CAN AT ANY TIME INVOKE TEMPORARY "EXTERNAL" CONTROL OF THE VISUAL EFFECTS OF A GIVEN DATA FIELD BY MEANS OF A **STATUS (STS)** COMMAND. This command will override the **VBC**, **VGT**, **VBT**, and **VLT** commands currently applying to that field, but will cease to be effective when system power is cycled, or when "STATUS" control of the given DATA FIELD is subsequently "internalized."
- "INTERNALIZATION" OF "STATUS" CONTROL:

If, following the application of a **STATUS (STS)** command to a given DATA CHANNEL (No. x), you wish to revert to the *internal* "STATUS" control defined by the last **VBC**, **VGT**, **VBT**, and **VLT** commands to have been entered for that channel, you will have to enter a command of

STS x = INT [CR]

* **PLEASE NOTE:** The "**BIT CONTROL**" **STATUS (VBC)** will not work for any version of the Model **10BVT60** Video Text Card. It *will* work, however, for any version of the Model **10BVT65** "Touchscreen" Video Text Card (see Section 3.C.5).

2. INTERNAL (DEFAULT) CONTROL OF DATA-FIELD "STATUS": **VBC**, **VGT**, **VBT**, and **VLT** COMMANDS

a. THE "**BIT CONTROL**" STATUS (**VBC**) COMMAND*

When *internal* "STATUS" control is in effect for a given DATA CHANNEL—either upon system powerup or upon "internalization" of "STATUS" control by means of a **STS x = INT [CR]** command—the VISUAL EFFECTS exhibited the DATA FIELD associated with that channel will directly depend on the channel's "**BIT CONTROL**" STATUS (**VBC**) setting.

The purpose of the **VBC** command is to specify the VISUAL EFFECTS a given DATA FIELD is to exhibit *when the state of a given system LOGIC BIT is "Logic 1."* The command has this form:

VBC x = s ON BIT q [CR] *

where "x" is the number of the DATA CHANNEL associated with the given DATA FIELD; "s" is the two- or three-character "STATUS" code defining the desired VISUAL EFFECTS (Section 2.C.12(a)); and "q" is the number of any system LOGIC BIT (0 through 999).

For example, a command of

VBC 367 = 02B ON BIT 845 [CR] *

specifies that when Bit No. 845 is at *Logic 1*, the DATA FIELD associated with Channel No. 367 should be displayed, on a monochrome monitor, with *blinking black characters on a full-intensity (white) background*.

You can *cancel* an existing "**BIT CONTROL**" STATUS (**VBC**) command for DATA CHANNEL No. x by commanding

VBC x = N/A [CR] *

With regard to the "BIT CONTROL" STATUS of a DATA CHANNEL at any time, there are three possible situations:

1. the LOGIC BIT No. q specified by the **VBC** command last entered for that channel is at *Logic 1*. In this case, the VISUAL EFFECTS indicated by the "s" value of the **VBC** command will be displayed.
2. LOGIC BIT No. q is at *Logic 0*. In this case, control of the channel's VISUAL EFFECTS will automatically descend to the three limit-related "STATUS"-defining commands discussed in the following section: "**GREATER THAN**" STATUS (**VGT**), "**BETWEEN**" STATUS (**VBT**), and "**LESS THAN**" STATUS (**VLT**).
3. Either *no* **VBC** command has been entered for the channel, or the last-entered **VBC** command has been *cancelled* by a command of **VBC x = N/A [CR] ***. As in the above case, control of the channel's VISUAL EFFECTS will now automatically descend to the **VGT**, **VBT**, and **VLT** commands presently in effect for that channel.

* **PLEASE NOTE:** The "**BIT CONTROL**" STATUS (**VBC**) will not work for any version of the Model 10BVT60 Video Text Card. It *will* work, however, for any version of the Model 10BVT65 "Touchscreen" Video Text Card (see Section 3.C.5).

b. THE "GREATER THAN" STATUS (VGT), "BETWEEN" STATUS (VBT), and "LESS THAN" STATUS (VLT) COMMANDS

When *internal* "STATUS" control is in effect for a given DATA CHANNEL, and when either *no* **VBC** command is in effect for that channel or the LOGIC BIT to which the currently effective **VBC** command refers is at a state of *Logic 0*, then and only then will the channel's "real-world" limit condition produce specific VISUAL EFFECTS for the channel's displayed DATA FIELD, as defined by the last **VGT**, **VBT**, and **VLT** commands to have been entered for the channel. This "limit condition" in turn depends on whether the data reported by the channel is "GREATER THAN" both limit values preset for the channel by means of the **HIGH LIMIT (HIL)** and **LOW LIMIT (LOL)** commands discussed in Section 2.E, whether it is "BETWEEN" these two values, or whether it is "LESS THAN" both values.

To set the VISUAL EFFECTS to be exhibited by DATA CHANNEL No. x when the channel's data reading is *greater than both preset limits*, command

VGT x = s [CR] *

where "s" is again the "STATUS" code defining the desired VISUAL EFFECTS (see Section 2.C.12(a)).

Similarly, to set the VISUAL EFFECTS to be exhibited when the channel's data reading lies *between* the two preset limit values (i.e., when it is *greater than or equal to the preset lower limit and less than or equal to the preset upper limit*), command

VBT x = s [CR] *

—and to set the VISUAL EFFECTS to be exhibited when the data reading is *less than both preset limits*, command

VLT x = s [CR] *

For example, a command of

VGT 29 = OY [CR] *

specifies that, given the "STATUS"-control conditions described above, a "GREATER THAN" limit condition for Channel No. 29 will cause the channel's data to be displayed, on a color monitor, with *black characters on a yellow background*. Similarly, a command of

VLT 189 = 12B [CR] *

specifies that a "LESS THAN" condition for Channel No. 189 will produce, on a monochrome monitor, a data display of *blinking half-intensity characters on a full-intensity (white) background*.

For other examples of these commands, see the "Limit Setup 'Getting Started' Procedure," Section 2.F.1.

3. TEMPORARY EXTERNAL CONTROL OF DATA-FIELD "STATUS": **STS** COMMAND

As mentioned above, the **STATUS (STS)** command is a "RUN-TIME" COMMAND, the purpose of which is to give an *external* agency (operator or computer) direct, temporary control of the VISUAL EFFECTS of a given DATA FIELD—regardless of any internal "STATUS-defining" commands currently in effect.

The form of the command is

STS x = s [CR]

where "x" is the number of the DATA CHANNEL associated with the given DATA FIELD, and "s" is the two- or three-character "STATUS" code defining the desired VISUAL EFFECTS (Section 2.C.12(a)).

Remember that a **STATUS (STS)** command will always *override* any other ("internal") "STATUS"-defining commands that have been entered for the given DATA CHANNEL, and that it will remain in effect until either

- a. DataPAC power is cycled, or
- b. "STATUS" control for the channel is "internalized" by entering a command of the form

STS x = INT [CR]

For example, regardless of the **VBC, VGT, VBT,** and **VLT** commands presently in effect for Channel No. 17, a command of

STS 17 = CB [CR]

will cause the channel's DATA FIELD to be displayed, on a color monitor, with *cyan (light blue) characters on a dark blue background*, while

STS 17 = BRF [CR]

will yield a rapid ("flashing") alternation of *blue characters on a red background with red characters on a blue background*.

4. SETTING VISUAL EFFECTS FOR TIME AND DATE CHANNELS: **VBT** COMMAND

Your system's TIME and DATE readings are permanently dedicated to Channel Nos. **998** and **999**, respectively. Both of these channels are set at the factory for an initial "STATUS" of **WHITE ON BLACK (WO** for a color monitor; **20** for a monochrome monitor).

By using the "**BETWEEN**" **STATUS (VBT)** command, however, you can easily change the VISUAL EFFECTS applying to the displayed TIME and/or DATE. Thus, to change the "STATUS" of the TIME display to a new value "s," you need only command

VBT 998 = s [CR] *

—and to change the "STATUS" of the DATE display, command

VBT 999 = s [CR] *

(for the "STATUS" code "s," see Section 2.C.12(a), above).

For example, to produce a powerup display of TIME with *blinking white characters on a green background*, command

VBT 998 = WGB [CR] *

Note that the **STS**, **VBC**, **VG**T, and **VLT** commands do not apply to these two special channels.

C. SETTING VISUAL EFFECTS FOR A BIT-STATE FIELD

1. THE BIT-STATE DISPLAY: DESIGNATOR PAIRS

To establish the appearance of a displayed BIT-STATE FIELD, you must first select a "DESIGNATOR PAIR" of a given POLARITY and "STATUS."

The "DESIGNATOR PAIR" of a BIT-STATE FIELD is a pair of alphanumeric "words" describing physical test conditions that correspond to the two possible logic states that may be assumed by the LOGIC BIT associated with that field. At any time, *one* of the two words will appear in the displayed BIT-STATE FIELD. Which word will appear will depend on

- a. the PAIR POLARITY you have selected (i.e., which of the two words is to designate a *Logic 1* condition, and which is to designate a *Logic 0*), and
- b. the actual logic state of the bit in question.

Table 2.C.4, below, lists the eight "standard" DESIGNATOR PAIRS with which your DataPAC is initially loaded (**HIGH/LOW**, **ON/OFF**, **OPEN/CLOSED**, **UP/DOWN**, **IN/OUT**, **GO/STOP**, **SET/RESET**, **PASS/FAIL**). Any of these may be replaced by a DESIGNATOR PAIR of your own choice, following the **BDP** procedure given below.

On a color monitor, each of the DataPAC's eight "standard" DESIGNATOR PAIRS can be displayed with one of four "standard" VISUAL-EFFECT PAIRS:

WHITE on BLACK for the *Logic 1* word;
RED on WHITE for the *Logic 0* word

BLACK on GREEN for the *Logic 1* word;
BLACK on RED for the *Logic 0* word

WHITE on GREEN for the *Logic 1* word;
WHITE on RED for the *Logic 0* word

GREEN on BLACK for the *Logic 1* word;
RED on BLACK for the *Logic 0* word

On a monochrome monitor, the only "standard" VISUAL-EFFECT PAIR is

WHITE on BLACK for the *Logic 1* word;
BLACK on WHITE for the *Logic 0* word.

As with the DESIGNATOR PAIRS themselves, you can replace any "standard" VISUAL EFFECTS with others of your own choice, again using the **BDP** command, as explained below.

2.C.12.

SETTING VISUAL EFFECTS FOR CHANNEL DISPLAY FIELDS

Table 2.C.4: "Pair Numbers" (q) for Standard Bit-State DESIGNATOR PAIRS

Pair	COLOR Visual Effects*			
	WHITE on BLACK* [= Logic 1] RED on WHITE* [= Logic 0]	BLACK on GREEN [= Logic 1] BLACK on RED [= Logic 0]	WHITE on GREEN [= Logic 1] WHITE on RED [= Logic 0]	GREEN on BLACK [= Logic 1] RED on BLACK [= Logic 0]
HIGH [= Logic 1]	1	9	17	25
LOW [= Logic 0]				
ON [= Logic 1]	2	10	18	26
OFF [= Logic 0]				
OPEN [= Logic 1]	3	11	19	27
CLOSED [= Logic 0]				
UP [= Logic 1]	4	12	20	28
DOWN [= Logic 0]				
IN [= Logic 1]	5	13	21	29
OUT [= Logic 0]				
GO [= Logic 1]	6	14	22	30
STOP [= LOGIC 0]				
SET [= Logic 1]	7	15	23	31
RESET [= Logic 0]				
PASS [= Logic 1]	8	16	24	32
FAIL [= Logic 0]				

* MONOCHROME equivalent for WHITE on BLACK is *WHITE on BLACK*; for RED on WHITE, *BLACK on WHITE*.

2. ASSIGNING A DESIGNATOR PAIR TO A BIT-STATE FIELD: BSD COMMAND

To specify for the display of a given LOGIC BIT a "standard" DESIGNATOR PAIR from Table 2.C.4, above, along with one of the four "standard" VISUAL-EFFECT PAIRS there given for each DESIGNATOR PAIR, you can use the **BIT STATE DISPLAY (BSD)** command. This command has two forms. The form you use will determine the POLARITY of the selected DESIGNATOR PAIR:

- a. If the desired assignment of *Logic 1* and *Logic 0* states to the "words" of the selected DESIGNATOR PAIR corresponds to that given in the above table, then you can command

BSD r = q [CR] *

where "r" is the number of the system LOGIC BIT to be displayed (0 through 999), and "q" is the "Pair Number," as given in the table.

- b. If, however, the desired assignment of *Logic 1* and *Logic 0* states is the *inverse* of that shown in Table 2.C.4, you should command

BSD r = /q [CR] *

Suppose, for example, that you want to use for the display of LOGIC BIT No. 7 the **UP/DOWN** word pair with *black on green* for *Logic 1* and *black on red* for *Logic 0*, and you want **UP** to describe the *Logic 1* state of Bit No. 7. Table 2.C.4 gives a "Pair Number" (q) of "12" for this combination of DESIGNATOR PAIR and VISUAL EFFECTS; therefore, you should enter

BSD 7 = 12 [CR] *

If, however, you want to *invert* the POLARITY indicated for this DESIGNATOR PAIR in the table, so that the word **DOWN** corresponds to *Logic 1*, you should enter

BSD 7 = /12 [CR] *

See also the example given in the following section.

NOTE: Unless otherwise specified by the purchaser, every DataPAC is shipped with an *initial BSD* setting of **q = 1** for all LOGIC BITS. That is, until otherwise reset, each bit will, if at *Logic 1*, be displayed by the word **HIGH** (in *white on black*), or, if at *Logic 0*, by the word **LOW** (in *red on white* or *black on white*).

3. SPECIFYING A NEW DESIGNATOR PAIR: BDP COMMAND

If you want to create a DESIGNATOR PAIR *not given* in the above table, and to specify particular VISUAL EFFECTS for this pair, you may use the **BIT DESIGNATOR PAIR (BDP)** command:

BDP q = s₁, TERM₁; s₂, TERM₂ [CR] *

where "q" (the "Pair Number") is any integer from 1 through 32. "TERM₁" and "TERM₂" are alphanumeric designations of your choice, of up to *seven* characters each. "TERM₁" describes the *Logic 1* condition; "TERM₂," the *Logic 0* condition. "s₁" and "s₂" are "STATUS" values that encode the VISUAL EFFECTS you want to appear when the conditions occur that are described, respectively, by "TERM₁" and "TERM₂" (for "STATUS" values, see Section 2.C.12(a)).

Note that the newly specified DESIGNATOR PAIR will replace the like-numbered pair in Table 2.C.4, which represents the contents of the DataPAC's DESIGNATOR-PAIR memory.

For example, suppose that

- a. a "good" test condition is to be indicated when a particular LOGIC BIT—say, Bit No. 347—is at a *Logic 1* level, and
- b. you want this condition to produce the word **GOOD** on the bit's displayed BIT-STATE FIELD, with *white* characters on a *violet* background. The opposite condition (a *Logic 0* for Bit No. 347) is to produce the word **BAD**, with *blinking yellow* characters on a *red* background.

To establish this new pair of terms as, say, "Pair No. 5" (replacing **IN/OUT-white on black/red on white** in the DESIGNATOR-PAIR memory), you should command

BDP 5 = WV, GOOD: YRB, BAD [CR] *

You may now assign the new DESIGNATOR PAIR to Bit No. 347, using the first form of the **BIT STATE DISPLAY (BSD)** command given in the preceding section (since "TERM₁" = **GOOD** = the *Logic 1* state of the bit):

BSD 347 = 5 [CR] *

If at any time you want to *reverse* the POLARITY of the new pair— that is, to make "TERM₂" (**BAD**) correspond to the *Logic 1* state of Bit No. 347—you should command

BSD 347 = /5 [CR] *

Note that a reversal of PAIR POLARITY does *not* reverse the respective "STATUS" assignments; "s₁" is always dedicated to "TERM₁," and "s₂" to "TERM₂."

4. SPECIFYING NEW VISUAL EFFECTS FOR AN EXISTING DESIGNATOR PAIR

If you want to change only the VISUAL EFFECTS to be exhibited by an existing DESIGNATOR PAIR No. q, you can use a **BDP** command of the form

BDP q = s₁: s₂ [CR] *

Suppose, for example, that you want to use the "standard" **PASS/FAIL** word pair, but don't want to use any of the four "standard" VISUAL-EFFECT PAIRS given in Table 2.C.4. Instead, you want the word **PASS** to be displayed by *yellow on blue*, and **FAIL** to be displayed by *flashing green on red*. You need only command

BDP 8 = YB: GRF [CR] *

d. SETTING TEXT AND VISUAL EFFECTS FOR A MESSAGE FIELD: **MES** COMMAND

1. ENTERING A SYSTEM MESSAGE

The **MESSAGE (MES)** command lets you specify the *alphanumeric text* to appear in the displayed MESSAGE FIELD of a given system MESSAGE, along with the desired VISUAL EFFECTS for that display. The form of the command is

MES m = s, \$ [CR]

where "m" is the number of the MESSAGE associated with the given MESSAGE FIELD (1 through 16), and "s" is the two- or three-character "STATUS" code defining the desired VISUAL

EFFECTS (see Section 2.C.12(a)). "s" is followed, in the command entry, by a *comma*, and then by the actual *text* of the MESSAGE (represented in the command expression by "\$"). This text may take up to 15 characters, including spaces.

Note that the **MESSAGE (MES)** command is a "RUN-TIME" COMMAND, and does *not* require that the EEPROM Write Protect Switch be ON. This allows rapid computer-downloading of "temporary" MESSAGES for the purpose of alerting the operator to critical control situations, prompting suitable control actions, etc.

Suppose, for example, that you have assigned a particular MESSAGE FIELD to system Message No. 11, via the procedure given in Section 2.C.5(g), and that you want the MESSAGE to be displayed in this field to read

CLOSE VALVE NO. 7!!!!

with *blinking white characters on a red background*. You should then arrange to issue a command of

MES 11 = WRB, CLOSE VALVE NO. 7!!!! [CR]

at the moment you want the MESSAGE to appear.

Such a MESSAGE display can be *automatically* triggered by the detection of a specific logic event or process condition by including the appropriate **MES** command in an **EXECUTE (EXU)** or **COMMAND (CMD)** statement (as in the fourth example given in Section 2.K.2).

Remember that MESSAGES are analogous to "live data." They are not written into nonvolatile EEPROM. When system power is interrupted, therefore, all MESSAGES automatically revert to "blank," and every MESSAGE "STATUS" to GREEN ON BLACK ("GB") or HALF INTENSITY ON BLACK ("10").

You should also note that an interrogation of **MES m [CR]** will yield a response of **s, "\$"**—i.e., MESSAGE "STATUS" code, comma, MESSAGE text *in quotation marks*. The quotation marks do not appear in the displayed MESSAGE, nor should they be entered in the "WRITE" form of the **MES** command, above, unless they are to be literally included in the MESSAGE text.

2. SPECIFYING NEW VISUAL EFFECTS FOR AN EXISTING MESSAGE

If you want to change *only the VISUAL EFFECTS* to be exhibited by an existing system MESSAGE No. m, you can use a command of the form

MES m = s [CR]

where "s" is the new "STATUS" assignment for MESSAGE No. m.

e. SETTING VISUAL EFFECTS FOR A VIDEO PLAYBACK FIELD

The VISUAL EFFECTS of a VIDEO PLAYBACK FIELD can be controlled by the **STATUS (STS)** command *only*. At powerup, every such field will always default to a "STATUS" of **WHITE ON BLACK (WO** for a color monitor; **20** for a monochrome monitor).

To temporarily change the VISUAL EFFECTS exhibited by the VIDEO PLAYBACK FIELD assigned to a given VIDEO PLAYBACK PSEUDOCANNEL No. x (where "x" can be any number from 1000 through 1299), you may apply a "RUN-TIME" COMMAND of

STS x = s [CR]

where "s" is the two- or 3-character "STATUS" code defining the desired VISUAL EFFECTS (Section 2.C.12(a)).

Section 2.D

Downloading of Numeric Data: "**CHN**=" Command



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A "PSEUDOCHANNEL" is an ANALOG INPUT CHANNEL containing numeric data that does not represent a "live" physical measurement of a "real-world" phenomenon. Unlike a "REAL" ANALOG INPUT CHANNEL, it has no actual I/O "LOCATION."

There are several kinds of PSEUDOCHANNELS, including

a. CALCULATE PSEUDOCHANNELS

These contain data that has been *internally calculated* in accordance with a **CALCULATE (CLC)** command, as described in Section 2.J.

b. PLAYBACK PSEUDOCHANNELS ("NORMAL" AND "VIDEO")

These contain data that has been evoked from "*historical*" memory through the PLAYBACK function discussed in Section 3.B.4 ("Digital History Recording and Playback").

c. LINEARIZATION PSEUDOCHANNELS

These report specially *linearized* data for specified DATA CHANNELS or other PSEUDOCHANNELS (see Section 2.L).

d. DOWNLOAD PSEUDOCHANNELS ("VOLATILE" AND "NONVOLATILE")

These contain data that has been *downloaded* by a computer or operator, using a special "RUN-TIME WRITE" form of the **CHANNEL (CHN)** command, as explained in the present section. (Use of the **CHN** command for *random access of channel data* is treated in Section 1.H. The "**CHN=**" form may also be used to dedicate a "BINARY" or "BCD" INPUT CHANNEL to the reading of a given BIT GROUP—see Section 3.B.2.(e).)

There are two forms of "DOWNLOAD" PSEUDOCHANNELS: **VOLATILE** and **NONVOLATILE** (or "KEEP-ALIVE"). The latter type are used for keeping constant numerical values "alive" (in nonvolatile EEPROM) while system power is down. (Note that "KEEP-ALIVE" DOWNLOAD PSEUDOCHANNELS should *not* be used to replace VOLATILE DOWNLOAD PSEUDOCHANNELS in an application where data will be downloaded often. This might cause the EEPROM's "write limit" of 10,000 to be exceeded.)

e. TIMER PSEUDOCHANNELS ("INCREMENTAL" AND "DECREMENTAL")

The data reading of a TIMER PSEUDOCHANNEL will be automatically incremented or decremented by "1" every time the system's clock-time reading increments by *one second* since the PSEUDOCHANNEL was last scanned. As explained in Section 2.M.2, a TIMER PSEUDOCHANNEL is set or reset just like a DOWNLOAD PSEUDOCHANNEL, using the "**CHN=**" command.

A CALCULATE, PLAYBACK, or LINEARIZATION PSEUDOCHANNEL is automatically "configured" as soon as it is defined by a **CALCULATE (CLC)**, **PLAYBACK (PLA)**, or **LINEARIZE (LIN)** command, respectively. A DOWNLOAD or TIMER PSEUDOCHANNEL, on the other hand, **MUST BE CONFIGURED BY THE USER DURING SETUP, BEFORE IT CAN BE LOADED WITH DATA.**

2.D.2.

SETUP OF DOWNLOAD PSEUDOCHANNELS

To configure a DOWNLOAD PSEUDOCHANNEL (of either kind), you need to turn on the DataPAC's EEPROM Switch and specify an appropriate two-character TYPE code "v," via the **TYPE (TYP)** command:

TYP x = v [CR] *

where "x" is the Channel Number you wish to assign to the given PSEUDOCHANNEL, and where "v" is given by the following table. TIMER PSEUDOCHANNELS are also set up by the **TYP** command (see Section 2.M.2).

Table 2.D.1

"Type" of Pseudochannel	Channel Type Code ("v")
VOLATILE DOWNLOAD PSEUDOCHANNEL	D0
NONVOLATILE ("KEEP-ALIVE") DOWNLOAD PSEUDOCHANNEL	D1
INCREMENTAL TIMER PSEUDOCHANNEL	D2
DECREMENTAL TIMER PSEUDOCHANNEL	D3

An example of the "TYPING" of a DOWNLOAD PSEUDOCHANNEL is given in Section 2.F.2(c), "Continuous Display of Limit Value."

----- NOTE -----

If you are establishing a DOWNLOAD PSEUDOCHANNEL of either kind to be used for the display of a *constant* data value, you will maximize your system's scan speed by assigning to this PSEUDOCHANNEL a Channel Number "x" *outside the effective SCAN RANGE* (see Section 1.F.1). In such a case, the PSEUDOCHANNEL'S data reading will be displayed with a prefix of "&," if a command of **VSS = 1 [CR]*** is in effect.

If Channel No. x is a PSEUDOCHANNEL of *any* kind, a **RESET (RST)** command of the form

RST x [CR] *

will "retype" the channel to "D0" (see Appendix C).

a. VOLATILE DOWNLOAD PSEUDOCANNELS (TYPE "D0")

Once a VOLATILE DOWNLOAD PSEUDOCANNEL No. x has been initially configured by a command of **TYP x = D0 [CR] ***, you can then load it with a constant data value "w," at any time during normal operation, by commanding

CHN x = w [CR]

("w" is any allowable data value, as defined in Section 1.H.1).

Being a VOLATILE DOWNLOAD PSEUDOCANNEL, Channel No. x will report the specified data value "w" only *temporarily*—that is, only until DataPAC power is turned off, or until a new value is downloaded by a subsequent **CHN x = w [CR]** command.

AT POWERUP, EVERY VOLATILE DOWNLOAD PSEUDOCANNEL WILL AUTOMATICALLY DEFAULT TO A READING OF ZERO.

