C5/K1/K3

Integrated Satellite Terminal System
C-Band/Ku-Band
Installation and Operation Manual

Part Number MN/C5K1K3.IOM
Revision 0

EFData is an ISO 9001 Registered Company

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Part Number MN/C5K1K3.IOM
Revision 0
November 25, 1998

Comtech EFData, 2114 West 7th Place, Tempe, Arizona 85281 USA, (480) 333-2200, FAX: (480) 333-2161.

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The product, manufactured by EFData, is warranted against defects in material and workmanship for a period of one year from the date of shipment. During the warranty period, EFData will, at its option, repair or replace products that prove to be defective.

For equipment under warranty, the customer is responsible for freight to EFData and all related custom, taxes, tariffs, insurance, etc. EFData is responsible for the freight charges **only** for return of the equipment from the factory to the customer. EFData will return the equipment by the same method (i.e., Air, Express, Surface transportation) as the equipment was sent to EFData.

Limitations of Warranty

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Preface

About this Manual

This manual provides installation and operation information for the EFData C-Band or Ku-Band Integrated Satellite Terminal System. This is a technical document intended for earth station engineers, technicians, and operators responsible for the operation and maintenance of the Integrated Satellite Terminal System.

Conventions and References Used in this Manual

Cautions and Warnings

CAUTION

CAUTION indicates a hazardous situation that, if not avoided, may result in minor or moderate injury. CAUTION may also be used to indicate other unsafe practices or risks of property damage.

WARNING

WARNING indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

Metric Conversions

Metric conversion information is located on the inside back cover of this manual. This information will assist the operator in cross-referencing English to Metric conversion.

EMC Directive

Directive: EN55022

This equipment meets EN55022.

This is a Class A product. In a domestic environment, it may cause radio interference in which the user may require to take adequate measures.

Federal Communications Commission (FCC)

This equipment meets CFR47 FCC, Part 15 for Class A operation. This equipment complies with Part 15 of the FCC rules. Operation is subject to the following two conditions:

1. This satellite terminal system should not cause harmful interference.

2. This device must accept any interference received, including interference that may cause undesired operation.

Note: To ensure compliance, properly shielded cables for DATA I/O shall be used. More specifically, these cables shall be double-shielded from end-to-end, ensuring a continuous shield.

Directive: Low Voltage Directive (LVD)

The following information is applicable for European Low Voltage Directive (EN60950):

<HAR>	Type of power cord required for use in the European Community.
⚠	CAUTION: Double-pole/Neutral Fusing. ACHTUNG: Zweipolige bzw. Neutralleiter-Sicherung.

International Symbols:

~	Alternating Current.
Fuse symbol	Fuse.

Notes:

1. For additional symbols, refer to "Cautions and Warnings" listed earlier in this preface.
2. Applicable testing is performed routinely as a condition of manufacturing on all units to ensure compliance of EN60950 for Safety.

Related Documents

- *EFData Manual MN/C5CM.IOM C5 Terminal Installation and Operation Manual (draft available)*
- *EFData Manual MN/KUCM.IOM Ku-Band Terminal Installation and Operation Manual (draft available)*
- *EFData Operating Instructions 01/QUA-014 Qualification for Purchased Power Supplies*
- *EFData Specification SP/6420 SDT-5200 Terminal Modem (IDU)*
- *EFData Specification SP/6422 LNA Specification*
- *EFData Specification SP/6423 C-Band 2-Way Outdoor RF Unit (ODU)*
- *EFData Specification SP/6424 C5 Terminal System – Continuous*
- *EFData Specification SP/7630 K1, K3 Terminal System – Continuous*
- *EFData Specification SP/7642 Ku-Band 2-Way Outdoor RF Unit (ODU)*

Reporting Comments or Suggestions Concerning this Manual

Comments and suggestions regarding the content and design of this manual will be appreciated. To submit comments, please contact the EFData Customer Support Department according to the following information.

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2114 West 7th Street
Tempe, Arizona 85281 USA

(602) 968-0447 (Main EFData Number)
(602) 333-4357 (Customer Support Desk)
(602) 921-9012 (FAX)

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service@efdata.com

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1. Request a Return Material Authorization (RMA) number from the EFData Customer Support Department.

2. Be prepared to supply the Customer Support representative with the model number, serial number, and a description of the problem.

3. To ensure that the product is not damaged during shipping, pack the product in its original shipping carton/packaging.

4. Ship the product back to EFData. (Shipping charges should be prepaid.)

For more information regarding the warranty policies, refer to the disclaimer page located behind the title page of this manual.

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Figures

Tables

Chapter 1. INTRODUCTION

This chapter introduces the Integrated Satellite Terminal System. This system can be configured into three units:

- C5 C-Band – (Transmit Power Rating: 5.0W)
- K1 Ku-Band – (Transmit Power Rating: 0.8W)
- K3 Ku-Band – (Transmit Power Rating: 2.5W)

Collectively, the configured unit is referred to as “the Satellite Terminal System.”

1.1 Overview

The satellite terminal system is designed for maximum reliability and performance in the C-Band (Figure 1-1) or Ku-Band (Figure 1-2) applications.

Figure 1-1. The C-Band (C5) System

Figure 1-2. The Ku-Band (K1 or K3) System

Refer to Table 1-1 for a matrix of customer-selectable configured units.

Table 1-1. Customer-Selectable Configured Units

System	IDU	ODU C-Band	ODU Ku-Band 1W	ODU Ku-Band 3W	LNA
C5	SDT-5200	X			X
K1	SDT-5200		X		
K3	SDT-5200			X	

C-Band System - A block diagram (Figure 1-3) illustrates the system as a single thread, single channel per carrier per carrier (SCPC), very small aperture terminal (VSAT) consisting of a full featured modem, an up converter/transceiver, and a low-noise amplifier (LNA) designed to meet the needs of single and/or multiple site installations.

Ku-Band System - A block diagram (Figure 1-4) illustrates the system as a single thread, single channel per carrier per carrier (SCPC), and very small aperture terminal (VSAT) consisting of a full featured modem and an up converter/transceiver.

The outdoor unit (ODU) is a weatherproof enclosure housing the up converter, solid-state power amplifier, automatic level control, block down converter, IF interfaces, monitor and control (M&C), and a DC power converter.

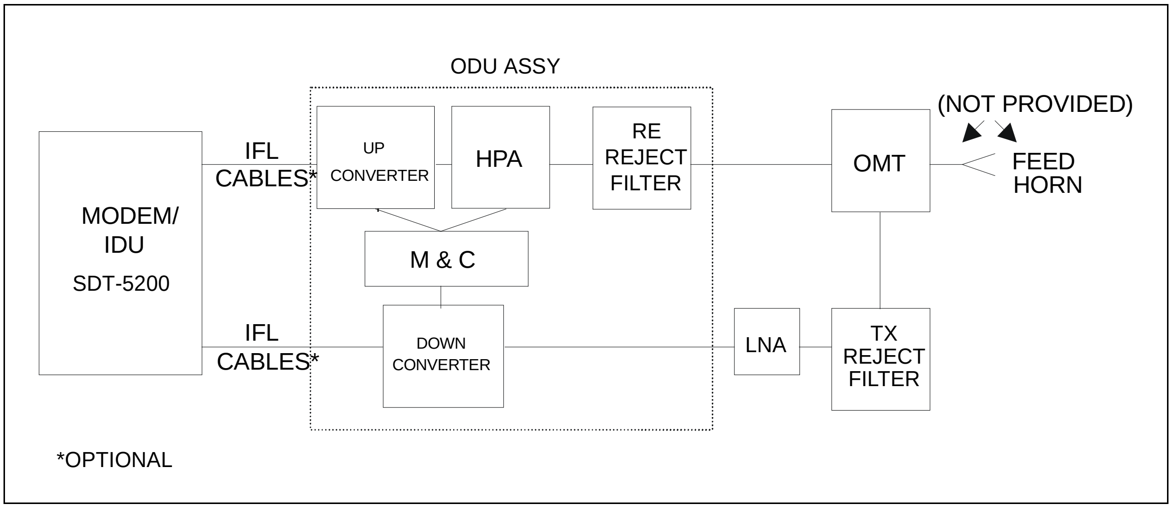

Figure 1-3. C-Band System Block Diagram

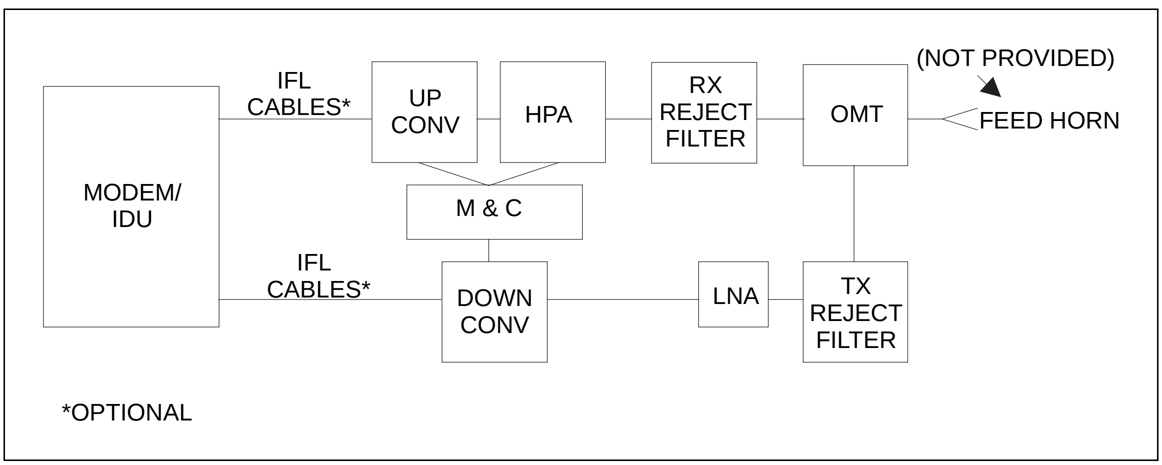

Figure 1-4. Ku-Band System Block Diagram

Note: Modulator uplink carries power for the ODU, LNA, 50 MHz REF, and coded M&C.

1.1.1 Description

The SDT-5200 indoor unit (IDU) is a 1 RU rack-mounted module that includes all the functionality of a variable data rack modem, along with the high-stability reference and power supply for the ODU.

Microcontrollers in both the IDU and ODU monitor and control all operational parameters and status of the system. The system also reports terminal configuration status, as well as fault status of all system components. A simple command set allows configuration, control, and retrieval of status information.

The C-Band satellite terminal system is divided into three areas of operation:

1. SDT-5200 Indoor Unit (IDU). A complete, variable data rate modem, high stability references, and power supply for the ODU in a 1 RU package.

2. Outdoor Unit (ODU). A weatherproof C-Band up converter/power amplifier and a low noise block (LNA) down converter. The ODU is mounted on the spar of the antenna and is connected via coaxial cables to the IDU and the LNA.

3. Low Noise Amplifier (LNA) Assembly. Consists of a waveguide Transmit Reject Filter (TRF) and LNA.

C-Band - The ODU accepts a 790 ± 11 MHz TXIF signal and transmits it in the 5.925 to 6.425 GHz frequency band. Output power level is controlled by an ALC loop to provide extremely stable output power regardless of temperature variations.

C-Band - The low noise assembly (LNA) (60°K standard noise temperature) on the OMT accepts an RF signal in the 3.7 to 4.2 GHz band and amplifies the desired signal to be received. The ODU down converters converts the signal to an IF of 950 to 1450 MHz.

The Ku-Band satellite terminal system is divided into two areas of operation:

1. SDT-5200 Indoor Unit (IDU). A complete, variable data rate modem, high stability references, and power supply for the ODU in a 1 RU package.

2. Outdoor Unit (ODU). The ODU is mounted on the antenna feed horn and directly connected to the OMT. In addition, it also directly interfaces via two coaxial cables to the IDU.

Ku-Band - The ODU accepts a 790 ± 11 MHz TXIF signal and transmits it in the 14.0 to 14.5 GHz frequency band. The maximum available transmit power is +29 dBm (P1dB) or +34 dBm (P1dB) depending on the option selected. Output power level is controlled by an ALC loop to provide extremely stable output power regardless of temperature variations.

Ku-Band - The ODU accepts an RF signal in one of several Ku frequency bands. The ODU amplifies, then down-converts the signal to an IF of 950 to 1450 MHz. An integrated transmit band reject filter prevents the integrated low noise amplifier (LNA) from being overloaded.

1.1.2 Additional Features

The system contains the following additional features:

Note: These features are fully described in Appendix A.

- Fully Accessible System Topology (FAST): EFData's FAST system allows immediate implementation of different options through the user's keypad.

- Sequential Decoder: The sequential decoder is used in Closed Network applications, typically in Frequency Division Multiple Access (FDMA).

- Asymmetrical Loop Timing: Asymmetrical loop timing is the same timing method that is designed into the SDM-650B TROJAN interfaces.

- INTELSAT Reed-Solomon Operation: The Reed-Solomon Codec works in conjunction with the interface card to provide concatenated convolutional encoding and decoding.

- Automatic Uplink Power Control (AUPC): The AUPC feature works with the ASYNC option to allow remote communication between a local modem and a remote modem.

- Asynchronous Channel Unit Overhead: The asynchronous (ASYNC) interface option provides the interface for terrestrial data and single ASYNC overhead channel.

1.2 Modem Feature Upgrade (FAST)

The SDT-5200 indoor unit (IDU) has a variety of options available as shown in Table 1-2. Options are available through conventional means as well as through EFData's FAST system. For detailed description of the FAST feature and all options, refer to Appendix A.

Note: EFData has included a DEMO Mode in the Utility menu. This feature will allow the operator to experience any of the FAST options. This feature has a 60-minute time limit, after which, the unit will return to its previous configuration.

Table 1-2. FAST Options

Hardware	Single Data Rate	Variable Data Rate (up to 512 kbit/s)	Variable Data Rate (up to 4.375 Mbit/s)	Sequential Decoder	Viterbi Decoder	Async Loop Timing	Reed-Solomon Codec	ASYNC/ AUPC Overhead
Base SDT-5200	X							
FAST Options to the Base SDT-5200	N/A	X	X	X	X	X	N/A	N/A
FAST Options with Reed-Solomon Hardware	N/A	N/A	N/A	N/A	N/A	N/A	X	N/A
FAST Options with Overhead Hardware	N/A	N/A	N/A	N/A	N/A	N/A	N/A	X

Note: The basic SDT-5200 is shipped with either Sequential or Viterbi decoder.

1.3 Modes of Operation

The ASYNC/AUPC option allows an additional overhead channel to be multiplexed and demultiplexed from the data carrier. Two mechanisms are provided for automatic uplink power control (AUPC) within a closed network.

- One method, which requires the optional ASYNC/AUPC interface card, is used for control between two links to sustain sufficient transmit power to maintain a programmed E_b/N_0 at both ends.

- The second method is used for self-monitoring the carrier from the same uplink with the local demodulator, requires no additional hardware, and is software-selectable. This method is appropriate for applications such as paging networks, where the uplink is transmit-to receive only devices. The self-monitoring AUPC function is not available when the ASYNC/AUPC interface option is installed.

The IDU interfaces between Single-Channel per Carrier (SCPC) fixed-rate terminal equipment operating within the following specifications:

- The IDU is capable of data rates from 2.4 kbit/s to 4.375 Mbit/s and includes a 1×10^{-9}/day standard internal frequency reference.

Note: The IDU can be configured to add overhead/framing to the data.

Available modulation types include:

- Bi-Phase Shift Keying (BPSK).

- Quadrature Phase Shift Keying (QPSK).

An internal channel unit, conforming to IESS-308 and -309 emulation specifications, provides overhead designated for an Engineering Service Channel (ESC).

1.4 Component Description

The C-Band (Figure 1-3) is divided into three distinct areas of operations:

Table 1-3. C-Band Three Areas of Operation

Model/Part No.	Component
SDT-5200	Satellite Data Terminal
Type 30-0120-172	Outdoor Unit
Model No. 6307	Low Noise Amplifier

The Ku-Band (Table 1-4) is divided into two distinct areas of operations:

Table 1-4. Ku-Band Two Areas of Operation

Model/Part No.	Component
SDT-5200	Satellite Data Terminal
1W or 3W Ku-Band	Outdoor Unit

1.4.1 SDT-5200 Indoor Unit

The SDT-5200 Indoor unit (Figure 1-5), here after referred to as the IDU, is divided into four sections:

- Modulator
- Demodulator
- Interface
- Monitor and Control (M&C)

Modulator **-** The modulator converts the baseband data to a shaped, modulated IF from 779 to 801 MHz. The modulator output also provides the M&C control link, DC power, and reference for the terminal outdoor unit.

Demodulator – The demodulator converts an IF of 950 to 1450 MHz down to baseband.

Interface – The interface provides a link between the Digital Test Equipment (DTE) and the modem. Several industry-standard interfaces are available, as well as EFData proprietary.

Monitor & Control – The M&C uses a microcontroller to control all operational parameters and monitor system status. The system also reports modem configuration status, as well as fault status of the modem. A simple command set allows configuration, control, and retrieval of status information.

Figure 1-5. SDT-5200 Indoor Unit

1.4.2 C-Band Outdoor Unit (ODU)

The ODU (Figure 1-6) consists of the following assemblies:

- Power Amplifier
- Up Converter/Block Down Converter
- Automatic Level Control
- Data Link for Fault Sensing and Control
- Switching Power Converter
- Radio Frequency Terminal

The ODU is a weatherproof C-Band up converter/transmitter that automatically adjusts for cable losses and changes between the IDU and the ODU. The transmit (TX) power level can be adjusted between +27 to +34 dBm. The ODU interfaces to the IDU using a two coaxial cables. The cables consist of the following signals:

- Cable No.1
  - TX signal
  - M&C link
  - Reference OSC
  - DC power
- Cable No. 2
  - RX signal

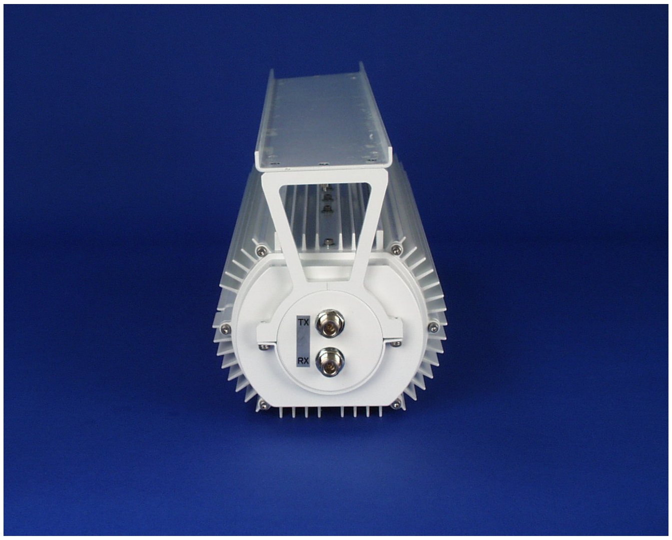

Figure 1-6. C-Band ODU

1.4.3 Ku-Band Outdoor Unit (ODU)

The Ku-Band ODU (K1 or K3) is a weatherproof, enclosed unit, housing the up converter, solid-state power amplifier, automatic level control, integrated low-noise amplifier (LNA), block down converter, IF interface, monitor and control (M&C), and DC power converter.

The ODU connects directly to the OMT and is cabled to the transmit and receive connectors of the IDU.

The ODU consists of the following assemblies:

- Power Amplifier
- Up Converter
- Automatic Level Control
- Data Link for Fault Sensing and Control
- Switching Power Converter
- LNA converter (Internal)

The ODU is a weatherproof Ku-Band up converter/transmitter that automatically adjusts for cable losses and changes between the IDU and the ODU. The transmit (TX) power level can be adjusted between +29 to +34 dBm. The ODU interfaces to the IDU using a pair of coaxial cables, consisting of the following signals:

- One Cable
    - ♦ TX signal
    - ♦ M&C link
    - ♦ Reference OSC
    - ♦ DC power
- Second Cable
    - ♦ RX signal

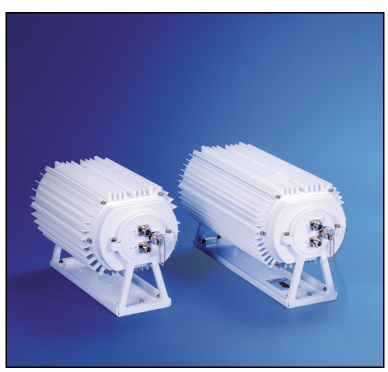

Figure 1-7. Ku-Band ODU

1.4.4 Low-Noise Phase-Locked Amplifier (LNA)

Note: This component is used in the C5 system only.

LNA (Figure 1-8) consists of a waveguide Transmit Reject Filter (TRF). The LNA standard noise temperature is 60°K. The LNA’s DC power is supplied from the ODU.

The LNA is mounted to the OMT and is cabled to the ODU.

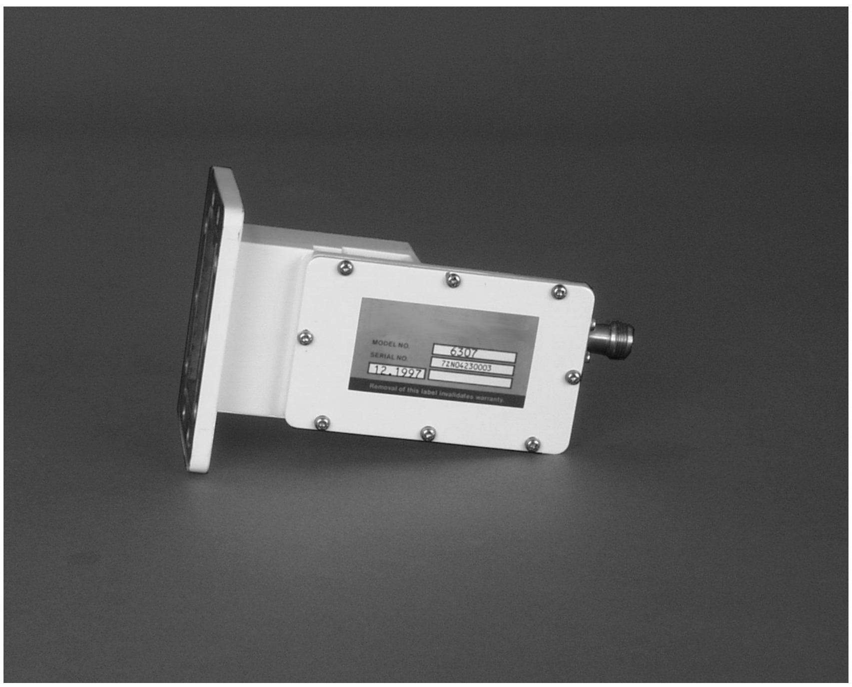

Figure 1-8. LNA

1.5 Options

The following options (Table 1-5)are applicable to the Ku-Band configuration only.

Refer to for Ku-Band options.

Table 1-5. Ku-Band Options

Description	Options
Transmit Power	0.8W 2.5 W
Receive Frequency Band	10.95 to 11.45 GHz 11.2 to 11.7 GHz 11.7 to 12.2 GHz 12.25 to 12.75 GHz

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Chapter 2
SPECIFICATIONS

The chapter provides the necessary specifications for the Satellite Terminal System.

2.1 C-Band System Specifications

Refer to Table 2-1 for the C-Band system specifications.

Table 2-1. C-Band System Specifications

Parameter	Specifications
TX Band	5.925 to 6.425 GHz
RX Band	3.7 to 4.2 GHz
RF Output Connector	Type N, female (on ODU)
RF Input Connector	CPR229G Wave Guide (on LNA assembly)
LNA/ODU Interconnect	50Ω, N male connectors – both sides
ODU/OMT Interconnect	50Ω, N male connectors – both sides 0.5 dB maximum attenuation at 3.7 to 4.2 GHz
IDU/ODU Interconnect:	Two coaxial cables
TX Cable	50Ω, N male connectors – both sides 20 dB maximum attenuation at 790 MHz, 2Ω maximum
RX Cable	50Ω, N male connectors – both sides 25 dB maximum attenuation at 950 to 1450 MHz, 2Ω maximum

Table 2-1. C-Band System Specifications (Continued)

Parameter	Specifications
Data I/O Connector	EIA-530-A, 25-pin D-sub, female (EIA-422, EIA-232, V.35) EIA-449, 37-pin D-sub, female (EIA-422) – optional EFD Standard, 50-pin D-sub, female – (ASYNC) – optional V.35, 34-pin Winchester - optional
Alarm Connector	Form-C Contact, 9-pin D-sub, female
Fault Connector	Form-C Contact, 9-pin D-sub, female
Auxiliary Connector	Open Collector, 9-pin D-sub, female
Remote Connector	EIA-232 or EIA-485, 9-pin D-sub, female
Prime Power – IDU	85 to 264 VAC, 47 to 63 Hz, using a 6-foot (2-meter) cable with a 3-prong plug. Meets EFData QUA_014 Operating Procedure.
Power Consumption: Total System	 150W maximum
Agency Compliance: Safety Emissions Susceptibility	 CE MARK – EN60950 CE MARK – EN55022-1 CE MARK – EN50082-1

2.1.1 C-Band Receive Specifications

Refer to Table 2-2 for receive specifications.

Table 2-2. C-Band Receive Specifications

Parameter	Specifications
Frequency Range	3.7 to 4.2 GHz
Frequency Resolution	100 Hz
Noise Figure	≤ 20 dB
RX Image Rejection	45 dBm minimum
Aggregate Signal Level, Maximum	-27 dBm at ODU down converter input
Symbol Rate Range (variable)	4.8 to 2500 ks/s
Data Rate Range (variable): QPSK BPSK	 4.8 to 4375 kbit/s, in 1 bit/s steps 2.4 to 1250 kbit/s, in 1 bit/s steps
Forward Error Correction	Viterbi K = 7 decoder, 1/2, 3/4, and 7/8 rate Optional: Sequential k = 36 1/2, 3/4 and 7/8 rate Optional: Reed-Solomon IESS 308/309 Concatenated 225, 205, T = 10.
Modulator Output IF Shape	EFD Closed CSC Closed FDC Closed
Demodulation	Coherent QPSK or BPSK
Acquisition Range	0 to 70 kHz in 1 Hz steps
Bit Error Rate (BER): Viterbi 1/2 rate Viterbi 1/2 rate with Reed-Solomon	 1 x 10^{-8} for E_b/N_0 7.2 dB 1 x 10^{-10} for E_b/N_0 5.0 dB
Ambiguity Resolution Method	Differential decoder
Descrambling	CCITT V.35 IESS modified, CCITT V.35 (EFD/CSC), FDC, 2^{15}-1 SYNC
Clock Jitter	2.0 dB maximum jitter gain, 4% RMS of 1/data rate absolute.

2.1.2 C-Band Transmit Specifications

Refer to Table 2-3 for transmit specifications.

Table 2-3. C-Band Transmit Specification

Parameter	Specifications
Frequency Range	5.925 to 6.425 GHz, in 100 Hz steps
Frequency Resolution	100 Hz
Maximum Power (P1db)	≥ +37 dBm, measured with a CW signal at ODU output connector
Power Range	+25 to +38 dBm, measured with a CW signal at ODU output connector
Power Resolution	0.1 dB steps
Output S/N Ratio	> 50 dB
Power Accuracy	± 1.5 dB at +37 dBm ± 2.0 dB at +27 dBm
Power Flatness	≤ 0.2 dB over any 1 MHz segment
Power Temperature Stability	± 0.75 dB maximum -40° to +55°C (-40° to +131°F)
Group Delay Variation	≤ 25 ns, over any 2.5 MHz segment
3rd IMD Intercept Point	+44 dBm minimum measured with two carriers 17 dB below intercept point at TX output with ALC ON measured with CW signal.
TX Frequency Drift/Temperature (IDU)	± 1 x 10^{-8} from 0° to +50°C (32° to 122°F)
Daily Frequency Stability	± 1 x 10^{-9} (at constant temperature)
Annual Reference Frequency Aging	< 5 x 10^{-8} (front panel adjustment for lifetime aging)
TX Phase Noise	< -65 dBc/Hz at 100 Hz < -70 dBc/Hz at 1 kHz < -70 dBc/Hz at 10 kHz < -75 dBc/Hz at 100 kHz or < 2.8° RMS SSB integrated 100 Hz to 1 MHz at ≥ +27 dBm output
Undesired Sideband Suppression	< -30 dBc
Carrier Suppression	< -35 dBc
Spurious	< -15 dBm
Harmonics	< -20 dBc
RF OFF Level	< -30 dBm
C-Band Output VSWR	≤ 1.5:1, 50Ω, 5.925 to 6.425 GHz
Symbol Rate Range (variable)	4.8 to 2500 ks/s
Data Rate Range (variable): QPSK BPSK	 4.8 to 4375 kbit/s, in 1 bit/s steps 2.4 to 1250 kbit/s, in 1 bit/s steps
Modulator Output IF Shape	EFD Closed CSC Closed FDC Closed
Modulation	Coherent QPSK or BPSK
Forward Error Correction	Viterbi K = 7 decoder, 1/2 3/4, and 7/8 rate Optional: Sequential k = 36, 1/2, 3/4, and 7/8 rate Optional: Reed-Solomon IESS 308/309 Concatenated 225, 205, T = 10.
Scrambling	CCITT V.35 IESS modified, CCITT V.35 (EFD/CSC), FDC, 2^{15}-1 SYNC

2.1.3 C-Band Transmit Reject Filter Specifications

Refer to Table 2-4 for transmit reject filter specifications.

Table 2-4. C-Band TX Reject Filter Specifications

Parameter	Specifications
Passband	3.7 to 4.2 GHz
Insertion Loss	0.035 dB maximum
Stop Band	5.85 to 6.425 GHz
Rejection	55 dB minimum
Flange Connection	CPR-229 G

2.1.4 C-Band Modulator-Related Specifications

2.1.4.1 Digital Data Rate

The digital data rate (Table 2-5) selectable in 1 Hz steps. The symbol rate is automatically calculated based on the programmed data rate. Data rates entered that exceed the data rate or symbol rate specification are rejected at entry.

The symbol rate range is 4.8 to 2500 ks/s.

Table 2-5. C-Band Digital Data Rate

Modulation Type	Encoding Type	Data Rate Range	
BPSK 1/2	Viterbi	2.4 kbit/s	1.25 Mbit/s
QPSK 1/2	Viterbi	4.8 kbit/s	2.5 Mbit/s
QPSK 3/4	Viterbi	7.2 kbit/s	3.75 Mbit/s
QPSK 7/8	Viterbi	8.4 kbit/s	4.375 Mbit/s
BPSK 1/2	Sequential	2.4 kbit/s	1.25 Mbit/s
QPSK 1/2	Sequential	4.8 kbit/s	2.5 Mbit/s
QPSK 3/4	Sequential	7.2 kbit/s	3.75 Mbit/s
QPSK 7/8	Sequential	8.4 kbit/s	4.375 Mbit/s
BPSK 1/2	Viterbi and Reed-Solomon	2.4 kbit/s	1.138 Mbit/s
QPSK 1/2	Viterbi and Reed-Solomon	4.8 kbit/s	2.277 Mbit/s
QPSK 3/4	Viterbi and Reed-Solomon	7.2 kbit/s	3.416 Mbit/s
QPSK 7/8	Viterbi and Reed-Solomon	8.4 kbit/s	3.986 Mbit/s
BPSK 1/2	Sequential and Reed-Solomon	2.4 kbit/s	1.138 Mbit/s
QPSK 1/2	Sequential and Reed-Solomon	4.8 kbit/s	2.277 Mbit/s
QPSK 3/4	Sequential and Reed-Solomon	7.2 kbit/s	3.416 Mbit/s
QPSK 7/8	Sequential and Reed-Solomon	8.4 kbit/s	3.986 Mbit/

Note: In ASYNC overhead operation, the maximum data rate is limited to 2048 kbit/s for QPSK modulation, and 1024 kbit/s for BPSK modulation.

2.1.4.2 Modulation and Encoding Types

Refer to Table 2-6 for combinations of modulation and forward error correction encoding.

Table 2-6. C-Band Modulation Encoding Types

Encoder	Code Rate	Modulation
Viterbi, K7	1/2	BPSK
Viterbi, K7 Reed-Solomon	1/2 225/205 Closed	BPSK BPSK
Viterbi, K7	1/2, 3/4, 7/8	QPSK
Viterbi, K7 Reed-Solomon	1/2, 3/4, 7/8 225/205 Closed	QPSK QPSK
Sequential	1/2	BPSK
Sequential Reed Solomon	1/2 225/205 Closed	BPSK BSPK
Sequential (EFD, CSD, FDC)	1/2, 3/4, 7/8	QPSK
Sequential Reed-Solomon	1/2, 3/4, 7/8 225/205 Closed	QPSK QPSK

Note: Reed-Solomon concatenated coding uses INTELSAT IESS 308/309 polynomial and is fully capable with SDM-300/SDM-300A closed network operation.

2.1.4.3 Scrambling Types

The customer may select one of the following:

- CCITT V.35 (EFData/Comstream compatible). Sequential only.
- CCITT V.35 INTELSAT modified. Viterbi only.
- Fairchild compatible. Sequential only.
- 2^{15} –1 Synchronous for use in ASYNC overhead mode.
- Modified V.35 (Closed Network Reed-Solomon).
- None.

2.1.4.4 Interleaver (Reed-Solomon Codec)

Depth 8 (Closed Network, ASYNC).

Note: The Reed-Solomon depth 8 interleaver is based on the IESS-310 specification for 8PSK and is adapted for QPSK/PRSK operation.

2.1.5 C-Band Transmit (TX)

2.1.5.1 Transmit Frequency

The operator can select the center frequency of the output spectrum from 5.925 to 6.425 GHz, in 100 Hz steps.

2.1.5.2 Transmit Frequency Reference

The standard internal reference frequency has a stability-over-temperature of ± 0.001 PPM.

The internal high stability oxcillator can be adjusted from the front panel to calibrated and counteract aging of the crystals.

2.1.5.3 Phase Noise

Note: Phase noise and RMS phase deviation (Table 2-7)shall be met at all times, at all frequencies, at all temperatures, and at all power levels.

Table 2-7. C-Band Phase Noise

Condition	Specification	
Phase noise of the transmit output carrier	dBc/Hz	Offset from Carrier
	-65.0	100 Hz
	-70.0	1 kHz
	-70.0	10 kHz
	-75.0	100 kHz
RMS Phase Deviation	10 Hz to 1 MHz, ≤ 2.8°	
Output Signal to Noise Ratio	≥ 50 dB	

2.1.5.4 Transmit Output Switch

When set to OFF, no signal present at the wave-guide flange is greater than -60 dBm, measured in a 3 kHz bandwidth.

2.1.5.5 Transmit Power

- The transmit power is operator-selectable from +25 to +38 dBm, in 0.1 dB steps.
- The maximum drift due to temperature change is ± 0.75 dB. (The ALC feature of the ODU is used.)
- The transmit power accuracy is ± 2.0 dB at +25 dBm and ± 1.5 dB at +38 dBm.
- The transmit output is flat within 0.2 dB over any 1 MHz segment.

2.1.5.6 Modulated Output Shape

The terminal meets the following transmit output spectral mask specifications, subject to the limitations of a 50 dB S/N ratio. The desired mask is selectable from the front panel or remotely.

- Closed Network (EFData/Comstream)
- Closed Network (Fairchild compatible)

2.1.5.7 Spurious Emissions

Spurious emissions are measured at the C-Band ODU output Type N female connector. The measurement is done with the carrier ON, in continuous mode, and modulated by the correct data/clock signal.

- Spurious emissions measured in a 3 kHz bandwidth at the transmit output are ≤ -15 dBm from 3.7 to 8 GHz, excluding a band ± 1 MHz from the carrier.
- Spurious emissions measured in a 3 kHz bandwidth from 3.7 to 4.2 GHz are ≤ -100 dBm.
- The carrier is suppressed to ≤ -35 dBc in normal operating mode.
- The undesired sidebands of the modulated signal is suppressed to ≤ -35 dBc.
- The harmonics of the modulated signal is < -20 dBc.

2.1.6 C-Band Transmit Test Modes

The following transmit test modes are available to the customer. Spurious emissions in the following test modes will be ≤ -30 dBc.

- CW – Outputs a single carrier at the defined frequency.
- Offset – Dual sideband signal with lower sideband and carrier suppressed ≤ 30 dBc.
- Dual sideband – Suppressed carrier ≤ 30 dBc.

2.1.7 C-Band Modulator Spectrum Rotation

The customer can select normal or inverted spectrum of the Modulator Output.

2.1.8 C-Band Output VSWR

The VSWR into a 50Ω load is ≤ 1.5:1 for the frequency range of 5.925 to 6.425 GHz.

2.1.9 C-Band Transmit Frequency Change Time

Upon receiving a command to change the TX RF frequency, the terminal reprograms the IDU and ODU accordingly. The transmit frequency is stable in < 500 ms.

2.1.10 C-Band Demodulator-Related Specifications

2.1.10.1 Digital Data Rate

The digital data rate (Table 2-8) is selectable in 1 bit/s steps. The symbol rate is automatically calculated on the programmed data rate. Data rates entered that exceed the data rate or symbol rate specification are rejected at entry.

The symbol rate range is 4.8 to 2500 ks/s.

Table 2-8. C-Band Digital Data Rate

Modulation Type	Decoding Type	Data Rate Range	
BPSK 1/2	Viterbi	2.4 kbit/s	1.25 Mbit/s
QPSK 1/2	Viterbi	4.8 kbit/s	2.5 Mbit/s
QPSK 3/4	Viterbi	7.2 kbit/s	3.75 Mbit/s
QPSK 7/8	Viterbi	8.4 kbit/s	4.375 Mbit/s
BPSK 1/2	Sequential	2.4 kbit/s	1.25 Mbit/s
QPSK 1/2	Sequential	4.8 kbit/s	2.5 Mbit/s
QPSK 3/4	Sequential	7.2 kbit/s	3.75 Mbit/s
QPSK 7/8	Sequential	8.4 kbit/s	4.375 Mbit/s
BPSK 1/2	Viterbi and Reed-Solomon	2.4 kbit/s	1.138 Mbit/s
QPSK 1/2	Viterbi and Reed-Solomon	4.8 kbit/s	2.277 Mbit/s
QPSK 3/4	Viterbi and Reed-Solomon	7.2 kbit/s	3.416 Mbit/s
QPSK 7/8	Viterbi and Reed-Solomon	8.4 kbit/s	3.986 Mbit/s
BPSK 1/2	Sequential and Reed-Solomon	2.4 kbit/s	1.138 Mbit/s
QPSK 1/2	Sequential and Reed-Solomon	4.8 kbit/s	2.277 Mbit/s
QPSK 3/4	Sequential and Reed-Solomon	7.2 kbit/s	3.416 Mbit/s
QPSK 7/8	Sequential and Reed-Solomon	8.4 kbit/s	3.986 Mbit/s

Note: In ASYNC overhead operation, the maximum data rate is limited to 2048 kbit/s for QPSK modulation, and 1024 kbit/s for BPSK modulation.

2.1.10.2 Demodulation and FEC Decoding Types

Refer to Table 2-9 for combinations of modulation and forward error correction (FEC) encoding.

Table 2-9. C-Band Modulation and Encoding Types

Encoder	Code Rate	Modulation
Viterbi, K7	1/2	BPSK
Viterbi, K7 Reed-Solomon	1/2 225/205 Closed	BPSK BPSK
Viterbi, K7	1/2, 3/4, 7/8	QPSK
Viterbi, K7 Reed-Solomon	1/2, 3/4, 7/8 225/205 Closed	QPSK QPSK
Sequential	1/2	BPSK
Sequential Reed-Solomon	1/2 225/205 Closed	BPSK BSPK
Sequential (EFD, CSD, FDC)	1/2, 3/4, 7/8	QPSK
Sequential Reed-Solomon	1/2, 3/4, 7/8 225/205 Closed	QPSK QPSK

2.1.10.3 Descrambling Types

The customer may select one of the following:

- CCITT V.35 (EFData/Comstream compatible). Sequential only.
- CCITT V.35 INTELSAT modified. Viterbi only.
- Fairchild compatible. Sequential only.
- 2^{15}-1 Synchronous for use in ASYNC overhead mode.
- Modified V.35 (Closed Network Reed-Solomon).
- None.

2.1.10.4 Deinterleaver (Reed-Solomon Codec)

Depth 8 (Closed Network).

Note: The Reed-Solomon depth 8 deinterleaver is based on the IESS-310 specification for 8PSK and is adapted for QPSK/BPSK operation.

2.1.10.5 Receive Frequency

The receive frequency can be selected by the user from 3.7 to 4.2 GHz, in 100 Hz steps. The actual value of offset from the programmed frequency is available to the user on the front panel as well as the remote port. The resolution of this value is 1 Hz; the accuracy is ± 25 kHz.

2.1.10.6 Receive Input Power (Composite)

The terminal can operate to its specified performance under all of the following conditions:

- The sum of all carriers and noise in receive band is ≤ -27 dBm at the ODU down converter input.
- The sum of all carriers within 10 MHz from the desired is ≤ +30 dBc relative to the desired carrier.
- The sum of all carriers is ≤ +50 dBc relative to the desired carrier for operation at 64 ks/s and below, or ≤ +40 dBc at > 64 ks/s operation.

2.1.10.7 Demodulator IF Input Shape

The terminal can be set to match any of the following spectral mask specifications:

- Closed Network (EFData/Comstream).
- Closed Network (Fairchild compatible).

2.1.10.8 Channel Spacing/Adjacent Carrier Performance

The terminal bit error performance will be degraded < 0.5 dB with the following receive signal:

- Two like-modulated carriers spaced 1.3 times the symbol rate from the receive frequency, and/or 1.2 times the acquisition range, whichever is larger.
- Each adjacent carrier up to 10 dBc higher in power than the desired carrier.
- Single adjacent carrier spaced 1.4 times symbol rate up to +20 dBc higher in power than the desired carrier.

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2.2 Ku-Band System Specifications

Refer to Table 2-10 for system specifications.

Table 2-10. Ku-Band System Specifications

Parameter	Specification
Transmit Band	14.0 to 14.5 GHz
Receive Band	10.95 to 11.45 GHz 11.20 to 11.7 GHz 11.70 to 12.2 GHz 12.25 to 12.75 GHz
OMT/FEED Interface	Circular Waveguide Flange (WC-75)
IDU/ODU interconnect: TX Cable RX Cable	 50Ω, N male connector (both ends) 20 dB maximum atten at 790 MHz, 2Ω maximum 50Ω, N male connector (both ends) 25 dB maximum atten at 950 to 1450 MHz, 2Ω maximum
APS Connector	Type N female with waterproof cap DC voltage corresponding to IDU RX signal level
Data I/O Connector	EIA-530. 25-pin D sub, female (EIA-422, EIA-232, V.35) EIA-449, 37-pin D sub, female (EIA-422) Optional EFD Standard, 50-pin D sub, female (ASYNC) Optional V.35, 34-pin Winchester Optional
Alarm Connector	Form C Contact, 9-pin D sub, female
Fault Connector	Form C Contact, 9-pin D sub, female
Auxiliary Connector	Open Collector, 9-pin D sub, female
Prime Power – IDU	8.5 to 264 VAC, 47 to 63 Hz, using a 6 foot (2 meter) cable 3-prong plug: Meets EFData QUA_014 Operating Procedures
Power Consumption Total System –AC	225W maximum K1 – 0.8W K3 – 2.5W
Agency Compliance: Safety Emission Susceptibility	 CE MARK – EN60950 CE MARK – EN60950 CE MARK – EN50082-1

2.2.1 Ku-Band Transmit Specifications

Refer to Table 2-11 for Ku-Band transmit specifications.

Table 2-11. Ku-Band Transmit Specifications

Parameter	Specification
Frequency Range	14.0 to 14.5 GHz
Frequency Resolution	100 Hz
Maximum Power (P1dB)	≥ +30 dBm or ≥ +35 dBm, measured with a CW signal
Power Range	+17 to +30 dBm or +22 to +35 dBm, measured with a CW signal
Power Resolution	0.1 dB steps
Output S/N Ratio	> 50 dB
Power Accuracy	± 1.5 dB at maximum power ± 2.0 dB at maximum power
Power Flatness	≤ 0.2 dB over any 1 MHz segment
Power Temperature Stability	± 0.75 dB, maximum –40° to +55°C (–40° to +127°F)
Group Delay Variation	≤ 25 ns p-p, over any 2.5 MHz segment
3rd IMD Intercept Point	+44 dBm minimum, measured with two carriers 17 dB below intercept point at transmit output with ALC ON measured with CW signal
Transmit Frequency Drift/Temperature	± 1 x 10^{-8} from 0° to +50°C (32° to 122°F) (IDU)
Daily Frequency Stability	± 1 x 10^{-9} (at constant temperature)
Annual Reference Frequency Aging	< 5 x 10^{-8} (front panel adjustment for lifetime aging)
Transmit Phase Noise	< 3.0° RMS SSB integrated 100 Hz to 1 MHz
Undesired Sideband Suppression	< -30 dBc
Carrier Suppression	< -35 dBc
Spurious	< -13 dBm
Harmonics	< -20 dBc
RF Off Level	< - 30 dBm
Ku-Band Output VSWR	≤ 1.5:1, 50Ω, 14.0 to 14.5 GHz
Symbol Rate Range (Variable)	4.8 to 2500 ks/s
Data Rate Range (Variable): QPSK BPSK	 4.8 to 4375 kbit/s, in 1.0 bit/s steps 2.4 to 1250 kbit/s, in 1.0 bit/s steps
Modulator Output IF Shape	EFD Closed, CSC Closed, FDC Closed
Modulation	Coherent QPSK or BPSK
Forward Error Correction	Viterbi K = 7, 1/2, 3/4, 7/8 rate Optional: Sequential K = 36, 1/2, 3/4, 7/8 rate Optional: Reed-Solomon IESS 308/309 Concatenated 225.205 T = 10
Scrambling	CCITT V.35 IESS modified, CCITT V.35 (EFD/CSC). FDC, 2^{15}-1 SYNC

2.2.2 Ku-Band Receiver Specifications

Refer to Table 2-12 for Ku-Band receiver specifications.

Table 2-12. Ku-Band Receiver Specifications

Parameter	Specifications
Frequency Range	10.95 to 11.45 GHz 11.2 to 11.7 GHz 11.7 to 12.2 GHz 12.25 to 12.75 GHz
Frequency Resolution	100 Hz
System Noise Figure	< 160 K
Receive Image Rejection	30 dB, minimum
Maximum Aggregate Signal Level	-75 dBm at ODU OMT input
Symbol Rate Range (Variable)	4.8 to 2500 ks/s
Data Rate Range (Variable): QPSK BPSK	 4.8 to 4375 kbit/s, in 1.0 bit/s steps 2.4 to 1250 kbit/s, in 1.0 bit/s steps
Forward Correction	Viterbi K = 7 Decoder, 1/2, 3/4, 7/8 rate Optional: Sequential K = 36, 1/2, 3/4, 7/8 rate Optional: Reed-Solomon IESS 308/309 Concatenated 225.205 T = 10
Demodulator IF Shape	EFD Closed, CSC Closed, FDC Closed
Demodulation	Coherent QPSK or BPSK
Acquisition Range	0 to 70 kHz, in 1 Hz steps
Bit Error Rate: Viterbi 1/2 Rate Viterbi 1/2 Rate with Reed-Solomon	 1 x 10^{-8} for E_b/N_0 7.2 dB 1 x 10^{-10} for E_b/N_0 5.0 dB
Ambiguity Resolution Method	Differential Decoder
Data Buffer	0 to 50 ms in 1ms steps
Descrambling	CCITT V.35 IESS modified, CCITT V.35 (EFD/CSC), FDC, 2^{15}-1 SYNC
Clock Jitter	2.0 dB maximum jitter gain, 4% RMS of 1/data rate absolute

2.2.3 Ku-Band Modulator-Related Specifications

2.2.3.1 Digital Data Rate

The digital data rate (Table 2-13) is selectable in 1 Hz steps. The symbol rate is automatically calculated based on the programmed data rate. Data rates that exceed the data rate or symbol rate specification are rejected at entry.

The symbol rate range is 4.8 kHz to 2.5 MHz.

Table 2-13. Ku-Band Digital Data Rate

Modulation Type	Encoding Type	Data Rate Range	
BPSK 1/2	Viterbi	2.4 kbit/s	1.25 Mbit/s
QPSK 1/2	Viterbi	4.8 kbit/s	2.5 Mbit/s
QPSK 3/4	Viterbi	7.2 kbit/s	3.75 Mbit/s
QPSK 7/8	Viterbi	8.4 kbit/s	4.375 Mbit/s
BPSK 1/2	Sequential	2.4 kbit/s	1.25 Mbit/s
QPSK 1/2	Sequential	4.8 kbit/s	2.5 Mbit/s
QPSK 3/4	Sequential	7.2 kbit/s	3.75 Mbit/s
QPSK 7/8	Sequential	8.4 kbit/s	4.375 Mbit/s
BPSK 1/2	Viterbi and Reed-Solomon	2.4 kbit/s	1.138 Mbit/s
QPSK 1/2	Viterbi and Reed-Solomon	4.8 kbit/s	2.277 Mbit/s
QPSK 3/4	Viterbi and Reed-Solomon	7.2 kbit/s	3.416 Mbit/s
QPSK 7/8	Viterbi and Reed-Solomon	8.4 kbit/s	3.986 Mbit/s
BPSK 1/2	Sequential and Reed-Solomon	2.4 kbit/s	1.138 Mbit/s
QPSK 1/2	Sequential and Reed-Solomon	4.8 kbit/s	2.277 Mbit/s
QPSK 3/4	Sequential and Reed-Solomon	7.2 kbit/s	3.416 Mbit/s
QPSK 7/8	Sequential and Reed-Solomon	8.4 kbit/s	3.986 Mbit/

Note: In ASYNC overhead operation, the maximum data rate is limited to 2048 kbit/s for QPSK modulation, and 1024 kbit/s for BPSK modulation.

2.2.3.2 Modulation and Encoding Types

Refer to Table 2-14 for combinations of modulation and forward error correction encoding.

Table 2-14. Modulation Encoding Types

Encoder	Code Rate	Modulation
Viterbi, K7	1/2	BPSK
Viterbi, K7 Reed-Solomon	1/2 225/205 Closed	BPSK BPSK
Viterbi, K7	1/2, 3/4, 7/8	QPSK
Viterbi, K7 Reed-Solomon	1/2, 3/4, 7/8 225/205 Closed	QPSK QPSK
Sequential	1/2	BPSK
Sequential Reed Solomon	1/2 225/205 Closed	BPSK BSPK
Sequential (EFD, CSD, FDC)	1/2, 3/4, 7/8	QPSK
Sequential Reed-Solomon	1/2, 3/4, 7/8 225/205 Closed	QPSK QPSK

Note: Reed-Solomon concatenated coding uses INTELSAT IESS 308/309 polynomial and is fully capable with SDM-300/SDM-300A closed network operation.

2.2.3.3 Scrambling Types

The customer may select one of the following:

- CCITT V.35 (EFData/Comstream compatible). Sequential only.
- CCITT V.35 INTELSAT modified. Viterbi only.
- Fairchild compatible. Sequential only.
- 2^{15} –1 Synchronous for use in ASYNC overhead mode.
- Modified V.35 (Closed Network Reed-Solomon).
- None.

2.2.3.4 Interleaver (Reed-Solomon Codec)

Depth 8 (Closed Network, ASYNC).

Note: The Reed-Solomon depth 8 interleaver is based on the IESS-310 specification for 8PSK and is adapted for QPSK/BPSK operation.

2.2.4 Ku-Band Transmit (TX)

2.2.4.1 Transmit Frequency

The operator can select the center frequency of the output spectrum from 14.0 to 14.5 GHz, in 100 Hz steps.

2.2.4.2 Transmit Frequency Reference

The standard internal reference frequency has a stability-over-temperature of ± 0.001 PPM.

2.2.4.3 Phase Noise

Note: RMS phase deviation and output signal to noise ration will be met at all times, at all frequencies, at all temperatures, and at all power levels.

1. The maximum RMS phase deviation due to spurs and noise integrated from 100 Hz to 1 MHz is less than 3.0°.
2. The Output Signal to Noise Ratio is ≥ 50 dB for all output power levels.

2.2.4.4 Transmit Output Switch

When set to OFF, no signal present at the wave-guide flange is greater than -30 dBm, measured in a 3 kHz bandwidth.

2.2.4.5 Transmit IF Power

1. The transmit power is operator-selectable from +17 to +30 dBm or +22 to +35 dBm, in 0.1 dB steps.

2. The maximum drift due to temperature change is ± 0.75 dB. (The ALC feature of the ODU is used.)

3. The transmit power accuracy is ± 2.0 dB at minimum power and ± 1.5 dB at maximum power.

4. The transmit output is flat within 0.2 dB over any 1 MHz segment.

2.2.4.6 Modulated Output Shape

The terminal meets the following transmit output spectral mask specifications, subject to the limitations of a 50 dB S/N ratio. The desired mask is selectable from the front panel or remotely.

- Closed Network (EFData/Comstream)
- Closed Network (Fairchild compatible)

2.2.4.7 Spurious Emissions

Spurious emissions are measured at the Ku-Band ODU output Type N female connector. The measurement is done with the carrier ON, in continuous mode, and modulated by the correct data/clock signal.

1. Spurious emissions measured in a 3 kHz bandwidth at the transmit output are ≤ -13 dBm from 10.7 to 15 GHz., excluding a band ± 1 MHz from the carrier.

2. Spurious emissions measured in a 3 kHz bandwidth from 10.95 to 12.75 GHz are ≤ -126 dBm.

3. The carrier is suppressed to ≤ -35 dBc in normal operating mode.

4. The undesired sidebands of the modulated signal is suppressed to ≤ -30 dBc.

5. The harmonics of the modulated signal is < -20 dBc.

2.2.4.8 Transmit Test Modes

The following transmit test modes are available to the operator. Spurious emissions in the following test modes will be ≤ -30 dBc.

- CW – Outputs a single carrier at the defined frequency.
- Offset – Dual sideband signal with lower sideband and carrier suppressed ≤ 30 dBc.
- Dual sideband – Suppressed carrier ≤ 30 dBc.

2.2.4.9 Modulator Spectrum Rotation

The customer can select normal or inverted spectrum of the Modulator Output.

2.2.4.10 Output VSWR

The VSWR into a 50Ω load is ≤ 1.5:1 for the frequency range of 14.0 to 14.5 GHz.

2.2.4.11 TX Frequency Change Time

Upon receiving a command to change the TX RF frequency, the terminal reprograms the IDU and ODU accordingly. The transmit frequency is stable in < 500 ms.

2.2.5 Ku-Band Receive (RX) Specifications

2.2.5.1 Digital Data Rate

The digital data rate (Table 2-15) is selectable in 1 bit/s steps. The symbol rate is automatically calculated on the programmed data rate. Data rates that exceed the data rate or symbol rate specification are rejected at entry.

The symbol rate range is 4.8 to 2500 ks/s.

Table 2-15. Ku-Band Digital Data Rate

Modulation Type	Decoding Type	Data Rate Range	
BPSK 1/2	Viterbi	2.4 kbit/s	1.25 Mbit/s
QPSK 1/2	Viterbi	4.8 kbit/s	2.5 Mbit/s
QPSK 3/4	Viterbi	7.2 kbit/s	3.75 Mbit/s
QPSK 7/8	Viterbi	8.4 kbit/s	4.375 Mbit/s
BPSK 1/2	Sequential	2.4 kbit/s	1.25 Mbit/s
QPSK 1/2	Sequential	4.8 kbit/s	2.5 Mbit/s
QPSK 3/4	Sequential	7.2 kbit/s	3.75 Mbit/s
QPSK 7/8	Sequential	8.4 kbit/s	4.375 Mbit/s
BPSK 1/2	Viterbi and Reed-Solomon	2.4 kbit/s	1.138 Mbit/s
QPSK 1/2	Viterbi and Reed-Solomon	4.8 kbit/s	2.277 Mbit/s
QPSK 3/4	Viterbi and Reed-Solomon	7.2 kbit/s	3.416 Mbit/s
QPSK 7/8	Viterbi and Reed-Solomon	8.4 kbit/s	3.986 Mbit/s
BPSK 1/2	Sequential and Reed-Solomon	2.4 kbit/s	1.138 Mbit/s
QPSK 1/2	Sequential and Reed-Solomon	4.8 kbit/s	2.277 Mbit/s
QPSK 3/4	Sequential and Reed-Solomon	7.2 kbit/s	3.416 Mbit/s
QPSK 7/8	Sequential and Reed-Solomon	8.4 kbit/s	3.986 Mbit/s

Note: In ASYNC overhead operation, the maximum data rate is limited to 2048 kbit/s for QPSK modulation, and 1024 kbit/s for BPSK modulation.

2.2.5.2 Demodulation and FEC Decoding Types

Refer to Table 2-16 for combinations of the modulation and forward error correction encoding.

Table 2-16. Ku-Band Demodulation and Encoding Types

Encoder	Code Rate	Modulation
Viterbi, K7	1/2	BPSK
Viterbi, K7 Reed-Solomon	1/2 225/205 Closed	BPSK BPSK
Viterbi, K7	1/2, 3/4, 7/8	QPSK
Viterbi, K7 Reed-Solomon	1/2, 3/4, 7/8 225/205 Closed	QPSK QPSK
Sequential	1/2	BPSK
Sequential Reed-Solomon	1/2 225/205 Closed	BPSK BSPK
Sequential (EFD, CSD, FDC)	1/2, 3/4, 7/8	QPSK
Sequential Reed-Solomon	1/2, 3/4, 7/8 225/205 Closed	QPSK QPSK

2.2.5.3 Descrambling Types

The customer may select one of the following:

- CCITT V.35 (EFData/Comstream compatible). Sequential only.
- CCITT V.35 INTELSAT modified. Viterbi only.
- Fairchild compatible. Sequential only.
- 2^{15}-1 Synchronous for use in ASYNC overhead mode.
- Modified V.35 (Closed Network Reed-Solomon).
- None.

2.2.5.4 Deinterleaver (Reed-Solomon Codec)

Depth 8 (Closed Network).

Note: The Reed-Solomon depth 8 deinterleaver is based on the IESS-310 specification for 8PSK and is adapted for QPSK/BPSK operation.

2.2.5.5 Receive Frequency

The operator in 100 Hz steps can select the receive frequency in one of the following bands:

- 10.95 to 11.45 GHz
- 11.2 to 11.7 GHz
- 11.7 to 12.2 GHz
- 12.25 to 12.75 GHz

The actual value of offset from the programmed frequency is available to the user on the front panel as well as the remote port. The resolution of this value is 1 Hz.

2.2.5.6 Receive Input Power (Composite)

The terminal can operate to its specified performance under all of the following conditions:

- The sum of all carriers and noise in receive band is ≤ -75 dBm at the ODU OMT input.

- The sum of all carriers within 10 MHz from the desired is ≤ +30 dBc relative to the desired carrier.

- The sum of all carriers is ≤ +50 dBc relative to the desired carrier for operation at 64 ks/s and below, or ≤ +40 dBc at > 64 ks/s operation.

2.2.5.7 Demodulator IF Input Shape

The terminal can be set to match any of the following spectral mask specifications:

- Closed Network (EFData/Comstream).
- Closed Network (Fairchild compatible).

2.2.5.8 Channel Spacing/Adjacent Carrier Performance

The terminal bit error performance will be degraded less than 0.5 dB with the following receive signal:

- Two like-modulated carriers spaced 1.3 times the symbol rate from the receive frequency, and/or 1.2 times the acquisition range, whichever is larger.
- Each adjacent carrier up to 10 dBc higher in power than the desired carrier.
- Single adjacent carrier spaced 1.4 times symbol rate up to +20 dBc higher in power than the desired carrier.

2.3 Bit Error Rate Performance

Note: The following BER performance data applies to the C-Band and Ku-Band units.

Table 2-18 through Table 2-21 list the Bit Energy-to-Noise Ratio (E_b/N_0) required to achieve 10^{-3} to 10^{-10} BER.

Refer to Table 2-17 for BER performance curves for various options.

Table 2-17. BER Performance

Table	Option
2-18	Viterbi Decoder
2-19	Viterbi and Reed-Solomon
2-20	56 kbit/s Sequential Decoder
2-21	1544 kbit/s Sequential Decoder

2.3.1 Performance with Noise and Viterbi Decoder

Refer to Table 2-18 for noise and Viterbi decoder BER.

Refer to Figure 2-1.

Table 2-18. Noise and Viterbi Decoder

E_b/N_0 (dB) Specification			
BER	**1/2 Rate**	**3/4 Rate**	**7/8 Rate**
10^{-3}	3.8	4.9	6.1
10^{-4}	4.6	5.7	6.9
10^{-5}	5.3	6.4	7.6
10^{-6}	6.0	7.2	8.3
10^{-7}	6.6	7.9	8.9
10^{-8}	7.2	8.5	9.6

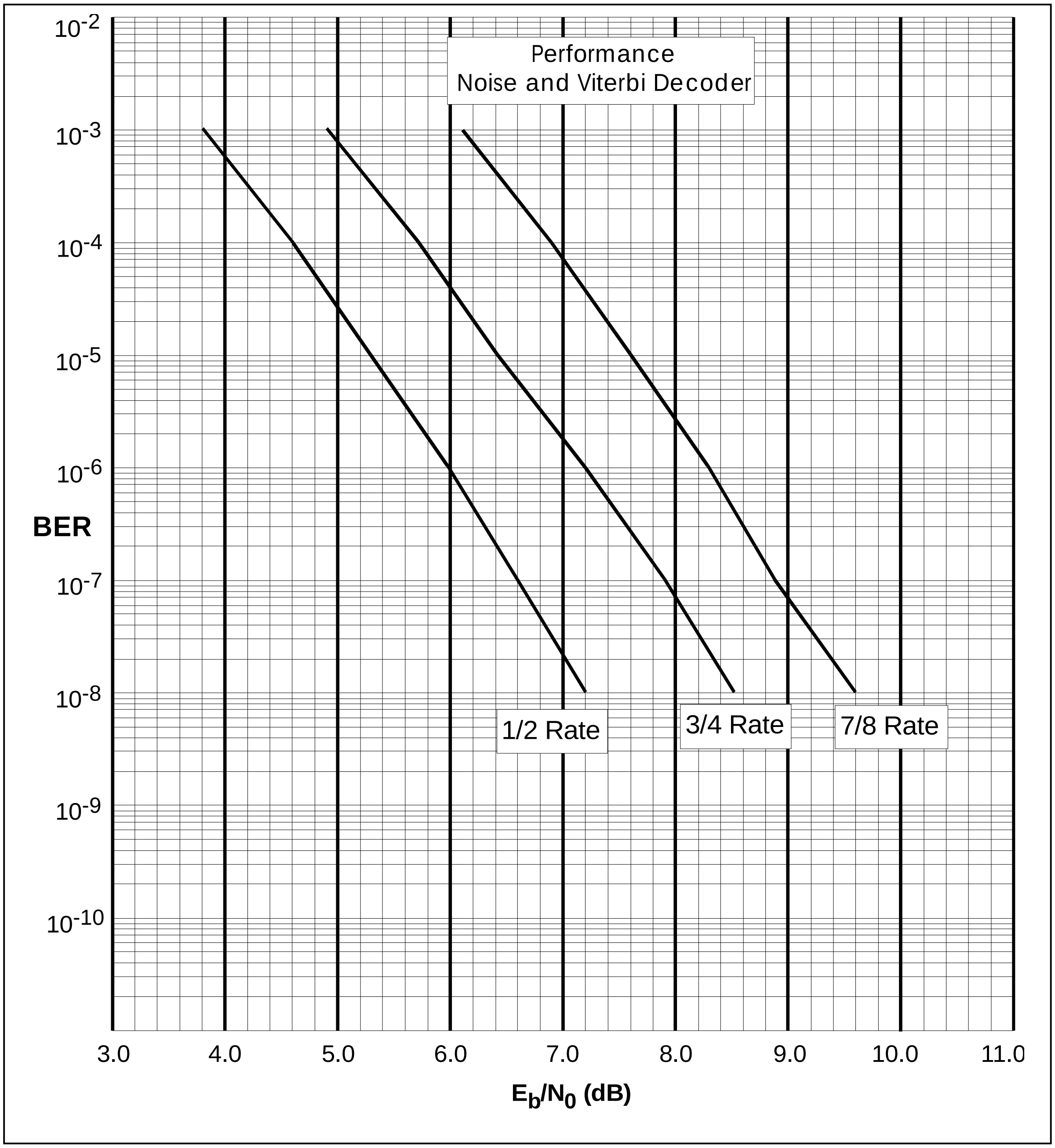

Figure 2-1. Performance with Noise and Viterbi Decoder

2.3.2 Performance with Noise, Viterbi Decoder, and Reed-Solomon (Optional)

Refer to Table 2-19 for noise, Viterbi decoder, and Reed-Solomon BER.

Refer to Figure 2-2.

Table 2-19. Noise, Viterbi Decoder, and Reed-Solomon

E_b/N_0 (dB) Specification			
BER	**1/2 Rate**	**3/4 Rate**	**7/8 Rate**
10^{-6}	4.1	5.6	6.7
10^{-7}	4.2	5.8	6.9
10^{-8}	4.4	6.0	7.1
10^{-10}	5.0	6.3	7.5

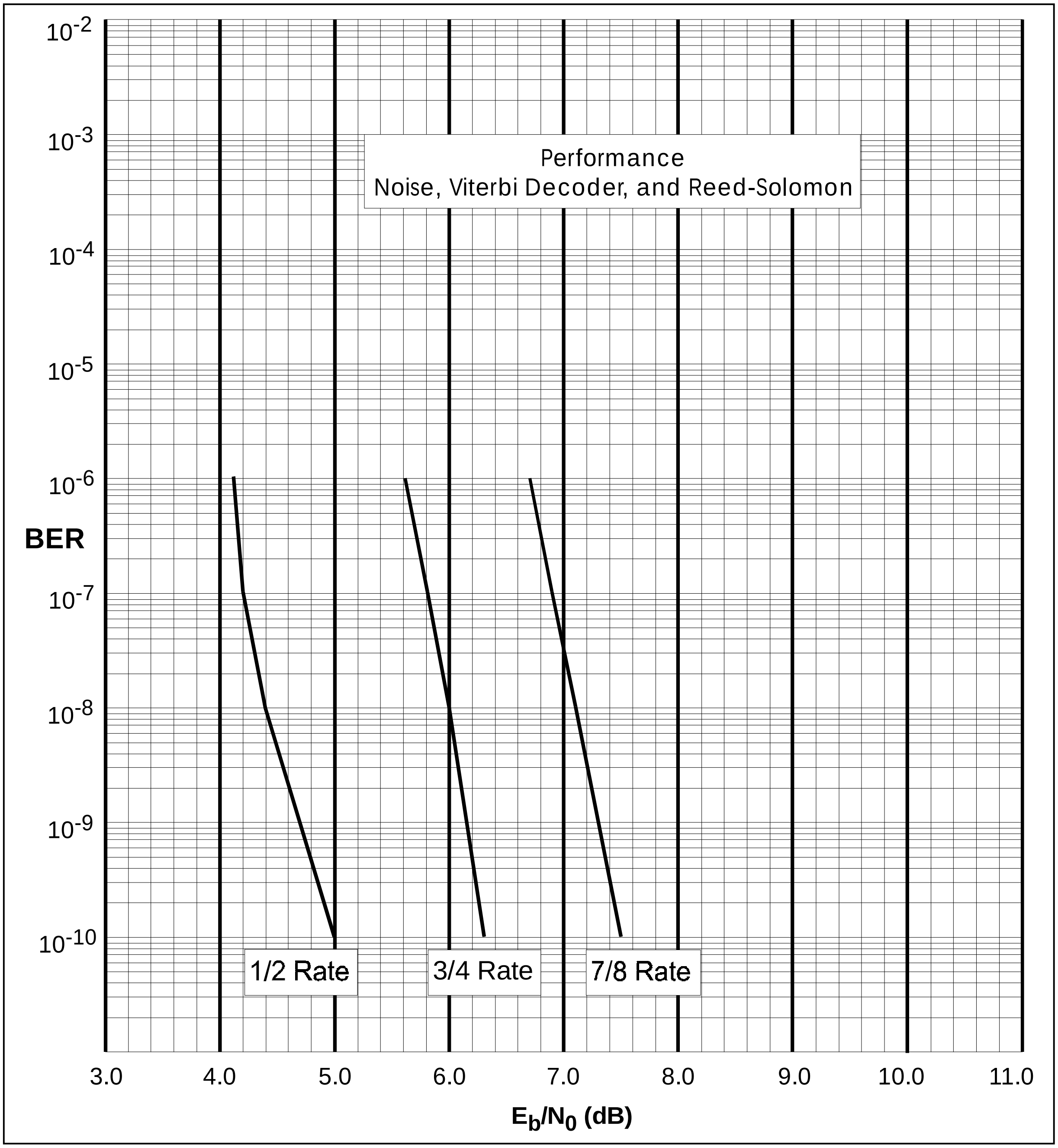

Figure 2-2. Performance with Noise, Viterbi Decoder, and Reed-Solomon

2.3.3 Performance with Noise, 56 kbit/s, and Sequential Decoder (Optional)

Refer to Table 2-20 for noise, 56 kbit/s, Sequential decoder BER.