To load each VOLATILE DOWNLOAD PSEUDOCANNEL in the range from No. x through No. y with the same fixed data value "w," command

CHN x TO y = w [CR]

b. NONVOLATILE ("KEEP-ALIVE") DOWNLOAD PSEUDOCANNELS (TYPE "D1")

Once a NONVOLATILE ("KEEP-ALIVE") DOWNLOAD PSEUDOCANNEL No. x has been initially configured by a command of **TYP x = D1 [CR] ***, you can then load it with a constant data value "w" by commanding

CHN x = w [CR] *

THE EEPROM SWITCH MUST BE ON IN ORDER FOR THE DOWNLOADED DATA VALUE "w" TO BE WRITTEN INTO NONVOLATILE MEMORY. Channel No. x will in this case continue to report the specified value "w" even after the recycling of DataPAC power.

To load each NONVOLATILE DOWNLOAD PSEUDOCANNEL in the range from No. x through No. y with the same fixed data value "w," command

CHN x TO y = w [CR] *

----- NOTE -----

You may, if you wish, apply the **"CHN="** command to *any* system DATA CHANNEL—including an ANALOG OUTPUT CHANNEL (Section 3.A.2) or a "REAL" ANALOG INPUT CHANNEL that reports "live" variable data. However, in view of the fact that channels with variable data are normally updated every scan cycle, the application of this command makes sense only for channels whose data is only occasionally modified (e.g., a "MAX" CALCULATE PSEUDOCANNEL) or does not change at all (as in the present application). See Section 2.J.2 for the use of the **"CHN="** command to reset a scanned "MAX" or "MIN" PSEUDOCANNEL.

2.D.4.

LOADING A VOLATILE DOWNLOAD PSEUDOCHANNEL WITH THE READING OF ANOTHER DATA CHANNEL

a. LOADING OF A SINGLE CHANNEL

You can arrange to transfer to a given VOLATILE DOWNLOAD PSEUDOCHANNEL No. x the *current data reading* of system DATA CHANNEL No. y, one time only, by commanding

CHN x = CHN y [CR]

where Channel No. y can be any DATA CHANNEL—"REAL," "PSEUDO," or "CONVERSION"—other than Channel No. x. Channel No. y need *not* be within the current SCAN RANGE.

This form of the "**CHN=**" command can be applied only to a VOLATILE DOWNLOAD PSEUDOCHANNEL (TYPE "D0"), which will report the reading of Channel No. y only until the DataPAC is turned off, or until it is assigned to yet another channel (No. z) by a subsequent entry of **CHN x = CHN z [CR]**. At powerup, PSEUDOCHANNEL No. x will automatically default to a reading of *zero*.

NOTE: The above command loads PSEUDOCHANNEL No. x with the current reading of another system DATA CHANNEL (No. y), without altering that reading in any way. To set up PSEUDOCHANNELS that perform *mathematical operations* on the readings of other channels, see the **CALCULATE (CLC)** command (Section 2.J).

b. LOADING OF A RANGE OF CHANNELS

To load each VOLATILE DOWNLOAD PSEUDOCHANNEL in the range from No. x through No. y with the current data reading of a single DATA CHANNEL No. "a," command

CHN x TO y = CHN a [CR]

where $y > x$. Channel No. "a" need *not* be within the current SCAN RANGE.

To load each VOLATILE DOWNLOAD PSEUDOCHANNEL in the range from No. x through No. y with the current data reading of the corresponding DATA CHANNEL in the range from No. "a" through No. "b," command

CHN x TO y = CHN a, b [CR]

where $y > x$, $b > a$, and $(y - x) = (b - a)$. Any or all of Channel Nos. "a" through "b" may lie outside the current SCAN RANGE.

For example, to effect a one-to-one transfer of the "field of answers" reported by "REAL" CHANNEL Nos. 49 through 55 to VOLATILE DOWNLOAD PSEUDOCHANNEL Nos. 271 through 277, you need only command

CHN 271 TO 277 = CHN 49, 55 [CR]

Section 2.E

"Locking" and "Unlocking" of Data: **LOK** and **UNL** Commands



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2.E.1.

"LOCKING" ONE OR MORE DATA CHANNELS: LOK COMMAND

By entering a command of

LOK [CR]

you can inhibit the automatic updating of the DataPAC's DATA RAM. In this way, you can instantly and indefinitely "*lock*" (or "*freeze*") *all variable data values* as they existed the moment the command was applied. THIS INCLUDES THE DATA FOR CHANNEL NOS. 998 (TIME) AND 999 (DATE), AS WELL AS ALL TIMER PSEUDOCHANNELS (Section 2.M.2). YOU SHOULD TAKE CARE NOT TO ENTER A **LOK [CR]** COMMAND WHILE THE MODEL 10BDR64 HISTORY CARD IS IN THE PROCESS OF RECORDING DATA (see Section 3.B.4(d.5)).

To inhibit the automatic updating of DATA CHANNEL No. x, *only*, command

LOK x [CR]

To inhibit the automatic updating of all DATA CHANNELS from Channel No. x to and including Channel No. y, *only*, command

LOK x TO y [CR]

The **LOCK (LOK)** command is principally used to avoid "time skew" within a given set of data readings, which can result from slow transmission or processing rates, time-sharing considerations, etc. The **SNAPSHOT (SNP)** command, described in Section 1.H.2, permits the "dumping" of a "time-coherent" data set from the DataPAC's COMPUTER INTERFACE PORT by *automatically* applying the **LOCK (LOK)** command immediately before the transmission of data and the **UNLOCK (UNL)** command as soon as the transmission has stopped.

LOK can also be used to "hold" for an indefinite time a critical data value that is prone to decay. See, for example, Section 3.A.5, where the **LOCK (LOK)** command lets you hold for observation a volatile "MAX minus MIN" reading.

Note that one or more "locked" DOWNLOAD PSEUDOCHANNELS *can* be updated by means of the "**CHN=**" command (as discussed in Section 2.D), without having to "unlock" the PSEUDOCHANNEL(S).

"UNLOCKING" ONE OR MORE "LOCKED" DATA CHANNELS: UNL COMMAND

2.E.2.

To "unlock" the DATA RAM, thus resuming normal automatic updating of *all* scanned DATA CHANNELS, including Nos. 998 (TIME) and 999 (DATE), command

UNL [CR]

Note that after application of the **UNL [CR]** command, you need not reset TIME or DATE; these values will be automatically and properly updated upon "unlocking" of the DATA RAM.

To "unlock" Channel No. x, *only*, command

UNL x [CR]

To "unlock" all DATA CHANNELS from Channel No. x to and including Channel No. y, *only*, command

UNL x TO y [CR]

Section 2.F

Limits



System 10 Guidebook

2.F.1.

INTRODUCTION: A LIMIT SETUP "GETTING STARTED" PROCEDURE

All ANALOG INPUT and OUTPUT CHANNELS are automatically and continuously monitored for conformance to individually preset HIGH and LOW limit values. Each "set-point" limit value can be *fixed*, or it can be made to equal the existing reading of any other channel.

Special "LIMIT LOGIC" commands let you specify the particular *logic output* to be activated whenever the data value reported by a given channel lies within any one of three possible LIMIT ZONES: "GREATER THAN," "BETWEEN," or "LESS THAN." Such outputs can be latching or nonlatching. You can interrogate the system at any time for a channel's current limit values and for the LIMIT ZONE its data value currently occupies.

The remainder of the present section offers an overall "GETTING STARTED" procedure, which you should now run through with your DataPAC, to familiarize yourself with the sequence of commands involved. All commands used in the procedure are discussed in detail in the following sections.

NOTE THAT STEPS b, e, f, g, i, AND j OF THE FOLLOWING PROCEDURE APPLY ONLY TO DATAPACS WITH CRT DISPLAY.

- a. Select a "REAL" DATA CHANNEL which you have already calibrated, and which allows convenient input loading (e.g., an LVDT or Strain Gage Transducer Channel). This will be the "Channel No. x" referred to in the commands below.
- b. If your DataPAC has CRT "video capability," you should arrange to display the selected DATA CHANNEL (refer to the DATA-FIELD setup procedure in Section 1.D.2 or 2.C.5).

C. SET LOW LIMIT FOR CHANNEL NO. x: LOL COMMAND

Make sure the DataPAC's EEPROM Write Protect Switch is ON, and enter a command of

LOL x = l [CR] *

where "x" is the number of the DATA CHANNEL selected in Step a, and "l" is the desired *low-limit* value for this channel, expressed in desired engineering units. The *precision* of the entered "l" value should match that of the channel's data reading.

Here, let "l" be about 20% of the channel's full-scale reading. For example, if you're using a 50-pound load cell as source transducer for Channel No. x, which has been calibrated to read *tenths* of a pound, then enter an "l" value of 10.0.

d. SET HIGH LIMIT FOR CHANNEL NO. x: HIL COMMAND

Command

HIL x = h [CR] *

where "h" is the desired *high-limit* value, entered to the appropriate precision. Here, let "h" be about 80% of Channel No. x's full-scale reading. If, again, you were using a 50-pound load cell, enter an "h" value of 40.0.

e. SET "LESS THAN" VISUAL EFFECTS FOR CHANNEL NO. x: VLT COMMAND

If your DataPAC has a *color* display, enter a command of

VLT x = RYB [CR] *

This specifies that the displayed data value of Channel No. x should appear with *blinking red characters on a yellow background* when that value is LESS THAN the low-limit value "l" entered in Step c, above.

If your DataPAC has a *monochrome* display, command

VLT x = 02B [CR] *

to specify *blinking black characters on a white background* for data in the "LESS THAN" zone.

You should verify the effectiveness of the **VLT** command by removing all load from the channel's source transducer and observing the VISUAL EFFECTS of the resultant display.

f. SET "BETWEEN" VISUAL EFFECTS FOR CHANNEL NO. x: VBT COMMAND

To specify that when the data reading for Channel No. x lies BETWEEN (or is equal to one of) the two preset limit values ("l" and "h") the channel's data should be displayed, on a color display, with *green characters on a white background*, command

VBT x = GW [CR] *

For a monochrome display, command

VBT x = 12 [CR] *

to specify *half-intensity characters on a white background* for data in the "BETWEEN" zone.

Verify the effects of the command by producing an input between 20% and 80% of full scale and observing the resultant data display.

g. SET "GREATER THAN" VISUAL EFFECTS FOR CHANNEL NO. x: VGT COMMAND

To specify that when the data reading for Channel No. x is GREATER THAN the high-limit value "h" entered in Step d, above, the channel's data should be displayed, on a color display, as a *"flashing" alternation of blue characters on a red background with red characters on a blue background*, command

VGT x = BRF [CR] *

For a monochrome display, command

VGT x = 20F [CR] *

to specify a *"flashing" alternation of white characters on a black background with black characters on a white background* for data in the "GREATER THAN" zone.

Verify the effects of the command by producing an approximately full-scale input and observing the resultant data display.

h. SET "GREATER THAN" LOGIC FOR CHANNEL NO. x: LGT COMMAND

Select an unused system LOGIC BIT. This will be the "Bit No. r" referred to in the commands below.

To arrange for a "GREATER THAN" violation for Channel No. x to set Bit No. r to *Logic 1*, command

LGT x = r [CR] *

2.F.1.

INTRODUCTION: A LIMIT SETUP "GETTING STARTED" PROCEDURE

(This command assumes that Bit No. *r* is to be *nonlatching*—that is, that its state will return to *Logic 0* as soon as the high-limit violation for Channel No. *x* ceases to occur. If you wanted the bit to be *latching*, you would first have to command

SRC r = LIM, LAT [CR] *

For details, see Section 2.H.2(a.)

- i. Verify the activation of Bit No. *r* upon occurrence of a high-limit violation for Channel No. *x*, as follows:
 1. If your DataPAC has CRT "video capability," arrange to display the selected Bit No. *r* (refer to Section 2.C.5(f) for the setup of a BIT-STATE FIELD).
 2. Produce an input load for Channel No. *x* that is *below* the high-limit value "h" set in Step d.
 3. Observe the display of Bit No. *r*. Unless you have previously applied a **BIT STATE DISPLAY (BSD)** command to this bit (as explained in Section 2.C.12(c)), its state should now be displayed by the word **LOW** in *red on white* (for monochrome monitors, *black on white*).
 4. Now gradually increase the load on the source transducer for Channel No. *x*. As soon as this input exceeds the channel's high-limit value "h," the word **HIGH** will appear in the display of Bit No. *r*, in *white on black*. Remove all load, and the word **LOW** will reappear.

As mentioned above, Bit No. *r* can be made latching or nonlatching. It can also activate a *logic output* from a **Model 10AIO-16 or 10BIO-16 Universal Logic I/O Card** (for details, see Section 3.A.3 or 3.B.2).

j. CANCEL "GREATER THAN" LOGIC FOR CHANNEL NO. x: **LGT** COMMAND

To cancel the "GREATER THAN" logic you have set for Channel No. *x*, command

LGT x = N/A [CR] *

The existing data value of Channel No. *x* will no longer affect the display of Bit No. *r*.

- K. Repeat Steps h, i, and j, if desired, but now use the **"BETWEEN" LOGIC (LBT)** or **"LESS THAN" LOGIC (LLT)** command—instead of **LGT**—to activate a selected system bit when the data for Channel No. *x* lies, respectively, between the preset limit values, or below the low-limit value "l."

a. SETTING FIXED LIMIT VALUES

To set a fixed *low-limit* value for Channel No. x, which can be any DATA CHANNEL – "REAL," "PSEUDO," or "CONVERSION" – or any ANALOG OUTPUT CHANNEL, command

$$\text{LOL } x = l \text{ [CR] } *$$

where "l" is the desired low-limit value ($-32768 \leq l \leq 32768$). Similarly, to set a fixed *high-limit* value for Channel No. x, command

$$\text{HIL } x = h \text{ [CR] } *$$

where "h" is the desired high-limit value ($-32768 \leq h \leq 32768$).

Both "l" and "h" should be expressed in the *engineering units* selected for Channel No. x, and with the *same precision* (decimal-point location) as that of the channel's data readings.

Note: Until a **LOW LIMIT (LOL)** command has been applied to a given DATA CHANNEL, its effective low-limit value will be -3000 mV (or the "scaled" equivalent); until a **HIGH LIMIT (HIL)** command has been applied, its effective high-limit value will be $+3000$ mV (or equivalent).

b. SETTING VARIABLE LIMIT VALUES

To set the *low-limit* value for DATA CHANNEL No. x continuously equal to the reading of Channel No. z, command

$$\text{LOL } x = \text{CHN } z \text{ [CR] } *$$

Channel No. z can be any DATA CHANNEL—"REAL," "PSEUDO," or "CONVERSION"—or it can be an ANALOG OUTPUT CHANNEL (see Section 3.A.2). Note, however, that both Channel No. x and Channel No. z should be set to the *same precision* (decimal-point location).

Similarly, to set the *high-limit* value for Channel No. x continuously equal to the reading of Channel No. z, command

$$\text{HIL } x = \text{CHN } z \text{ [CR] } *$$

C. SOME USES OF VARIABLE LIMIT VALUES

1. CONTINUOUS DISPLAY OF LIMIT VALUE

For example, if you wish to display the high-limit value currently in effect for Channel No. 37 on the same VIDEO PAGE as the "live" data for that channel, you may use a second channel (say, No. 43) for this purpose:

- a. Since you will *download* into Channel No. 43 the high-limit settings to be effective for Channel No. 37, you must first "configure" Channel No. 43 to be a VOLATILE DOWNLOAD PSEUDOCHANNEL (see Section 2.D.1), by means of the following **TYPE (TYP)** command:

$$\text{TYP } 43 = \text{DO [CR] } *$$

- b. Arrange to display DOWNLOAD PSEUDOCHANNEL No. 43 on the same VIDEO PAGE as "REAL" CHANNEL No. 37 (for entry of display DATA FIELDS, see Section 2.C.5(e)).

- c. Command

$$\text{HIL } 37 = \text{CHN } 43 \text{ [CR] } *$$

2.F.2.

SETTING LIMIT VALUES: LOL AND HIL COMMANDS

d. Then command

CHN 43 = h [CR]

where "h" is the desired high-limit value for Channel No. 37.

Note that since the downloading of numeric data to a VOLATILE DOWNLOAD PSEUDO-CHANNEL does *not* require the EEPROM to be enabled, this technique allows "RUN-TIME" RESETTING OF LIMIT VALUES.

2. CONTINUOUS COMPARISON OF TWO DATA CHANNELS

By making the high- or low-limit value of Channel No. x continuously equal to the data reading of Channel No. y, you can easily determine at any time whether the present reading of Channel No. x is greater or less than the present reading of Channel No. y. Thus, following a command of

HIL x = CHN y [CR] *

a "GREATER-THAN" limit violation for Channel No. x will occur whenever the data value reported by Channel No. x is greater than the data value simultaneously reported by Channel No. y.

At any time, the data reading for a given channel will lie within one of three possible LIMIT ZONES, *numbered* as follows:

- 1 = the **LESS THAN ZONE**: data less than both preset limit values
- 2 = the **BETWEEN ZONE**: data between (or equal to one of) the preset limit values
- 3 = the **GREATER THAN ZONE**: data greater than both preset limit values

Through a **LIMIT ZONE (LZN)** command, you can cause LIMIT-ZONE information for a single channel or for a selected range of channels to be either transmitted from the DataPAC's COMPUTER INTERFACE PORT or displayed on its BILLBOARD (if present). This "LIMIT-ZONE information" consists of the *number* (1, 2, or 3) representing the LIMIT ZONE in which the channel's data currently lies. If the command is entered via the DataPAC's keyboard, the BILLBOARD will display the words **BELOW LIMIT**, **BETWEEN LIMIT**, or **ABOVE LIMIT**. Since **LZN** is a "data-transmission" command, it is treated in Section 1.H.2.

Through the **LIMITS (LIM)** command, you can instruct the DataPAC to include per-channel LIMIT-ZONE indication with any transmission initiated in response to a **CHANNEL (CHN)**, **DUMP (DMP)**, **SNAPSHOT (SNP)**, **STREAM (STR)**, or **HARD COPY (HCY)** command. The **NO LIMITS (NOL)** command may be used to cancel the **LIMITS (LIM)** command. See Section 1.H.3(b) for details of syntax.

2.F.4.

SETTING "LIMIT LOGIC": LLT, LBT, AND LGT COMMANDS

There are three "LIMIT LOGIC" commands that may be simultaneously applied to any given DATA CHANNEL: "**GREATER THAN**" LOGIC (LGT), "**BETWEEN**" LOGIC (LBT), and "**LESS THAN**" LOGIC (LLT). The effect of each command is to arrange for a specified system LOGIC BIT to be set to *Logic 1* when the channel's data reading lies in the corresponding LIMIT ZONE.

——— PLEASE NOTE ———

A LOGIC BIT No. *r* that is to be controlled by LIMIT LOGIC may be either *latching* or *nonlatching*. If it is to be latching, it is necessary to enter a **LOGIC SOURCE (SRC)** command of the form

SRC *r* = LIM, LAT [CR] *

before the appropriate LIMIT LOGIC command is entered. If the bit is to be nonlatching, no **SRC** command is required; you need only apply the appropriate **LGT**, **LBT**, or **LLT** command, as explained below. For a complete discussion of the **LOGIC SOURCE (SRC)** command and of the "latching" of bits, see Section 2.H ("System Logic Bits").

To specify a LOGIC BIT No. *r* to be set to *Logic 1* when the data value for Channel No. *x* is in the "LESS THAN" LIMIT ZONE, command

LLT *x* = *r* [CR] *

To specify a Bit No. *r* to be set when data for Channel No. *x* is in the "BETWEEN" LIMIT ZONE, command

LBT *x* = *r* [CR] *

To specify a Bit No. *r* to be set when data for Channel No. *x* is in the "GREATER THAN" LIMIT ZONE, command

LGT *x* = *r* [CR] *

Note that the state of a single LOGIC BIT can be made dependent—in a logic "OR" fashion—upon more than one limit condition. Thus, for example, the state of a given Bit No. 874 can be the result of *either* of two (or more) LIMIT LOGIC commands applying to the same or to different DATA CHANNELS—say,

LGT 201 = 874 [CR] *
LLT 201 = 874 [CR] *
LBT 7 = 874 [CR] *

As a consequence of these commands, Bit No. 874 will be at *Logic 1* whenever data for Channel No. 201 is in the "GREATER THAN" OR "LESS THAN" zone, OR whenever data for Channel No. 7 is in the "BETWEEN" zone.

To *cancel* an existing "**LESS THAN**" LOGIC (LLT) command, so that the presence of a "LESS THAN" limit condition for Channel No. *x* will have no effect on the state of any system LOGIC BIT, command

LLT *x* = N/A [CR] *

Similarly, to cancel a "**BETWEEN**" LOGIC (LBT) or "**GREATER THAN**" LOGIC (LGT) command, command

LBT *x* = N/A [CR] * or **LGT *x* = N/A [CR] ***

respectively.

Section 2.G

Setting Other Data-Channel Parameters



System 10 Guidebook

2.G.1.

SETTING SCALING FACTOR AND ZERO OFFSET: EMM AND BEE COMMANDS

Every "REAL" DATA CHANNEL in your system has two calibration constants ("m" and "b"). Once entered in the DataPAC's CENTRAL PROCESSOR, these two numbers operate continuously and automatically on the ratio of the channel's analog input signal to the positive full-scale voltage of its chosen input "TYPE" (x) to produce an appropriately proportioned data reading (y), in accordance to the linear relation "y = mx + b." The coefficient "m" is the SCALING (or "GAIN") FACTOR, while the term "b" is the ZERO OFFSET. For a general discussion of DATA-CHANNEL calibration, see Section 1.G.1.

A channel's effective SCALING FACTOR and ZERO OFFSET are automatically computed and stored when the channel is calibrated by one of the methods discussed in Section 1.G. THUS, YOU NEED NOT NORMALLY CONCERN YOURSELF WITH THE EXISTING VALUES OF THESE TWO CONSTANTS.

Under certain special circumstances, however, such as the "Special Two-Point Calibration for LVDT Inputs" (Section 1.G.6), you may need to load a specific "m" and/or "b" value for a given channel, using the **SCALING FACTOR (EMM)** and/or **OFFSET (BEE)** command, respectively.

To set to a value of "m" the SCALING FACTOR to be applied to Channel No. x, command

EMM x = m [CR] *

This command may be used to reset a "REAL" DATA CHANNEL'S *precision*, which depends on the precision of its "m" value, regardless of the method used to calibrate the channel.

To set to a value of "b" the ZERO OFFSET to be applied to Channel No. x, command

BEE x = b [CR] *

This command may be used to reset a CALCULATE PSEUDOCHANNEL'S *precision*, which depends on the precision of its "b" value, if present (see Section 2.J.1).

In their "READ" form, these commands also allow *backup storage* of a channel's calibration data, as explained in Section 2.P.3. Stored calibration constants can be *reloaded* from backup memory (disk, tape, etc.), via the "WRITE" form of the **EMM** and **BEE** commands, in order to restore a previous channel configuration or to quickly change to a new one, *without having to recalibrate*.

In addition to the normal-mode *analog* filtering automatically applied to most analog conditioner channels, *digital* filtering is provided by the DataPAC's CENTRAL PROCESSOR for all system DATA CHANNELS, with smoothing constants selectable on a per-channel basis via the **FILTER (FIL)** command. The effect of the digital filter is to remove small unwanted dynamic signal components, while allowing large-scale fluctuations to pass unaffected.

To set the digital filter for Channel No. x, command

FIL x = f [CR] *

where "f" is an integer from -1 through 9. These "filter constant" values signify increasing amounts of automatic digital filtering, where "-1" = NO FILTERING; "0" = ONLY ENOUGH FILTERING TO MASK INTRINSIC SYSTEM NOISE; and "9" = MAXIMUM FILTERING. All active "REAL" DATA CHANNELS are normally factory-set for an initial filter constant of "5," except for *Thermocouple* channels, which are usually set at "8."

2.G.3.

SETTING TARE OFFSET: TAR COMMAND

The **TARE (TAR)** command is identical in effect to the **ZERO (ZRO)** command, discussed in Section 1.G.5, except that the entered ZERO OFFSET ("b") value is now stored in *volatile RAM memory*, instead of nonvolatile EEPROM, and will therefore be lost on interruption of power. Since the EEPROM is not involved, you can use **TAR** whenever "RUN-TIME" zeroing is required—as, for example, in a succession of rapid batch weighings, where container weight must be continuously "tared" out of the measurement.

Thus, to zero DATA CHANNEL No. x at any time during normal operation, command

TAR x [CR]

To zero all DATA CHANNELS from Channel No. x to and including Channel No. y, command

TAR x TO y [CR]

----- NOTE -----

When applying the single-channel form of the **TARE (TAR)** command, make sure that the specified DATA CHANNEL lies within the currently effective SCAN RANGE (see Section 1.F.1). When using the "x TO y" form of the command, make sure that the specified range of channels to be zeroed is within or equal to the current SCAN RANGE. APPLYING **TAR** TO AN UNSCANNED CHANNEL WILL PROBABLY RESULT IN AN ERRONEOUS DATA READING FOR THAT CHANNEL.

Section 2.H

System Logic Bits



System 10 Guidebook

Table 2.H.0

System 10 Bits and Bit Groups

Bits	Bit Group	Bits	Bit Group
0 - 15	1	496 - 511	32
16 - 31	2	512 - 527	33
32 - 47	3	528 - 543	34
48 - 63	4	544 - 559	35
64 - 79	5	560 - 575	36
80 - 95	6	576 - 591	37
96 - 111	7	592 - 607	38
112 - 127	8	608 - 623	39
128 - 143	9	624 - 639	40
144 - 159	10	640 - 655	41
160 - 175	11	656 - 671	42
176 - 191	12	672 - 687	43
192 - 207	13	688 - 703	44
208 - 223	14	704 - 719	45
224 - 239	15	720 - 735	46
240 - 255	16	736 - 751	47
256 - 271	17	752 - 767	48
272 - 287	18	768 - 783	49
288 - 303	19	784 - 799	50
304 - 319	20	800 - 815	51
320 - 335	21	816 - 831	52
336 - 351	22	832 - 847	53
352 - 367	23	848 - 863	54
368 - 383	24	864 - 879	55
384 - 399	25	880 - 895	56
400 - 415	26	896 - 911	57
416 - 431	27	912 - 927	58
432 - 447	28	928 - 943	59
448 - 463	29	944 - 959	60
464 - 479	30	960 - 975	61
480 - 495	31	976 - 991	62

Your DataPAC has internal registers for 1000 internal binary variables. These SYSTEM LOGIC BITS may be used for a number of purposes, including

- *logic I/O* for process control (ANY BIT MAY BE DESIGNATED AS EITHER AN INPUT OR AN OUTPUT—see below, and Section 3.A.3 or 3.B.2)
- implementation of *digital I/O* (BINARY or BCD—see Section 3.B.2)
- *automatic triggering* of standard DataPAC commands via the **EXECUTE (EXU)** and **COMMAND (CMD)** commands (see Section 2.K)
- automatic "TIMEOUT" indication (see Section 2.B.6)
- "queue status" indication (see Section 2.K.2)
- initiation of *limit-violation responses* (see below), including VISUAL-EFFECT changes for displayed DATA CHANNELS, LOGIC BITS, MESSAGES, and VIDEO PLAYBACK PSEUDOCHANNELS (see Section 2.C.12)
- automatic *starting and halting of "history" recordings* (see Section 3.B.4).

The system's 1000 LOGIC BITS are numbered from "Bit No. 0" through "Bit No. 999."* They are divided into **BIT GROUPS** of 16 bits each. The first BIT GROUP consists of LOGIC BIT Nos. 0 through 15, and is designated by a "RANK" Number of "1." The second BIT GROUP has a RANK of "2," and consists of Bit Nos. 16 through 31; the BIT GROUP of RANK "3" consists of Bit Nos. 32 through 47; of RANK "4," Bit Nos. 48 through 63, and so on (see Table 2.H.0, left).

BEFORE IT CAN BE PUT TO USE, A SYSTEM BIT MUST HAVE A "LOGIC SOURCE." This source will continuously tell the bit what *logic state* it is to assume.

The **LATCH MODE** of a bit—i.e., whether or not it will "latch" upon being set—will be determined by the last **LOGIC SOURCE (SRC)** command to have been applied to that bit, except in the case of *nonlatching* "LIMIT LOGIC" and of bits which are "autosourcing" (see Section 2.H.2, below).

There are five principal LOGIC SOURCES, summarized in Table 2.H.1, below. These sources are *mutually exclusive*. THUS, AT ANY GIVEN TIME, THE STATE OF A GIVEN BIT WILL BE DETERMINED BY *ONLY ONE* OF THE FOLLOWING:

a. "LIMIT LOGIC"

This is predefined for the bit via the "**LESS THAN**" LOGIC (LLT), "**BETWEEN**" LOGIC (LBT), and "**GREATER THAN**" LOGIC (LGT) commands discussed in Section 2.F.4.

b. A LOGIC INPUT

This must be received by an optional **Model 10AIO-16 or 10BIO-16 Universal Logic I/O Card** at the specific LOGIC I/O PORT that corresponds to that bit.

c. AN EXTERNAL BIT-SETTING COMMAND

The **SET BIT (BIT)** command is a "RUN-TIME" COMMAND which is "externally" applied by the operator or computer to set either a single LOGIC BIT or a range of LOGIC BITS to a given logic state.

* NOTE: Bit 999 is reserved for the "Software" EEPROM Switch (see the Appendix at the end of this section.)

2.H.1.

INTRODUCTION: BITS, BIT GROUPS, AND LOGIC SOURCES

The **BINARY (BIN)**, **BINARY CODED DECIMAL (BCD)**, and **HEXADECIMAL (HEX)** commands are "RUN-TIME" COMMANDS which are "externally" applied to set the sixteen members of a system BIT GROUP to a given logic-state configuration. The **HEXADECIMAL (HEX)** command may also be used to set a *range* of BIT GROUPS to the same hexadecimal configuration.

Any of these commands may also be part of an **EXECUTE (EXU)** or **COMMAND (CMD)** statement, as in the example given in Section 2.H.3, below.

d. A "SPECIAL BIT" ASSIGNMENT

Any LOGIC BIT can be assigned one of several special system functions, including

1. "timeout" indication, via the **TIMEOUT (TMO)** command,
2. indication of the status of the CENTRAL PROCESSOR'S COMPUTER QUEUE, via the **COMPUTER STATUS BIT (CSB)** command, and
3. indication of the status of the CENTRAL PROCESSOR'S PERIPHERAL QUEUE, via the **PERIPHERAL STATUS BIT (PSB)** command.

e. AUTOMATIC "COPROCESSOR" LOGIC SOURCING

In this case, the state of the bit is controlled by a system COPROCESSOR CARD.

Setup of each of these five LOGIC SOURCES is explained in detail in the following section.

Note here that, AT SYSTEM POWERUP, ONE AND ONLY ONE LOGIC SOURCE WILL BE IN EFFECT FOR ANY GIVEN LOGIC BIT, depending on the specific "command history" of that bit. It is possible, however, to indirectly *combine* the effects of several different sources, as explained in Section 2.H.3.

NOTE TOO THAT ANY BIT TO WHICH A LOGIC SOURCE HAS *NOT* BEEN ASSIGNED— EITHER EXPLICITLY, BY THE OPERATOR/COMPUTER, OR AUTOMATICALLY, BY THE SYSTEM ITSELF—WILL ALWAYS DEFAULT TO A SOURCE OF "EXTERNAL, NONLATCHING," AND WILL ALWAYS READ *LOGIC 0*.

Table 2.H.1.

Summary of Logic Sources

Logic Source	Method of Specification
1. LIMIT LOGIC:	
LATCHING	SRC r = LIM, LAT [CR] * , followed by LGT, LBT, or LLT command
NONLATCHING	LGT, LBT, or LLT command
2. LOGIC INPUT:	
LATCHING	SRC r = INP, LAT [CR] * (requires properly initialized Model 10AIO-16 or 10BIO-16)
NONLATCHING	SRC r = INP, NON [CR] * (requires properly initialized Model 10AIO-16 or 10BIO-16)
3. EXTERNAL CONTROL:	
"RUN-TIME"	<p>[single LOGIC BIT or range of LOGIC BITS:]</p> <p>BIT r = 1 [CR]; BIT r = 0 [CR]; BIT r TO q = 1 [CR]; BIT r TO q = 0 [CR]</p> <p>[single BIT GROUP:]</p> <p>BIN k = d [CR]; BIN k = CHN c [CR] BCD k = d [CR]; BCD k = CHN c [CR] (see Section 3.B.2(e) for an explanation of these commands)</p> <p>[single BIT GROUP or range of BIT GROUPS:]</p> <p>HEX k = h [CR]; HEX k TO l = h [CR]</p> <p>BIT, BIN, BCD, and HEX commands RELEASED BY BIT r = INT [CR]</p>
"DEFAULT"	SRC r = EXT [CR] * , followed by one of the above BIT, BIN, BCD, or HEX commands
4. "SPECIAL BIT"	
	"Autosourcing" with appropriate defining command (TMO, CSB, PSB, etc.)
5. COPROCESSOR	
	"Autosourcing" with assignment of bit to COPROCESSOR CARD

NOTE: The **LOGIC SOURCE (SRC)** commands discussed below are given in the *single-bit* form only. Any **SRC** command can also be applied to a *range* of bits—i.e., to all bits from Bit No. *r* to and including Bit No. *q*—by entering the command as

$$\text{SRC } r \text{ TO } q = \dots [\text{CR}] *$$

a. "LIMIT LOGIC"

As explained in Section 2.F.4, "LIMIT LOGIC" refers to the setting of a specified system LOGIC BIT whenever the data reading for a given channel lies within a specified LIMIT ZONE.

LIMIT LOGIC can be either "latching" or "nonlatching."

1. LATCHING "LIMIT LOGIC"

If you want the state of Bit No. *r* to be determined by the LIMIT LOGIC asserted by a "**GREATER THAN**" LOGIC (LGT), "**BETWEEN**" LOGIC (LBT), or "**LESS THAN**" LOGIC (LLT) command, and the bit is to be *latching*, a **LOGIC SOURCE (SRC)** command of the form

$$\text{SRC } r = \text{LIM, LAT } [\text{CR}] *$$

must precede entry of the respective **LGT**, **LBT**, or **LLT** command (these commands are described in Section 2.F.4).

The above **SRC** command informs the CENTRAL PROCESSOR that the LOGIC SOURCE of Bit No. *r* is "**LIMIT LOGIC**," and that the bit is to be **LATCHING**.

For the *releasing* of latched bits, see the **RELEASE (RLS)** command, Section 2.H.4, below.

2. NONLATCHING "LIMIT LOGIC"

If the state of Bit No. *r* is to be controlled by the LIMIT LOGIC asserted by a "**GREATER THAN**" LOGIC (LGT), "**BETWEEN**" LOGIC (LBT), or "**LESS THAN**" LOGIC (LLT) command, and the bit is to be *nonlatching*, you need only apply the appropriate **LGT**, **LBT**, or **LLT** command, as described in Section 2.F.4. In this case, *no* **LOGIC SOURCE (SRC)** command is necessary.

For example, a command of the form

$$\text{LGT } 51 = 5 [\text{CR}] *$$

directs LOGIC BIT No. 5 to assume a nonlatching state of *Logic 1* when the data for Channel No. 51 lies in the "GREATER THAN" limit zone (that is, when its value *exceeds* both preset limit values for that channel). Since it is nonlatching, Bit No. 5 will automatically return to a state of *Logic 0* as soon as the data reading for Channel No. 51 ceases to lie in the "GREATER THAN" zone.

b. LOGIC INPUT

To place Bit No. *r* under direct control of the *logic input* received at the corresponding LOGIC I/O PORT of a properly initialized **Model 10AIO-16** or **10BIO-16 Universal Logic I/O Card**, and to specify the desired LATCH MODE of this bit, you should command, during setup,

$$\text{SRC } r = \text{INP, I } [\text{CR}] *$$

where "l" is a three-letter code word, either **LAT** or **NON** (thus determining whether Bit No. r is to operate in LATCHING or NONLATCHING mode, respectively). Again, to *release* a latched bit, see the **RELEASE (RLS)** command, Section 2.H.4.

Before applying the above **SRC** command, however, you must first "initialize" the Logic I/O Card, following the procedure given in Section 3.A.3 or 3.B.2. That is, you must first enter an appropriate **ASLOT** or **BSLOT** command in order to establish a *one-to-one correspondence* between the card's sixteen LOGIC I/O PORTS and the sixteen members of the system BIT GROUP to which the bit in question belongs.

----- NOTE -----

IN THE ABSENCE OF THE ABOVE **SRC** COMMAND, THE SYSTEM WILL AUTOMATICALLY ASSUME THAT ANY LOGIC I/O PORT CORRESPONDING TO BIT NO. r IS AN *OUTPUT* PORT (again, see Section 3.A.3 or 3.B.2 for "Setup of Logic I/O Ports").

C. EXTERNAL BIT CONTROL

1. TEMPORARY ("RUN-TIME") EXTERNAL CONTROL: BIT, BIN, BCD AND HEX COMMANDS

At any time during system operation, and *regardless of any previous LOGIC-SOURCE assignment*, you may temporarily assign an "external" LOGIC SOURCE to any given Bit No. r by applying a **SET BIT (BIT)** command to that bit or a **BINARY (BIN), BINARY CODED DECIMAL (BCD), or HEXADECIMAL (HEX)** command to the BIT GROUP to which it belongs. ANY OF THESE "RUN-TIME" COMMANDS WILL OVERRIDE ANY EXISTING LOGIC-SOURCE DESIGNATION FOR THE BIT IN QUESTION.

Since they are strictly "RUN-TIME" COMMANDS, at system powerup any and all **BIT, BIN, BCD, or HEX** commands applied prior to the last power shutdown are no longer in effect. This is true even for bits that default on powerup to "external control" (see below).

Note also that a **BIT, BIN, BCD, or HEX** command may be part of an **EXECUTE (EXU) or COMMAND (CMD)** statement, in which case its effect will be the same as if it had been received directly from an *external* operator or computer (see Section 2.K for "Automatic Command Execution").

a. SETTING AND READING A SINGLE BIT OR A RANGE OF BITS: BIT COMMAND

To set the state of LOGIC BIT No. r to either *Logic 0* or *Logic 1*, command, respectively, either

BIT r = 0 [CR] or BIT r = 1 [CR]

To *read* the state of any Bit No. r, command

BIT r [CR]

When entered via the COMPUTER INTERFACE PORT, this interrogation will produce an output from that port of either

r, 0 [CR] [LF] or r, 1 [CR] [LF]

depending on the present state of Bit No. r.

To set to *Logic 0* or *Logic 1* the state of every bit from Bit No. *r* through Bit No. *q*, command, respectively, either

BIT *r* TO *q* = 0 [CR] or BIT *r* TO *q* = 1 [CR]

To cause the DataPAC to issue from its COMPUTER INTERFACE PORT the current logic states, in sequence, for all bits from Bit No. *r* through Bit No. *q*, command, *via the COMPUTER INTERFACE PORT*,

BIT *r* TO *q* [CR]

(See also Section 1.A.3(d) for the "range" form of a "READ" COMMAND.) Again, the RESPONSE FORMAT will be, for every answer transmitted, either

***r*, 0 [CR] [LF] or *r*, 1 [CR] [LF]**

b. SETTING A BIT GROUP OR RANGE OF BIT GROUPS

1. SETTING A BIT GROUP TO BINARY CONFIGURATION: **BIN** COMMAND

The **BINARY (BIN)** command lets you set a single BIT GROUP to a sixteen-bit configuration that represents, in BINARY form, either a constant numerical value or the current (analog) data value of a given system DATA CHANNEL. See Section 3.B.2(e) for details.

2. SETTING A BIT GROUP TO BINARY CODED DECIMAL CONFIGURATION: **BCD** COMMAND

The **BINARY CODED DECIMAL (BCD)** command lets you set a single BIT GROUP to a sixteen-bit configuration that represents, in BCD form, either a constant numerical value or the current (analog) data value of a given system DATA CHANNEL. See Section 3.B.2(e) for details.

3. SETTING ONE OR MORE BIT GROUPS TO HEXADECIMAL CONFIGURATION: **HEX** COMMAND

To set all sixteen bits of the system BIT GROUP of RANK No. *k* such that their configuration is exactly represented by the four-character hexadecimal word "*h*," command

HEX *k* = *h* [CR]

For example, suppose that you want the states of the sixteen bits of BIT GROUP No. 3 (i.e., Bit Nos. 32 through 47) to be, in order,

0 0 1 0 1 1 1 0 1 1 0 1 0 1 1 0

where the rightmost binary value in the series is the state of the lowest-numbered bit (No. 32). As can be seen from the table, below, this bit configuration can be encoded by the hexadecimal word **2ED6**. You would therefore command

HEX 3 = 2ED6 [CR]

To *read* the existing configuration assumed by BIT GROUP No. *k*, expressed as a hexadecimal word, simply command

HEX *k* [CR]

The DataPAC will answer only with the appropriate hexadecimal word "h," without any BIT GROUP Number "echo."

To set to the hexadecimal word "h" every BIT GROUP from BIT GROUP No. k through BIT GROUP No. l, command

HEX k TO l = h [CR]

To cause the DataPAC to issue from its COMPUTER INTERFACE PORT the current hexadecimal configurations, in sequence, for all BIT GROUPS from BIT GROUP No. k through BIT GROUP No. l, command, *via the COMPUTER INTERFACE PORT,*

HEX k TO l [CR]

(See also Section 1.A.3(d) for the "range" form of a "READ" COMMAND.)

Table 2.H.2.

Binary-Hexadecimal Equivalents

Binary	Hex	Binary	Hex
0000	0	1000	8
0001	1	1001	9
0010	2	1010	A
0011	3	1011	B
0100	4	1100	C
0101	5	1101	D
0110	6	1110	E
0111	7	1111	F

2. RETURNING TO PREVIOUS LOGIC SOURCE

As mentioned above, the application of the **SET BIT (BIT), BINARY (BIN), BINARY CODED DECIMAL (BCD),** or **HEXADECIMAL (HEX)** command to LOGIC BIT No. r—or to the BIT GROUP of which it is a member—will always override any existing LOGIC-SOURCE designation for that bit.

TO REVOKE THIS OVERRIDING, THUS RETURNING CONTROL OF BIT NO. r TO THE EEPROM-STORED LOGIC-SOURCE ASSIGNMENT THAT WAS IN EFFECT WHEN THE **BIT, BIN, BCD,** OR **HEX** COMMAND WAS ENTERED, COMMAND

BIT r = INT [CR]

To return all bits from Bit No. r through Bit No. q to their respective EEPROM-stored source assignments, command

BIT r TO q = INT [CR]

3. DEFAULT TO EXTERNAL CONTROL

During setup, you can arrange for your system to default, on powerup, to "external" control of Bit No. r by commanding

SRC r = EXT [CR] *

This command will cancel any previous **SRC** command applying to Bit No. *r*, and will confer future control of the bit solely to subsequent **SET BIT (BIT)**, **BINARY (BIN)**, **BINARY CODED DECIMAL (BCD)**, and/or **HEXADECIMAL (HEX)** commands.

d. "SPECIAL BIT" ASSIGNMENT

You can set up "special bits" for your system, including

- a TIMEOUT BIT, as specified by a **TIMEOUT (TMO)** command (Section 2.B.6). This bit will be set to *Logic 1* when no recognizable character has been received at the DataPAC's COMPUTER INTERFACE PORT for a specific period of time, and will return to *Logic 0* as soon as such a character is subsequently received.
- a COMPUTER STATUS BIT, as specified by a **COMPUTER STATUS BIT (CSB)** command (Section 2.K.2), which will be set to *Logic 1* when the CENTRAL PROCESSOR'S COMPUTER QUEUE is empty, and to *Logic 0* when it is not.
- a PERIPHERAL STATUS BIT, as specified by a **PERIPHERAL STATUS BIT (PSB)** command (Section 2.K.2), which will be set to *Logic 1* when the CENTRAL PROCESSOR'S PERIPHERAL QUEUE is empty, and to *Logic 0* when it is not.

Such bits are "autosourcing." That is, once the appropriate bit-specifying command has been entered, NO ADDITIONAL **LOGIC SOURCE (SRC)** COMMAND NEED BE APPLIED TO THE BIT.

NOTE: If you subsequently interrogate for the LOGIC SOURCE of a "special bit," via a "READ" COMMAND of **SRC r [CR]**, you will get an answer of **EXT, NON**.

e. "COPROCESSOR" LOGIC SOURCING

System 10 includes a number of "smart" (microprocessor-equipped) cards, through which one or more LOGIC BITS or BIT GROUPS can be "sourced." Examples of "COPROCESSOR CARDS" are the **Model 10BACI Auxiliary Computer Interface Card**, the **Model 10BD4 Satellite Interface Card**, and the **Model 10BD1 Satellite Slave Card**. For the sourcing of LOGIC BITS to an AUXILIARY COMPUTER INTERFACE (ACI) via a special "B-SLOT" form of the SRC command, see Section 3.B.5(c.7) of this Guidebook. For the dedication of specific BIT GROUPS to a DataPAC SATELLITE via the **SATELLITE SYSTEM BITS (SSB)** command, see Section 3.B.3(b.6).

In such cases, the sourcing of bits assigned to a COPROCESSOR CARD is automatically effected when the card is set up. That is, the DataPAC's CENTRAL PROCESSOR will be automatically informed of any COPROCESSOR to which a given bit has been assigned, and which therefore represents its immediate LOGIC SOURCE *from the CENTRAL PROCESSOR'S point of view*. THEREFORE, NO **LOGIC SOURCE (SRC)** COMMAND REFERRING TO THAT BIT NEED BE APPLIED TO THE DATAPAC (i.e., THE CENTRAL PROCESSOR).

Note, however, that any bit dedicated to a SATELLITE COPROCESSOR (Model 10BD4 or 10BD1) will nonetheless have to be "sourced" with respect to the SATELLITE itself. That is, an appropriate LOGIC-SOURCE specification technique will have to be directed *to the SATELLITE that is the "data origin" of the bit in question*, in order to inform it of whether that bit is to be directly controlled by local LIMIT LOGIC, a local LOGIC INPUT, "external" bit-setting commands issued to the SATELLITE, etc.

For possible responses to a "READ" COMMAND of **SRC r [CR]**, where Bit No. *r* is COPROCESSOR-SOURCED, see Section 4 of this Guidebook, under the **SRC** mnemonic.

It has been stressed that the five LOGIC SOURCES discussed in the preceding section are mutually exclusive; the state of a given logic bit may be determined by only *one* LOGIC SOURCE at any given time.

It is nevertheless possible to *combine* results from more than one source in a "Logic OR" fashion. To do so, you may use the **EXECUTE (EXU)** command to couple the "real" bit in question with an "EXECUTE" *trigger bit*, as shown in the following example. For a full discussion of the **EXECUTE (EXU)** command, see Section 2.K.

As an example, suppose that you want Bit No. 137 to be set by *either*

- a "LESS THAN" limit condition for Channel No. 5 *or*
- a specific LOGIC INPUT received by a Model 10AIO-16 or 10BIO-16 Universal Logic I/O Card.

As explained in the following procedure, your first step will be to assign *one* of these two LOGIC SOURCES directly to Bit No. 137, via either the **LOGIC SOURCE (SRC)** command or, in the case of nonlatching "LIMIT LOGIC," via an appropriate LIMIT LOGIC command (**LGT**, **LBT**, or **LLT**). You will then assign the *other* source indirectly, via an **EXECUTE (EXU)** statement containing the **SET BIT (BIT)** command. In this example, we will assign a source of "nonlatching LIMIT LOGIC" directly to Bit No. 137, using the **"LESS THAN" LOGIC (LLT)** command.

a. Enter a command of

LLT 5 = 137 [CR] *

This directs Bit No. 137 to assume a nonlatching state of *Logic 1* when the data for Channel No. 5 lies in the "LESS THAN" LIMIT ZONE.

b. Now we must select a presently unused "trigger bit" to couple with Bit No. 137 through the **EXECUTE (EXU)** function. The trigger bit must, of course, be within your system's 32-bit "EXECUTE BASE GROUP" (see Section 2.K.2). In this example, let the trigger bit be Bit. No. 29.

c. Use the **LOGIC SOURCE (SRC)** command to designate a LOGIC INPUT as the *source of the trigger bit*, and to place this bit in the *nonlatching* mode:

SRC 29 = INP, NON [CR] *

d. Now enter

EXU 29 = BIT 137 = 1 [CR] *

This command directs that when the trigger bit (No. 29) goes to *Logic 1*, Bit No. 137 will be simultaneously set at *Logic 1*. Since Bit No. 29 will go to *Logic 1* only when an appropriate logic input is received, we have effectively "sourced" Bit No. 137 to this logic input. Note, however, that the logic input by which you wish to control Bit No. 137 is NOT to be received at the system's LOGIC I/O PORT No. 137, but at the LOGIC I/O PORT corresponding to the mediating trigger bit (see Section 3.A.3 or 3.B.2 for "Setup of Logic I/O Ports").

2.H.3.

USE OF EXECUTE (EXU) COMMANDS TO SET MULTIPLE LOGIC SOURCES

- e. Because the **SET BIT (BIT)** command always overrides any previously designated LOGIC SOURCE, it is necessary to enter a second **EXECUTE (EXU)** command:

EXU /29 = BIT 137 = INT [CR] *

The effect of this command is to return control of Bit No. 137 to its previously designated LOGIC SOURCE—i.e., "LESS THAN" LIMIT LOGIC for Channel No. 5—when the trigger bit goes back to *Logic 0*. Without this second **EXU** command, Bit No. 137 would remain under exclusive "external" control, and would be unresponsive to subsequent "LESS THAN" violations for Channel No. 5, until such time as system power were cycled.

After it has been set to *Logic 1*, a *nonlatching* LOGIC BIT will revert to a state of *Logic 0* as soon as the condition or conditions responsible for its activation cease to occur. A *latching* bit, on the other hand, will remain at *Logic 1*, regardless of the subsequent behavior of the monitored test or process, until

- a. it is "released" (or "unlatched") via a **RELEASE (RLS)** command, *and*
- b. it is not currently commanded by its designated LOGIC SOURCE to be in a *Logic 1* state.

To release a latched Bit No. *r*, command

RLS *r* [CR]

To release all bits from Bit No. *r* through Bit No. *q*, command

RLS *r* TO *q* [CR]

Note that if the bit is currently commanded by its LOGIC SOURCE to be at *Logic 1*, the **RELEASE (RLS)** command will have no immediate effect on its state. Because it has been "released," however, the bit *will* return to *Logic 0* as soon as it is so commanded by its source.

The **RLS** command applies only to those bits which have been specified as "latching" by an appropriate **LOGIC SOURCE (SRC)** command. The only function of the **RLS** command is to "unlatch" a latched bit, which action will reset the bit to *Logic 0* if all other conditions permit. **RLS CANNOT ALTER THE BIT'S CURRENT LATCH MODE**—i.e., whether or not it will latch when next set.

For the inclusion of a **RELEASE (RLS)** command within an **EXECUTE (EXU)** statement, see the third example in Section 2.K.2(b).

2.H.5.