Refer to Figure 2-3.

Table 2-20. Noise, 56 kbit/s, and Sequential Decoder

E_b/N_0 (dB) Specification			
BER	**1/2 Rate**	**3/4 Rate**	**7/8 Rate**
10^{-3}		4.6	5.5
10^{-4}	4.1	5.1	6.1
10^{-5}	4.5	5.5	6.6
10^{-6}	5.0	5.9	7.3
10^{-7}	5.4	6.4	7.8
10^{-8}	5.8	6.8	8.4

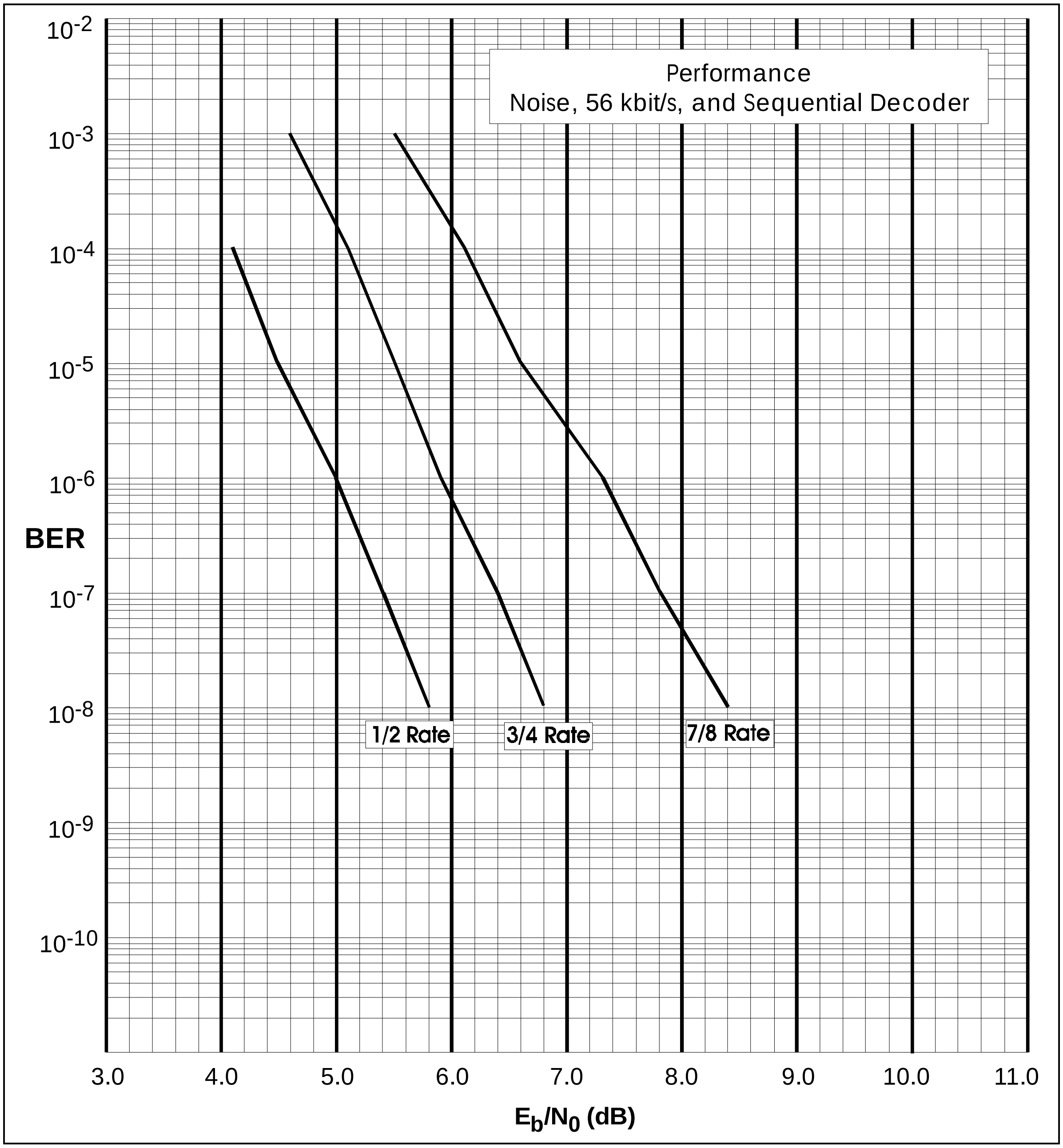

Figure 2-3. Performance with Noise, 56 kbit/s, and Sequential Decoder

2.3.4 Performance with Noise, 1544 kbit/s, and Sequential Decoder

Refer to Table 2-21 for noise, 1544 kbit/s, sequential decoder BER.

Refer to Figure 2-4.

Table 2-21. Noise, 1544 kbit/s, and Sequential Decoder

E_b/N_0 (dB) Specification			
BER	**1/2 Rate**	**3/4 Rate**	**7/8 Rate**
10^{-3}	4.8	5.2	6.0
10^{-4}	5.2	5.7	6.4
10^{-5}	5.6	6.1	6.9
10^{-6}	5.9	6.5	7.4
10^{-7}	6.3	7.0	7.9
10^{-8}	6.7	7.4	8.4

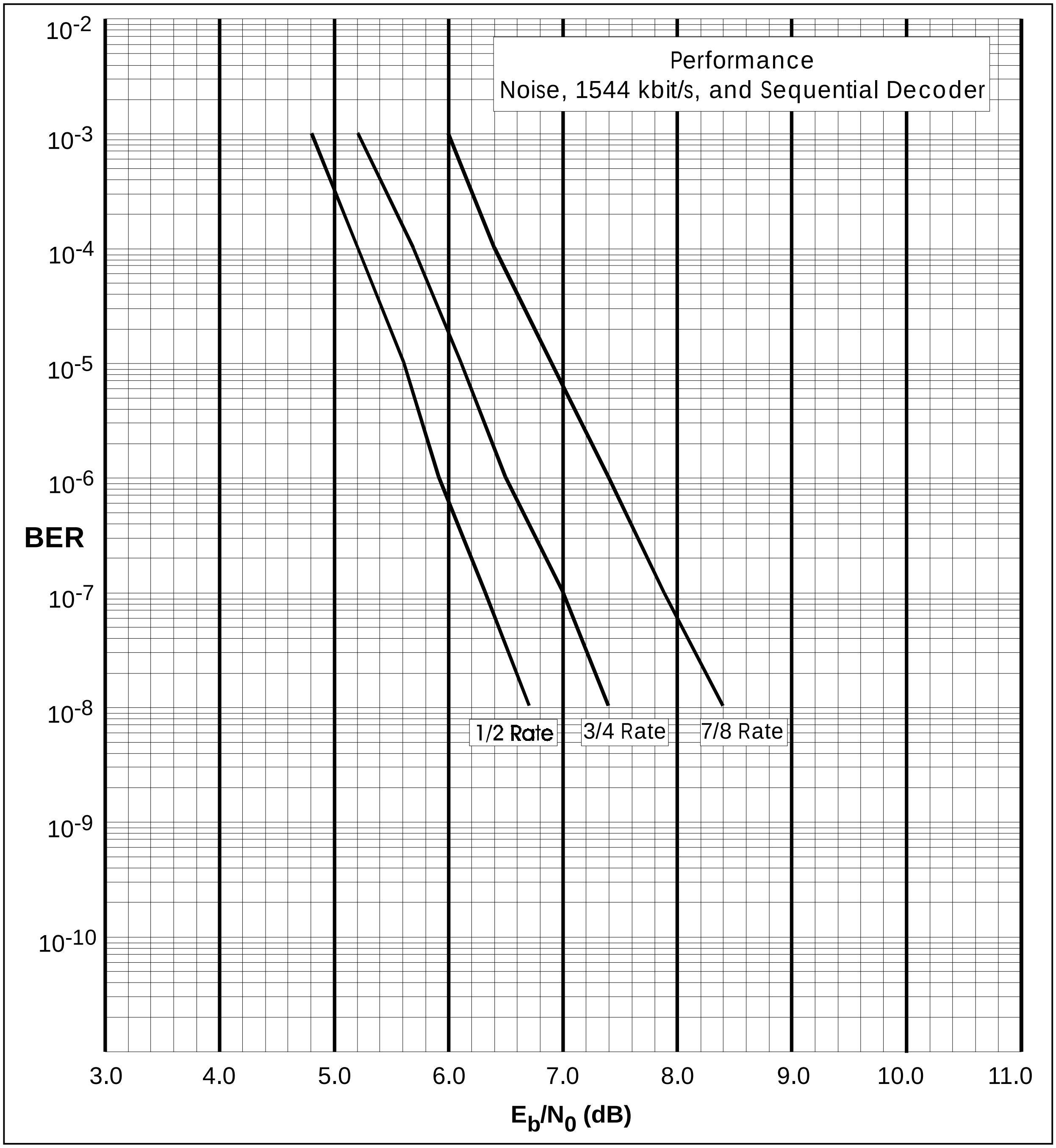

Figure 2-4. Performance with Noise, 1544 kbit/s, and Sequential Decoder

2.4 Acquisition Times

Refer to Table 2-22 for acquisition times.

Table 2-22. Acquisition Times

Viterbi 6 dB E_b/N_0 with ± 35 kHz frequency Uncertainty			
Code Rate	**Data Rate**	**Tacq**	**P (t < Tacq)**
1/2	< 9.6 kbit/s	< 10 sec	95%
1/2	≥ 9.6 < 64 kbit/s	< 5 sec	95%
1/2	≥ 64 < 196 kbit/s	< 1 sec	95%
1/2	≥ 196 < 512 kbit/s	< 10 sec	95%
1/2	≥ 512 < 1000 kbit/s	< 2.5 sec	95%
1/2	≥ 1 < 2.5 Mbit/s	< 1 sec	95%
Sequential 6 dB E_b/N_0 with ± 35 kHz frequency Uncertainty			
Code Rate	**Data Rate**	**Tacq**	**P (t < Tacq)**
1/2	2.4 < 4.8 kbit/s	< 20 sec	95%
1/2	≥ 4.8 < 9.6 kbit/s	< 10 sec	95%
1/2	≥ 9.6 < 64 kbit/s	< 5 sec	95%
1/2	≥ 64 < 196 kbit/s	< 1 sec	95%
1/2	≥ 196 < 512 kbit/s	< 17 sec	95%
1/2	≥ 512 < 1000 kbit/s	< 2.5 sec	95%
1/2	≥ 1 < 2.5 Mbit/s	<1 sec	95%

2.4.1 Receive IF Carrier Acquisition Range

The terminal will automatically lock to a correctly formatted carrier, which is within 35 kHz of the display receive frequency.

2.4.2 AGC Output (IDU)

A programmable DC output, proportional to the IDU receive signal level is located at the rear of the panel at 10 mA maximum, 0 to 10V. Default levels are 0v for minimum signal condition, and 10V for maximum signal condition. The low level can be programmable from 10 to 0V in 0.1V increments.

2.4.3 APS Output (ODU)

The Antenna Pointing System (APS) output on the ODU has DC output as follows:

1. Before the demodulator locks to the desired carrier, the output toggles from 0 to +5 VDC at approximately a 0.5 Hz rate.

2. After the demodulator acquires the carrier, the output varies from 0 to +5 VDC, proportional to the receive input signal level into the IDU.

2.5 Interface Specifications

2.5.1 Clock

2.5.1.1 Transmit Clock Source

The transmit clock can be selected by the operator from the following sources:

- Terrestrial: Must be ± 100 PPM of the programmed rate.
- SCT (Internal): ± 0.01 PPM.

2.5.1.2 Send Clock Timing Source

The send clock timing source output can be generated from the following sources:

- Internal
- External
- Loop Timed

If loop timing is selected, the send clock timing output can be:

- External: Must be ± 100 PPM of the selected data rate.
- Receive Satellite Clock: Data rate must be ± 100 PPM of the transmit data rate.

If the asymmetrical clock loop option (ASLT) is selected, the send clock timing output can be:

- External clock, which can be any multiple of 8 kHz as long as it, is ≥ 32 kHz and ≤ 4.3.76 MHz, or any multiple of 600 Hz as long as it is ≥ 2.4 kHz and ≤ 64 kHz.
- Receive clock, which can be any multiple of 8 kHz as long as it is ≥ 32 kHz and ≤ 4.376 MHz or any multiple of 600 Hz as long as it is ≥ 2.4 kHz and ≤ 64 kHz.

2.5.1.3 Transmit Clock Switching Due to Failure of Selected Clock

The terminal will automatically switch the transmit clock source to SCT internal on failure of terminal timing.

2.5.1.4 Transmit Clock Phase Adjustment

The transmit clock phase can be set by the operator to NORMAL, INVERTED, or AUTO mode.

2.5.1.5 Transmit Data Phase Adjustment

The transmit data phase can be set by the operator to NORMAL or INVERTED.

2.5.1.6 Doppler Buffer Clock Source

The Doppler/plesiochronous buffer clock can be selected by the operator from the following sources:

Receive Clock	
Transmit Terrestrial Clock	Must be within ± 100 PPM of the nominal receive data rate. Or it can be any multiple of 8 kHz as long as it is ≥ 64 kHz but ≤ 4.376 MHz or any multiple of 8 kHz or 600 Hz as long as it is ≥ 32 kHz and < 64 kHz, or any multiple of 600 Hz as it is ≥ 2.4 kHz but ≤ 32 kHz.
External Clock	Must be within ± 100 PPM of the nominal. Or it can be any multiple of 8 kHz as long as it is ≥ 32 kHz but ≤ 4.376 MHz or any multiple of 600 Hz as long as it ≥ 2.4 kHz but ≤ 32 kHz.
SCT (Internal)	± 0.01 PPM

2.5.1.7 Receive Clock Switching Due to Failure of Selected Clock

The terminal will automatically switch the receive clock source to receive satellite on failure of the selected clock.

2.5.1.8 Receive Clock Phase Adjustment

The receive clock phase can be set by the operator to NORMAL or INVERTED.

2.5.1.9 Receive Data Phase Adjustment

The receive data phase can be set by the operator to NORMAL or INVERTED.

2.5.1.10 Receive Clock Jitter

The receiver has a clock jitter gain of < 2.0 dB. The absolute jitter on the output clock is < 4% RMS of 1/data rate at 7.0 dB E_b/N_0.

2.5.1.11 Receive Doppler/Plesiochronous Buffer

The receive Doppler buffer can be configured by the operator to the following modes:

1. Bypass (Buffer set to minimum depth for emulation of previous products).
2. Selectable: 32 to 262,144 bits, in 16 bit steps.
3. Selectable: 0 to 50 ms, in 1 ms steps.
4. When running framed data, the buffer will slip in configured plesiochronous steps.

2.5.1.12 Buffering Center

The operator can set the buffer to 50%. The modem will automatically set the buffer to 50% after receive signal acquisition or a buffer overflow/underflow.

2.5.1.13 Loopback Modes

The operator can select one of the following interface loopback test modes:

- Baseband: Near end and far end.
- Interface: Near end and far end (only available with either the Reed-Solomon or ASYNC/AUPC daughter card installed).

2.5.1.14 Fault Outputs

Modulator Fault	Open collector output, 15V maximum, 20 mA maximum current sink, fault is open circuit.
Demodulator Fault	Open collector output, 15V maximum, 20 mA maximum current sink, fault is open circuit.

2.5.2 Terrestrial Interface Types

2.5.2.1 Universal

The following electrical interface types are available through the EIA-530, 25-pin D data I/O connector:

- EIA-232
- V.35
- EIA-422

Optional mechanical interfaces also are available. See Chapter 3 for pinout data on the following connectors:

- 37-pin D (EIA-449)
- 34-pin Block (V.35)
- 50-pin D

ASYNC/AUPC interfaces are available through the optional 50-pin data I/O connector. In order to satisfy the mechanical specification, the correct breakout panel must be connected to the modem.

2.5.2.2 EIA-232 Specification

Refer to Table 2-23 for EIA-232 specifications.

Table 2-23. EIA-232 Specifications

EIA-232 Specification	
Circuit Supported	TXD, TXC, RSD, RXC, DSR, DCD, CTS, LL, RTS, MC, ST
Driver Amplitude (RXD, RXC, ST, CTS, DCD, DSR)	True: 10V ± 5V False: -10V ± 5V
Receiver Amplitude (TXD, TXC, RTS, LL, MC)	True: Minimum +1V False: Maximum –1V
Impedance	5000 ± 2000Ω < 2500pF
Data Rate	9.6 to 120 kbit/s

TXD	Send Data
RXD	Receive Data
RTS	Request to Send
CTS	Clear to Send
DCD	Carrier Detect
DSR	Receiver Ready
MC	Master Clock

LL	Local Loopback
ST	Send Timing
RXC	Receive Timing
TXC	Terminal Timing
MF	MOD Fault
DF	DEMOD Fault

2.5.2.3 V.35 Specification V.10, V.11 Specification, Circuit Supported

Refer to Table 2-24 for V.35 specifications.

Table 2-24. V.35 Specifications

V.35 Specification	
Circuit Supported	SD, SCT, SCTE, RD, SCR, DSR, RLSR, RTS, CTS, MC, DSR, LL
Driver Amplitude (RD, SCR, SCTE, CTS, RLSD, DSR)	± 0.5V-PK, ± 20% differential, into 100Ω
Amplitude (SCT, SD, RTS, LL, MC)	± 0.2V min into 100Ω
Polarity (SD, SCT, SCTE, RD, SCR)	True when B positive with respect to A False when A positive with respect to B
Polarity (RTS, CTS, DSR, RLSD)	True when < -0.2v with respect to ground False when > +0.2V with respect to ground
Phasing (SCTE, SCR)	False-to-True transition nominally in center of data bit.
Symmetry (SCT, SCTE, SCR)	50% ± 5%

SD-A, SD-B	Send Data
SCT-A, SCT-B	Serial Clock Transmit
RD-A, RD-B	Receive Data
SCR-A, SCR-B	Serial Clock Receive
SCTE-A, SCTE-B	Transmission Signal Timing
MC-A, MC-B	Master Clock
RTS	Request to Send
CTS	Clear to Send
DSR	Data Set Ready
RLSD	Receive Line Signal Detect
LL	Local Loopback
MF	MOD Fault (ttl)
DF	DEMOD Fault (ttl)

Note: All other specifications are per CCITT V.10 and V.11.

2.5.2.4 EIA-449/EIA-422 Specifications

Refer to Table 2-25 for EIA-449/EIA-422 specifications.

Table 2-25. EIA-449/EIA-422 Specifications

EIA-449/EIA-422 Specification	
Circuit Supported	SD, ST, TT, RD, RT, DM, RR, RS, CS, MC
Amplitude (RD, RT, ST, DM, RR)	± 2V differential into 100Ω
Impedance (SD, TT, MC)	4kΩ True when B positive with respect to A False when A positive with respect to B
Phasing (RD, RT)	False-to-True transition of RT nominally in center of RD data bit.
Symmetry (ST, TT, RT)	50% ± 5%

SD-A, SD-B	Send Data
ST-A, ST-B	Send Timing
RD-A, RD-B	Receive Data
RS-A, RS-B	Request to Send
RT-A, RT-B	Receive Timing
CS-A, CS-B	Clear to Send
DM-A, DM-B	Data Mode
RR-A, RR-B	Receiver Ready
TT-A, TT-B	Terminal Timing
MC-A, MC-B	Master Clock
MF	MOD Fault (ttl)
DF	DEMOD Fault (ttl)

2.5.3 Asynchronous Overhead Specification (Optional)

The operator can select EIA-232 or EIA-485 for either the transmit or receive asynchronous overhead data type.

Refer to Table 2-26 for asynchronous specifications.

Table 2-26. Asynchronous Specifications

Primary Data Rates Supported	
Interfaces: EIA-422 V.35 EIA-232	 9.6 kbit/s, 19.2 kbit/s, 32 kbit/s to 2.048 Mbit/s 9.6 kbit/s, 19.2 kbit/s, 32 kbit/s to 2.048 Mbit/s 9.6 to 120 kbit/s
Asynchronous ESC	
Maximum Data Rate	1.875% of primary channel
Channel Interface	EIA-232 EIA-485 (2-Wire) Half-Duplex EIA-485 (4-Wire) Full-Duplex
Connector	25-pin D on breakout panel (UB300)
Available Baud Rates	110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, bit/s
Protocol Format	5, 6, 7, 8 data bits Even, Odd, No Parity 1 or 2 stop bits (1 or 1.5 for 5 bit)
EIA-232 Specifications	
Circuits Supported	SD, RD, RTS, CTS
Amplitude (RD, RTS)	True: 14V ± 11V False: -14V ± 11V
Amplitude (TD, DSR, CTS)	True: 11V ± 2V False: -11V ± 2V
Impedance	5000 ± 2000Ω < 2500 pF
Baud Rate	1/512 times the primary data rate
AUPC Specifications	
Target Power Levels	C-Band: +25 to +38 dBm Ku-Band K1: +17 to +30 dBm Ku-Band K3: +22 to +35 dBm
Target E_b/N_0 Level	3.2 to 16.0 dB, in 01 dB steps
Tracking Rate	0.5 to 6.0 dB/min, in 0.5 dB/min steps
Local/Remote Carrier Loss Setting (Local Has Priority)	Maximum – go to highest power output level Nominal – go to preprogrammed output level Hold – No action Note: Local carrier loss has priority over remote carrier loss.
AUPC Test Modes	2047 test pattern for remote BER monitoring Remote baseband loopback test

2.5.3.1 Local Automatic Uplink Power Control (AUPC)

AUPC functions are available with ASYNC interface. The operator can select local AUPC to be enabled or disabled.
The operator can select the E_b/N_0 target setpoint from 3.2 to 16.0 dB in 0.1 dBm steps.

2.5.3.2 Remote AUPC

1. The operator can select remote AUPC to be enabled or disabled.

2. The operator can select a remote TX 2047 test pattern and a remote baseband loopback to be enabled or disabled.

3. The operator can monitor the remote AUPC 2047 BER.

2.6 System Specifications

2.6.1 Test Modes

Refer to Table 2-27 for available test modes.

Table 2-27. Test Modes

Test Mode	Description
RF Loopback	Tunes the RX frequency to the satellite downlink frequency for the configured TX frequency. A C-Band system will tune the RX frequency 2.225 GHz below the TX frequency. A Ku-Band system will tune the RX frequency 2.3 GHz below the TX frequency. **Note:** The TX and RX data rates must be the same for the modem to lock.
IF Loopback	Tunes the RX IF to a sample of the TX IF output. The IF out is not affected. **Notes:** 1. The TX and RX data rates must be the same for the modem to lock. 2. Since the TX IF output is active, RF OFF must be selected if transmission is not intended.
BIST (Built in Self Test)	The IDU has the ability to generate 2^{11}-1 (2047) PN data and pass the data through the interface, modulator, and demodulator sections of the IDU. The IDU generates noise in the IF path to simulate a satellite environment. This feature invokes on power up or by the operator and the result checked against specification (and a fault is flagged if the unit fails). This feature can be turned off at the front panel (if desired) to minimize initialization time.
RS CORR Off	Turns off the Reed-Solomon decoder data error correction circuitry. Data flow is then routed through the normal data paths without error correction. **Note:** Available with Reed-Solomon Interface only.
Baseband Loopback	Internally switches the modulator clock and data signals to the demodulator. Also, loops the external DTE TX clock and data to the external receiver.
2047 Pattern Generator	Inserts an industry standard 2047 pattern in place of the TX data stream. **Note:** Available with Overhead card installed.
Interface Loopback	Internally switches the modulator clock and data (with overhead data) signals to the demodulator. Also, loops the external DTE TX clock and data to the external DTE receiver. **Note:** Available with Overhead or Reed-Solomon option installed.
2047 Pattern Monitor	Monitors the RX data for 2047 pattern. If 2047 pattern is present; this test mode provides an indication of Bit Error Rate (BER). The RX data is not interrupted. **Note:** Available with Overhead card installed.
ODU Enable	Disables ODU faults and alarms.

2.6.2 Remote Control

All terminal functions are controlled remotely through the remote connector on the rear panel. Refer to Appendix B for the Remote Control Specification. Refer to Table 2-28 for functions controlled.

Table 2-28. Remote Control Functions

Transmit	
Digital Data Rate	2.4 kbit/s to 4.375 Mbit/s, in 1 bit steps
Code Rate	BPSK 1/2 QPSK 1/2, 3/4, and 7/8
Encoder Type	Viterbi Sequential
Reed-Solomon Encoder	On or Off
Transmit Frequency	C-Band: 5.925 to 6.425 GHz, in 100 Hz steps Ku-Band: 14.0 to 14.5 GHz, in 100 Hz steps
Transmit RF	On or Off
Transmit Modulation Type	EFD, CSC, FDC, and all closed networks
Transmit Power	C-Band: +25 to +38 dBm, in 0.1 dB steps Ku-Band K1: +17 to +30 dBm, in 0.1 dB steps Ku-Band K3: +22 to +35 dBm, in 0.1 dB steps
Scrambler Enable	On or Off
Differential Encoder	On or Off
Transmit Spectrum Rotation	Normal or Inverted
Transmit BPSK Bit Order	Normal or Inverted
Carrier Only Mode	Normal, Dual, Offset, or Center
Receive	
Digital Data Rate	2.4 to 4375 kbit/s, in 1 bit steps
Code Rate	BPSK 1/2 QPSK 1/2, 3/4, and 7/8
Decoder Type	Viterbi or Sequential
Reed-Solomon Decoder	On or Off
Receive Frequency	C-Band: 3.7 to 4.2 GHz Ku-Band: 10.95 to 11.45 GHz, in 100 Hz steps 11.2 to 11.7 GHz, in 100 Hz steps 11.7 to 12.2 GHz, in 100 Hz steps 12.25 to 12.75 GHz, in 100 Hz steps
Receive Modulation Type	EFD, CSC, FDC, and all closed networks
Descrambler Enable	On or Off
Differential Decoder	On or Off
Receive Spectrum Rotation	Normal or Inverted
Receive BPSK Bit Order	Normal or Inverted
IF Loopback	On or Off
Sweep Center	-35 kHz to +35 kHz, in 1 Hz steps
Sweep Width	0 to 70 kHz, in 1 Hz steps
Sweep Reacquisition	0 to 999 seconds
BERT Threshold	10^{-3} to 10^{-8} or Off
Interface	
Transmit OH Type	ASYNC or None
Receive OH Type	ASYNC or None
Transmit Driver Type	V.35, EIA-422, or EIA-232

Table 2-29. Remote Control Functions (Continued)

Interface (Continued)	
Receive Driver Type	V.35, EIA-422, or EIA-232
Transmit Clock	Internal, External, or Reference
External Clock Reference	8.0 to 10000 kHz
Receive Buffer Size	32 to 262144 bit/s, in 16 bit/s steps or 0 to 50 ms, in 1 ms step
Transmit Clock Phase	Auto, Normal, or Inverted
Buffer Clock	Internal, External, Reference, or Saturated
Receive Clock Phase	Normal or Inverted
Baseband Loopback	On or Off
Interface Loopback	On or Off
Interface Loop Timing	On or Off
Transmit Framing	T1 or E1, None, or G.704
Receive Framing	T1 or E1, None, or G.704
Substitute Pattern	TX2047
Error Select	RX2047
Transmit Coding	AMI, HDB3, B8ZS
Receive Coding	AMI, HDB3, B8ZS
Transmit Data Fault	None, Data, AIS
Receive Data Fault	None, Data, AIS
ASYNC TX Baud Rate	110 to 38400
ASYNC RX Baud Rate	110 to 38400
ASYNC TX Channel Character Length	5, 6, 7, or 8
ASYNC RX Channel Character Length	5, 6, 7, or 8
ASYNC TX Channel Stop Bits	1 or 2
ASYNC RX Channel Stop Bits	1 or 2
ASYNC TX Channel Parity	Even, Odd, or None
ASYNC RX Channel Parity	Even, Odd, or None
ASYNC TX Electrical Interface	EIA-232 or EIA-485
ASYNC RX Electrical Interface	EIA-232 or EIA-485
Transmit Data Phase	Normal or Inverted
Receive Data Phase	Normal or Inverted
CTS Time Delay	0 to 999 seconds
System	
Reference Frequency Offset	
Clear Stored Faults	
Terminal Operation Mode	TX, RX, Duplex
System Modem Type	ASYNC, EFD, or Custom
Local AUPC Mode	On or Off
RTS TX-IF Control Mode	On or Off
Local AUPC	
Power (C-Band)	+25 to + 38 dBm, in 0.1 dB steps
Power (Ku-Band K1)	+17 to + 30 dBm, in 0.1 dB steps
Power (Ku-Band K3)	+22 to + 35 dBm, in 0.1 dB steps
E_b/N_0 Target	3.2 to 16.0, in 0.1 dB steps
Maximum Tracking Rate	0.5 to 6.0 dB/min, in 0.5 dB steps
Carrier Loss Action	Hold, Nominal, or Maximum

2.7 Component Specifications

2.7.1 Options

Refer to Table 2-29 for options.

Table 2-29. Options

Option	Remarks
Sequential or Viterbi Codec	Modem can be supplied: Viterbi only Sequential only Viterbi or Sequential
Reed-Solomon Codec	Concatenates with Viterbi or Sequential
Asynchronous Interface	Includes automatic uplink power control (AUPC)
EIA-422/449 Interface	
34-pin Winchester (V.35)	
Signal Data/Code Rate	
≤ 512 kbit/s maximum data rate	
≤ 5.0 Mbit/s maximum data rate	
Asynchronous Loop Timing (SCT)	
48 VDC Primary Power	
24 VDC Primary Power	

2.7.2 SDT-5200 (IDU) System Specifications

The SDT-5200 IDU is a complete, variable-rate satellite modem, high-stability reference, and power supply in a 1 RU package.

Refer to Table 2-30 for IDU system specifications.

Table 2-30. SDT-5200 System Specifications

Parameter	Specifications
IF Output Connector	Type N female
IF Input Connector	Type N female
RX-AUX Connector	BNC female
Data I/O Connector	EIA-530, 25-pin D sub, female (EIA-422, EIA-232, and V.35) EIA-449, 37-pin D sub, female, (EIA-422) Optional EFD Standard, 50-pin D sub, female (ASYNC) Optional V.35, 34-pin Winchester Optional
Alarm Connector	Form C Contact, 9-pin D sub, female
Fault Connector	Form C Contact, 9-pin D sub, female
Auxiliary Connector	Open Collector, 9-pin D sub, female
Remote Connector	EIA-232 or EIA-485, 9-pin D sub, female
Prime Power	85 to 264 VAC, 47 to 63 Hz, using a 6 foot (2 meter) cable 3-prong plug: meets EFData QUA-014, Operating Procedures.
Power Consumption	60W maximum
Size Weight Mounting	1.75H x 19W x 17.8D inches (4.4 x 48.26 x 45.21 cm) 12 lb. maximum (5 kg) Standard 19-inch (48.26 cm) rack. Must accept front and rear mounts and accept standard rack mount slides.
Temperature Humidity Shock	0 to 50°C (32 to 122°F) 90% non-condensing When any one corner of the IDU is dropped from 1 cm onto a hard surface, the IDU will not take any errors or faults.
Agency Compliance: Safety Emissions Susceptibility	 CE MARK – EN60950 CE MARK – EN55022-1 CE MARK – EN50082-1
Warm-up Time	< 30 minutes

2.7.2.1 IDU Transmit Specification

Refer to Table 2-31 for IDU transmit specifications.

Table 2-31. IDU Transmit Specifications

Parameter	Specifications
Output Frequency Range	779 to 801 MHz, in 100 Hz steps
Frequency Stability	± 0.01 ppm
Output Power	-10 dBm (factory calibrated)
Output Impedance	50Ω ± 10%
Output Return Loss	> 12 dB
Output S/N Ratio	> 50 dB
Output Phase Noise	< -63 dBc/Hz at 100 Hz < -73 dBc/Hz at 1 kHz < -83 dBc/Hz at 10 kHz < -93 dBc/Hz at 100 kHz
Undesired Sideband Suppression	< -30 dBc
Carrier Suppression	< -35 dBc
Spurious	< -50 dBc in any 3 kHz BW
Harmonics	< -45 dBc
Output Off Level	< -50 dBm
ODU Power (from center conductor of IF Output)	+36 VDC (2.5A maximum), ± 1 VDC
ODU Reference	50 MHz at –3 dBm
ODU M&C Data Link	Half Duplex, ASK Modulated serial digital data with either a 3. 68 MHz
Modulated Output Shaping	EFData Closed, Comstream Closed, Fairchild Closed
Modulation	Coherent QPSK or BPSK
Symbol Rate Range (variable):	4.8 to 2500 ks/s
Data Rate Range (variable): QPSK BPSK	 4.8 to 4375 kbit/s, in 1.0 bit/s steps 2.4 to 1250 kbit/s, in 1.0 bit/s steps
Forward Error Correction	Viterbi K = 7, 1/2, 3/4, and 7/8 rate Optional: Sequential K = 36, 1/2, 3/4, 7/8 rate Optional: Reed-Solomon IESS 308/309 Concatenated 225.205 T = 10
Scrambling	CCITT V.35 IESS modified, CCITT V.35 (EFD or CSC Closed), FDC, 2^{15}-1 SYNC
Transmit Frequency Change Time	< 200 ms

2.7.2.2 IDU Receive Specification

Refer to Table 2-32 for IDU receive specifications.

Table 2-32. IDU Receive Specifications

Parameters	Specifications
IF Input Frequency Range	950 to 1450 MHz, in 100 Hz steps
IF Input Level Desired Signal	-135 dBm +10 log (Symbol Rate) minimum -85 dBm +10 log (Symbol Rate) maximum
IF Input Composite Power: Symbol Rate > = 64 ks/s < = 64 ks/s Absolute Maximum	 +40 dBc with respect to RX signal +50 dBc with respect to RX signal -5 dBm
IF Input Impedance	50Ω ± 10%
IF Input Return Loss (950 to 1700 MHz)	> = 10 dB at 50Ω
RX-AUX Output	Nominal 0 dB gain from IF Input ± 3 dB
Baseband Filtering	EFData Closed, Comstream Closed, Fairchild Closed
Demodulation	Coherent QPSK or BPSK
Acquisition Range	0 kHz to 70 kHz, programmable in 100 Hz increments, range is rounded to nearest multiple of the opening symbol rate
Symbol Rate Range (variable)	4.8 to 2500 ks/s
Data Rate Range (variable) QPSK BPSK	 4.8 to 4375 kbit/s, in 1.0 bit/s steps 2.4 to 1250 kbit/s, in 1 bit/s steps
Forward Error Correction	Viterbi K = 7, 1/2, 3/4, 7/8 rate Optional: Sequential K = 36, 1/2, 3/4, 7/8 rate Optional: Reed-Solomon IESS 308/309 Concatenated 225.205 T = 10
Bit Error Rate: Viterbi 1/2 Rate Viterbi 1/2 Rate (with Reed-Solomon)	 1×10^{-8} for E_b/N_0 7.2 dB 1×10^{-10} for E_b/N_0 5.0 dB
Ambiguity Resolution Method	Differential Decoder
Descrambling	CCITT V.35 IESS modified, CCITT V.35 (EFD or CSC Closed), FDC, 2^{15}-1 SYNC

2.7.3 C-Band Outdoor Unit

The C-Band ODU is mounted on the feed support arm of a wide variety of parabolic antennas ranging from 1.2 to 3.1 meters in diameter. The ODU interfaces other components by two coaxial cables. The C-Band LNA, OMT, and feed horn assembly are mounted at the focus of the antenna. The ODU directly interfaces to the IDU.

Refer to Table 2-33 for C-Band ODU specifications.

Table 2-33. C-Band ODU Specifications

Parameter	Specifications
Physical: Size Weight	 See Figure 2-5 and Figure 2-6. 30 lb. maximum (13.6 kg)
Environmental: Temperature: Operating Survival	 -40° to +55°C (-40° to +131°F) -50° to +80°C (-58° to +176°F)
Thermal Gradient	10°C/15 min (50°F/15 min)
Humidity	0% to 100% relative at -40° to +55°C (-40° to +131°F) 95% at 65°C (149°F) for 72 hours
Precipitation	4 inch/hour with wind speed of 45 miles/hour with gusts to 50 mile/hour
Salt Fog	810/Method 506.2
Sand and Dust	810/Method 509.2
Altitude Operating Survival	810/Method 510.1 0 to 25,000 ft (0 to 7620 km) 0 to 50,000 ft (0 to 15,240 km)
Solar Radiation	360 BTU/hr/ft^2 at +50°C (122°F)
ES Discharge	10 kV operation, 15 kV survival, IEC pub 801-2 **Note:** Excluding any center point of any connector.
Shock	The unit will pass data without SYNC loss at 64 kbit/s, QPSK 1/2 rate when subjected to a shock of 10g’s at 10 sec (half sine) on x, y, and z axes. The unit will survive a shock of 40g’s at 10msec on x, y, and z axes in non-operating mode. **Note:** Without mounting cradle.

Table 2-34. C-Band ODU Specifications (Continued)

Parameter	Specifications
Environmental: Vibration	The unit will pass data without SYNC loss at 64 kbit/s, QPSK 1/2 rate when exposed to 10 minutes per axis plus 5 minute resonant dwell at four major resonance's per axis at a level of 1.0g (0-Peak), and to 2.41 G_{rms} (approx.) of random vibration specified as follows: Frequency / Slope / PSD 5 to 100 Hz / 0 / 0.020 g^2/Hz 100 to 137 Hz / -6 dB/oct / - 137 to 350 Hz / 0 / 0.0107 g^2/Hz 350 to 500 Hz / -6 dB/oct / - 500 Hz / - / 0.0052g^2/Hz The unit will survive vibration during transportation as follows: 5 to 200 Hz at 1.5 peak sinusoidal acceleration in shipping container.
Interfaces:	
TX IF Input	Type N Female
RX IF Output	Type N Female
APS Output	Type N Female, with chained waterproof cap
TX Output	Type N Female
RX Input	Type N Female

2.7.4 Ku-Band Outdoor Unit

The ODU accepts a 790 ± 11 MHz TX IF signal, and transmits the signal in the 14.0 to 14.5 GHz frequency band. The maximum available transmit power is +29 dBm (P1dB) or +34 dBm (P1dB) depending on the option selected. Output power level is controlled by an ALC loop to provide extremely stable output power regardless of temperatures variations.

Refer to Table 2-34 for Ku-Band ODU specifications.

Table 2-34. Ku-Band ODU Specifications

Parameter	Specifications
K1 (0.8W)	
Size	See Figure 2-7.
Weight	12 lbs (5 kg) maximum
K3 (2.5W)	
Size	See Figure 2-7.
Weight	22 lbs (9.98 kg), includes cradle maximum
Environmental:	
Temperature:	
Operating	-40° to +55°C (-40° to +131°F)
Survival	-50° to +80°C (-58° to +176°F)
Thermal Gradient	10°C/15 min (50°F/15 min)
Humidity	0% to 100% relative at -40° to +55°C (-40° to +131°F) 95% at 65°C (149°F) for 72 hours
Precipitation	4 inch/hour with wind speed of 45 miles/hour with gusts to 50 mile/hour
Salt Fog	810/Method 506.2
Sand and Dust	810/Method 509.2
Altitude	810/Method 510.1
Operating	0 to 25,000 ft (0 to 7620 km)
Survival	0 to 50,000 ft (0 to 15,240 km)
Solar Radiation	360 BTU/hr/ft^2 at +50°C (122°F)
ES Discharge	10 kV operation, 15 kV survival, IEC pub 801-2
	Note: Excluding any center point of any connector.

Table 2-35. Ku-Band ODU Specifications (Continued)

Parameter	Specifications
Environmental: Shock	The unit will pass data without SYNC loss at 64 kbit/s, QPSK 1/2 rate when subjected to a shock of 10g's at 10 sec (half sine) on x, y, and z axes. The unit will survive a shock of 40g's at 10msec on x, y, and z axes in non-operating mode. **Note:** Without mounting cradle.
Vibration	The unit will pass data without SYNC loss at 64 kbit/s, QPSK 1/2 rate when exposed to 10 minutes per axis plus 5 minute resonant dwell at four major resonance's per axis at a level of 1.0g (0-Peak), and to 2.41 G_{rms} (approx.) of random vibration specified as follows: <u>Frequency</u> — <u>Slope</u> — <u>PSD</u> 5 to 100 Hz — 0 — 0.020 g^2/Hz 100 to 137 Hz — -6 dB/oct — - 137 to 350 Hz — 0 — 0.0107 g^2/Hz 350 to 500 Hz — -6 dB/oct — - 500 Hz — - — 0.0052g^2/Hz The unit will survive vibration during transportation as follows: 5 to 200 Hz at 1.5 peak sinusoidal acceleration in shipping container.

2.7.5 C-Band LNA Specifications

Refer to Table 2-35 for C-Band LNA specifications

Table 2-35. C-Band LNA Specifications

Parameter	Specifications
Gain	44 to 52 dB (over the full band and operating temperature range)
1 dB Gain Compression Point	≤ 0 dBm
RF Input W/G	CPR-229 G
Input Power	+12 to +18 VDC at 120 mA maximum
Frequency Band	3.7 to 4.2 GHz
Output Connector	Type N female, 50Ω
Noise Temperature	< 60°K at 25°C (77°F)
Particulars: Operating Temperature Size Weight	 -40° to +55°C (-40 ° to +131°F) 2W x 8D x 2H inches (approx.) (5 W x 20 D x 5 W cm) < 2 lb. (< 0.9 kg)

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2.8 Dimensional Envelopes

2.8.1 SDT-5200 Dimensional Envelope

Refer to Figure 2-5 for the dimensional envelope.

Note: All dimensions are in English units, centimeters are in parentheses.

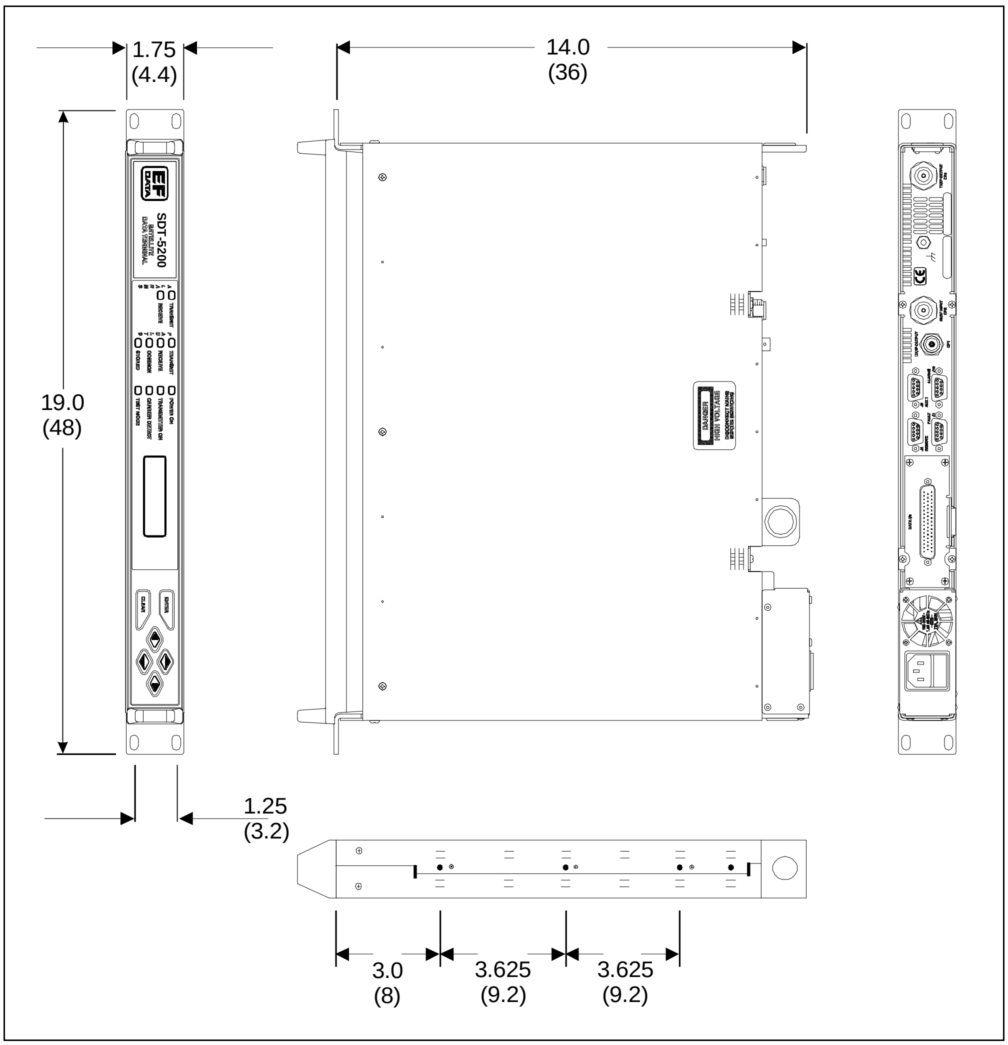


Figure 2-5. SDT-5200 Dimensional Envelope

2.8.2 C-Band Outdoor Unit (ODU) Dimensional Envelope

Refer to Figure 2-6 for C-Band ODU dimensional envelope.

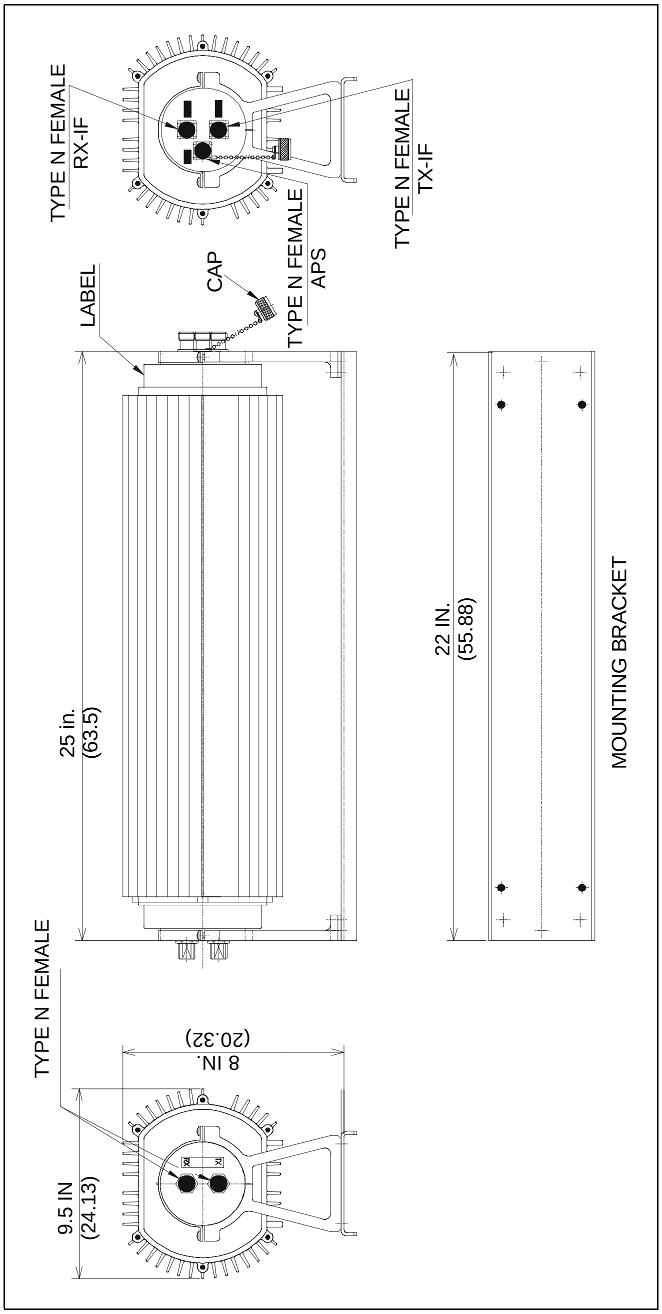


Figure 2-6. C-Band ODU Dimensional Envelope

2.8.3 Ku-Band Outdoor Unit Dimensional Envelope

Refer to Figure 2-7 for Ku-Band ODU dimensional envelope.

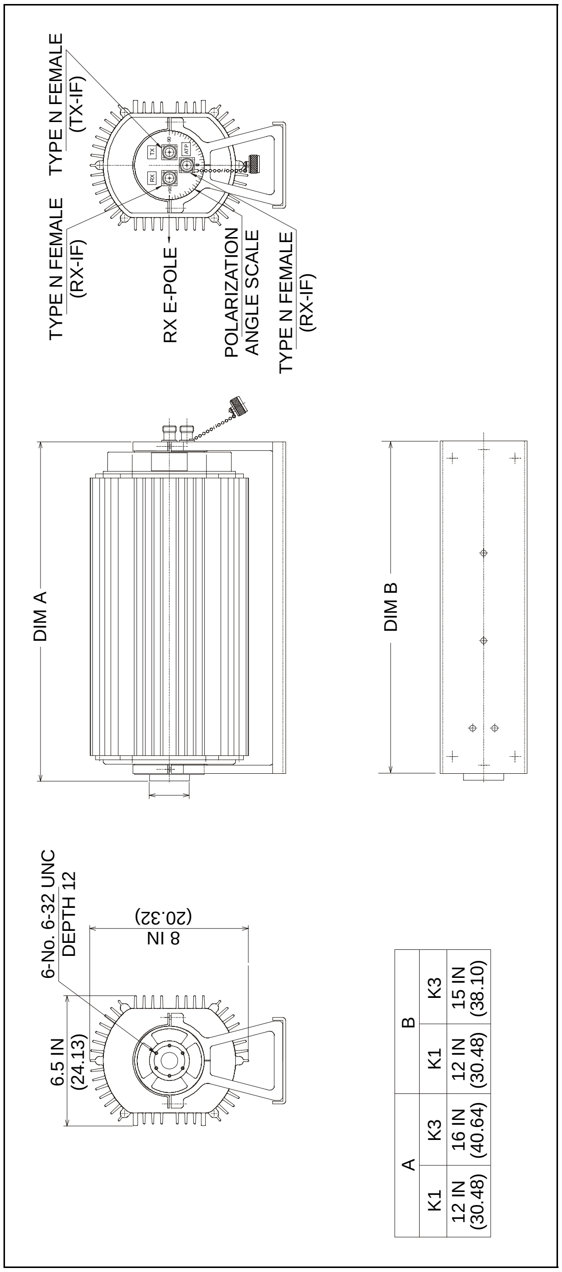


Figure 2-7. Ku-Band ODU Dimensional Envelope

Chapter 3. INSTALLATION

This chapter provides installation and mounting instructions for the Satellite Terminal System.

3.1 Unpacking

The Satellite Terminal System and manual are packaged in pre-formed, reusable, cardboard cartons containing foam spacing for maximum shipping protection.

CAUTION

Do not use any cutting tool that will extend more than 1 inch (2.5 cm) into the container. This can cause damage to the modem.

Unpack the Satellite Terminal System as follows:

1. Cut the tape at the top of the carton indicated by OPEN THIS END.
2. Remove the cardboard/foam space covering the unit.
3. Remove the unit, manual, and power cord from the carton.
4. Save the packing material for storage or reshipment purposes.
5. Inspect the equipment for any possible damage incurred during shipment.
6. Check the equipment against the packing list to ensure the shipment is correct.

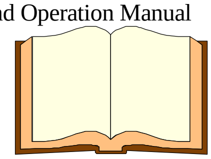
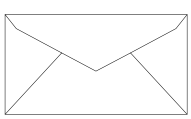
3.2 Equipment Inspection

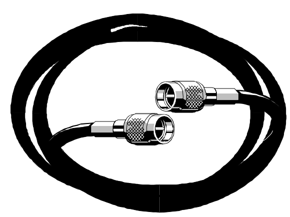
3.2.1 Included Parts

A typical Satellite Terminal System contains the following components:

Notes:

1. Parts are not drawn to scale.
2. Because each installation can be customized, this manual will provide instructions for installing the universal mounting kit.

Qty.	Description
1	C-Band Satellite Terminal System Components 
1	Installation and Operation Manual 
1	Envelope containing the test data 

Qty.	Description
1	Ku-Band Satellite Terminal System Components 
2	Cable Assembly (See 3.2.1.1) (Optional) 

3.2.1.1 Cable Assembly (Customer-Furnished)

CAUTION

EFData recommends the use of a high-performance cable assembly for the Satellite Terminal System. A non-high-performance cable assembly may result in damage to the LNA.

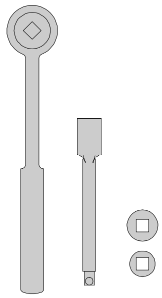
The Satellite Terminal System is manufactured to accommodate a transmit attenuation of 20 dB maximum between the IDU and the ODU, and a receive attenuation of 25 dB maximum between the IDU and receive LNA. The optional IFL cable assembly offered by EFData is a high-performance cable selected to accommodate the attenuation of the unit's IFL losses incurred up to 300 metric feet, maximum.

Refer to the following for cable characteristics:

- Double shielded: > 90 dB
- Bend Radius: ≈1 inch
- TX 2Ω maximum
- Temperature Range: -40° to +85°C (-40° to +185°F)
- Rugged construction, weather sealed.
- RX 5Ω maximum

Tools Required

Note: Equivalent substitutes may be used for listed items.

Qty.	Description
1 1 1 1	3/8” drive ratchet. 3” x 3/8” drive extension. 5/16” x 3/8” drive socket. (Metric equivalent: 8 x 9mm) 1/4” x 3/8” drive socket. (Metric equivalent: 6 x 9mm) 
1	5/16” combination wrench. *(Metric equivalent: 8mm combination wrench with a 6 pt. Box end.)* 
1	1/4” combination wrench. *(Metric equivalent: 6mm combination wrench with a 6 pt. Box end.)* 

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3.3 Satellite Terminal System Installation

3.3.1 IDU Installation

Refer to Figure 3-1.

1. Install the IDU as follows:

   a. If required, install the mounting bracket in equipment rack. Install and tighten the bracket bolts.

   b. Loosen the screw with flat washer located on the left side of modem chassis. Mount the modem chassis into the equipment rack and slide the screw with flat washer through the slot of the mounting bracket. Tighten the screw sufficiently to allow the modem chassis to slide in the bracket.

   c. Connect the cables to the proper locations on the rear panel. Refer to Section 3.4 for connector pinouts, placement, and function.

   d. Connect the primary power cable to the power source. Before turning on the power switch, become familiar with the front panel operation in Chapter 4.

   e. Perform operational testing of the Satellite Terminal System as outline in Chapter 6, System Checkout.

2. Connect cables as necessary.

CAUTION

Ensure the transmit and receive cables are properly installed. Improper installation of the cables will cause the LNA to be damaged.

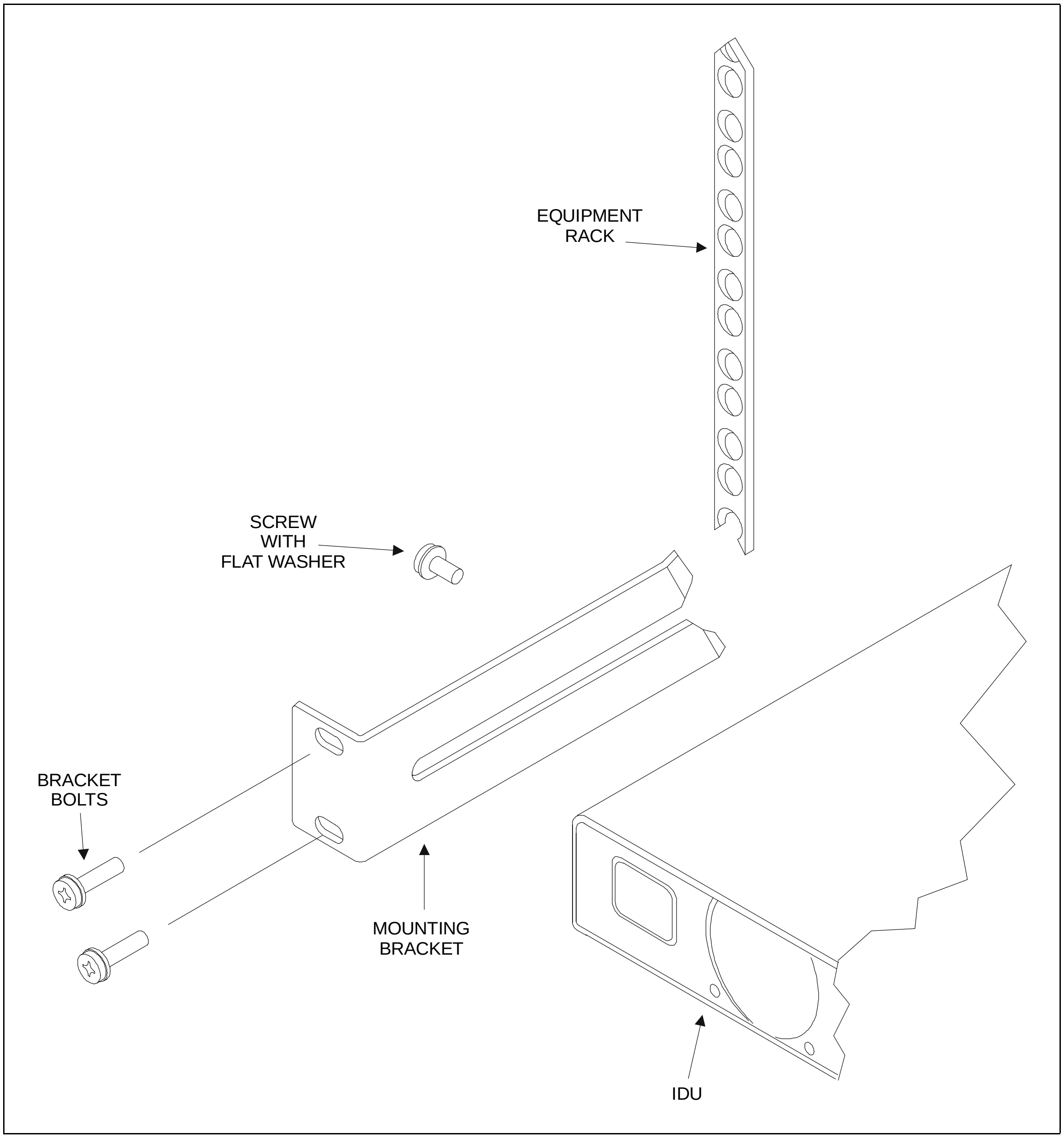


Figure 3-1. IDU Installation

3.3.2 ODU Installation

3.3.2.1 C-Band ODU Installation

1. Install LNA with TRF to OMT as follows.

    a. Visually check connection of the LNA to the TRF. Ensure attaching hardware is present and secured.

    b. Position the antenna waveguide in place on the RF IN connector and secure with 1/4-20 x 1 bolts, 1/4 split lockwashers, 1/4 flat washers, and 1/4-20 nuts. Do not tighten the bolts and nuts at this time. (See Figure 3-2.)

    c. Tighten bolts and nuts according to the illustrated sequence shown in Figure 3-2.

    d. Remove the plastic covers from all the connectors and attach the appropriate cables.

    e. Place the appropriate o-ring on the LNA.

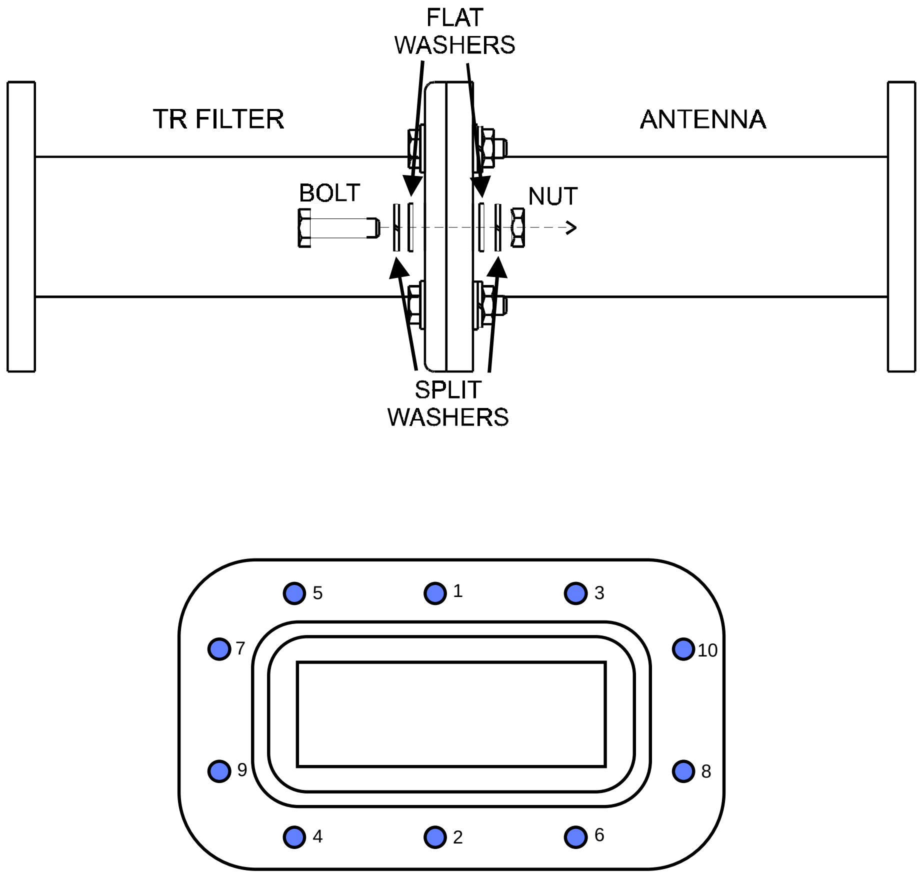
    f. Position the LNA on the OMT and secure in place using 10 screws, split washers, flat washers, and nuts.

2. Install ODU (Figure 3-3)as follows:

    a. Install ring brackets on the ODU and secure to bracket using supplied hardware.

    b. Position the ODU on the satellite spar and secure with two U-bolts, four split washers, and four nuts.

    Note: Selection of o-ring is determined by the addition of an o-ring groove in the LNA flange. Use larger o-ring if groove is present.



TIGHTEN BOLTS PER ILLUSTRATED SEQUENCE

Figure 3-2. LNA Installation

3. Connect cables as follows:

   a. Connect receive cable from the ODU to the IDU CP2 connector.

   c. Connect transmit cable from the ODU to the IDU CP1 connector.

   d. Connect the receive cable to the C-Band LNA (mounted on the OMT).

   e. Connect the transmit cable to the OMT.

4. Perform operational testing of the C-Band System as outlined in Chapter 6, System Checkout.

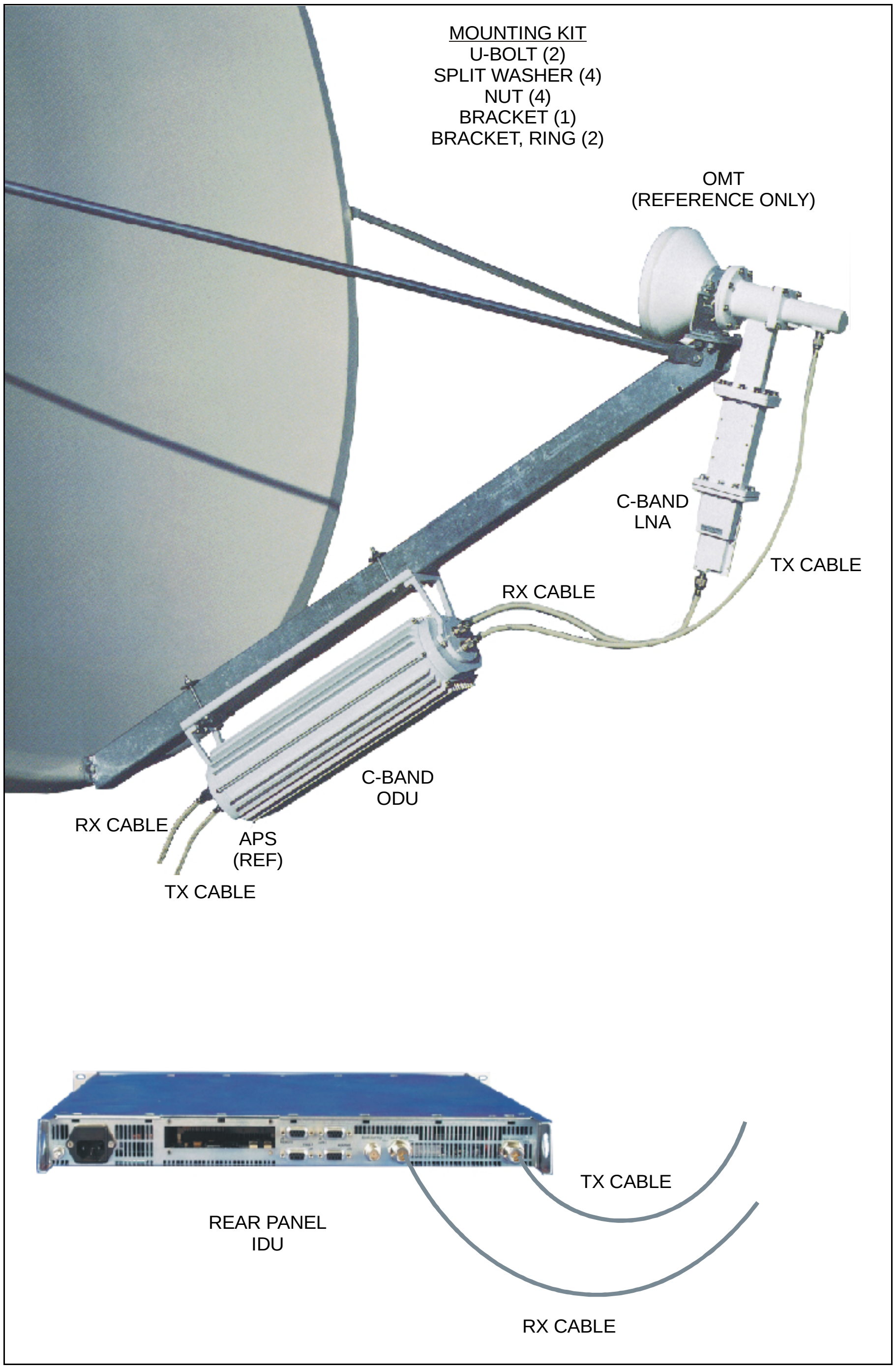


Figure 3-3. C-Band ODU Installation

3.3.2.2 Ku-Band ODU Installation

Refer to Figure 3-4.