DISABLING THE READING OF SYSTEM BITS: NOB AND BTS COMMANDS

It is possible to increase your system's internal scan rate by disabling the reading of system LOGIC BITS with each scan cycle. To do so, enter the **NO BITS (NOB)** command:

NOB [CR]

Note that application of the **NOB** command will disable all other commands that depend on the reading of system logic-bit states, such as **EXECUTE (EXU)**, **"BIT CONTROL" STATUS (VBC)**, etc. It may therefore be used to temporarily disable all system EXECUTE functions, as explained in Section 2.K.2(f). Note, however, that the **NOB** command does *not* affect the reading of system CONDITIONAL BITS (Section 2.K.3), but may affect the *triggering* of such bits if they are dependent on system LOGIC-BIT states.

To *cancel* the **NO BITS (NOB)** command, thus resuming the reading of system bits with each scan cycle, enter the **BITS (BTS)** command:

BTS [CR]

On system powerup, the **BTS** condition will be in effect by default.

To turn ON the DataPAC's or 10AFIFO's EEPROM Switch, you can enter the following **SET BIT (BIT)** command (for the 10AFIFO, it must be entered through the FIFO COMPUTER PORT*):

BIT 999 = 1 [CR]

To turn OFF the EEPROM Switch, enter a command of

BIT 999 = 0 [CR]

* For an "A-sized" DataPAC with an installed 10AFIFO, a **BIT 999 = 1 [CR]** command entered at the FIFO COMPUTER PORT will turn on *both* the 10AFIFO's EEPROM Switch *and* that of the DataPAC; similarly, a command of **BIT 999 = 0 [CR]** will turn off both EEPROM Switches.

Section 2.1

Keyboard "Prompt" Functions:
KEY Command



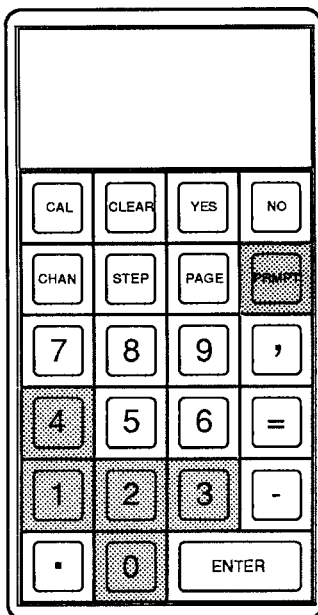
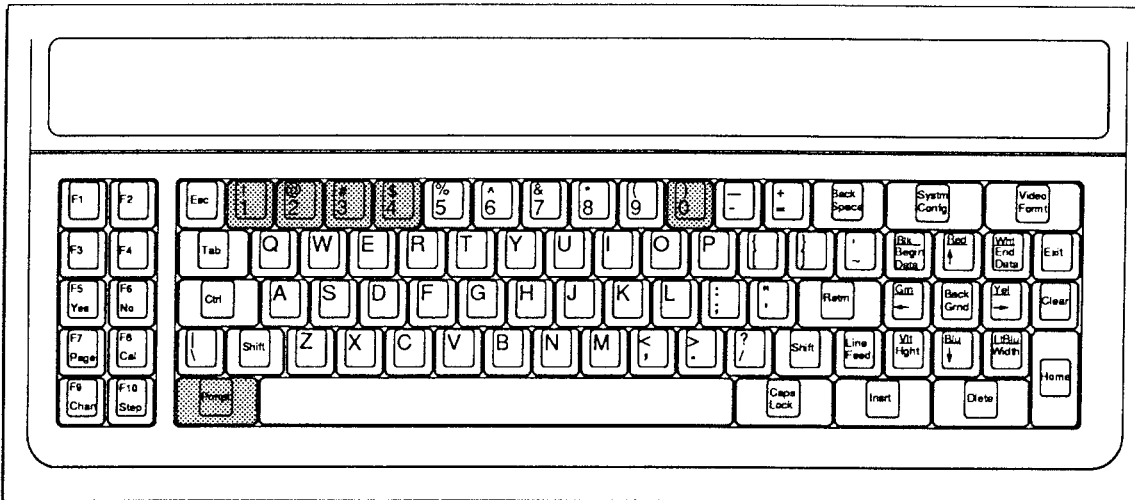
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2.1

KEYBOARD "PROMPT" FUNCTIONS: KEY COMMAND

The **KEY (KEY)** command lets you program an EXTENDED KEYBOARD or OPERATOR'S KEYBOARD for the rapid entry of up to five selected DataPAC commands. Specifically, it allows any standard three-letter MNEMONIC to be communicated to the DataPAC by pressing the keyboard's Prmpt (PROMPT) key, and then the 0, 1, 2, 3, or 4 key (see Fig. 2.1.1).

Fig. 2.1.1 a) Extended Keyboard



PLEASE NOTE

THIS MANUAL SECTION DOES NOT APPLY TO NEWER VERSIONS OF THE **MODEL 10P80A** AND **MODEL 10P80D** EXTENDED KEYBOARDS, WHICH **DO NOT** HAVE A **PROMPT (Prmpt)** KEY.

b) Operator's Keyboard

This function considerably extends the utility of the optional OPERATOR'S KEYBOARD, which can now serve to enter selected commands for numerical (nonliteral) setup, for system interrogation, and for the performance of normal "run-time" operations.

The general form of the **KEY** command is

KEY k = XXX [CR] *

where "k" is the number of the key to be assigned to the command "XXX" ($0 \leq k \leq 4$).

To *cancel* the existing "prompt" assignment for key "k," command

KEY k = N/A [CR] *

----- NOTE -----

You should enter in the **KEY** statement only the *three letters* ("XXX") that constitute the BASIC MNEMONIC of the function to be "prompted." NO NUMERICAL ARGUMENT (Channel No., Bit No., Message No., Page No., etc.) IS TO BE INCLUDED IN THE **KEY** COMMAND ITSELF (see the second and third examples below).

For example, suppose that you want to be able to initiate a "dump" of all scanned channels, by means of the OPERATOR KEYBOARD'S "4" key. You must first enter the following command, via either the EXTENDED KEYBOARD or the DataPAC's COMPUTER INTERFACE PORT:

KEY 4 = DMP [CR] *

After that, a data "dump" will be issued by the DataPAC whenever you press **Prmpt** and then **4** on either of the two keyboards.

Or suppose that you want to dedicate the key sequence **Prmpt 1** to the **PRINT PAGE (PRI)** command (assuming that your system includes an optional Model 10VFO132 Formatted Output Card, described in Section 3.C.3). Simply command

KEY 1 = PRI [CR] *

Remember that you should enter in the **KEY** statement only the three-letter MNEMONIC of the command to be "prompted"—in this case, **PRI**. If you now wish to transmit from the 10VFO132's PRINTER INTERFACE PORT the stored VIDEO PAGE FORMAT No. 25, you need only

- press the **Prmpt** key
- press the **1** key
- type **25**
- press CARRIAGE RETURN ([CR])

Finally, suppose that you want to use the key sequence **Prmpt 2** to initiate the high-limit-setting function of the **HIL** command (see Section 2.F.2). You will then enter

KEY 2 = HIL [CR] *

If you now wish to set the high limit of a particular DATA CHANNEL (say, Channel No. 53) to a particular numeric value (say, 1423), you need only

- press the **Prmpt** key
- press the **2** key
- type **53=1423**
- press CARRIAGE RETURN ([CR])

Section 2.J

Cross-Channel Calculations: **CLC** Command



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Your system lets you define a number of special PSEUDOCANNELS whose reported values represent *mathematical functions* of one or more other system DATA CHANNELS. These functions include *square root*, *absolute value*, *maximum* (most positive value), and *minimum* (least positive value). They permit real-time computation of such process variables as Efficiency, Horsepower, Specific Fuel Consumption, Power Factor, Lift-Drag Ratio, Spring Modulus, and many more.

A "CALCULATE PSEUDOCANNEL" is automatically configured as soon as it is defined by the entry of an appropriate **CALCULATE (CLC)** command. NO **TYPE (TYP)** COMMAND NEED BE ENTERED.

The thirteen **CALCULATE (CLC)** commands are listed below, along with the "TYPE" code that is automatically assigned to each kind of CALCULATE PSEUDOCANNEL when its respective defining command is entered. In these expressions,

- "x" is the Channel Number you wish to assign to the given CALCULATE PSEUDOCANNEL; "y" and "z" are any Channel Numbers *other than "x."*
- "m" and "b" are constants, *positive or negative*, entered by the user. The **CLC** commands given below show these values as positive. To enter a *negative "m,"* simply enter a minus sign (-) before the value; to enter a negative "b," replace the plus sign preceding the value by a minus sign.

Either or both of these constants may be *omitted*, if desired, from any **CLC** command statement. If you omit the "m" term, a coefficient of *unity* ("1") is assumed; if you omit the "b" term, an offset of *zero* is assumed.

The *precision* with which the calculated values are displayed is determined by the precision (i.e., the *decimal-point location*) of the "b" term, if it has been entered. This is true even if the entered "b" value is *zero*. For example, by entering a "b" of "0" in any of the **CLC** equations below, you will cause the calculated value to be displayed to the nearest unit, while entering a "b" of "0.0" will yield the nearest *tenth* of a unit. If you have chosen to *omit* the "b" term, then the calculated value will be displayed with the same precision as Channel No. "y" (see the fourth example in Section 2.J.3, below).

An appropriate **ZERO OFFSET (BEE)** command may therefore be used to *reset* the precision for an existing CALCULATE PSEUDOCANNEL (see Section 2.G.1).

Like all DATA CHANNELS, CALCULATE PSEUDOCANNELS will be updated with each scan cycle only when they are within the currently effective SCAN RANGE (Section 1.F.1).

NOTE: IT IS RECOMMENDED THAT YOU SET UP ALL SYSTEM CALCULATE PSEUDOCANNELS TO THE *SAME* DECIMAL-PLACE RESOLUTION. MIXING CALCULATE RESOLUTIONS WILL TEND TO SLOW DOWN THE SYSTEM SCAN SPEED.

a. MULTIPLICATION OF A SINGLE CHANNEL BY A CONSTANT:

$$\text{CLC } x = m(\text{CHN } y) + b \text{ [CR]}^* \quad \text{[TYPE F6]}$$

b. DIVISION OF A SINGLE CHANNEL BY A CONSTANT:

$$\text{CLC } x = (\text{CHN } y)/m + b \text{ [CR]}^* \quad \text{[TYPE FC]}$$

c. ADDITION OF TWO CHANNELS:

$$\text{CLC } x = m(\text{CHN } y + \text{CHN } z) + b \text{ [CR]}^* \quad \text{[TYPE F0]}$$

d. SUBTRACTION OF ONE CHANNEL FROM ANOTHER:

$$\text{CLC } x = m(\text{CHN } y - \text{CHN } z) + b \text{ [CR]}^* \quad \text{[TYPE F1]}$$

2.J.1.

SETUP OF CALCULATE PSEUDOCANNELS

e. MULTIPLICATION OF TWO CHANNELS:

$$\text{CLC } x = m(\text{CHN } y)(\text{CHN } z) + b \text{ [CR] }^*$$
 [TYPE F2]

f. MULTIPLICATION OF TWO CHANNELS, DIVIDED BY A CONSTANT:

$$\text{CLC } x = (\text{CHN } y)(\text{CHN } z)/m + b \text{ [CR] }^*$$
 [TYPE F5]

g. DIVISION OF ONE CHANNEL BY ANOTHER (SCALED NUMERATOR):

$$\text{CLC } x = m(\text{CHN } y)/(\text{CHN } z) + b \text{ [CR] }^*$$
 [TYPE F3]

h. DIVISION OF ONE CHANNEL BY ANOTHER (SCALED DENOMINATOR):

$$\text{CLC } x = (\text{CHN } y)/(\text{CHN } z)m + b \text{ [CR] }^*$$
 [TYPE F4]

i. DIVISION OF A CONSTANT BY A CHANNEL:

$$\text{CLC } x = m/(\text{CHN } y) + b \text{ [CR] }^*$$
 [TYPE F7]

j. SQUARE ROOT OF A CHANNEL:

$$\text{CLC } x = m(\text{SQR CHN } y) + b \text{ [CR] }^*$$
 [TYPE F8]

k. ABSOLUTE VALUE OF A CHANNEL:

$$\text{CLC } x = m(\text{ABS CHN } y) + b \text{ [CR] }^*$$
 [TYPE F9]

l. MAXIMUM VALUE OF A CHANNEL:

$$\text{CLC } x = m(\text{MAX CHN } y) + b \text{ [CR] }^*$$
 [TYPE FA]

m. MINIMUM VALUE OF A CHANNEL:

$$\text{CLC } x = m(\text{MIN CHN } y) + b \text{ [CR] }^*$$
 [TYPE FB]

A "MAXIMUM" or "MINIMUM" CALCULATE PSEUDOCHANNEL No. x will always read, respectively, the *most positive* or *least positive* value reported by the specified Channel No. y since PSEUDOCHANNEL No. x was last reset.

To reset a MAX- or MIN-indicating PSEUDOCHANNEL at any time during normal operation, you can use the "**CHN=**" command discussed in Section 2.D. Here, however, you will be loading a fixed data value into a "live" (i.e., continuously scanned) channel.

Specifically, you will load CALCULATE PSEUDOCHANNEL No. x with a value *below its present reading*, if it is a MAX-indicating channel. If it is a MIN-indicating channel, you will load a value *above its present reading*. Of course, the loaded value will be retained only momentarily in the DATA RAM, until Channel No. x is next scanned, whereupon it will be replaced by the channel's current reading.

For example, if PSEUDOCHANNEL No. x is displaying a MAXIMUM in the positive realm, commanding

CHN x = 0 [CR]

will effectively reset this channel to the historical present. See also Section 3.A.4 ("Analog Peak Capture").

2.J.3. EXAMPLES OF THE CALCULATE (CLC) COMMAND

a. SPECIFIC GRAVITY CORRECTION OF FLOW MEASUREMENT

Suppose that Channel No. 7 is assigned to a Model 10A40 Frequency Input Conditioner Card, the output of which represents "volumetric flow." To correct to *mass-flow* units, a known *specific gravity correction factor (K)* must be applied. Mass-flow could then be read—to *tenths of a unit*—by a CALCULATE PSEUDOCHANNEL No. x defined by this command:

$$\text{CLC } x = K(\text{CHN } 7) + 0.0 \text{ [CR]} *$$

b. TEMPERATURE-SCALE CONVERSION

You can set up a CALCULATE PSEUDOCHANNEL No. x to convert the Celsius reading of RTD Channel No. 91 to the Fahrenheit scale, with a resolution of 1 degree F, by a command of

$$\text{CLC } x = 1.8(\text{CHN } 91) + 32 \text{ [CR]} *$$

c. CABLE DIAMETER MEASUREMENT

Cable diameter can be determined by summing the displacement signals obtained from two opposing LVDT gaging rollers, and multiplying by a coefficient of 1/2. If the displacement-signal channels are Channel Nos. 10 and 13, then the CALCULATE PSEUDOCHANNEL No. x for diameter measurement to *hundredths of a unit* would be defined by

$$\text{CLC } x = .5(\text{CHN } 10 + \text{CHN } 13) + 0.00 \text{ [CR]} *$$

d. CALCULATION OF HORSEPOWER

If Channel No. 368 contains a *torque* measurement (to *tenths of a footpound*) and Channel No. 5 contains the corresponding *RPM* measurement, then a CALCULATE PSEUDOCHANNEL No. x for measurement of the resulting Horsepower (to *tenths of a horsepower*) would be set up by a command of

$$\text{CLC } x = (\text{CHN } 368)(\text{CHN } 5)/5252 \text{ [CR]} *$$

Note that since the offset term ("+ b") has been omitted from the **CLC** expression, the precision of the computed Horsepower will equal that of Channel No. 368.

e. CALCULATION OF POWER FACTOR

To calculate the power factor of a three-phase electric motor, we need three "real-world" measurements (Volts, Amperes, Watts) and *two* **CLC** commands. Let voltage be reported by Channel No. 22, amperage by Channel No. 97, and wattage by Channel No. 3. Since the power factor is given by (WATTS)/(VOLT-AMPERES), we will first establish a CALCULATE PSEUDOCHANNEL to represent *volt-amperes*, assigning it a Channel Number of "100":

$$\text{CLC } 100 = (\text{CHN } 22)(\text{CHN } 97) \text{ [CR]} *$$

The power factor itself will then be computed by a second CALCULATE PSEUDOCHANNEL—say, Channel No. 101—as defined by

$$\text{CLC } 101 = (\text{CHN } 3)/(\text{CHN } 100) \text{ [CR]} *$$

To cancel the current CALCULATE PSEUDOCHANNEL assignment for Channel No. x, enter a **RESET (RST)** command of

RST x [CR] *

This will reset the "TYPE" code for Channel No. x to "D0" (VOLATILE DOWNLOAD PSEUDOCHANNEL). A subsequent interrogation of **CLC x [CR]** will receive an answer of **N/A**. Note that the "WRITE" form of the **TYPE (TYP)** command will have no effect on a CALCULATE PSEUDOCHANNEL.

Section 2.K

Automatic Command Execution: **EXU** and **CMD** Commands



System 10 Guidebook

The extremely versatile **EXECUTE (EXU)** command lets the computer or operator load selected standard MNEMONIC COMMANDS into the DataPAC *in advance*, to be executed automatically upon detection of a predefined logic event, AS THOUGH THE SPECIFIED COMMAND(S) HAD BEEN RECEIVED DIRECTLY FROM THE COMPUTER OR OPERATOR THE MOMENT THE TRIGGERING EVENT OCCURRED.

Each **EXECUTE (EXU)** command specifies a particular system LOGIC BIT, plus one or more standard commands to be executed by the DataPAC whenever that bit changes from *Logic 0* to *Logic 1* or from *Logic 1* to *Logic 0*.

Automatic execution of commands will be instantaneous and in the same sequence in which they are specified in the **EXECUTE (EXU)** command, unless the number and nature of commands to be executed require their temporary placement in a "COMMAND QUEUE" until such time as they may be put into effect. COMMAND QUEUES and the means of monitoring their status are discussed in Section 2.K.2(d), below.

By basing the automatic execution of given MNEMONIC COMMANDS on the perceived transition of one or more specified "trigger" bits, you can easily set up *preplanned, intelligent reactions to predictable situations and events*, thereby greatly reducing communications and processing burdens. More importantly, proper and prompt reactions to *emergency conditions* can be assured, even though the supervisory computer may be unable, at the time, to give attention to the process.

As explained in Section 2.K.2(e), a special command may be applied to ensure that no EXECUTE functions are active until approximately *fifteen seconds after system powerup*. This prevents the random triggering of EXECUTES that may occur when power is turned on, a situation that can have adverse results, especially when critical control sequences are involved.

The **COMMAND (CMD)** command is very similar to the **EXECUTE (EXU)** command, since it also permits one or more standard MNEMONIC COMMANDS to be instantly executed upon detection of a logic-state transition of a given "trigger" bit. There are two important differences, however: (1) for the **COMMAND (CMD)** command to be effective, your DataPAC must have CRT "video capability" (i.e., it must include a VIDEO CARD SET), and (2) the "trigger" bit for a **COMMAND (CMD)** command will be a special system CONDITIONAL BIT, as defined by a **CONDITIONAL (CDL)** command. Also, a fifteen-second delay after powerup is automatically invoked for all COMMAND functions.

The **CONDITIONAL (CDL)** command lets you define one of a possible ten CONDITIONAL BITS provided by the system. As explained in Section 2.K.3(a), the logic state of a given CONDITIONAL BIT can be made directly dependent upon one or more selected bistate conditions—specifically, upon

- a. the LOGIC STATE(S) of one or more LOGIC BITS
- b. the LIMIT CONDITION(S) of one or more DATA CHANNELS
- c. the occurrence of one or more CLOCK-TIME READINGS, each registering passage of a specified TIME INTERVAL.

The precise way in which you want the state of a given CONDITIONAL BIT to depend upon a particular combination of system LOGIC, LIMIT, and/or TIME- INTERVAL conditions will be indicated by the Boolean algebraic expression you enter in the **CDL** command defining that bit (see Section 2.K.3, below).

----- PLEASE NOTE -----

An "A-Sized" DataPAC with a Model 10ACP100 Central Processor of Software Version 11.1 or higher provides 24 independent TIMERS, each of which may be used to trigger a system LOGIC BIT at a precise "time of day" (according to the system time-of-day clock). The triggered bit can then be used to execute one or more desired functions via an **EXECUTE (EXU)** command. See Section 2.M.3 for use of the TIMER commands.

a. FORM AND USE OF THE EXU COMMAND

To specify one or more standard MNEMONIC COMMANDS to be executed by the DataPAC upon the transition of system LOGIC BIT No. *r* from a *Logic 0* to a *Logic 1* state, command

EXU r = \$ [CR] *

To specify one or more commands to be executed upon the transition of Bit No. *r* from a *Logic 1* to a *Logic 0* state, command

EXU /r = \$ [CR] *

Unless the **EXECUTE BASE GROUP (XBG)** command has been previously applied, the Bit Number "r" entered in the above commands must be from within your system's *first two* BIT GROUPS—that is, "r" must be an integer *from 0 through 31*. As explained below, the **EXECUTE BASE GROUP (XBG)** command lets you specify *any two* BIT GROUPS to be the 32 system LOGIC BITS that may serve to trigger **EXECUTE (EXU)** command strings.

"\$" is a string of up to 32 ASCII characters, literally stating any command or commands that the DataPAC can recognize. These are the command or commands to be automatically executed upon the "setting" or "resetting" of Bit No. *r*. When more than one command are entered in the "\$" string, adjacent commands should be separated by a *colon (:)*, as shown in the examples below.

Note that a given "trigger" Bit No. *r* can be the subject of only *one* **EXECUTE (EXU)** command of each form ("normal" or "inverse"). You may, however, use a single **EXU** statement (of either form) to specify a *series* of commands to be applied, in sequence, upon detection of the given bit transition. Also, the same sequence of commands can be entered for more than one **EXU** command, specifying a *different* "trigger" bit each time. In this way, different logic events can serve to apply the same command or command sequence, in a "logic-OR" manner. The examples given in the following section will help you understand some of the ways in which the **EXU** command may be used.

To *cancel* an existing **EXECUTE (EXU)** command applying to the *Logic 0 to Logic 1* transition of Bit No. *r*, command

EXU r = N/A [CR] *

To cancel an existing **EXU** command applying to the *Logic 1 to Logic 0* transition of Bit No. *r*, command

EXU /r = N/A [CR] *

b. EXAMPLES OF THE EXU COMMAND

NOTE: In these examples, the "nonqueuing" of commands is assumed (see Section 2.K.2(d), below). Also note that, as for all MNEMONIC COMMANDS given in this Guidebook, *spaces* are shown in the following **EXU** and **CMD** commands (Section 2.K.3(d)), but only for the sake of clarity. SPACES SHOULD NOT BE ENTERED IN ACTUAL **EXU** OR **CMD** COMMANDS, UNLESS THEY ARE PART OF AN ACTUAL "TEXT" STRING (as, for example, in a **HEADER (HDR)**, **TAILER (TLR)**, **SEND (SND)**, or **MESSAGE (MES)** command). INSERTION OF A SPACE IMMEDIATELY FOLLOWING THE "EQUALS" SIGN OF AN **EXU** OR **CMD** COMMAND WILL IN FACT NULLIFY THAT COMMAND.

See also Section 2.H.3 on the "Use of **EXECUTE (EXU)** Commands to Set Multiple Logic Sources."

2.K.2.

THE EXECUTE (EXU) COMMAND

1. A command of

EXU 300 = DMP 10 TO 25 [CR] *

will cause the DataPAC to issue a "dump" of the data for all channels from Channel No. 10 to and including Channel No. 25, when the state of Bit No. 300 is perceived to change from *Logic 0* to *Logic 1* (for the **DUMP (DMP)** command, see Section 1.H.2(b)).

2. Suppose that you enter both

EXU 4 = PAG 44 : ITR [CR] *

and

EXU /27 = PAG 44 : ITR [CR] *

If now EITHER Bit No. 4 goes "high" (*Logic 0* to *Logic 1*) OR Bit No. 27 goes "low" (*Logic 1* to *Logic 0*), then two things will happen: (1) the system CRT will display VIDEO PAGE FORMAT No. 44 (see the **PAGE (PAG)** command, Section 2.C.3), and (2) the computer will be interrupted (see the **COMPUTER INTERRUPT (ITR)** command, Section 2.B.6(b)). Bit No. 4 could be the "ORed" result of several limit settings, while Bit No. 27 could be the logic input from an external safety switch.

3. Commanding

EXU 1 = RLS 97 : INC 233 [CR] *

causes the "latch" of Bit No. 97 to be released as soon as Bit No. 1 is seen to go "high" (see the **RELEASE (REL)** command, Section 2.H.4). Also, the number reported by DOWNLOAD PSEUDOCHANNEL No. 233 will be automatically incremented by "1" (see the **INCREMENT (INC)** command, Section 2.M.1). Here, Bit No. 1 might represent a logic input from a manual switch depressed by an operator to release a latched alarm, after the condition causing the alarm has been corrected. Channel 233 might be a PSEUDOCHANNEL set up for the purpose of *counting* the total number of times the alarm is released.

4. Suppose that you have entered a command of

EXU /22 = MES 15 = RWB, SHUTDOWN BOILER NO. 3 [CR] *

The transition of Bit No. 22 from *Logic 1* to *Logic 0* will then cause the following text to be immediately displayed in the MESSAGE FIELD assigned to system MESSAGE No. 15, in *blinking red characters on a white background*:

SHUTDOWN BOILER NO. 3

(for the **MESSAGE (MES)** command, see Section 2.C.12(d)).