1. Install ODU as follows:

   a. Install ring brackets on the ODU and secure to bracket using supplied hardware.

   b. Connect the ODU to the OMT and secure with two U-bolts, four split washers, and four nuts.

   c. Connect the receive cable from the ODU to the IDU CP2 connector.

   d. Connect the transmit cable from the ODU to the IDU CP1 connector.

CAUTION

1. The transmit and receive cables may be 300 feet (91 meters) in length (maximum). Ensure the cables are protected to avoid shorting, arcing, or damage that would impair its function.
2. Ensure the transmit and receive cables are properly installed. Improper installation of the cables will cause the LNA to be damaged.

2. Perform operational testing of the Ku-Band System as outlined in Chapter 6, System Checkout.

Figure 3-4. Ku-Band ODU Installation

3.3.2.3 K1/K3 ODU 90° Rotation Check

Refer to Figure 3-5.

1. Loosen ring bracket around the ODU.

2. Rotate ODU to obtain maximum signal reception (left and right, a maximum of 90°).

3. Tighten hardware to secure ODU in place.

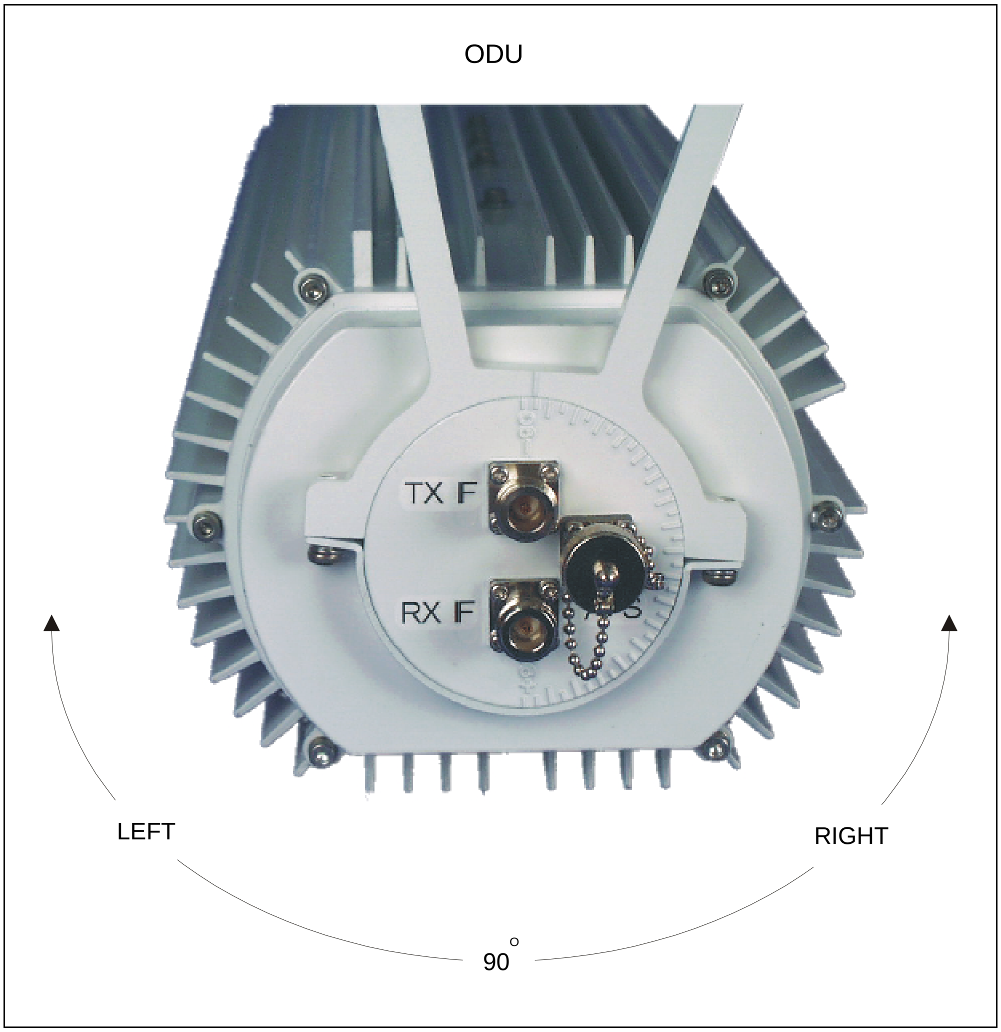


Figure 3-5. ODU 90° Rotation Check

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3.4 External IDU Connections

When a breakout panel, such as the UB-300, is not required, the rear panel connectors provide all necessary external connections between the modem and other equipment. Table 3-1 lists these connectors.

Note: Refer to the EFData *UB-300 Universal Breakout Panel Installation and Operation Manual* for connecting the UB-300 breakout panel.

Table 3-1. Modem Rear Panel Connectors

Name	Ref. Desig.	Connector Type	Function
REMOTE	J6	9-pin D	Remote Interface
FAULT	J7	9-pin D	FORM C Fault Relay Contacts
DATA I/O	J8	25-pin D 34-pin 37-pin D 50-pin D	Data Input/Output (standard modem) V.35 EIA-422 Overhead Interface See Figure 3-6 through Figure 3-9.
AUX 1	J9	9-pin D	(TTL) Faults Satellite Clock Demod I/Q Automatic Gain Control (AGC) Out
ALARMS	J10	9-pin D	FORM C Alarm Relay Contacts
RX/IF OUTPUT	CP1	BNC	RF Output. Monitor
RX/IF INPUT	CP2	TNC	L-Band input.
TX/IF OUTPUT	CP3	Type N	RF Output (+36 VDC)
AC INPUT	NONE	IEC	
GROUND	NONE	10-32 Stud	

Note: The European EMC Directive (EN55022, EN50082-1) requires using properly shielded cables for DATA I/O. These cables shall be double-shielded from end-to-end, ensuring a continuous ground shield.

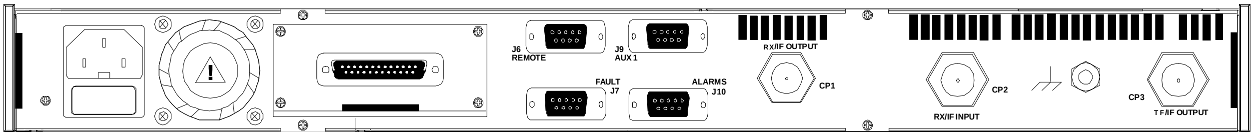


Figure 3-6. Basic Modem, 25-Pin D Connector

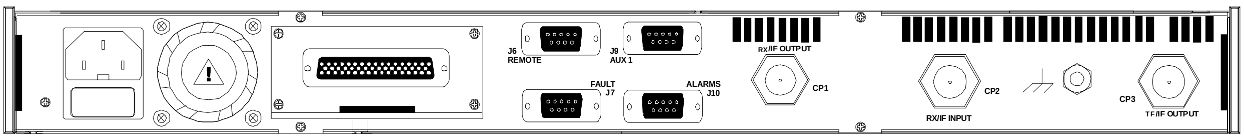


Figure 3-7. Overhead Option, 50-Pin D Connector

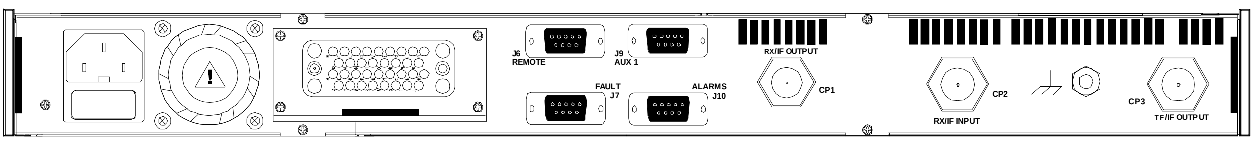


Figure 3-8. (V.35) 34-Pin Winchester Connector

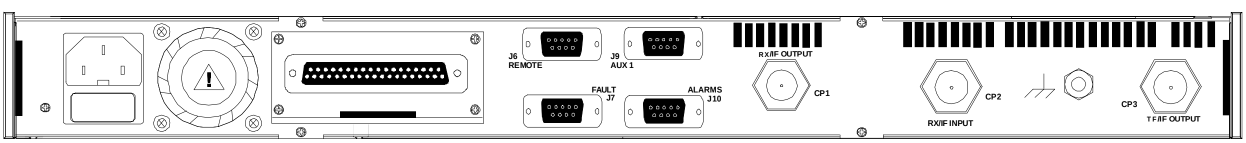


Figure 3-9. EIA-422/449, 37-Pin D Connector

3.4.1 Remote Connector and Pinouts (J6)

The remote connector is a 9-pin female D connector (J6) located on the rear panel of the modem. Screw locks are provided for mechanical security of the mating connector.

The remote connector interfaces the M&C functions to a remote location. The remote location can be an M&C computer located away from the modem, but attached via cable to the remote connector. This DCE interface can be either EIA-485 or EIA-232. Refer to Appendix B for a description of the remote interface. Refer to Table 3-2 for pinout information.

Table 3-2. Remote Connector and Pinouts (J6)

EIA-485			EIA-232	
	4-Wire Mode	2-Wire Mode		
Pin #	Name	Name	Pin #	Name
1		GND	1	
2			2	RD (RX)
3			3	TD (TX)
4	+TX	+RX/TX	4	
5	-TX	-RX/TX	5	GND
6			6	DSR
7			7	RTS
8	+RX	+RX/TX	8	CTS
9	-RX	-RX/TX	9	

3.4.2 Fault Connector and Pinouts (J7)

The fault connector provides Form C contact closures for fault reporting. The three Form C summary fault contacts are Modulator, Demodulator, and Common Equipment.

The fault interface connection is a 9-pin female D connector (J7) located on the rear panel of the modem. Form contact; ratings 1A maximum at 24 VDC, 0.5A at 120 VAC. Screw locks are provided for mechanical security on the mating connector. Refer to Table 3-3 for pinout information.

Table 3-3. Fault Connector and Pinouts (J7)

Pin #	Signal Function	Name
1	Common equipment is not faulted	NO
2		COM
3	Common equipment is faulted	NC
4	TX is not faulted	NO
5		COM
6	TX is faulted	NC
7	RX is not faulted	NO
8		COM
9	RX is faulted	NC

Refer to Chapter 6 for a discussion of monitored faults. To obtain a system summary fault, connect all the Form C contacts in parallel.

3.4.3 Data I/O Interface Connector (J8)

The DATA I/O interface connector conducts data input and output signals to and from the modem and connects to the customer's terrestrial equipment, breakout panel, or protection switch. The modem is currently available with a choice of four DATA I/O connectors, as follows:

- 25-pin D connector (EIA-530) is the standard connector shipped with a base platform modem.
- 50-pin D connector (EFData Proprietary) is the standard connector when the modem is ordered with the optional overhead PCB or if the overhead PCB has been installed in the field.
- 37-pin D is an alternate connector (EIA-449) available upon special request for the base platform modem.
- 34-pin Winchester is an alternate connector (V.35) available upon special request for the base platform modem.

The DATA I/O pinout is different for each of the interface configurations. For pinout information, refer to the appropriate table as follows:

Standard 25-pin D connector	Table 3-4
Optional 50-pin D connector	Table 3-5
Optional 37-pin D connector	Table 3-6
Optional 34-pin Winchester connector	Table 3-7

Table 3-4. 25-Pin D Connector Pinouts

25-Pin D Connector			
Pin #	**EIA-422**	**EIA-232**	**V.35**
1	SHLD	SHLD	SHLD
2	SD-A	TXD	SD-A
3	RD-A	RXD	RD-A
4	RS-A	RTS	RTS
5	CS-A	CTS	CTS
6	DM-A	DSR	DSR
7	SIGGND	SIGGND	SIGGND
8	RR-A	DCD	RLSD
9	RT-B		SCR-B
10	RR-B		
11	TT-B		SCT-B
12	ST-B		SCTE-B
13	CS-B		
14	SD-B		SD-B
15	ST-A	ST	SCTE-A
16	RD-B		RD-B
17	RT-A	RXC	SCR-A
18	LL	LL	LL
19	RS-B		
20*	MC-A	MC	MC-A
21	DF	DF	DF
22	DM-B		
23*	MC-B		MC-B
24	TT-A	TXC	SCT-A
25	MF	MF	MF

***Note:** Use the MASTER clock for EXTERNAL clock input. This clock input should equal the data rate unless the Asymmetrical Loop Timing Option (ASLT) is available. The ASLT option allows selection of different clock rates that vary from the digital data rate. Refer to the Utility/Modem Type/Modem Options menu for the ASLT option information.

Note: The 50-pin connector requires a breakout panel for the external connections between the modem and terrestrial equipment.

Table 3-5. 50-Pin Connector Pinouts

Pin #	ASYNC	Pin #	ASYNC
34	Not Used	31	V.35/EIA-422 CTS-B
18	Not Used	48	V.35 DSR/EIA-422 DM-A
36	Not Used	32	V.35 DSR/EIA-422 DM-B
20	Not Used	8	Not Used
35	V.35/EIA-422 EXCA In	25	Not Used
19	V.35/EIA-422 EXCB In	41	Not Used
37	V.35/EIA-422 SD-A In	9	Not Used
38	V.35/EIA-422 SD-B In	26	Not Used
21	V.35/EIA-422 ST-A Out	42	Not Used
22	V.35/EIA-422 ST-B Out	10	Not Used
4	ESC TXDB In (*see Note 1*)	27	Not Used
5	ESC TXDA In (*see Note 2*)	43	Not Used
39	V.35/EIA-422 RD-A Out	11	Not Used
40	V.35/EIA-422 RD-B Out	28	Not Used
23	V.35/EIA-422 RT-A Out	44	Not Used
24	V.35/EIA-422 RD-B Out	12	V.35/EIA-422 SCTE/TT-A
6	ESC RXDB Out *(see Note 3)*	13	V.35/EIA-422 SCTE/TT-B
7	ESC RXDA Out *(see Note 2)*	14	Not Used
45	V.35/EIA-422 RTS-A	15	Not Used
29	V.35/EIA-422 RTS-B	17	Not Used
46	V.35 RLSD/EIA-422 RR-A	16	Not Used
30	V.35 RLSD/EIA-422 RR-B	50	Not Used
47	V.35/EIA-422 CTS-A	3	AGC Out

Notes:

1. EIA-422 only.
2. EIA-232 and EIA-485 only.
3. EIA-485 only.

Table 3-6. EIA-449 MIL-188 114, 37-Pin Connector Pinouts

37	EIA-422	37	EIA-422
6	RD-A	27	CS-B
24	RD+B	13	RR-A
4	SD-A	31	RR+B
22	SD+B	11	DM-A
17	TT-A	29	DM+B
35	TT+B	16	MC-A
5	ST-A	34	MC+B
23	ST+B	21	DF
8	RT-A	3	MF
26	RT+B	20	SIGGND
7	RS-A	1	SHIELD
25	RS+B	19	SHIELD
9	CS-A	37	SIGGND

Notes:

1. There are jumpers on the PL/6031 EIA-422 interface. Place the jumpers on the center pin and the pin towards the Master Clock (MC) to allow an external clock input on Pins 16 and 34.
2. If desired, place the jumpers on the TR side to allow an external clock input on Pins 12 and 30. Place the jumpers on the TR side for Demand Assigned Multiple Access (DAMA) applications.

Table 3-7. 34-Pin Winchester Connector Pinouts (V.35)

34	V.35	34	V.35
R	RX Data A (RD A)	C	Request to Send (RTS)
T	RX Data B (RD B)	D	Clear to Send (CTS)
P	Send Data A (SD A)	F	RX Line Signal Detect (RLSD)
S	Send Data B (SD B)	E	Data Set Ready (DSR)
Y	Serial Clock TX A (SCT A)	c (CC)	External Reference Clock A (EXC A)
a (AA)	Serial Clock TX B (SCT B)	d (DD)	External Reference Clock B (EXC B)
U	Serial Clock TX External A (SCTE A)	n (NN)	Demodulator Fault
W	Serial Clock TX External B (SCTE B)	m (MM)	Modulator Fault
V	Serial Clock RX A (SCR A)	A	Ground
X	Serial Clock RX B (SCR B)	B	Ground

Note: Pins H, J, K, L, M, N, Z, b (BB), e (EE), f (FF), h (HH), j (JJ), k (KK), l (LL) have no connection.

The IDU is available with a Winchester™ V.35 as the data I/O connector (PL/6032). There is a jumper on the unit that either opens or closes the CC line. The interface is shipped with jumpers in positions 2 and 3, because:

1. EFData has determined that several locations use Fireberd™ test equipment and a conflict will occur if CC is connected between the modem and the Fireberd™.

2. Placing the jumper in positions 2 and 3 opens up the CC line, because the TTC/Fireberd™ test equipment interfaces use the line for DTE/DCE control.

3. Grounding pin CC at the Fireberd™ interface will change the Fireberd ™ to a DCE device.

4. EFData uses the CC and DD for the input master clock (same as the external clock input to the modem). To input an external clock, change the jumper to positions 1 and 2 (the pin closest to the Winchester connector).

3.4.3.1 Data I/O Interface Connector (J8) Removal/Installation

Note: The following procedures outline the removal and installation of the Data I/O connector (J8). These procedures are written with the assumption that the same configured connector will be reinstalled. However, the operator does have an option to install a differently configured connector.

Refer to Table 3-8 for a matrix explaining connector options.

Table 3-8. Connector (J8) Matrix

Modem Configuration	EIA-232	EIA-422/EIA-449	V.35	Overhead
25-pin Connector	X	X	X	
34-pin Connector			X	
37-pin Connector		X		
50-pin Connector	X	X	X	X

3.4.3.1.1 Data I/O Connector (J8) Removal

Refer to Figure 3-10.

1. (For Ribbon-Configured Connector) Remove Data I/O connector (J8) as follows:

   a. Remove four screws securing the rear panel to the chassis.
   b. Pull out rear panel to gain access to disconnect connector (J8).
   b. Disconnect connector (J8) from the PCB.
   c. Remove the four screws securing connector (J8) to the rear panel.
   d. Remove the connector (J8).

2. Remove 50-pin Data I/O connector (J8) as follows:

   a. Remove the four screws securing the connector (J8) to the rear panel.

   b. Establish a grip on connector (J8) and pull backwards until separation of the connectors is obtained.

   c. Remove connector (J8).

3.4.3.1.2 Data I/O Connector (J8) Installation

Refer to Figure 3-10.

1. (For Ribbon-Configured Connector) Install Data I/O connector (J8) as follows:

   a. Position connector (J8) in rear panel.

   CAUTION

   Use care when connecting the data I/O connector (J8) to the PCB. Damage to the connector pins may render the data I/O connector (J8) unserviceable. Misalignment can be the result.

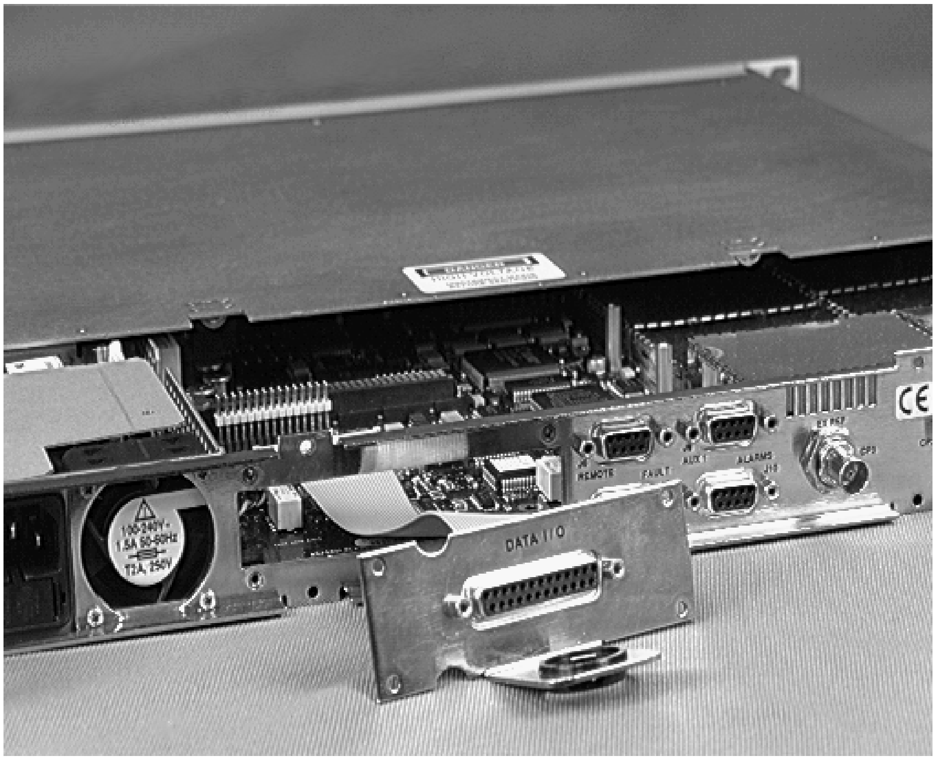
   b. Connect connector (J8) to the PCB.
   c. Secure connector (J8) to the rear panel with four screws.
   d. Position the rear panel to mate with the chassis and secure with four screws.

2. Install 50-pin Data I/O connector (J8) as follows:

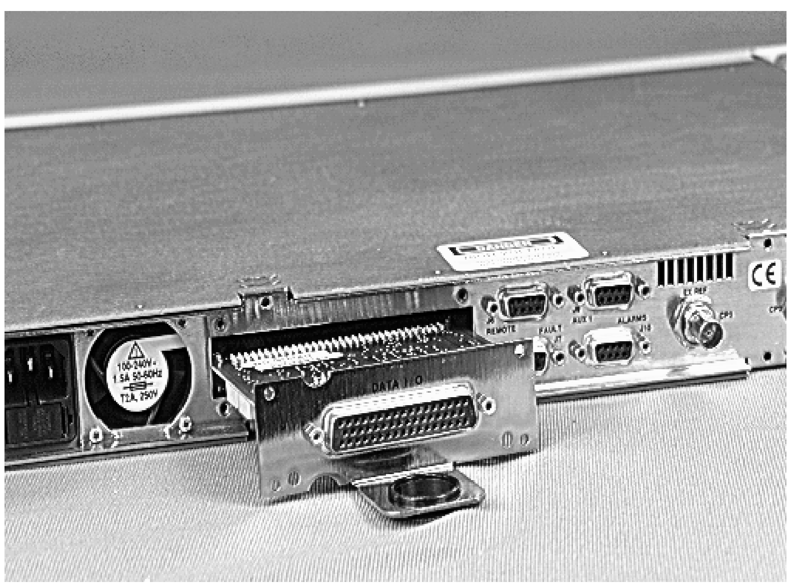
   CAUTION

   Use care when connecting the Data I/O connector (J8) to the PCB. Damage to the connector pins may render the data I/O connector (J8) unserviceable. Misalignment can be the result.

   a. Connect connector (J8) to the PCB.
   b. Secure connector (J8) using four screws.



For Ribbon-Configured Connector



For 50-Pin Connector with Overhead Interface Board

Figure 3-10. Data I/O Connector (J8) Removal/Installation

3.4.4 Auxiliary Connector and Pinouts (J9)

AUX connection is a 9-pin female D connector (J9) located on the rear panel of the modem. Screw locks are provided for mechanical security on the mating connector.

Refer to Table 3-9 for pinout information

Table 3-9. AUX Connector and Pinouts (J9)

Pinout		
Pin #	**Name**	**Function**
1	SAT_CLK-	SATELLITE CLOCK -
2	NC	NO CONNECTION
3	SAT_CLK+	SATELLITE CLOCK +
4	MDFLTTTL	TRANSMITTER TTL FAULT
5	GND	GROUND
6	RX_Q	RX Q Channel Eye
7	DMDFLTTL	RECEIVER TTL Fault
8	RX _I	RX I Channel Eye
9	AGC	AGC Output

3.4.5 Alarm (J10)

The alarm interface connection is a 9-pin female D connector located on the rear panel of the IDU. Screw locks are provided for mechanical security on the mating connector.

Refer to Table 3-10 for pinout information.

Table 3-10. Alarm Pinouts

Pinout		
Pin #	**Name**	**Function**
1	NO	ALARM 1 IS ALARMED
2	COM	COMMON
3	NC	ALARM 1 IS OK
4	NO	ALARM 2 IS ALARMED
5	COM	COMMON
6	NC	ALARM 2 IS OK
7	NO	ALARM 3 IS ALARMED
8	COM	COMMON
9	NC	ALARM 3 IS OK

Notes:

1. There are jumpers on the PL/6031 EIA-422 interface. Place the jumpers on the center pin and the pin towards the Master Clock (MC) to allow an external clock input on pins 16 and 34.
2. If desired, place the jumpers on the TR side to allow an external clock input on pins 12 and 30. Place the jumpers on the TR side for Demand Assigned Multiple Access (DAMA) applications.
3. As of the publication date of this manual, the MC external clock input must be a differential signal. Future layouts will allow for either differential or single input clock with a ground.

3.5 IDU–ODU Interconnections

3.5.1 C-Band (IDU-ODU) Interconnections (CP1, CP2, CP3)

RX/IF	
IDU Connector Type	N-Type Female connector
LNA Connector Type	N-Type Female connector
Cable Type	50Ω, -25 dB maximum attenuation at 1700 MHz, 5Ω maximum
TX/IF	
IDU Connector Type	N-Type Female connector
ODU Connector Type	N-Type Female connector
Cable Type	50Ω, 20 dB maximum attenuation at 750 MHz, 2Ω maximum

3.5.2 Ku-Band (IDU-ODU) Interconnections (CP1, CP2, CP3)

RX/IF	
IDU Connector Type	TNC, Female connector
ODU Connector Type	TNC, Female connector
Cable Type	50Ω, -25 dB maximum attenuation at 1450 MHz
TX/IF	
IDU Connector Type	N-Type Female connector
ODU Connector Type	N-Type Female connector
Cable Type	50Ω, 20 dB maximum attenuation at 790 MHz, 2Ω maximum

3.6 Power Entry

3.6.1 AC Option (Standard)

Input Power	300W maximum, 125W typical
Input Voltage	85 to 230 VAC, 47 to 63 Hz Unit switches ranges automatically
Connector Type	I.E.C.
Fuse Protection	3A slo-blo Line and neutral fusing 5mm type fuses

3.7 Ground Connector (GND)

A #10-32 stud on the rear panel of the modem is used for connecting a common chassis ground among all equipment.

Note: The AC power connector provides the safety ground.

Chapter 4. OPERATION

This chapter describes the front panel operation of the modem, including the menus and their explanations, software configuration, clocking information, and buffering.

For information about remote control operation, refer to Appendix B.

4.1 Front Panel

The modem front panel (Figure 4-1) enables control of modem configuration parameters and displays the modem status.

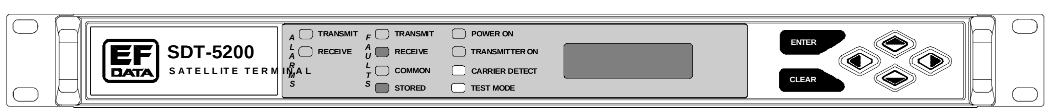


Figure 4-1. Front Panel View

The front panel features include:

- 32-character, 2-line LCD display
- 6-button keypad for local control
- 10 LEDs to provide overall status at a glance

All functions are accessible at the front panel by entering one of six pre-defined Function Select categories or levels:

- Configuration
- Monitor
- Faults/Alarms
- Stored Faults/Alarms
- Remote AUPC
- Utility

4.1.1 LED Indicators

The 10 LEDs on the front panel indicate:

- General modem summary faults
- Status
- Alarms

The indicators are defined as follows:

Name	LED	Explanation
Faults		
Transmit	Red	A fault condition exists in the transmit chain.
Receive	Red	A fault condition exists in the receive chain.
Common	Red	A common equipment fault condition exists.
Stored	Yellow	A fault has been logged and stored. The fault may or may not be active.
Status		
Power On	Green	Power is applied to the modem.
Transmitter On	Green	Transmitter is currently on. This indicator reflects the actual condition of the transmitter, as opposed to the programmed condition.
Carrier Detect	Green	Decoder is locked.
Test Mode	Yellow	Flashes when the modem is in a test configuration.
Alarms		
Transmit	Yellow	A transmit function is in an alarm condition.
Receive	Yellow	A receive function is in an alarm condition.

4.1.2 Front Panel Keypad

The front panel keypad permits local operation of the modem. The keypad consists of six keys (Figure 4-2).

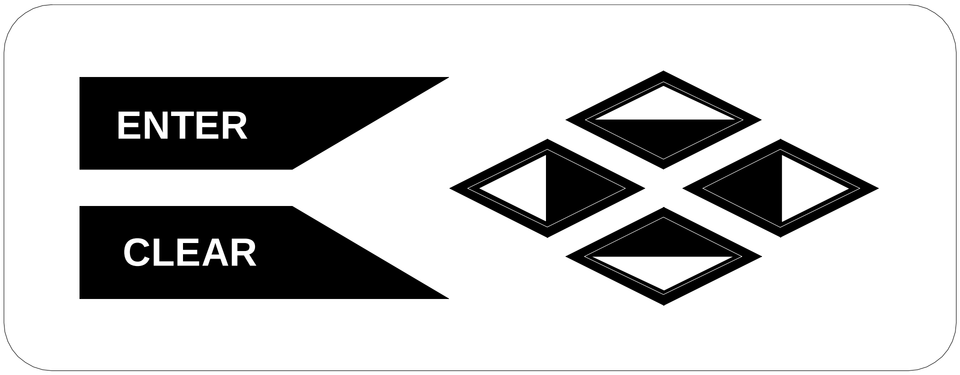


Figure 4-2. Keypad

Each key provides one or more logical functions. These functions are defined in the following table.

ENTER	This key is used to select a displayed function or to execute a modem configuration change.
CLEAR	This key is used to back out of a selection or to cancel a configuration change which has not been executed using [ENTER]. Pressing [CLEAR] to return the display to the previous selection.
Left and Right Diamond Keys	These keys are used to move to the next selection or to move the cursor functions. **Note:** Throughout this chapter, [←] and [→] are used to indicate left and right diamond keys.
Top and Bottom Diamond Keys	These keys are used primarily to change configuration data (numbers). At times, they are also used to move from one section to another. **Note:** Throughout this chapter, [↑] and [↓] are used to indicate top and bottom diamond keys.

The modem responds by beeping whenever a key is pressed:

- A single beep indicates a valid entry and the appropriate action was taken.
- A double beep indicates an invalid entry or a parameter is not available for operation.

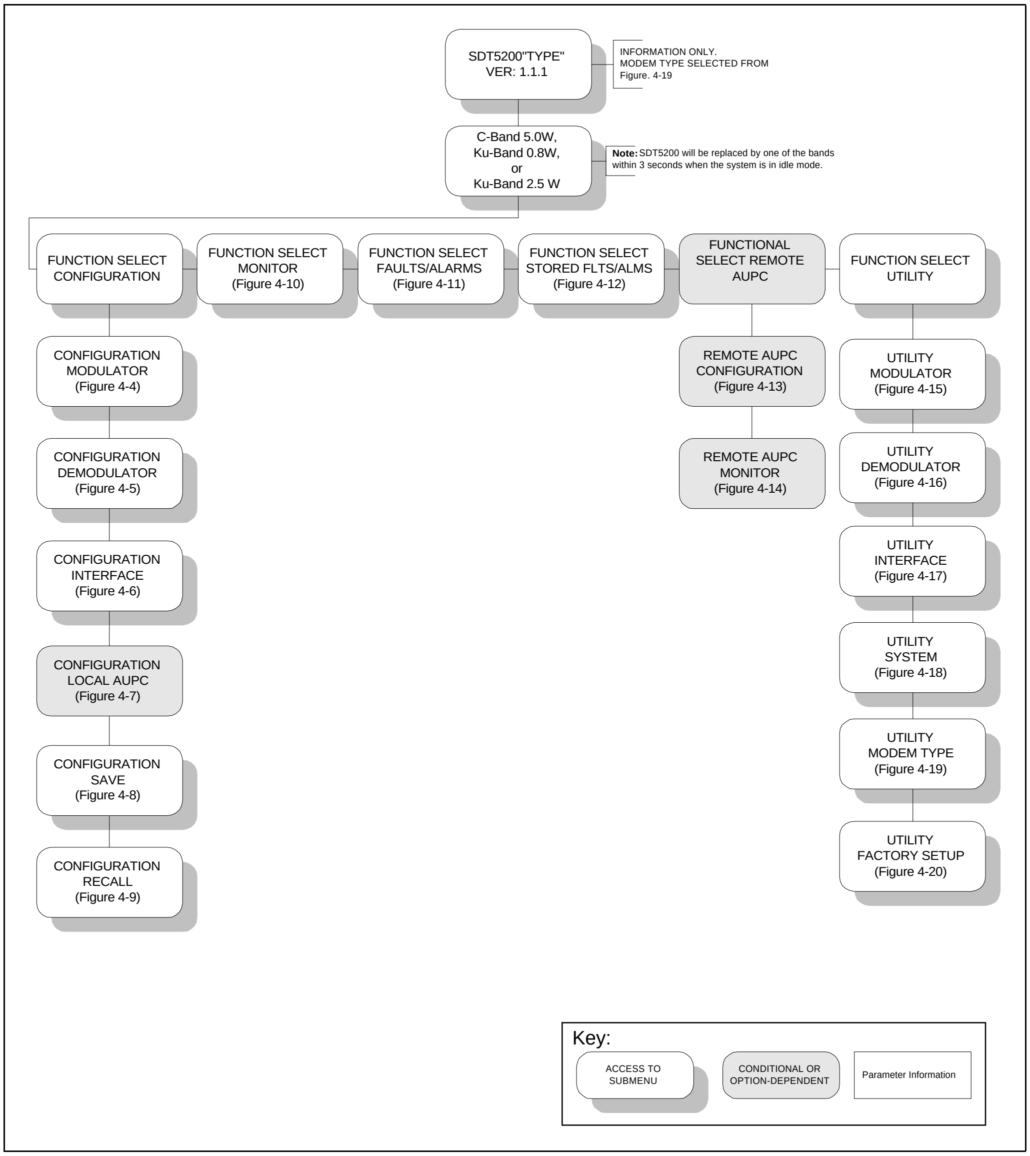


Figure 4-3. Main Menu

4.1.3 Menu System

Note: The Utility Factory Setup (Figure 4-20) menu is for EFData service personnel only. Entering this menu without authorization may cause the modem to operate incorrectly.

Use the Main menu Figure 4-3 as a quick reference for accessing the modem functions. To access and execute all functions, refer to Figure 4-4 through Figure 4-19. For further configuration details, refer to Section 4.2.

When the modem power is applied, the base level of the menu system displays the sign-on message:

- Line 1 of the sign-on message is the modem model number and type.
- Line 2 is the version number of the firmware.

The main level of the menu system is Function Select. To access this level from the sign-on message, press the [←] or [→] keys. From the Function Select menu; select one of the functional categories:

- Configuration
- Monitor
- Faults/Alarms
- Stored Faults/Alarms
- Remote AUPC (ASYNC mode only)
- Utility

Press [←] or [→] to move from one selection to another. When line 2 displays the desired function, select that level by pressing [ENTER]. After entering the appropriate functional level, press [←] or [→] to move to the desired function.

To view or change the modem’s configuration, enter the Configuration level from the Function Select menu. Once in the Configuration menu, press [←] or [→] to scroll through the Configuration menu selection:

- Modulator
- Demodulator
- Interface
- Save
- Recall

Press [ENTER] to select the desired Configuration menu option. To view the options for the selected configuration parameters, press [←] or [→]. To change a configuration parameter, press [ENTER] to begin the change process.

Press [↑] or [↓] to change the parameters. After the display represents the correct parameters, press [ENTER] to execute the change. This action initiates the necessary programming by the modem.

To undo a parameter change before execution, press [CLEAR].

Notes:

1. Figure 4-4 through Figure 4-20 list the front panel menu window selections.
2. Menus or commands that are specific to certain modem configurations are only accessible after selecting the appropriate modem configuration. This prevents incompatible parameters from accidentally being selected.
3. All of the windows are accessible in the Custom mode. Take caution not to select incompatible parameters, as the modem does not shut out incompatible command choices in the Custom mode.

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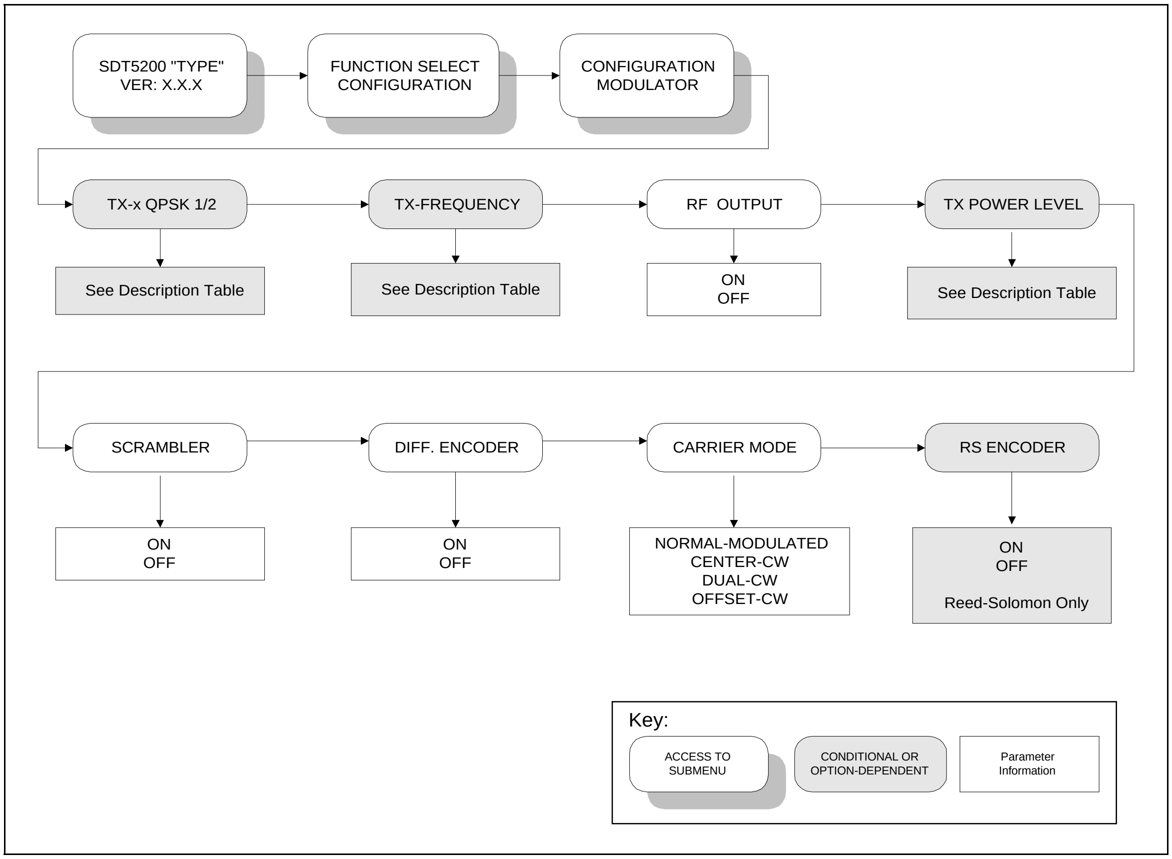

Figure 4-4. Configuration Modulator Menu

4.1.3.1 Configuration Modulator

Refer to Figure 4-4.

TX-x/Type/Code Rate	Transmit code rate/type selection. Select one of four (A, B, C, or D) pre-defined transmitter code/data rate combinations or a variable rate selection (V). <u>Code Rate</u> <u>Data Rate Range</u> BPSK 1/2 2.4 to 1250 kbit/s QPSK 1/2 4.8 to 2500 kbit/s QPSK 3/4 7.2 to 3750 kbit/s QPSK 7/8 8.4 to 4370 kbit/s **Notes:** 1. Maximum Symbol Rate: 2500 kbit/s. 2. Maximum Data Rate for Low Var. Rate: 512 kbit/s. Upon entry, the current transmitter rate is displayed with the flashing cursor on the first character of the code rate on line 1. Line 2 displays the data rate. Press [←] or [→] to make the selection. To select the currently defined variable data rate, select TX-V, and press [ENTER] twice. To change the rate using the variable rate selection, press [ENTER] when TX-V is displayed. A flashing cursor is displayed on the first character of the coding type on line 1. Press [←] or [→] to move the flashing cursor, and [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change. **Note:** When the TX rate has been programmed, the transmitter is automatically turned off to prevent swamping of other channels. To turn the transmitter on, use the TX-IF Output function.
TX-FREQUENCY	C-Band - Programs the modulators transmit frequency between 5.925 to 6.425 GHz in 100 Hz steps. Ku-Band - Programs the modulators transmit frequency between 14.0 to 14.5 GHz in 100 Hz steps. Upon entry, the current transmitter frequency is displayed with the flashing cursor on the first character. Press [←] or [→] to move the flashing cursor, and [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change. **Note:** When the transmitter frequency is changed, the transmitter is automatically turned off to prevent the possible swamping of other channels. To turn the transmitter on, use the TX-IF Output function.
RF OUTPUT	Programs the modulator output on or off. Upon entry, the status of the output is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.

TX POWER LEVEL	C-Band - Programs the modulator output power level from +25.0 to +39.0 dBm. Ku-Band K1 - Programs the modulator output power level from +17.0 to + 30.0 dBm. Ku-Band K3 - Programs the modulator output power level from +22.0 to + 35.0 dBm. An offset can be added through the Utility menu to remove losses or gains in the system. Upon entry, the current transmitter power level is displayed with the flashing cursor on the first character. Press [↑] or [↓] to increase or decrease the output power level in 0.1 dBm steps. Press [ENTER] to execute the change. **Note:** The front panel display may be changed in the power offset utility. Using that function does not change the actual output power level.
SCRAMBLER	Programs the scrambler on or off. Upon entry, the status of the scrambler is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
DIFF. ENCODER	Programs the differential encoder on or off. Upon entry, the status of the differential encoder is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.

<table>
<tr><td>CARRIER MODE

(Test Mode Configuration)</td><td>Programs the modem for continuous wave mode. Four modes of operation are available:
NORMAL-MODULATED: The Carrier mode is normally in the off position. To execute any of the Carrier continuous wave modes, enter the Carrier mode and select the test mode of choice.
CENTER-CW: Generates a carrier at the current modulator frequency. This can be used to measure the output frequency.
DUAL-CW: Generates a dual side-band suppressed carrier signal. Side-bands are at one-half of the symbol rate from the carrier. This is used to check the channel balance and carrier null.
OFFSET-CW: Generates a single, upper, side-band-suppressed carrier signal. The upper side-band is at one-quarter of the symbol rate from the carrier. This is used to check the quadrature. When inverted spectrum is selected, this generates a single, lower, side-band-suppressed carrier.
Upon entry, the Center mode is displayed. To activate this test mode, press [ENTER]. Press [↑] or [↓] to select the desired mode.

To return to the Configuration menu, press [CLEAR].

Note: When [CLEAR] is pressed, the modem is configured to the state before CW mode was invoked. The transmitter is automatically turned off to prevent the possible swamping of other channels. To turn the transmitter on, use the IF Output function.</td></tr>
<tr><td>RS ENCODER</td><td>Programs the Reed-Solomon encoder on or off.

Upon entry, the status of the Reed-Solomon encoder is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.

Note: Programming the Reed-Solomon encoder automatically turns off the RF transmitter (because of symbol rate changes). If none of the proper overhead types and data rates apply, the Reed-Solomon encoder program in the on state will be rejected (double beep).</td></tr>
</table>

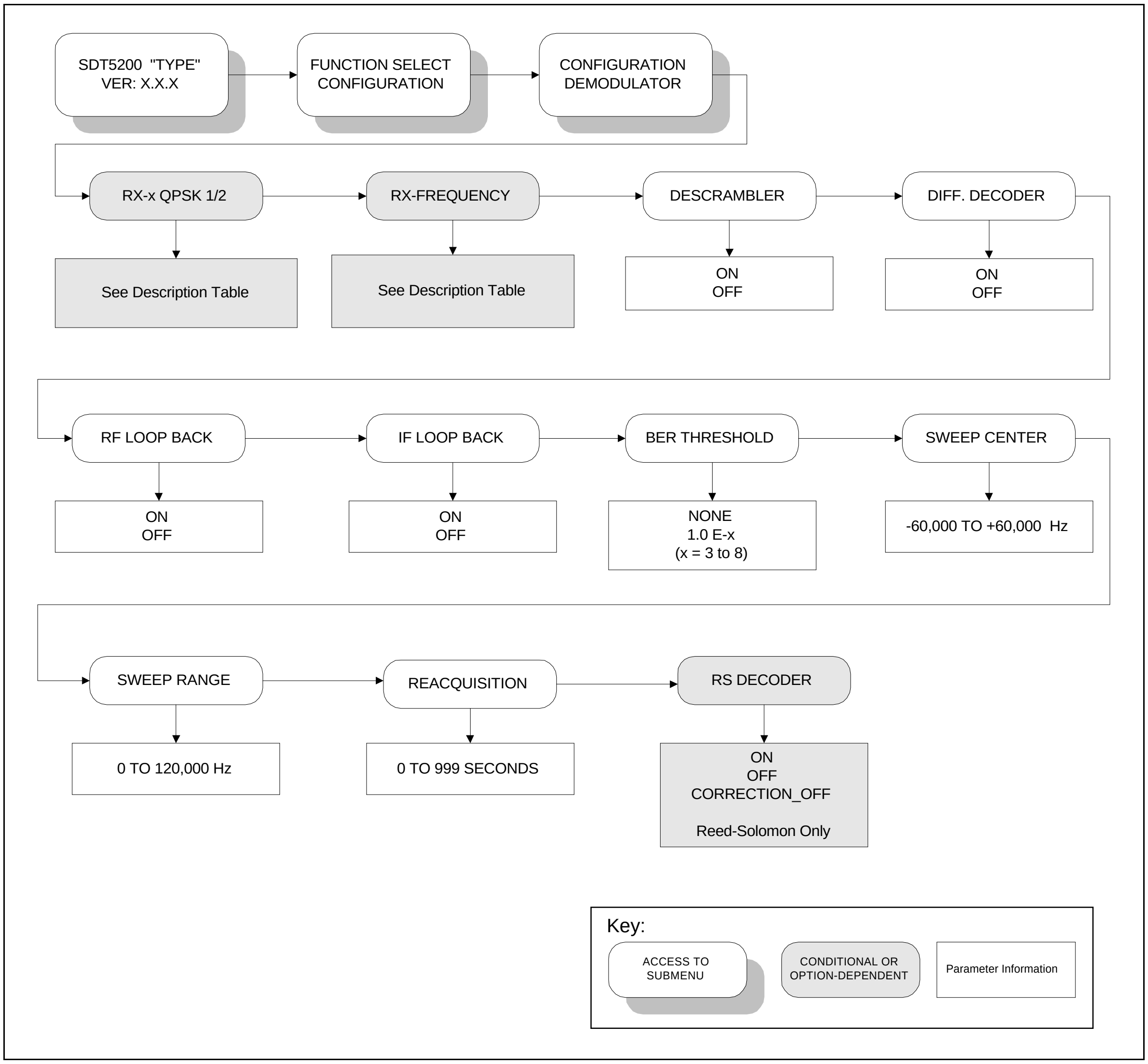

Figure 4-5. Configuration Demodulator Menu

4.1.3.2 Configuration Demodulator

Refer to Figure 4-5.

RX-x /Type/Code Rate	Receiver code rate/type selection. Select one of four (A, B, C, or D) pre-defined receiver decoder/data rate combinations or a variable rate selection (V). <u>Code Rate</u> <u>Data Rate Range</u> BPSK 1/2 2.4 to 1250 kbit/s QPSK 1/2 4.8 to 2500 kbit/s QPSK 3/4 7.2 to 3750 kbit/s QPSK 7/8 8.4 to 4375 kbit/s **Notes:** 1. Maximum Symbol Rate: 2500 kbit/s. 2. Maximum Data Rate for Low Var. Rate: 512 kbit/s. Upon entry, the current receiver rate is displayed with the flashing cursor on the first character of the code rate on line 1. The data rate is displayed on line 2. Press [↑] or [↓] to select one of four pre-defined rates (A, B, C, or D). To select the currently defined variable data rate, select RX-V, and press [ENTER] twice. To change the rate using the variable rate selection, press [ENTER] when RX-V is displayed. A flashing cursor is displayed on the first character of the coding type on line 1. Press [←] or [→] to move the flashing cursor, and [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
RX-FREQUENCY	C-Band - Programs the demodulator receive frequency within 3.70 to 4.20 GHz. Ku-Band - Programs the demodulator receive frequency within 10.95 to 11.45 GHz 11.2 to 11.7 GHz. 11.7 to 12.25 GHz. 12.25 to 12.75 GHz **Note:** In 100 Hz steps. Upon entry, the current receive frequency is displayed with the flashing cursor on the first character. Press [←] or [→] to move the flashing cursor, and [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
DESCRAMBLER	Programs the descrambler on or off. Upon entry, the status of the descrambler is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
DIFF. DECODER	Programs the differential decoder on or off. Upon entry, the status of the differential decoder is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.

RF LOOPBACK	Tunes the RX frequency to the satellite downlink frequency for the configured TX frequency. A C-Band frequency will tune the RX frequency to 2.225 GHz below the TX frequency. A Ku-Band frequency will tune the RX frequency 2.3 GHz below the TX frequency. **Note:** The TX and RX data rates must be the same for the modem to lock.
IF LOOP BACK *(Test Mode Configuration)*	Programs the modem for IF loopback operation. When IF loopback is turned on, the demodulator input is connected to the modulator output through an internal attenuator. The demodulator is programmed to the same frequency as the modulator. An attenuator within the modem connects the IF Out to the IF In. When IF loopback is turned off, the demodulator is tuned to the previous frequency and is reconnected to the IF input. Refer to Figure 4-21 for a block diagram of IF loopback operation. **Note:** IF loopback nullifies RF loopback. Upon entry, the status of IF loopback is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
BER THRESHOLD	Sets the BER threshold. If the BER threshold set is exceeded, a receive fault will be indicated by the modem status indicators. BER threshold may be set from 1.0 E-3 to 1.0 E-8, or may be disabled by specifying NONE. Upon entry, the current setting of the BER threshold is displayed. Press [↑] or [↓] to select the desired setting. Press [ENTER] to execute the change.
SWEEP CENTER	Programs the sweep center frequency for the directed sweep function. When in directed sweep, the value from the sweep monitor screen (when the modem was last lock) should be entered for the sweep center frequency. The sweep center frequency can be set in the range from -35,000 to +35,000 Hz. Upon entry, the current setting of the BER threshold is displayed. Press [↑] or [↓] to select the desired setting. Press [ENTER] to execute the change.
SWEEP RANGE	Programs the overall travel of the sweep width range during acquisition in the directed sweep mode. The sweep width may be set from 0 to 70000 Hz. When set at 70000 Hz, the modem is in the normal acquisition mode. The smaller the range, the faster the modem will lock, provided the receive carrier center frequency is within the RX IF frequency sweep range. Upon entry, the current programmed setting is displayed. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.

REACQUISITION	Programs the sweep reacquisition mode time duration. This is the time that the modem will remain in a narrow sweep after loss of acquisition. After this timer runs out, the modem will return to the normal acquisition sweep. The reacquisition time is 0 to 999 seconds. Upon entry, the current programmed setting is displayed with a flashing cursor on the first character. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Select the number of seconds desired for the reacquisition mode. Press [ENTER] to execute the change.
RS DECODER *(Test Mode Configuration)*	Programs the Reed-Solomon decoder on, Correction off, or off. Upon entry, the status of the Reed-Solomon decoder is displayed. Use [↑] or [↓] to select one of the following modes: • **ON:** Enables the Reed-Solomon decoder to provide data error corrections. • **CORRECTION_OFF:** Turns off the Reed-Solomon decoder data error correction circuitry. Data flow is then routed through normal data paths without error corrections. • **OFF:** The RS decoder is normally disabled (off position). To execute any of the Reed-Solomon decoder modes, enter the desired Reed-Solomon decoder and select the desired mode. Press [ENTER] to execute the change. **Note:** If none of the proper overhead types or data rates apply, the Reed-Solomon decoder in the on state will be rejected (double beep). With the Reed-Solomon decoder turned on (not off or Correction off), the corrected BER will be reported from the outer decoder (Reed-Solomon decoder).

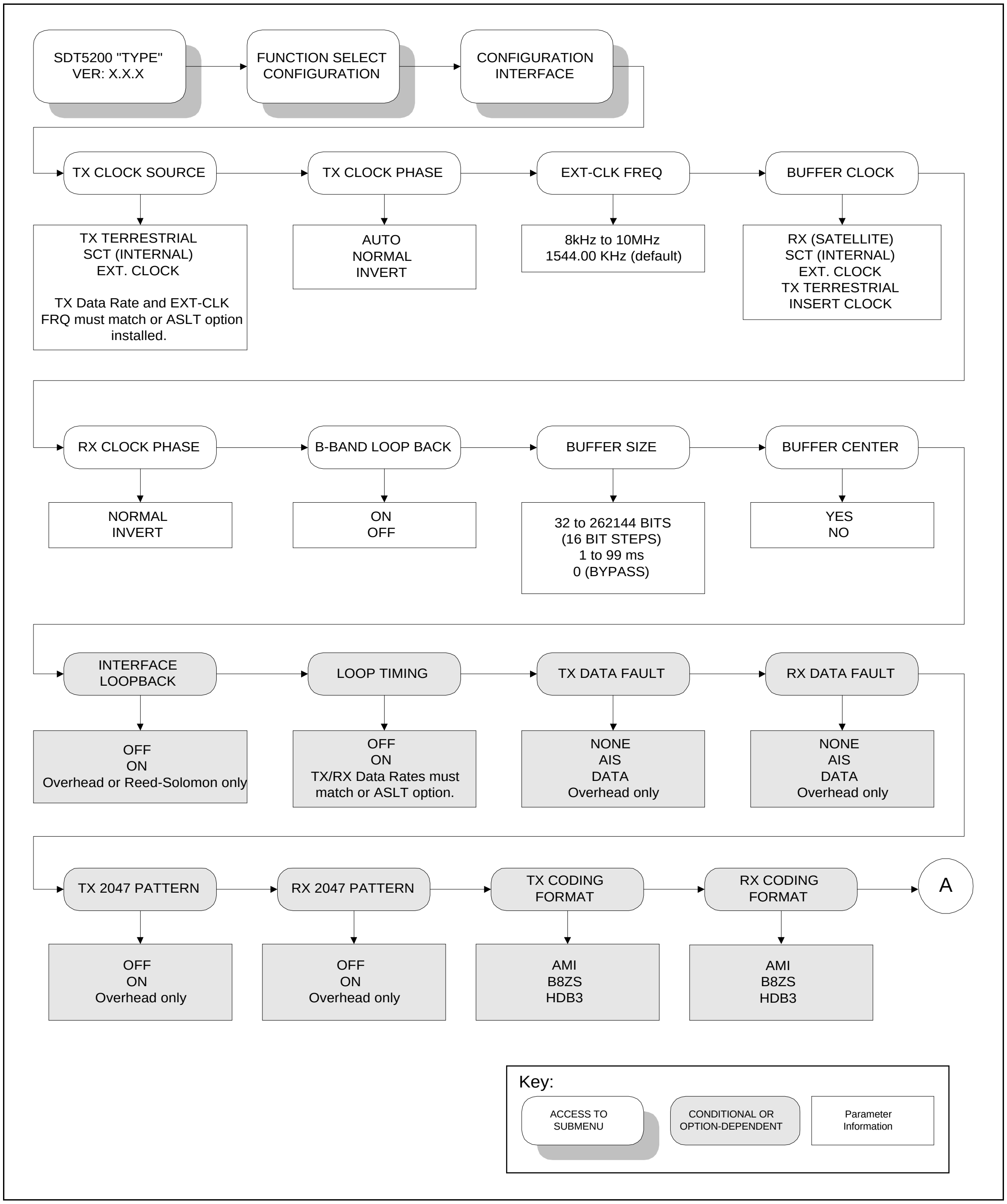

Figure 4-6. Configuration Interface Menu

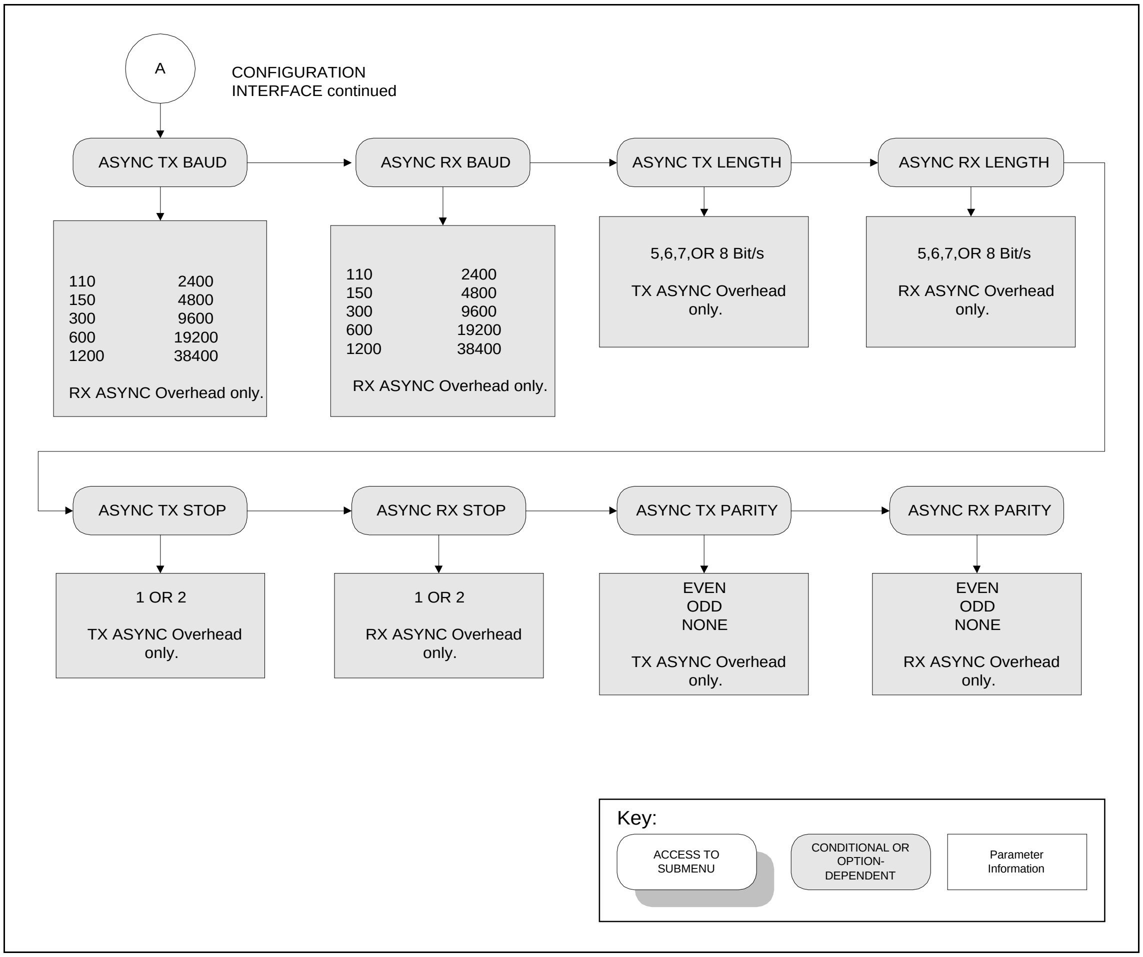

Figure 4-6A. Configuration Interface Menu (Continued)

4.1.3.3 Configuration Interface

Refer to Figure 4-6.

TX CLOCK SOURCE	Programs the clock source for the modem transmitter clock to the following configurations: • **TX TERRESTRIAL:** Sets the TX clock to recover timing from the incoming clock/data. • **SCT (INTERNAL):** Sets the TX clock to operate from the modem internal clock (this is also the fallback clock). **Note:** When loop timing is enabled, SCT (LOOP) is displayed instead of SCT (INTERNAL). • **EXT. CLOCK:** Sets the TX clock to operate from the external reference clock. Transmit Clock source must be phase/frequency locked to the data that is being transmitted. The correct frequency must be programmed into EXT-CLK FREQ. Upon entry, the current transmit clock setting is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
TX CLOCK PHASE	Programs the TX clock phase to AUTO, NORMAL, or INVERT. Upon entry, the current setting of the TX clock phase is displayed. Press [↑] or [↓] to make the selection. When AUTO is selected, the modem will automatically select NORMAL or INVERT to properly phase the TX clock with the TX data. Press [ENTER] to execute the change.
EXT-CLK FREQ	Programs the external reference clock input frequency between 8 kHz to 10 MHz. This clock frequency can be any multiple of 600 Hz from 2.4 to < 64 kHz, and can be any multiple of 8 kHz from 32 kHz to 4.376 MHz. This can be used for the Doppler/plesiochronous buffer reference. It can be a reference to SCT. Upon entry, the current setting for the external reference is displayed. Press [←] or [→] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.

<table>
<tr><td>BUFFER CLOCK</td><td>Programs the interface buffer output clock to one of the following modes:
RX (SATELLITE): Sets the output buffer clock to the satellite clock.
SCT (INTERNAL): Sets the buffer clock to operate from the modem internal clock. This is also the fallback clock.
EXT. CLOCK: Sets this clock source to the external clock.
TX TERRESTRIAL: Sets the buffer output clock to recover timing from the incoming TX data clock.
INSERT CLOCK: Selects the recovered clock from the insert send data input received from the terrestrial equipment.
Upon entry, the current setting of the plesiochronous buffer clock is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.</td></tr>
<tr><td>RX CLOCK PHASE</td><td>Programs the RX clock phase to Normal or Inverted.

Upon entry, the status of the RX Clock is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.</td></tr>
<tr><td>B-BAND LOOP BACK

(Test Mode Configuration)</td><td>Programs the modem for baseband loopback operation.

When baseband loopback is turned on, the data and timing signals are switched from the demodulator to the modulator on the modem side of the interface. The DTE baseband signals are also looped back from the transmitter data and clock to receiver data and clock on the customer side of the interface. This is a bi-directional loopback of the baseband data. Refer to Figure 4-22 for a block diagram of baseband loopback operation.

Upon entry, the status is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.</td></tr>
<tr><td>BUFFER SIZE</td><td>Sets the size of the buffer.

Upon entry, the current buffer length is displayed. Press [↑] or [↓] to select the desired buffer size. The buffer size is displayed in seconds or bits. Enter the Utility Interface menu to change the buffer units to seconds or bits. If selecting seconds, choose from 1 to 99 ms, in increments of 1 ms or 0 (Bypass). If selecting bits, choose from 32 to 262144 bits, in increments of 16 bits. Press [ENTER] to execute the change.

Note: To have the modem calculate the plesiochronous shift, set the buffer units to ms. When a specific buffer depth is desired, set the buffer units to bits. Select bits or ms from the Utility Interface menu.</td></tr>
<tr><td>BUFFER CENTER</td><td>This configuration function is used to center the buffer. Choosing YES centers the buffer.

Press [ENTER] twice to center the buffer.</td></tr>
</table>

INTERFACE LOOPBACK *(Test Mode Configuration)*	Programs the modem for Interface Loopback operation. When INTERFACE LOOPBACK is turned on, data is looped back at the modem side of the interface. This is a bi-directional loop back of the data after the base band data has had the overhead added. Refer to Figure 4-23 for the interface block diagram. Upon entry, the status is displayed. [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** This menu is only available when the overhead interface PCB or Reed-Solomon PCB is installed.
LOOP TIMING	Programs the transmit clocking to the RX satellite clock. TX and RX data rates must be equal unless the asymmetrical loop timing option is enabled. Upon entry, the status is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
TX DATA FAULT	Transmit data fault. Press [↑] or [↓] to select one of the following modes: • **NONE:** The transmit interface fault Data/AIS is not activated. • **ALARM INDICATION SIGNAL (AIS):** Sets transmit interface fault Data/AIS to monitor a fault condition of all 1s from customer data input to the modem. • **DATA:** Sets transmit interface fault Data/AIS to monitor a fault condition of all 1s or 0s. This is referred to as a data-stable condition, which means that the data is not transitioning. Upon entry, the current TX data fault that is being monitored is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** This menu is only available when the overhead interface PCB is installed.

RX DATA FAULT	Receive data fault. Press [↑] or [↓] to select one of the following modes: The data monitored for RX data is coming from the satellite. Refer to TX DATA FAULT for a description of function choices. Upon entry, the current RX data fault that is being monitored is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** This menu is only available when the overhead interface PCB is installed.
TX 2047 PATTERN *(Test Mode Configuration)*	Programs the transmitter to on or off to insert a 2047 pattern instead of the normal transmit data. Upon entry, the status is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** This menu is only available when the overhead interface PCB is installed.
RX 2047 PATTERN *(Test Mode Configuration)*	Programs the modem to receive a 2047 pattern as the normal receive data, and allows the BER monitor to work on that 2047 pattern. Upon entry, the status is displayed. Press [↑] or [↓] to select on or off. Press [ENTER] to execute the change. **Note:** This menu is only available when the overhead interface PCB is installed.
TX CODING FORMAT	Programs the transmitter for AMI, B8ZS, or HDB3 coding of the baseband data. Upon entry, the current coding format is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** This menu is only available when the TX G.703 interface is programmed.
RX CODING FORMAT	Programs the receiver for AMI, B8ZS, or HDB3 coding. Upon entry, the current coding format is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** This menu is only available when the RX G.703 interface is programmed.
ASYNC TX BAUD	Programs the ASYNC overhead TX baud rate for 110 to 38400 bit/s. Upon entry, the status of the ASYNC TX baud rate is displayed. Press [↑] or [↓] to select on of the following baud rates (bit/s): 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400. Press enter to execute the change. **Note:** Only available for the ASYNC option.

ASYNC RX BAUD	Programs the ASYNC overhead RX baud rate for 110 to 38400 bit/s. Upon entry, the status of the ASYNC RX baud rate is displayed. Press [↑] or [↓] to select on of the following baud rates (bit/s): 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400. Press [ENTER] to execute the change. **Note:** Only available for the ASYNC option.
ASYNC TX LENGTH	Programs the ASYNC overhead TX word length for 5, 6, 7, or 8 bits. Upon entry, the status of the ASYNC TX word length is displayed. Press [↑] or [↓] to select the selection. Press [ENTER] to execute the change. **Note:** Only available for the ASYNC option.
ASYNC RX LENGTH	Programs the ASYNC overhead RX word length for 5, 6, 7, or 8 bits. Upon entry, the status of the ASYNC RX word length is displayed. Press [↑] or [↓] to select the selection. Press [ENTER] to execute the change. **Note:** Only available for the ASYNC option.
ASYNC TX STOP	Programs the ASYNC overhead TX stop bits for 1 or 2. Upon entry, the status of the ASYNC TX stop bits is displayed. Press [↑] or [↓] to select the selection. Press [ENTER] to execute the change. **Note:** Only available for the ASYNC option.
ASYNC RX STOP	Programs the ASYNC overhead RX stop bits for 1 or 2. Upon entry, the status of the ASYNC RX stop bits is displayed. Press [↑] or [↓] to select the selection. Press [ENTER] to execute the change. **Note:** Only available for the ASYNC option.
ASYNC TX PARITY	Programs the ASYNC overhead TX parity for EVEN, ODD, or NONE. Upon entry, the status of the ASYNC TX parity is displayed. Press [↑] or [↓] to select the selection. Press [ENTER] to execute the change. **Note:** Only available for the ASYNC option.
ASYNC RX PARITY	Programs the ASYNC overhead RX parity for EVEN, ODD, or NONE. Upon entry, the status of the ASYNC RX parity is displayed. Press [↑] or [↓] to select the selection. Press [ENTER] to execute the change. **Note:** Only available for the ASYNC option.

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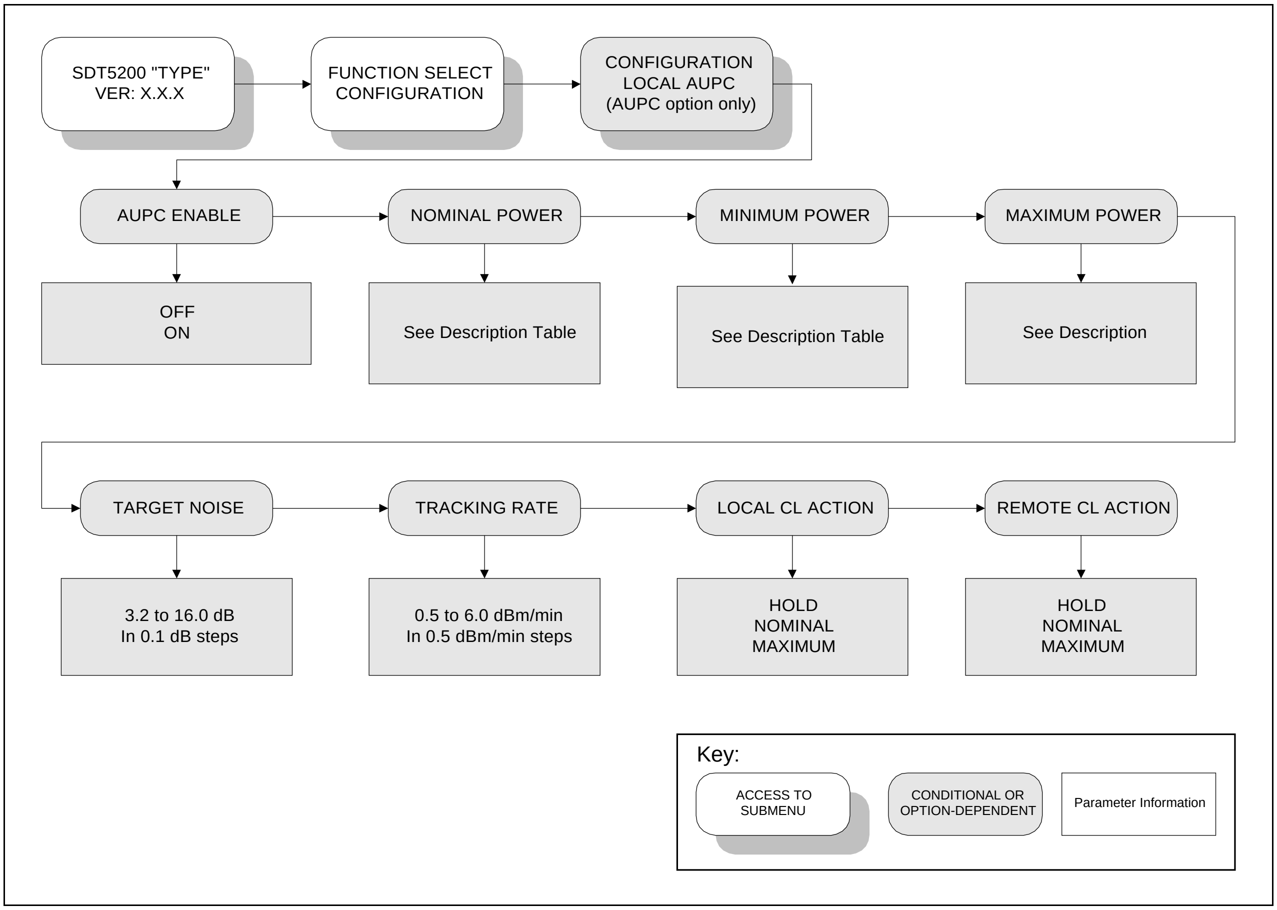

Figure 4-7. Configuration Local AUPC Menu

4.1.3.4 Configuration Local AUPC

Refer to Figure 4-7.

AUPC ENABLE	Programs the AUPC On or Off. Upon entry, the status is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
NOMINAL POWER	C-Band - Programs the nominal power value of the AUPC. The nominal power value can range from +25.0 to +38.0 dBm, in 0.5 dBm steps. Ku-Band K1 - Programs the nominal power value of the AUPC. The nominal power value can range from +17.0 to +30.0 dBm, in 0.5 dBm steps. Ku-Band K3 - Programs the nominal power value of the AUPC. The nominal power value can range from +22.0 to +35.0 dBm, in 0.5 dBm steps. Upon entry, the current nominal power value is displayed. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
MINIMUM POWER	C-Band - Programs the minimum power value of the AUPC. The nominal power value can range from +25.0 to +39.0 dBm, in 0.5 dBm steps. Ku-Band K1 - Programs the minimum power value of the AUPC. The minimum power value can range from +17.0 to +30.0 dBm, in 0.5 dBm steps. Ku-Band K3 - Programs the minimum power value of the AUPC. The minimum power value can range from +22.0 to +35.0 dBm, in 0.5 dBm steps. Upon entry, the current minimum power level is displayed. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
MAXIMUM POWER	C-Band - Programs the maximum power value of the AUPC. The maximum power value can range from +25.0 to +39.0 dBm, in 0.5 dBm steps. Ku-Band K1 - Programs the maximum power value of the AUPC. The maximum power value can range from +17.0 to +30.0 dBm, in 0.5 dBm steps. Ku-Band K3 - Programs the maximum power value of the AUPC. The maximum power value can range from +22.0 to +35.0 dBm, in 0.5 dBm steps. Upon entry, the current maximum power level is displayed. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
TARGET NOISE	Programs the E_b/N_0 target set point. The E_b/N_0 target set point ranges from 3.2 to 16.0 dB, in 0.1 dB steps. Upon entry, the current E_b/N_0 target set point is displayed. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.

TRACKING RATE	Programs the maximum tracking rate of the AUPC. Maximum tracking rate can range from 0.5 to 6.0 dBm/minute, in 0.5 dBm/minute steps. Upon entry, the current maximum tracking rate is displayed. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change.
LOCAL CL ACTION	Programs the local carrier loss for HOLD, NOMINAL, or MAXIMUM. Upon entry, the status of the local carrier loss is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
REMOTE CL ACTION	Programs the remote carrier loss for HOLD, NOMINAL, or MAXIMUM. Upon entry, the status of the remote carrier loss is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.

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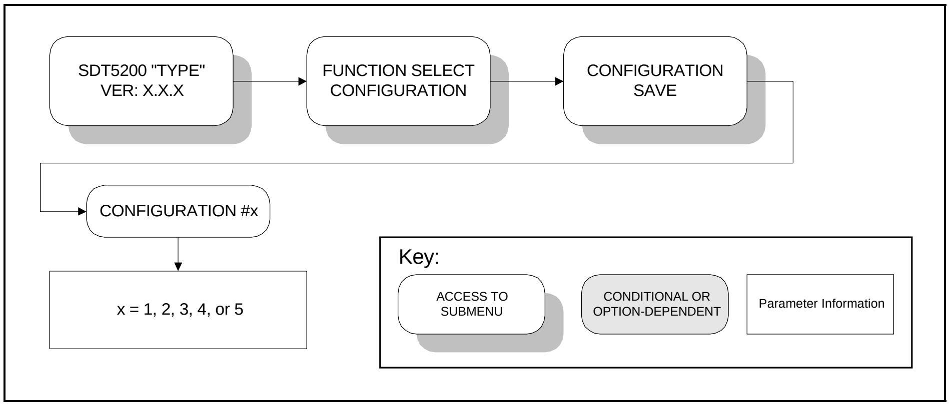

Figure 4-8. Configuration Save Menu

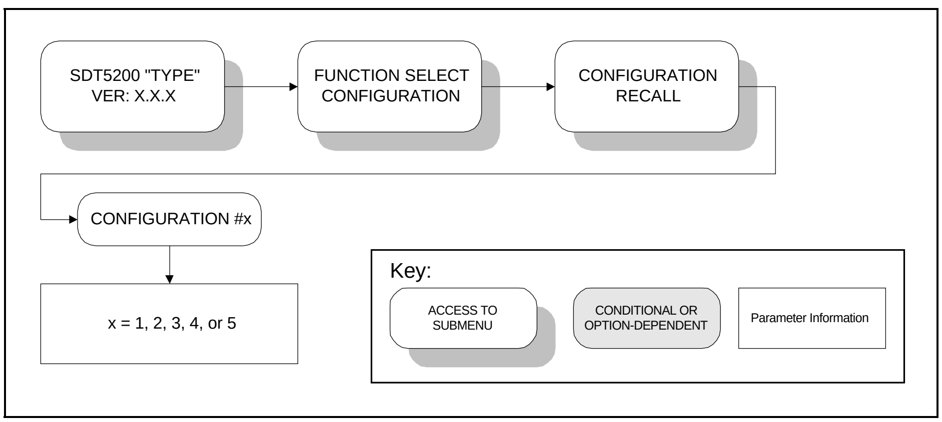

Figure 4-9. Configuration Recall Menu

4.1.3.5 Configuration Save

Refer to Figure 4-8.

The Configuration Save menu allows programming of configuration parameters into memory on the M&C. There are five memory locations that may be used to store specific configuration setups that are used frequently.

After changing the configuration parameters to the desired settings, enter the Configuration Save menu and select memory location 1 through 5. Press [ENTER] to execute the save.

4.1.3.6 Configuration Recall

Refer to Figure 4-9.

The Configuration Recall menu allows the user to recall a previously saved configuration setup. Upon entry, select memory location 1 through 5 by pressing [↑] or [↓]. Press [ENTER] to execute the recall.

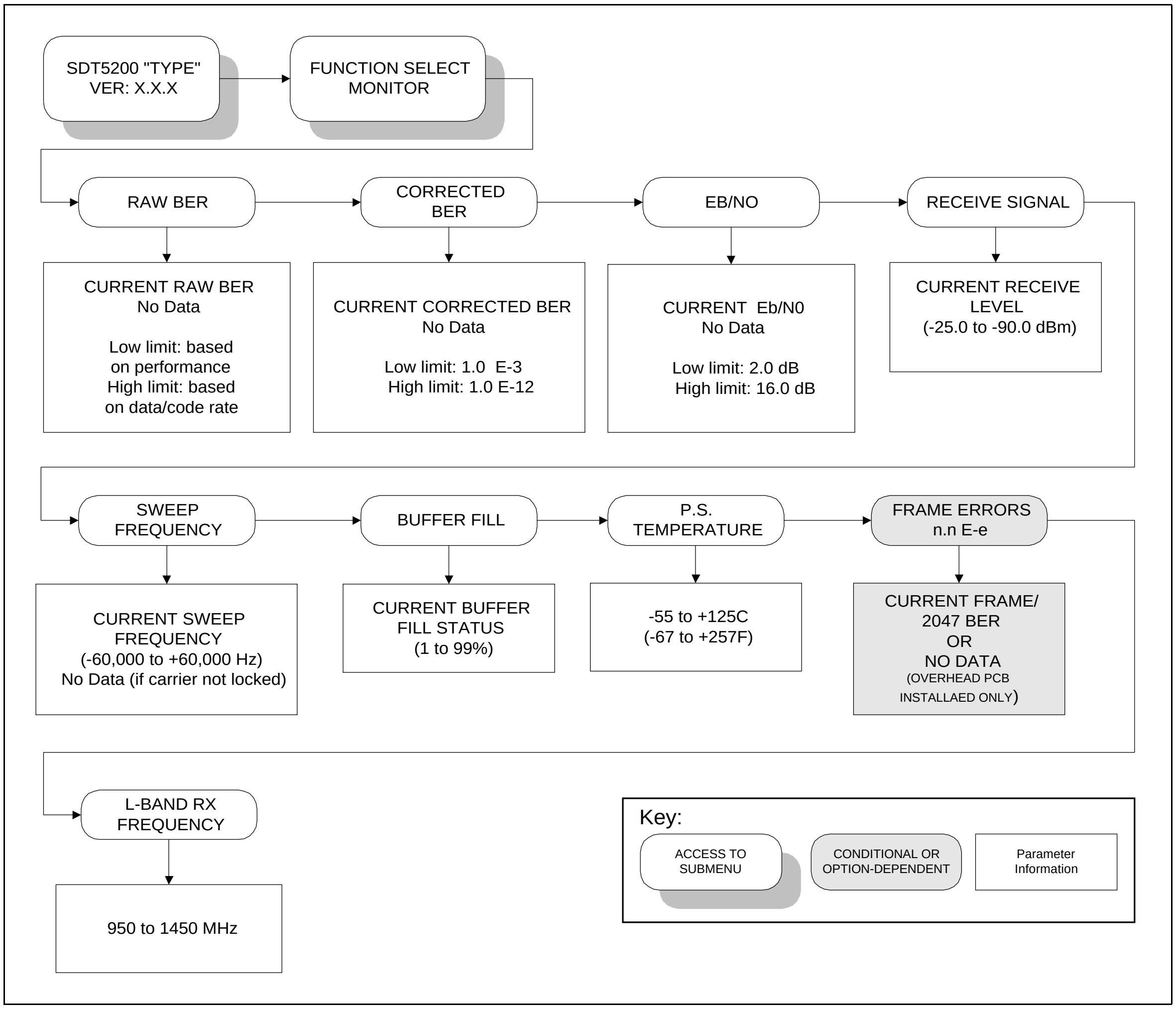

Figure 4-10. Monitor Menu

4.1.3.7 Monitor

Refer to Figure 4-10.

When the Monitor level is entered press [←] or [→] to select the desired monitor function. Each monitor function is displayed in real time as long as it is selected.

RAW BER	Displays the current BER or "No Data" (if carrier is not locked). Range: < m.m E-e to > m.m E-e. **Note:** Low limit is based on performance. High limit is based on data/code rate.
CORRECTED BER	Displays the current corrected BER or "No Data" (if carrier is not locked). Range: 1.0 E-3 to 1.0 E-12.
EB/N0	Displays the current E_b/N_0 or "No Data" (if carrier is not locked). Range: 2.0 to 16.0 dB.
RECEIVE SIGNAL	Displays the current receive signal level. Range: -25.0 to -95.0 dBm for symbol rates ≤ 190 ks/s. -15.0 to -85.0 dBm for symbol rates > 190 ks/s.
SWEEP FREQUENCY	Displays the current offset frequency or "No Data" (if carrier is not locked). Range: -35,000 to +35,000 Hz.
BUFFER FILL	Displays the current plesiochronous buffer fill status percent. Range: 1 to 99%.
P.S. TEMPERATURE	Displays the current P.S. temperature in degrees Celsius. Range: -55° to +125°C (-67° to +257°F).
FRAME ERRORS	Displays current frame errors or data if carrier/2047 is not locked. **Note:** Available with Overhead card only.
L-BAND RX FREQUENCY	Displays the frequency being received at the RX input of the IDU. Range: 950 to 1450 MHz (in 100 Hz steps)

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4.1.3.8 Faults/Alarms

Refer to Figure 4-11.

The Faults/Alarms menu is accessible from the Function Select menu. The Faults/Alarms are similar to monitor functions, as they display the current fault status of the group being displayed.

Press [←] or [→] to move between the following Faults/Alarms groups:

- Modulator
- Demodulator
- Transmit Interface
- Receive Interface
- Common Equipment

Line 2 of the display shows the current Faults/Alarms status in real time. For each parameter monitored, fault status is displayed as one of the following:

- "–" indicates that no fault or alarm exists.
- "+" indicates that a fault exists, and will cause switching in a redundant system.
- Reversed contrast "+" indicates an active alarm.

Unlike faults, alarms do not cause switching to occur. To display labels for individual faults or alarms, press [ENTER].

Press [←] or [→] to move the flashing cursor to make the selection. The label for that Fault/Alarm is then displayed on line 1 of the display. Press [CLEAR] to exit this level of operation and return to the previous level.

The following sections outline the faults and alarms monitored and displayed in each group.

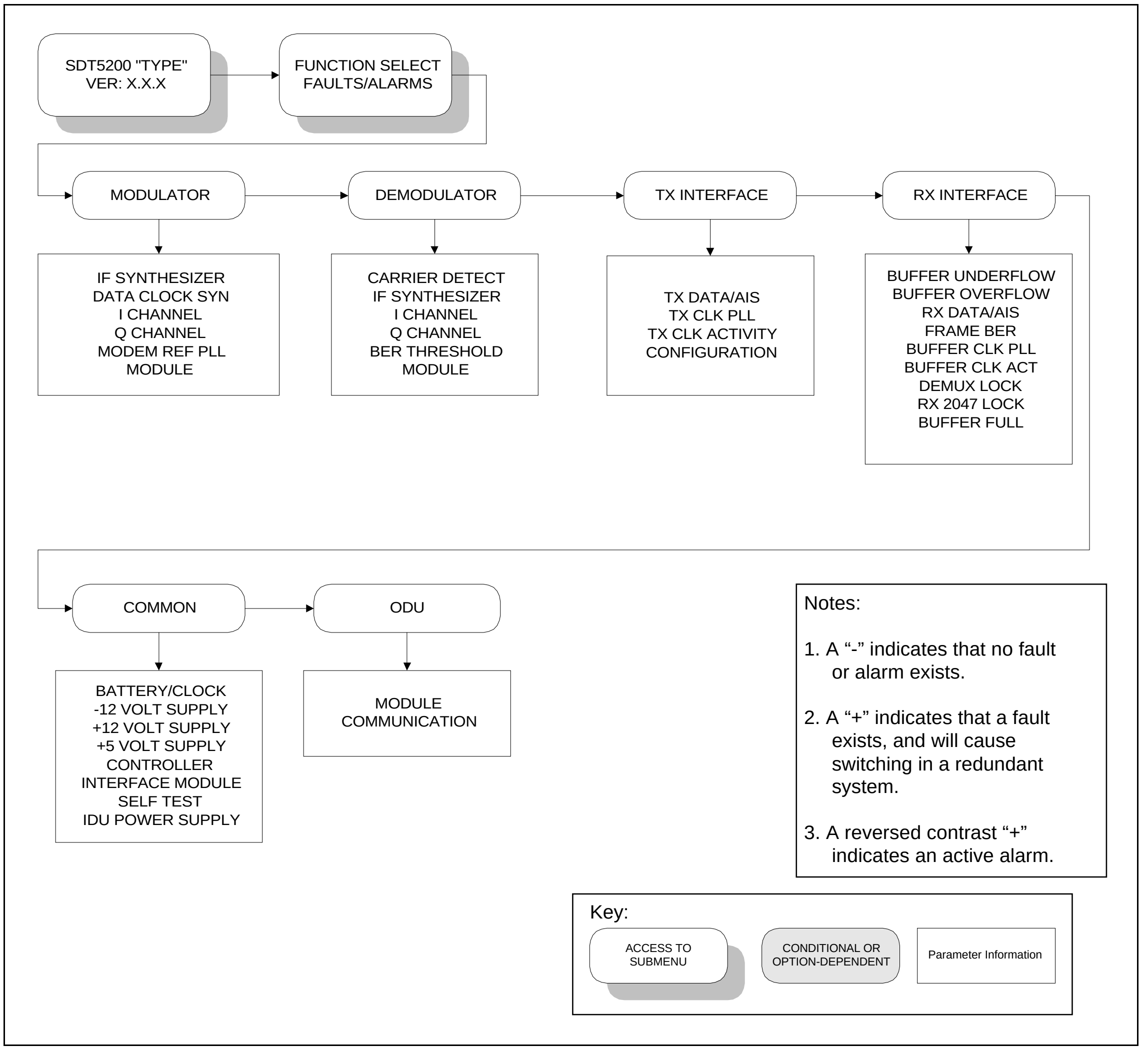

Figure 4-11. Faults/Alarms Menu

4.1.3.8.1 Modulator Faults

IF SYNTHESIZER	Modulator IF synthesizer fault.
DATA CLOCK SYN	Transmit clock synthesizer fault. Indicates the internal Voltage Controlled Oscillator (VCO) has not locked to the incoming data clock.
I CHANNEL	I channel data activity fault.
Q CHANNEL	Q channel data activity fault.
MODEM REF PLL	MODEM REF PLL not locked.
MODULE	Modulator module fault. Typically indicates that the modulator module is missing or will not program.

4.1.3.8.2 Demodulator Faults

CARRIER DETECT	Carrier detect fault. Indicates the decoder is not locked.
IF SYNTHESIZER	Demodulator IF synthesizer fault. Indicates the IF synthesizer is not locked.
I CHANNEL	I channel activity fault. Indicates a loss of activity in the I channel of the quadrature demodulator.
Q CHANNEL	Q channel activity fault. Indicates a loss of activity in the Q channel of the quadrature demodulator.
BER THRESHOLD	Secondary alarm result of the BER threshold set in the DEMOD Configuration menu.
MODULE	Demodulator/decoder module fault. Typically indicates that the demod/decoder module is missing or will not program.

4.1.3.8.3 Transmit Interface Faults

TX DATA/AIS	Data or AIS. When data fault is selected in the Interface Configuration menu, the fault indicates a data stable condition. This indicates the data is all 1s or 0s (i.e., data is not transitioning). When AIS is selected, the alarm indicates the data is all 1s from customer data input to the modem. When None is selected in the Interface Configuration menu, the TX Data/AIS Fault/Alarm is not activated. **Note:** AIS is an alarm, not a switching fault.
TX CLK PLL	Transmitter phase-locked loop fault. Indicates the transmitter Phase-Locked Loop (PLL) is not locked.
TX CLK ACTIVITY	Activity detector alarm of the selected interface transmit clock. The interface will fall back to the internal clock when this alarm is active.
CONFIGURATION	TX interface configuration fault. Indicates the TX interface cannot execute a programmed configuration parameter.

4.1.3.8.4 Receive Interface Faults

BUFFER UNDERFLOW	Buffer underflow alarm. Indicates that a buffer underflow has occurred.
BUFFER OVERFLOW	Buffer overflow alarm. Indicates that a buffer overflow has occurred.
RX DATA/AIS	Data or AIS. When data fault is selected in the Configuration Interface menu (Figure 4-6), the fault indicates a data stable condition. This indicates the data coming from the satellite is all 1s or 0s (i.e., data is not transitioning). When AIS is selected, the Alarm indicates the data is all 1s from the satellite. When None is selected in the Configuration Interface menu, the RX Data/AIS Fault/Alarm is not activated. **Note:** AIS is an alarm, not a switching fault.
FRAME BER	Frame BER fault. Indicates that the frame BER exceeds 1^{-3}.
BUFFER CLK PLL	Buffer clock phase-locked loop fault. Indicates the buffer clock PLL is not locked.
BUFFER CLK ACT	Activity detector alarm of the selected interface receive clock. The interface will fall back to the satellite clock when this fault is active.
DEMUX LOCK	DEMUX lock fault. Indicates that the DEMUX is not locked.
RX 2047 LOCK	RX 2047 lock alarm. Indicates the RX 2047 data pattern is not locked. **Note:** This alarm is only active if RX 2047 is ON.
BUFFER FULL	Buffer full alarm. Indicates the buffer is less than 10% or greater than 90% full.

4.1.3.8.5 Common Equipment Faults

BATTERY/CLOCK	Battery or clock fault.
-12V SUPPLY	-12V power supply fault.
+12V SUPPLY	+12V power supply fault.
+5V SUPPLY	+5V power supply fault.
CONTROLLER	Controller fault. Typically indicates the controller has gone through a power on/off cycle.
INTERFACE MODULE	Interface module fault. Typically indicates that the interface module is missing or will not program.
SELF TEST	Built in self-test fault.
IDU POWER SUPPLY	IDU Power Supply fault. Typically indicates that the power supply is missing or will not program.

4.1.3.8.6 Outdoor Unit

MODULE	Module fault
COMMUNICATION	Communication alarm.

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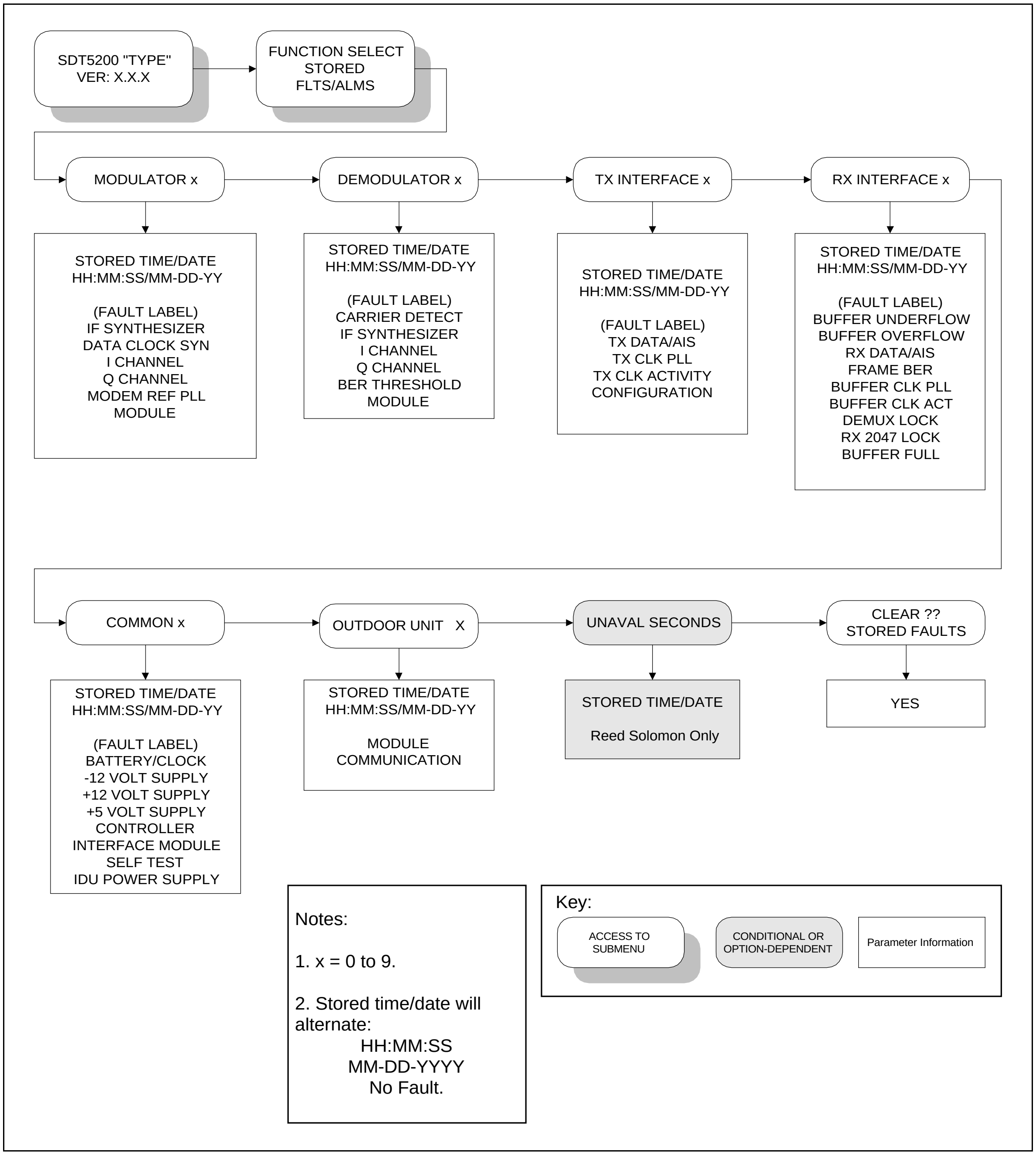

Figure 4-12. Stored Faults/Alarms Menu

4.1.3.9 Stored Faults/Alarms

Refer to Figure 4-12.

The modem stores the first 10 (Flt0 through Flt9) occurrences of fault status changes in each of the following major fault categories:

- Modulator
- Demodulator
- Transmit Interface
- Receive Interface
- Common Equipment

Each fault status change is stored with the time and date of the occurrence of the fault. Stored faults may be viewed by entering the stored faults level from the Select menu. Refer to Sections 4.1.3.8.1 through 4.1.3.8.6 for fault explanations. UNAVAL SECONDS fault information appears in Section 4.1.3.9.1.

Stored faults are not maintained through controller power-on reset cycle. However, the last known time is maintained in nonvolatile Random Access Memory (RAM). On power-up, a common equipment fault is logged (Flt0) with that last known time and date. In addition, on power-up, an additional common equipment fault is logged (Flt1) to indicate the power-up time and date. The power-down and power-up times are logged as common equipment fault 0 and common equipment fault 1, respectively.

On entering the stored faults level, press [←] or [→] to move between the fault groups and the "Clear Stored Faults?" selections. The time and date of the first stored fault status (Flt0) for the selected group will be displayed alternately on line 2 of the display. Press [↑] or [↓] to cycle through the selected group has stored fault status (Flt0 through Flt9). To display the fault status associated with the displayed time and date, press [ENTER]. To identify the fault, press [←] or [→] to move the flashing cursor. To clear the currently logged stored faults, press [ENTER] when the "Clear Stored Faults/Yes?" selection is displayed.

Note: Faults are stored in time sequence, with the oldest fault status change stored in Flt0, and the most recent in Flt9. Only the first 10 fault status changes are stored. All stored faults, which have not been used, indicate "No Fault" on the display.

4.1.3.9.1 Unavailable Seconds Fault

UNAVAL SECONDS x	A fault is indicated if the Reed-Solomon Codec could not correct bit errors in one block, that has serialized data in any given second. **Note:** This is available only with the Reed-Solomon option.

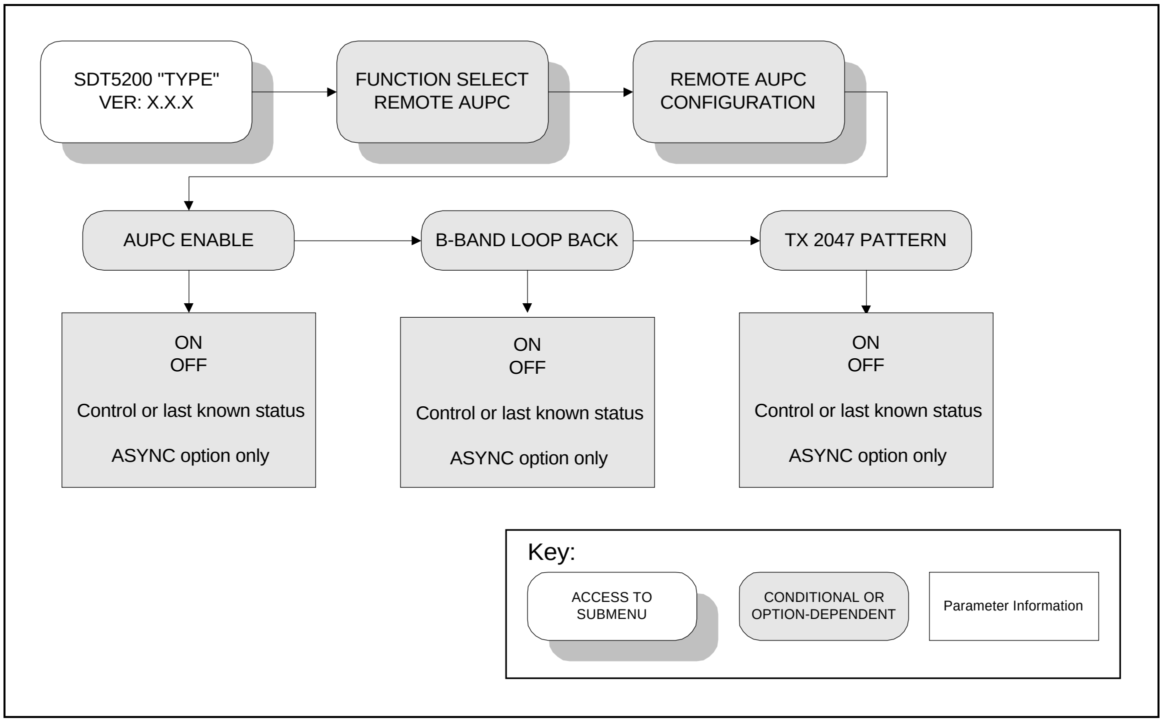

Figure 4-13. Remote AUPC Configuration Menu

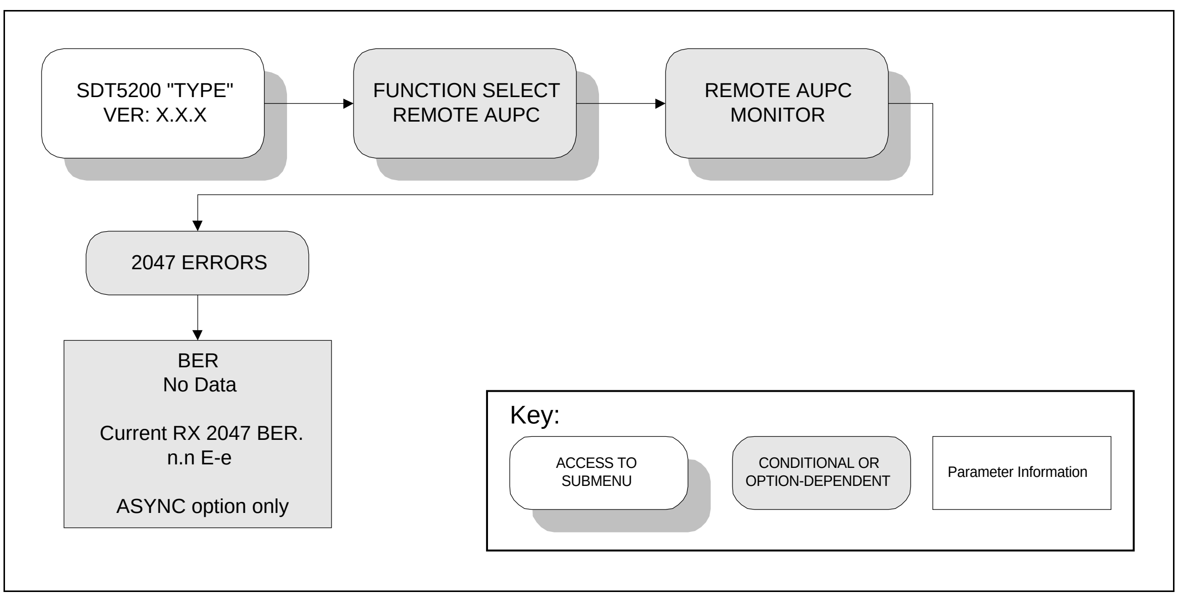

Figure 4-14. Remote AUPC Monitor Menu

4.1.3.10 Remote AUPC

To view or change the Remote AUPC functions, enter the Remote AUPC menu from the Function Select menu on the front panel. After entering the Remote AUPC menu, press [←] or [→] to select the Configuration or Monitor menu. Enter the selected menu by pressing [ENTER]. Press [←] or [→] to view the selected configuration parameters.

Note: This is only available with the ASYNC/AUPC overhead option.

4.1.3.10.1 Remote AUPC Configuration

Refer to Figure 4-13.

AUPC ENABLE	Programs the AUPC feature on or off. Upon entry, the status of the remote AUPC is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** This program is for control or last known status.
B-BAND LOOP BACK	Programs the remote baseband loopback on or off. Upon entry, the status of the remote baseband loopback is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** This program is for control or last known status.
TX 2047 PATTERN	Programs the remote TX 2047 pattern on or off. Upon entry, the status of the remote TX 2047 is displayed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** This program is for control or last known status.

4.1.3.10.2 Remote AUPC Monitor

Refer to Figure 4-14.

2047 ERRORS	Receive 2047 BER. This is a monitor point that displays the current RX 2047 BER. If no data is available, “No Data” is displayed.

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4.1.3.11 Utility

The Function Select Utility menu is divided into the following categories:

- Modulator
- Demodulator
- Interface
- System
- Modem Type
- Factory Setup

Provisions are also made for assigning data and code rates to the modulator and demodulator.

After entering the Utility menu, press [←] or [→] to select the desired sub-menu, and press [ENTER].

Notes:

1. The Utility Factory Setup menu is for EFData service personnel only. Entering this menu without authorization may cause the modem to operate incorrectly.
2. Changes in the Utility menu may cause changes in other front panel menus.

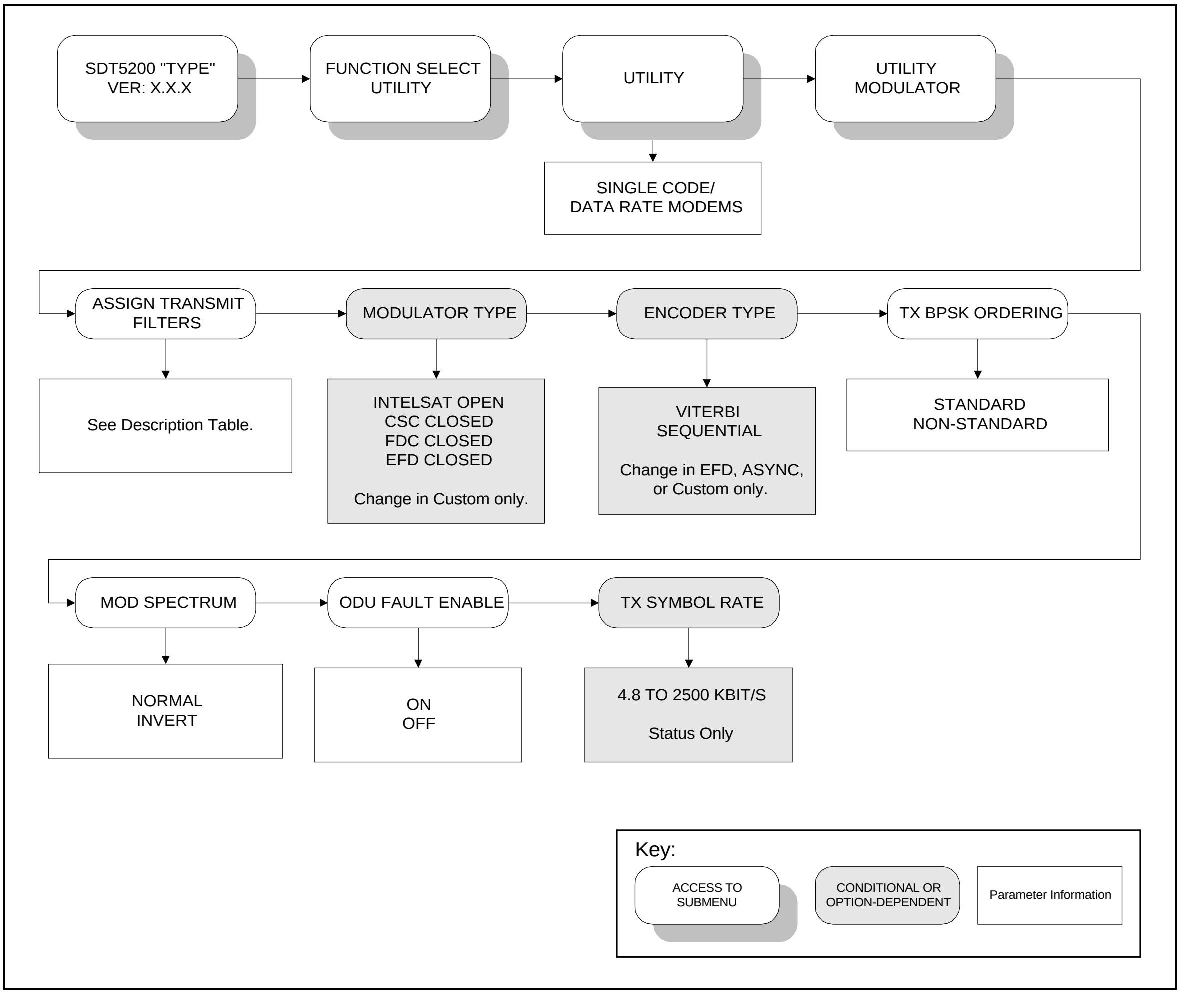

Figure 4-15. Utility Modulator Menu

4.1.3.11.1 Utility Modulator

Refer to Figure 4-15.

<table>
<tr><td>UTILITY</td><td>Displays single code/data rate modems only.

If CR/DR is blank, [ENTER] CR: ____ code and data rate one time.

If CR/DR is displayed, DR: _____ KB, then fixed code/data rate is shown.</td></tr>
<tr><td>ASSIGN TRANSMIT FILTERS</td><td>Transmit filter display/assignment utility. Used to make filter rate re-assignments. The modulator has five symbol rate filter presets designated as A, B, C, D, and V.

<u>Code Rate</u>   <u>Data Rate Range</u>
BPSK 1/2   2.4 to 1250 kbit/s
QPSK 1/2   4.8 to 2500 kbit/s
QPSK 3/4   7.2 to 3750 kbit/s
QPSK 7/8   8.4 to 4375 kbit/s

Notes:
1. Maximum Symbol Rate: 2500 kbit/s
2. Maximum Data Rate for Low Var. Rate: 512 kbit/s
3. Switching between modem type resets the filter presets to their factory defined values. Refer to Figure 4-15 for other code rates assigned to the modem.

To change a preset assignment, press [ENTER] when the data for that preset is displayed. Press [←] or [→] until the flashing cursor is at the parameter to be changed, then [↑] or [↓] to change that parameter. After all changes have been made, press [ENTER] to confirm the assignment. If a preset data/code rate is changed and the modem is currently using that preset, the modem will be reprogrammed to the new data/code rate.</td></tr>
<tr><td>MODULATOR TYPE</td><td>Transmit filter type select. Select EFD CLOSED, CSC CLOSED, or FDC CLOSED network filtering.

Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.

Note: TX filter type is selectable only when CUSTOM is selected for the modem type in the Utility Modem Type menu.</td></tr>
<tr><td>ENCODER TYPE</td><td>Encoder type selection. Select Viterbi or Sequential encoder type.

Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.</td></tr>
<tr><td>TX BPSK ORDERING</td><td>Transmit BPSK bit ordering selection. Select STANDARD or NON-STANDARD.

Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.</td></tr>
<tr><td>MOD SPECTRUM</td><td>Programmable vector rotation allows the operator to select Normal or Inverted (INVERT) for spectrum reversal of the I and Q baseband channels.

Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.</td></tr>
</table>

ODU FAULT ENABLE	ODU Fault Enable selection. Select on or off.
TX SYMBOL RATE	Status only. Displays the current TX Symbol Rate within 4.800 to 2500 kbit/s.

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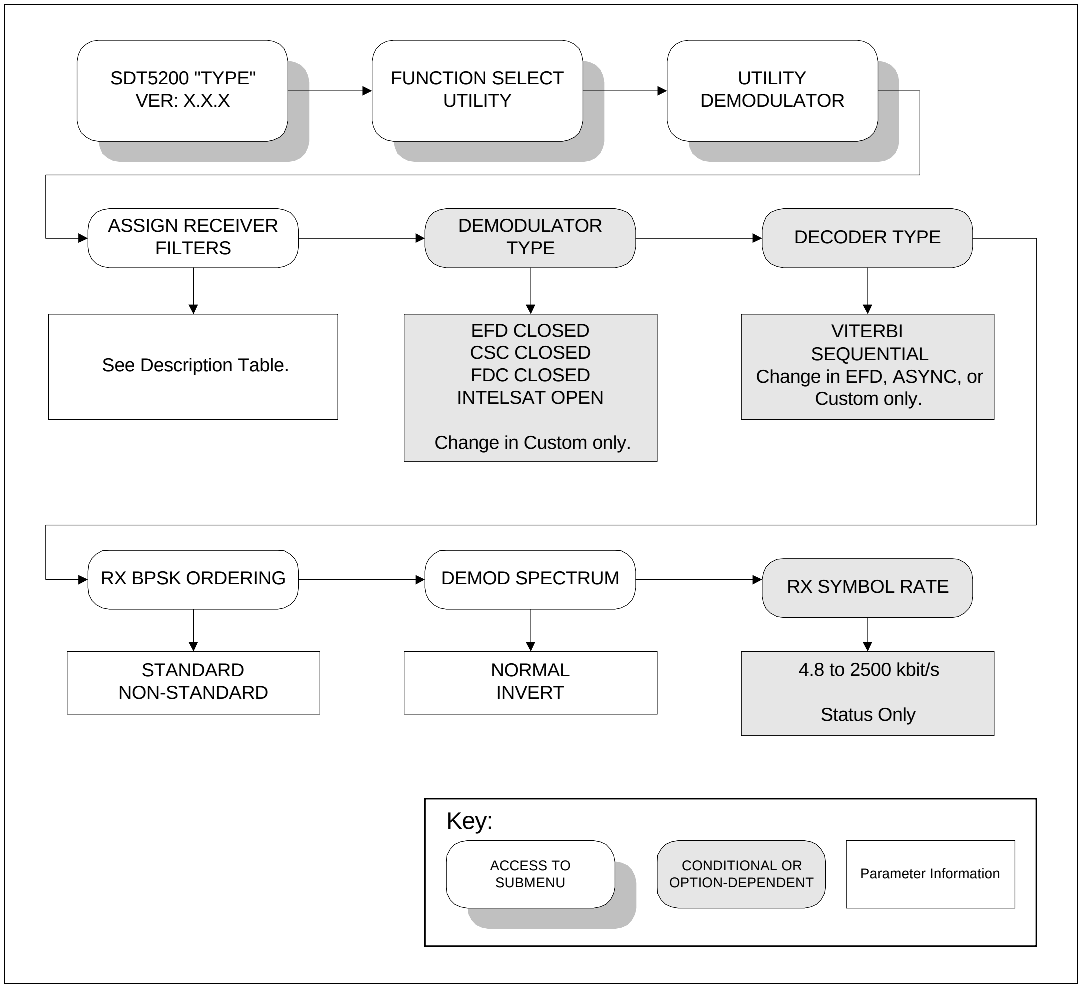

Figure 4-16. Utility Demodulator Menu

4.1.3.11.2 Utility Demodulator

Refer to Figure 4-16.

ASSIGN RECEIVER FILTERS	Receive filter display/assignment utility. Used to view the current filter rate assignments and to make filter rate reassignments (A, B, C, D, and V). <u>Code Rate</u> — <u>Data Rate Range</u> BPSK 1/2 — 2.4 to 1250 kbit/s QPSK 1/2 — 4.8 to 2500 kbit/s QPSK 3/4 — 7.2 to 3750 kbit/s QPSK 7/8 — 8.4 to 4375 kbit/s **Notes:** 1. Maximum Symbol Rate: 2500 kbit/s 2. Maximum Data Rate for Low Var. Rate: 512 kbit/s To change a preset assignment, press [ENTER] when the data for that preset is displayed. Press [←] or [→] until the flashing cursor is at the parameter to be changed, then [↑] or [↓] to change that parameter. After all changes have been made, press [ENTER] to confirm the assignment. If a preset data/code rate is changed and the modem is currently using that preset, the modem will be reprogrammed to the new data/code rate. **Note:** These assignments are used for the selection of the RX rate in the Configuration Interface menu.
DEMODULATOR TYPE	Receive filter type select. Select Type INTELSAT OPEN, EFD CLOSED, CSC CLOSED, or FDC CLOSED network receive filtering. Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** RX FILTER TYPE is selectable only when Custom is selected for modem type in the Utility Modem Type menu.
DECODER TYPE	Decoder type selection. Select Viterbi or Sequential decoder type. The modem must have the proper hardware enabled. Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** This window is only available when Custom or ASYNC mode is selected for modem type in the Utility Modem Type menu.
RX BPSK ORDERING	Receive BPSK bit ordering selection. Select STANDARD or NON-STANDARD. Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
DEMOD SPECTRUM	Programmable vector rotation. Select Normal or Inverted (INVERT) for spectrum reversal of the I and Q baseband channels. Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
RX SYMBOL RATE	Status only. Displays the current RX Symbol Rate within 4.800 to 2500 kbit/s.

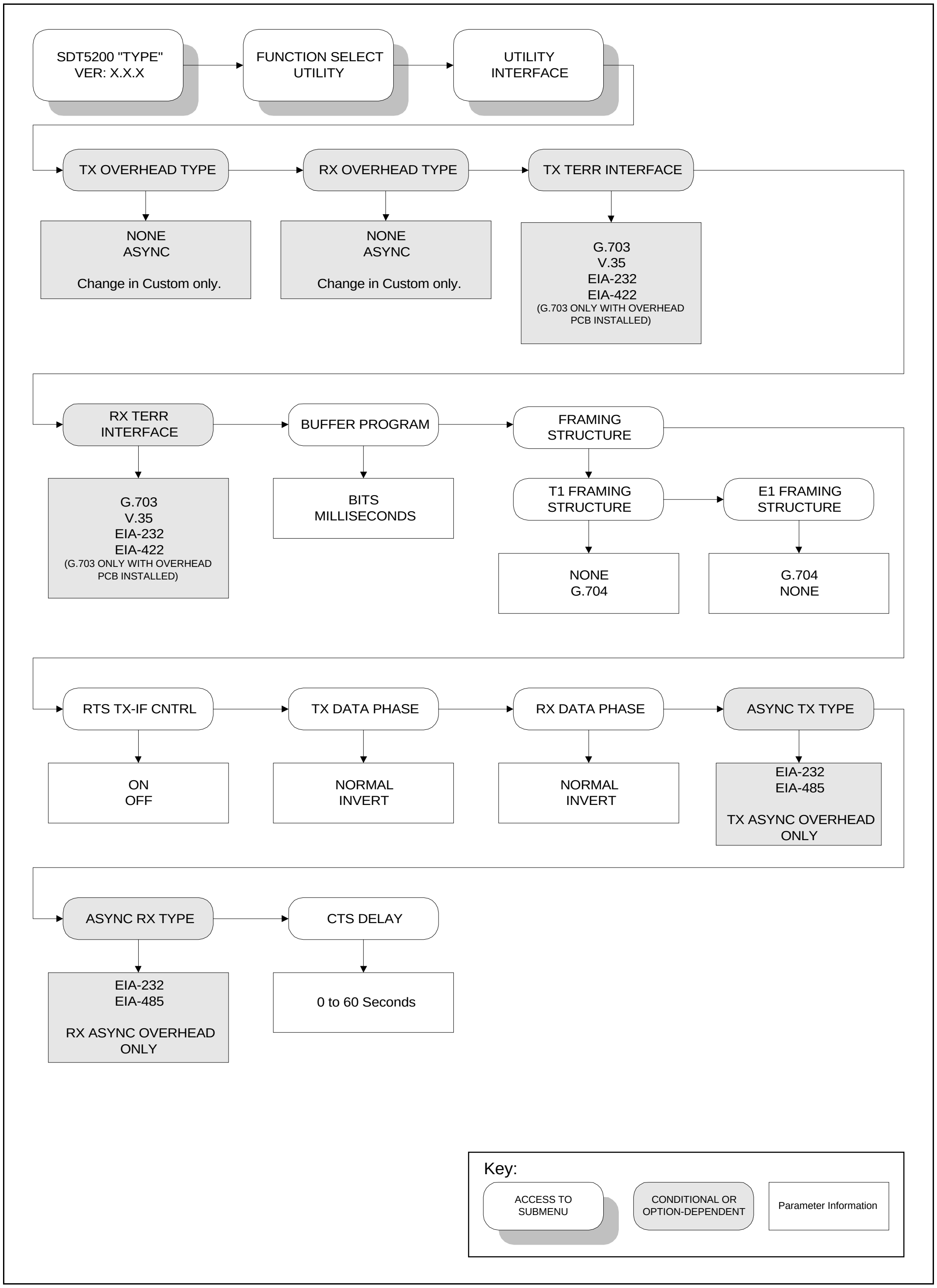

Figure 4-17. Utility Interface Menu

4.1.3.11.3 Utility Interface

Refer to Figure 4-17.

TX OVERHEAD TYPE	Select NONE or ASYNC for TX overhead type. Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** Overhead types are selectable only when Custom is selected for modem type.
RX OVERHEAD TYPE	Select NONE or ASYNC for RX overhead type. Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** Overhead types are selectable only when Custom is selected for modem type.
TX TERR INTERFACE	Displays the TX interface type EIA-232, EIA-422, or V.35. Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** G.703 is available only when the overhead interface PCB is installed.
RX TERR INTERFACE	Displays the TX interface type EIA-232, EIA-422, or V.35. Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** G.703 is available only when the overhead interface PCB is installed.
BUFFER PROGRAM	Buffer unit program function. Select MILLISECONDS or BITS. Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** To have the modem calculate the plesiochronous shift, set the buffer units to MILLISECONDS. For a specific buffer depth, set the buffer units to BITS.
FRAMING STRUCTURE	Displays the currently selected framing type and structure of the data. This function is used with the buffer program in ms for plesiochronous buffer slips. Upon entry, the framing type (T1 or E1) is displayed on Line 1. The framing structure of each type (None or G.704) is displayed on Line 2. Press [←] or [→] and [↑] or [↓] to select framing structure and type. Press [ENTER] to execute the change.
RTS TX-IF CNTRL	Programs the modem to allow a Request To Send (RTS) signal to enable the output when data is ready for transmission. Upon entry, press [↑] or [↓] to make the selection. Press [ENTER] to execute the change

TX DATA PHASE	TX data phase relationship. Use this option to select Normal or Invert for the TX data relationship to the selected TX clock. Upon entry, press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
RX DATA PHASE	RX data phase relationship. Use this option to select Normal or Invert for the RX data relationship to the selected RX clock. Upon entry, press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
ASYNC TX TYPE	Select EIA-232, EIA-485 for ASYNC overhead type. Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** Available only with ASYNC overhead option.
ASYNC RX TYPE	Select EIA-232 or EIA-485 for ASYNC overhead type. Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** Available only with ASYNC overhead option.
CTS DELAY	Sets the delay in seconds (0 to 60) for the Clear To Send (CTS) signal. Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.

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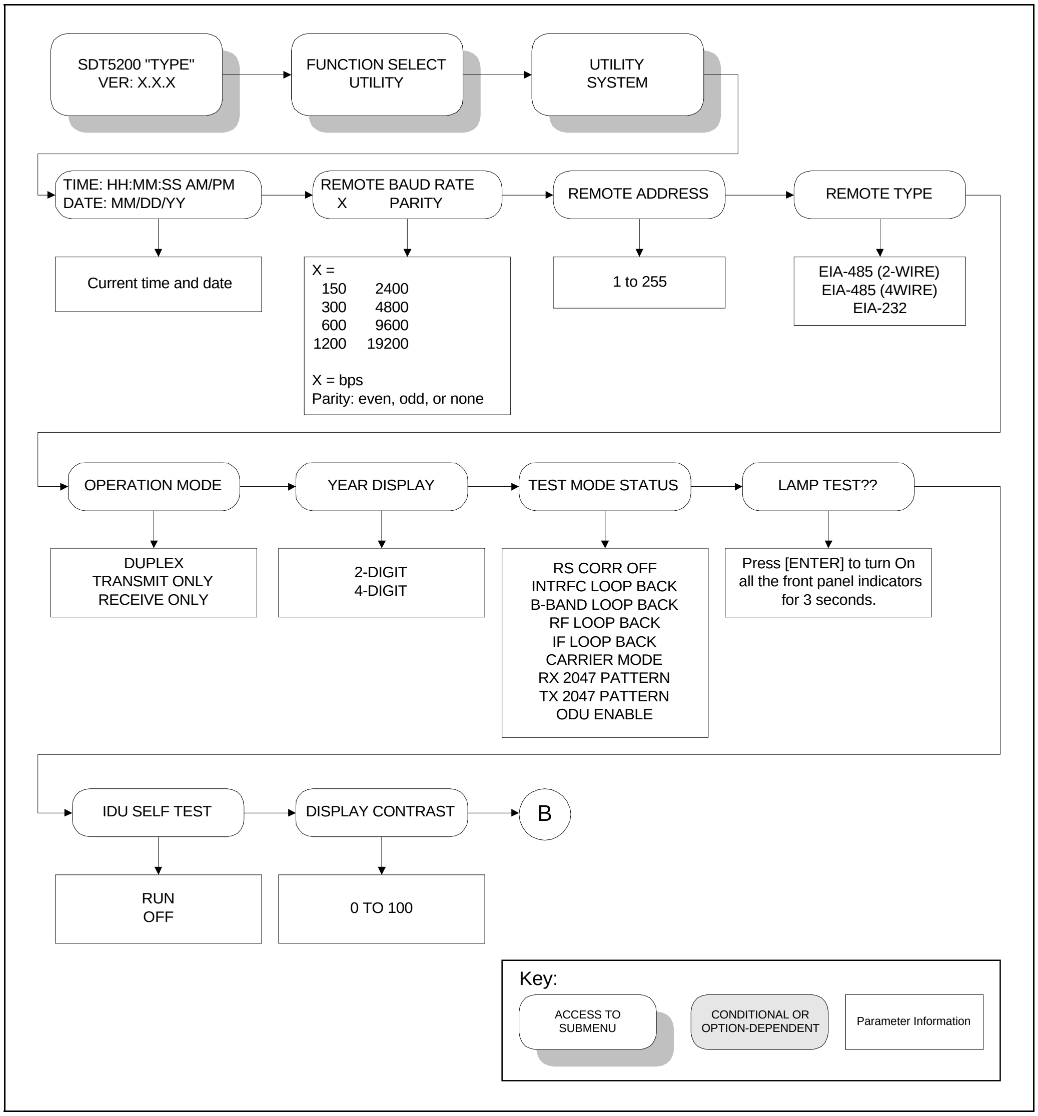

Figure 4-18. Utility System Menu

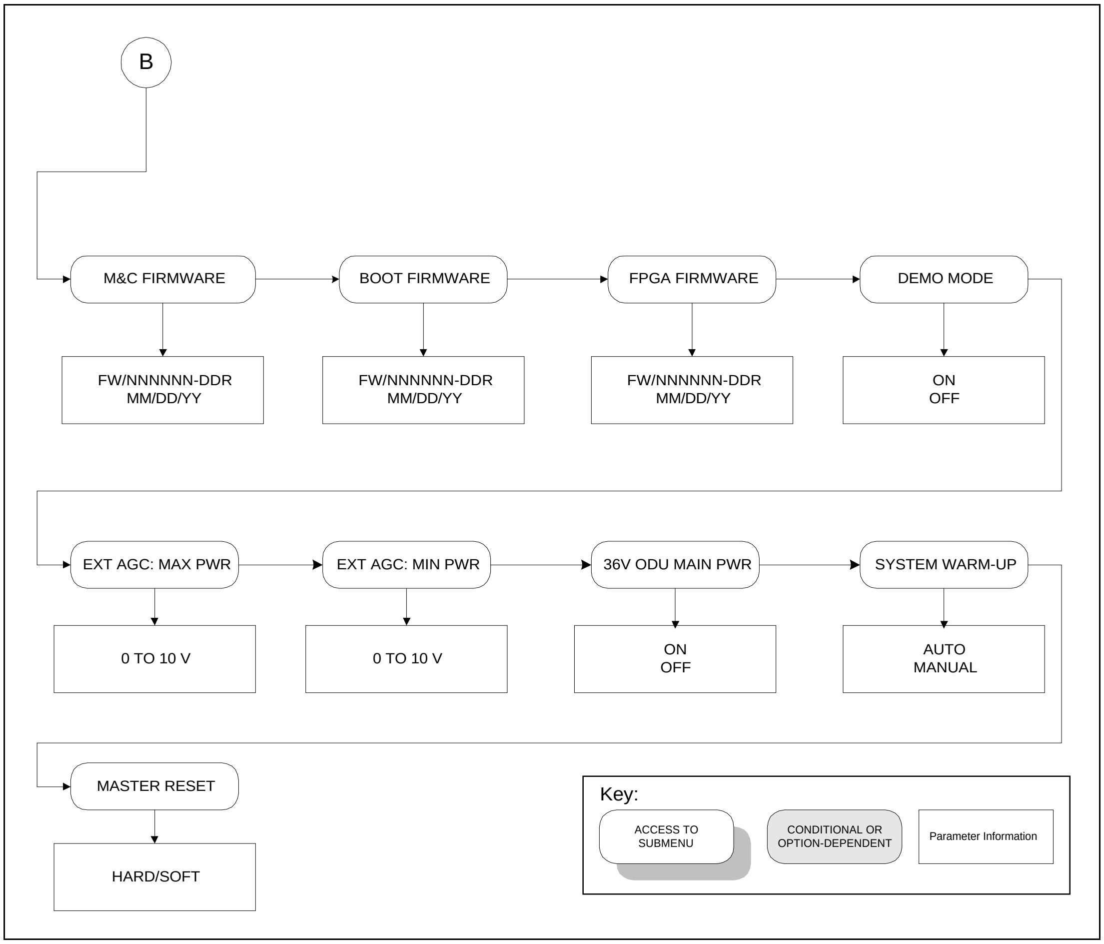

Figure 4-18A. Utility System Menu (Continued)

4.1.3.11.4 Utility System

Refer to Figure 4-18.

TIME: HH:MM:SS AM/PM DATE: MM/DD/YY	Time of day and date display/set function. The current time and date in the modem's memory are displayed when selected. To change the modem time and/or date, press [ENTER]. Press [←] or [→] to position the cursor over the parameter to be changed. Press [↑] or [↓] to change the parameter. Once the parameters are displayed as desired, press [ENTER] to set the time and date.
REMOTE BAUD RATE X PARITY	The parity and baud rate settings of the modem are displayed. To change the modem baud rate and/or parity, press [ENTER]. Press [←] or [→] to position the cursor over the parameter to be changed. Press [↑] or [↓] to change the parameter. Once the parameters are displayed as desired, press [ENTER] to set the baud rate and parity. The parity can be set to EVEN, ODD, or NONE.
REMOTE ADDRESS	The current modem address is displayed (1 to 255). **Note:** Address 0 is reserved as a global address. To change the remote address, press [ENTER]. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
REMOTE TYPE	Select EIA-485 (2-WIRE), EIA-485 (4-WIRE), or EIA-232. Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
OPERATION MODE	Programs the modem for DUPLEX, TRANSMIT ONLY, or RECEIVE ONLY operation. Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change. **Note:** When TRANSMIT ONLY or RECEIVE ONLY are selected, the appropriate faults are masked from the Faults and Stored Faults menus.
YEAR DISPLAY	Selects either 2-digit or 4-digit display. Upon entry, the operational status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.

TEST MODE STATUS	Test mode status indicator. The following modem test points are listed and display a "+" when a test mode is active: • RS CORR OFF • INTRFC LOOP BACK • B-BAND LOOP BACK • RF LOOP BACK • IF LOOPBACK • CARRIER MODE • RX 2047 PATTERN • TX 2047 PATTERN • ODU DISABLE To view the test modes, press [ENTER]. Press [↑] or [↓] to make the selection.
LAMP TEST??	Lamp test function. Press [ENTER] to turn the front panel indicators on for three seconds.
SELF TEST	Select OFF, AUTO, or RUN. After completion of the test, SELF-TEST ("PASSED" or "FAILED") is displayed. • OFF: bypasses built-in self-test. • AUTO: initiates built-in self test when turning on modem. • RUN: initializes self-test.
DISPLAY CONTRAST	Sets the contrast setting of the Front Panel menu. Press [ENTER] to begin. Press [↑] or [↓] to increment or decrement the number at the flashing cursor, from 0 to 100. Press [ENTER] to execute the change.
M&C FIRMWARE	Displays the M&C module firmware version. The display includes the month, day, and year.
BOOT FIRMWARE	Displays the boot firmware version. The display includes the month, day, and year.
FPGA FIRMWARE	Displays the FPGA module firmware version. The display includes the month, day, and year.
DEMO MODE	Select this menu to examine the various options available for the system. This display will last for 60 minutes, then the unit will return to the last setting.
EXT AGC: MAX PWR	Sets the AGC voltage for a receive signal level of -25.0 dBm. The voltage range is 0.0 to 10.0V, in 0.5V steps. Upon entry, the current external AGC voltage level is displayed. Press [↑] or [↓] to increment or decrement the AGC voltage level in 0.5V steps. Press [ENTER] to execute the change. **Note:** For any receive signal level between -25.0 and -60.0 dBm, the software will interpolate the required AGC voltage.
EXT AGC: MIN PWR	Sets the AGC voltage for a receive signal level of -60.0 dBm. The voltage range is 0.0 to 10.0V, in 0.5V steps. Upon entry, the current external AGC voltage level is displayed. Press [↑] or [↓] to increment or decrement the AGC voltage level in 0.5V steps. Press [ENTER] to execute the change. **Note:** For any receive signal level between -25.0 and -60.0 dBm, the software will interpolate the required AGC voltage.
36V ODU MAIN POWER	Enables +36 VDC power to the ODU.