5. As a final example, suppose that you have entered

EXU 103 = CHN 99 = 0 : CHN 47 = 1200 : BIT 5 = 1 [CR] *

When Bit No. 103 goes "high," PSEUDOCHANNEL Nos. 99 and 47 are downloaded with data values "0" and "1200," respectively (these might be set-points for load- and speed-control servo loops). Also, Bit No. 5 is set to *Logic 1*, an action which might be used in turn to trigger yet another **EXECUTE (EXU)** command sequence.

C. REDEFINITION OF "EXECUTE BASE GROUP": **XBG** COMMAND

Prior to shipment, a DataPAC is normally set to employ only the 32 bits of its *first two* BIT GROUPS for the purpose of triggering **EXECUTE (EXU)** command strings. These are Bit Nos. 0 through 31 (for an explanation of BIT GROUPS and their "RANK" numbers, see Section 2.H.1).

By means of the **EXECUTE BASE GROUP (XBG)** command, however, you can assign a DataPAC's **EXECUTE (EXU)** statements to the bits of *any two* BIT GROUPS, which need not be contiguous. Thus, to specify the first of the two BIT GROUPS to be used for **EXU** commands, command

$$\mathbf{XBG\ 1 = k_1\ [CR]\ *}$$

where "k₁" is the RANK number of the desired BIT GROUP and where $1 \leq k_1 \leq 61$ (EXECUTES cannot be based on BIT GROUP No. 62). To specify the second of the two BIT GROUPS to be used for **EXU** commands, command

$$\mathbf{XBG\ 2 = k_2\ [CR]\ *}$$

where "k₂" is some RANK Number different from "k₁" ($1 \leq k_2 \leq 61$).

Each form of the **XBG** command permits the shifting of half of your DataPAC's current **EXECUTE (EXU)** statements from one BIT GROUP to another. Thus, for example, if a series of **EXU** statements have already been set up for the first two BIT GROUPS, a command of

$$\mathbf{XBG\ 2 = 4\ [CR]\ *}$$

will translate the series of **EXU** commands applying to BIT GROUP No. 2 (i.e., Bit Nos. 16 through 31) to BIT GROUP No. 4 (Bit Nos. 48 through 63). The **EXU** command formerly applying to Bit No. 16 will now apply to Bit No. 48; that formerly applying to Bit No. 17 will now apply to Bit No. 49; etc.

The **EXECUTE BASE GROUP (XBG)** command is particularly useful in assigning **EXECUTE (EXU)** functions to a SATELLITE DataPAC, *separate* from the **EXU** functions to be performed by the HOST DataPAC (for details, see Section 3.B.3).

d. MONITORING EXECUTE COMMAND QUEUES: **CSB** AND **PSB** COMMANDS

Unless you have instructed otherwise by means of a **NO BITS (NOB)** command (Section 2.H.5), your DataPAC's CENTRAL PROCESSOR will scan all system LOGIC BITS with each complete scan cycle. If any "trigger bits" are at this time perceived to have changed their respective logic states, these "changed" bits will be assembled into an "EXECUTE COMMAND LIST," in the order of their Bit Numbers (lowest-numbered bit first). The command strings specified by the **EXECUTE (EXU)** commands pertaining to these bits will now be communicated to the system, in the same order.

All commands addressed to the CENTRAL PROCESSOR itself and *not requiring an output response from the COMPUTER INTERFACE PORT* will be executed immediately. However, commands that cause output from the COMPUTER INTERFACE PORT (**DMP**, **STR**, **SND**, etc.), or commands addressed to a system COPROCESSOR (e.g., "video" commands, commands to a Satellite or History Card, etc.), require that the CENTRAL PROCESSOR first ascertain the *readiness* of the COMPUTER INTERFACE PORT or respective COPROCESSOR to receive such commands.

2.K.2.

THE EXECUTE (EXU) COMMAND

If the CENTRAL PROCESSOR finds that the COMPUTER INTERFACE PORT is "not ready" for an output-generating command included in an **EXECUTE (EXU)** statement, that command will be placed in the COMPUTER COMMAND QUEUE, where it will remain until

- the COMPUTER INTERFACE PORT is found to be "ready," and
- no other commands *precede* it in the queue.

When these two conditions occur, then and only then will the command be executed.

Similarly, if a COPROCESSOR is found to be "not ready" for a command specifically addressed to it, that command will be placed in the PERIPHERAL COMMAND QUEUE, where it will remain until

- the COPROCESSOR is found to be "ready," and
- no other commands *precede* it in the queue.

----- **NOTE** -----

BECAUSE OF THE POSSIBILITY OF COMMAND "QUEUING," THE COMMANDS SPECIFIED BY AN **EXECUTE (EXU)** STATEMENT MAY NOT BE EXECUTED IN THE SAME SEQUENCE IN WHICH THEY WERE ENTERED IN THAT STATEMENT.

Each of the two COMMAND QUEUES can store up to 32 individual commands. If either queue becomes full, and if a subsequently triggered **EXU** string contains one or more commands that would normally be placed in that queue, THEN THESE COMMANDS WILL BE DISCARDED.

You can assign to any system LOGIC BIT No. *r* the function of monitoring the status of the COMPUTER COMMAND QUEUE, by entering a **COMPUTER STATUS BIT (CSB)** command:

CSB = r [CR] *

Bit No. *r* will now be at *Logic 1* only when the COMPUTER COMMAND QUEUE is *empty*.

To cancel the current COMPUTER STATUS BIT assignment, command

CSB = N/A [CR] *

Similarly, you can use any system bit to monitor the status of the PERIPHERAL COMMAND QUEUE, via the **PERIPHERAL STATUS BIT (PSB)** command:

PSB = r [CR] *

Bit No. *r* will now be at *Logic 1* only when the PERIPHERAL COMMAND QUEUE is *empty*.

To cancel the current PERIPHERAL STATUS BIT assignment, command

PSB = N/A [CR] *

The COMPUTER STATUS BIT and PERIPHERAL STATUS BIT are both "autosourcing" (see Section 2.H.2(d)). Since they indicate the "empty" condition of the COMMAND QUEUES, they can be used to ensure that all of the commands of the last **EXU** sequence to have been triggered *have in fact been executed*, before a new sequence is allowed to be triggered. Thus, they can prevent overrunning of the queues, and the resultant discarding of unexecuted commands.

Suppose, for example, that you have entered an **EXECUTE (EXU)** command of

EXU 50 = \$ [CR] *

where "\$" is a string of commands addressed to a system COPROCESSOR, and where the "trigger bit" (No. 50) is controlled by an appropriate "LIMIT LOGIC" command (**LGT**, **LBT**, or **LLT**). You now wish to make sure that the execution of the command sequence "\$" *can only be triggered when the PERIPHERAL COMMAND QUEUE is empty*.

1. First set up a PERIPHERAL STATUS BIT (say, Bit No. 49):

PSB = 49 [CR] *

2. Next arrange to have the "trigger bit" of the above **EXU** command be set to *Logic 0* whenever the PERIPHERAL STATUS BIT goes from *Logic 1* to *Logic 0* (indicating that the PERIPHERAL COMMAND QUEUE is no longer empty). You can do this by means of another **EXU** command:

EXU /49 = BIT 50 = 0 [CR] *

3. Finally, you should arrange to have a transition of the PERIPHERAL STATUS BIT from *Logic 0* to *Logic 1* (indicating an emptying of the PERIPHERAL COMMAND QUEUE) restore the "LIMIT LOGIC" previously controlling the state of the "trigger bit":

EXU 49 = BIT 50 = INT [CR] *

e. POWERUP DELAY OF EXECUTE FUNCTIONS: **EXM** COMMAND

To prevent the triggering of system **EXECUTE (EXU)** sequences during the first 15 seconds after system powerup, enter an **EXECUTE MODE (EXM)** command of

EXM = D [CR] *

NOTE: THIS COMMAND WILL NOT WORK WITH AN "A-SIZED" DATAPAC (ANY VERSION OF THE MODEL 10KU, 10K1, 10K2, 10K4T, etc.)

As mentioned above, this step will prevent the random triggering of EXECUTE functions that may occur when the DataPAC is activated. System **CONDITIONAL (CDL)**-triggered sequences are *automatically* delayed for 15 seconds after powerup.

To cancel the EXECUTE delay, so that the triggering of EXECUTE sequences can begin immediately upon DataPAC powerup, command

EXM = E [CR] *

f. DISABLING ALL EXECUTE FUNCTIONS: **NOB** AND **BTS** COMMANDS

To temporarily disable all system **EXECUTE (EXU)** functions, you may use the **NO BITS (NOB)** command, described in Section 2.H.5, unless you require the system to continue to report logic data while the EXECUTES are disabled. The effect of this command is to disable the reading of all system LOGIC BITS with each scan cycle, and thus to disable all other commands that depend on the reading of system logic-bit states.

To re-enable all system EXECUTE functions, you may use the **BITS (BTS)** command (see again Section 2.H.5). This command is in effect, by default, on system powerup.

2.K.3.

THE COMMAND (CMD) COMMAND

a. SPECIFYING CONDITIONAL BITS: CDL COMMAND

All DataPACs with CRT "video capability" include ten CONDITIONAL BITS (Nos. 1 through 10). The state of a CONDITIONAL BIT is determined solely by the "conditions" specified by a corresponding **CONDITIONAL (CDL)** command. Thus, the CONDITIONAL BITS should not be confused with your system's 1000 LOGIC BITS, whose states are determined by various LOGIC SOURCES, as explained in Section 2.H.

To specify the precise combination of system LOGIC, LIMIT, and TIME-INTERVAL conditions that will cause a given CONDITIONAL BIT No. *q* to assume a state of *Logic 1*, command

$$\text{CDL } q = \text{B [CR]} *$$

"B" is a string of characters representing a *Boolean algebraic expression* of this general form:

[MNEMONIC plus BIT, CHANNEL, or INTERVAL NUMBER] [OPERATOR]
[MNEMONIC plus BIT, CHANNEL, or INTERVAL NUMBER] [OPERATOR] . . .

The expression "B" may contain up to 16 **MNEMONIC** terms and up to 15 **OPERATORS**. The allowable MNEMONICS are **BIT**, **HIL**, **LOL**, and **INT**. The allowable logic OPERATORS are "*" ("AND") and "+" ("OR").

WARNING! WHEN ENTERING A **CDL** COMMAND VIA THE COMPUTER INTERFACE PORT, DO NOT ALLOW THE "B" STRING TO EXCEED 73 CHARACTERS.

Each "MNEMONIC plus BIT, CHANNEL, or INTERVAL NUMBER" term in the **CDL** expression refers to an actual system LOGIC STATE, DATA-CHANNEL LIMIT STATUS, or TIME INTERVAL. Thus, for example, the term **BIT 66** means "when Bit No. 66 is high"; **HIL 29** means "when data for Channel No. 29 is in the 'GREATER THAN' limit zone"; and **LOL 4** means "when data for Channel No. 4 is in the 'LESS THAN' limit zone."

TIME-INTERVAL (**INT**) numbers are given in the following table. These are integral multiples of one-second, one-minute, or one-hour intervals, as registered by the system's time-of-day clock reading. Thus, for example, the term **INT 9** is a condition that occurs every 10 seconds; technically, it means "when the system clock reads **XX:XX:X0** (hours:minutes:seconds—"X" is any digit)."

Table 2.K.1. System "CONDITIONAL" TIME INTERVALS

Interval	TIME-INTERVAL Number
1 sec	6
2 sec	7
5 sec	8
10 sec	9
20 sec	10
1 min	11
2 min	12
5 min	13
10 min	14
20 min	15
1 hr	16
2 hr	17
4 hr	18
8 hr	19
12 hr	20
24 hr	21

The MNEMONICS **BIT**, **HIL**, and **LOL** may be entered in "normal" or "inverse" form. Inversion is indicated by a "/" preceding the MNEMONIC, and signifies the *opposite* condition. For example, **/BIT 45** means "when Bit No. 45 is low"; **/LOL 7** means "when data for Channel No. 7 does NOT lie in the 'LESS THAN' limit zone."

The examples given in the following section will help to clarify the combined use of these "conditionality" terms. Again, the **CONDITIONAL (CDL)** command asserts that CONDITIONAL BIT No. q will assume a logic state of "1" when and only when the existing states of the system conditions indicated by the terms of the expression "B" are such that their *logical combination*, as represented by that expression, yields a total "truth" value of "1."

To *cancel* the current definition of CONDITIONAL BIT q, command

CDL q = N/A [CR] *

b. EXAMPLES OF CONDITIONAL STATEMENTS

1. As an example of a simple application of the **CONDITIONAL (CDL)** command, suppose we wish to set up CONDITIONAL BIT No. 3, which is to assume a logic state of "1" when and only when EITHER system Bit No. 179 is at *Logic 1* OR system Bit No. 584 is at *Logic 1*. The appropriate command would be

CDL 3 = BIT 179 + BIT 584 [CR] *

Note that *spaces* are shown in this and the following examples; however, they are not transmitted to the DataPAC, and do not count as command "characters."

2. As another example, suppose that we wish to set up CONDITIONAL BIT No. 4, which is to assume a logic state of "1" when and only when the data for Channel No. 28 is in the "GREATER THAN" limit zone, AND the data for Channel No. 29 is NOT in the "LESS THAN" limit zone. We would then command

CDL 4 = HIL 28 * /LOL 29 [CR] *

3. If we wish to set up CONDITIONAL BIT No. 10, which is to assume a state of *Logic 1* at *five-minute intervals*, we would command

CDL 10 = INT 13 [CR] *

4. Finally, to offer a more complicated situation, suppose we wish to set up CONDITIONAL BIT No. 5, which is to assume a logic state of "1" when and only when the following system condition occurs:

EITHER

Bit No. 56 is "0" AND Bit No. 57 is "1"

OR

Channel No. 28 has a HIGH LIMIT violation AND Channel No. 34 has a LOW LIMIT violation

AND

a clock-time interval of 20 seconds has just elapsed.

2.K.3.

THE COMMAND (CMD) COMMAND

The appropriate command would be

CDL 5 = /BIT 56 * 57 + HIL 28 * LOL 34 * INT 10 [CR] *

Note that "**BIT**" is *not* entered just before "57" in the above command. The reason for this is that when a single MNEMONIC type (**BIT**, **HIL**, or **LOL**) applies to a sequence of more than one bit or channel, the MNEMONIC *need not be repeated* before each Bit Number or Channel Number of the sequence.

This is the case even if "normal" and "inverse" terms are mixed within the sequence. Such a mixture occurs in the above example, where the first term is "inverse" and the second is "normal." Note, however, that a Bit or Channel Number entered *without* an immediately preceding MNEMONIC will default to a "normal" interpretation, unless the number is itself preceded by a slash ("/"). Thus, if the second term had also been "inverse"—that is, if the first "condition" had been

Bit No. 56 is "0" AND Bit No. 57 is "0"

—then an acceptable command would have been

CDL 5 = /BIT 56 * /57 . . . [CR] *

C. DISPLAY OF CONDITIONAL STATEMENTS: **SHO** COMMAND

See "THE CONDITIONAL DIRECTORY," Section 2.C.2(c).

d. FORM AND USE OF THE **COMMAND (CMD)** COMMAND

The **COMMAND (CMD)** command is identical in form to the **EXECUTE (EXU)** command (Section 2.K.2, above).

Thus, to specify one or more commands to be executed by the DataPAC upon the transition of system CONDITIONAL BIT No. *q* from a *Logic 0* to a *Logic 1* state, command

CMD q = \$ [CR] *

—and to specify one or more commands to be executed upon the transition of CONDITIONAL BIT No. *q* from a *Logic 1* to a *Logic 0* state, command

CMD /q = \$ [CR] *

As with the **EXECUTE (EXU)** command, "\$" is an ASCII CHARACTER STRING of up to 32 characters, literally stating any command or commands that can be recognized by the DataPAC. Again, the multiple command delimiter is the colon (:). See the examples of the **EXECUTE (EXU)** command given in Section 2.K.2, above.

To *cancel* an existing **COMMAND (CMD)** command applying to the *Logic 0 to Logic 1* transition of CONDITIONAL BIT No. *q*, command

CMD q = N/A [CR] *

—and to *cancel* an existing **COMMAND (CMD)** command applying to the *Logic 1 to Logic 0* transition of CONDITIONAL BIT No. q, command

CMD /q = N/A [CR] *

----- NOTE -----

COMMAND (CMD) commands are "queued," in much the same way as are **EXECUTE (EXU)** commands (see Section 2.K.2(d) for details)—*except* that there is no special "STATUS BIT" to indicate when the queue is empty.

The **CMD** queue can store a large number of commands, the exact number being dependent on the nature of the command strings involved. When the **CMD** queue is full, judgment of any CONDITIONAL BITS referred to by any subsequently entered **COMMAND (CMD)** commands will be suspended, until room is once more available in the queue.

Section 2.L

Linearization Of Data Channels: **LIN** Command



System 10 Guidebook

2.L.1.

SYSTEM 10 "CUSTOM LINEARIZATION"

The "L" Option can be added to any DataPAC, and can be used for high-speed linearization of up to eight different system DATA CHANNELS. These channels will most likely represent *nonlinear sensor inputs*, but may also be system PSEUDOCHANNELS that report variable data.

This option is particularly recommended for flowmeter and special thermocouple channels, where it can normally achieve better than manufacturer's accuracy specifications. For use of the "L" Option and **LINEARIZE (LIN)** command to implement 0.01-degree RTD resolution, see the "Options and Accessories" subsection of Section 1.E.2.10A16-4A.

Using a total of 58 segments anchored at any of 256 breakpoints to profile the input curve at any selected position on the curve, the "L" option can normally achieve linearity with errors of less than 0.05% of full scale.

Up to eight customized linearization ("look-up") tables will be loaded into the DataPAC's EEPROM memory at the factory, in accordance with purchaser's specifications. The same table can be shared by more than one signal of a given type (e.g., TC, RTD, etc.). If an external computer is available, the tables can be downloaded by the user, in the field. A special diskette-based program is included with the "L" Option for this purpose. This menu-driven software will run on any IBM PC or Daytronic Industrial Personal Computer (IPC).

An alternative linearization technique involving the application of **CALCULATE (CLC)** commands is presented in Appendix H.

* * *

PLEASE NOTE: THE "L OPTION" IS NOW A STANDARD FEATURE OF ALL SYSTEM 10 MAINFRAMES.

LINPAC V SOFTWARE IS SUPPLIED FREE OF CHARGE WITH EVERY MAINFRAME. This software allows the creation/editing, loading, backup, and restoration of up to eight customized linearization tables. It also lets the user create a curve-generating linearization function "on-line" on a per-segment basis, to be subsequently loaded from the software to a connected System 10 mainframe. Any currently loaded function can be downloaded from the mainframe to the computer's hard disk for storage or editing. LinPAC V is totally menu-driven, with clean, simple setup instructions and ample tutorial guides.

The LINPAC V package includes the following individual programs:

- **LIN** — lets the user
 - create and save linearization functions either from an existing "look-up" data table (see the **EDLIN** program, below) or "on-line," on a per-segment basis
 - download a linearization function to System 10's EEPROM memory for immediate implementation
 - upload a linearization function from System 10 to disk file for storage or editing
 - perform an EEPROM WRITE TEST
- **EDLIN** — allows creation and/or editing of up to eight internal linearization tables. Up to 58 separate input points—along with their corresponding output values—can be used to create a table that defines an application-specific linearization curve
- **USERTIPS** — operating guide for the new LinPAC user
- **COMMLINK** — establishes serial communications with System 10
- **TERMINAL** — uses the PC as a "dumb terminal" for sending command/queries to System 10
- **DAS1** — for simple "live" data display of up to 1000 channels

a. SETTING UP A "REAL" LINEARIZATION CHANNEL

Linearization of a given ANALOG INPUT CHANNEL No. x can be initiated by means of a user- or computer-entered command of the form

LIN x = Fn(CHN x) [CR]*

The letter "F" is to be entered to the right of the equals sign, followed by a number ("n") from 1 through 8. The number "n" designates the specific prestored linearization table (or "Function") which is to operate continuously on DATA CHANNEL No. x. This command automatically reassigns to the linearized channel (No. x) a "TYPE" designation of "EA." Note that, like any "REAL" channel, a "REAL" LINEARIZATION CHANNEL is physically "located" to a specific sub-channel of an appropriate Signal Conditioner Card; such a channel *applies a specific custom linearization curve to itself.*

b. SETTING UP A "PSEUDOCHANNEL" LINEARIZATION CHANNEL

A "PSEUDOCHANNEL" LINEARIZATION CHANNEL is NOT physically "located," and serves to apply a specific custom linearization curve *to any channel other than itself.* To create such a channel (here, No. y), you should apply a command of the form

LIN y = Fn(CHN x) [CR]*

where "x" is the number of some channel other than "y." This sets up PSEUDOCHANNEL No. y (of TYPE "EA") to report data for Channel No. x that has been linearized on the basis of the prestored look-up table No. "n."

2.L.3.

CANCELLING A LINEARIZATION CHANNEL: RST COMMAND

To cancel the current LINEARIZATION CHANNEL assignment for Channel No. x, enter a **RESET (RST)** command of

RST x [CR] *

This will reset the "TYPE" code for Channel No. x to "D0" (VOLATILE DOWNLOAD PSEUDOCHANNEL). A subsequent interrogation of **LIN x [CR]** will receive an answer of **N/A**. Note that the "WRITE" form of the **TYPE (TYP)** command will have no effect on a LINEARIZATION PSEUDOCHANNEL.

Section 2.M

Internal Counter/ Timer Functions



System 10 Guidebook

2.M.1.

EVENT COUNTING VIA DOWNLOAD PSEUDOCHANNEL: INC AND DEC COMMANDS

Any VOLATILE or NONVOLATILE DOWNLOAD PSEUDOCHANNEL can serve as an "event counter" for the system. As explained in Section 2.D, the "**CHN=**" command is used to load either type of DOWNLOAD PSEUDOCHANNEL with *fixed* data, or to load a VOLATILE DOWNLOAD PSEUDOCHANNEL with *variable* data (continuously equal to the reading of another DATA CHANNEL).

The data value currently reported by a DOWNLOAD PSEUDOCHANNEL No. x—either VOLATILE ("TYPE D0") or NONVOLATILE ("TYPE D1")—will be *incremented* by exactly "1" upon entry of an **INCREMENT (INC)** command:

INC x [CR]

To increment by "1" the respective data values contained in all DOWNLOAD PSEUDOCHANNELS (of either type) from Channel No. x to and including Channel No. y, command

INC x TO y [CR]

NOTE: The **INCREMENT (INC)** command is also used to increment the count reading of a **Model 10ACT01 Counter/Timer Card** in the "COUNTER" MODE, or that of a **Model 10ACC-4 Totalizer Card**. In this case, the increment value (1, 10, or 100) is set via the **RANGE (RNG)** command (see Section 3.A.1).

Similarly, you may *decrement* by "1" the data value of a single DOWNLOAD PSEUDOCHANNEL (of either type)—or the data values for a range of such channels—by entering, respectively,

DEC x [CR] or DEC x TO y [CR]

----- NOTE -----

THE **INCREMENT (INC)** AND **DECREMENT (DEC)** COMMANDS SHOULD ONLY BE APPLIED TO "TYPE D0" AND "TYPE D1" DOWNLOAD PSEUDOCHANNELS.

Note also that, as mentioned in Section 2.D.2, DOWNLOAD PSEUDOCHANNELS containing *fixed* data values are usually not included in the system SCAN RANGE. In the case of an incremental or decremental "event-counting" DOWNLOAD PSEUDOCHANNEL, however, you may or may not wish to have it regularly scanned, depending on your application.

The third example in Section 2.K.2(b) shows how you can use an **EXECUTE (EXU)** command to apply an **INC** or **DEC** command *automatically*, as soon as a specified LOGIC BIT is perceived to change its state. The logic-state transition of this "trigger bit" can in turn be made dependent on the occurrence of the "event(s)" to be counted (see also Section 2.H, "System Logic Bits").

For example, suppose that DOWNLOAD PSEUDOCHANNEL No. 2 is dedicated to the counting of *unacceptable parts* on a production line, with reference to standard high/low limit values. Either a high-limit or a low-limit violation can be made to set a given LOGIC BIT—say, Bit No. 33—via the "**GREATER THAN**" LOGIC (**LGT**) or "**LESS THAN**" LOGIC (**LLT**) command discussed in Section 2.F.4. You can then arrange for Bit No. 33's "going high" to increment by "1" the current data value of DOWNLOAD PSEUDOCHANNEL No. 2, by means of an **EXECUTE (EXU)** statement:

EXU 33 = INC 2 [CR] *

The **DECREMENT (DEC)** command is useful for indicating to the operator *how many parts remain to be tested*. Thus, a DOWNLOAD PSEUDOCHANNEL is initially loaded with the total number of tests to be run, and this value is made to decrease by "1" with the completion of every test.

You may set up an INCREMENTAL TIMER PSEUDOCHANNEL No. x by entering a **TYPE (TYP)** command of the form

TYP x = D2 [CR] *

The number reported by Channel No. x will increase by exactly "1" every time the system's clock-time reading increments by *one second* since the channel was last scanned. Since the time base for Channel No. x is the system time-of-day clock, its long-term accuracy is the same as the clock's; the short-term error in its update time can, however, be as large as the total time necessary to scan all channels (in large systems, this can be as much as 0.4 second).

Similarly, you may set up a DECREMENTAL TIMER PSEUDOCHANNEL No. x by commanding

TYP x = D3 [CR] *

The value reported by this channel will decrease by "1" each second.