SYSTEM WARM UP	Displays status of warm-up as either: AUTO: 5 minutes MANUAL: 0 to 15 minutes Upon entry, the status may be changed. Press [↑] or [↓] to make the selection. Press [ENTER] to execute the change.
MASTER RESET	Master reset function. CAUTION ***Initiating a hard reset will reset the modem and place the default configuration settings in ROM. Initiating a soft reset will reset the modem hardware, but saves the current configuration settings.*** Select [ENTER] once to access HARD or SOFT. Press [←] or [→] to make the selection. Press [ENTER]. Press [→] five times to move the cursor to YES. Select YES and press [ENTER] again. **Note:** The following parameters do not revert to default settings after a hard reset: • Address • Parity • Baud Rate • Remote Type • Ext AGC: Min Pwr • Ext AGC: Max Pwr • Display Contrast

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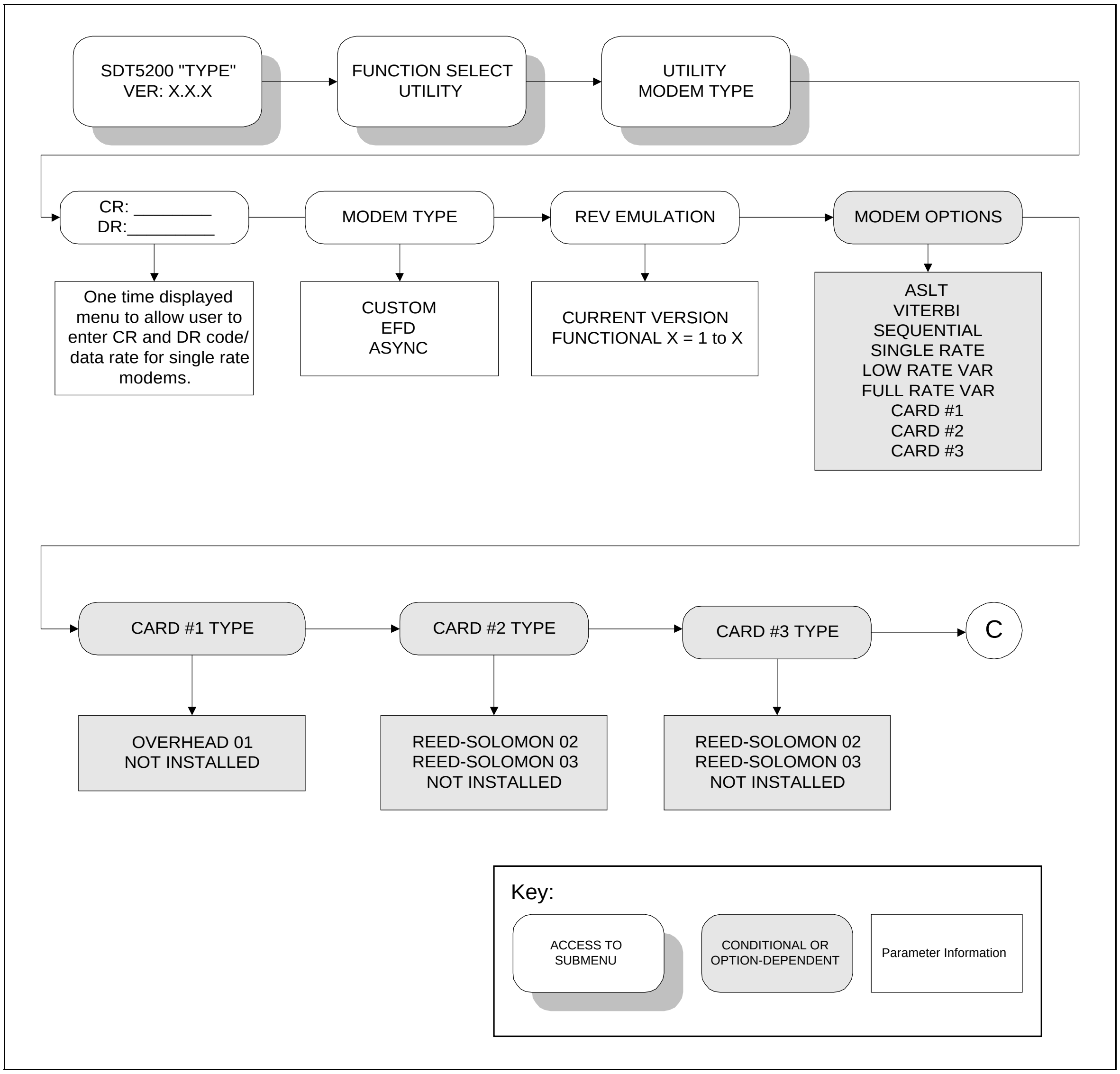

Figure 4-19. Utility Modem Type Menu

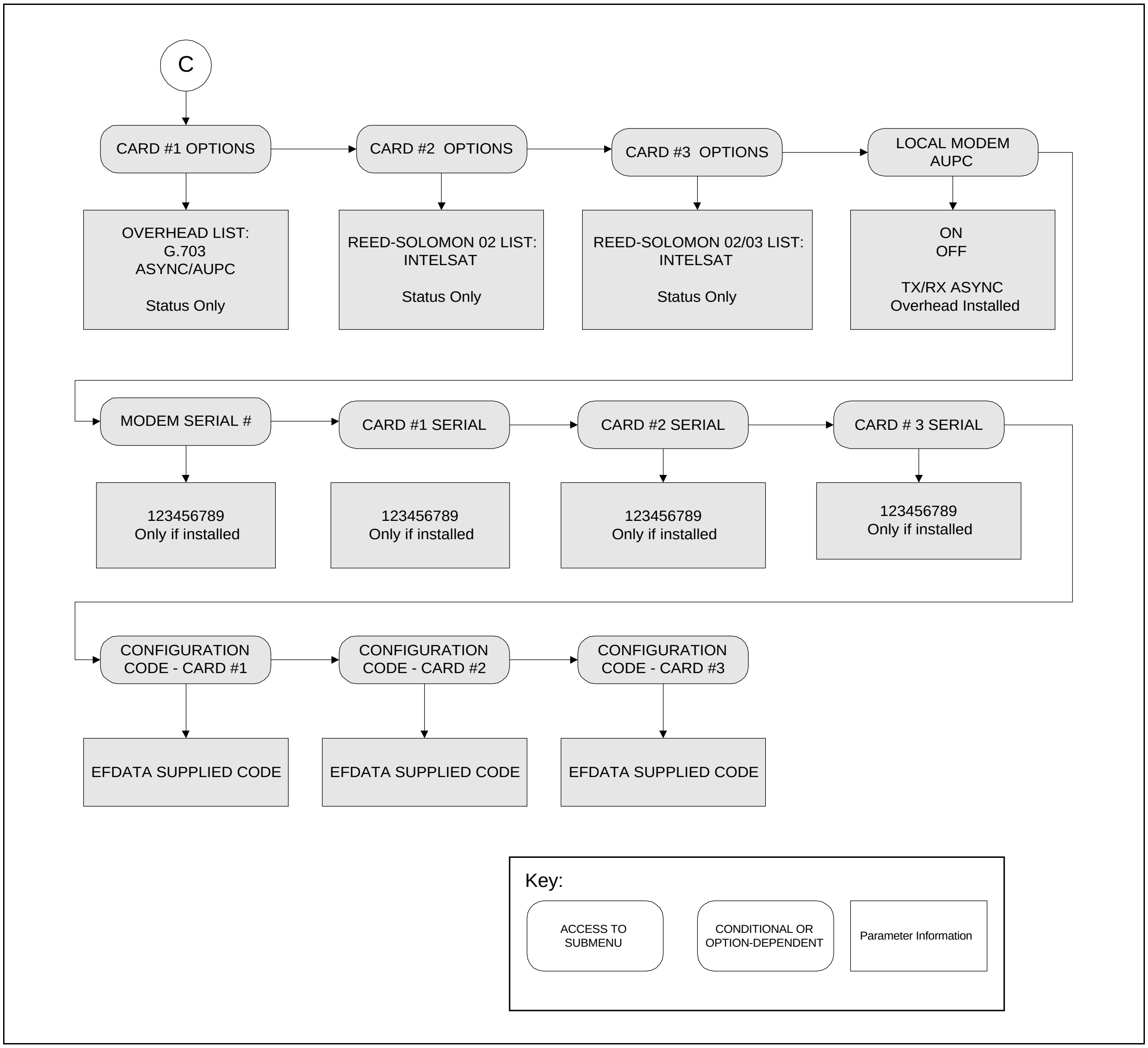

Figure 4-19A. Utility Modem Type Menu (Continued)

4.1.3.11.5 Utility Modem Type Functions

Refer to Figure 4-19.

UTILITY	Displays single code/data rate modems only. If CR/DR is blank, [ENTER] CR: ____ code and data rate one time. If CR/DR is displayed, DR: _____ KB, then fixed code/data rate is shown.
MODEM TYPE	Selects the following types of modem operation: • CUSTOM — Allows user to make all selections from the Front Panel menu • EFD — Closed Network Operation • ASYNC — Asynchronous operation When the modem is changed from one type of operation to another, the modem will be reset to the default configurations of the new modem type. The RF-IF Output must be turned on to get the modem to lock. If the existing modem type is the same as the type entered, the modem will not change any parameters. If the modem type is changed to Custom, no parameters will be changed. If the modem will not allow the modem type selection, that type of operation may not be an available option. Select MODEM OPTIONS and OVERHEAD OPTIONS to see which modem operations are allowed. CAUTION ***Use caution when modifying the Custom Type. This type accepts all changes to the modem, including incompatible parameter changes. Only experienced modem operators who are familiar with all of the controls should use Custom type.*** **Note:** Refer to Section 4.2.1 for additional modem type information.

<table>
<tr><td>REV EMULATION</td><td>Programs an emulation mode of a previous functional revision. This allows the user to select the CURRENT VERSION or FUNCTIONAL X.

Note: The number displayed in the CURRENT VERSION position increases with each software version change.

Upon entry, the CURRENT VERSION is displayed. Press [↑] or [↓] to select the FUNCTIONAL version. Press [ENTER] to execute the change.

Notes:
1. Programming a current version (default) allows all features and options (if installed) to operate normally.
2. Programming a FUNCTIONAL version (X) eliminates any changes that affect the later version. Only functional changes are affected by the revision emulation feature.
3. A correction change (e.g., VER 3.1.2) remains fixed in accordance with the latest version. Since the revision emulation default is the current version, program the functional version at the start of each operation.
4. The revision emulation feature does not affect some interface changes for the direct operation of the modem (Configuration save/recall, test mode screen in the Utility/System, all factory setup modes, etc.).</td></tr>
<tr><td>MODEM OPTIONS</td><td>(Status Only).

Displays the installed modem options.

If the option is installed, a “+” symbol is displayed. To view the available options press [ENTER]. Observe for the flashing cursor. Press the [←] [→] arrows to move from one symbol to the next. The first line will display the option. The second line will display the status:

• A “+” symbol indicates the option is installed.
• A “-” symbol indicates the option is FAST accessible.
• An “x” symbol indicates the option is Not Installed or Field Upgradable.</td></tr>
<tr><td>CARD #1 Type</td><td>(Status Only.)

Displays installed overhead options.</td></tr>
<tr><td>CARD #2 Type</td><td>(Status Only.)

Displays installed Reed-Solomon 02 options.</td></tr>
<tr><td>CARD #3 TYPE</td><td>(Status Only.)

Displays installed Reed-Solomon 03 options.</td></tr>
<tr><td>CARD #1 OPTIONS</td><td>(Status Only.)

Displays installed overhead options.</td></tr>
<tr><td>CARD #2 OPTIONS</td><td>(Status Only.)

Displays installed Reed-Solomon 02 options.</td></tr>
<tr><td>CARD #3 OPTIONS</td><td>(Status Only.)

Displays installed Reed-Solomon 03 options.</td></tr>
<tr><td>LOCAL MODEM AUPC</td><td>Configures the modem for the self-monitoring Local Modem AUPC mode.

Note: The self-monitoring Local Modem AUPC mode is not used when the ASYNC/AUPC interface option is installed.

Refer to Appendix A for more information.</td></tr>
</table>

MODEM SERIAL #	(Status Only.) Displays the modem serial number.
CARD #1 SERIAL #	(Status Only.) Displays the first daughter card serial number.
CARD #2 SERIAL #	(Status Only.) Displays the second daughter card serial number.
CARD #3 SERIAL #	(Status Only.) Displays the third daughter card serial number.
CONFIGURATION CODE - MODE	EFData-supplied code. On entry, the current configuration code is displayed with the flashing cursor on the first character. Press [←] or [→] to move the flashing cursor. Press [↑] or [↓] to increment or decrement the digit at the flashing cursor. Press [ENTER] to execute the change. Entering this code enables the corresponding modem option. To purchase an option, contact an EFData Customer Support for more information.
CONFIGURATION CODE - CARD #1	Provides the means to enter modem-specific code necessary to access certain options. Refer to Appendix A for more information. **Note:** Displays only when daughter card is installed.
CONFIGURATION CODE - CARD #2	Provides the means to enter modem-specific code necessary to access certain options. Refer to Appendix A for more information. **Note:** Displays only when second daughter card is installed.
CONFIGURATION CODE - CARD #3	Provides the means to enter modem-specific code necessary to access certain options. Refer to Appendix A for more information. **Note:** Displays only when third daughter card is installed.

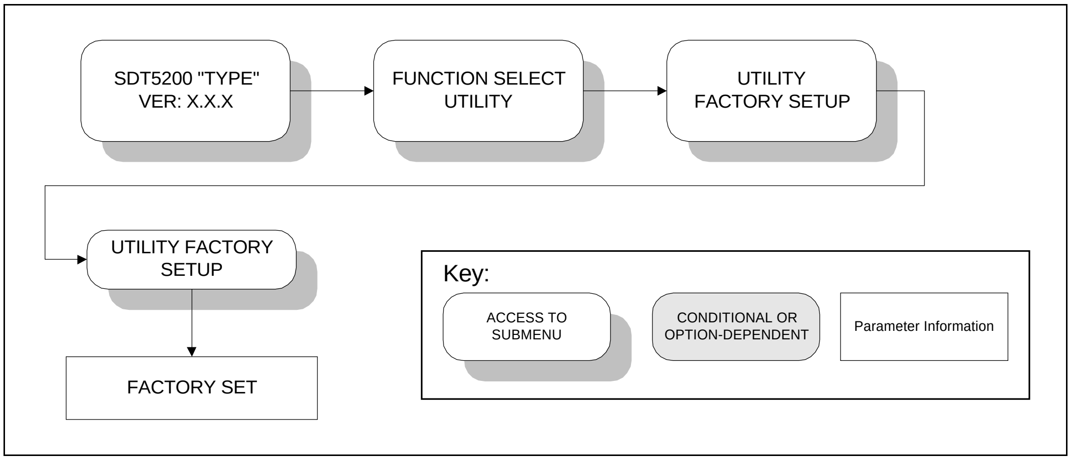

Figure 4-20. Utility Factory Setup Menu

4.1.3.11.6 Utility Factory Setup

Refer to Figure 4-20.

CAUTION

This configuration is used for factory alignment. Factory setup should not be changed by unauthorized persons. Doing so can cause modem failure.

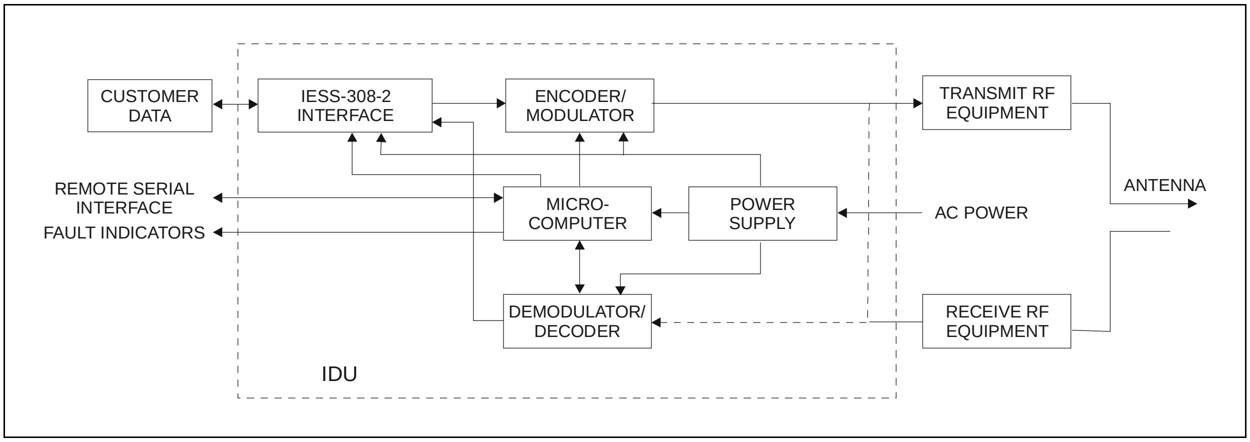

Figure 4-21. IF Loopback

Note: When IF loopback is turned on, the demodulator is looped back to the modulator inside the modem and the demodulator is programmed to the same frequency as the modulator. This test mode will verify the operation of the modem. When IF loopback is turned off, the demodulator is programmed back to the previous frequency and is reconnected to the IF input.

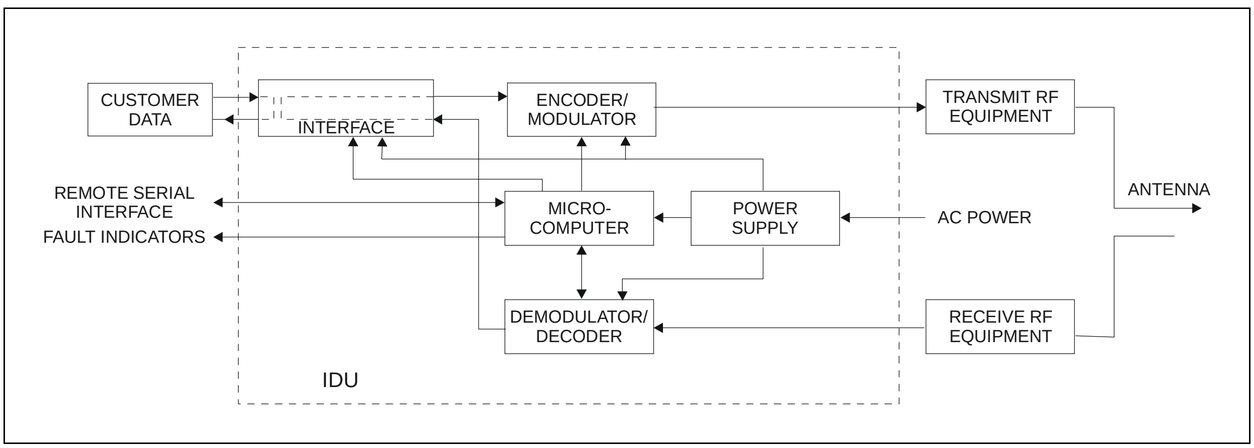

Figure 4-22. Baseband Loopback

Note: When baseband loopback is turned on, data is looped back on the customer side of the interface. This is a bi-directional loopback of the baseband data. This test mode will verify the customer equipment and cabling between the modem and the customer equipment.

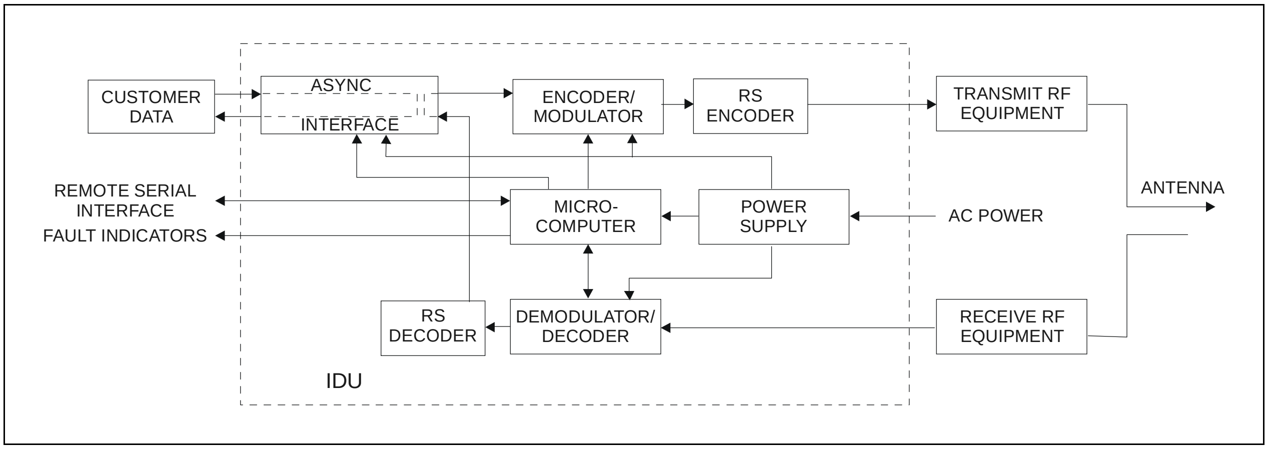

Figure 4-23. Interface Loopback

Note: When interface loopback is turned on, data is looped back on the modem side of the interface. This is a bi-directional loopback of the data after the baseband data had the 16/15 overhead added for ASYNC; Add 225/205 for Reed-Solomon overhead. This test mode will verify the internal channel unit interface operation.

4.2 Software Configuration

4.2.1 Modem Types

Refer to Figure 4-19.

Refer to Table 4-1 for configuring the modem to the following types of operation. Each type allows the user to operate the modem under the requirements of the configuration specifications listed below.

Table 4-1. Modem Types

Configuration	Specification
EFD	EFData Closed Network
Custom	Access all modes
ASYNC	Asynchronous Overhead
Emulation Types	**Specification**
Revision Emulation	Emulates earlier released software remote protocol

4.2.1.1 EFD Closed Network Operation

The modem does not require any additional hardware installed to operate in EFD Closed Network configuration. The basic modem configuration, which includes the 25-pin D Data I/O connector, supports V.35, EIA-422, and EIA-232 data with no overhead. The EFData closed network configuration allows the IDU to be compatible with any EFData closed network application, including the SDM-300 modem.

The IDU can be compatible with other closed network applications by selecting different modulator and demodulator types. Fairchild and Comstream compatible closed network systems can be supported with the IDU modem. When selecting these modulator and demodulator types, the modem becomes compatible with Fairchild or Comstream closed network modems that may be at the distant end of the link.

Refer to Appendix A for more information on EFD Closed Network theory of operation.

Refer to Table 4-2 for EFD Closed Network parameter settings.

Table 4-2. EFD Closed Network Parameter Settings

Parameter	Front Panel Setting	Reference Menu
Modem Type	EFD	Utility Modem Type
TX Data/Code Rate	TX-V, QPSK 1/2	Configuration Modulator
TX-IF Output	ON	Configuration Modulator
RX Data/Code Rate	RX-V, QPSK 1/2	Configuration Demodulator
TX Clock Source	TX Terrestrial	Configuration Interface
Buffer Clock Source	Satellite Clock	Configuration Interface
Modulator Type	EFD Closed (All modulator types are accessible)	Utility Modulator
Encoder Type	Viterbi or Sequential	Utility Modulator
Demodulator type	EFD Closed (All modulator types are accessible)	Utility Demodulator
Decoder Type	Viterbi or Sequential	Utility Demodulator
TX Overhead Type	None	Utility Interface
RX Overhead Type	None	Utility Interface
Interface Type	EIA-422, EIA-232, or V.35	Utility Interface
Buffer Program	Bits or Milliseconds	Utility Interface
RTS TX-IF Cntrl	OFF or ON	Utility Interface
CTS Delay	0 Seconds	Utility Interface

4.2.1.2 Custom Operation

Note: If the IDU serves as the backup unit for a rack of modems having different hardware and FAST options, then the backup modem should have all of the features and hardware found in the other modems.

Operating in Custom mode allows access to all front panels menus, including the Utility menus. The Custom operation mode is manly used when the modem must function with no overhead in an open network application.

A protection switch can make use of the Custom operation mode when the modem is configured as a backup modem. Because the backup modem is operating in Custom Mode, the switch can program all the backup modem parameters. Thus, the one backup modem can be made compatible with all of the various application types found in the rack.

Refer to Appendix A for more information on Custom theory of operation.

4.2.1.3 ASYNC/AUPC Operation

To operate in the Asynchronous/AUPC configuration, the following cards must be installed in the modem:

- Overhead ASYNC/AUPC card
- 50-pin D relay adapter card

The ASYNC/AUPC option is a FAST feature that must be enabled using the front panel and the Utility Modem Type menu. Table 4-3 lists parameters that are accessible once the ASYNC/AUPC modem type is enabled.

Table 4-3. Asynchronous Parameter Settings

Parameter	Front Panel Setting	Reference Menu
Modem Type	ASYNC	Utility Modem Type
TX Data/Code Rate	TX-V, BPSK 1/2 or QPSK 1/2, 3/4, or 7/8	Configuration Monitor
TX-IF Output	ON	Configuration Demodulator
RX Data/Code Rate	RX-V, BPSK 1/2 or QPSK 1/2, 3/4, or 7/8	Configuration Demodulator
Encoder Type	Viterbi/Sequential	Utility Modulator
Decoder Type	Viterbi/Sequential	Utility Demodulator
ASYNC TX Baud	110 to 38400 bit/s	Configuration Interface
ASYNC RX Baud	110 to 38400 bit/s	Configuration Interface
ASYNC TX Length	5 to 8 bits	Configuration Interface
ASYNC RX Length	5 to 8 bits	Configuration Interface
ASYNC TX Stop	1 or 2 bits	Configuration Interface
ASYNC TX Parity	Even, Odd, or None	Configuration Interface
ASYNC RX Parity	Even, Odd, or None	Configuration Interface
Local AUPC	ON or OFF	Configuration Local AUPC
Power: (C-Band)	+25 to +38 dBm, in 0.5 dBm steps	Configuration Local AUPC
Power: (Ku-Band K1)	+19 to +30 dBm, in 0.5 dBm steps	Configuration Local AUPC
Power: (Ku-Band K3)	+22 to +35 dBm, in 0.5 dBm steps	Configuration Local AUPC
Target E_b/N_0	3.2 to 16.0 E_b/N_0	Configuration Local AUPC
Tracking Rate	0.5 to 6.0 dBm/min.	Configuration Local AUPC
Local CL Action	Hold, Nominal, or Maximum	Configuration Local AUPC
Remote CL Action	Hold, Nominal, or Maximum	Configuration Local AUPC
Remote AUPC	ON or OFF	Function Remote AUPC
AUPC Enable	ON or OFF	Function Remote AUPC
Baseband Loopback	ON or OFF	Function Remote AUPC

Asynchronous Overhead with AUPC is a closed network application that gives the user the ability to communicate from the hub site to the remote site through the added overhead. The user can use the AUPC feature that remotely controls the remote modem's power level, according to parameters programmed by the user. The user can also remotely monitor and control the remote modem by sending remote commands over the link via the overhead. This can be accomplished by a local terminal or Monitor and Control system.

Refer to Appendix A for more information on the Asynchronous interface with AUPC.

4.3 Revision Emulation Operation

To program an emulation mode from Version 1.1.1 through the current version, use the revision emulation feature in the Utility Modem Type menu.

Refer to Table 4-4.

Table 4-4. SDT-5200 IDU Revision Emulation

Software Version #	Firmware #	Description of Change
1.1.1	FW/7414-1	Original release.

4.4 Clocking Options

Clocking of the data from the terrestrial equipment to the satellite (and vice versa) will depend on the application. This section describes the most common options and recommended configurations.

4.4.1 EIA-232, EIA-422, or V.35 Master/Master

Refer to Figure 4-24 for:

- Clocking block diagram
- Transmit clock options
- Buffer clock options
- V.35 timing signals
- EIA-422 timing signals

4.4.2 EIA-232, EIA-422, or V.35 Master/Slave

Refer to Figure 4-25 for:

- Clocking block diagram
- Transmit clock options
- Buffer clock options
- V.35 timing signals
- EIA-422 timing signals

The use of loop timing in the modem is an option for both EIA-422 and V.35 operation.

SCT (LOOP): SCT (INTERNAL) clock no longer applies when the modem has loop timing on. The transmit clock source is now recovered from the receive satellite data. This recovered clock is put out on the ST line and is used to clock the terrestrial equipment. The transmit terrestrial clock is now essentially the same as the receive satellite clock, except that it has been buffered by the terrestrial equipment. Select transmit TERRESTRIAL for the transmit clock source when in loop timing. The SCT (LOOP) indication serves as a reminder that the SCT internal clock is now the recovered clock, not the internal oscillator. Select SCT (LOOP) when the terrestrial equipment does not provide a transmit terrestrial clock.

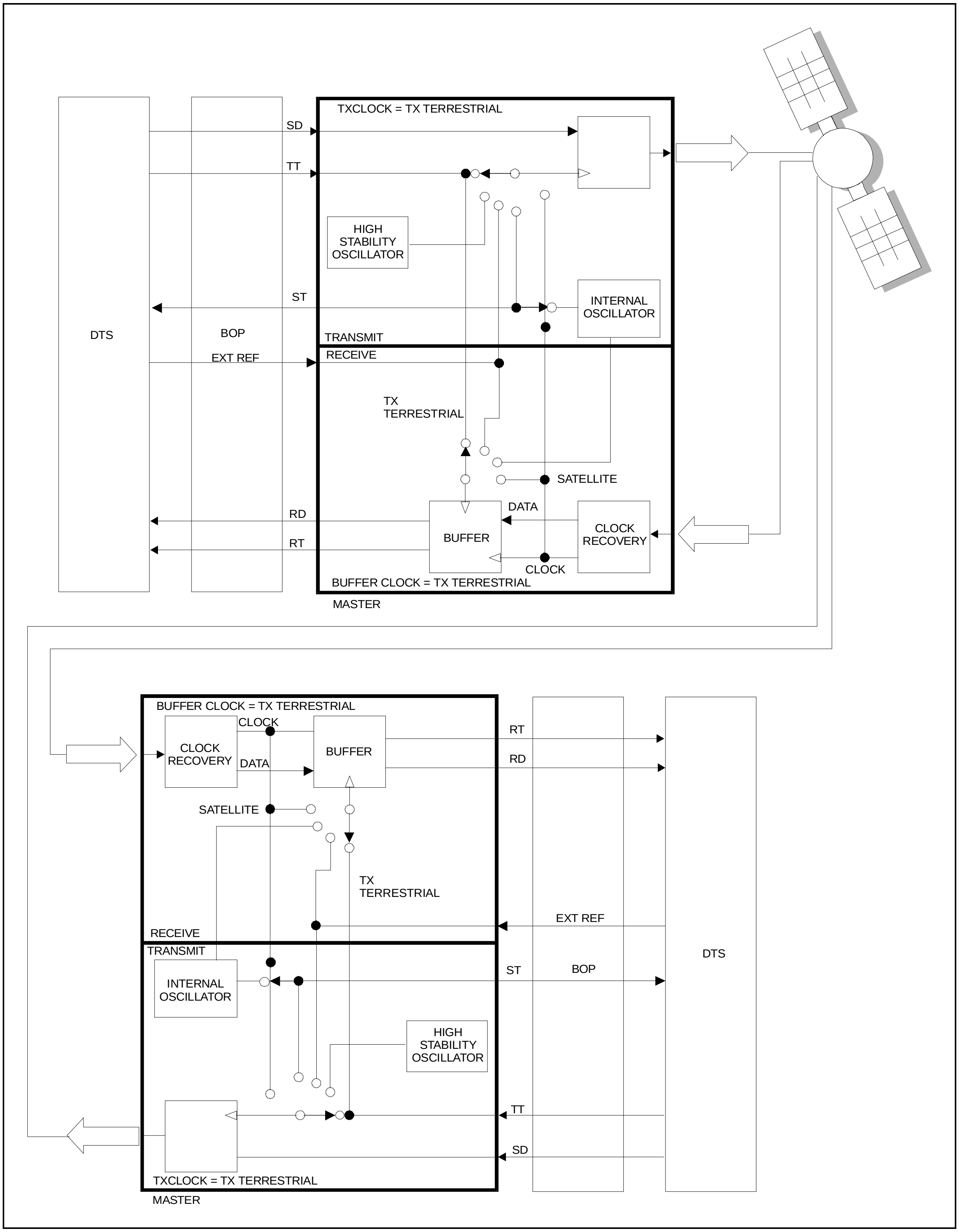

Figure 4-24. EIA-422, EIA-232, or V.35 Master/Master Clocking Diagram

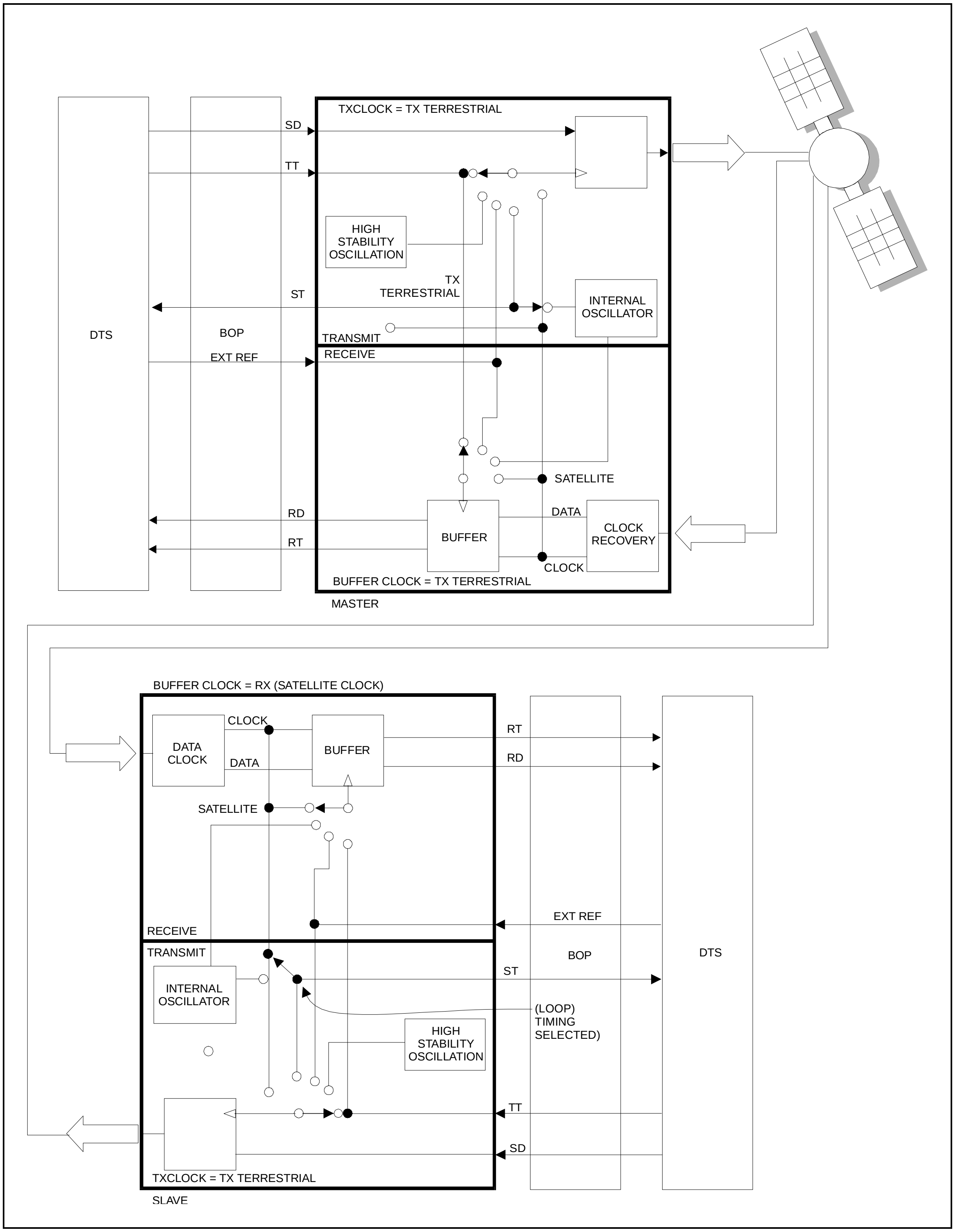

Figure 4-25. EIA-422, EIA-232, or V.35 Master/Slave Clocking Diagram

4.5 Buffering

The receive buffer serves two purposes:

- Plesiochronous buffering of two dissimilar clock frequencies (normally the far end transmit clock versus the local network clock). The clocks may be very close in frequency to each other and will normally slip at a constant rate. Figure 4-26 shows plesiochronous operation for dissimilar clocks. If incoming traffic is too fast, an occasional bit will be lost. If incoming traffic is too slow, an occasional bit will be repeated.

- Doppler buffer of the signal of the satellite. The Doppler shift results from the “figure 8” (Figure 4-27) station-keeping movement performed by the satellite in space over a period of one day. Doppler shift should not result in a clock slip, as the buffer will constantly fill and empty.

If the two earth stations are configured as master/slave, then the buffer need only be configured for Doppler operation. The buffer will then have sufficient capacity for the Doppler shift on the outward and return paths.

A buffer setup for Doppler operation only will typically require less depth than one intended for both Doppler and plesiochronous operation.

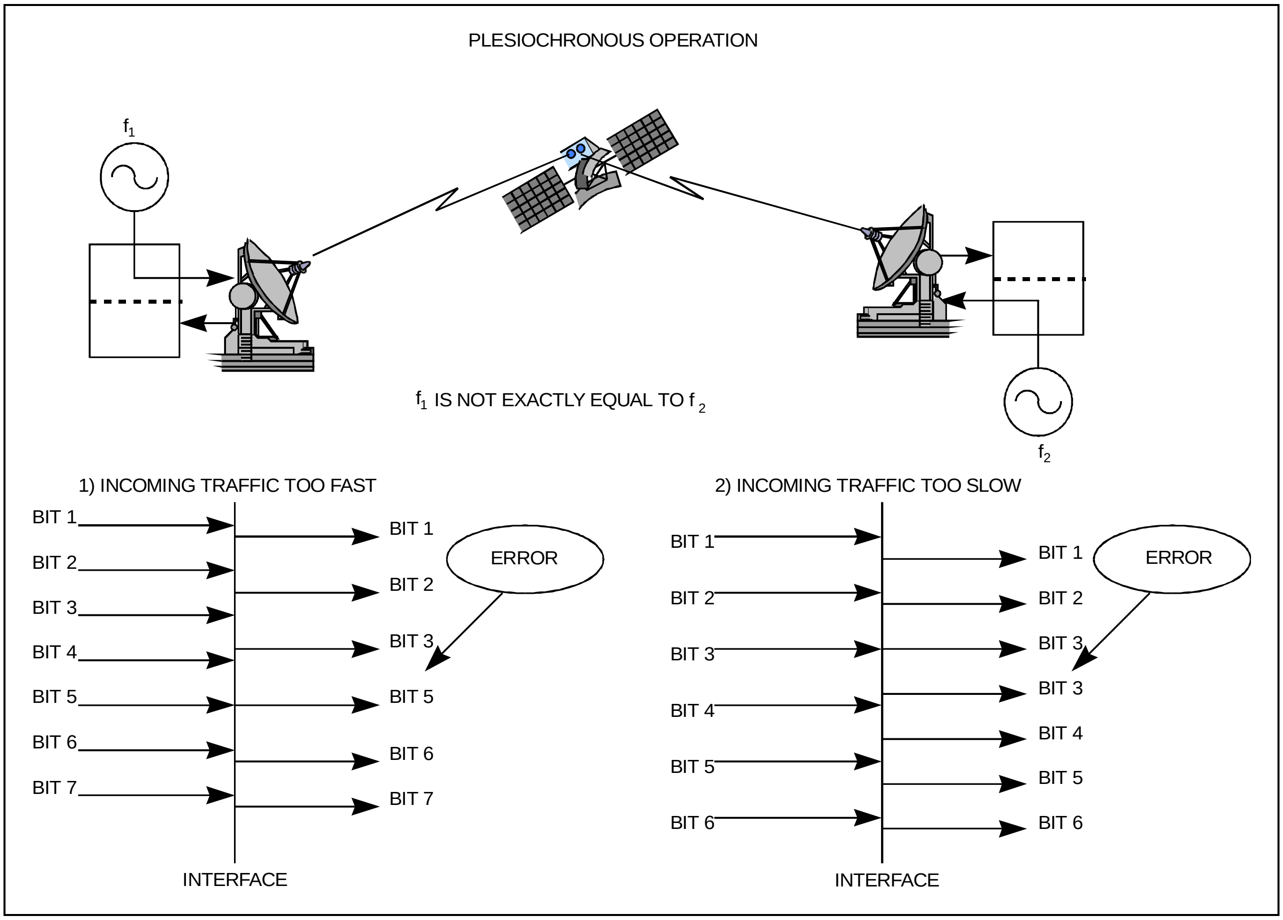

Figure 4-26. Clock Slip

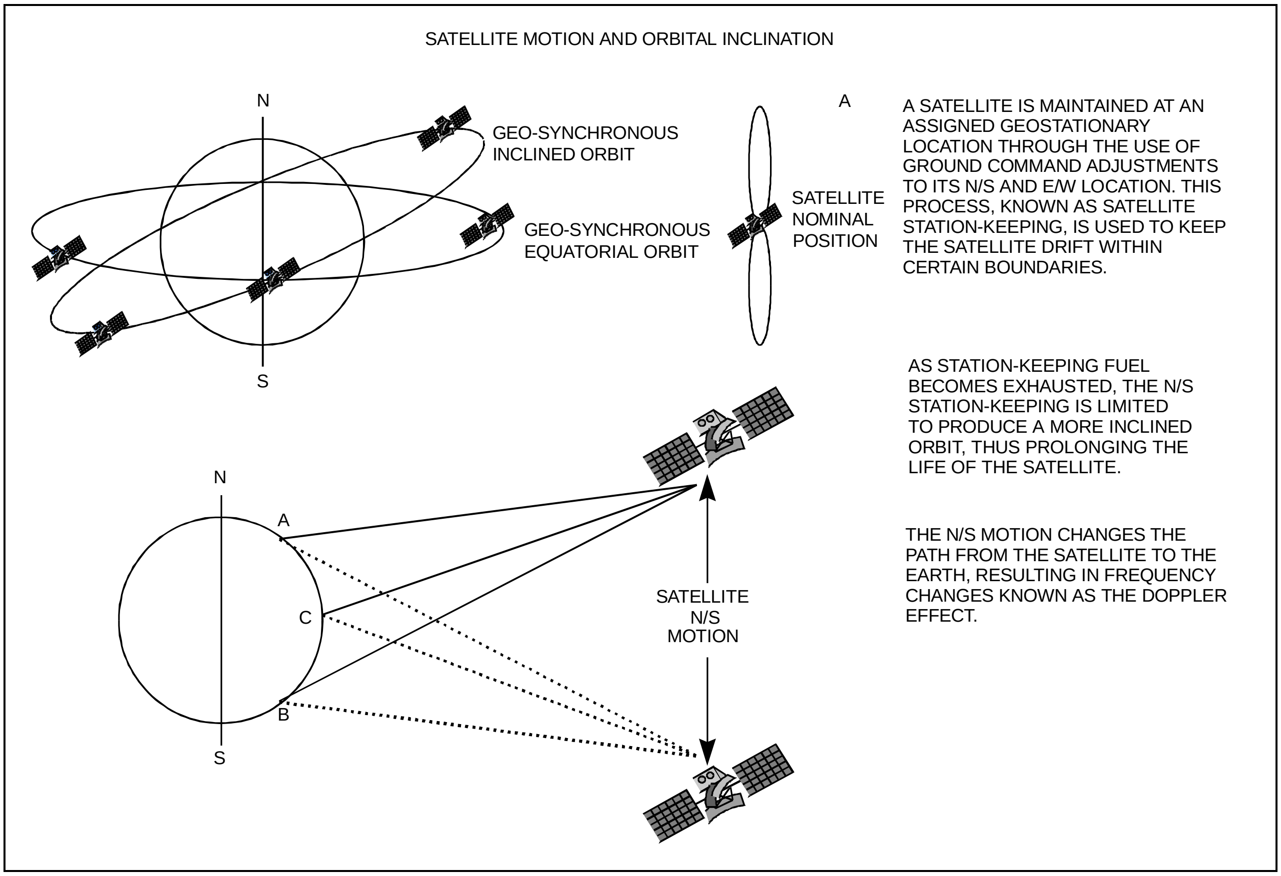

Figure 4-27. Doppler Shift

4.5.1 Buffer Size

The depth of the receive buffer depends on four parameters:

- Doppler shift caused by satellite
- Stability of each clock (plesiochronous/Doppler operation)
- Frame/Multiframe length of multiplexed data format
- Allowable time between clock slips

4.5.1.1 Doppler

A geostationary satellite should be positioned directly over the equator and orbit with a duration of 24 hours. In practice, the exact inclination of the satellite (relative to the equator) is influenced by the earth, moon, and sun’s gravity, as well as solar wind. Station-keeping motors are required to maintain the orbital position.

When viewed from the earth, the satellite appears to prescribe and ellipse in space, degrading to a “figure 8” as the angle of inclination increases.

The orbit of the satellite can result in a peak-to-peak altitude variation of ± 2% (85 km), while the station keeping of a newly launched satellite will typically be ± 0.1° (150 km). The total effect will be 172 km relative to the nominal 42,164 km radius.

Depending upon the location of the earth station relative to the satellite, the variation in propagation delay will typically be 1.15 ms (up to satellite and back down), therefore a buffer depth of 2 ms is sufficient to cope with most commercial satellites.

Since station-keeping involves using fuel in the motors, the “lifetime” of the satellite can be extended by allowing the satellite to drift into a wider “figure 8” and using the motor less often.

The older satellites will be found in a more inclined orbit with the station-keeping varying in latitude by as much as ± 4°. The total effect of the inclined orbit may result in a typical variation in path delay of 35 ms.

4.5.1.2 Plesiochronous

The stability of station reference clocks is normally 1 x 10^{-12} (derived from a cesium standard). While the stability is exceptionally high, the two clocks are not in synchronization with each other and will eventually pass by each other.

The clock used for the transmit signal is passed over the satellite, but will not be used at the receive earth station where a national network derives its time locally. A buffer will fill with data using the clock from the satellite and will empty using the local clock. The object of the buffer is to ensure that the buffer overflows or underflows at regular, determinable intervals (typically every 40 days).

The buffer depth required (from center to end) will be:

Minimum slip period (seconds) ∗ [stability of far end (transmit) clock + stability of local clock]

For example:

Far end (transmit) clock stability	1 x 10^{-9}
Local (buffer) clock	1 x 10^{-11}
Minimum clock slip	40 days

Buffer Depth = (40 x 24 x 60 x 60) x (1 x 10^{-9} + 1 x 10^{-11}) = 3.49 ms

Because the buffer will either fill or empty (depending on the frequency relationship of the two clocks), the total buffer depth will be 2 x 3.49 ms = 6.98 ms.

4.5.1.3 Frame/Multiframe Length

The depth of the receive buffer required has been discussed in Section 4.5.1, and is applicable to all unframed data.

When the data is framed (such as 2048 kbit/s G.732 or 1544 kbit/s G.733), it is desirable to provide slips in predefined locations. The advantage of organized slip locations (in relation to the frame) is that multiplexing equipment does not lose sync and outages on any channel are kept to a minimum.

A 2048 kbit/s frame structure commonly used is G.732. This has a frame length of 256 bits with 16 frames per multiframe (4096 bits total, or 2 ms).

4.5.1.4 Total Buffer Length

The size of the buffer will be determined as described in Sections 3.4.1.1 through 3.4.1.3. Using the examples from the three previous sections, the total buffer depth (end to end) will be:

> Doppler + Plesiochronous (rounded up to the nearest multiframe)
> 1.15 ms + 6.98 ms = 8.13 ms

If the frame length is 2 ms, then the nearest multiframe will be 10 ms, or 20,480 bits.

4.5.2 Converting Between Bits and Seconds

4.5.2.1 Bits to Seconds

1/Data Rate x Bits = Seconds.

4.5.2.2 Seconds to Bits

Data Rate x Seconds = Bits.

4.6 Initial Defaults

Initial default settings for the Satellite Terminal System are listed in Table 4-5.

Table 4-5. Initial Defaults

Function	C5	K1	K3	C5 ASYNC
Modulator Configuration				
TX DATA RATE (kbit/s)	64	64	64	64
CODE RATE	1/2	1/2	1/2	1/2
MODULATION	QPSK	QPSK	QPSK	QPSK
TX IF FREQ (GHz)	6.425	14.500	14.500	6.425
RF OUTPUT	OFF	OFF	OFF	OFF
TX POWER (dBm)	+32.0	+24.0	+29.0	+32.0
SCRAMBLER	ON	ON	ON	ON
DIFF ENCODER	ON	ON	ON	ON
CARRIER MODE	Normal	Normal	Normal	Normal
REED-SOLOMON ENCODER	Note 1	Note 1	Note 1	Note 1
Demodulator Configuration				
RX DATA RATE	64	64	64	64
CODE RATE	1/2	1/2	1/2	1/2
DEMODULATION	QPSK	QPSK	QPSK	QPSK
RX IF FREQ (GHz)	4.200	12.200	11.700	4.200
DESCRAMBLER	ON	ON	ON	ON
DIFF DECODER	ON	ON	ON	ON
RF LOOP	OFF	OFF	OFF	OFF
IF LOOP	OFF	OFF	OFF	OFF
BER THRESHOLD	NONE	NONE	NONE	NONE
SWEEP CENTER	0 Hz	0 Hz	0 Hz	0 Hz
SWEEP RANGE	70k	70k	70k	70k
REACQUISITION	0 SEC	0 SEC	0 SEC	0 SEC
REED-SOL DECODER	Note 1	Note 1	Note 1	Note 1
Interface Configuration				
TX CLK SOURCE	SCT(INT)	SCT(INT)	SCT(INT)	SCT(INT)
TX CLK PHASE	AUTO	AUTO	AUTO	AUTO
EXT-REF FREQ	1544K	1544K	1544K	1544K
BUFFER CLK	RX (SAT)	RX (SAT)	RX (SAT)	RX (SAT)
RX CLK PHASE	NORM	NORM	NORM	NORM
BASEBAND LOOP	Off	Off	Off	Off
INTERFACE LOOP	Off (Note 2)	Off (Note 2)	Off (Note 2)	Off (Note 2)
BUFFER SIZE	384	384	384	384
LOOP TIMING	Off	Off	Off	Off
TX DATA FAULT	Note 2	Note 2	Note 2	Off
RX DATA FAULT	Note 2	Note 2	Note 2	Off
TX 2047	Note 2	Note 2	Note 2	Off
RX 2047	Note 2	Note 2	Note 2	Off
ASYNC TX BAUD	Note 3	Note 3	Note 3	1200
ASYNC RX BAUD	Note 3	Note 3	Note 3	1200
ASYNC TX LENGTH	Note 3	Note 3	Note 3	7
ASYNC RX LENGTH	Note 3	Note 3	Note 3	7

Table 4-5. Initial Defaults (Continued)

Function	C5	K1	K3	C5 ASYNC
Interface Configuration (Continued)				
ASYNC TX STOP	Note 3	Note 3	Note 3	2
ASYNC RX STOP	Note 3	Note 3	Note 3	2
ASYNC TX PARITY	Note 3	Note 3	Note 3	Even
ASYNC RX PARITY	Note 3	Note 3	Note 3	Even
TX CODING	Notes 2, 4	Notes 2, 4	Notes 2, 4	N/A (AMI)
RX CODING	Notes 2, 4	Notes 2, 4	Notes 2, 4	N/A (AMI)
Modulator Utility				
TX FILTER A	64k 1/2 QPSK	64k 1/2 QPSK	64k 1/2 QPSK	64k 1/2 QPSK
TX FILTER B	96k 1/2 QPSK	96k 1/2 QPSK	96k 1/2 QPSK	96k 1/2 QPSK
TX FILTER C	128k 1/2 QPSK	128k 1/2 QPSK	128k 1/2 QPSK	128k 1/2 QPSK
TX FILTER D	38.4k 1/2 QPSK	38.4k 1/2 QPSK	38.4k 1/2 QPSK	38.4k 1/2 QPSK
TX FILTER V	19.2k 1/2 QPSK	19.2k 1/2 QPSK	19.2k 1/2 QPSK	19.2k 1/2 QPSK
MODULATOR TYPE	EFD	EFD	EFD	EFD
ENCODER	Viterbi	Viterbi	Viterbi	Viterbi
TX BPSK ORDERING	Standard	Standard	Standard	Standard
MOD SPECTRUM	Normal	Normal	Normal	Normal
ODU FAULT ENABLE	On	On	On	On
TX SYMBOL RATE	64.0 ks/s	64.0 ks/s	64.0 ks/s	64.0 ks/s
Demodulator Utility				
RX FILTER A	64k 1/2 QPSK	64k 1/2 QPSK	64k 1/2 QPSK	64k 1/2 QPSK
RX FILTER B	96k 1/2 QPSK	96k 1/2 QPSK	96k 1/2 QPSK	96k 1/2 QPSK
RX FILTER C	128k 1/2 QPSK	128k 1/2 QPSK	128k 1/2 QPSK	128k 1/2 QPSK
RX FILTER D	38.4k 1/2 QPSK	38.4k 1/2 QPSK	38.4k 1/2 QPSK	38.4k 1/2 QPSK
RX FILTER V	19.2k 1/2 QPSK	19.2k 1/2 QPSK	19.2k 1/2 QPSK	19.2k 1/2 QPSK
DEMODULATOR TYPE	EFD	EFD	EFD	EFD
DECODER	Viterbi	Viterbi	Viterbi	Viterbi
RX BPSK ORDERING	Standard	Standard	Standard	Standard
DEMOD SPECTRUM	Normal	Normal	Normal	Normal
RX SYMBOL RATE	64.0 ks/s	64.0 ks/s	64.0 ks/s	64.0 ks/s

Table 4-5. Initial Defaults (Continued)

Function	C5	K1	K3	C5 ASYNC
Interface Utility				
TX OVERHEAD TYPE	None	None	None	ASYNC
RX OVERHEAD TYPE	None	None	None	ASYNC
TX TERR INTERFACE	EIA-422	EIA-422	EIA-422	EIA-422
RX TERR INTERFACE	EIA-422	EIA-422	EIA-422	EIA-422
BUFFER PROGRAM	BITS	BITS	BITS	BITS
T1/E1 FRAMING STRUCTURE	Note 4 (G.704)	Note 4 (G.704)	Note 4 (G.704)	Note 4 (G.704)
RTS TX-IF CNTRL	Off	Off	Off	Off
TX DATA PHASE	Normal	Normal	Normal	Normal
RX DATA PHASE	Normal	Normal	Normal	Normal
CTS DELAY	0 sec	0 sec	0 sec	0 sec
ASYNC TX TYPE	Note 3	Note 3	Note 3	EIA-232
ASYNC RX TYPE	Note 3	Note 3	Note 3	EIA-232
System Utility				
TIME/DATE	12:00 AM 7/04/76	12:00 AM 7/04/76	12:00 AM 7/04/76	12:00 AM 7/04/76
REMOTE BAUD/ PARITY	19200 Even	19200 Even	19200 Even	19200 Even
REMOTE ADDRESS	1	1	1	1
REMOTE TYPE	EIA-232	EIA-232	EIA-232	EIA-232
OPERATION MODE	Duplex	Duplex	Duplex	Duplex
YEAR DISPLAY	2-Digit	2-Digit	2-Digit	2-Digit
IDU SELF TEST	Off	Off	Off	Off
DISPLAY CONTRAST	64	64	64	64
DEMO MODE	Off	Off	Off	Off
EXT AGC MAX PWR	0.0V	0.0V	0.0V	0.0V
EXT AGC MIN PWR	10.0V	10.0V	10.0V	10.0V
POWER SWITCH	On	On	On	On
SYSTEM WARM-UP	MANUAL (BYPASS)	MANUAL (BYPASS)	MANUAL (BYPASS)	MANUAL (BYPASS)
Modem Utility				
MODEM TYPE	Custom	Custom	Custom	ASYNC
MODEM EMULATION	NONE	NONE	NONE	NONE
REV EMULATION	Current Version	Current Version	Current Version	Current Version
LOCAL AUPC	Note 3	Note 3	Note 3	OFF

Notes:

1. Displayed only with TX or RX Reed-Solomon installed.
2. Displayed only with Overhead Interface installed.
3. Displayed only with ASYNC Overhead enabled.
4. Applies only when G.703 Terrestrial Interface is selected.

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Chapter 5. THEORY OF OPERATION

This chapter defines the theory of operation data for the Satellite Terminal System, which includes:

- Indoor Unit (IDU)
- Outdoor Unit (ODU)
- (For C-Band Only) Low Noise Amplifier (LNA)

5.1 Satellite Terminal System

The Satellite Terminal System is a complete, variable rate satellite modem, high stability reference, and power supply in 1 RU box. The IDU is designed to be integrated with an outdoor unit for either C-Band (C5) or Ku-Band (K1 or K3).

5.2 SDT-5200 Satellite Data Terminal

5.2.1 Monitor and Control (M&C)

The Monitor & Control uses a microcontroller to control all operational parameters and monitor system status. The system also reports modem configuration status and fault status of the unit. A simple command set allows configuration, control, and retrieval of status information.

A block diagram of the M&C is shown in Figure 5-1.

5.2.2 Theory of Operation

The M&C section is composed of the following subsections:

- Analog-to-Digital Converter (ADC)
- Digital-to-Analog Converter (DAC)
- Fault and Alarm Relays
- IDU to ODU Control (ASK) Interface
- Microcontroller with Universal Asynchronous Receiver/Transmitter (UART)
- Read Access Memory (RAM)
- Read Only Memory (ROM)
- Universal ASYNC
- User Interface

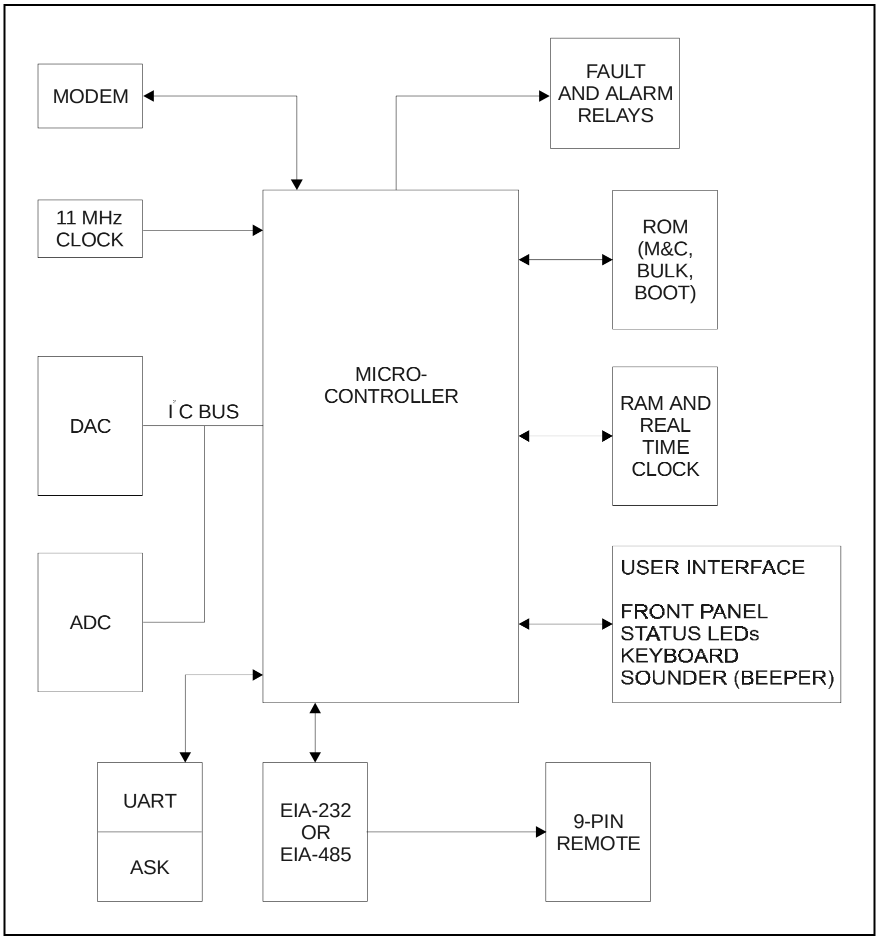


Figure 5-1. M&C Block Diagram

The heart of the M&C card is the Dallas™ 80C310 microcontroller operating at 11 MHz. This Microcontroller contains 256 kbit/s of internal RAM. The external ROM is 29F040 (512 kbit/s).

ROM access times must be equal to or greater than 150 ns. The RAM can be 8 kbit/s or 32 kbit/s in size. This RAM chip is internally battery-backed and contains a real time clock used by the M&C.

The non-volatile RAM on the M&C module allows the module to retain configuration information without prime power for 1 year (approximately). If the modem is powered down, the M&C microcontroller carry out the following sequence.

1. When power is applied to the M&C, the microcontroller checks the non-volatile memory to see if valid data has been retained. If valid data has been retained, the modem is reconfigured to the parameters maintained by the RAM.

2. If the non-volatile memory fails the valid data test, a default configuration from ROM is loaded into the system.

The UART supports serial ASYNC communications channels (remote port) with a maximum data rate of 19200 bit/s. The UART is a built-in peripheral of the microcontroller. The communications type can be EIA-232, EIA-485 (2-wire), and software selectable.

The ASK UART operates at a data rate of 9600 bit/s. The modulator modulates at 312.5 kHz carrier with the data to be transmitted to the ODU. This carrier is multiplexed onto the modulator cable. The ASK demodulator converts the 312.5 kHz signal received on the modulator cable from the ODU into a data stream for the UART. The communications sequence is initiated by the IDU and the ODU sends a response within a specified time limit.

The DAC supplies a voltage that controls the contrast of the display. The ADC monitors all the voltages from the power supply. The DAC and ADC are mapped to the Microcontroller with an Integrated Circuit (IC) bus.

The user interface includes the following parts:

- Front panel
- Status LEDs
- Keyboard
- Sounder (beeper)

All functions are memory-mapped to the microcontroller.

5.2.3 Remote Baud Rate

The remote communications baud rate and parity are programmed by the front panel control in the Utility System menu (refer to Chapter 4). The programmed baud rate and parity are maintained indefinitely in RAM on the M&C module. The parity bits can be set to EVEN or ODD. The available baud rate are listed below:

- 150
- 300
- 600
- 1200
- 2400
- 4800
- 9600
- 19200

5.2.4 Remote Address

To communicate with the established remote communications protocol, configure each modem for one address between 1 and 255. Each modem on a common remote communications link (EIA-485) must have a distinct address. Use the front panel control in the Utility System menu (Chapter 4) to program the address.

An EIA-485/EIA-232 communications link remotely controls and monitors all modem functions. Use the 2- or 4-wire, half-duplex EIA-485 interface to connect between two or more modems and switches on a common communications link. Use the EIA-232 interface to communicate with a single modem.

Note: Address 0 is reserved as a global address which simultaneously addresses all devices on a given communications link.

5.2.5 SDT-5200 Custom Modem Defaults

Refer to Chapter 4, Initial Defaults.

5.3 Modulator

The modulator provides PSK modulated carriers within the 780 to 800 MHz range. The types of modulation that encode the transmitted baseband data from the interface PCB are:

- BPSK
- QPSK

Refer to Section 4.2.3 for a description of each modulation type.

A block diagram of the modulator is shown in Figure 5-2.

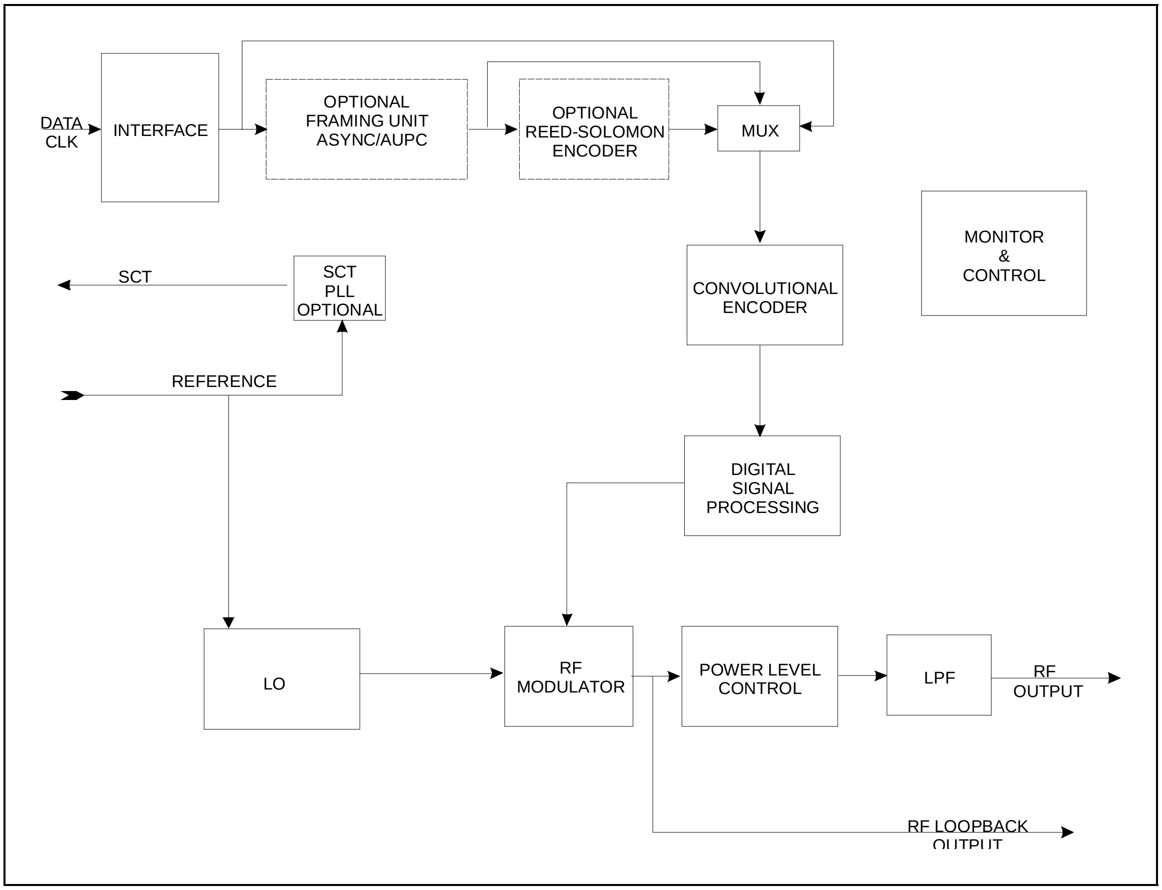


Figure 5-2. Modulator Block Diagram

5.3.1 Modulator Specifications

Refer to Chapter 2, Specifications.

5.3.2 Theory of Operation

The modulator is composed of eight basic subsections. These subsections are divided into the baseband processing section and the RF section of the modulator. The modulator controls all programmable functions on this module. Fault information from the modulator is sent to the M&C.

The major modulator subsections are:

- Scrambler/Differential Encoder
- Convolutional Encoder
- Programmable Vector Rotation
- I/Q Nyquist Filters
- Modulator
- RF Synthesizer
- Output Amplifier
- Output Level Control

If the modem is so equipped, the optional overhead or Reed-Solomon PCB first processes the data. The data is then sent to the scrambler for energy dispersal, and then to the differential encoder. The differential encoder is a 2-bit encoder, which allows for resolution of two of the four ambiguity states of the QPSK demodulator.

The data is sent to the convolutional encoder for encoding the baseband data. The code rates 1/2, 3/4, and 7/8 are based on the symbol rate range of 2.4 kbit/s to 2.5 Mbit/s. For Viterbi codes, the convolutional encoder encodes the data at 1/2 rate. If the selected code rate is 3/4, then 2 of every 6 symbols are punctured. For 3 bits in, there are 4 symbols out.

For Sequential codes, the convolutional encoder generates the parity bits from the input data stream, which allows for error correction at the far end of the link. The rate of the encoder may be 1/2, 3/4, or 7/8. For example, the 7/8 rate puts out 8 symbols for every 7 bits in. In QPSK mode, the data is split into two separate data streams to drive the I and Q channels of the modulator. Refer to Section 4.2.3 for the theory of modulation types.

After the convolutional encoder, the data is sent to a programmable vector rotation circuit. This feature provides the user with data communications compatibility for spectrum reversal of the I and Q channels before and after satellite transmission.

The I and Q channel data then pass through a set of variable rate digital Nyquist filters.

The RF synthesizer is comprised of a Direct Digital Synthesis (DDS) chip; a voltage controlled crystal oscillator (VCXO) loop, and an L-Band oscillator. It provides a signal of 1498 to 1502 MHz in 200 Hz graduated steps to the RF Modulator chip. The modulator chip divides the frequency of this input by two to generate I and Q carriers at the desired IF output frequency. The modulator combines the I and Q carriers and the I and Q baseband signals from the digital modulator to create a modulated carrier at 749 to 751 MHz in 100 Hz graduated steps.

For C-Band only - The output of the modulator is fed into a gain control circuit. The attenuation level programmed by the M&C is a function of the desired C-Band output power and the actual power measured at the ODU output.

Gain stages and a low pass filter to remove harmonics follow the attenuated signal. It is then multiplexed onto the Modulator output cable to be transmitted to the ODU.

5.3.3 Theory of Modulation Types

The modulation types for the modem include BPSK and QPSK.

The PSK data transmission encoding method uses the phase modulation technique. This method varies the phase angle of the carrier wave to represent a different bit value for the receiver. The higher levels of modulation are required for an operating range that has a limited bandwidth.

The order of modulation is represented by mPSK, where “m” relates to the number of discrete phase angles. Refer to the following list for a brief description of the modulation types.

- BPSK: 2 discrete phase angles represent the 2 possible states of a symbol.
- QPSK: 4 discrete phase angles represent the 4 possible states of a symbol.

Note: The code rate determines the number of symbols per bit.

5.3.3.1 BPSK Encoding

The modulator converts transmitted baseband data into a modulated BPSK carrier at 2.4 to 1250.0 kbit/s (1/2 rate). Using vector analysis of the constellation pattern, BPSK represents one symbol with the carrier phase at either 0° or 180°. The 1/2 rate encoding at the convolutional encoder provides two symbols output for every bit input.

Code Rate	Symbols/Bit	Bits/Hz
1/2	2	0.5

5.3.3.2 QPSK Encoding

The modulator converts transmitted baseband data into a modulated QPSK carrier at 4.8 to 4375.0 kbit/s.

Using vector analysis of the constellation pattern, QPSK represents a symbol with the carrier phase angle at 45°, 135°, 225°, or 315°. The 1/2, 3/4, and 7/8 rates encoded at the convolutional encoder provide the desired input/output bit rates.

Code Rate	Symbols/Bit	Bits/Hz
1/2	2	1
3/4	1.5	1.33
7/8	1.143	1.75

5.4 Demodulator

A block diagram of the demodulator is shown in Figure 5-3.

The demodulator converts PSK modulated carriers (refer to Chapter 2, Specifications) to a demodulated baseband data stream. The converted modulation types are BPSK and QPSK (refer to Section 5.2.3 for a description of modulation types). The demodulator then performs FEC on the data stream using Viterbi or Sequential decoding algorithms.

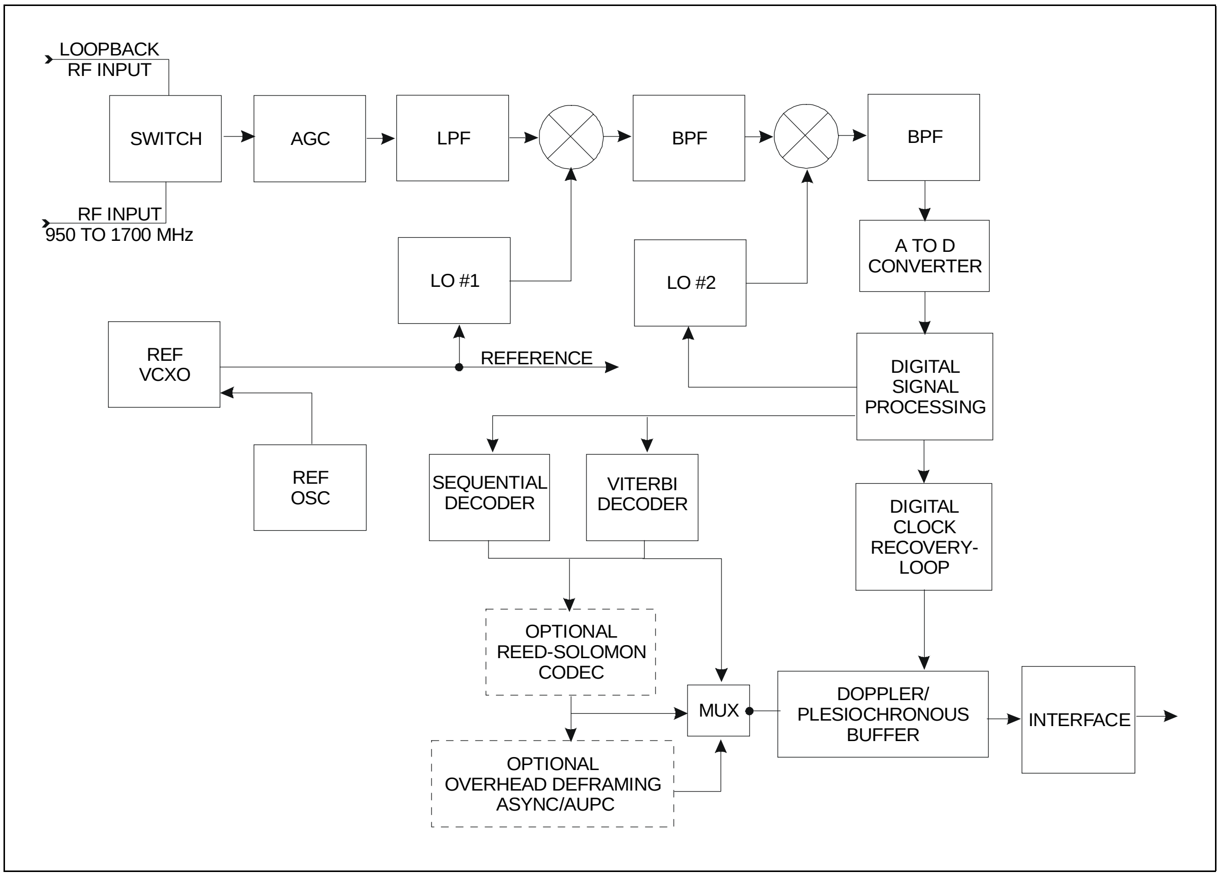


Figure 5-3. Demodulator Block Diagram

5.4.1 Demodulator Specifications

Refer to Chapter 2, Specifications for demodulator specifications.

5.4.2 Theory of Operation

The demodulator functions as an advanced, digital, coherent-phase-lock receiver and decoder. Demodulator faults are also reported to the front panel. The demodulator consists of the following basic subsections.

- Digital Costas Loop
- RF Section
- Automatic Gain Control
- Analog-to-Digital Converter (ADC)
- Soft Decision Mapping
- Programmable Vector Rotation
- Digital Nyquist Filters
- FEC Decoder
- Digital Clock Recovery Loop
- Decoder

The modulated IF signal enters the RF module for conversion to an IF frequency. The IF is then sampled by an A to D converter and digitally demodulated. The I and Q data is then sent to the digital Nyquist filters, resulting in a filtered, digital representation of the received signal. The digital data is then sent to four separate circuits:

- Automatic Gain Control
- Carrier Recovery (Costas) Loop
- Clock Recovery Loop
- Soft Decision Mapping

The AGC provides a gain feedback signal to the RF section. This closed loop control ensures that the digital representation of the I and Q channels is optimized for the Costas and Clock loops, as well as the soft-decision mapping circuitry.

When the active decoder determines that the modem is locked, the M&C stops the sweep and begins the destress process. This involves fine tuning the DDS based on the phase error in the Costas loop. The destress process continues as long as the modem is locked. If the carrier is interrupted, the M&C resumes the sweep process.

The digital Costas loop, in conjunction with a Direct Digital Synthesizer (DDS), performs the carrier recovery function. The Costas loop consists of a Costas phase detector, loop filter, and DDS, all implemented digitally. The DDS performs the function of a Voltage-Controlled Oscillator (VCO) in an analog implementation, but can be easily programmed to the desired center frequency via the M&C. The output of the DDS is sent to the RF module and provides the reference to which the local oscillator is locked. The M&C sweeps the local oscillator (via DDS programming) through the user-specified sweep range.

The digital clock loop, in conjunction with another DDS, performs the clock recovery function. The clock loop consists of a phase detector, loop filter, and DDS, all implemented digitally. The DDS performs the function of a VCO in an analog implementation. The recovered data and symbol clocks are then used throughout the demodulator.

The soft decision mapper converts the digital I and Q data to 3-bit soft decision values. These values are then fed to the programmable vector rotation circuit, providing compatibility with spectrum reversal of the I and Q channels.

The output of the vector rotation circuit is then sent to the Viterbi decoder and optional Sequential decoder. The output is then sent to the optional Reed-Solomon or Overhead PCB.

5.5 Decoder

The IDU can be configured in any of the following forms:

- Basic IDU (Sequential or Viterbi Decoder)
- FAST options (Sequential or Viterbi Decoder)
- FAST options with Reed-Solomon hardware (Sequential or Viterbi Decoder)

Refer to Appendix A for additional information.

5.6 Terrestrial Interface Types

Refer to Table 5-1 for electrical and mechanical interfaces.

Table 5-1. Terrestrial Interface Types

Terrestrial Interface Types	Specification
Electrical interface types available for the EIA-530-A, 25-pin "D" data I/O connector:	EIA-232 EIA-422 V.35
Optional mechanical interfaces:	37-pin "D" EIA-449 34-pin block V.35 50-pin "D"
Interface types available through the optional 50-pin data I/O connector:	ASYNC/AUPC

The terrestrial interface functions include:

- Multiplexing various types of ESC into the data
- Buffering the receive data
- Demultiplexing various types of ESC from the data
- Monitoring and displaying the interface status without interruption of service

The terrestrial interface block diagram is shown in Figure 5-4.

The terrestrial interfaces for the modem are defined by data communication standards MIL-STD-188/EIA-449, EIA-232, or V.35. The interface receivers and drivers for these standards, as well as the handshake signals for MIL-STD-188 and V.35, are selectable through the front panel selection.

Refer to Appendix A for additional information concerning these options.

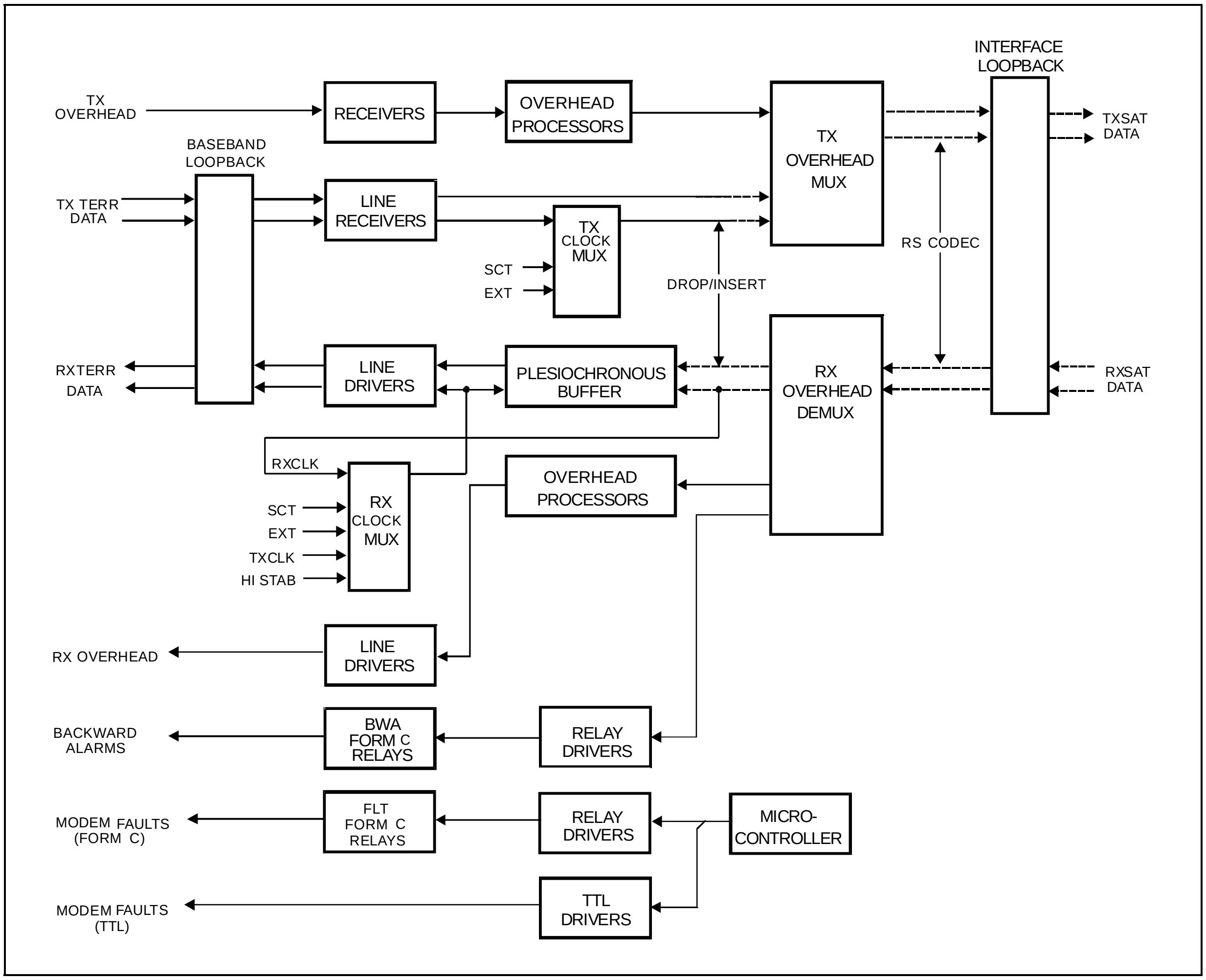


Figure 5-4. Terrestrial Interface Block Diagram

Chapter 6. SYSTEM CHECKOUT

This chapter provides the following information:

- Satellite Terminal System Checkout
- Fault Isolation
- Module Replacement and Identification

6.1 Satellite Terminal System Checkout

CAUTION

This equipment contains parts and assemblies sensitive to damage by ESD. Use ESD precautionary procedures when touching, removing, or inserting PCBs.

The IDU comes equipped with an internal self-test feature. This feature is designed to provide the operator with maximum confidence that the modem is operational without installing external equipment.

A 2047 pattern is generated by the modem and routed through all sections. This is accomplished by placing the modem in IF and baseband loopback. Pseudo Gaussian noise is introduced to the modulated IF section allowing the modem to check its indicated E_b/N_0 against the known E_b/N_0 of the demodulated input. Observe the following:

- If this measurement falls outside of a specified window, the modem declares a failed test.

- If an overhead card and/or Reed-Solomon card are installed, the signal is routed through the card, verifying their operation.

- Faults, if any, are stored in the Stored Fault menu.

6.2 Interface Checkout

Use the following procedures and test setup in Figure 6-1 to inspect the interface.

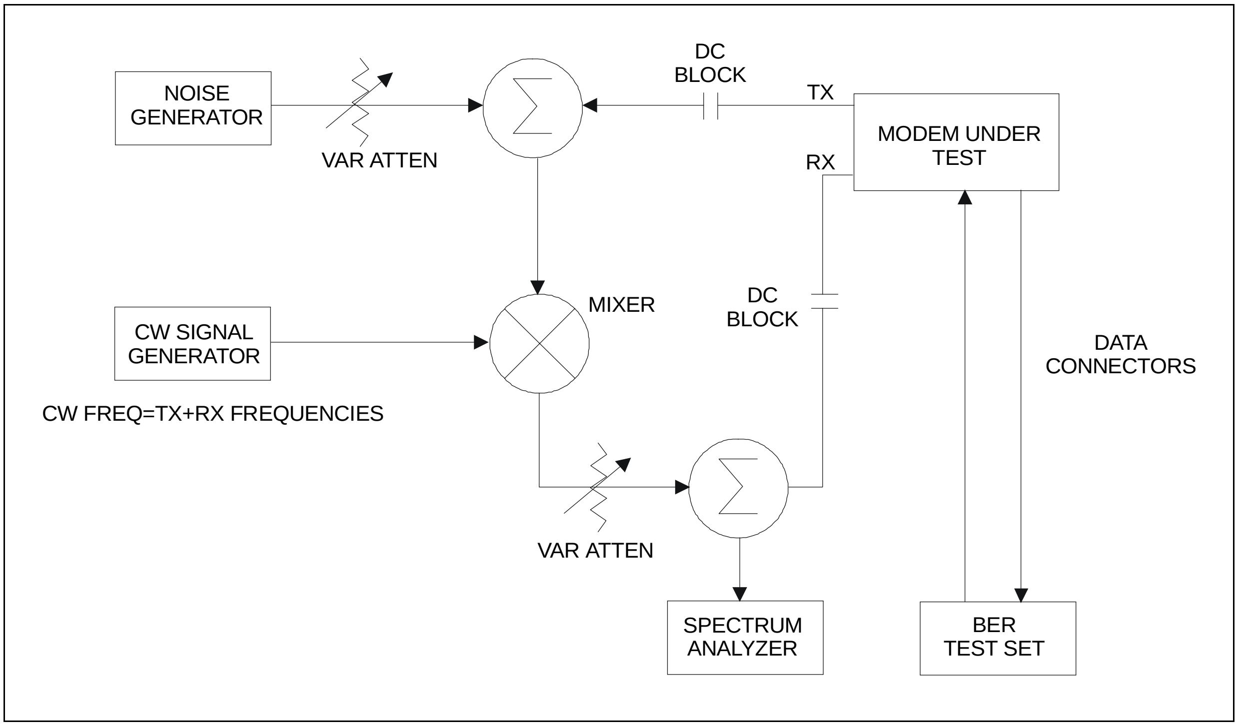


Figure 6-1. Fault Isolation Test Setup

1. Connect a BER test setup to the appropriate IDU data connector as shown in Figure 6-1. Refer to Chapter 3 for External IDU Connections.

2. Set up the IDU for baseband loopback operation by using the Configuration Interface front panel menu (Chapter 4). The IDU will run error free. Refer to Chapter 3 for a block diagram of the baseband loopback operation.

3. Perform only if Overhead Interface is installed: Change the IDU from baseband loopback to interface loopback operation by using the Configuration Interface front panel menu (Chapter 4). The IDU will run error free. Refer to Chapter 4 for a block diagram of the interface loopback operation.

6.2.1 Modulator Checkout

Use the following procedure to check out the modulator:

1. Set up the equipment as shown in Figure 6-1. Refer to Chapter 2 for modulator specification.

2. Set up the IDU for operation by using the Configuration Modulator and Demodulator front panel menus.

3. Clear all transmit faults by correct use of data and clock selection (Chapter 4).

4. Measure the E_b/N_0 with a receiver that is known to be properly operating. Refer to Table 6-1 and Figure 6-2 to check for proper E_b/N_0 level. The (S+N)/N is measured by taking the average level of the noise and the average level of the IDU spectrum top. Use this measurement for the first column on Table 6-1. Read across the page to find the S+N and E_b/N_0 for the specific code rates.

   Note: Once the demodulator has locked to the incoming signal, the Modulator menu will display signal level, raw BER, corrected BER, and E_b/N_0. Refer to Chapter 2 for examples of BER performance curves.

5. Connect a spectrum analyzer to the IDU as shown in Figure 6-1. Ensure the IF output meets the appropriate mask and spurious specifications. Measure the power output at different levels and frequencies.

   Note: A typical output spectrum is shown in Figure 6-3.

6. To check the frequency and phase modulation accuracy:

   a. Set the IDU to the continuous wave Center-CW by using the Carrier Mode front panel menu (Chapter 4). A pure carrier should now be present at the IF output. This should only be used for frequency measurements. In this mode, spurious and power measurements will be inaccurate.

   b. Set the IDU to the continuous wave Offset mode by using the Carrier Mode front panel menu (Chapter 4). This generates a single, upper side-band suppressed carrier signal. Ensure the carrier and side-band suppression is < -35 dBc.

Table 6-1. Conversion to S/N and E_b/N_0 Chart

(dB)	Code	Rate 1/2	Code	Rate 3/4	Code	Rate 7/8
(S+N)/N	S/N	E_b/N_0	S/N	E_b/N_0	S/N	E_b/N_0
4.0	1.8	1.8	1.8	0.0	1.8	-0.6
4.5	2.6	2.6	2.6	0.8	2.6	0.2
5.0	3.3	3.3	3.3	1.6	3.3	0.9
5.5	4.1	4.1	4.1	2.3	4.1	1.6
6.0	4.7	4.7	4.7	3.0	4.7	2.3
6.5	5.4	5.4	5.4	3.6	5.4	3.0
7.0	6.0	6.0	6.0	4.3	6.0	3.6
7.5	6.6	6.6	6.6	4.9	6.6	4.2
8.0	7.3	7.3	7.3	5.5	7.3	4.8
8.5	7.8	7.8	7.8	6.1	7.8	5.4
9.0	8.4	8.4	8.4	6.7	8.4	6.0
9.5	9.0	9.0	9.0	7.2	9.0	6.6
10.0	9.5	9.5	9.5	7.8	9.5	7.1
10.5	10.1	10.1	10.1	8.3	10.1	7.7
11.0	10.6	10.6	10.6	8.9	10.6	8.2
11.5	11.2	11.2	11.2	9.4	11.2	8.8
12.0	11.7	11.7	11.7	10.0	11.7	9.3
12.5	12.2	12.2	12.2	10.5	12.2	9.8
13.0	12.8	12.8	12.8	11.0	12.8	10.3
13.5	13.3	13.3	13.3	11.5	13.3	10.9
14.0	13.8	13.8	13.8	12.1	13.8	11.4
14.5	14.3	14.3	14.3	12.6	14.3	11.9
15.0	14.9	14.9	14.9	13.1	14.9	12.4
15.5	15.4	15.4	15.4	13.6	15.4	12.9
16.0	15.9	15.9	15.9	14.1	15.9	13.5
16.5	16.4	16.4	16.4	14.6	16.4	14.0
17.0	16.9	16.9	16.9	15.2	16.9	14.5
17.5	17.4	17.4	17.4	15.7	17.4	15.0
18.0	17.9	17.9	17.9	16.2	17.9	15.5
18.5	18.4	18.4	18.4	16.7	18.4	16.0
19.0	18.9	18.9	18.9	17.2	18.9	16.5
19.5	19.5	19.5	19.5	17.7	19.5	17.0
20.0	20.0	20.0	20.0	18.2	20.0	17.5

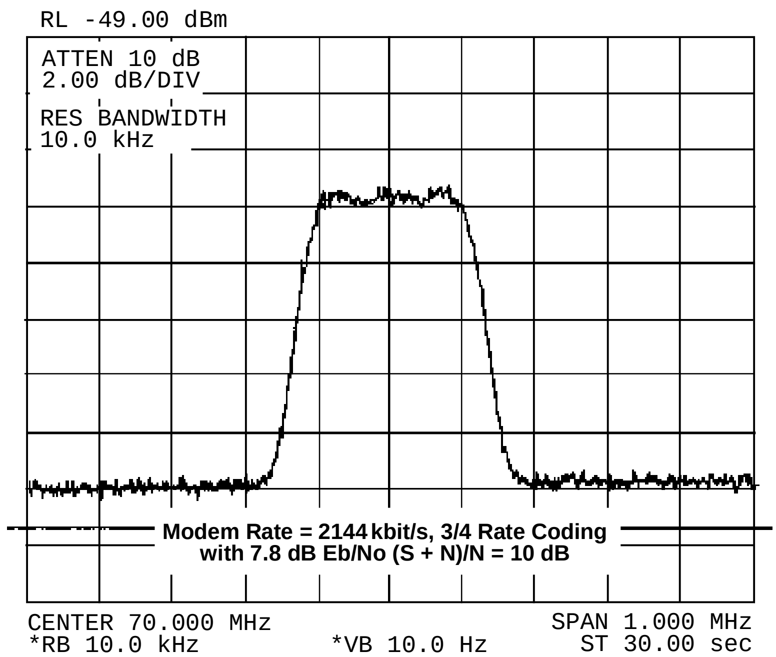


Figure 6-2. Typical Output Spectrum (with Noise)

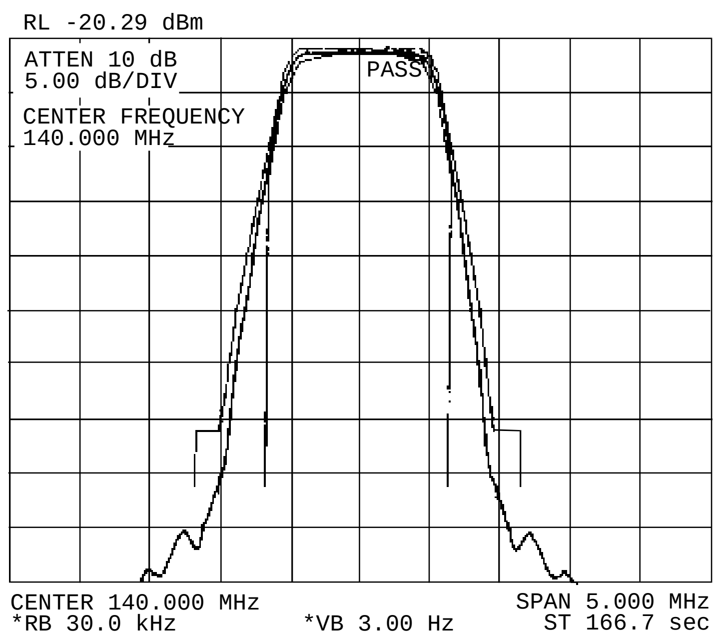


Figure 6-3. Typical Output Spectrum (without Noise)

6.2.2 Demodulator Checkout

Use the following procedure to test the demodulator.

1. Set up the equipment as shown in Figure 6-1. Refer to Chapter 2 for the demodulator specifications.

2. Set up the IDU with an external IF loop and level. Use a properly operating modulator, and ensure that power levels, data rates, code rates, etc., are compatible.

3. Allow the IDU to lock up. Depending on the up and down conversion of high or low mix. (See Figure 6-4.) When the green carrier-detect LED is on and the demultiplexer lock fault has been cleared (where applicable), the IDU will run at the specified error rate. Run the transmit power level (input amplitude) over the full range, and offset the transmit frequency from the receive frequency by 35 kHz. Ensure the IDU still runs within the specified error rate.

4. Set up the IDU to check the constellation patterns with an oscilloscope that is set in the X-Y mode. Typical constellation patterns with noise and without noise are shown in Figure 6-5. These test points are available on the auxiliary connector (J9, pins 6 and 8). It is not necessary to open the modem to look at these test points.

6.2.3 ODU Checkout

1. Connect the cable between the IDU TX output and ODU.

2. Enable the ODU (Utility Modulator Fault).

3. Verify no ODU faults are reported at the IDU.

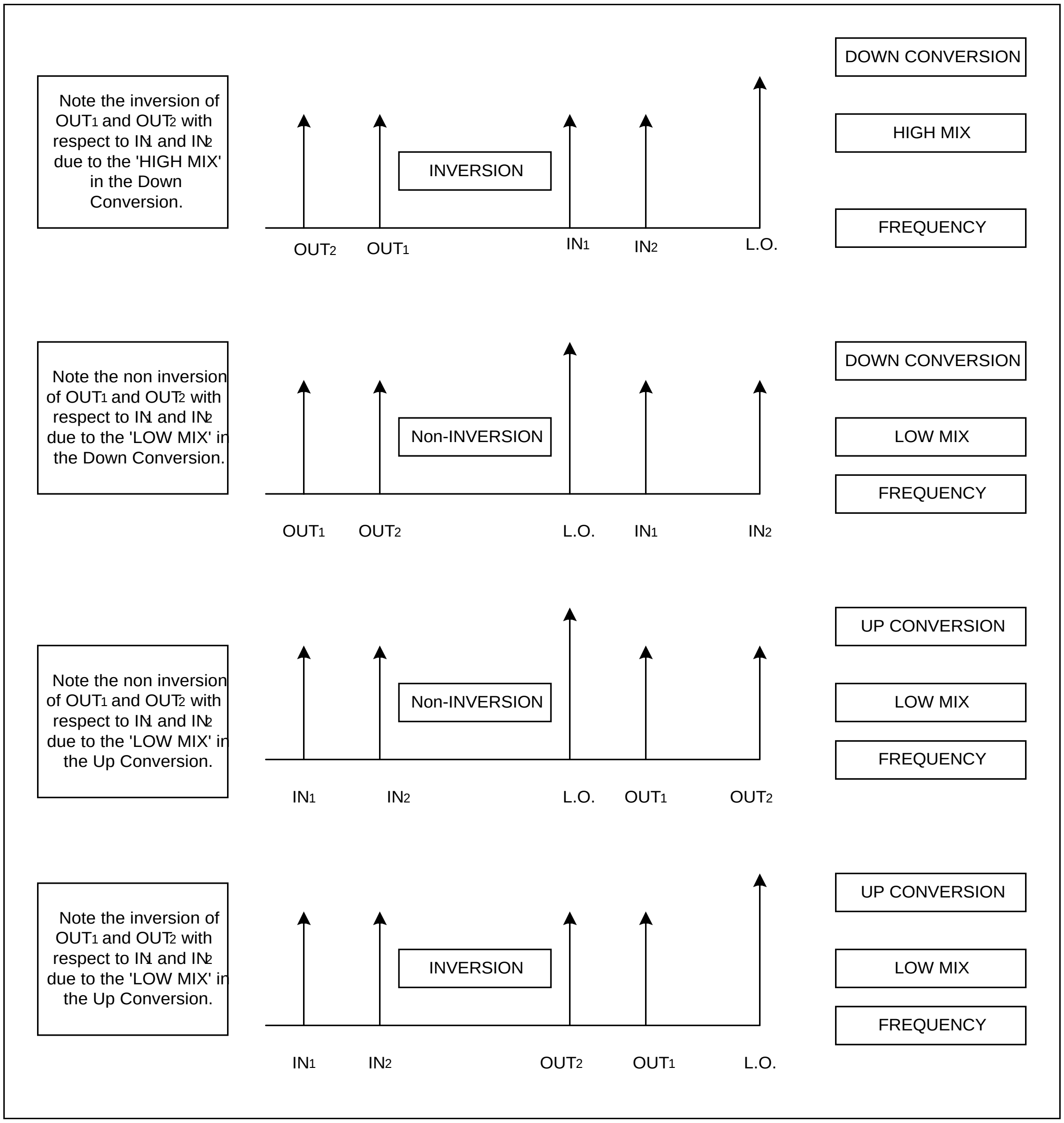
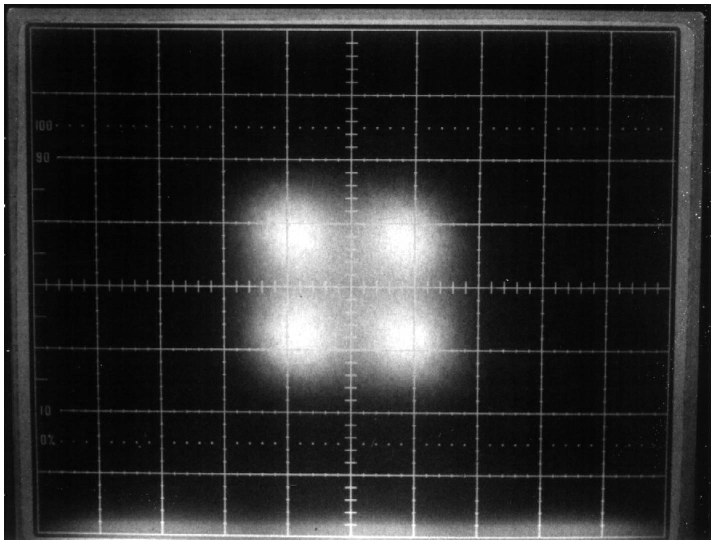
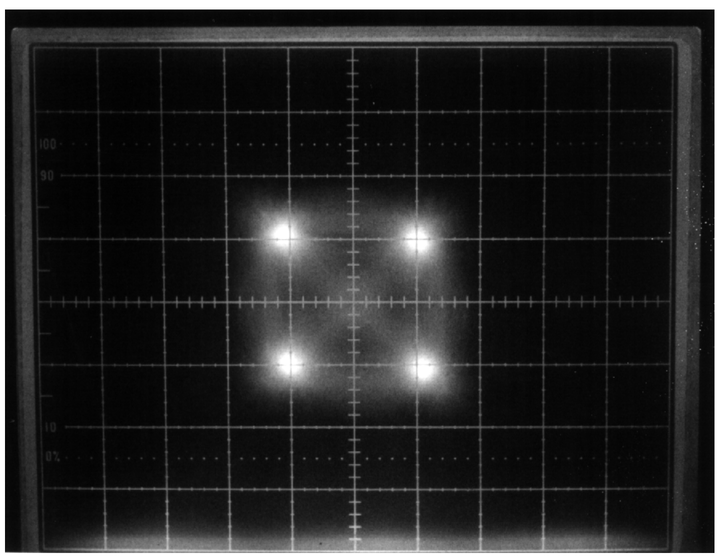


Figure 6-4. Spectral Inversion



WITH NOISE



WITHOUT NOISE

Figure 6-5. Typical Eye Constellations

6.3 Fault Isolation

The IDU design allows a technician to repair a faulty modem on location.

CAUTION

This equipment contains parts and assemblies sensitive to damage by ESD. Use ESD precautionary procedures when touching, removing, or inserting PCBs.

The fault isolation procedure lists the following categories of faults or alarms.

- Modulator
- Demodulator
- Transmit Interface
- Receive Interface
- Common Equipment
- Outdoor Unit

Note: Each fault or alarm category includes possible problems and the appropriate action required to repair the modem.

If any of the troubleshooting procedures mentioned earlier in this chapter do not isolate the problem, and EFData Customer Support assistance is necessary, have the following information available for the representative:

- Modem configuration. Modem configuration includes the modulator, demodulator, interface, or local AUPC sections.

- Faults (active or stored).

6.3.1 System Faults/Alarms

System faults are reported in the “Faults/Alarms” menu, and stored faults are reported in the “Stored Flts/Alms” menu. Refer to Chapter 4 for more information. To determine the appropriate action for repairing the modem, refer to Table 6-2 for a listing of possible problems.

Table 6-2. Fault Tree

TRANSMITTER FAULTS	TX IF OUTPUT OFF	TX FAULT LED	TX FAULT RELAY (1)	RX FAULT LED	RX FAULT RELAY (2)	COM EQ FAULT LED	COM EQ FAULT RELAY (3)	TX ALARM LED	TX ALARM RELAY #2 (4)	RX ALARM LED	RX ALARM RELAY #3 (5)	SPARE RELAY ALARM #1	TX AIS	RX AIS
IF SYNTHESIZER	X	X	X										X	
DATA CLOCK SYN	X	X	X										X	
I CHANNEL	X	X	X										X	
Q CHANNEL	X	X	X										X	
MODEM REF PLL	X	X	X										X	
MODULE	X	X	X										X	
RECEIVER FAULTS														
CARRIER DETECT				X	X									X
IF SYNTHESIZER				X	X									X
I CHANNEL				X	X									X
Q CHANNEL				X	X									X
BER THRESHOLD										X	X			
MODULE				X	X									X

Legend

Note	Fault/Alarm Relay	Test Points Connector/Pins
1	TX FAULT	Pin 4 (NO), 5 (COM), 6 (NC) ****
2	RX FAULT	Pin 7 (NO), 8 (COM), 9 (NC) ****
3	COM EQ FAULT	Pin 1 (NO), 2 (COM), 3 (NC) ****
4	TX ALARM #2	Pin 4 (NO), 5 (COM), 6 (NC) +
5	RX ALARM #3	Pin 7 (NO), 8 (COM), 9 (NC) +

**** A connection between the common and NC contacts indicate fault.
***** Signal is open collector high impedance if faulted.
\+ A connection between the common and NO contacts indicate alarm.

Table 6-2. Fault Tree (Continued)

TX INTERFACE FAULTS	TX IF OUTPUT OFF	TX FAULT LED	TX FAULT RELAY (1)	RX FAULT LED	RX FAULT RELAY (2)	COM EQ FAULT LED	COM EQ FAULT RELAY (3)	TX ALARM LED	TX ALARM RELAY #2 (4)	RX ALARM LED	RX ALARM RELAY #3 (5)	SPARE RELAY ALARM #1	TX AIS	RX AIS
TX DATA/AIS								X	X					
TX CLK PLL	X	X	X										X	
TX CLK ACTIVITY								X	X				X	
CONFIGURATION	X	X	X										X	
RX INTERFACE FAULTS														
BUFFER UNDERFLOW											X	X		
BUFFER OVERFLOW											X	X		
RX DATA/AIS											X	X		
FRAME BER				X	X									X
BACKWARD ALARM														
BUFFER CLK PLL				X	X									X
BUFFER CLK ACT											X	X		
DEMUX LOCK														
RX 2047 LOCK											X	X		
BUFFER FULL											X	X		

Legend

Test Note	Fault/Alarm Relay	Test Points Connector/Pins
1	TX FAULT	Pin 4 (NO), 5 (COM), 6 (NC) ****
2	RX FAULT	Pin 7 (NO), 8 (COM), 9 (NC) ****
3	COM EQ FAULT	Pin 1 (NO), 2 (COM), 3 (NC) ****
4	TX ALARM #2	Pin 4 (NO), 5 (COM), 6 (NC) +
5	RX ALARM #3	Pin 7 (NO), 8 (COM), 9 (NC) +

**** A connection between the common and NC contacts indicate fault.
***** Signal is open collector high impedance if faulted.
\+ A connection between the common and NO contacts indicate alarm.

Table 6-2. Fault Tree (Continued)

COMMON EQUIP FAULTS	TX IF OUTPUT OFF	TX FAULT LED	TX FAULT RELAY (1)	RX FAULT LED	RX FAULT RELAY (2)	COM EQ FAULT LED	COM EQ FAULT RELAY (3)	TX ALARM LED	TX ALARM RELAY #2 (4)	RX ALARM LED	RX ALARM RELAY #3 (5)	SPARE RELAY ALARM #1	TX AIS	RX AIS
BATTERY/CLOCK						X								
-12V POWER SUPPLY						X	X							
+12V POWER SUPPLY						X	X							
+5V SUPPLY						X	X							
CONTROLLER						X	X						X	X
INTERFACE MODULE						X								
SELF TEST						X	X						X	X
IDU POWER SUPPLY						X	X						X	X
ODU Faults														
Module	x	x	x										x	
Communication	x	x	x										x	

Legend		
Test Note	**Fault/Alarm Relay**	**Test Points Connector/Pins**
1	TX FAULT	Pin 4 (NO), 5 (COM), 6 (NC) ****
2	RX FAULT	Pin 7 (NO), 8 (COM), 9 (NC) ****
3	COM EQ FAULT	Pin 1 (NO), 2 (COM), 3 (NC) ****
4	TX ALARM #2	Pin 4 (NO), 5 (COM), 6 (NC) +
5	RX ALARM #3	Pin 7 (NO), 8 (COM), 9 (NC) +
****	A connection between the common and NC contacts indicate fault.	
*****	Signal is open collector high impedance if faulted.	
+	A connection between the common and NO contacts indicate alarm.	

6.3.2 Faults/Alarms Display

General fault, status, and alarm information are indicated by 10 LEDs located on the modem's front panel.

A fault (red LED) indicates a fault that currently exists in the modem.

When a fault occurs, it is stored in the stored fault memory, and indicated by the single yellow LED.

The LED is turned off when the fault clears. If the fault clears, the occurrence is also stored.

A total of 10 occurrences of any fault can be stored. Each fault or stored fault indicated by a front panel LED could be one of many faults. To determine which fault has occurred, use the Fault or Stored Fault front panel menu. Refer to Chapter 4 for information on the Fault or Stored Fault front panel menu.

Alarms are considered minor faults, which will not switch the modem offline in a redundant system. Alarms are shown in the Fault or Stored Fault front panel menu by a reversed contrast (white on black) character that appears at the display panel.

6.3.3 Faults/Alarms Analysis

This section describes the possible problems and actions to take for the following faults:

- Modulator
- Demodulator
- Transmit interface
- Receive interface
- Common equipment

6.3.3.1 Transmitter Faults

Fault/Alarm	Possible Problem and Action
IF SYNTHESIZER	Modulator IF synthesizer fault. This is considered a major alarm, and will turn off the modulator output. Return the modem for repair.
DATA CLOCK SYN	Transmit data clock synthesizer fault. This fault indicates that the internal clock VCO has not locked to the incoming data clock, or the internal clock synthesizer has not locked to the internal reference. This is considered a major alarm, and will turn off the modulator output. Ensure the proper data rate has been set up and selected, and the incoming data rate matches the modem selections.
I CHANNEL	Activity alarm for the I channel digital filter. This alarm is considered a major alarm, and will turn off the modulator IF output. An alarm in this position indicates either a fault in the scrambler, or if the scrambler is disabled, the alarm indicates a loss of incoming data. If the fault is active with the scrambler turned off, check for input data at the DATA I/O connector.
Q CHANNEL	Activity alarm for the Q channel digital filter. Use the I channel procedure.
MODEM REFERENCE PLL	Internal reference activity fault. Indicates clock reference not detected.
MODEM REF PLL	Modem Ref PLL fault. Typically indicates that the Modem Ref PLL is missing or will not program.

6.3.3.2 Receiver Faults

Fault/Alarm	Possible Problem and Action
CARRIER DETECT	Carrier detect fault. Indicates the decoder is not locked. This is the most common fault displayed in the modem. Any problem from the input data on the modulator end of the circuit to the output of the decoder can cause this alarm. First, ensure the demodulator has an RF input at the proper frequency and power level. Ensure the demodulator data rate is properly programmed. Refer to the fault isolation procedure for Data Clock Syn in the modulator section. Verify the frequency of the data transmitted from the modulator is within 100 PPM.
IF SYNTHESIZER	Demodulator IF synthesizer fault. Indicates the demodulator IF synthesizer is faulted. This fault is a hardware failure. Contact the EFData Customer Support Department.
I CHANNEL	Indicates a loss of activity in the I channel of the quadrature demodulator. Typically indicates a problem in the modulator side of the circuit. Check for proper RF input to the demodulator. If the input to the demodulator is correct, then the problem is in the baseband processing.
Q CHANNEL	Indicates a loss of activity in the Q channel of the quadrature demodulator. Follow the same procedure for the I channel fault.
BER THRESHOLD	Indicates the preset BER threshold has been exceeded. Setting of this alarm is done in the Utility menu. This is an alarm based on the corrected BER reading on the front panel.
MODULE	Demodulator module fault. Typically indicates that the demodulator module is missing or will not program. Contact the EFData Customer Support Department.

6.3.3.3 Transmit Interface Faults

Fault/Alarm	Possible Problem and Action
TX DATA/AIS	Data or incoming AIS. When the AIS is selected in the Interface Configuration menu for TX DATA FAULT, the transmit interface alarm TX DATA/AIS is monitoring a fault condition of all 1s from customer data input to the modem. When DATA is selected in the Interface Configuration menu for TX DATA FAULT, the TX interface alarm TX DATA/AIS is monitoring a fault condition of all 1s or 0s. This is referred to as a data-stable condition (data is not transitioning). This alarm indicates there is trouble in the chain sending data to the modem. This indication is a monitor function only, and aids in isolating the trouble source in a system.
TX CLOCK PLL	Transmitter phase-locked loop fault. Indicates the transmitter PLL is not locked to the reference of the interface transmit clock recovery oscillator. Contact the EFData Customer Support Department.
TX CLOCK ACT	Activity detector alarm of the selected interface transmit clock. Indicates the selected TX clock is not being detected. Check the signal of the selected TX clock source to verify the signal is present. The interface will fall back to the internal clock when this alarm is active.
CONFIGURATION	Indicates invalid TX interface configuration.

6.3.3.4 Receive Interface Faults

Fault/Alarm	Possible Problem and Action
BUFFER UNDERFLOW	Buffer underflow alarm. Indicates the plesiochronous buffer has underflowed. Buffer underflow is normally a momentary fault (there are clock problems if this alarm is continuously present). This alarm is included in this section to be consistent with the fault reporting system and to be correctly registered in the stored fault memory. The time and date of the first 10 receive buffer underflow faults are stored in battery-backed memory as an aid to troubleshooting. The interval between stored overflow/underflow events can be used to determine relative clock accuracies.
BUFFER OVERFLOW	Buffer overflow alarm. Indicates the plesiochronous buffer has overflowed. The problems and actions in the buffer underflow section apply to this alarm.
RX DATA/AIS	Data or incoming AIS. The data monitored for RX data is coming from the satellite. When the AIS is selected for RX DATA FAULT in the Interface Configuration menu, the RX DATA/AIS is monitoring an alarm condition of all 1s from the satellite. When DATA is selected for RX DATA FAULT in the Interface Configuration menu, the RX DATA/AIS is monitoring a alarm condition of all 1s or 0s. This is referred to as a data-stable condition (data is not transitioning). The alarm indicates trouble in receiving data from the satellite. The indication is a monitor function only to help isolate the source of trouble in a system.
FRAME BER	The receive decoded error rate has exceeded 10^{-3} over a 60-second period measured on the framing bits. This is defined as a major (prompt) receive alarm by INTELSAT specifications IESS-308. In a redundant system, a switch-over will be attempted. Since some data must be correctly received to indicate this fault, receive AIS will not be substituted. This fault is to be sent as a backward alarm to the distant end. This must be wired externally, as faults other than from the modem may need to enter the fault tree.

Fault/Alarm	Possible Problem and Action
BUFFER CLK PLL	Buffer clock phase-locked loop fault. The buffer synthesizer is the wrong frequency or will not lock. Ensure the selected buffer clock source is at the proper frequency and level. If the fault continues, contact the EFData Customer Support Department.
BUFFER CLK ACT	Activity detector alarm of the selected interface receive clock. The interface will fall back to the satellite clock when this fault is active.
DEMUX_LOCK	Demultiplexer synchronization lock fault. This fault means that the demultiplexer is unable to maintain valid frame and multiframe alignment. The usual cause is invalid or absent receive data. This is a major (prompt) alarm. The alarm will cause insertion of receive AIS (all 1s) and the switch-over will be attempted. This fault is to be sent as a backward alarm to the distant end. This fault will occur when no carrier is present, but will probably never occur with a correct signal.
RX 2047 LOCK	RX 2047 lock alarm. Indicates the RX 2047 data test pattern is not being received by the decoder. The alarm probably indicates the transmitter is not set correctly.
BUFFER FULL	Buffer full alarm. Indicates the buffer is < 10% or > 90% full.

6.3.3.5 Common Equipment Faults

Fault/Alarm	Possible Problem and Action
BATTERY/CLOCK	M&C battery voltage or clock fault. Indicates a low voltage in the memory battery. Typically, this fault will be active when a modem has been hard reset or the firmware has been changed. When a hard reset has been executed or the firmware has been changed, this fault will typically be active when the modem is first turned on.
-12 VOLT SUPPLY	-12V power supply fault. Indicates a high or low voltage condition. Level is ± 5%. Check for a short on the -12V line from the power supply or on any of the plug-in boards.
+12 VOLT SUPPLY	+12 VDC power supply fault. Use the same procedure as with -12V fault.
+5 VOLT SUPPLY	+5V power supply fault. Use the same procedure as with a -12V fault. The +5V supply requires a minimum load of 1A.
CONTROLLER	Controller fault. Indicates a loss of power in the M&C card. Typically indicates the controller has gone through a power on/off cycle.
INTERFACE MODULE	Interface module fault. Indicates a problem in programming the interface card or Reed-Solomon.
SELF TEST	After completion of the test, SELF TEST ("PASSED" or "FAILED") is displayed. • OFF: bypasses built-in self test. • AUTO: initiates built-in self test when turning on modem. • RUN: initializes self test.
IDU Power Supply	Indicates a temperature failure in the IDU power supply.

6.3.3.6 ODU Faults

Module	ODU failure.
Communication	ASK communication failure.

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Appendix A. OPTIONS

This appendix describes the options available for the Satellite Terminal System. Available options are:

- Fully Accessible System Topology (FAST) Options
- Conventional Options
- Software and Hardware Upgrades

A.1 FAST Accessible Options

EFData's FAST system allows immediate implementation of different options through the user interface keypad. Some FAST options are available through the basic platform unit, while others require that the unit be equipped with optional hardware or that the hardware be installed in the field. Refer to Table A-1 for a listing of possible configurations.

The options available through the FAST architecture include:

- ASYNC/AUPC
- Decoder
- Asymmetrical Loop Timing
- Variable Data Rates

Other options are available through conventional changes such as installing daughter card PCBs. Refer to Section A.2, Conventional Options, for additional information.

Table A-1. FAST Options and Required Configurations

Hardware	Single Data Rate	Variable Data Rate (up to 512 kbit/s)	Variable Data Rate (up to 4.375 Mbit/s)	Sequential Decoder	Viterbi Decoder	Async Loop Timing	Reed-Solomon Codec	ASYNC/ AUPC Overhead
Base SDT-5200	X							
FAST Options to the Base SDT-5200	N/A	X	X	X	X	X	N/A	N/A
FAST Options with Reed-Solomon Hardware	N/A	N/A	N/A	N/A	N/A	N/A	X	N/A
FAST Options with Overhead Hardware	N/A	N/A	N/A	N/A	N/A	N/A	N/A	X

Note: The basic SDT-5200 is shipped with either Sequential or Viterbi decoder.

A.1.1 FAST System Theory

FAST is an enhancement feature available only in EFData products, enabling on-location upgrade of the operating feature set—in the rack—without removing a modem from the setup. When service requirements change, the operator can upgrade the topology of the modem to meet those requirements within minutes after confirmation by EFData. This accelerated upgrade can be accomplished only because of FAST's extensive use of programmable devices incorporating EFData-proprietary signal processing techniques. These techniques allow the use of a unique access code to enable configuration of the available hardware. The access code can be purchased at any time from EFData. Once obtained, the access code is loaded into the unit through the front panel keyboard or the rear remote port.

With the exclusive FAST technology, operators have maximum flexibility for enabling functions as they are required. FAST allows an operator to order a modem precisely tailored for the initial application, reducing risk and cost overruns during the application integration process.

A.1.2 Implementation

FAST is factory-implemented in the modem at the time of order. Hardware options for basic modems can be ordered and installed either at the factory or in the field. The operator can select options that can be activated easily in the field, depending on the current hardware configuration of the modem.

A.1.2.1 Activation Procedure

1. Obtain IDU serial number as follows:

   a. Press [CLEAR] to return to the Main menu.

   b. Use [←] and [→] to select Function Select menu.

   c. Press [ENTER].

   d. Use [←] and [→] to select Utility Modem Type menu.

   e. Press [ENTER].

   f. Use [←] and [→] to select Modem Serial # menu.

   g. Record serial number: ____________________

2. Select desired features as follows:

   a. Use [←] and [→] to select Modem Options menu.

   b. Press [ENTER].

   c. Scroll through the Modem Options and check off all features that display a "+" sign as follows:

HIGH POWER	[ ]	SINGLE RATE	[ ]
HIGH STABILITY	[ ]	LOW RATE VOLTAGE	[ ]
ASLT	[ ]	FULL RATE VARIABLE	[ ]
VITERBI	[ ]	CARD #1 PCB	[ ]
SEQUENTIAL	[ ]	CARD #2 PCB	[ ]

Notes:

1. If the menu displays a "0", the unit will need to be returned to the manufacturer for the desired hardware upgrade.
2. If the unit displays an "X," the unit can be upgraded in the field.
3. If the unit displays a "+", the feature is installed.
4. If the unit displays a "-," the feature is FAST accessible.

   d. Press [CLEAR].

   e. Use [←] and [→] to select CARD #1 (Overhead Card) menu.

   f. Record Card #1 serial number, if displayed:______________

   g. Use [←] and [→] select CARD #2 (Reed-Solomon Card) menu.

h. Record Card #2 serial number, if displayed:______________

i. Press [CLEAR].

3. Contact an EFData sales representative to order features.

4. EFData Customer Support personnel will verify the order and provide an invoice and instructions.

5. Enter access codes as follows:

   a. Press [CLEAR] to return to the Main menu.

   b. Use [←] and [→] to select Function Select Utility menu.

   c. Press [ENTER].

   d. Use [←] and [→] to select Utility Modem Type menu.

   e. Press [ENTER].

   f. Use [←] and [→] to select Configuration Code Modem menu.

   g. Press [ENTER].

   h. Menu appears as follows:

      AAAAAAAAAA
      AAAAAAAAAA

   i. Enter the access code.

      Use the following example for practice:

      Use [↑][↓] to input: 5CBB397F4D
      Press [→].
      Use [↑][↓] to input: 773B285AA5
      Press [ENTER].
      Display exhibit “WRONG CODE ENTERED”.

6. If properly re-initialized, the display exhibits “REINITIALIZED” and reset.

7. Check upgrade as follows:

   a. Press [CLEAR] to return to the Main menu.

   b. Use [←] and [→] to select Function Select Utility menu.

   c. Press [ENTER].

   d. Use [←] and [→] to select Utility Modem Type menu.

   e. Press [ENTER].

   f. Use [←] and [→] to select Modem Options menu.

   g. Press [ENTER].

   h. Use [←] and [→] to scroll through features. Visually check selected features for a "+" sign. If a "+" sign is evident, the upgrade is completed.

8. If upgrade is incorrect, the menu display will exhibit "WRONG CODE ENTERED." Repeat procedures. Contact EFData Customer Support personnel for further instructions, if the error message remains.

A.2 Interface Options

A.2.1 Asynchronous Interface/AUPC

The asynchronous (ASYNC) interface option provides the interface for terrestrial data and a single ASYNC overhead channel. Typically used for earth-station-to-earth-station communication, the overhead channel is multiplexed onto the data and transmitted at an overhead rate of 16/15 of the main channel. The AUPC feature works with the ASYNC option to allow remote communication between a local modem and a remote modem.

Refer to Figure A-1 for a modem block diagram with the ASYNC/AUPC interface option.

EIA-422, or V.35 interfaces are available for terrestrial data input and output. These interfaces can be selected via the front panel.

EIA-485 or EIA-232 interfaces are available for ASYNC channel input and output. These interfaces can also be selected from the front panel. Fixed 1/15 overhead is added to the data when an ASYNC channel is being used. With the ASYNC channel enabled, the terrestrial data rate can be from 8 to 2048 kbit/s. The ASYNC channel I/O protocol can be as follows:

Baud	110 to 38400
Data Bits	5 to 8
Parity	odd, even, or none
Stop Bits	1 or 2

Note: Certain combinations of baud rate, data rate, parity, and stop bits will limit the maximum baud rate allowed for continuous throughput based on terrestrial data rate.

ASYNC overhead is a 1/15 rate overhead channel composed of the following:

- AUPC information (if installed)
- EIA-232 or EIA-485 data
- Framing information
- Parity bits
- Valid data flags

The rate of asynchronous data transfers may be selected by the operator, with the maximum rate available limited to 1.875% of the synchronous data rate.

The ASYNC interface PCB also provides its own Doppler buffer, which has a maximum depth of 32 ms at the highest terrestrial data rate. Buffer fill status can be checked in the Monitor menu on the front panel of the modem. Depth selection and centering of the buffer are provided in the Configuration Interface menu.

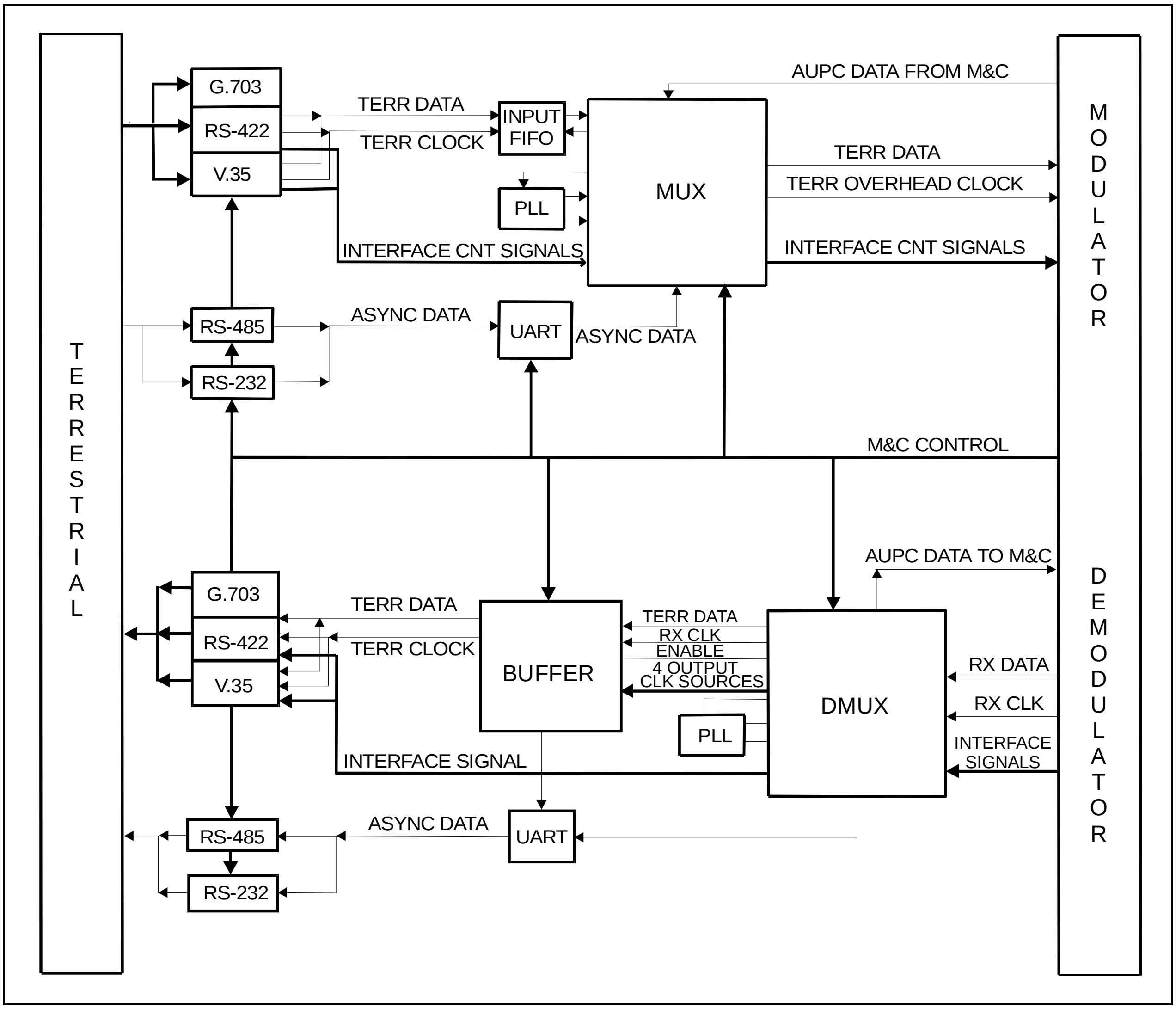
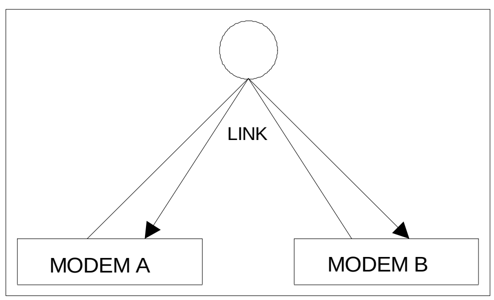


Figure A-1. ASYNC/AUPC Block Diagram

A.2.1.1 Local AUPC

The AUPC function allows each of two modems in a closed link to control the output of the other modem. Both modems must have the AUPC options enabled. These options are:

AUPC ENABLE	Enables the AUPC to function locally.
NOMINAL POWER	Output power level. Can be used for problem conditions, if chosen.
MINIMUM POWER	Sets minimum output power to be used.
MAXIMUM POWER	Sets maximum output power to be used.
TARGET NOISE	Desired E_b/N_0 of the local modem.
TRACKING RATE	Sets speed at which modems will adjust to output power.
LOCAL CL ACTION	Defines action that local modem will take if it loses carrier (Maximum, Minimum, or Hold).
REMOTE CL ACTION	Defines action that local modem will take if remote modem reports carrier loss (Maximum, Minimum, or Hold).



With AUPC enabled on both modems (A and B), if modem A loses carrier:

1. Modem A sets its output power (MAXIMUM, MINIMUM, OR HOLD) as specified by LOCAL CL ACTION.
2. Modem A then sends a “lost carrier” command to modem B.
3. Modem B sets its output power (MAXIMUM, MINIMUM, OR HOLD) as specified by REMOTE CL ACTION.
4. Once modem A has reacquired the carrier, it sends commands to modem B to achieve the desired E_b/N_0. During this time, modem B sends commands to modem A to increase or decrease power to maintain modem B’s target E_b/N_0.

Notes:

1. Local carrier loss always takes priority over remote carrier loss.
2. The RX AUPC link is dead when the carrier is lost.

A.2.1.1.1 Self-Monitoring Local Modem AUPC Control

Note: This feature is available with or without the overhead PCB installed. Self-monitoring AUPC is not used when the ASYNC/AUPC option is installed, because the ASYNC/AUPC feature uses the overhead channel to control the modem's output power.

The operator can allow the modulator to control its own transmit power when the earth station is in the same satellite footprint. The operator should tune the demodulator to receive its own signal, similar to a satellite loop.

Note: This option can be used for half-duplex operation and for one signal transmitting to many sites. For full-duplex operation, use a separate demodulator.

This option is located in the Utility/Modem Type/Local Modem AUPC menu. Proceed as follows:

1. Locate and enable the option.

2. Set all configuration parameters.

Notes:

1. EFData does not recommend increasing the power to the satellite without consulting with the satellite controller.
2. Be careful not to set carrier output to the high-side when there is a loss of carrier due to severe weather.
3. Do not use the distant end receive signal to compensate for local rain fade unless allowances are made for a narrow window for transmit level changes.
4. Changes in local weather will attribute to cause level unbalancing in the transmit signal. The transmit signal is attenuated due to heavy, dense, or cloud conditions.

A.2.1.2 Remote AUPC

This feature allows the user to monitor and control a remote modem location using the front panel or serial port of the local modem. The operator can set or reset the following commands:

- Baseband loopback
- TX 2047 pattern
- AUPC enable

The user can remotely monitor the receive 2047 BER. Refer to Appendix B for a description of remote operation.

A.2.1.3 Theory of Operation

A.2.1.3.1 Terrestrial Data Interfaces

Two I/O interfaces are provided for the terrestrial data source: EIA-422 and V.35. The operator must select the terrestrial interface type from the front panel under the Utility Interface menu. Once selected, I/O data is routed to and from the appropriate drivers and receivers.

A.2.1.3.2 ASYNC Data Interfaces

The EIA-485 and EIA-232 I/O interfaces are provided for the ASYNC data source. The operator must select the ASYNC data interface type from the front panel under the Utility Interface menu. Once selected, the I/O data is routed to and from the appropriate drivers and receivers.

A.2.1.3.3 Multiplexer Operation

The multiplexer receives terrestrial and ASYNC data from the selected receivers. The terrestrial data flows into a small First In/First Out (FIFO) buffer. The FIFO buffer aids in the rate exchange between the terrestrial data rate and the overhead rate. The data can be clocked into the multiplexer by the terrestrial clock or an internal clock.

ASYNC data is received by the receive section of a Universal Asynchronous Receiver/ Transmitter (UART) programmed by the M&C for the correct data protocol. The incoming ASYNC data is sampled with a 16x clock in the middle of the bit time.

AUPC data is received from a serial M&C interface. The overhead clock is generated from the terrestrial data clock by a phase-locked loop. Inside the multiplexer, overhead bits (1/16) are added to create a sub-frame, frame, and multi-frame structure. The AUPC data from the M&C interface and the ASYNC data are inserted into the framing structure. The framed data is output to the modulator card on the modem at the overhead rate.

A.2.1.3.4 Demultiplexer Operation

The demultiplexer section functions in a “reverse” manner to the multiplexer side. Data, including overhead, is received from the demodulator card in the modem at the overhead rate.

The demultiplexer locates the framing in the overhead and locks to the frame sync pattern generated by the multiplexer on the transmitting end. Once locked to the framing, the terrestrial data is clocked into the Doppler buffer with the overhead clock and an enable line.

The ASYNC channel data is stripped out of the frame structure, and is buffered in the transmit portion of a UART. The UART then transmits the data with the selected protocol to the appropriate drivers to the end user. The AUPC data is also stripped from the frame structure and is sent to the M&C via a serial interface.

A.2.1.3.5 Buffer Operation

The buffer has two serial interfaces to the M&C interface. The first serial interface is used to download the desired buffer size. The second serial interface is used to provide the M&C with the information necessary to calculate the fill status of the buffer. Three discrete lines are provided:

- One line to center the buffer on command.
- Two lines to indicate either an overflow or underflow condition.

The Doppler buffer receives data clocked by the overhead clock from the demodulator and an enable line from the demultiplexer. The data is stored in RAM. Four options are allowed to clock the data out of the buffer:

- External
- Internal
- Receive
- Transmit

Based on this selection, terrestrial data is clocked out of the buffer to the selected drivers and on to the end user.

A.2.1.3.6 Loop Timing Operation

A loop timing option is provided. When loop timing is selected, the Doppler buffer output clock is forced to the receive clock by the M&C. An M&C-controlled multiplexer switches the Send Timing (ST) pin to output the receive clock. The receive clock is sent out the ST pin to the appropriate interface drivers and on to the user. The operator is left with the option of clocking terrestrial data into the multiplexer on the transmit side with either the external clock source Terminal Timing (TT) or the internal clock source. The internal clock source is the same as the ST pin.

A.2.1.3.7 Baseband Loopback Operation

A baseband loopback option is provided. When selected, the input terrestrial data and clock from the operator are looped back to the user as the output terrestrial data and clock.

The terrestrial data and clock output from the demultiplexer are also looped to the terrestrial data and clock input at the multiplexer.

A.2.1.3.8 Non-ASYNC Operation

The ASYNC interface has pass-through capability. If ASYNC is turned off in the Configuration Interface menu, then a standard EIA-422, or V.35 interface is selected. The modem will operate as a standard, EIA-422, or V.35 interface with no overhead. Instead of changing jumpers on the interface PCB to change polarities for various signals, polarity inversion is available in the Utility Interface menu for the following signals:

- Data Mode (DM)
- Monitor and Control (MC)
- Receive Data (RD)
- Receive Timing (RT)
- Receiver Ready (RR)
- Request to Send (RS)
- Send Data (SD)
- Send Timing (ST)
- Terminal Timing (TT)

A.2.1.3.9 ASYNC Channel EIA-485 Operation

The ASYNC interface is compatible with a 2- wire interface for the EIA-485 channel. The 2-wire operation is selected via the front panel. In the 2-wire mode, the EIA-485 receivers are disabled whenever the data is to be transmitted down the 2-wire interface.

A.2.1.3.10 Valid ASYNC Baud Rates

The ASYNC baud rates are limited by the terrestrial data rates. The following table shows the relationships between data and baud rates.

If DR ≤ 15.999K	Maximum baud rate is 150
If DR ≤ 31.999K	Maximum baud rate is 300
If DR ≤ 63.999K	Maximum baud rate is 600
If DR ≤ 127.999K	Maximum baud rate is 1200
If DR ≤ 255.999K	Maximum baud rate is 2400
If DR ≤ 511.999K	Maximum baud rate is 4800
If DR ≤ 1023.999K	Maximum baud rate is 9600
If DR ≤ 2047.999K	Maximum baud rate is 19200
If DR ≤ 2048.999K	Maximum baud rate is 38400

The following table lists examples.

If DR = 8.000K	Baud rate can be 150 or lower
If DR = 16.000K	Baud rate can be 300 or lower
If DR = 32.000K	Baud rate can be 600 or lower
If DR = 64.000K	Baud rate can be 1200 or lower
If DR = 128.000K	Baud rate can be 2400 or lower
If DR = 256.000K	Baud rate can be 4800 or lower
If DR = 512.000K	Baud rate can be 9600 or lower
If DR = 1024.000K	Baud rate can be 19200 or lower
If DR = 2048.000K	Baud rate can be 38400 or lower

A.2.1.4 Front Panel Operation

For information on the additional front panel operations that are specific to the ASYNC interface, refer to Chapter 4. The following menus are affected:

- Configuration Interface
- Configuration Local AUPC
- Remote AUPC Configuration
- Remote AUPC Monitor
- Utility Interface

A.2.1.5 ASYNC Remote Operation

Remote modems can be controlled over the ASYNC channel from the local (or "hub") modem. Refer to Table A-2 for a list of combinations:

Table A-2. ASYNC Remote Operation

Configuration #	Local Modem	To Remote Modem	Table #
1	EIA-232	EIA-232	Table A-3
2	EIA-232	EIA-485 (2-wire)	Table A-4
3	EIA-485 (2-wire)	EIA-232	Table A-5

For each of the above combinations, front panel control settings and pinouts for local and remote cables are listed in the following sections.

Before remote ASYNC communications can be implemented, the following must occur:

- At both the local and remote modems, front panel configuration parameters must be set for each type of configuration.
- Industry-standard cables must be used at both modems.

To implement remote ASYNC operation, use the configuration information found in the applicable section and perform the following steps:

1. Set the jumpers on the remote modem M&C/Display PCB according to the information found in the applicable configuration section.
2. Set the local modem front panel controls according to the information found in the applicable configuration section.
3. Connect the local modem 25-pin ASYNC connection (via breakout panel or Y cable) to the terminal using the pinout information found in the applicable configuration section. Refer to Figure A-2.
4. Set the remote modem front panel controls according to the information found in the applicable configuration section.
5. Connect the remote modem 25-pin ASYNC connection (via breakout panel or Y cable) to the 9-pin J6 port at the rear of the modem using the pinout information found in the applicable configuration section. Refer to Figure A-3.