In most cases, you will probably want to include any and all TIMER PSEUDOCHANNELS within your system's current SCAN RANGE.

To *set or reset* a TIMER PSEUDOCHANNEL of either type, you may use the "**CHN=**" command, as explained in Section 2.D, just as you would to load a fixed data value into a DOWNLOAD PSEUDOCHANNEL.

INCREMENTAL TIMER PSEUDOCHANNELS are useful for indicating *how long it took to run a test*; DECREMENTAL TIMER PSEUDOCHANNELS can be used to let the operator know *how much time (of a prespecified period) is left*.

2.M.3

USE OF TIMER COMMANDS FOR "A-SIZED" DATAPACS

Every "A-Sized" DataPAC with a Model 10ACP100 Central Processor of Software Version 11.1 or higher provides 24 independent TIMERS, each of which may be used to trigger a system LOGIC BIT at a precise "time of day" (according to the system time-of-day clock). The triggered bit can then be used to execute one or more desired functions via an **EXECUTE (EXU)** command (see Section 2.K).

To load a given TIMER with a specific time value, you will use the **TIMER (TMR)** command. To link a given LOGIC BIT to a given TIMER, you will use the **TIMER BIT (TBT)** command. Both commands are SETUP COMMANDS, and require that the EEPROM Switch be ON.

The general form of the **TIMER (TMR)** command is

TMR m = T [CR] *

where "m" is the number of the TIMER being set ($0 \leq m \leq 23$), and "T" is a six-digit number expressing any legal time-of-day reading (hour/minute/second) from "000000" (=midnight) to "235959" (=one second until midnight).

To disable a given TIMER ("m") *plus all TIMERS of a number greater than "m,"* you can enter a command of

TMR m = N/A [CR] *

The times to which the disabled TIMERS have last been set will remain in memory.

The general form of the **TIMER BIT (TBT)** command is

TBT m = r [CR] *

where, again "m" is the number of the TIMER in question ($0 \leq m \leq 23$), and "r" is the number of any system LOGIC BIT ($0 \leq r \leq 1000$). When the time-of-day clock registers the time value that has been set for TIMER "m," LOGIC BIT No. r will be set high (*Logic 1*) for a period of *one complete scan cycle*, after which it will return to the low (*Logic 0*) state.

Note that the trigger bit "r" **MUST BE "SOURCED" AS A LIMIT BIT** in order for it to be set by a TIMER (see Section 2.H).

To unlink Bit No. "r" from TIMER No. "m," you can enter a command of

TBT m = N/A [CR] *

Section 2.N

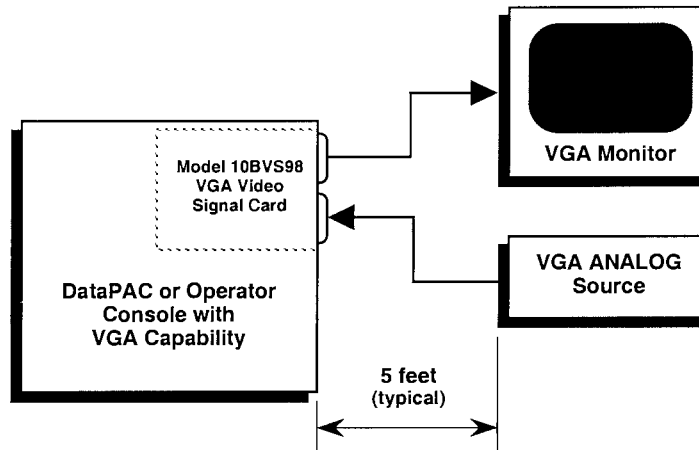
Video Inputs and Outputs



System 10 Guidebook

All System 10 mainframes with COLOR CRT video capability—that is, all “10KN3,” “10KN6,” and “10KN8A” mainframe versions—provide fully **VGA-compatible** video INPUT and OUTPUT (640 x 480 VGA format, with a horizontal refresh rate of 31.5 kHz). As shown in the figure below, this lets the mainframe transmit VGA output to any monitor capable of receiving it, and to receive VGA input from any external VGA source.*

Fig. 2.N.1 VGA I/O



As explained in the following section, you can toggle between the display of “internal” System 10 VIDEO PAGE FORMATS (see Section 2.C of this manual) and externally-sourced video screens by a simple keystroke or on application of the **VIDEO MODE (VID)** command.

Versions of the Model 10KN7 mainframe provide two separate video OUTPUTS, details of which are given in Section 2.N.3**:

- a two-wire **RS-170 Composite Video Signal** for delivery to an external MONOCHROME monitor (3.4 V peak-to-peak, negative sync)
- a standard nine-wire “**RGB**” **Output** for delivery to an external CGA/EGA COLOR monitor

* Note that a mainframe with COLOR CRT video capability will accept CGA/EGA/VGA input only from a VGA ANALOG CARD; it will not accept digital video signals from CGA/EGA cards. Special retrofit kits are available for users who wish to upgrade older mainframes to VGA. System 10 VIDEO PAGES composed with the older **Model 10BVS95 Video Signal Card** can be upgraded to VGA resolution simply by calling them to display when the **Model 10BVS98 VGA Video Signal Card** is present. Video pages composed on the **Model 10BVS90 Video Signal Card** may require some re-editing.

** If you wish a Model 10KN7 to receive an RS-170 or RGB video INPUT, the externally mounted **Model 10CVIOP Video I/O Processor** may be used; contact the Daytronic service department for availability and operating instructions.

2.N.2.

STANDARD VGA INPUT / OUTPUT (MODELS 10KN3, 10KN6, 10KN8A)

For the location of your mainframe's VGA INPUT AND OUTPUT CONNECTORS, see the respective "rear elements" diagram in Section 2 of the "On the Air" book for B-sized mainframes (in the front of this Guidebook).

The user must furnish his or her own VGA cable connections to and from the System 10 mainframe (VGA cables may be ordered directly from the Daytronic factory). The nondetachable cable on most commercial VGA monitors is typically 5 feet in length. However, with proper VGA "extension" provisions—including cable characteristics, buffering, and termination—significantly longer cable lengths can be supported. VGA I/O pin assignments are as follows:

Pin No.	Function
1	VIDEO RED
2	VIDEO GREEN
3	VIDEO BLUE
6,7,8,10	GROUND
13	HORIZONTAL SYNC
14	VERTICAL SYNC

NOTE: The two video settings described in Section 2.C.1(a) are important. The "BVS" value for a 10KN3, 10KN6, or 10KN8A should always be "95." That is, the

BVS = 95 [CR]*

command should always be in effect. Unless otherwise dictated by the frequency characteristics of your VGA monitor, it is recommended that you enter a **VIDEO DISPLAY UNIT (VDU)** setting of

VDU = C, 60 [CR]*

(i.e., "Color," "60 Hz").

ALSO NOTE: The Model 10BVS98 VGA Video Signal Card is preset at the factory for "normal" VGA mode with *inverted vertical and inverted horizontal sync*. If you need to change either or both sync signals to *noninverted* form, you should

1. Turn OFF the mainframe's EEPROM Switch, turn OFF the mainframe power, and remove the 10BVS98 card from the mainframe (see Section 1.B for "Card Insertion and Removal").
2. Locate the two sets of SYNC MODE JUMPER PINS on the 10BVS98 board (see Fig. 2.N.2, below): the upper set (J101) is for VERTICAL SYNC; the lower set (J100), for HORIZONTAL SYNC. One "minijumper" is provided for each pin set, for interconnecting any two horizontally adjacent jumper pins. The factory setting (both signals inverted) is shown in the figure.
3. To change either sync signal to noninverted form, reposition the corresponding jumper to interconnect the first (rightmost) and middle pins.
4. Reinstall the 10BVS98 card and reactivate the mainframe.

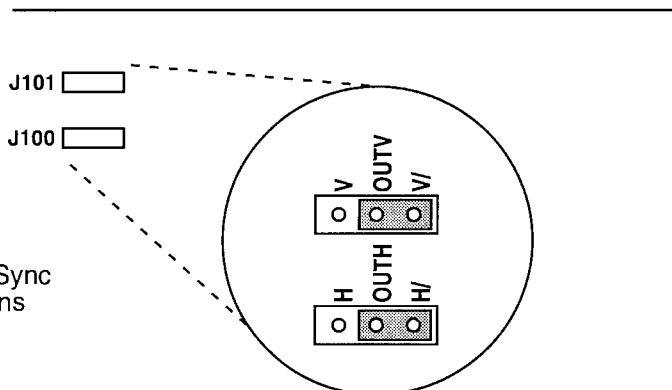


Fig. 2.N.2 VGA Sync Mode Jumper Pins

In order to *display* a received VGA video input, the mainframe must first be placed in the **EXTERNAL VIDEO MODE** by a command of

VID = EXT [CR]

To return the mainframe to a display of the system's **INTERNAL** video pages—with “live” data, messages, etc.—simply command

VID = INT [CR]

The EEPROM Switch need not be on for the **VIDEO MODE (VID)** command to be effective. At powerup, the **INTERNAL VIDEO MODE** is in effect, by default.

You can use the keyboard's **Ctrl (CONTROL)** and **System Config (SYSTEM CONFIGURATION)** keys in place of the **VID** command, to toggle back and forth between **INTERNAL** and **EXTERNAL** displays. Simply press the **Ctrl** key and hold it down while you press the **System Config** key. The **System Config** key has a red indicator light to tell you that the CRT is in the **EXTERNAL** mode.

2.N.3.

MODEL 10KN7 VIDEO OUTPUTS

For the location of the 10KN7's RS-170 and "RGB" VIDEO OUTPUT CONNECTORS, see Fig. 2.1.c in Section 2 of the "On the Air" book for B-sized mainframes (in the front of this Guidebook).

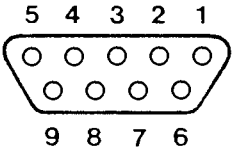
a. MONOCHROME (RS-170)

Using an RCA phono-type jack on the rear of the 10KN7 mainframe, this two-wire connection between the mainframe and an external monochrome monitor should be a low-loss, 75-ohm coaxial cable, suitable for video-signal frequencies. Maximum cable length is approximately 100 feet.

b. RGB COLOR (CGA)

Pin assignments for the 10KN7's rear-panel "RGB" OUTPUT CONNECTOR are as follows (NOTE THAT THIS IS THE "DAYTRONIC STANDARD RGB PINOUT," WHICH DIFFERS FROM THE CGA-MODE "IBM STANDARD"; FOR THIS REASON, *THE 10KN7'S RGB OUTPUT SHOULD NEVER BE WIRED PIN-TO-PIN TO A DEVICE THAT USES "IBM STANDARD RGB PINOUT"*):

Pin No.	Function	
1	Horizontal Sync (TTL level negative true*)	
2	Video Common	
3	BLUE (TTL level positive true)	
4	GREEN (TTL level positive true)	
5	RED (TTL level positive true)	
6	Vertical Sync (TTL level negative true*)	
7	Power Common	
8	+12 V-DC	
9	Composite Video Output (2 V peak-to-peak, positive white; negative sync)	



*NOTE: Polarity of either or both "Sync" lines can be inverted on request.

You should use a *low-loss shielded cable* for each of the color drive signals, and *shielded cable* for each of the two "Sync" lines. Cable can be coaxial or twisted-pair. Maximum cable length is approximately 100 feet. Special "DAYTRONIC TO IBM" cables are available for CGA connections.

----- CAUTION -----

MAKE SURE THAT "RGB" OUTPUT PIN 8 (± 12 V-DC) CONNECTS TO THE CORRESPONDING MONITOR INPUT PIN, WHICH MAY OR MAY NOT BE THE MONITOR'S "PIN NO. 8." SEVERE INSTRUMENT DAMAGE COULD RESULT FROM THE CONNECTION OF "RGB" OUTPUT PIN 8 TO SOME OTHER MONITOR PIN.

IN ANY CASE, NEVER CONNECT A VIDEO MONITOR TO THE 10KN7 WHILE THE MONITOR IS ON.

Section 2.0

Optional Operator Console: Model 10CCONB



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The Model 10CCONB Operator Console is only for use within Daytronic “SATELLITE” NETWORKS. Within a Model 10BD4-based network this unit

- a. provides remote color CRT display of data acquired by one or more mainframe “nodes” within the network—or of an external color VGA video input received by the “console” itself—on standard CRT VIDEO PAGES that are locally formattable and either locally or remotely selectable
- b. permits a local operator to issue “GLOBAL” COMMANDS to any other member of the network.

The connections to be made between a 10CCONB and the satellite network’s HOST DataPAC are discussed in Section 3.B.3 of this Guidebook (“Satellite Network Systems”). The same section also treats the use of an Operator Console to issue “GLOBAL” COMMANDS.

The 10CCONB offers the same *video functions* as a Model 10KN8A mainframe. These include

- composition, storage, and selection of up to 100 VIDEO PAGE FORMATS, through a plug-in **Model 10P80A Extended Keyboard** (supplied with the 10CCONB), as described in Section 2.C
- standard VGA video input and output, as described in Section 2.N
- optional formattable printer output via the **Model 10VFO132 Formatted Output Card**, as described in Section 3.C.3
- optional video bargraph display and video memory extension via the **Model 10VGM500 Video Graphics Memory Card**, as described in Section 3.C.4

An Operator Console differs from a B-sized mainframe satellite, however, in several important ways:

- IT HAS NO “LOCAL DATA” CAPABILITY; it cannot acquire, process, and transmit “real-world” analog and logic data.
- IT WILL THEREFORE RESPOND ONLY TO MNEMONIC COMMANDS RELATING TO SYSTEM 10 VIDEO FUNCTIONS, BOTH STANDARD AND OPTIONAL (e.g., **VIDEO MODE (VID)**, **LOGO (LGO)**, **PAGE (PAG)**, **SAVE (SAV)**, **“GREATER THAN” STATUS (VGT)**, etc.) AND WITH SETUP AND OPERATION OF THE CONSOLE AS A “SATELLITE” UNIT (e.g., **ASSIGN SATELLITE NUMBER (ASN)**, **OPEN (OPN)**, **NODE (NOD)**, etc.).
- When set to “INTERNAL VIDEO MODE,” it will display data received from the satellite network through its “CONSOLE INTERFACE PORT.” Analogous to a DataPAC’s COMPUTER INTERFACE PORT, the CONSOLE INTERFACE PORT includes an external “video” RS-485 converter connector, and is preconfigured to recognize the interface protocols required for network data and command interchanges (see Section 3.B.3).

Section 2.P

Backup Provisions



System 10 Guidebook

The DataPAC stores important system CONFIGURATION AND CALIBRATION DATA in its nonvolatile EEPROM memory. The commands presented in this section let you *offload such data to permanent external storage* on disk, tape, etc., and to subsequently *download it back into the DataPAC's EEPROM* in order to restore a previous setup configuration immediately, IN THE EVENT THAT EEPROM MEMORY IS LOST OR ALTERED AS A RESULT OF ACCIDENT, BOARD REPLACEMENT, OR DELIBRATE SYSTEM RECONFIGURATION.

In general, you may issue to the DataPAC (via its COMPUTER INTERFACE PORT) the "READ" form of *any* standard SETUP COMMAND that involves the entry of configuration/calibration value(s) into EEPROM memory—such as **TYPE (TYP)**, **LOCATE (LCT)**, **TERMINATOR (TER)**, **FILTER (FIL)**, **ZERO (ZRO)**, **FORCE (FRC)**, **HIGH LIMIT (HIL)**, **LOW LIMIT (LOL)**, **CALCULATE (CLC)**, **LOGIC SOURCE (SRC)**, **EXECUTE (EXU)**, and so on—in order to output from the COMPUTER INTERFACE PORT the respective configuration/calibration data currently in EEPROM memory. This output may be offloaded to disk file, or to some other form of permanent external storage.

The corresponding "WRITE" form of the SETUP COMMAND in turn allows you to *reload* the configuration/calibration data in question at any later time. This you may do via either the COMPUTER INTERFACE PORT or the EXTENDED KEYBOARD (if present).

----- NOTE -----

Several Daytronic **SofPAC** programs exist for "backing up" and "cloning" (i.e., duplicating) a DataPAC's setup configuration, including VIDEO PAGE FORMATS.

2.P.2.

BACKUP STORAGE OF CHANNEL SETUP CONFIGURATION: CON COMMAND

The **CONFIGURE (CON)** command has a general "READ" form of

CON x [CR]

Application of this command via the COMPUTER INTERFACE PORT will cause the DataPAC to issue from that port a special ASCII STRING ("\$\$") of up to 100 characters. THIS ASCII STRING ENCODES IN MACHINE LANGUAGE ALL NECESSARY INFORMATION PERTINENT TO THE SETUP OF THE SPECIFIED DATA CHANNEL NO. x, including the respective TYPE and LOCATION codes, digital filter setting, ZERO OFFSET and SCALING FACTOR, high- and low- limit values, LIMIT-LOGIC assignments, and any other "special treatment" factors relating to the channel. It may be offloaded to disk file, or to some other form of permanent external storage.

A typical response output to a command of **CON x [CR]** might look like this:

3060,32,0,25,2037,117,-3000,3000,637,637,637 [CR][LF]

Here encoded are current settings for Channel No. x for SCALING FACTOR, ZERO OFFSET, decimal-point location, TYPE, LOCATION, FILTER, LOW LIMIT, HIGH LIMIT, "GREATER THAN" LOGIC, "BETWEEN" LOGIC, and "LESS THAN" LOGIC, in that order. Note that since the ASCII string "\$" is a representation of DataPAC setup parameters *in machine language*, corresponding "human" values for these parameters will not necessarily appear in the string.

Note also that the "READ" form of the **CONFIGURE (CON)** command will have no effect if entered via the KEYBOARD.

The "WRITE" form of the **CONFIGURE (CON)** command is

CON x = \$ [CR] *

and lets you *reload* a previously offloaded configuration string "\$." THE EFFECT OF THIS COMMAND IS THEREFORE TO RESTORE THE CHANNEL CONFIGURATION ENCODED BY THE ASCII STRING "\$." NO FURTHER CONFIGURATION/CALIBRATION OF CHANNEL NO. x IS REQUIRED.

As explained in Section 2.G.1, the **SCALING FACTOR (EMM)** and **ZERO OFFSET (BEE)** commands let you set a DATA CHANNEL's effective SCALING FACTOR and ZERO OFFSET ("m" and "b," respectively, of the linear relation "y = mx + b"—see also Section 1.G.1, "Introduction" to "Calibration of Data Channels").

In their "READ" forms—

EMM x [CR] and **BEE x [CR]**

—these commands also allow backup offloading of a channel's *calibration data*. Thus, entering either of the above commands via the DataPAC's COMPUTER INTERFACE PORT will cause the DataPAC to output from that port the corresponding calibration constant for Channel No. x presently in EEPROM memory. This value may be offloaded to disk file, or to some other form of permanent external storage.

Stored calibration constants can be subsequently *reloaded* from backup memory via the "WRITE" forms of the **EMM** and **BEE** commands:

EMM x = m [CR] * and **BEE x = b [CR] ***

(see Section 2.G.1). THE EFFECT OF THESE COMMANDS IS TO RESTORE A PREVIOUS CALIBRATION CONFIGURATION FOR THE SPECIFIED CHANNEL OR TO QUICKLY CHANGE TO A NEW ONE—WITHOUT HAVING TO ACTUALLY RECALIBRATE.

2.P.4.

BACKUP STORAGE OF VIDEO PAGE FORMATS: VUL, VDL, and LNE COMMANDS

See Section 2.C.11 for the use of the **VIDEO UPLOAD (VUL)**, **VIDEO DOWNLOAD (VDL)**, and **LINE (LNE)** commands.

Section 2.Q

LCD Graphics (DataPAC "G" Option)

PLEASE NOTE

This manual section applies only to older LCD-display mainframes and accessories (Models **10K2C**, **10K4T-D**, **10LCD12A**, and **10LCD12-2**) equipped with the **"G" OPTION**.



System 10 Guidebook

----- NOTE -----

This Guidebook section treats setup of the special "XY" and "STRIP-CHART" LCD VIDEO PAGES provided by "A-SIZED" DataPACs with the "G" OPTION. For "normal" (i.e., DATA-CHANNEL) LCD PAGES, see Section 1.D.1 of this Guidebook. For modification of the LCD BILLBOARD "LOGO" via the **LOGO (LGO)** command, see Section 2.C.4(a).

You may at any time call a given LCD VIDEO PAGE No. p to display by means of the **PAGE (PAG)** command or the keyboard's **Page** key, as explained in Section 1.D.1(c).

a. SELECTING PAGE TYPE: **PGT** COMMAND

All of the DataPAC's 40 LCD VIDEO PAGES are initially set to display twelve DATA-CHANNEL readings (i.e., they are of the "DATA" page type). To specify that a given LCD Page No. p is to be dedicated to *X versus Y* plotting of data values, you must enter a **PAGE TYPE (PGT)** command of

PGT p = XY [CR] *

where $1 \leq p \leq 40$.

Similarly, to specify that a given LCD Page No. p is to be dedicated to 3-pen *strip-chart* plotting of data values, you must enter a command of

PGT p = STRIP [CR] *

To reconvert an "XY" or "STRIP-CHART" LCD VIDEO PAGE No. p to the normal "DATA" format discussed in Section 1.D.1, enter a command of

PGT p = DATA [CR] *

Note, however, that when a page is *reset* to "DATA" type, its LIST will be reset to initial ("cold-boot") values (i.e., Channel Nos. 1 through 12 for Page No. 1; Channel Nos. 13 through 24 for Page No. 2; etc.).

b. SETUP OF AN "XY" PAGE

1. DEFINING PAGE LIST : **PGL** COMMAND

To specify the two DATA CHANNELS on which the plot displayed by "XY" LCD VIDEO PAGE No. p is to be based, enter a **PAGE LIST (PGL)** command of

PGL p = x, y [CR] *

where Channel No. x is to take the *horizontal* axis of the display, and Channel No. y the *vertical* axis. Channel Nos. x and y may be any system DATA CHANNELS with the exception of Nos. 998 (TIME) and 999 (DATE); these may not be displayed on an "XY" page. Assigning a page "type" of "XY" to Page No. p via the **PAGE TYPE (PGT)** command (see above) should *precede* application of the **PGL** command to that page.

2. SETTING GRAPH SCALES: **GRX** AND **GRY** COMMANDS

You should now set the full-scale display range for the "x" channel of "XY" LCD VIDEO PAGE No. p, by entering a **GRAPH RANGE X (GRX)** command of

GRX p = l, h [CR] *

where "l" is the low (minimum) value of the range and "h" is the high (maximum) value; $-32768 \leq l < h \leq 32768$. This range determines the actual scaling of Page No. p's x-axis.

Similarly, to set the full-scale display range for the "y" channel—thereby scaling Page No. p's y-axis—enter a **GRAPH RANGE Y (GRY)** command of

GRY p = l, h [CR] *

where, again $-32768 \leq l < h \leq 32768$.

The *precision* (i.e., decimal-point location) of the "l" and "h" values entered in any one **GRX** or **GRY** command *must be the same*. Also, if the precision of these values does not match that of the corresponding DATA CHANNEL (No. x or No. y), it will be automatically changed so that it does.

The current low-value and high-value entries for each graph axis will be displayed on the "XY" page.

3. SETTING GRAPH LEGENDS: **LEG** COMMAND

Each axis of "XY" LCD VIDEO PAGE No. p will be labelled with the engineering-unit legend (up to four alphanumeric characters) that has been entered for the corresponding DATA CHANNEL (No. x or No. y) via the **LEGEND (LEG)** command. For application of this command, see Section 1.D.1(b) of this Guidebook. Note that all DATA CHANNELS are preset at the factory for an initial legend display of **MVV**. ALSO NOTE THAT FOLLOWING AN **LEG** COMMAND, THE DISPLAYED LEGEND WILL NOT CHANGE UNTIL THE PAGE IS AGAIN "CALLED" OR ITS GRAPH SCALE REDEFINED. THUS, ENTERING A COMMAND OF **PAG = p [CR]**—where "p" is the number of the currently displayed page—WILL UPDATE THE CHANGED LEGEND.

c. SETUP OF A "STRIP-CHART" PAGE

1. DEFINING RECORDER LIST : **LST** COMMAND

----- NOTE -----

BEFORE SETTING UP ANY INDIVIDUAL "STRIP-CHART" LCD VIDEO PAGES, YOU SHOULD FIRST ENTER THE "LIST" OF ALL DATA CHANNELS TO BE RECORDED BY THE DATAPAC'S LCD STRIP-CHART RECORDER. THIS "LIST" SHOULD INCLUDE ALL CHANNELS TO APPEAR ON ALL "STRIP-CHART" PAGES. Recording of data may take place at regular time intervals or on every DataPAC scan cycle (see the **INTERVAL (INT)** command, Section 2.Q.1(c.5), below).

To instruct the STRIP-CHART RECORDER to automatically record one or more system DATA CHANNELS, you will use a form of the **LIST (LST)** command:

LST = x₁, x₂, ... , x_n [CR] *

where each "x" term in the sequence is either a single channel number or a range of channel numbers expressed in the form "x TO y" (where y > x). Note that

- A RECORDER'S "LIST," AS DEFINED BY THE ABOVE **LST** COMMAND, CAN TAKE UP TO 78 CHARACTERS, INCLUDING COMMAS.
- THE SEQUENCE OF DATA CHANNELS AND/OR CHANNEL RANGES (x₁, x₂, etc.) MUST BE ENTERED *IN ASCENDING ORDER* (see the example below).
- Channel Nos. 998 (TIME) and 999 (DATE) may not be entered in the **LST** expression.
- The above **LST** command should be entered *before* any **PAGE LIST (PGL)** commands that refer to individual "STRIP-CHART" pages (see below).
- A STRIP-CHART RECORDER'S "LIST" WILL DETERMINE ITS MAXIMUM "DEPTH"—I.E., THE MAXIMUM NUMBER OF RECORDINGS IT CAN HOLD. This DEPTH cannot otherwise be "set" (unlike the DEPTH of a History Card recorder). For DEPTH interrogation via the **DEPTH (DPT)** command, see Section 2.Q.2(e), below.

If, for example, you wanted to plot Channel Nos. 1, 3, 7, 16, 17, 18, 19, 20, 21, 28, and 30 versus time on various "STRIP-CHART" pages, you would first enter a command of

LST = 1, 3, 7, 16 TO 21, 28, 30 [CR] *

and then proceed to set up your actual "STRIP-CHART" pages, selecting one, two, or three channels from this "LIST" for each page, as explained in the following section.

2. DEFINING PAGE LIST: PGL COMMAND

To specify the *one, two, or three* DATA CHANNELS to be plotted versus time on "STRIP-CHART" LCD VIDEO PAGE No. p, enter an appropriate **PAGE LIST (PGL)** command. Thus, to plot Channel No. x *only*, command

PGL p = x, x, x [CR] *

To plot Channel Nos. x and y *only*, command

PGL p = x, y, y [CR] *

Finally, to plot all three channels (Nos. x, y, and z), command

PGL p = x, y, z [CR] *

Channels x, y, and z must all be included in the "LIST" expression for the DataPAC's STRIP-CHART RECORDER (see above). Assigning a page "type" of "STRIP" to Page No. p via the **PAGE TYPE (PGT)** command (Section a, above) should *precede* application of the **PGL** command to that page.

3. SETTING GRAPH SCALES: GRX, GRY, AND GRZ COMMANDS

You should now set the full-scale display range for each of the three (or fewer) channels to be plotted on "STRIP-CHART" LCD VIDEO PAGE No. p. To set the range for Channel No. x, enter

a **GRAPH RANGE X (GRX)** command of

GRX p = l, h [CR] *

This range determines the actual scaling of the *vertical* axis representing Channel No. x.

Similarly, to set ranges for Channel Nos. y and z—thereby scaling the respective vertical axes—enter a **GRAPH RANGE Y (GRY)** and **GRAPH RANGE Z (GRZ)** command, respectively:

GRY p = l, h [CR] * and **GRZ p = l, h [CR] ***

In each case, "l" is the low (minimum) value of the range in question and "h" is the high (maximum) value; $-32768 \leq l < h \leq 32768$. The *precision* (i.e., decimal-point location) of the "l" and "h" values entered in any one **GRX**, **GRY**, or **GRZ** command *must be the same*.* Also, if the precision of these values does not match that of the corresponding DATA CHANNEL (No. x, y, or z), it will be automatically changed so that it does.

NOTE THAT ONLY THE (VERTICAL) SCALE FOR CHANNEL NO. x WILL BE DISPLAYED ON A "STRIP-CHART" PAGE.

4. **SETTING CHANNEL x LEGEND: LEG COMMAND**

ONLY THE LEGEND OF CHANNEL NO. x WILL BE DISPLAYED ON A "STRIP-CHART" PAGE.

The **LEGEND (LEG)** command may be used to enter the desired engineering-unit legend (up to four alphanumeric characters) for this channel. For application of the **LEG** command, see Section 1.D.1(b) of this Guidebook. Note that all DATA CHANNELS are preset at the factory for an initial legend of **MVV**. ALSO NOTE THAT FOLLOWING AN **LEG** COMMAND, THE DISPLAYED LEGEND WILL NOT CHANGE UNTIL THE PAGE IS AGAIN "CALLED" OR ITS GRAPH SCALE REDEFINED. THUS, ENTERING A COMMAND OF **PAG = p [CR]**—where "p" is the number of the currently displayed page—WILL UPDATE THE CHANGED LEGEND.

5. **SETTING RECORDING INTERVAL: INT COMMAND**

You will use the **INTERVAL (INT)** command to specify the time interval at which the DataPAC's STRIP-CHART RECORDER is to make successive recordings of all DATA CHANNELS in its current "LIST." The selected INTERVAL VALUE will in turn determine the effective "time length" for every "STRIP-CHART" display, as given in the table below.

NOTE: THE HORIZONTAL TIME SCALE APPEARING ON THE BOTTOM OF THE STRIP-CHART DISPLAY DOES NOT REFLECT THE RECORDING INTERVAL AND "TIME LENGTH" CURRENTLY IN EFFECT. IN MOST APPLICATIONS, THIS DISPLAYED TIME SCALE SHOULD BE IGNORED.

Thus, to set the plotting interval and "time length" for all "STRIP-CHART" pages, command

INT = t [CR] *

where "t" is an integer from 1 through 16, or the letter "S" (see the table below).

Note that when an interval of "S" is selected, the STRIP-CHART RECORDER will record current data values for all its "listed" channels *with each DataPAC scan cycle*. In this case, the "time

* NOTE ALSO: The three commands must be entered in this order: **GRX**, **GRY**, **GRZ**.

2.Q.1

SETUP OF LCD GRAPHICS

length" of each "STRIP-CHART" LCD VIDEO PAGE will be 200 "FRAMES" of data (i.e., 200 plotted sets of data for the page's three (or fewer) channels).

The letter appearing in the lower left-hand corner of every "STRIP-CHART" page indicates the unit in which the *displayed* time scale is expressed: "S" for seconds, "M" for minutes, and "H" for hours. AGAIN, YOU SHOULD IN GENERAL IGNORE THIS TIME SCALE, SINCE IT DOES NOT REFLECT THE ACTUAL RECORDING INTERVAL OR EFFECTIVE "TIME LENGTH" OF THE DISPLAY.

Table 2.Q.1

"Strip-Chart" Recording Intervals and "Time Lengths"

Interval No. ("I")	Interval Value	"Time Length"
1	10 milliseconds	2 seconds
2	20 milliseconds	4 seconds
3	50 milliseconds	10 seconds
4	100 milliseconds	20 seconds
5	200 milliseconds	40 seconds
6	500 milliseconds	100 seconds
7	1 second	3.3 minutes
8	2 seconds	6.6 minutes
9	5 seconds	16.6 minutes
10	10 seconds	33.3 minutes
11	20 seconds	66.6 minutes
12	1 minute	3.3 hours
13	2 minutes	6.6 hours
14	5 minutes	16.6 hours
15	10 minutes	33.3 hours
16	20 minutes	66.6 hours
S	(SCAN)	(200 FRAMES)

6. SETTING "STRIP-CHART" DISPLAY/RECORDER MODE: **GZL** AND **GZR** COMMANDS

At any time during normal operation, you can specify either a *scrolling* or *nonscrolling* chart for ALL of your DataPAC's "STRIP-CHART" LCD VIDEO PAGES.

a. "ZERO LEFT" MODE

To cause the chart *to scroll to the left with each new data recording*, you should enter a **GRAPH ZERO LEFT (GZL)** command of

GZL [CR]

This is a "RUN-TIME" COMMAND, and does not require that the DataPAC's EEPROM Switch be on. The "ZERO LEFT" MODE is always in effect, by default, on DataPAC powerup.

Concerning "ZERO LEFT" MODE, you should also note that

1. In this mode, the STRIP-CHART RECORDER will *stop* when it reaches the end of its memory (i.e., its maximum DEPTH, as determined by the last-entered **LIST (LST)**)

command—see above). AFTER IT HAS STOPPED, THE RECORDER CAN ONLY BE RESTARTED BY APPLICATION OF A **RECORDER CLEAR (REC)** COMMAND FOLLOWED BY A **RECORDER START (RES)** COMMAND, OR BY RECYCLING POWER.

2. In this mode (only), the entire display may be further scrolled either backwards or forwards in time by means of the keyboard's **ARROW KEYS**—but only when plotting has been halted by a **RECORDER HALT (REH)** command or by the RECORDER'S reaching its maximum DEPTH (see Section 2.Q.2(f) for details).

b. "ZERO RIGHT" MODE

To produce a *nonscrolling chart* on every "STRIP-CHART" page, you should enter a **GRAPH ZERO RIGHT (GZR)** command or

GZR [CR]

Like **GZL**, this is a "RUN-TIME" COMMAND, and does not require that the DataPAC's EEPROM Switch be on.

Concerning "ZERO RIGHT" MODE, you should also note that

1. When this mode is in effect, the right-hand extreme of the chart is always "time 0" (i.e., "now").
2. In this mode, the STRIP-CHART RECORDER *will not stop* when it reaches the end of its memory (i.e., its maximum DEPTH). INSTEAD, IT WILL CONTINUE TO RECORD, OVERWRITING THE OLDEST RECORDING IN MEMORY WITH EACH NEW RECORDING, UNTIL IT IS COMMANDED TO HALT.
3. When this mode is in effect, manual scrolling of the display by means of the ARROW KEYS is *not* possible.
4. The STRIP-CHART RECORDER will always revert to "ZERO LEFT" MODE on DataPAC powerup, by default (see the **GZL** command, above).

a. CLEARING A DISPLAYED "XY" GRAPH: **GCL** COMMAND

To clear the "XY" plot currently on display, enter a **GRAPH CLEAR (GCL)** command of

GCL [CR]

Following this command, "XY" plotting will restart immediately from current x, y values.

b. RAISING AND LOWERING GRAPH "PENS": **PEN** COMMAND

1. CONTROL OF "XY" PEN

If an "XY" LCD VIDEO PAGE is currently on display, a command of

PEN = UP [CR]

will "raise" the display "pen." That is, it will *discontinue* the plotting of x versus y data points.

A subsequent command of

PEN = DOWN [CR]

will "lower" the display pen (resuming the plotting of "XY" points from current values). This command is in effect, by default, on powerup.

An interrogation of

PEN [CR]

will read the "pen" status of the "XY" page currently on display, answering either **UP** or **DOWN**.

2. CONTROL OF "STRIP-CHART" PENS

If a "STRIP-CHART" LCD VIDEO PAGE is currently on display, a command of

PEN = UP [CR]

will "raise" all three display "pens." That is, it will *discontinue* the time-plotting of data for all three channels (Nos. x, y, and z).

A subsequent command of

PEN = DOWN [CR]

will "lower" all three display pens (resuming the plotting of data for all three channels from current values). This command is in effect, by default, on powerup.

An interrogation of

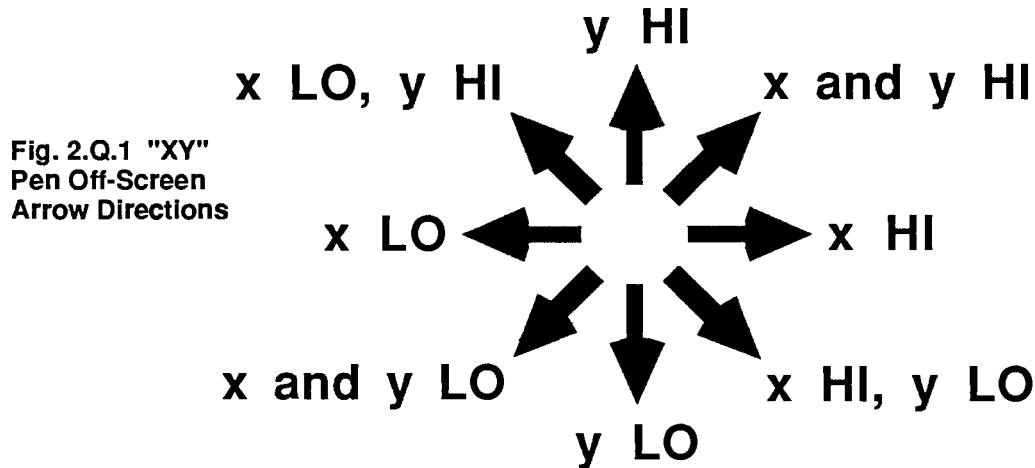
PEN [CR]

will read the "pen" status for the "STRIP-CHART" page currently on display, answering either **UP** or **DOWN**.

c. "PEN OFF-SCREEN" INDICATION

On every "XY" LCD VIDEO PAGE, a "pen off-screen" locator arrow will appear in the lower left corner of the display whenever the current value for either DATA CHANNEL (No. x or y) lies *outside the full-scale range* specified for display of that channel by the **GRAPH RANGE X (GRX)** or **GRAPH RANGE Y (GRY)** command, respectively (Section 2.Q.1(b.2), above)—or whenever *both* channels are "out-of-range" at the same time.

As shown in Fig. 2.Q.1, the direction of the arrow indicates whether one or both channels are presently off-scale, and also the nature of the respective off-scale condition(s) (i.e., HIGH or LOW).



On a "STRIP-CHART" LCD VIDEO PAGE, an "out-of-range" condition for any of the three plotted channels will be indicated by a flattening of that channel's plot at the respective range extreme (top of graph for HIGH, bottom of graph for LOW).

d. "STRIP-CHART" RECORDER CONTROL

1. CLEARING THE RECORDER : REC COMMAND

A **RECORDER CLEAR (REC)** command of

REC [CR]

will clear the DataPAC's STRIP-CHART RECORDER'S memory, thus bringing its "current DEPTH" (number of recorded data sets currently in memory) to *zero*. The next recording made following application of an **REC** command will have a DEPTH of "1," being the first recording to be entered in the recorder's "cleared" memory.

NOTE: RECYCLING OF DATAPAC POWER WILL ALSO CLEAR RECORDER MEMORY.

If your "STRIP-CHART" pages are in "ZERO LEFT" MODE (see Section 2.Q.1(6.a), above), commanding **REC [CR]** will have the effect of resetting the leftward-scrolling chart to "zero" (i.e., "now").

AS MENTIONED EARLIER, A RECORDER IN "ZERO LEFT" MODE WHICH HAS STOPPED BECAUSE IT HAS REACHED THE END OF ITS MEMORY CAN ONLY BE RESTARTED BY

APPLICATION OF A **RECORDER CLEAR (REC)** COMMAND FOLLOWED BY A **RECORDER START (RES)** COMMAND, OR BY RECYCLING POWER.

2. HALTING THE RECORDER: **REH** COMMAND

A **RECORDER HALT (REH)** command of

REH [CR]

will halt the DataPAC's STRIP-CHART RECORDER, preventing it from making further recordings, until application of a **RECORDER START (RES)** command, or until DataPAC power is recycled.

The **REH** command may be used to temporarily *freeze* the displayed plot for all "STRIP-CHART" pages.

3. RESTARTING THE RECORDER: **RES** COMMAND

A **RECORDER START (RES)** command of

RES [CR]

will restart a STRIP-CHART RECORDER that has been halted by a **RECORDER HALT (REH)** command, *from the point where it was halted*. Unlike the **RECORDER CLEAR (REC)** command, it does not clear the recorder memory or reset the chart to "time 0" (if in "ZERO LEFT" MODE).

e. "STRIP-CHART" DEPTH INTERROGATION: **DPT** COMMAND

The following "READ" form of the **DEPTH (DPT)** command may be used to learn both the *maximum* and the *current* DEPTH of the DataPAC's STRIP-CHART RECORDER:

DPT [CR]

This interrogation will return an answer of **m, c**. Here, "m" is the maximum DEPTH (total FRAME capacity) of the recorder, as determined by the recorder's "LIST" (Section 2.Q.1(c.1)), and "c" is the current DEPTH (number of FRAMES of recorded data presently in memory).

NOTE: TO *UPDATE* THE DISPLAYED ANSWER TO A KEYBOARD-ENTERED COMMAND OF **DPT [CR]**, PRESS THE **Step** KEY.

When the "current DEPTH" (c) becomes equal to the "maximum DEPTH" (m), an answer of **m, m** will be returned. (If the recorder is presently in "ZERO LEFT" MODE, it will now *stop* recording, and can only be restarted by application of a **RECORDER CLEAR (REC)** command followed by a **RECORDER START (RES)** command, or by recycling power; if it is in "ZERO RIGHT" MODE, it will now overwrite the oldest recording in memory with each new recording.)

f. MANUAL SCROLLING OF "STRIP-CHART" PAGES IN "ZERO LEFT" MODE: "ARROW" AND "HOME" KEYS

When 1) your "STRIP-CHART" pages are in "ZERO LEFT" MODE and 2) the STRIP-CHART RECORDER has been halted by a **RECORDER HALT (REH)** command or by the recorder's having reached its maximum DEPTH, then you can cause the chart currently on display to scroll either

backwards or forwards in time. Taking place in successive intervals of one full "time length," this scrolling of the display lets you rapidly review the "data history" of the channels assigned to the page in question.

Thus, to scroll a halted "STRIP-CHART" page backwards in time by one full "time length," press the **LEFT ARROW** (←) key. To scroll the page forward in time by one full "time length," press the **RIGHT ARROW** (→) key. Obviously, you cannot scroll the display farther back than the oldest recording currently in memory or farther forward than the last recording to have been made.

To return a manually scrolled display to the "present" time (i.e., the plot that was on display when the recorder was halted), press the **Home** key.

Section 2.R

Front-Panel Keypad Operations



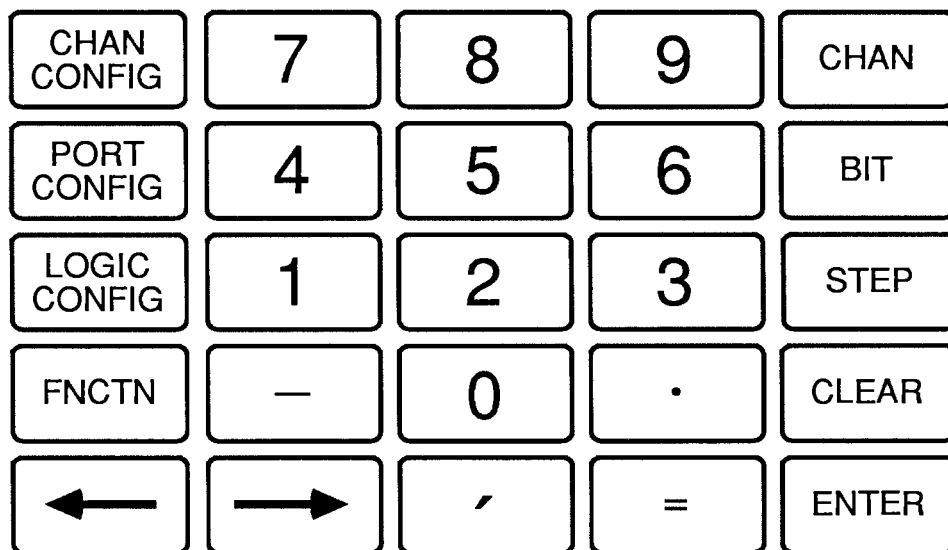
System 10 Guidebook

2.R.1

This Guidebook section explains the use of the *front-panel keypad and two-line LCD display* for those DataPACs so equipped (Models 10KU-KD, 10K1-KD, 10K4T-KD, etc.). The keypad greatly simplifies DataPAC setup by letting the operator review in rapid sequence all pertinent "configuration parameters" for any selected DATA CHANNEL or LOGIC BIT, for the DataPAC itself, and for the DataPAC's COMPUTER INTERFACE PORT. Any displayed channel or bit parameter—with the exception of channel "TYPE"—may in turn be "stepped" through an entire range of channels or bits. Parameters involving purely *numerical* values (decimal or hexadecimal) may be immediately reset via the keypad, as prompted by a cursor in the display. Parameters which involve algebraic or literal expressions (such as **CLC**, **EXU**, **SRC**, **ITR** etc.) may be modified by means of an optional Model 10P80A Extended Keyboard (the keyboard plugs in the rear of the mainframe).

When not in use for any of the various keypad-controlled configuration procedures, the two-line LCD display shows the DataPAC's pre-entered LOGO in the top ("BILLBOARD") line, and in the bottom line it shows the "live" reading of the last channel or bit to have been "called" to display. When not in a configuration mode, it will also display any and all keystrokes entered through a connected 10P80A Extended Keyboard, and the appropriate response or prompting message to any standard "READ" COMMAND so entered. For modification of the DataPAC LOGO, see Section 2.C.4(a) of this Guidebook. On DataPAC powerup, the display will always show the "live" reading of Channel No. 1.

Fig. 2.R.1 DataPAC Front-Panel Keypad



----- WARNING -----

**DO NOT USE SHARP OR POINTED OBJECTS TO DEPRESS
THE FRONT-PANEL KEYS.**

"CLEAR," "ENTER," "ARROWS," & "FUNCTION" KEYS **2.R.2**

a. THE "CLEAR" AND "ENTER" KEYS

The **CLEAR** key must be pressed in order to exit a given "configuration" mode ("CHANNEL," "LOGIC," or "PORT"). In this case, the display *must* be "cleared" before the DataPAC

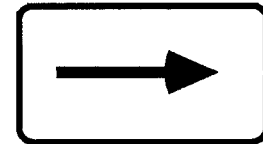
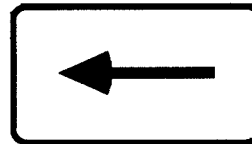
can receive subsequent command entries from the Extended Keyboard. Regardless of the "configuration" mode currently in effect, pressing the **CLEAR** key will return to the LCD display the existing LOGO and the "live" reading of the last DATA CHANNEL or LOGIC BIT to have been "called" to display ("calling" of channels and bits is treated in Sections 3.a and 5.a, respectively, below).

If the "BILLBOARD" contains the response to a "READ" COMMAND entered from the Extended Keyboard, or the response to an interrogation using the **CHAN** or **BIT** key, it can be "cleared" by pressing the **ENTER** key (not the **CLEAR** key). In this case, the BILLBOARD will also automatically clear upon subsequent entry of a keyboard or keypad character.



b. THE "ARROW" KEYS

These keys may be used to move the "BILLBOARD" *cursor* one space at a time to the left or right, respectively, when modifying the numerical value of a "configuration" parameter (see below).



They also serve to *scroll* the LCD "BILLBOARD" (top line) to the left or right, if this line contains a command, answer, or prompting message longer than 16 characters. If such is the case, you will first need to move the cursor to the rightmost character space of the line by repeatedly pressing the rightward-pointing "**ARROW**" key, before the line will begin to scroll leftward. Note that the BILLBOARD LOGO cannot be scrolled, and should therefore be no more than 16 characters in length.

c. THE "FUNCTION" KEY

The key labelled **FNCTN** (**FUNCTION**) is identical to the **PROMPT** key on Daytronic Extended and Operator's Keyboards. By pressing this key, followed by the **0**, **1**, **2**, **3**, or **4** key, you can communicate any standard three-letter MNEMONIC to the DataPAC, as prespecified by a **KEY** command. The procedure is fully explained in Section 2.1 of this Guidebook.



If, for example, you want to use the key sequence **FNCTN 3** to initiate the high-limit-setting function of the **HIL** command (Section 2.F.2), you would first enter a command of

KEY 3 = HIL [CR] *

To now set to a given numeric value (say, 1423) the high limit of a particular DATA CHANNEL (say, Channel No. 7) *from the keypad alone*, you need only

1. Press the **FNCTN** key.
2. Press the **3** key ("HIL" will now appear in the BILLBOARD).
3. Enter **7 = 1423** via the keypad.
4. Press the **ENTER** key.

2.R.3

CHANNEL INTERROGATION

To "call" to the LCD display the current "live" value of a particular DATA CHANNEL, you need only

1. Press the **CHAN** key.
2. Enter via the keypad the number of the channel you wish to display.
3. Press the **ENTER** key. A "live" reading of the channel will now appear in *both* the top and the bottom LCD lines.

For example, if you wanted to "call" Channel No. 23, you need only press, in sequence,



If you now pressed the **STEP** key, the bottom line of the display would show "live" data for the *next* channel in numeric sequence (here, No. 24), while the top ("BILLBOARD") line would retain the reading of the originally interrogated channel (No. 23). By pressing **STEP** repeatedly, you can "step" rapidly through an entire channel range. NOTE, HOWEVER, THAT—AS IN ALL FOLLOWING PROCEDURES—YOU CANNOT "BACKSTEP" THROUGH A RANGE OF CHANNELS (OR BITS); YOU CAN ONLY "STEP" IN ASCENDING CHANNEL- (OR BIT-) NUMBER SEQUENCE. To invoke a lower-numbered channel (or bit) than the one presently displayed, you will have to "call" that channel (or bit), via the **CHAN** (or **BIT**) key.



Note that you cannot "call" Channel No. 998 (TIME) or 999 (DATE) to the LCD display.

Note too that if a LOGIC BIT is currently being displayed, you can return to a "live" display of the last DATA CHANNEL to have been "called" simply by pressing the **CHAN** key.

----- PLEASE NOTE -----

The **CHAN** key is to be used to READ the value of a given channel by temporarily viewing it in the "BILLBOARD" region of the LCD display, as explained above.

THE **CHAN** KEY SHOULD NOT BE USED TO WRITE CHANNEL VALUES TO THE DATA RAM, via the key sequence **CHAN**, [number], =, [number]. UNDER CERTAIN CONDITIONS, THIS CAN CAUSE UNRELIABLE CHANNEL READINGS.

If you want to be able to load channel values from a DataPAC's front-panel keypad, you can use the **FUNCTN** key, as explained in Section 2.R.2(c), to automatically enter the "**CHN**" mnemonic.

The "CHANNEL CONFIGURATION" sequence for a given DATA CHANNEL will display the channel's "TYPE" (TYP) designation followed by all other parameters presently applicable to that channel. These parameters include

FILTER (FIL); "LOCATION" (LCT); SCALING FACTOR (EMM); ZERO OFFSET (BEE); HIGH LIMIT (HILIM); LOW LIMIT (LOLIM); "LOWER THAN" LOGIC (LLT); "BETWEEN" LOGIC (LBT); and "GREATER THAN" LOGIC (LGT).