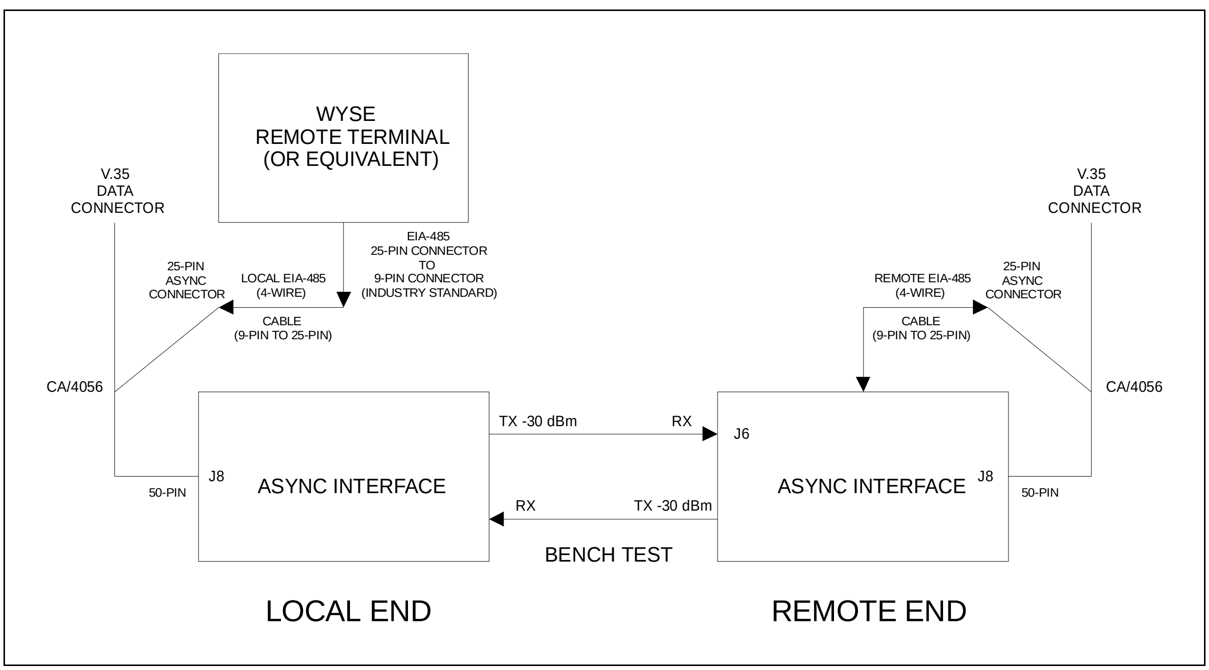


Figure A-2. Remote ASYNC Connection Diagram for Y Cable

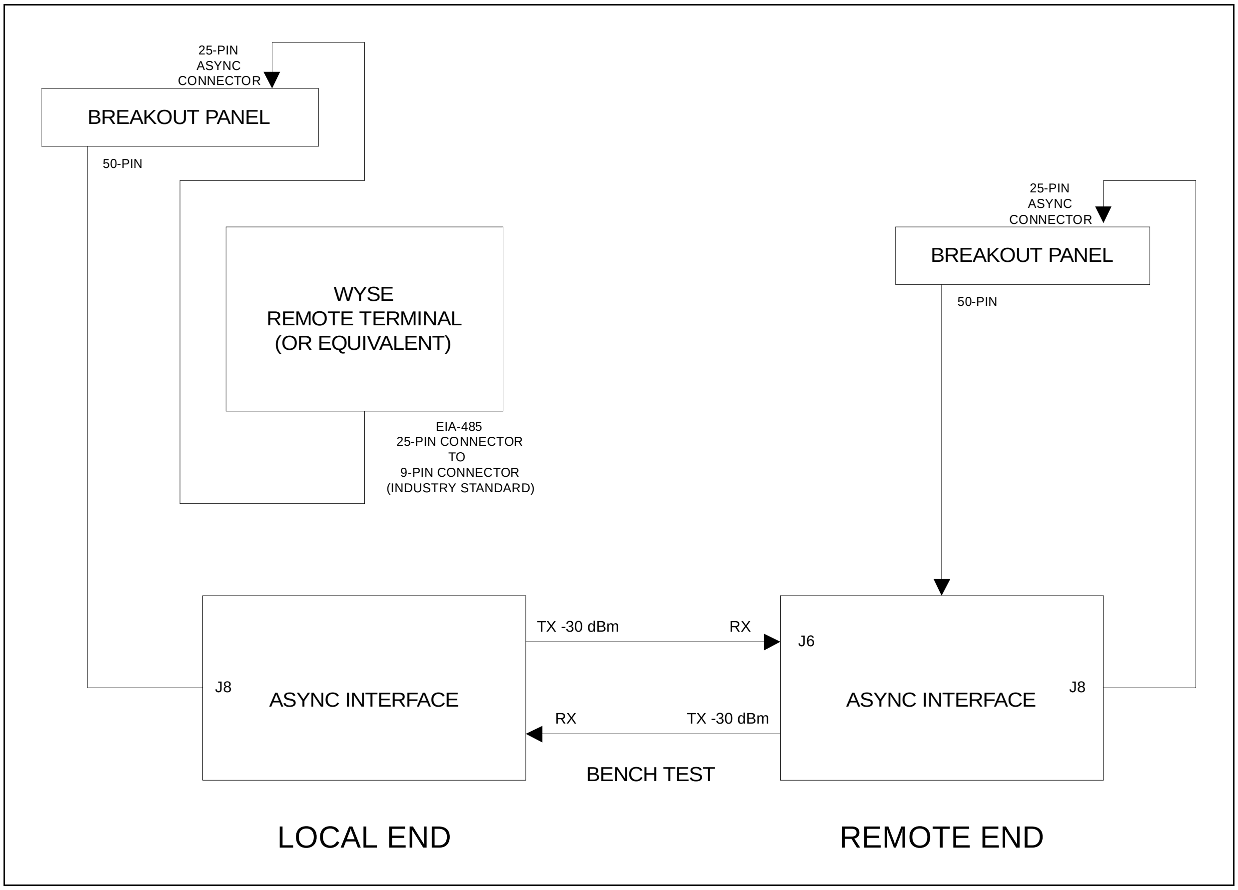


Figure A-3. Remote ASYNC Connection Diagram for Breakout Panel

A.2.1.5.1 Configuration #1 (Local EIA-232 to Remote EIA-232)

Table A-3. Local EIA-232 to Remote EIA-232

#1. Local End Modem Settings for EIA-232	
Utility Interface Menu	
ASYNC TX and RX Type	EIA-232
Configuration Interface Menu	
ASYNC TX and RX Baud Rate	150 to 38400 *(See A.1.4.3.10)*
ASYNC TX and RX Length	7 bits
ASYNC TX and RX Parity	Even
ASYNC TX Stop	2 bits
#1. Remote End Modem Settings for EIA-232	
Utility Interface Menu	
ASYNC TX and RX Type	EIA-232
Configuration Interface Menu	
ASYNC TX and RX Baud Rate	150 to 38400 *(See A.1.4.3.10)*
ASYNC TX and RX Length	7 bits
ASYNC TX and RX Parity	Even
ASYNC TX Stop	2 bits
Utility System Menu	
Remote Baud Rate	Equal to ASYNC TX and RX baud rate
Parity	Even
Address	1 to 255

The local end cable connects the 25-pin female ASYNC connector (on either the breakout panel or the Y cable) to the EIA-232 remote terminal (WYSE or laptop computer). The pinout of the local cable is listed in the following table.

#1. Local End EIA-232			
9-Pin Female Connector		25-Pin Male Connector	
RX	2	3	TX
TX	3	2	RX
GND	5	7	GND

The remote end cable connects the 25-pin female ASYNC connector (on either the breakout panel or the Y cable) to the 9-pin female connector, J6, at the rear of the modem. The pinout of the remote cable is listed in the following table.

#1. Remote End EIA-232			
9-Pin Male Connector		25-Pin Male Connector	
RX	2	2	RX
TX	3	3	TX
GND	5	7	GND

A.2.1.5.2 Configuration #2 (Local EIA-232 to Remote EIA-485 [2-Wire])

Table A-4. Local EIA-232 to Remote EIA-485 (2-Wire)

#3. Local End Modem Settings for EIA-232	
Utility Interface Menu	
ASYNC TX and RX Type	EIA-232
Configuration Interface Menu	
ASYNC TX and RX Baud Rate	150 to 38400 *(See A.1.4.3.10)*
ASYNC TX and RX Length	7 bits
ASYNC TX and RX Parity	Even
ASYNC TX Stop	2 bits
#3. Remote End Modem Settings for EIA-485 (2-Wire)	
Utility Interface Menu	
ASYNC TX and RX Type	EIA-485 (2-wire)
Configuration Interface Menu	
ASYNC TX and RX Baud Rate	150 to 38400 *(See A.1.4.3.10)*
ASYNC TX and RX Length	7 bits
ASYNC TX and RX Parity	Even
ASYNC TX Stop	2 bits
Utility System Menu	
Remote Baud Rate	Equal to ASYNC TX and RX baud rate
Parity	Even
Address	1 to 255

The local end cable connects the 25-pin female ASYNC connector (on either the breakout panel or the Y cable) to the EIA-232 remote terminal (WYSE or laptop computer). The pinout of the local cable is listed in the following table.

#3. Local End EIA-232			
9-Pin Female Connector		**25-Pin Male Connector**	
RX	2	3	TX
TX	3	2	RX
GND	5	7	GND

The remote end cable connects the 25-pin female ASYNC connector (on either the breakout panel or the Y cable) to the 9-pin female connector, J6, at the rear of the modem. The pinout of the remote cable is listed in the following table.

#3. Remote End EIA-485 (2-Wire)			
9-Pin Male Connector		**25-Pin Male Connector**	
TX/RX+	4	14, 16	TX+, RX+
TX/RX-	5	2, 3	TX-, RX-

A.2.1.5.3 Configuration #3 (Local EIA-485 [2-Wire] to Remote EIA-232)

Table A-5. Local EIA-485 (2-Wire) to Remote EIA-232

#7. Local End Modem Settings for EIA-485 (2-Wire)	
Utility Interface Menu	
ASYNC TX and RX Type	EIA-485 (2-wire)
Configuration Interface Menu	
ASYNC TX and RX Baud Rate	150 to 38400 (*See A.1.4.3.10)*
ASYNC TX and RX Length	7 bits
ASYNC TX and RX Parity	Even
ASYNC TX Stop	2 bits
#7. Remote End Modem Settings for EIA-232	
Utility Interface Menu	
ASYNC TX and RX Type	EIA-232
Configuration Interface Menu	
ASYNC TX and RX Baud Rate	150 to 38400 (*See A.1.4.3.10)*
ASYNC TX and RX Length	7 bits
ASYNC TX and RX Parity	Even
ASYNC TX Stop	2 bits
Utility System Menu	
Remote Baud Rate	Equal to ASYNC TX and RX baud rate
Parity	Even
Address	1 to 255

The local end cable connects the 25-pin female ASYNC connector (on either the breakout panel or the Y cable) to the EIA-485 (2-wire) remote terminal (WYSE or laptop computer). The pinout of the local cable is listed in the following table.

#7. Local End EIA-485 (2-Wire)			
9-Pin Female Connector		25-Pin Male Connector	
TX/RX+	4	14, 16	TX+/RX+
TX/RX-	5	2, 3	TX-/RX-

In addition, the following table lists the pinout for the WYSE terminal cable using an EIA-232 to EIA-485 converter.

#7. Local End WYSE Cable With Converter			
25-Pin Male Connector		9-Pin Male Connector	
TX-/RX-	2, 5	5	TX/RX-
TX+/RX+	14, 17	4	TX/RX+
(See Note)	18, 21		

Note: Disables RD during TD.

The remote end cable connects the 25-pin female ASYNC connector (on either the breakout panel or the Y cable) to the 9-pin female connector, J6, at the rear of the modem. The pinout of the remote cable is listed in the following table.

#7. Remote End EIA-232			
9-Pin Male Connector		25-Pin Male Connector	
RX	2	2	RX
TX	3	3	TX
GND	5	7	GND

A.2.1.6 ASYNC/AUPC Modem Defaults

Refer to Table A-6 for ASYNC/AUPC modem defaults.

Table A-6. ASYNC/AUPC Modem Defaults

Modulator		Demodulator	
Data Rate	A	Data Rate	A
TX Rate A	64 kbit/s, QPSK 1/2	RX Rate A	64 kbit/s, QPSK 1/2
TX Rate B	256 kbit/s, QPSK 1/2	RX Rate B	256 kbit/s, QPSK 1/2
TX Rate C	768 kbit/s, QPSK 1/2	RX Rate C	768 kbit/s, QPSK 1/2
TX Rate D	2048 kbit/s, QPSK 1/2	RX Rate D	2048 kbit/s, QPSK 1/2
TX Rate V	128 kbit/s, QPSK 1/2	RX Rate V	128 kbit/s, QPSK 1/2
IF Frequency	70 MHz	IF Frequency	70 MHz
IF Output	OFF	Descrambler	ON
TX Power Level	+0 dBm	Differential Decoder	ON
Scrambler	ON	RF Loop Back	OFF
Differential Encoder	ON	IF Loop Back	OFF
CW Mode	Normal (OFF)	BER Threshold	NONE
RS Encoder	OFF	Sweep Center Freq.	0 Hz
Modulator Type	EFD Closed	Sweep Range	60000 Hz
Encoder Type	Viterbi	Sweep Reacquisition	0 seconds
Mod Spectrum	Normal	RS Decoder	OFF
Mod Power Fixed	0 dB	Demodulator Type	EFD Closed
		Decoder Type	Viterbi
		Demod Spectrum	Normal
Interface			
TX Clock Source	TX Terrestrial	Frame Structure E1 Data	G.704
Buffer Clock Source	RX Satellite	Frame Structure T2 Data	G.743
TX Clock Phase	Auto	Frame Structure E2 Data	G.742
RX Clock Phase	Normal	TX Terr Interface	G.703
EXT-REF Frequency	1544.000 kHz	RX Terr Interface	G.703
Baseband Loopback	OFF	TX Data Phase	Normal
Interface Loopback	OFF	RX Data Phase	Normal
Loop Timing	OFF	Async TX Baud	110 bps
TX Data/AIS Fault	NONE	Async RX Baud	110 bps
RX Data/AIS Fault	NONE	Async TX Length	7 Bits
TX 2047 Pattern	OFF	Async RX Length	7 Bits
RX 2047 Pattern	OFF	Async TX Stop	2 Bits
TX Coding Format	AMI	Async RX Stop	2 Bits
RX Coding Format	AMI	Async TX Parity	EVEN
Buffer Programming	Bits	Async RX Parity	EVEN
Buffer Size	384	TX Overhead Type	Async
Frame Structure T1 Data	G.704	RX Overhead Type	Async
Local AUPC			
AUPC ENABLE	OFF	Target Noise	6.0 dB
Nominal Power	+0.0 dBm	Tracking Rate	0.5 dB/MIN
Minimum Power	-20.0 dBm	Local CL Action	Hold
Maximum Power	+5 dBm	Remote CL Action	Hold

A.2.2 Decoder

A.2.2.1 Sequential Decoder

The sequential decoder is used in closed network applications, typically in Frequency Division Multiple Access (FDMA) satellite communications systems. The sequential decoder is a FAST option.

Refer to Figure A-4 for a block diagram of the sequential decoder.

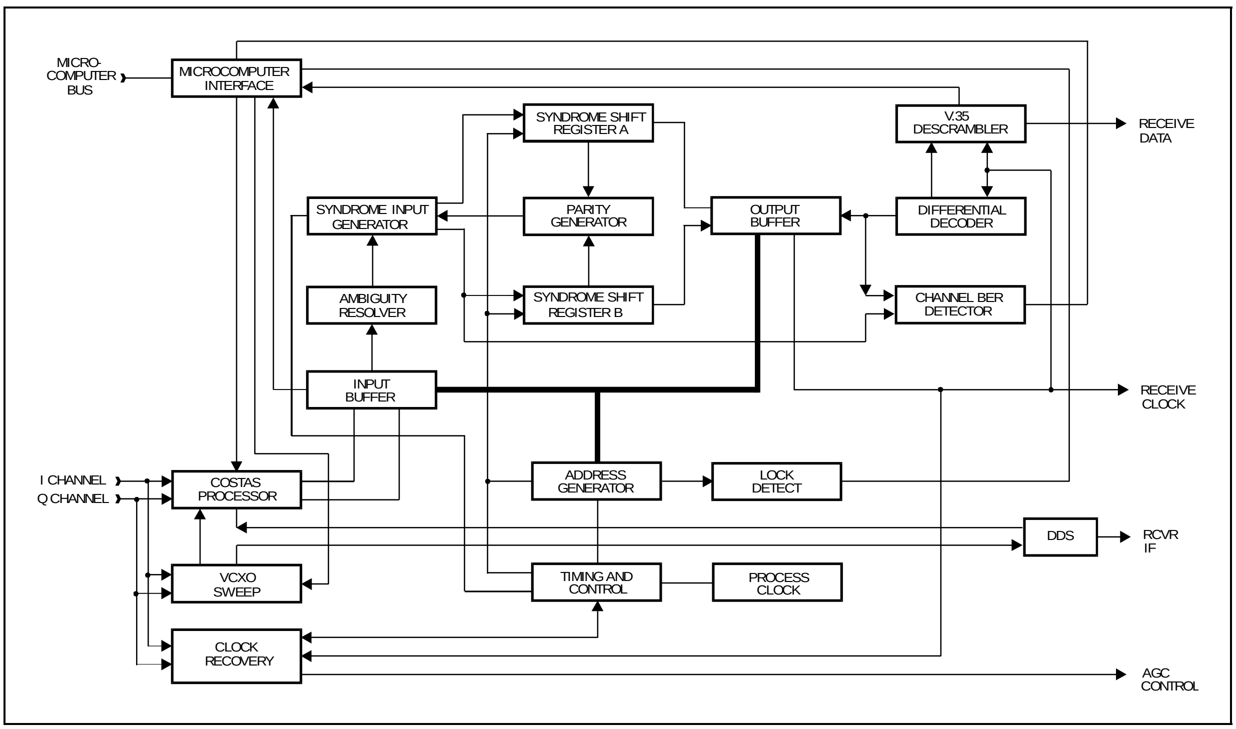


Figure A-4. Sequential Decoder Block Diagram

A.2.2.1.1 Theory of Operation

The sequential decoder also works in conjunction with the convolutional encoder at the transmitting modem to correct bit errors in the received data stream from the demodulator.

The sequential decoder processes 2-bit quantized I&Q channel data symbols from the demodulator. This data is assumed to be a representation of the data transmitted, corrupted by additive white Gaussian noise. The decoder's task is to determine which bits have been corrupted by the transmission channel, and correct as many as possible. This is accomplished by the use of parity bits added by the encoder to the data stream before transmission.

The possible sequences of bits, including parity output by the encoder, are listed on a code tree. The decoder uses the parity bits and knowledge of the code tree to determine the most likely correct sequence of data bits for a given received sequence.

The search proceeds from a node in the code tree by choosing the branch with the highest metric value (highest probability of a match between the received data and a possible code sequence). The branch metrics are added to form the cumulative metric. As long as the cumulative metric increases at each node, the decoder assumes it is on the correct path, and continues forward. If the decoder makes a wrong decision, the cumulative metric will decrease rapidly as the error propagates through the taps of the parity generator. In this case, the decoder tries to back up through the data to the last node where the metric was increasing, then take the other branch.

In an environment with severe errors, the decoder will continue to search backwards for a path with an increasing metric until it either finds one, runs out of buffered data, or runs out of time and must deliver the next bit to the output.

The decoder processes data at a fixed rate, which is much higher than the symbol rate of the input data. This allows it to evaluate numerous paths in its search for the most likely one during each symbol time.

Data enters the input RAM of the decoder from the demod processor in 2-bit soft decision form for both I&Q channels, as shown in the block diagram (Figure 4-3). The input RAM buffers the data to provide history for the backward searches. Data from the RAM passes through the Ambiguity Corrector, which compensates for the potential 90° phase ambiguity of the demodulator.

The syndrome input generator converts the 2-bit soft decision data into a single bit per channel, and simultaneously corrects some isolated bit errors. The data is then shifted through the syndrome shift registers, which allows the parity generator to detect bit errors. The resulting error signal provides the feedback to the timing and control circuitry to allow it to direct the data along the path of the highest cumulative metric.

The corrected data is buffered through the output RAM and re-timing circuit, which provides a data stream to the differential decoder and descrambler at the constant rate of the data clock. The data and the clock are then output from the card.

The sequential decoder also provides a lock detect signal to the M&C when the error rate has dropped below a threshold level. The M&C monitors these signals and takes appropriate action.

The raw BER count is made by comparing the input and output decoder data. Because the output data contains many fewer errors than the input, differences in the two can be counted to yield the raw BER. The raw BER is sent to the M&C for further processing.

A.2.2.2 Viterbi Decoder

The Viterbi decoder operates in conjunction with the convolutional encoder at the transmit modem. The decoder uses a decoding algorithm to provide FEC on the received data stream for errors occurring in the transmission channel.

A block diagram of the Viterbi decoder is shown in Figure A-5.

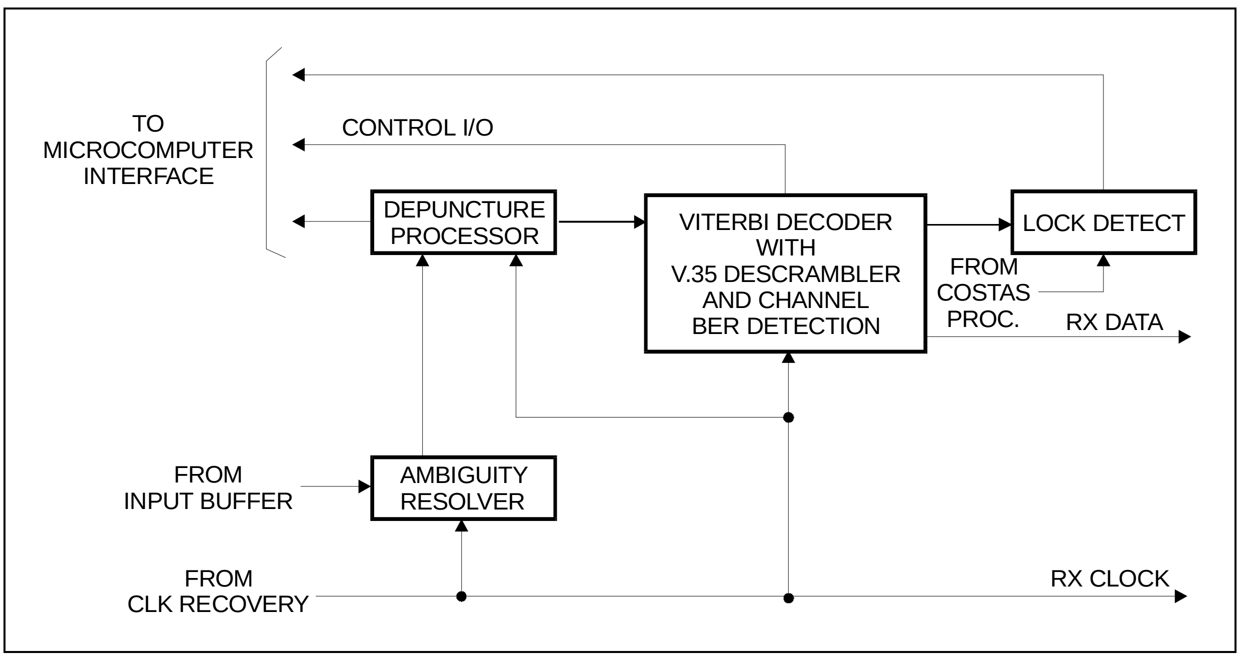


Figure A-5. Viterbi Decoder Block Diagram

A.2.2.2.1 Specifications

Refer to Table A-7 for Viterbi specification.

Table A-7. Viterbi Specification

Parameter	Specification
BER	See Chapter 2
Maximum Data Rate	2.50 Mbit/s (rate 1/2) 3.75 Mbit/s (rate 3/4) 4.375 Mbit/s (rate 7/8)
Synchronization Time	8000 bits (maximum)
Output Fault Indicators	Activity detection of I and Q data sign bits
Raw BER Detection	From 0 to 255 bits out of 1024 samples
Differential Decoding	2-phase or none
Constant Length	7

A.2.2.2.2 Theory of Operation

The Viterbi decoder processes 3-bit quantized R0 and R1 parallel code bits or symbols from the demodulator. The quantization is 3-bit soft-decision in sign/magnitude format. This data is a representation of the data transmitted, corrupted by additive white Gaussian noise. The task of the decoder is to determine which symbols have been corrupted by the transmission channel and correct as many errors as possible. The code symbols produced by the encoder provide the data for this task.

The seven functions used in processing the data stream are:

- Add-Select-Compare (ASC) computer processing
- Computing branch metric values
- Differential decoding
- Depuncturing
- Descrambling
- Memory storage
- Phase compensation with an ambiguity resolver

The data is first sent through an ambiguity resolver for compensating the potential 90° phase ambiguity inherent in a QPSK demodulator. The data is then de-punctured if the decoder is operating in the 3/4 or 7/8 rates. The de-puncture pattern is the same as the puncture pattern used in the encoder.

A set of branch metric values is then computed for each of the received symbol pairs. This is related to the probability that the received symbol pair was actually transmitted as one of the four possible symbol pairs.

The branch metrics are then processed by the ASC computer. The ASC computer makes decisions about the most probable transmitted symbol stream with the state metrics computed for the previous 64 decoder inputs.

The results of the ASC computer are stored in the path memory (80 states in depth). The path with the maximum metric is designated as the survivor path, and its data is used for output. The difference between the minimum and the maximum path metrics is used as the means of determining synchronization of the decoder.

The output data is then descrambled and differentially decoded. Both of these processes are optional, and may be selected by the user locally or remotely. The data from the differential decoder is sent to the interface PCB for formatting and output. The synchronization signal is used for lock-detect and sent to the M&C.

The raw BER count is generated from the minimum and maximum metrics and sent to the M&C for further processing. Refer to Chapter 2 for Viterbi decoder BER specifications.

A.2.2.3 Reed-Solomon Decoder

Refer to Section A.3, Reed-Solomon, for Reed-Solomon information.

A.2.3 Asymmetrical Loop Timing

Asymmetrical Loop Timing is the same timing method that is designed into the SDM-650B TROJAN interfaces. Refer to Figure A-6 and Figure A-7 for transmit and receive Asymmetrical Loop Timing block diagram. There are two advantages for using Asymmetrical Loop Timing:

- Versatility: The user can select different transmit and receive data rates, yet still clock the send data with the receive satellite clock.

- Fits easily into on site clocking schemes: The user may clock the send data with a clock that is not necessarily operating at the same rate as the data rate.

The send timing may only be referenced from an external clock source that is equal to the data rate in the basic modem.

The asymmetrical clock loop reference must be one of the following:

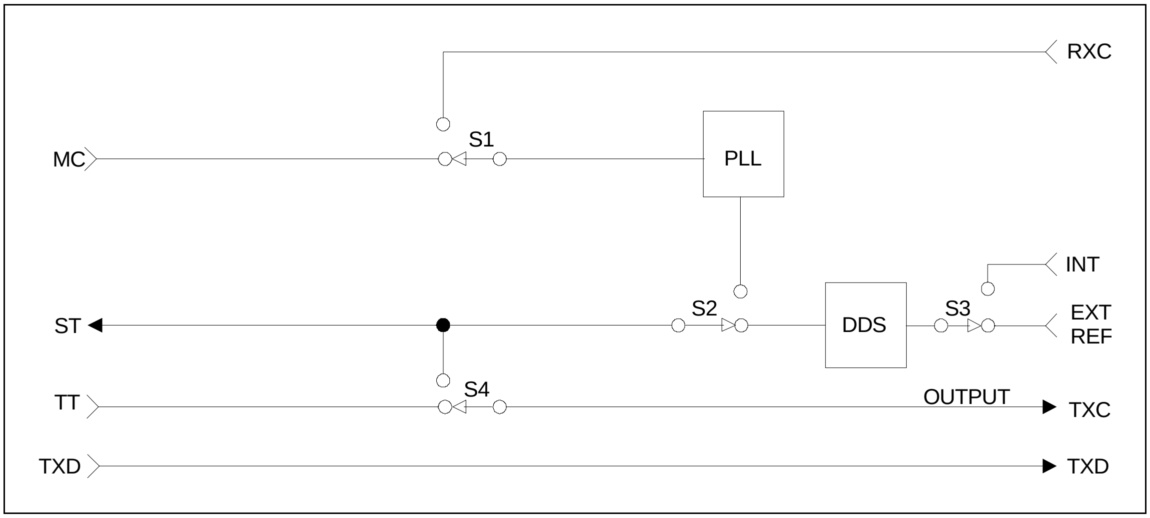
- Transmit terrestrial clock
- External clock input
- Receive clock input

Notes:

1. The clock inputs are as follows:
   a. $\geq$ 64 kHz shall be divisible by 8 kHz.
   b. $\geq$ 32 kHz but < 64 kHz shall be divisible by 600 Hz or 8 kHz.
   c. < 32 kHz shall be divisible by 600 Hz.

2. The transmit clock source can be the same at the receive digital data rate or EXT CLOCK if they are $\pm$ 100 PPM. This is provided on the basic unit, with or without the asymmetrical loop timing option.

The transmit data is normally clocked into the modem with the Terminal Timing (TT) clock in typical EIA-422 operation. The received data is clocked out with the Receive Timing (RT) clock. The asymmetrical loop timing option allows the transmit and receive data to be clocked with the same, or a multiple of the same clock. The added benefit is that the transmit and receive data rates do not have to be the same.

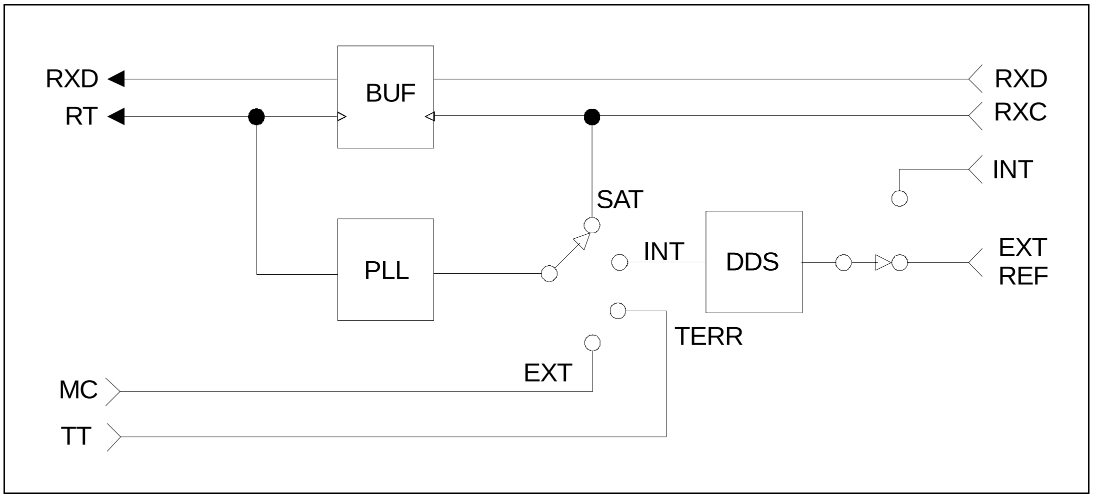


Clock Selection	S1 set to:	S2 set to:	S3 set to:	S4 set to:
TX TERR (TT)		DDS	INT	TT
INT (SCT)		DDS	INT	ST
SCT (INT)		DDS	EXT REF (See Note 2)	ST
SCT (LOOP)		DDS	EXT REF (See Note 2)	ST
INT (LOOP) (See Note 1)	RXC	PLL		ST
EXT CLOCK	MC	PLL		ST

Notes:

1. When CONFIGURATION INTERFACE → LOOP TIMING is set to ON, SCT (INT) will change to read: SCT (LOOP).
2. When CONFIGURATION MOD → MOD REF is set to EXT MOD, S3 will switch to the EXT REF position.

Figure A-6. Transmit Section of the Asymmetrical Loop Timing Block Diagram



Note: PLL will be bypassed when the receive data rate is set to the transmit data rate. This will disable the Asymmetrical Mode.

Figure A-7. Receive Section of the Asymmetrical Loop Timing Block Diagram

Example:

Master/Slave Clocking Setup:

1. Master site has a 10 MHz clock that is needed as the clock source.
2. Unequal data rates: 4.096 Mbit/s and 2.152 Mbit/s (numbers divisible by 8).

Master Site Option No. 1:

1. Set Configuration/Modulator/ Modem Reference to EXT 10 MHz.
2. Set Configuration/Interface/TX Clock Source to SCT (Internal).

Note: The SCT clock is slaved off the 10 MHz input. The 10 MHz reference should be placed into CP3 of the modem.

3. Set Configuration/Interface/ Buffer Clock to SCT (Internal).

Master Site Option No. 2:

1. Set Configuration/Modulator/Modem Reference to INTERNAL.
2. Set Configuration/Interface/EXT-CLK Frequency to 10 MHz to INTERNAL.
3. Set Configuration/Interface/TX Clock Source and Buffer Clock to EXT Clock.

Note: Input the 10 MHz clock at either the EXC (CP5) clock, unbalanced input of the SMS-7000 data switch module, or balanced pins 7 and 8 of the switch module, V3. This external clock input will go into the modem on pins 35 and 19 of the 50-pin connector, located at the rear of the modem.

Slave Site:

1. Set Configuration/Interface/Loop Timing to ON.
2. Set Configuration/Interface/TX Clock Source to SCT (LOOP)
   or
   TX Terrestrial, Only if the user equipment can provide the proper slaved clock to the modem.

Note: SCT Internal changes to loop when Loop Timing is set to ON.

3. Set Configuration/Interface/Buffer Clock to RX (“Satellite) “Buffer Bypass.”

A.3 Reed-Solomon Option

A.3.1 Reed-Solomon Codec

The modem must have the Reed-Solomon PCB installed to access this feature. The Reed-Solomon Codec PCB is a 4.75” x 6.00” (12.07 x 15.24 cm) daughter card that is located on the main PCB (Figure A-8).

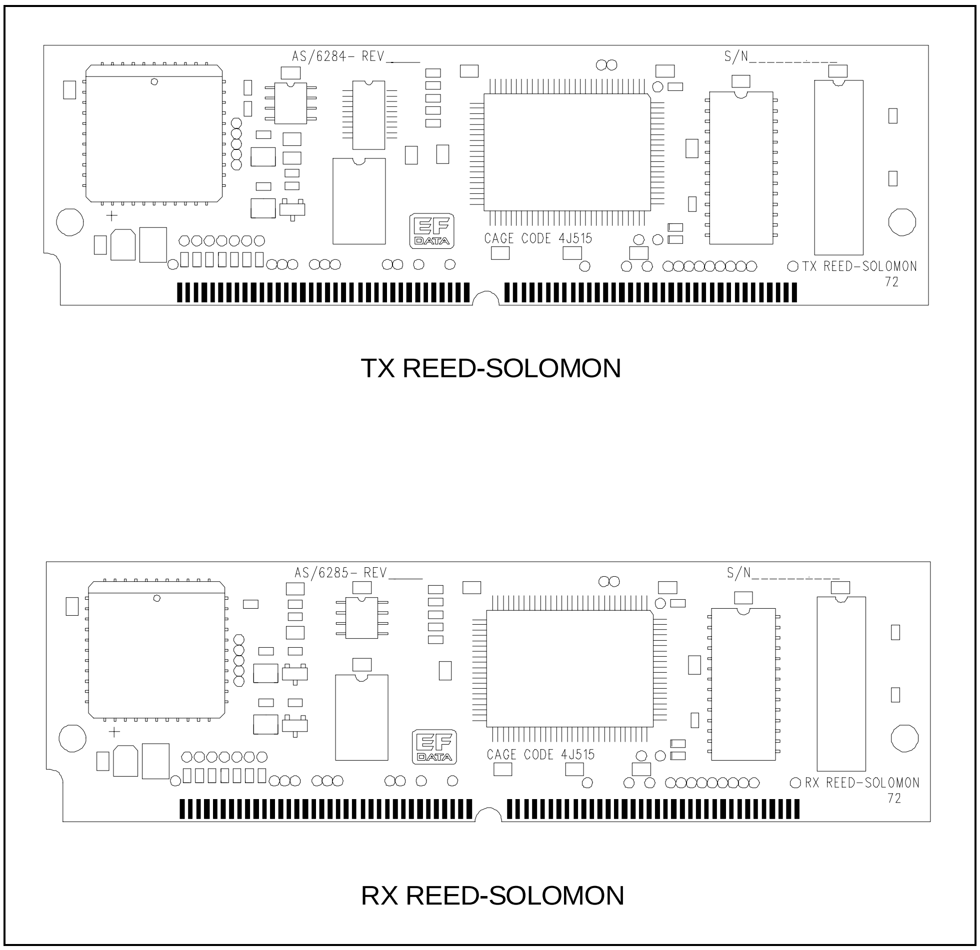


Figure A-8. Reed-Solomon PCB

The Reed-Solomon Codec works in conjunction with the Viterbi decoder and includes additional framing, interleaving, and Codec processing to provide concatenated FEC and convolutional encoding and decoding.

Refer to Figure A-9 for a block diagram of the Reed-Solomon Codec.

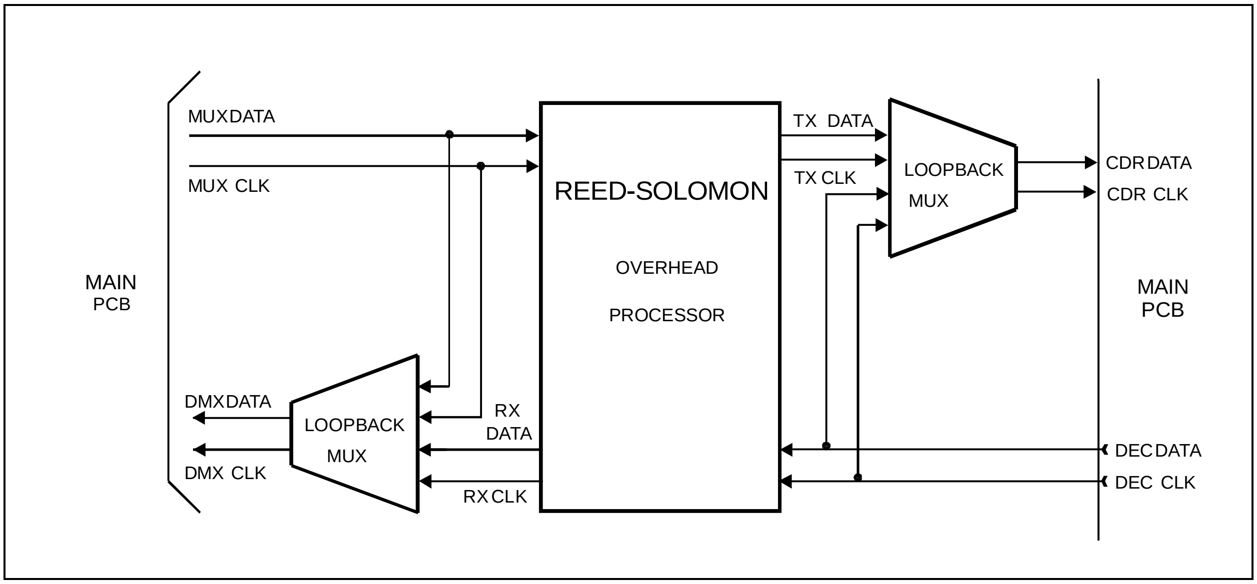


Figure A-9. Reed-Solomon Codec Block Diagram

A.3.1.1 Specifications

Refer to Table A-8 overhead types and data rates supported by the Reed-Solomon Codec option are listed below. Refer to Chapter 2 for BER specifications.

Table A-8. Specifications

Overhead Type	Data Rate
ASYNC	2.4 to 2048 kbit/s
No Overhead	2.4 to 4.555 kbit/s

A.3.1.2 Theory of Operation

The Reed-Solomon Codec works in conjunction with the interface card to provide concatenated convolutional encoding and decoding.

The two main sections of the Codec are:

- Reed-Solomon encoder (Section A.3.1.3)
- Reed-Solomon decoder (Section A.3.1.4)

A.3.1.3 Reed-Solomon Encoder

A block diagram of the Reed-Solomon encoder section is shown in Figure A-10.

The Reed-Solomon encoder section includes the following circuits:

- Parallel/Serial Converter
- RAM Interleaver
- Reed-Solomon Codec (encoder section)
- Serial/Parallel Converter
- Synchronous Scrambler

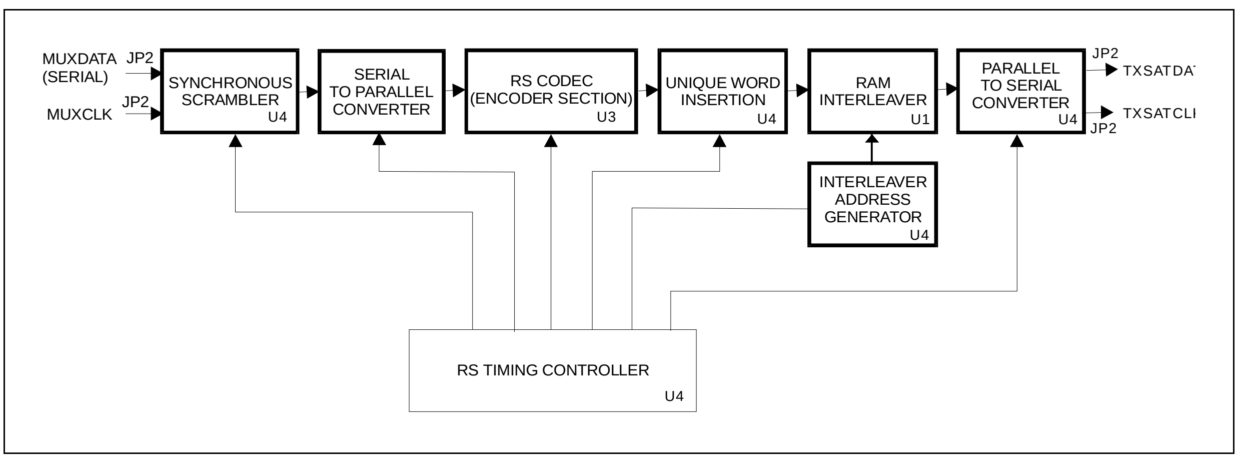


Figure A-10. Reed-Solomon Encoder Section Block Diagram

The data and clock signals (MUXDATA and MUXCLK) come from the multiplexer on the main PCB, and are sent to the Reed-Solomon encoder section. Since the data input to the Reed-Solomon encoder is serial, the data passes through a self-synchronizing serial scrambler, in accordance with INTELSAT-308 Rev. 6B specification.

The host software allows the scrambler to be turned on or off at the front panel as required by the user. If the scrambler is disabled, the data passes through the scrambler unaltered.

The data then passes through a serial/parallel converter, and on to a FIFO. The serial/parallel converter changes the data to an 8-bit word. A synchronous FIFO buffers the incoming data, because the rate is different than the encoded data rate. Once buffered by the FIFO, the data passes to the Reed-Solomon Codec.

Refer to Figure A-10 for the Reed-Solomon code page format. The Reed-Solomon outer Codec reads the data in blocks of k bytes, and calculates and appends check bytes to the end data block. The letter n represents the total number of bytes in a given block of data out of the Codec. The letter k represents the number of data bytes in a given block.

The term, $n - k = 2t$, is the total number of check bytes appended to the end of the data. This is referred to as the "Reed-Solomon overhead." The term's ***k, n***, and ***t*** will vary, depending on the Reed-Solomon coding used. The output data is passed to a block interleaver.

Since errors from the Viterbi decoder usually occur in bursts, a block interleaver with a depth of four is used in accordance with the INTELSAT-308 Rev. 6B specification. The interleaver has the effect of spreading out the errors across blocks of data instead of concentrating the errors in a single block of data. Since there are fewer errors in any given block, there is a greater chance that the Reed-Solomon decoder can correct the errors on the receiving end of the satellite link. To allow the decoder to synchronize to the data, four unique words are inserted in the last two bytes of the last two pages at the end of each page of data (refer to Figure A-11).

Once the data passes through the interleaver, it is fed through a parallel/serial converter and sent back to the interface PCB. After further processing by the interface PCB, the data is sent to the modulator PCB.

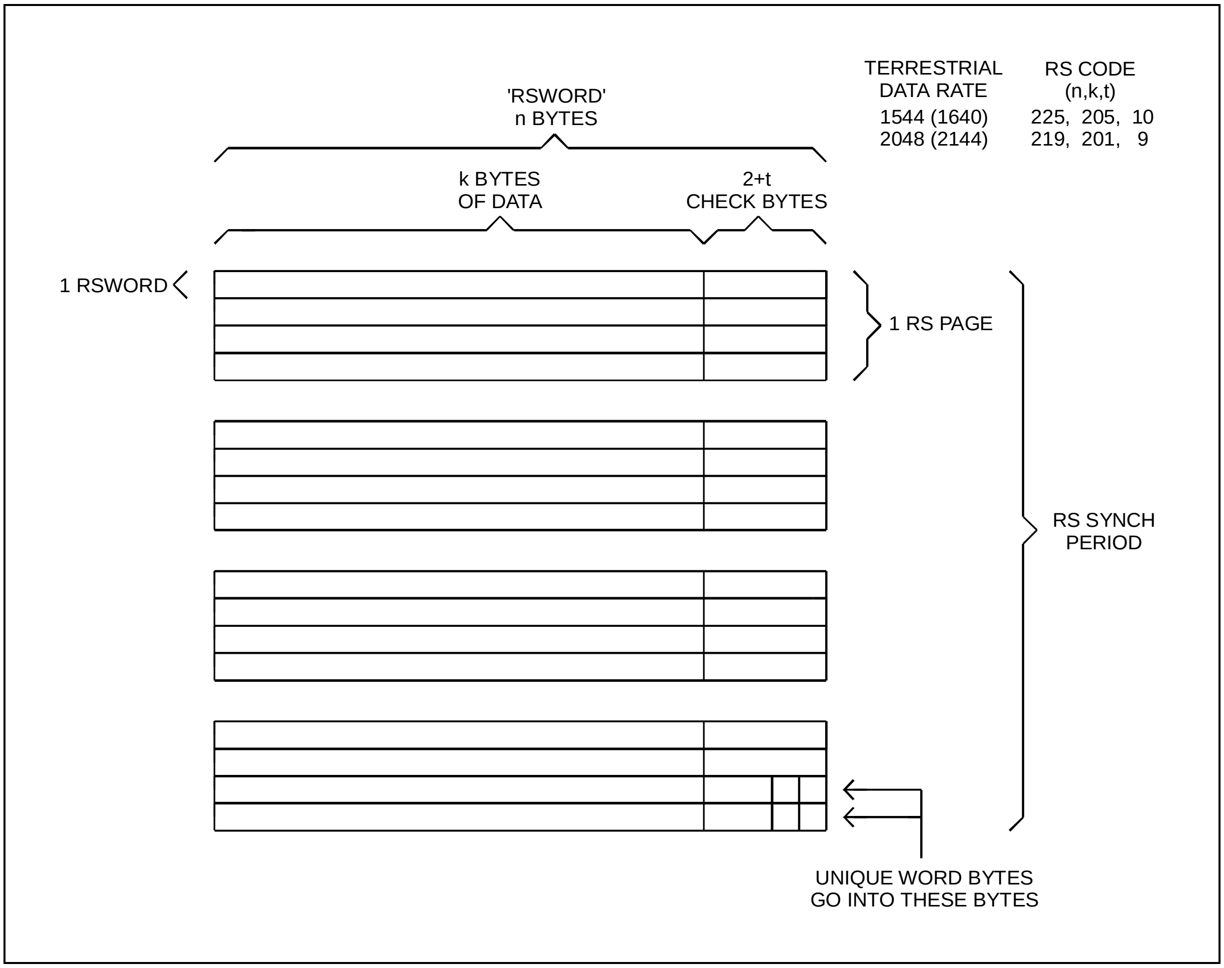


Figure A-11. Reed-Solomon Code Page Format

A.3.1.4 Reed-Solomon Decoder

Refer to Figure A-12 for a block diagram of the Reed-Solomon decoder section.

The Reed-Solomon decoder section includes the following circuits:

- Parallel/Serial Converter
- RAM Deinterleaver
- Reed-Solomon Codec (decoder section)
- Serial/Parallel Converter
- Synchronous Descrambler

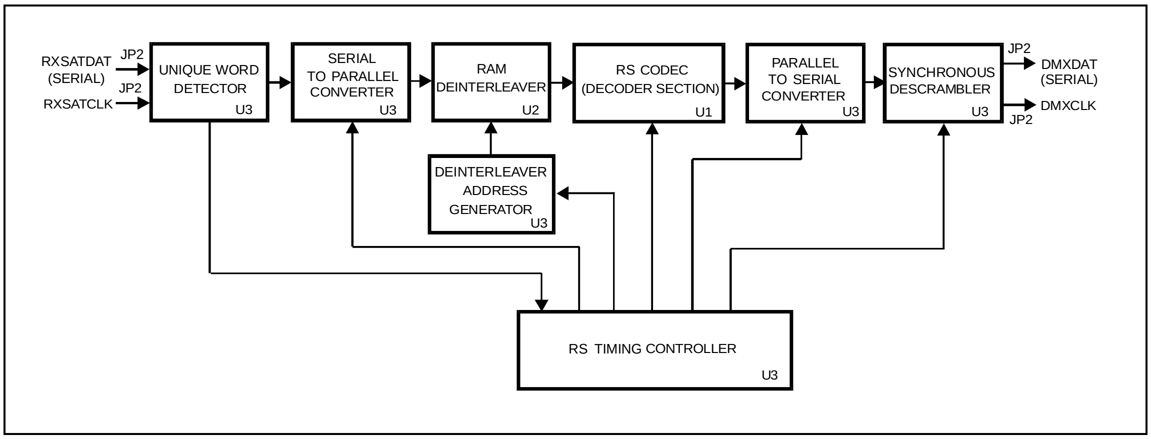


Figure A-12. Reed-Solomon Decoder Section Block Diagram

The data and clock signals come from the demultiplexer on the interface PCB, and are sent to the Reed-Solomon decoder section.

The data is sent through a serial/parallel converter. Because it was block interleaved by the encoder, the data must pass through a de-interleaver with the same depth as the interleaver used on the encoder. The de-interleaver is synchronized by the detection of the unique words, which are placed at the end of each page by the interleaver on the encoder.

Once the de-interleaver is synchronized to the incoming data, the data is reassembled into its original sequence, in accordance with the INTELSAT-308 Rev. 6B specification. The data is then sent to the Reed-Solomon outer decoder.

Refer to Figure A-11 for the Reed-Solomon code page format. The outer Codec reads the data in blocks of ***n*** bytes and recalculates the check bytes that were appended by the encoder. If the recalculated data bytes do not match the check bytes received, the Codec makes the necessary corrections to the data within the data block. The letter n represents the total number of bytes in a given block of data out of the Codec. The letter k represents the number of data bytes in a given block.

The term ***n - k = 2t*** is the total number of check bytes appended to the end of the data. The term’s ***k, n,*** and ***t*** will vary depending on the Reed-Solomon coding used. The Codec then sends the corrected data to a FIFO.

Because the check bytes are not part of the real data, a synchronous FIFO is used to buffer the data and strip the check bytes out of the blocks of data. The data then passes through a parallel converter to be serialized.

The data is sent through a self-synchronizing serial descrambler in accordance with the INTELSAT-308 Rev. 6B specification. The descrambler converts the data back into the original data that the user intended to send. The synchronous descrambler is synchronized by the detection of the unique word at the end of each Reed-Solomon page. The data is then sent to the interface PCB for further processing.

A.3.1.5 Reed-Solomon Specifications (Optional)

Refer to Table A-9 for Reed-Solomon optional specifications.

Table A-9. Reed-Solomon Specifications Optional

Overhead Type	Data Rate
ASYNC	2.4 to 2048 kbit/s
No Overhead	2.4 to 3.986 kbit/s

A.3.1.6 Unpacking

CAUTION

This equipment contains parts and assemblies sensitive to damage by ESD. Use ESD precautionary procedures when touching, removing, or inserting PCBs.

1. Remove the Reed-Solomon PCB and mounting hardware from the cardboard caddypack and anti-static material.

2. Check the packing list to ensure the shipment is complete.

3. Inspect the Reed-Solomon PCB for any shipping damage.

A.3.1.7 Installation

The following tool is required to install the overhead interface PCB:

Description	Application
Phillips ™ Screwdriver	To remove and replace cross-point screws.

Use the following information to install the Reed-Solomon Codec PCB as a daughter card on the main PCB.

Refer to Figure A-13 for installation location of the Reed-Solomon daughter card.

CAUTION

Turn the power off before installation. High current VDC is present. Failure to do so could result in damage to modem components.

1. Turn off the modem and unplug the power supply.

2. Remove the rear panel retaining screws. Using the finger pulls, slide the main modem assembly out from the rear of the modem chassis.

3. Install the Reed-Solomon PCB to the main PCB by mating the male simm connectors with the female simm connectors in the position shown in Figure A-13.

4. After completing the above installation procedure, turn on the modem. If the Reed-Solomon PCB was installed properly, the Utility Interface/Interface Module menu will display “OPT:Reed-Solomon” Refer to Chapter 4 for more information.

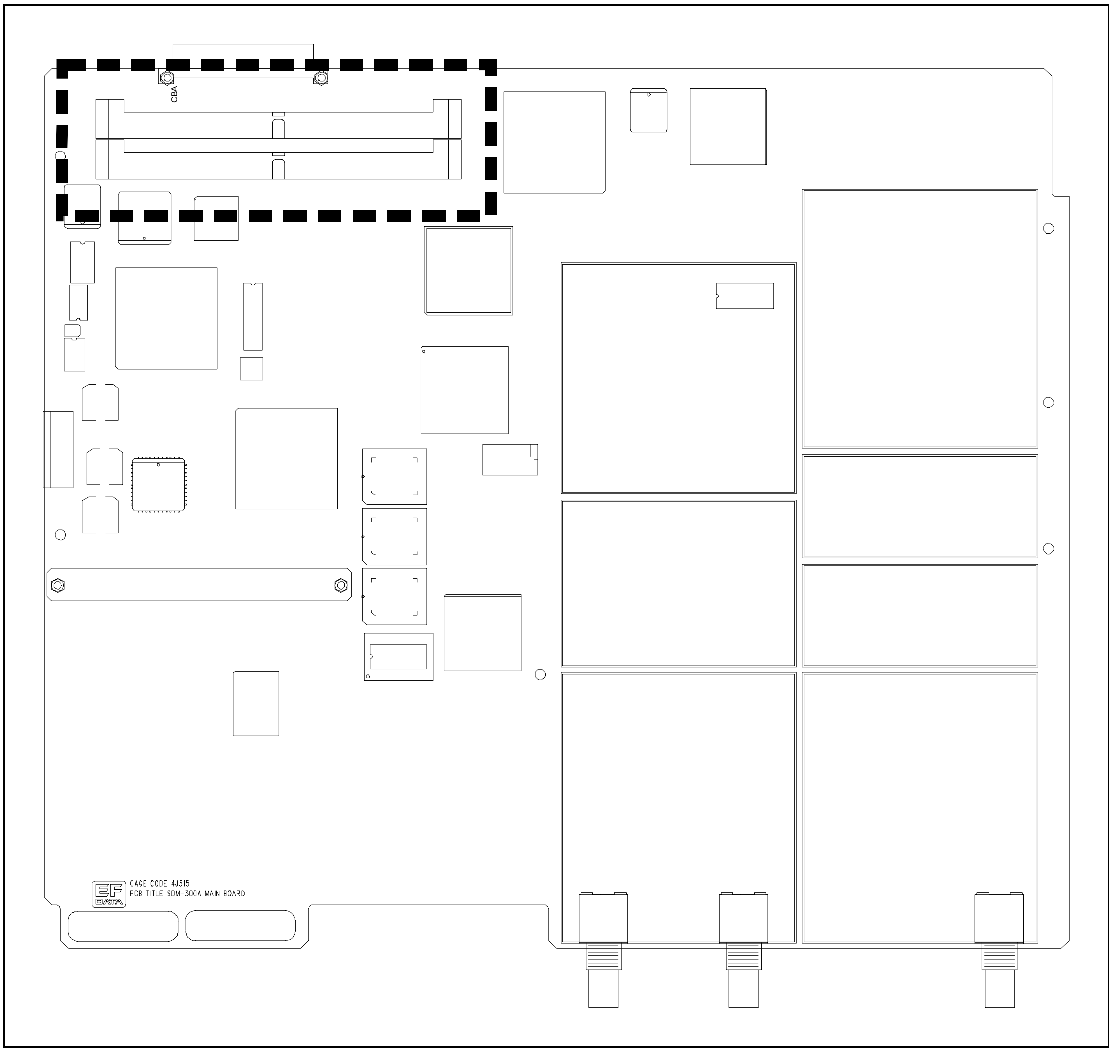


Figure A-13. Reed-Solomon Codec Installation

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Appendix B. REMOTE CONTROL OPERATION

This appendix describes the remote control operation of the C5 Satellite Terminal System.

- Firmware number: FW/7414-1-
- Software version: 1.1.1

B.1 General

Remote controls and status information are transferred via an EIA-485 (optional EIA-232C) serial communications link.

Commands and data are transferred on the remote control communications link as US ASCII-encoded character strings.

The remote communications link is operated in a half-duplex mode.

Communications on the remote link are initiated by a remote controller or terminal. The modem never transmits data on the link unless it is commanded to do so.

B.2 Message Structure

The ASCII character format used requires 11 bits/character:

- 1 start bit
- 7 information bits (or 8 Information bits) with 1 parity bit (odd/even) or
- 8 information bits with no parity bits
- 2 stop bits

Messages on the remote link fall into the categories of commands and responses.

Commands are messages, which are transmitted to a satellite modem, while responses are messages returned by a satellite modem in response to a command.

The general message structure is as follows:

- Start Character
- Device Address
- Command/Response
- End of Message Character

B.2.1 Remote Control

All terminal functions can be controlled remotely through the Remote connector on the rear panel.

Interface Types:

- EIA-485 (2- or 4-Wire)
- EIA-232
- Baud Rate Range (150 to 19.2 kbit/s)
- ASCII Characters
- 11 bits per character:

B.2.2 Monitored Signals

The operator can display/read one of the following, continually-updated performance monitors:

- Receive signal level -15 to -85 dBm, ± 5 dB for Symbol Rates > 190 ks/s
  -25 to -100 dBm, ± 5 dB for Symbol Rates ≤ 190 ks/s
- Raw BER
- Corrected BER
- Eb/N0, 0.1 dB resolution
- Receive frequency offset, 1 Hz resolution
- Sweep frequency
- Buffer fill status

B.2.3 Faults Monitored

Faults monitored by the terminal and the action taken at each occurrence of the fault is monitored.

B.2.4 Start Character

A single character precedes all messages transmitted on the remote link. This character flags the start of a message. This character is:

- "<" for commands
- ">" for responses

B.2.5 Device Address

The device address is the address of the one satellite modem which is designated to receive a transmitted command, or which is responding to a command.

Valid device addresses are 1 to 3 characters long, and in the range of 1 to 255.

Note: Address 0 is reserved as a global address which simultaneously addresses all devices on a given communications link. Devices do not acknowledge global commands.

Each satellite modem, which is connected to a common remote communications link must be, assigned its own unique address. Addresses are software selectable at the modem, and must be in the range of 1 to 255.

B.2.6 Command/Response

The command/response portion of the message contains a variable-length character sequence, which conveys command and response data.

If a satellite modem receives a message addressed to it, which does not match the established protocol or cannot be implemented, a negative acknowledgment message is sent in response. This message is:

- >add/?ER1_parity error'cr''lf']
  (Error message for received parity errors.)
- >add/?ER2_invalid parameter'cr''lf']
  (Error message for a recognized command, which cannot be implemented or has parameters, which are out of range.)
- >add/?ER3_unrecognizable command'cr''lf']
  (Error message for unrecognizable command or bad command syntax.)
- >add/?ER4_modem in local mode'cr''lf']
  (Modem in local error; send the REM command to go to remote mode.)
- >add/?ER5_hard coded parameter'cr''lf']
  (Error message indicating that the parameter is hardware dependent and may not be changed remotely.)

Note: “add” is used to indicate a valid 1 to 3 character device address in the range between 1 and 255.

B.2.7 End Character

Each message is ended with a single character, which signals the end of the message:

- “cr” Carriage return character for commands
- “]” End bracket for responses

B.3 Configuration Commands/Responses

B.3.1 Modulator

Modulator Frequency	 Command: Response: Status: Response: Command: Response: Status: Response:	C-Band: <add/MF_n.nnnnnnn'cr' >add/MF_n.nnnnnnn'cr' RF_OFF'cr''lf'] <add/MF_'cr' >add/MF_n.nnnnnnn'cr''lf'] Ku-Band: <add/MF_nn.nnnnnnn'cr' >add/MF_nn.nnnnnnn'cr' RF_OFF'cr''lf'] <add/MF_'cr' >add/MF_nn.nnnnnnn'cr''lf']	C-Band: Where: n.nnnnnnn = Frequency in GHz, 5.9250000 to 6.4250000 in 100 Hz steps. Ku-Band: Where: nn.nnnnnnn = Frequency in GHz, 14.0000000 to 14.5000000 in 100 Hz steps. Note: When the modulator frequency is programmed, the RF output is switched off.
RF Output (IF Output)	Command: Response: Status: Response:	<add/RF_xxx'cr' >add/RF_xxx'cr''lf'] <add/RF_'cr' >add/RF_xxx'cr''lf']	Where: xxx = ON or OFF. Note: If the user try to turn RF to ON or OFF during system warm up, the response message will be RF_OFF_SYSTEM_WARM_UP.
Modulator Rate Preset Assignment	Command: Response: Status: Response:	<add/AMRx_nnnn_mmmm.mmm'cr' >add/AMRx_nnnn_mmmm.mmm'cr''lf'] <add/AMRx_'cr' >add/AMRx_nnnn_mmmm.mmm'cr''lf']	Where: x = A, B, C, D, or V [Preset designator]. nnnn = 1/2 (QPSK 1/2), [Coder rate], 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), QPSK (QPSK 1/1). mmmm.mmm = Data rate in kHz.
Modulator Rate Preset Selection	Command: Response: Status:	<add/SMRx_'cr' >add/SMRx_'cr' RF_OFF'cr''lf'] See MR command.	Where: x = A, B, C, D, or V (Preset designator). Note: Setting the modulator rate turns off the RF transmitter.
Modulator Rate Variable Assignment & Selection	Command: Response: Status:	<add/SMRV_nnnn_mmmm.mmm'cr' >add/SMRV_nnnn_mmmm.mmm'cr' RF_OFF'cr''lf'] See MR command.	Where: nnnn = 1/2 (QPSK 1/2), [Coder rate], 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2) mmmm.mmm = Data rate in kHz. Note: Setting the modulator turns off the RF transmitter.

Set Modulator Output Power Level	Command: Response: Status:	<add/MOP_snn.n'cr' >add/MOP_snn'cr''lf'] >add/MOP_snn.n'cr''lf']	C-Band: Where: snn.n = +25 to +38 in 1 steps. K1 Ku-Band: Where: snn.n = +17 to +30 in 1 steps. K3 Ku-Band: Where: snn.n = +22.0 to +35.0 in 0.1 steps (nominal range in dBm). Note: The MOP_ command will return status only when local AUPC is enabled.
Scrambler Enable	Command: Response: Status: Response:	<add/SE_xxx'cr' >add/SE_xxx'cr''lf'] <add/SE_'cr' >add/SE_xxx'cr''lf']	Where: xxx = ON or OFF.
Differential Encoder Enable	Command: Response: Status: Response:	<add/DENC_xxx'cr' >add/DENC_xxx'cr''lf'] <add/DENC_'cr' >add/DENC_xxx'cr''lf']	Where: xxx = ON or OFF.
Modulator Type	Command: Response: Status: Response:	<add/MT_xxxx'cr' >add/MT_xxxx'cr''lf'] <add/MT_'cr' >add/MT_xxxx'cr''lf']	Where: xxxx = EFD (EF DATA CLOSED NETWORK), CSC (COMSTREAM CLOSED NETWORK), FDC (FAIRCHILD CLOSED NETWORK).
Modulator Encoder Type	Command: Response: Status: Response:	<add/MET_xxx'cr' >add/MET_xxx'cr''lf'] <add/MET_'cr' >add/MET_xxx'cr''lf']	Where: xxx = VIT (K-7 VITERBI ENCODER), SEQ (SEQUENTIAL ENCODER).
Modulator Spectrum Rotation	Command: Response: Status: Response:	<add/MSR_xxx'cr' >add/MSR_xxx'cr''lf'] <add/MSR_'cr' >add/MSR_xxx'cr''lf']	Where: xxx = NRM (normal spectrum), INV (inverted spectrum).
Reed-Solomon Encoder Enable	Command: Response: Status: Response:	<add/RSEN_xxx'cr' >add/RSEN_xxx'cr'lf'] <add/RSEN_'cr' >add/RSEN_xxx'cr''lf']	Where: xxx = ON or OFF.
Transmit BPSK Data Ordering	Command: Response: Status: Response:	<add/TDA_xxx'cr' >add/TDA_xxx'cr''lf'] <add/TDA_'cr' >add/TDA_xxx'cr''lf']	Where: xxx = NRM (STANDARD), INV (NON-STANDARD).
Carrier Only Mode	Command: Response: Status: Response:	<add/COM_xxxxxx'cr' >add/COM_xxxxxx'cr''lf'] <add/COM_'cr' >add/COM_xxxxxx'cr''lf']	Where: xxxxxx = OFF (NORMAL-MODULATED), DUAL (DUAL-CW), OFFSET (OFFSET-CW), CENTER (CENTER-CW).

B.3.2 Demodulator

Demodulator Band	Command: Response: Status: Response:	<add/DB_x'cr' >add/DB_x'cr''lf'] <add/DB_'cr' >add/DB_x'cr''lf']	Where: x = A (BAND A), B (BAND B), C (BAND C), D (BAND D). Note: For Ku-Band only.
Set Demodulator Frequency	 Command: Response: Status: Response: Command: Response: Status: Response:	C-Band: <add/DF_n.nnnnnnn'cr' >add/DF_n.nnnnnnn'cr''lf'] <add/DF_'cr' >add/DF_n.nnnnnnn'cr''lf'] Ku-Band: <add/DF_nn.nnnnnnn'cr' >add/DF_nn.nnnnnnn'cr''lf'] <add/DF_'cr' >add/DF_nn.nnnnnnn'cr''lf']	C-Band: Where: n.nnnnnnn = Frequency in GHz, 3.7000000 to 4.2000000 (100 Hz steps) Ku-Band: BAND A: Where: nn.nnnnnnn = Frequency in GHz, 11.7000000 to 12.2000000 (100 Hz steps) BAND B: Where: nn.nnnnnnn = Frequency in GHz, 10.9500000 to 11.4500000 (100 Hz steps) BAND C: Where: nn.nnnnnnn = Frequency in GHz, 11.2000000 to 11.7000000 (100 Hz steps) BAND D: Where: nn.nnnnnnn = Frequency in GHz, 12.2500000 to 12.7500000 (100 Hz steps)
Demodulator Rate Preset Assignment	Command: Response: Status: Response:	<add/ADRx_nnnn_mmmm.mmm'cr' >add/ADRx_nnnn_mmmm.mmm'cr''lf'] <add/ADRx_'cr' >add/ADRx_nnnn_mmmm.mmm'cr''lf']	Where: x = A, B, C, D, or V [Preset designator]. nnnn = 1/2 (QPSK 1/2), [Decoder rate], 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2). mmmm.mmm = Data rate in kHz.
Demodulator Rate Preset Selection	Command: Response: Status:	<add/SDRx_'cr' >add/SDRx_'cr''lf'] See DR command.	Where: x = A, B, C, D, or V (Preset designator).
Demodulator Rate Variable Assignment & Selection	Command: Response: Status:	<add/SDRV_nnnn_mmmm.mmm'cr' >add/SDRV_nnnn_mmmm.mmm'cr''lf'] See DR command.	Where: nnnn = 1/2 (QPSK 1/2), [Decoder rate], 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2). mmmm.mmm = Data rate in kHz.
Descramble Enable	Command: Response: Status: Response:	<add/DE_xxx'cr' >add/DE_xxx'cr''lf'] <add/DE_'cr' >add/DE_xxx'cr''lf']	Where: xxx = ON or OFF.
Differential Decoder Enable	Command: Response: Status: Response:	<add/DDEC_xxx'cr' >add/DDEC_xxx'cr''lf'] <add/DDEC_'cr' >add/DDEC_xxx'cr''lf']	Where: xxx = ON or OFF.
RF Loopback	Command: Response: Status: Response:	<add/RFL_xxx'cr' >add/RFL_xxx'cr''lf'] <add/RFL_'cr' >add/RFL_xxx'cr''lf']	Where: xxx = ON or OFF.