If a "CALCULATE" (CLC) function has been dedicated to the channel, it will also appear in the sequence.

To invoke the "CHANNEL CONFIGURATION" sequence for a given channel, simply

- a. Press the **CHAN CONFIG** key (the words "CHANNEL CONFIG" will appear in the bottom display line, while the BILLBOARD goes blank).
- b. Enter via the keypad the number of the channel (this number will appear in the first BILLBOARD space(s)).
- c. Press **ENTER**.



The channel's two-character hexadecimal "TYPE" code will now be displayed in the BILLBOARD, in square brackets ([]), and with the cursor initially under the first character. If you do not wish to change the existing "TYPE" code for this channel, press the **ENTER** key again to step to the next parameter in the "CHANNEL CONFIGURATION" sequence.

If, however, you now wish to modify the channel's "TYPE" code, proceed as follows:

1. If the first hexadecimal "TYPE" character is to be a *number* (0 - 9), simply press the respective number key. The cursor will then automatically shift to the second character.
2. If the first "TYPE" character is to be a *letter* (A - F), press the **STEP** key repeatedly until that letter appears. You must then press the rightward-pointing "**ARROW**" key to move the cursor to the second character (you can subsequently move the cursor back to the first character, if necessary, by pressing the leftward-point "**ARROW**" key).
3. If the second "TYPE" character is to be a *number*, press the respective number key; if it is to be a *letter*, press the **STEP** key repeatedly until it appears.
4. To enter the new "TYPE" coded for the channel and to step to the next parameter in the "CHANNEL CONFIGURATION" sequence, press the **ENTER** key (DON'T FORGET TO TURN ON THE DATAPAC'S REAR-PANEL EEPROM "WRITE PROTECT" SWITCH).

Note: "TYPE" is the only "CHANNEL CONFIGURATION" parameter for which the **STEP** key is used in modifying its value. For this reason, you cannot use the **STEP** key to advance through a range of channel "TYPES," as you can for all other parameters in this sequence.

- d. As each "CHANNEL CONFIGURATION" parameter appears in sequence, you have the option of leaving it as it is and stepping to the next parameter by pressing **ENTER**, or of modifying it by pressing the appropriate number keys, along with **MINUS SIGN** (-) and/or **DECIMAL POINT** (.), if needed. Again, you may use the "**ARROW**" keys to move the cursor rightward or leftward until it is under the character you wish to change.

Concerning "CHANNEL CONFIGURATION," please note that

- You cannot "backstep" through the parameter sequence; you can only start the sequence over again, via the **CHAN CONFIG** key, or continue stepping forward until you come "back around" to the beginning of the channel list.
- You cannot enter "N/A" as a parameter value from the keypad; you will have to use the DataPAC's Extended Keyboard to enter a SETUP COMMAND of the form **[MNEMONIC] n = N/A**.
- You cannot modify a **CALCULATE (CLC)** command from the keypad; you will have to use the Extended Keyboard.
- To change a parameter's existing numeric value to a value that has *fewer significant digits*, use the "0" key to enter leading zeros. Suppose, for example, that a channel's **HILIM** value is to be changed from "1000" to "500." With the cursor under the "1" of "1000," press "0" (four zeros will now be displayed, the cursor having moved under the second zero from the left). Then press the "5" key. You may use the same technique to change an existing parameter setting of "N/A" to a numeric value of fewer than three significant digits (e.g., to change "N/A" to "003").
- For any given "CHANNEL CONFIGURATION" parameter except "TYPE" (**TYP**), you may advance one-by-one through a *range* of channels by pressing the **STEP** key repeatedly. Note, however, that, as mentioned above, you cannot "backstep" through a channel range. Assume, for example, that you have used the **STEP** key to review the **FILTER (FIL)** constants applying to Channel Nos. 8 through 15. When you invoke the next parameter in sequence by pressing **ENTER**, you will find that this parameter does not refer to the original channel (No. 8), but to the last "stepped to" channel (No. 15). To return to the configuration values of a lower-numbered channel, you will have to start the "CHANNEL CONFIGURATION" sequence over again.

a. BIT INTERROGATION

To "call" to the LCD display the current state of a particular LOGIC BIT, you need only

1. Press the **BIT** key.
2. Enter via the keypad the number of the bit you wish to display.
3. Press the **ENTER** key. A "live" reading of the bit will now appear in *both* the top and the bottom LCD lines.

For example, if you wanted to "call" Bit No. 38, you need only press, in sequence,



For stepping through a LOGIC-BIT range via the **STEP** key, see Section 3.a, above, which gives this procedure with reference to DATA CHANNELS.

Note that if a DATA CHANNEL is currently being displayed, you can return to a "live" display of the last LOGIC BIT to have been "called" simply by pressing the **BIT** key.

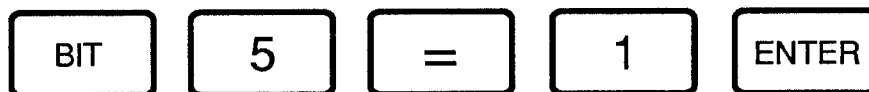
b. SETTING A BIT

NOTE: YOU CAN ONLY SET THE STATE OF A LOGIC BIT FROM THE KEYPAD IF THAT BIT IS "EXTERNALLY" SOURCED (I.E., IF A COMMAND OF **SRC r = EXT [CR] * IS CURRENTLY IN EFFECT FOR THAT BIT—see Section 2.H.2 of this Guidebook for a full explanation of LOGIC-BIT "sourcing"). IF YOU ATTEMPT TO SET A BIT THAT HAS NOT BEEN EXTERNALLY SOURCED, THE **EQUALS SIGN (=)** KEY (STEP 3 BELOW) WILL NOT WORK.**

To set an externally sourced bit to *Logic 1* or *Logic 0*.

1. Press the **BIT** key.
2. Enter via the keypad the number of the bit.
3. Press the **EQUALS SIGN (=)** key.
4. Press the "1" key or the "0" key, respectively.
5. Press the **ENTER** key.

If, for example, you wish to set Bit No. 5 to a *Logic 1* state, simply press, in sequence, The setting of a given bit will also "call" that bit to the bottom line of the LCD display.



2.R.6

LOGIC CONFIGURATION

The "LOGIC CONFIGURATION" sequence for a given LOGIC BIT consists of

- 1) the bit's current LOGIC SOURCE (**SRC**);
- 2) any EXECUTE (**EXU**) string to be triggered by a transition of the bit from *Logic 0* to *Logic 1*; and
- 3) any EXECUTE (**EXU**) string to be triggered by a transition of the bit from *Logic 1* to *Logic 0* (this is the "**EXU /**" form of the command—see Section 2.K.2 of this Guidebook).

NONE OF THESE PARAMETERS MAY BE MODIFIED FROM THE KEYPAD.

To invoke the "LOGIC CONFIGURATION" sequence for a given bit, simply

- a. Press the **LOGIC CONFIG** key (the words "LOGIC CONFIG" will appear in the bottom display line, while the BILLBOARD goes blank).
- b. Enter via the keypad the number of the bit (this number will appear in the first BILLBOARD space).
- c. Press the **ENTER** key. The bit's current LOGIC SOURCE assignment will appear. To step to the bit's associated "EXU," press **ENTER** again; to step to the associated "EXU /," press **ENTER** again.



As with "CHANNEL CONFIGURATION" parameters, above, you can advance through a *range* of bits for any given "LOGIC CONFIGURATION" parameter by pressing the **STEP** key repeatedly. Remember that, as with channels, you cannot "backstep" through a range of bits.

a. GENERAL ANALOG CONFIGURATION

This configuration sequence is initiated by means of the **CHAN CONFIG** key, but *without specifying a particular Channel Number*. The parameters involved are

SATELLITE BASE CHANNEL (**SBC**); TERMINATOR (**TER**); SCAN RANGE (**SCN**);
DATE (**DTE**); and TIME (**TME**).

For information concerning these commands, refer to Section 4 of this Guidebook ("Command Directory").

To invoke the DataPAC's "GENERAL ANALOG CONFIGURATION" sequence, simply

1. Press the **CHAN CONFIG** key (the words "CHANNEL CONFIG" will appear in the bottom display line, while the BILLBOARD goes blank).
2. Press **ENTER**. The DataPAC's current "SATELLITE BASE CHANNEL" assignment will be displayed. As with "CHANNEL CONFIGURATION," above, you have the option of leaving each parameter as it is and stepping to the next parameter by pressing **ENTER**, or of modifying it by pressing the appropriate number keys. (In the case of the **SCN** value, you will also have to enter a *comma*—via the "," key—to separate the two range-defining numbers. See Section 1.F.1(b) for the command syntax.) Again, you may use the "**ARROW**" keys to move the cursor rightward or leftward until it is under the number you wish to change.

b. GENERAL LOGIC CONFIGURATION

This configuration sequence is initiated by means of the **LOGIC CONFIG** key, but *without specifying a particular Bit Number*. The parameters involved are

A SLOT (**ASL**); EXECUTE BASE GROUP NO. 1 (**XBG1**); EXECUTE BASE GROUP NO. 2
(**XBG2**); EXECUTE (**EXU**); COMPUTER STATUS BIT (**CSB**); and PERIPHERAL STATUS BIT
(**PSB**).

For information concerning these commands, refer to Section 4 of this Guidebook ("Command Directory").

To invoke the DataPAC's "GENERAL LOGIC CONFIGURATION" sequence, simply

1. Press the **LOGIC CONFIG** key (the words "LOGIC CONFIG" will appear in the bottom display line, while the BILLBOARD goes blank).
2. Press **ENTER**. The current "A SLOT" assignment for BIT GROUP NO. 1 will be displayed. As with "CHANNEL CONFIGURATION," above, you have the option of leaving each parameter as it is and stepping to the next parameter by pressing **ENTER**, or of modifying it by pressing the appropriate number keys (**EXU** is an exception; it can be modified only through the DataPAC's Extended Keyboard). Again, you may use the "**ARROW**" keys to move the cursor rightward or leftward until it is under the number you wish to change.

Note that **ASL** and **EXU** are the only parameters in this sequence through which you may "step" via the **STEP** key. In the case of **ASL**, you will step through a range of BIT GROUPS. In the case of **EXU**, the **STEP** function also toggles between "normal" and "inverse" EXECUTES. Thus, the first **EXU** to be displayed is the "normal" EXECUTE statement associated with the transition of Bit No. 0 from *Logic 0* to *Logic 1*. Pressing **STEP** once will display the "inverse" EXECUTE ("**EXU /**") applying to Bit No. 0's transition from *Logic 1* to *Logic 0*. Pressing **STEP** again will display the "normal" EXECUTE for Bit No. 1; pressing it again will display "**EXU /1**"; and so on.

2.R.8

PORT CONFIGURATION

You will initiate the "PORT CONFIGURATION" sequence by pressing the **PORT CONFIG** key only (you need not press **ENTER**). The parameters displayed in this sequence are

BAUD RATE (**BAU**); COMMAND TERMINATOR (**CMT**); OUTPUT TERMINATOR (**OPT**);
END-OF-TRANSMISSION TERMINATOR (**EOT**); COMPUTER INTERRUPT (**ITR**); TIMEOUT
(**TMO**); DELAY (**DLY**); ASSIGN SATELLITE NUMBER (**ASN**); COLUMNS (**CLM**); and
CHARACTERS PER CHANNEL (**CPC**).

For information concerning these commands, refer to Section 4 of this Guidebook ("Command Directory").



As with "CHANNEL CONFIGURATION," above, you have the option of leaving each parameter as it is and stepping to the next parameter by pressing **ENTER**, or of modifying it by via the keypad. **COMPUTER INTERRUPT (ITR)** and **BAUD RATE (BAU)** are exceptions. **ITR** can be modified only through the DataPAC's Extended Keyboard. As explained in Section 2.B.2 of this Guidebook, the RS-232-C protocols for an "A-SIZED" DataPAC's **COMPUTER INTERFACE PORT** are set by means of *switches* (only). The **BAU** command is not recognized by such DataPACs, whose response to a **BAU** interrogation will therefore always be "**BAU = SWITCH.**"

The DataPAC's **COMMAND TERMINATOR (CMT)**, **OUTPUT TERMINATOR (OPT)**, and **END-OF-TRANSMISSION TERMINATOR (EOT)** can be altered from the keypad, if desired. Since each of these parameters requires one or more hexadecimal numbers, the procedure for changing their existing values is the same as that given in Section 2.R.4, above, for the "TYPE" code of a channel. That is, if a number (0 - 9) is to be entered, use the respective number key; if a letter (A - F) is to be entered, press the **STEP** key repeatedly until it appears. In the case of the **OPT** and **EOT** values, you will have to enter a *comma*—via the "," key—to separate adjacent two-character hexadecimal words (see Section 1.H.3(g) for command syntax). Again, you may use the "**ARROW**" keys to move the cursor rightward or leftward until it is under the number you wish to change.

TIMEOUT (TMO), which follows **ITR**, also requires a comma to separate its two numbers (see Section 2.B.6(a)). Each of the remaining parameters in the sequence—**DLY**, **ASN**, **CLM**, and **CPC**—takes a simple decimal number entry.

Section 2.S

Optional Operator's Keyboards: Models 10P25A and 10P25D



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The **Models 10P25A Operator's Keyboard** is intended primarily for use with a "B-sized" mainframe (any 10KN3, 10KN6, 10KN7, or 10KN8A version), or with a Model 10CCONB Operator Console. The **Model 10P25D Operator's Keyboard**, supplying a two-line LCD "BILLBOARD," is intended primarily for use with "A-sized" mainframes that do not have their own internal LCD display—like the Models 10KU, 10K1C, and 10K4T—and which do NOT employ the Model 10LCD12A Display Option.

The keyboard to be used with any given mainframe model, along with the specific *functions* that this keyboard will provide when operated with that mainframe, are given in the following table. Each function is then described in general terms in one of the sections that follow.

<u>Mainframe Model</u>	<u>Keyboard To Be Used</u>	<u>Functions Available</u>
10KU-KD, 10K4T-KD*	10P25A or 10P25D	"KEY" PROMPTS LCD BILLBOARD "SCROLL" CHANNEL INTERROGATION BIT INTERROGATION BIT SETTING
10KU, 10K1C, 10K4T(A)*	10P25D recommended	"KEY" PROMPTS LCD BILLBOARD "SCROLL" CHANNEL INTERROGATION BIT INTERROGATION BIT SETTING
10K2C, 10K2D, 10K4T-D, 10K4T-DA**	10P25A	"KEY" PROMPTS CLEARING LCD BILLBOARD CHANNEL INTERROGATION LCD PAGE SELECTION
10KN3, 10KN6, 10KN7, 10KN8A	10P25A	"KEY" PROMPTS CLEARING CRT BILLBOARD CHANNEL INTERROGATION CRT PAGE SELECTION
10CCONB	10P25A	CLEARING CRT BILLBOARD CHANNEL INTERROGATION CRT PAGE SELECTION

* THE DATAPAC MUST HAVE A **DISPLAY (DIS)** SETTING OF **DIS = 1**.

** THE DATAPAC MUST HAVE A **DISPLAY (DIS)** SETTING OF **DIS = 2**.

For KEYBOARD CONNECTION, see Section 4 of the appropriate "On the Air" booklet in the front of this Guidebook.

Concerning operation of the Models 10P25A and 10P25D, please note that

1. THE "*" KEY IS NOT FUNCTIONAL ON EITHER KEYBOARD.
2. YOU MUST PRESS THE "ENTER" KEY TO TERMINATE ALL KEYBOARD COMMAND ENTRIES.
3. FOR THE MODEL **10P25A** TO WORK PROPERLY WITH A MODEL **10KU-KD** OR **10K4T-KD** DATAPAC, A COMMAND OF

DIS = 1 [CR] *

MUST BE IN EFFECT FOR THAT DATAPAC. IN THIS CASE, IT IS FIRST NECESSARY TO PRESS THE 10P25A'S "CALL" KEY TO INITIALIZE THE KEYBOARD AND ESTABLISH PROPER COMMUNICATIONS WITH THE DATAPAC.

4. FOR THE MODEL **10P25A** TO WORK PROPERLY WITH A MODEL **10K2C**, **10K2D**, **10K4T-D**, **10K4T-DA**, OR ANY DATAPAC USING THE **10LCD12A** DISPLAY OPTION, A COMMAND OF

DIS = 2 [CR] *

MUST BE IN EFFECT FOR THAT DATAPAC.

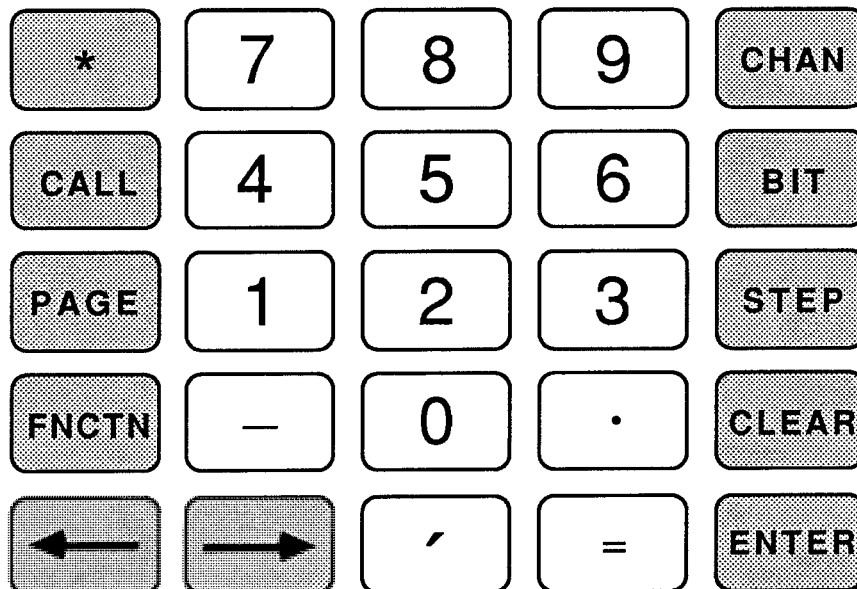
5. THE MODEL **10P25D** WILL ONLY WORK PROPERLY WITH A MODEL **10KU**, **10K1C**, OR **10K4T** DATAPAC FOR WHICH A COMMAND OF

DIS = 1 [CR] *

IS IN EFFECT (USE OF THE 10P25D WITH A MODEL 10K2C, 10K2D, 10K4T-D, 10K4T-DA, OR ANY DATAPAC USING THE 10LCD12A DISPLAY OPTION MAY IN FACT DAMAGE THE DATAPAC AND/OR KEYBOARD).

IT IS FIRST NECESSARY TO PRESS THE 10P25D'S "CALL" KEY TO INITIALIZE THE KEYBOARD AND ESTABLISH PROPER COMMUNICATIONS WITH THE 10KU, 10K1C, OR 10K4T DATAPAC.

Fig. 2.S.1 10P25A/10P25D Keypad



a. "KEY" PROMPTS: "FNCTN" KEY

The key labelled **FNCTN (FUNCTION)** is identical to the **PROMPT** key on a Daytronic Extended Keyboard. By pressing this key, followed by the **0, 1, 2, 3, or 4** key, you can communicate any standard three-letter MNEMONIC to the DataPAC, as prespecified by a **KEY** command. The procedure is fully explained in Section 2.I of this Guidebook.

If, for example, you want to use the key sequence **FNCTN 3** to initiate the high-limit-setting function of the **HIL** command (Section 2.F.2), you would first enter a command of

KEY 3 = HIL [CR] *

To now set to a given numeric value (say, 1423) the high limit of a particular DATA CHANNEL (say, Channel No. 7) *from the Operator's Keyboard alone*, you need only

1. Press the **FNCTN** key.
2. Press the **3** key ("HIL" will now appear in the BILLBOARD).
3. Enter **7 = 1423** via the keypad.
4. Press the **ENTER** key.

b. LCD BILLBOARD "SCROLL": "ARROW" KEYS

When the DataPAC/Keyboard system includes a *two-line ("small-scale") LCD DISPLAY*, the keyboard's left- and right-pointing **"ARROW"** keys may be used to move the cursor in the LCD "BILLBOARD" one space at a time to the left or right, respectively. They also serve to *scroll* the LCD BILLBOARD (top line) to the left or right, if this line contains a command, answer, or prompting message longer than 16 characters. If such is the case, you will first need to move the cursor to the rightmost character space of the line by repeatedly pressing the rightward-pointing "ARROW" key, before the line will begin to scroll leftward. Note that the BILLBOARD LOGO cannot be scrolled, and should therefore be no more than 16 characters in length.

c. CLEARING LCD BILLBOARD: "CLEAR" KEY

When the DataPAC system includes a *CRT DISPLAY* or *twelve-channel ("large-scale") LCD DISPLAY*, the **"CLEAR"** key serves to clear the currently displayed CRT or LCD "BILLBOARD" of the last command, response, or message, returning it to the existing LOGO and the "live" reading of data.

d. CHANNEL INTERROGATION: "CHAN" AND "STEP" KEYS

To read the current value of a particular DATA CHANNEL, you need only

- a. Press the **CHAN** key.
- b. Enter via the keyboard the number of the channel you wish to display.
- c. Press the **ENTER** key. The current reading of the channel will now appear in the "BILLBOARD" line of the system CRT or LCD display. **NOTE:** In the case of a *two-line ("small-scale") LCD DISPLAY*, a "live" reading of the channel will also appear under the BILLBOARD line.

For example, if you wanted to read Channel No. 23, you need only press, in sequence,
CHAN 2 3 ENTER

If you now pressed the **STEP** key, the BILLBOARD would show current data for the *next* channel in numeric sequence (here, No. 24). By pressing **STEP** repeatedly, you can "step" rapidly through an entire channel range. NOTE, HOWEVER, THAT YOU CANNOT "BACKSTEP" THROUGH A RANGE OF CHANNELS (OR BITS); YOU CAN ONLY "STEP" IN ASCENDING CHANNEL- (OR BIT-) NUMBER SEQUENCE. To invoke a lower-numbered channel (or bit) than the one presently displayed, you will have to "call" that channel (or bit), via the **CHAN** (or **BIT**) key.

Note that you cannot "call" Channel No. 998 (TIME) or 999 (DATE) to the BILLBOARD display.

e. BIT INTERROGATION: "BIT" AND "STEP" KEYS

To read the current state of a particular LOGIC BIT, you need only

- a. Press the **BIT** key.
- b. Enter via the keyboard the number of the bit you wish to display.
- c. Press the **ENTER** key. The current bit state will now appear in the "BILLBOARD" line of the system CRT or LCD display. NOTE: In the case of a *two-line ("small-scale") LCD DISPLAY*, a "live" reading of the bit will also appear under the BILLBOARD line.

For example, if you wanted to "call" Bit No. 38, you need only press, in sequence,

BIT 3 8 ENTER

For stepping through a LOGIC-BIT range via the **STEP** key, see Section d, above, which gives this procedure with reference to DATA CHANNELS.

Please Note

As explained in Section 2.S.2(d), the **CHAN** key is to be used to READ the value of a given channel by temporarily viewing it in the "BILLBOARD" region of the active LCD or CRT display. However, the **CHAN** key should NOT be used to WRITE channel values into the DATA RAM, via the sequence **CHAN, [number], =, [number]**. UNDER CERTAIN CONDITIONS, THIS CAN CAUSE UNRELIABLE CHANNEL READINGS.

If you want to be able to load channel values from an Operator's Keyboard, you can use the **KEY** command to arrange for the pressing of the **FUNCTION** key—followed by a selected number key from 0 through 4—to automatically enter the "CHN" mnemonic (see Section 2.S.2(a), above).

f. BIT SETTING: "BIT" AND "EQUALS" KEYS

NOTE: YOU CAN ONLY SET THE STATE OF A LOGIC BIT FROM THE OPERATOR'S KEYBOARD IF THAT BIT IS "EXTERNALLY" SOURCED (I.E., IF A COMMAND OF

SRC r = EXT [CR] *

IS CURRENTLY IN EFFECT FOR THAT BIT—see Section 2.H.2 of this Guidebook for a full explanation of LOGIC-BIT "sourcing"). IF YOU ATTEMPT TO SET A BIT THAT HAS NOT BEEN EXTERNALLY SOURCED, THE **EQUALS SIGN (=)** KEY (STEP c BELOW) WILL NOT WORK.

To set an externally sourced bit to *Logic 1* or *Logic 0*,

- a. Press the **BIT** key.
- b. Enter via the keyboard the number of the bit.
- c. Press the **EQUALS SIGN (=)** key.
- d. Press the "1" key or the "0" key, respectively.
- e. Press the **ENTER** key.

If, for example, you wish to set Bit No. 5 to a *Logic 1* state, simply press, in sequence,

BIT 5 = 1 ENTER

The setting of a given bit will also "call" that bit to the CRT or LCD BILLBOARD of the DataPAC/Keyboard system.

g. CALLING A VIDEO PAGE TO DISPLAY: "PAGE" KEY

When the DataPAC system includes a *CRT DISPLAY* or *twelve-channel ("large-scale") LCD DISPLAY*, you can use the "PAGE" key to select a stored CRT or LCD VIDEO PAGE for display:

- a. Press the **PAGE** key.
- b. Enter via the keyboard the number of the selected PAGE (see Section 1.D.1 or 2.C.2 of this Guidebook).
- c. Press the **ENTER** key.

For example, to "call" to display Page No. 48, simply press, in sequence,

PAGE 4 8 ENTER