IF Loopback	Command: Response: Status: Response:	<add/IFL_xxx'cr' >add/IFL_xxx'cr''lf'] <add/IFL_'cr' >add/IFL_xxx'cr''lf']	Where: xxx = ON or OFF.
Sweep Center Frequency	Command: Response: Status: Response:	<add/SCF_snnnnn'cr' >add/SCF_snnnnn'cr''lf'] <add/SCF_'cr' >add/SCF_snnnnn'cr''lf']	Where: snnnnn = -35000 to +35000 in 1 Hz steps.
Sweep Width Range	Command: Response: Status: Response:	<add/SWR_nnnnnn'cr' >add/SWR_nnnnnn'cr''lf'] <add/SWR_'cr' >add/SWR_nnnnnn'cr''lf']	Where: nnnnnn = 0 to 70000 in 1 Hz steps.
Sweep Reacquisition	Command: Response: Status: Response:	<add/SR_xxx'cr' >add/SR_xxx'cr''lf'] <add/SR_'cr' >add/SR_xxx'cr''lf']	Where: xxx = 0 to 999 (number of seconds).
Bit Error Rate Threshold	Command: Response: Status: Response:	<add/BERT_xxxx'cr' >add/BERT_xxxx'cr''lf'] <add/BERT_'cr' >add/BERT_xxxx'cr''lf']	Where: xxxx = NONE, or 1E-n, where n = 3, 4, 5, 6, 7, or 8 (exponent of threshold).
Demodulator Type	Command: Response: Status: Response:	<add/DT_xxxx'cr' >add/DT_xxxx'cr''lf'] <add/DT_'cr' >add/DT_xxxx'cr''lf']	Where: xxxx = EFD (EF DATA CLOSED NETWORK), CSC (COMSTREAM CLOSED NETWORK), FDC (FAIRCHILD CLOSED NETWORK).
Demodulator Decoder Type	Command: Response: Status: Response:	<add/DDT_xxx'cr' >add/DDT_xxx'cr''lf'] <add/DDT_'cr' >add/DDT_xxx'cr''lf']	Where: xxx = VIT (K-7 VITERBI ENCODER), SEQ (SEQUENTIAL ENCODER).
Demodulator Spectrum Rotation	Command: Response: Status: Response:	<add/DSR_xxx'cr' >add/DSR_xxx'cr''lf'] <add/DSR_'cr' >add/DSR_xxx'cr''lf']	Where: xxx = NRM (normal spectrum), INV (inverted spectrum).
Reed-Solomon Decoder Enable	Command: Response: Status: Response:	<add/RSDE_xxx'cr' >add/RSDE_xxx'cr''lf'] <add/RSDE_'cr' >add/RSDE_xxx'cr''lf']	Where: xxx = ON, OFF, or CORR_OFF.
Receive BPSK Data Ordering	Command: Response: Status: Response:	<add/RDA_xxx'cr' >add/RDA_xxx'cr''lf'] <add/RDA_'cr' >add/RDA_xxx'cr''lf']	Where: xxx = NRM (STANDARD), INV (NON-STANDARD).

B.3.3 Interface

Interface Transmit Overhead Type	Command: Response: Status: Response:	<add/ITOT_xxxxx'cr' >add/ITOT_xxxxx'cr''lf'] <add/ITOT_'cr' >add/ITOT_xxxxx'cr''lf']	Where: xxxxx = NONE, EFD, or ASYNC.
Interface Receive Overhead Type	Command: Response: Status: Response:	<add/IROT_xxxxx'cr' >add/IROT_xxxxx'cr''lf'] <add/IROT_'cr' >add/IROT_xxxxx'cr''lf']	Where: xxxxx = NONE, EFD, or ASYNC.
TX Driver Type	Command: Response: Status: Response:	<add/TXDR_xxxxx'cr' >add/TXDR_xxxxx'cr''lf'] <add/TXDR_'cr' >add/TXDR_xxxxx'cr''lf']	Where: xxxxx = G703, V35, RS422, or RS232.
RX Driver Type	Command: Response: Status: Response:	<add/RXDR_xxxxx'cr' >add/RXDR_xxxxx'cr''lf'] <add/RXDR_'cr' >add/RXDR_xxxxx'cr''lf']	Where: xxxxx = G703, V35, RS422, or RS232.
Transmit Clock	Command: Response: Status: Response:	<add/TC_xxx'cr' >add/TC_xxx'cr''lf'] <add/TC_'cr' >add/TC_xxx'cr''lf']	Where: xxx = INT (internal SCT clock), EXT (external TX terrestrial clock), REF (external clock-reference frequency).
External Clock-Reference Frequency	Command: Response: Status: Response:	<add/ERF_nnnnn.n'cr' >add/ERF_nnnnn.n'cr''lf'] <add/ERF_'cr' >add/ERF_nnnnn.n'cr''lf']	Where: nnnnn.n = 8.0 to 10000.0 (external clock frequency in kHz).
Transmit Clock Phase	Command: Response: Status: Response:	<add/TCP_xxxx'cr' >add/TCP_xxxx'cr''lf'] <add/TCP_'cr' >add/TCP_xxxx'cr''lf']	Where: xxxx = NRM (normal clock phasing), INV (inverted clock phasing), AUTO (automatic clock phasing).
Buffer Clock	Command: Response: Status: Response:	<add/BC_xxx'cr' >add/BC_xxx'cr''lf'] <add/BC_'cr' >add/BC_xxx'cr''lf']	Where: xxx = INT (internal SCT clock), EXT (external TX terrestrial clock), SAT (receive satellite clock), REF (external clock-reference frequency),
Receive Clock Phase	Command: Response: Status: Response:	<add/RCP_xxx'cr' >add/RCP_xxx'cr''lf'] <add/RCP_'cr' >add/RCP_xxx'cr''lf']	Where: xxx = NRM (normal clock phasing), INV (inverted clock phasing).
Base Band Loop Back	Command: Response: Status: Response:	<add/BBL_xxx'cr' >add/BBL_xxx'cr''lf'] <add/BBL_'cr' >add/BBL_xxx'cr''lf']	Where: xxx = ON or OFF.

Interface Loop-back	Command: Response: Status: Response:	<add/ILB_xxx'cr' >add/ILB_xxx'cr''lf'] <add/ILB_'cr' >add/ILB_xxx'cr''lf']	Where: xxx = ON or OFF.
Interface Loop Timing	Command: Response: Status: Response:	<add/ILT_xxx'cr' >add/ILT_xxx'cr''lf'] <add/ILT_'cr' >add/ILT_xxx'cr''lf']	Where: xxx = ON or OFF.
Interface Buffer Size			Buffer size programming is supported in two formats; bits, or milliseconds. The selected format must be chosen using the buffer programming command (IBP_). If the buffer is to be programmed in milliseconds and plesiochronous slips are required use the receive framing structure command (IRFS_) to define the proper framing format. Note: For Drop & Insert: Only milliseconds format is allowed.
Interface Buffer Size (Bit Format)	Command: Response: Status: Response:	<add/IBS_nnnnnn'cr' >add/IBS_nnnnnn'cr''lf'] <add/IBS_'cr' >add/IBS_nnnnnn'cr''lf']	Where: nnnnnn = 32 to 262144 in 16 bit increments.
Interface Buffer Size (Millisecond Format)	Command: Response: Status: Response:	<add/IBS_nn'cr' >add/IBS_nn'cr''lf'] <add/IBS_'cr' >add/IBS_nn'cr''lf']	Where: nn = 0 to 99 (buffer size in milliseconds).
Interface Buffer Center	Command: Response:	<add/IBC_'cr' >add/IBC_'cr''lf']	
Interface Buffer Programming	Command: Response: Status: Response:	<add/IBP_xxxx'cr' >add/IBP_xxxx'cr''lf'] <add/IBP_'cr' >add/IBP_xxxx'cr''lf']	Where: xxxx = BITS or MS (milliseconds). Note: For Drop & Insert: Only milliseconds format is allowed.
Interface Receive Framing Structure	Command: Response: Status: Response:	<add/IRFS_ff_ssss'cr' >add/IRFS_ff_ssss'cr''lf'] <add/IRFS_ff'cr' >add/IRFS_ff_ssss'cr''lf']	Where: ff = T1 or E1 (frame type). ssss = NONE or G704 (framing structure).
Interface Substitute Pattern (Transmit 2047 Pattern)	Command: Response: Status: Response:	<add/ISP_xxx'cr' >add/ISP_xxx'cr''lf'] <add/ISP_'cr' >add/ISP_xxx'cr''lf']	Where: xxx = ON or OFF.
Interface Read Error Select (Receive 2047 Pattern)	Command: Response: Status: Response:	<add/IRE_xxx'cr' >add/IRE_xxx'cr''lf'] <add/IRE_'cr' >add/IRE_xxx'cr''lf']	Where: xxx = ON or OFF.

Interface Coding Format Transmit	Command: Response: Status: Response:	<add/ICFT_xxxx'cr' >add/ICFT_xxxx'cr''lf'] <add/ICFT_'cr' >add/ICFT_xxxx'cr''lf']	Where: xxxx = AMI, HDB3, or B8ZS.
Interface Coding Format Receive	Command: Response: Status: Response:	<add/ICFR_xxxx'cr' >add/ICFR_xxxx'cr''lf'] <add/ICFR_'cr' >add/ICFR_xxxx'cr''lf']	Where: xxxx = AMI, HDB3, or B8ZS.
Transmit Data Fault	Command: Response: Status: Response:	<add/TDF_xxxx'cr' >add/TDF_xxxx'cr''lf'] <add/TDF_'cr' >add/TDF_xxxx'cr''lf']	Where: xxxx = NONE, DATA, or AIS.
Receive Data Fault	Command: Response: Status: Response:	<add/RDF_xxxx'cr' >add/RDF_xxxx'cr''lf'] <add/RDF_'cr' >add/RDF_xxxx'cr''lf']	Where: xxxx = NONE, DATA, or AIS.
ASYNC Transmit Overhead Baud Rate (TX ASYNC Overhead only)	Command: Response: Status: Response:	<add/TOBR_nnnnn'cr' >add/TOBR_nnnnn'cr''lf'] <add/TOBR_'cr' >add/TOBR_nnnnn'cr''lf']	Where: nnnnn = 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, or 38400.
ASYNC Receive Overhead Baud Rate (RX ASYNC Overhead only)	Command: Response: Status: Response:	<add/ROBR_nnnnn'cr' >add/ROBR_nnnnn'cr''lf'] <add/ROBR_'cr' >add/ROBR_nnnnn'cr''lf']	Where: nnnnn = 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, or 38400.
ASYNC Transmit Channel Character Length (TX ASYNC Overhead only)	Command: Response: Status: Response:	<add/TCCL_n'cr' >add/TCCL_n'cr''lf'] <add/TCCL_'cr' >add/TCCL_n'cr''lf']	Where: n = 5, 6, 7, or 8 (characters).
ASYNC Receive Channel Character Length (RX ASYNC Overhead only)	Command: Response: Status: Response:	<add/RCCL_n'cr' >add/RCCL_n'cr''lf'] <add/RCCL_'cr' >add/RCCL_n'cr''lf']	Where: n = 5, 6, 7, or 8 (characters).
ASYNC Transmit Channel Stop Bits (TX ASYNC Overhead only)	Command: Response: Status: Response:	<add/TCSB_n'cr' >add/TCSB_n'cr''lf'] <add/TCSB_'cr' >add/TCSB_n'cr''lf']	Where: n = 1 or 2 (stop bits).
ASYNC Receive Channel Stop Bits (RX ASYNC Overhead only)	Command: Response: Status: Response:	<add/RCSB_n'cr' >add/RCSB_n'cr''lf'] <add/RCSB_'cr' >add/RCSB_n'cr''lf']	Where: n = 1 or 2 (stop bits).
ASYNC Transmit Overhead Channel Parity (TX ASYNC Overhead only)	Command: Response: Status: Response:	<add/TOCP_xxxx'cr' >add/TOCP_xxxx'cr''lf'] <add/TOCP_'cr' >add/TOCP_xxxx'cr''lf']	Where: xxxx = ODD, EVEN, or NONE.

ASYNC Receive Overhead Channel Parity (RX ASYNC Overhead only)	Command: Response: Status: Response:	<add/ROCP_xxxx'cr' >add/ROCP_xxxx'cr''lf'] <add/ROCP_'cr' >add/ROCP_xxxx'cr''lf']	Where: xxxx = ODD, EVEN, or NONE.
ASYNC Transmit Communications Type (TX ASYNC Overhead only)	Command: Response: Status: Response:	<add/TCT_xxxxxxxx'cr' >add/TCT_xxxxxxxx'cr''lf'] <add/TCT_'cr' >add/TCT_xxxxxxxx'cr''lf']	Where: xxxxxxxx = RS232, RS485, (4 WIRE), RS485_2W (2 WIRE).
ASYNC Receive Communications Type (RX ASYNC Overhead only)	Command: Response: Status: Response:	<add/RCT_xxxxx'cr' >add/RCT_xxxxx'cr''lf'] <add/RCT_'cr' >add/RCT_xxxxx'cr''lf']	Where: xxxxx = RS232 or RS485.
Transmit Data Phase	Command: Response: Status: Response:	<add/TDP_xxxx'cr' >add/TDP_xxxx'cr''lf'] <add/TDP_'cr' >add/TDP_xxxx'cr''lf']	Where: xxxx = NRM (normal data phasing), INV (inverted data phasing).
Receive Data Phase	Command: Response: Status: Response:	<add/RDP_xxxx'cr' >add/RDP_xxxx'cr''lf'] <add/RDP_'cr' >add/RDP_xxxx'cr''lf']	Where: xxxx = NRM (normal data phasing), INV (inverted data phasing).
CTS Delay Time	Command: Response: Status: Response:	<add/CTSD_xx'cr' <add/CTSD_xx'cr''lf'] <add/CTSD_'cr' >add/CTSD_xx'cr''lf']	Where: xx = 0 to 60 (number of seconds).

B.4 System

Time Of Day	Command: Response: Status: Response:	<add/TIME_hh:mmxx'cr' >add/TIME_hh:mmxx'cr''lf'] <add/TIME_'cr' >add/TIME_hh:mmxx'cr''lf']	Where: hh = 1 to 12 (hours). mm = 00 to 59 (minutes). xx = AM or PM.
Date	Command: Response: Status: Response:	<add/DATE_mm/dd/yyyy'cr' >add/DATE_mm/dd/yyyy'cr''lf'] <add/DATE_'cr' >add/DATE_mm/dd/yyyy'cr''lf']	Where: mm = 1 to 12 (month). dd = 1 to 31 (day). yyyy = Year displayed in 4-digits (0000 to 9999). Note: Year may be displayed in (yy) 2-digits (00 to 99).
Remote Configures the MODEM for remote operation.	Command: Response:	<add/REM_'cr' >add/REM_'cr''lf']	The SDT5200 will respond to any status request at any time. However, the SDT5200 must be in 'Remote Mode' to change configuration parameters.
Clear Stored Faults	Command: Response:	<add/CLSF_'cr' >add/CLSF_'cr''lf']	This command is used to clear all stored faults logged by the SDT5200.
Modem Operation Mode	Command: Response: Status: Response:	<add/MOM_xxxxxxx'cr' >add/MOM_xxxxxxx'cr''lf'] <add/MOM_'cr' >add/MOM_xxxxxxx'cr''lf']	Where: xxxxxxx = TX_ONLY, RX_ONLY, or DUPLEX. This command configures the modem for simplex or duplex operation modes. When transmit only mode is selected receive faults are inhibited and when receive only mode is selected transmit faults are inhibited.
System Modem Type	Command: Response: Status: Response:	<add/SMT_xxxxxx'cr' >add/SMT_xxxxxx'cr''lf'] <add/SMT_'cr' >add/SMT_xxxxxx'cr''lf']	Where: xxxxxx = ASYNC, EFD, or CUSTOM.
Save Modem Configuration	Command: Response:	<add/SMC_n'cr' >add/SMC_n'cr''lf']	Where: n = 1, 2, 3, 4, or 5 (stored configuration number). This command saves the current modem configuration for recall at a later time using the 'RMC_' command. Up to five different modem configurations can be saved.
Recall Modem Configuration	Command: Response:	<add/RMC_n'cr' >add/RMC_n'cr''lf']	Where: n = 1, 2, 3, 4, or 5 (stored configuration number). This command causes the modem to be reprogrammed with configuration parameters previously saved using the 'SMC_' command. One of five saved configurations can be specified.
Local Modem AUPC Mode	Command: Response: Status: Response:	<add/LMA_xxx'cr' >add/LMA_xxx'cr''lf'] <add/LMA_'cr' >add/LMA_xxx'cr''lf']	Where: xxx = ON or OFF. This command configures the modem for the LOCAL MODEM AUPC mode. When 'ON' is selected, the AUPC configuration can be entered.

RTS TX-IF Control Mode	Command: Response: Status: Response:	<add/RTSM_xxx'cr' >add/RTSM_xxx'cr''lf'] <add/RTSM_'cr' >add/RTSM_xxx'cr''lf']	Where: xxx = ON or OFF. This command configures the modem for the RTS TX-IF control mode. If 'ON' is selected, the TX-IF output will only be turned on if the incoming RTS signal is asserted (also the TX-IF output has to be programmed ON and no major modulator faults are present). If 'OFF' is selected, the TX-IF output will operate normal ignoring the RTS signal.

B.5 Automatic Uplink Power Control (AUPC) Configuration Commands

AUPC Local Enable (ASYNC Overhead only)	Command: Response: Status: Response:	<add/LPC_xxx'cr' >add/LPC_xxx'cr''lf'] <add/LPC_'cr' >add/LPC_xxx'cr''lf']	Where: xxx = ON or OFF. Note: When programmed ON, the MOP (Modulator Output Power) command is not allowed, only MOP status is allowed.
AUPC Nominal Power Level (ASYNC Overhead only)	Command: Response: Status: Response:	<add/NOMP_snn.n'cr' >add/NOMP_snn.n'cr''lf'] <add/NOMP_'cr' >add/NOMP_snn.n'cr''lf']	C-Band: Where: snn.n = +25.0 to +38.0 in 0.1 steps (nominal range in dBm). K1 Ku-Band: Where: snn.n = +17.0 to +30.0 in 0.1 steps (nominal range in dBm). K3 Ku-Band: Where: snn.n = +22.0 to +35.0 in 0.1 steps (nominal range in dBm).
AUPC Maximum Power Limit (ASYNC Overhead only)	Command: Response: Status: Response:	<add/MAXP_snn.n'cr' >add/MAXP_snn.n'cr''lf'] <add/MAXP_'cr' >add/MAXP_snn.n'cr''lf']	C-Band: Where: snn.n = +25.0 to +38.0 in 0.1 steps (nominal range in dBm). K1 Ku-Band: Where: snn.n = +17.0 to +30.0 in 0.1 steps (nominal range in dBm). K3 Ku-Band: Where: snn.n = +22.0 to +35.0 in 0.1 steps (nominal range in dBm).
AUPC Minimum Power Limit (ASYNC Overhead only)	Command: Response: Status: Response:	<add/MINP_snn.n'cr' >add/MINP_snn.n'cr''lf'] <add/MINP_'cr' >add/MINP_snn.n'cr''lf']	C-Band: Where: snn.n = +25.0 to +38.0 in 0.1 steps (nominal range in dBm). K1 Ku-Band: Where: snn.n = +17.0 to +30.0 in 0.1 steps (nominal range in dBm). K3 Ku-Band: Where: snn.n = +22.0 to +35.0 in 0.1 steps (nominal range in dBm).
AUPC Eb/N0 Target Set Point (ASYNC Overhead only)	Command: Response: Status: Response:	<add/ENSP_nn.n'cr' >add/ENSP_nn.n'cr''lf'] <add/ENSP_'cr' >add/ENSP_nn.n'cr''lf']	Where: nn.n = 3.2 to 16.0 in .1 increments (Eb/N0 in dB).
AUPC Maximum Tracking Rate (ASYNC Overhead only)	Command: Response: Status: Response:	<add/MAXT_n.n'cr' >add/MAXT_n.n'cr''lf'] <add/MAXT_'cr' >add/MAXT_n.n'cr''lf']	Where: n.n = 0.5 to 6.0 in .5 increments (Max tracking rate in dBm/minute).

AUPC Local Carrier Loss Action (ASYNC Overhead only)	Command: Response: Status: Response:	<add/LCL_xxxx'cr' >add/LCL_xxxx'cr''lf'] <add/LCL_'cr' >add/LCL_xxxx'cr''lf']	Where: xxxx = HOLD, NOM, or MAX (power level setting when local carrier loss).
AUPC Remote Carrier Loss Action (ASYNC Overhead only)	Command: Response: Status: Response:	<add/RCL_xxxx'cr' >add/RCL_xxxx'cr''lf'] <add/RCL_'cr'>add/RCL_xxxx'cr''lf']	Where: xxxx = HOLD, NOM, or MAX (power level setting when remote carrier loss).
Remote Modem AUPC Commands			Notes: 1. Always wait 3 seconds between consecutive remote modem command/status polls. 2. If Local AUPC is not enabled status commands will return last known condition. They will also request status from the remote modem. This allows a second request to return proper status.
Remote AUPC Enable (ASYNC Overhead only)	Command: Response: Status: Response:	<add/RPC_xxx'cr' >add/RPC_xxx'cr''lf'] <add/RPC_'cr' >add/RPC_xxx'cr''lf']	Where: xxx = ON or OFF (remote AUPC enable).
Remote Interface Substitution Pattern (Transmit 2047 Pattern)	Command: Response: Status: Response:	<add/RISP_xxx'cr' >add/RISP_xxx'cr''lf'] <add/RISP_'cr' >add/RISP_xxx'cr''lf']	Where: xxx = ON or OFF (remote transmit 2047 pattern enable).
Remote Interface Base Band Loop Back (ASYNC Overhead only)	Command: Response: Status: Response:	<add/RBBL_xxx'cr' >add/RBBL_xxx'cr''lf'] <add/RBBL_'cr' >add/RBBL_xxx'cr''lf']	Where: xxx = ON or OFF (remote baseband loopback enable).
Remote Interface Read Error Status (Received 2047 pattern)	Command: Response: Command: Response:	<add/RRES_'cr' >add/RRES_nE-e'cr''lf'] Example: <add/RRES_'cr' >add/RRES_2E-6'cr''lf']	Where: n = 1 to 9 (error rate number). e = 2 to 6 (exponent). This command returns 2047 BER from the remote AUPC modem. If data is not valid, the message 'No_Data' is returned in lieu of BER data.

B.6 Status Commands/Responses

Modulator Configuration Status	Command: Response:	<add/MCS_'cr' >add/MCS_'cr' RF_xxx'cr' MF_n.nnnnnnn'cr' MR_nnnn_mmmm.mmm'cr' AMRA_nnnn_mmmm.mmm'cr' AMRB_nnnn_mmmm.mmm'cr' AMRC_nnnn_mmmm.mmm'cr' AMRD_nnnn_mmmm.mmm'cr' AMRV_nnnn_mmmm.mmm'cr' MOP_snn.n'cr' SE_xxx'cr' DENC_xxx'cr' MT_xxxxx'cr' MET_xxx'cr' COM_xxxxxx'cr' MSR_xxx'cr' RSEN_xxx'cr' TDA_xxx'cr''lf']	 RF Output Modulator Frequency Modulator Rate Preset 'A' Assignment Preset 'B' Assignment Preset 'C' Assignment Preset 'D' Assignment Preset 'V' Assignment Modulator Output Power Scrambler Enable Differential Encoder Modulator Type Modulator Encoder Type Carrier Only Mode Modulator Spectrum Rotation Reed-Solomon Encoder Transmit BPSK Data Ordering The Modulator configuration status command causes a block of data to be returned by the addressed modem. The block of data reflects the current configuration status of the modulator module. Additional configuration status of new options and features will always be appended to the end.
Modulator/ Coder Configuration Program Status	Command: Response:	<add/MCP_'cr' >add/MCP_'cr' SMT_xxxxxx'cr' ITOT_xxxxx'cr' MOM_xxxxxxx'cr' MT_xxxxx'cr' MET_xxx'cr' C-Band: MF_n.nnnnnnn'cr' Ku-Band: MF_nn.nnnnnnn'cr' MR_nnnn_mmmm.mmm'cr' LPC_xxx'cr' (Note 1) MOP_snn.n'cr' (Note 2) SE_xxx'cr' DENC_xxx'cr' ERF_nnnnn.n'cr' TC_xxx'cr' TCP_xxxx'cr' BBL_xxx'cr' ILB_xxx'cr' ILT_xxx'cr' ICFT_xxxx'cr' ISP_xxx'cr' TDF_xxxx'cr' TDP_xxxx'cr' MSR_xxx'cr' RSEN_xxx'cr' TXDR_xxxxxx'cr' TOBR_nnnnn'cr' (Note 1) TCCL_n'cr' (Note 1) TCSB_n'cr' (Note 1) TOCP_xxxx'cr' (Note 1) TCT_xxxxx'cr' (Note 1) NOMP_snn.n'cr' (Note 1)	 System Modem Type Interface Transmit Overhead Type Modem Operation Mode Modulator Type Modulator Encoder Type C-Band: Modulator Frequency Ku-Band: Modulator Frequency Modulator Rate AUPC Local Power Enable Modulator Output Power Scrambler Enable Differential Encoder External Reference Frequency Transmit Clock (Source) Transmit Clock Phase Baseband Loopback Interface Loopback Interface Loop Timing Interface Coding Format Transmit Interface Substitution Pattern (TX 2047) Transmit Data Fault Transmit Data Phase Modulator Spectrum Rotation Reed-Solomon Encoder TX Driver Type ASYNC Transmit Overhead Baud Rate ASYNC Transmit Channel Character Length ASYNC Transmit Channel Stop Bits ASYNC Transmit Overhead Channel Parity ASYNC Transmit Communications Type AUPC Nominal Power Value

		MINP_snn.n'cr' (Note 1) MAXP_snn.n'cr' (Note 1) LCL_xxxx'cr' (Note 1) RCL_xxxx'cr' (Note 1) CTSD_xx'cr' RTSM_xxx'cr' TDA_xxx'cr' RF_xxx'cr''lf']	AUPC Minimum Power Value AUPC Maximum Power Value AUPC Local Carrier Loss AUPC Remote Carrier Loss CTS Delay Time RTS TX-IF Control Mode Transmit BPSK Data Ordering RF Output (ON/OFF) This command is used by the EF Data M:N protection switch to collect information that is necessary to configure back-up modems. Because this command (content and/or order) can be changed at any time by EF Data, it is advisable that other commands ('MCS_' and 'ICS_', or 'BCS_') be used for M&C systems. Notes: 1. Data is only returned for TX ASYNC Overhead. 2. Data not returned if Local AUPC is enabled & TX ASYNC overhead.
Demodulator Configuration Status	Command: Response:	<add/DCS_'cr' >add/DCS_'cr' Ku-Band: DB_x'cr' C-Band: DF_n.nnnnnnn'cr' Ku-Band: DF_nn.nnnnnnn'cr' DR_nnnn_mmmm.mmm'cr' ADRA_nnnn_mmmm.mmm'cr' ADRB_nnnn_mmmm.mmm'cr' ADRC_nnnn_mmmm.mmm'cr' ADRD_nnnn_mmmm.mmm'cr' ADRV_nnnn_mmmm.mmm'cr' DE_xxx'cr' DDEC_xxx'cr' RFL_xxx'cr' IFL_xxx'cr' SCF_snnnnn'cr' SWR_nnnnn'cr' SR_xxx'cr' BERT_xxxx'cr' DT_xxxx'cr' DDT_xxx'cr' DSR_xxx'cr' RSDE_xxx'cr' RDA_xxx'cr''lf']	 Ku-Band: Demodulator Band C-Band: Demodulator Frequency Ku-Band: Demodulator Frequency Demodulator Rate Preset 'A' Assignment Preset 'B' Assignment Preset 'C' Assignment Preset 'D' Assignment Preset 'V' Assignment Descrambler Enable Differential Decoder RF Loopback IF Loopback Sweep Center Frequency Sweep Width Range Sweep Reacquisition BER Threshold Demodulator Type Demodulator Decoder Type Demodulator Spectrum Rotation Reed-Solomon Decoder Receive BPSK Data Ordering The Demodulator configuration status command causes a block of data to be returned by the addressed modem. The block of data reflects the current configuration of the demod. Additional configuration status of new options and features will always be appended to the end.

Demodulator/	Command:	<add/DCP_'cr'	
Decoder	Response:	>add/DCP_'cr'	
Configuration		SMT_xxxxxx'cr'	System Modem Type
Program		IROT_xxxxx'cr'	Interface Receive Overhead Type
Status		MOM_xxxxxxx'cr'	Modem Operation Mode
		BERT_xxxx'cr'	BER Threshold
		DT_xxxx'cr'	Demodulator Type
		DDT_xxx'cr'	Demodulator Decoder Type
		Ku-Band:	Ku-Band:
		DB_x'cr'	Demodulator Band
		C-Band	C-Band:
		DF_n.nnnnnnn'cr'	Demodulator Frequency
		Ku-Band::	Ku-Band:
		DF_nn.nnnnnnn'cr'	Demodulator Frequency
		DR_nnnn_mmmm.mmm'cr'	Demodulator Rate
		DE_xxx'cr'	Descrambler Enable
		DDEC_xxx'cr'	Differential Decoder
		RFL_xxx'cr'	RF Loopback
		IFL_xxx'cr'	IF Loopback
		SCF_snnnnn'cr'	Sweep Center Frequency
		SWR_nnnnn'cr'	Sweep Width Range
		SR_xxx'cr'	Sweep Reacquisition
		ERF_nnnnn.n'cr'	External Reference Frequency
		BC_xxx'cr'	Buffer Clock
		RCP_xxxx'cr'	Receive Clock Phase
		BBL_xxx'cr'	Baseband Loopback
		ILB_xxx'cr'	Interface Loop Back
		ILT_xxx'cr'	Interface Loop Timing
		ICFR_xxxx'cr'	Interface Coding Format Receive
		IRFS_T1_ssss'cr'	Interface Receive T1 Frame Structure
		IRFS_E1_ssss'cr'	Interface Receive E1 Frame Structure
		IBP_xxx'cr'	Interface Buffer Programming
		IRE_xxxx'cr'	Interface Read Error (RX 2047)
		RDF_xxxx'cr'	Receive Data Fault
		RDP_xxxx'cr'	Receive Data Phase
		IBS_nnnnnn'cr'	Interface Buffer Size
		DSR_xxx'cr'	Demodulator Spectrum Rotation
		RSDE_xxx'cr'	Reed-Solomon Decoder
		RXDR_xxxxxx'cr'	RX Driver Type
		ROBR_nnnnn'cr' (See Note)	ASYNC Receive Overhead Baud Rate
		RCCL_n'cr' Length (See Note)	ASYNC Receive Channel Character Length
		RCSB_n'cr' (See Note)	ASYNC Receive Channel Stop Bits
		ROCP_xxxx'cr' (See Note)	ASYNC Receive Overhead Channel Parity
		RCT_xxxxx'cr' (See Note)	ASYNC Receive Communications Type
		ENSP_nn. (See Note)	AUPC EBN0 Target Set Point
		MAXT_n.n'cr' (See Note)	AUPC Maximum Tracking Rate
		RDA_xxx'cr''lf']	Receive BPSK Data Ordering
			This command is used by the EF Data M:N protection switch to collect information that is necessary to configure back-up modems. Because this command (content and/or order) can be changed at any time by EF Data, it is advisable that other commands ('DCS_' and 'ICS_', or 'BCS_') be used for M&C systems.
			Note: Data is only returned for RX ASYNC Overhead.

Interface Configuration Status	Command:	<add/ICS_'cr'	
	Response:	>add/ICS_'cr'	
		TC_xxx'cr'	Transmit Clock (Source)
		ERF_nnnnn.n'cr'	External Reference Frequency
		TCP_xxxx'cr'	Transmit Clock Phase
		RCP_xxxx'cr'	Receive Clock Phase
		BBL_xxx'cr'	Base Band Loopback
		ILB_xxx'cr'	Interface Loopback
		ILT_xxx'cr'	Interface Loop Timing
		ICFT_xxxx'cr'	Interface Coding Format Transmit
		ICFR_xxxx'cr'	Interface Coding Format Receive
		BC_xxx'cr'	Buffer Clock (Source)
		IRFS_T1_ssss'cr'	Interface Receive Frame Structure (T1)
		IRFS_E1_ssss'cr'	Interface Receive Frame Structure (E1)
		IBP_xxx'cr'	Interface Buffer Programming
		IBS_nnnnnn'cr'	Interface Buffer Size
		ITOT_xxxxx'cr'	Interface Transmit Overhead Type
		IROT_xxxxx'cr'	Interface Receive Overhead Type
		ISP_xxx'cr'	Interface Substitution Pattern (TX 2047)
		IRE_xxxx'cr'	Interface Read Error (RX 2047)
		TDF_xxxx'cr'	Transmit Data Fault
		RDF_xxxx'cr'	Receive Data Fault
		TDP_xxxx'cr'	Transmit Data Phase
		RDP_xxxx'cr'	Receive Data Phase
		TXDR_xxxxxx'cr'	TX Driver Type
		RXDR_xxxxxx'cr'	RX Driver Type
		TOBR_nnnnn'cr' (Note 1)	ASYNC Transmit Overhead Baud Rate
		TCCL_n'cr' (Note 1)	ASYNC Transmit Channel Character Length
		TCSB_n'cr' (Note 1)	ASYNC Transmit Channel Stop Bits
		TOCP_xxxx'cr' (Note 1)	ASYNC Transmit Overhead Channel Parity
		TCT_xxxxx'cr' (Note 1)	ASYNC Transmit Communications Type
		ROBR_nnnnn'cr' (Note 2)	ASYNC Receive Overhead Baud Rate
		RCCL_n'cr' (Note 2)	ASYNC Receive Channel Character Length
		RCSB_n'cr' (Note 2)	ASYNC Receive Channel Stop Bits
		ROCP_xxxx'cr' (Note 2)	ASYNC Receive Overhead Channel Parity
		RCT_xxxxx'cr' (Note 2)	ASYNC Receive Communications Type
		LPC_xxx'cr' (Note 1)	AUPC Local Power Enable
		NOMP_snn.n'cr' (Note 1)	AUPC Nominal Power Value
		MINP_snn.n'cr' (Note 1)	AUPC Minimum Power Value
		MAXP_snn.n'cr' (Note 1)	AUPC Maximum Power Value
		LCL_xxxx'cr' (Note 1)	AUPC Local Carrier Loss
		RCL_xxxx'cr' (Note 1)	AUPC Remote Carrier Loss
		ENSP_nn.n'cr' (Note 2)	AUPC EBN0 Target Set Point
		MAXT_n.n'cr' (Note 2)	AUPC Maximum Tracking Rate
		RTSM_xxx'cr'	RTS TX-IF Control Mode
		CTSD_xx'cr''lf']	CTS Delay Time
			The Interface configuration status command causes a block of data to be returned by the addressed MODEM. The block reflects the current configuration of the interface. Additional configuration status of new options and features will always be appended to the end.
			Notes: 1. Data is only returned for TX ASYNC Overhead. 2. Data is only returned for RX ASYNC Overhead.

MODEM Faults Status (Summary)	Command: Response:	<add/MFS_'cr' >add/MFS_'cr' DMD_xxx'cr' MOD_xxx'cr' ITX_xxx'cr' IRX_xxx'cr' CEQ_xxx'cr' BWAL_xxx'cr' ODU_xxx'cr''lf']	 Demodulator (FLT/OK) Modulator (FLT/OK) Interface Transmit Side (FLT/OK) Interface Receive Side (FLT/OK) Common Equipment (FLT/OK) Backward Alarms (FLT/OK) ODU (FLT/OK)
Modulator Status	Command: Response:	<add/MS_'cr' >add/MS_'cr' RF_xxx'cr' MOD_xxx'cr' SYN_xxx'cr' DCS_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' SCT_xxx'cr' SFLT_xx'cr''lf']	 RF output (ON/OFF) actual status not config Module (OK/FLT) IF Synthesizer (OK/FLT) Data Clock Synthesizer (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) Modem Reference PLL Lock (OK/FLT) Number of stored faults logged (0 to 10)
Demodulator Status	Command: Response:	<add/DS_'cr' >add/DS_'cr' MOD_xxx'cr' CD_xxx'cr' SYN_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' BERT_xxx'cr' SFLT_xx'cr''lf']	 Demod Module (OK/FLT) Carrier Detect (OK/FLT) IF Synthesizer Lock (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) BER Threshold (OK/FLT) Number of stored faults logged (0 to 10)
Interface Transmit Side Status	Command: Response:	<add/ITXS_'cr' >add/ITXS_'cr' TXD_xxx'cr' PLL_xxx'cr' CLK_xxx'cr' SFLT_xx'cr''lf']	 Transmit Data/AIS (OK/FLT) Transmit Synthesizer PLL Lock (OK/FLT) Selected Transmit Clock Activity (OK/FLT) Number of Stored Faults Logged (0 to 10) Note: Reserved for future use.
Interface Receive Side Status	Command: Response:	<add/IRXS_'cr' >add/IRXS_'cr' UNFL_xxx'cr' OVFL_xxx'cr' RXD_xxx'cr' FBER_xxx'cr' CLK_xxx'cr' PLL_xxx'cr' DMUX_xxx'cr' 2047_xxx'cr' BUFF_xxx'cr' SFLT_xx'cr''lf']	 Buffer Underflow (OK/FLT) Buffer Overflow (OK/FLT) Receive Data Loss/AIS (OK/FLT) Frame BER (OK/FLT) Selected Buffer Clock Activity (OK/FLT) Buffer Clock PLL Lock (OK/FLT) Demux Lock (OK/FLT) 2047 Pattern Lock Detect (OK/FLT) Buffer Full (OK/FLT) Number of Stored Faults Logged (0 to 10)
Common Equipment Status	Command: Response:	<add/CES_'cr' >add/CES_'cr' M&C_xxx'cr' INT_xxx'cr' BAT_xxx'cr' +5_xxx'cr' +12_xxx'cr' -12_xxx'cr' PST_xxx'cr' ST_xxx'cr' MODE_xxxxxx'cr' SFLT_xx'cr''lf']	 Monitor & Control Module (OK/FLT) Data Interface/Overhead Module (OK/FLT) Battery/Clock (OK/FLT) +5V Power Supply (OK/FLT) +12V Power Supply (OK/FLT) -12V Power Supply (OK/FLT) IDU Power Supply (OK/FLT) Self Test (OK/FLT) Mode (LOCAL or REMOTE) Number of stored faults logged (0 to 10)

Outdoor Unit Status	Command: Response:	<add/OUS_'cr' >add/OUS_'cr' C-Band: MOD_xxx'cr' COM_xxx'cr' SFLT_xx'cr''lf']	 C-Band: Module (OK/FLT) Communication (OK/FLT) Number of stored faults logged (0 to 10)
Raw BER	Command: Response:	<add/RBER_'cr' >add/RBER_xm.mE-ee'cr''lf']	Where: x = < or > (data modifier to indicate that the error rate is less than or greater than the returned value). m.m = 1.0 to 9.9 (error rate mantissa). ee = 1 to 99 (error rate exponent). Notes: 1. The 'x' (< or >) parameter is only returned if the error rate has exceeded the computational resolution of the system. 2. 'No Data' is returned if the error rate cannot be calculated. 3. 'Sampling' is returned if not enough data is currently available to calculate the error rate.
Corrected BER	Command: Response:	<add/CBER_'cr' >add/CBER_xm.mE-ee'cr''lf']	Where: x = < or > (data modifier to indicate that the error rate is less than or greater than the returned value). m.m = 1.0 to 9.9 (error rate mantissa). ee = 1 to 99 (error rate exponent). Notes: 1. The 'x' (< or >) parameter is only returned if the error rate has exceeded the computational resolution of the system. 2. 'No Data' is returned if the error rate cannot be calculated. 3. 'Sampling' is returned if not enough data is currently available to calculate the error rate.

Interface Read Error Status	Command: Response:	<add/IRES_'cr' >add/IRES_tttt_xn.nE-ee'cr''lf']	Where: tttt = FRM (FRAME) or 2047 (indicates type of error being read). x = < or > (data modifier to indicate that the error rate is less than or greater than the returned value). m.m = 1.0 to 9.9 (error rate mantissa). ee = 1 to 99 (error rate exponent). This command returns frame or 2047 error rate. The 'IRE_' configuration command is used to select reading of frame or 2047 errors. Notes: 1. The 'x' (< or >) parameter is only returned if the error rate has exceeded the computational resolution of the system. 2. 'No Data' is returned if the error rate cannot be calculated. 3. 'Sampling' is returned if not enough data is currently available to calculate the error rate.
Eb/N0 Status	Command: Response:	<add/EBN0_'cr' >add/EBN0_xnn.ndB'cr''lf']	Where: x = < or > (data modifier to indicate that the Eb/N0 is less than or greater than the returned value). nn.n = 1.0 to 99.9 (Eb/N0 value). Notes: 1. The 'x' (< or >) parameter is only returned if the Eb/N0 has exceeded the computational resolution of the system. 2. 'No Data' is returned if the Eb/N0 cannot be calculated. 3. 'Sampling' is returned if not enough data is currently available to calculate the Eb/N0.
Modulator Rate Status	Command: Response:	<add/MR_'cr' >add/MR_nnnn_mmmm.mmm'cr''lf']	Where: nnnn = 1/2 (QPSK 1/2), [Coder rate], 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2), QPSK (QPSK 1/1). mmmm.mmm = Data rate in kHz.
Demodulator Rate Status	Command: Response:	<add/DR_'cr' >add/DR_nnnn_mmmm.mmm'cr''lf']	Where: nnnn = 1/2 (QPSK 1/2), [Decoder rate]. 3/4 (QPSK 3/4), 7/8 (QPSK 7/8), BP12 (BPSK 1/2). mmmm.mmm = Data rate in kHz.

Receive Signal Level Status	Command: Response:	<add/RSL_'cr' >add/RSL_xsnn.ndBm'cr''lf']	Where: x = < or > (data modifier to indicate that the receive signal level is less than or greater than the returned value). s = + or - (receive signal level sign, plus or minus). nn.n = 0.0 to 99.9 (receive signal level magnitude). Notes: 1. The 'x' (< or >) parameter is only returned if the level has exceeded the computational resolution of the system. 2. 'No Data' is returned if the level cannot be calculated. 3. 'Sampling' is returned if not enough data is currently available to calculate the level.
Interface Buffer Fill Status	Command: Response:	<add/IBFS_'cr' >add/IBFS_nn%'cr''lf']	Where: nn = 1 to 99 (relative to buffer depth).
Current Sweep Value	Command: Response:	<add/CSV_'cr' >add/CSV_xsnnnnn'cr' CD_yyy'cr''lf']	Where: x = < or > (data modifier to indicate that the sweep offset value is less than or greater than the returned value). s = + or - (sweep offset from center). nnnnn = 0 to 35000. yyy = OK or FLT (decoder lock status OK or FAULT). This command returns the current sweep offset value. Notes: 1. The 'x' (< or >) parameter is only returned if the level has exceeded the computational resolution of the system. 2. 'No Data' is returned if the level cannot be calculated. 3. 'Sampling' is returned if not enough data is currently available to calculate the level.
Power Supply Temperature	Command: Response:	<add/PST_'cr' >add/PST_snnn'cr''lf']	Where: s = + or -. nnn = 0 to 125 (Degrees Celsius). Note: 'No Data' is returned if the temperature cannot be read from power supply.

B.7 Stored Faults

Information on stored faults is returned when requested. If no stored fault exists for a given fault number, the words "NO Fault" will be returned instead of the normal time/date status information.

The following symbols are commonly used to define the stored faults status commands:

- # Fault number (0 to 9). "0" is the first fault stored.
- hh Hours in 24-hr. format.
- mm Minutes.
- ss Seconds.
- MM Month.
- DD Day.
- YY Year.

Modulator Stored Faults	Command: Response:	<add/MSF_#'cr' >add/MSF_# hh:mm:ss MM/DD/YY'cr' MOD_xxx'cr' SYN_xxx'cr' DCS_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' SCT_xxx'cr''lf']	Module (OK/FLT) IF Synthesizer (OK/FLT) Data Clock Synthesizer (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) Modem Reference PLL Lock (OK/FLT)
Demodulator Stored Faults	Command: Response:	<add/DSF_#'cr' >add/DSF_# hh:mm:ss MM/DD/YY'cr' MOD_xxx'cr' CD_xxx'cr' SYN_xxx'cr' ICH_xxx'cr' QCH_xxx'cr' BERT_xxx'cr''lf']	Demod Module (OK/FLT) Carrier Detect (OK/FLT) IF Synthesizer Lock (OK/FLT) I Channel (OK/FLT) Q Channel (OK/FLT) BER threshold (OK/FLT)
Interface Transmit Side Stored Faults	Command: Response:	<add/ITSF_#'cr' >add/ITSF_# hh:mm:ss MM/DD/YY'cr' TXD_xxx'cr' PLL_xxx'cr' CLK_xxx'cr''lf']	Transmit Data/AIS (OK/FLT) Transmit Synthesizer PLL Lock (OK/FLT) Selected Transmit Clock Activity (OK/FLT)
Interface Receive Side Stored Faults	Command: Response:	<add/IRSF_#'cr' >add/IRSF_# hh:mm:ss MM/DD/YY'cr' UNFL_xxx'cr' OVFL_xxx'cr' RXD_xxx'cr' FBER_xxx'cr' CLK_xxx'cr' PLL_xxx'cr' DMUX_xxx'cr' 2047_xxx'cr' Lock Detect (OK/FLT) BUFF_xxx'cr''lf']	Buffer Underflow (OK/FLT) Buffer Overflow (OK/FLT) Receive Data Loss/AIS (OK/FLT) Frame BER (OK/FLT) Selected Buffer Clock Activity (OK/FLT) Buffer Clock PLL Lock (OK/FLT) Demux Lock (OK/FLT) 2047 Pattern Lock Detect (OK/FLT) Buffer Full (OK/FLT)

Common Equipment Stored Faults	Command: Response:	<add/CSF_#'cr' >add/CSF_# hh:mm:ss MM/DD/YY'cr' M&C_xxx'cr' INT_xxx'cr' BAT_xxx'cr' +5_xxx'cr' +12_xxx'cr' -12_xxx'cr' PST_xxx'cr' ST_xxx'cr' PS_xxx'cr''lf']	Monitor & Control Module (OK/FLT) Data Interface/Overhead Module (OK/FLT) Battery/Clock (OK/FLT) +5V Power Supply (OK/FLT) +12V Power Supply (OK/FLT) -12V Power Supply (OK/FLT) IDU Power Supply (OK/FLT) Self Test (OK/FLT) Power Supply (OK/FLT)
Reed-Solomon Unavailable Seconds	Command: Response:	<add/RSSF_#'cr' >add/RSSF_# hh:mm:ss MM/DD/YY'cr' UNA_xxx'cr''lf']	Unavailable Seconds (FLT/OK)
Outdoor Unit Stored Faults	Command: Response:	<add/OUSF_#'cr' >add/OUSF_# hh:mm:ss MM/DD/YY'cr' MOD_xxx'cr' COM_xxx'cr''lf']	Module (OK/FLT) Communication (OK/FLT)

Bulk Consol. Analog Status	Command: Response:	<add/BCAS_'cr' >add/BCAS_p1,p2,p3, . . . pn'cr''lf']	This command is similar to the 'BCS_' command but, returns MODEM analog parameters. Additional status of new options and features will always be appended to the end.
Where 'pn' is the last parameter returned.			
	Parameter Number	**Parameter Name** (Command Reference)	**Description**
	1	**Receive Signal Level** (ref. 'RSL_' command).	p1 = xsnn.n, receive signal level in dBm.
	2	**Raw BER** (ref. 'RBER_' command).	p2 = xm.mE-ee.
	3	**Corrected BER** (ref. 'CBER_' command).	p3 = xm.mE-ee.
	4	**Interface Read Error Status** (ref. 'IRES_' command).	p4 = tttt_xm.mE-ee.
	5	**EB/N0** (ref. 'EBN0_' command).	p5 = xnn.n, EB/N0 in dB.
	6	**Buffer Fill Status** (ref. 'IBFS_' command).	p6 = nn%, buffer fill status.
Note: Parameters 2 through 6 are dependent on carrier acquisition, if the decoder is not locked empty data blocks are returned (,,,,,).			

Bulk Consol. Status	Command: Response:	<add/BCS_'cr' >add/BCS_p1,p2,p3, . . . pn'cr''lf']	This command causes bulk modem status to be returned. To reduce the length of the response, message parameter data are returned without identifiers. However, parameter identification can be determined by order of return. Each status parameter is terminated with a ',' (comma) except for the last parameter which has the standard message termination sequence ('cr''lf']). Most of the data returned is formatted the same way as the single command status request (refer to the appropriate portions of this document in preceding sections). Additional configuration status of new options and features will always be appended to the end.

Where 'pn' is the last parameter returned.

Parameter Number	Parameter Name (Command Reference)	Description
1	**Modulator RF output** (ref. 'RF_' command).	p1 = n, where 'n' is '0' (off) or '1' (on).
2	**Modulator IF frequency** (ref. 'MF_' command).	C-Band: p2 = n.nnnnnnn, IF frequency in GHz. Ku-Band: p2 = nn.nnnnnnn, IF frequency in GHz.
3	**Modulator rate** (ref. 'MR_' command).	p3 = nnnn_mmmm.mmm, code rate/data rate in Kbps.
4	**Modulator preset 'A' assignment** (ref. 'AMRA_' command).	p4 = nnnn_mmmm.mmm, code rate/data rate in Kbps.
5	**Modulator preset 'B' assignment** (ref. 'AMRB_' command).	p5 = nnnn_mmmm.mmm, code rate/data rate in Kbps.
6	**Modulator preset 'C' assignment** (ref. 'AMRC_' command).	p6 = nnnn_mmmm.mmm, code rate/data rate in Kbps.
7	**Modulator preset 'D' assignment** (ref. 'AMRD_' command).	p7 = nnnn_mmmm.mmm, code rate/data rate in Kbps.
8	**Modulator preset 'V' assignment** (ref. 'AMRV_' command).	p8 = nnnn_mmmm.mmm, code rate/data rate in Kbps.
9	**Modulator output power level** (ref. 'MOP_' command).	p9 = snn.n, transmitter output power level in dBm.
10	**Scrambler enable** (ref. 'SE_' command).	p10 = n, where 'n' is '0' (off) or '1' (on).
11	**Differential encoder enable** (ref. 'DENC_' command).	p11 = n, where 'n' is '0' (off) or '1' (on).
12	**Modulator type** (ref. 'MT_' command).	p12 = n, where 'n' is '0' (EFD), '1' (INTL), '3' (FDC),'4' (CSC), or '6' (SDM51).
13	**Modulator encoder type** (ref. 'MET_' command).	p13 = n, where 'n' is '0' (SEQ), '1' (VIT).
14	**Carrier only mode ON/OFF.**	p14 = n, where 'n' is '0' (off) or '1' (on).

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Parameter Number	Parameter Name (Command Reference)	Description
15	**Demodulator IF frequency** (ref. 'DF_' command).	C-Band: p15 = n.nnnnnnn, demodulator IF frequency in GHz. Ku-Band: p15 = nn.nnnnnnn, demodulator IF frequency in GHz.
16	**Demodulator rate** (ref. 'DR_' command).	p16 = nnnn_mmmm.mmm, code rate/data rate in Kbps.
17	**Demodulator preset A assignment** (ref. 'ADRA_' command).	p17 = nnnn_mmmm.mmm, code rate/data rate in Kbps.
18	**Demodulator preset B assignment** (ref. 'ADRB_' command).	p18 = nnnn_mmmm.mmm, code rate/data rate in Kbps.
19	**Demodulator preset C assignment** (ref. 'ADRC_' command).	p19 = nnnn_mmmm.mmm, code rate/data rate in Kbps.
20	**Demodulator preset D assignment** (ref. 'ADRD_' command).	p20 = nnnn_mmmm.mmm, code rate/data rate in Kbps.
21	**Demodulator preset V assignment** (ref. 'ADRV_' command).	p21 = nnnn_mmmm.mmm, code rate/data rate in Kbps.
22	**Descrambler enable** (ref. 'DE_' command).	p22 = n, where 'n' is '0' (off) or (on).
23	**Differential decoder enable** (ref. 'DDEC_' command).	p23 = n, where 'n' is '0' (off) or (on).
24	**Reserved null field.** **Demodulator Band** (ref. 'DB_' command)	Ku-Band: p24 = n, where 'n' is 'A', 'B,' or 'C' (RX Frequency band).
25	**RF Loopback** (ref. 'RFL_' command).	p25 = n, where 'n' is '0' (off) or '1' (on).
26	**IF Loopback** (ref. 'IFL_' command).	p26 = n, where 'n' is '0' (off) or '1' (on).
27	**Sweep Center frequency** (ref. 'SCF_' command).	p27 = snnnnn, sweep center frequency in Hertz.
28	**Sweep width range** (ref. 'SWR_' command).	p28 = nnnnn, sweep range in Hertz.
29	**Sweep reacquisition** (ref. 'SR_' command).	p29 = nnn, reacquisition time in seconds.
30	**BER threshold** (ref. 'BERT_' command).	p30 = xxxx, BER threshold.
31	**Demodulator type** (ref. 'DT_' command).	p31 = n, where 'n' is '0' (EFD), '1' (INTL), '3' (FDC), or '4' (CSC).
32	**Demodulator decoder type** (ref. 'DDT_' command).	p32 = n, where 'n' is '0' (SEQ) or '1' (VIT).

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Parameter Number	Parameter Name (Command Reference)	Description
33	**Transmit clock source** (ref. 'TC_' command).	p33 = n, where 'n' is '0' (INT), '1' (REF) or '2' (EXT).
34	**External reference frequency** (ref. 'ERF_' command).	p34 = nnnnn.n, external reference frequency in kHz.
35	**Transmit clock phase** (ref. 'TCP_' command).	p35 = n, where 'n' is '0' (NRM), '1' (INV), or '2' (AUTO).
36	**Receive clock phase** (ref. 'RCP_' command).	p36 = n, where 'n' is '0' (NRM) or '1' (INV).
37	**Baseband loopback** (ref. 'BBL_' command).	p37 = n, where 'n' is '0' (off) or '1' (on).
38	**Interface loopback** (ref. 'ILB_' command).	p38 = n, , where 'n' is '0' (off) or '1' (on).
39	**Interface loop timing** (ref. 'ILT_' command).	p39 = n, where 'n' is '0' (off) or '1' (on).
40	**TX Interface coding format** (ref. 'ICFT_' command).	40 = n, where 'n' is '0' (AMI), '2' (B8ZS), or '3' (HDB3).
41	**RX Interface coding format** (ref. 'ICFR_' command).	p41 = n, where 'n' is '0' (AMI), '2' (B8ZS), or '3' (HDB3).
42	**Buffer clock source** (ref. 'BC_' command).	p42 = n, where 'n' is '0' (INT), '1' (REF), '2' (EXT), '3' (SAT), or '5' (INS).
43	**Interface RX-T1 frame structure** (ref. 'IRFS_' command).	p43 = n, where n is '0' (NONE) or '1' (G704).
44	**Reserved null field.**	
45	**Interface RX-E1 frame structure** (ref. 'IRFS_' command).	p45 = n, where n is '0' (NONE) or '1' (G704).
46	**Reserved null field.**	
47	**Interface Buffer Programming** (ref. 'IBP_' command).	p47 = n, where 'n' is '0' (BITS) or '1' (MS).
48	**Interface buffer size** (ref. 'IBS_' command).	p48 = nnnnnn, buffer size in bits or milli seconds.
49	**Interface transmit overhead type** (ref. 'ITOT_' command).	p49 = n, where 'n' is '0' (NONE), '1' (IDR), '2' (IBS), '3' (DI), or '4' (ASYNC).
50	**Interface receive overhead type** (ref. 'IROT_' command).	p50 = n, where 'n' is '0' (NONE), '1' (IDR), '2' (IBS), '3' (DI), or '4' (ASYNC).
51	**Interface substitution pattern** (ref. 'ISP_' command).	p51 = n, where 'n' is '0' (off) or '1' (on).

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Parameter Number	Parameter Name (Command Reference)	Description
52	**Interface read error** (ref. 'IRE_' command).	p52 = n, where 'n' is '0' (FRMOFF) or '1' (2047/ON).
53	**Transmit data fault** (ref. 'TDF_' command).	p53 = n, where 'n' is '0' (NONE), '1' (DATA), or '2' (AIS).
54	**Receive data fault** (ref. 'RDF_' command).	p54 = n, where 'n' is '0' (NONE), '1' (DATA), or '2' (AIS).
55	**Interface service channel TX1** (ref. 'ISCL_' command).	p55 = nnn, service channel level in dBm.
56	**Interface service channel TX2** (ref. 'ISCL_' command).	p56 = nnn, service channel level in dBm.
57	**Interface service channel RX1** (ref. 'ISCL_' command).	p57 = nnn, service channel level in dBm.
58	**Interface service channel RX2** (ref. 'ISCL_' command).	p58 = nnn, service channel level in dBm.
59	**System modem type** (ref. 'SMT_' command).	p59 = n, where 'n' is '0' (IDR), '1' (IBS), '2' (EFD), '3' (CUSTOM), '4' (DI), or '5' (ASYNC).
60	**Modem operation mode** (ref. 'MOM_' command).	p60 = n, where 'n' is '1' (TX_ONLY), '2' (RX_ONLY), or '3' (DUPLEX).
61	**Modem remote/local mode.**	p61 = n, where 'n' is '0' (LOCAL) or '1' (REMOTE).
62	**Transmit data phase** (ref. 'TDP_' command).	p62 = n, where 'n' is '0' (NRM) or '1' (INV).
63	**Receive data phase** (ref. 'RDP_' command).	p63 = n, where 'n' is '0' (NRM) or '1' (INV).
64	**Reserved null field.**	
65	**Reserved null field.**	
66	**Reserved null field.**	
67	**Reserved null field.**	
68	**Reserved null field.**	
69	**Reserved null field.**	
70	**Modulator Spectrum Rotation** (ref. 'MSR_' command).	p70 = n, where 'n' is '0' (NRM) or '1' (INV).

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	Parameter Number	Parameter Name (Command Reference)	Description
	71	**Demodulator Spectrum Rotation** (ref. 'DSR_' command).	p71 = n, where 'n' is '0' (NRM) or '1' (INV).
	72	**Reed-Solomon Encoder Enable** (ref. 'RSEN_' command).	p72 = n, where 'n' is '0' (off) or '1' (on).
	73	**Reed-Solomon Decoder Enable** (ref. 'RSDE_' command).	p73 = n, where 'n' is '0' (FF), '1' (ON), or '2' (CORR_OFF).
	74 to 81	**Reserved null fields.** (ref. 'BW_TX1' command).	
	82	**TX Driver Type** (ref. 'TXDR_' command).	p82 = n, where 'n' is '0' (G.703), '1' (V.35), '2' (RS422), or '3' (RS232).
	83	**RX Driver Type** (ref. 'RXDR_' command).	p83 = n, where 'n' is '0' (G.703), '1' (V.35), '2' (RS422), or '3' (RS232).
	84	**Reserved null field.**	
(Note 1)	85	**ASYNC TX Overhead Baud Rate** (ref. 'TOBR_' command).	p85 = nnnnn, where 'nnnnn' is the currently programmed baud rate.
(Note 2)	86	**ASYNC RX Overhead Baud Rate** (ref. 'ROBR_' command).	p86 = nnnnn, where 'nnnnn' is the currently programmed baud rate.
(Note 1)	87	**ASYNC TX Channel Char. Length** (ref. 'TCCL_' command).	p87 = n, where 'n' is the currently programmed character length.
(Note 2)	88	**ASYNC RX Channel Char. Length** (ref. 'RCCL_' command).	p88 = n, where 'n' is the currently programmed character length.
(Note 1)	89	**ASYNC TX Channel Stop Bits** (ref. 'TCSB_' command).	p89 = n, where 'n' is the current number of stop bits programmed.
(Note 2)	90	**ASYNC RX Channel Stop Bits** (ref. 'RCSB_' command).	p90 = n, where 'n' is the current number of stop bits programmed.

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	Parameter Number	Parameter Name (Command Reference)	Description
(Note 1)	91	**ASYNC TX Channel Parity** (ref. 'TOCP_' command).	p91 = xxxx, where 'xxxx' is the currently programmed parity.
(Note 2)	92	**ASYNC RX Channel Parity** (ref. 'ROCP_' command).	p92 = xxxx, where 'xxxx' is the currently programmed parity.
(Note 1)	93	**ASYNC TX Communications Type** (ref. 'TCT_' command).	p93 = n, where 'n' is '0' (RS232), '1' (RS485_4WIRE), '2' (RS485_2WIRE).
(Note 2)	94	**ASYNC RX Communications Type** (ref. 'RCT_' command).	p94 = n, where 'n' is '0' (RS232), '1' (RS485).
(Note 1)	95	**AUPC Local Power enable ON/OFF** (ref. 'LPC_' command).	p95 = n, where 'n' is '0' (off) or '1' (on).
(Note 1)	96	**AUPC Nominal Power Value** (ref. 'NOMP_' command).	p96 = snn.n, where 'snn.n' Nominal Power Value in dBm.
(Note 1)	97	**AUPC Minimum Power Value** (ref. 'MINP_' command).	p97 = snn.n, where 'snn.n' Minimum Power Value in dBm.
(Note 1)	98	**AUPC Maximum Power Value** (ref. 'MAXP_' command).	p98 = snn.n, where 'snn.n' Maximum Power Value in dBm.
(Note 2)	99	**AUPC EBN0 Target Set Point** (ref. 'ENSP_' command).	p99 = nn.n, where 'nn.n' EBN0 Target Set Point in dB.
(Note 2)	100	**AUPC Max. Tracking Rate** (ref. 'MAXT_' command).	p100 = n.n, where 'n.n' is the Max. Tracking Rate in dB/Min.
(Note 1)	101	**AUPC Local Carrier Loss** (ref. 'LCL_' command).	p101 = n, where 'n' is '0' (HOLD), '1' (NOMINAL), or '2' (MAXIMUM).
(Note 1)	102	**AUPC Remote Carrier Loss** (ref. 'RCL_' command).	p102 = n, where 'n' is '0' (HOLD), '1' (NOMINAL), or '2' (MAXIMUM).
	103	**Reserved null field.**	

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Parameter Number	Parameter Name (Command Reference)	Description
104	**Reserved null field.**	
105	**Transmit BPSK Data Ordering** (ref. 'TDA_' command).	p105 = n, where 'n' is '0' (NRM) or '1' (INV).
106	**Receive BPSK Data Ordering** (ref. 'RDA_' command).	p106 = n, where 'n' is '0' (NRM) or '1' (INV).
107	**RTS TX-IF Control Mode** (ref. 'RTSM_' command).	p107 = n, where ,n, is '0' (OFF) or '1' (ON).
108	**CTS Delay Time** (ref. 'CTSD_' command).	p108 = nn, CTS delay time in seconds.
109	**Carrier Only Mode** (ref. 'COM_' command).	p109 = n, where 'n' is '0' (OFF),'1' (CENTER-CW), '2' (DUAL-CW), '3' (OFFSET-CW).

Notes:
1. Data will only be returned if TX Overhead is programmed for ASYNC. Comma is always returned.
2. Data will only be returned if RX Overhead is programmed for ASYNC. Comma is always returned.

Bulk Consol. Status Faults	Command: Response:	<add/BCSF_'cr' >add/BCSF_abcdefghijklmnopqrstu'cr''lf']	This command causes all modem fault status to be returned. To reduce the length of the response, fault status is embedded into the bit structure of the characters that are returned. Faults are indicated by a binary 1 in the designated bit position. Character 'a': Modulator fault status character 1. Bit 6 = 1 always. Bit 5 = Modulator module fault. Bit 4 = RF output status, actual not programmed status (1 = on, 0 = off). Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of modulator stored faults. Character 'b': Modulator fault status character 2. Bit 6 = 1 always. Bit 5 = IF Synthesizer. Bit 4 = reserved. Bit 3 = Data Clock Synthesizer. Bit 2 = I Channel. Bit 1 = Q Channel. Bit 0 = reserved. Character 'c': Modulator fault status character 3. Bit 6 = 1 always. Bit 5 = Modem Reference PLL Lock. Bit 4 = reserved. Bit 3 = reserved. Bit 2 = reserved. Bit 1 = reserved. Bit 0 = reserved. Character 'd': Demodulator fault status character 1. Bit 6 = 1 always. Bit 5 = Demod module fault. Bit 4 = Carrier detect status (0 for decoder lock). Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of demodulator stored faults. Character 'e': Demodulator fault status character 2. Bit 6 = 1 always. Bit 5 = IF Synthesizer Lock. Bit 4 = reserved. Bit 3 = I Channel. Bit 2 = Q Channel. Bit 1 = reserved. Bit 0 = BER threshold. Character 'f': Demodulator fault status character 3. Bit 6 = 1 always. Bit 5 = reserved. Bit 4 = reserved. Bit 3 = reserved. Bit 2 = reserved. Bit 1 = reserved. Bit 0 = reserved. Character 'g': Interface transmit side faults character 1. Bit 6 = 1 always. Bit 5 = reserved. Bit 4 = reserved. Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of interface transmit side stored faults.

			Character 'h': Interface transmit side faults character 2. Bit 6 = 1 always. Bit 5 = Transmit Data/AIS. Bit 4 = Transmit Synthesizer PLL Lock. Bit 3 = Selected Transmit Clock Activity. Bit 2 = reserved. Bit 1 = reserved. Bit 0 = Drop fault. Character 'i': Interface transmit side faults character 3. Bit 6 = 1 always. Bit 5 = reserved. Bit 4 = reserved. Bit 3 = reserved. Bit 2 = reserved. Bit 1 = reserved. Bit 0 = reserved. Character 'j': Interface receive side faults character 1. Bit 6 = 1 always. Bit 5 = reserved. Bit 4 = reserved. Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of interface receive side stored faults. Character 'k': Interface receive side faults character 2. Bit 6 = 1 always. Bit 5 = Buffer Underflow. Bit 4 = Buffer Overflow. Bit 3 = Receive Data Loss/AIS. Bit 2 = Frame BER. Bit 1 = reserved. Bit 0 = Selected Buffer Clock Activity. Character 'l': Interface receive side faults character 3. Bit 6 = 1 always. Bit 5 = Buffer Clock PLL Lock. Bit 4 = Demux Lock. Bit 3 = 2047 Pattern Lock Detect. Bit 2 = Buffer Full. Bit 1 = reserved. Bit 0 = reserved. Character 'm': Interface receive side faults character 4. Bit 6 = 1 always. Bit 5 = reserved. Bit 4 = reserved. Bit 3 = reserved. Bit 2 = reserved. Bit 1 = reserved. Bit 0 = reserved. Character 'n': Common equipment fault status character 1. Bit 6 = 1 always. Bit 5 = Monitor & Control Module. Bit 4 = Interface Module. Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of common equipment stored faults. Character 'o': Common equipment fault status character 2. Bit 6 = 1 always. Bit 5 = Battery/Clock. Bit 4 = +5V Power Supply. Bit 3 = reserved. Bit 2 = +12V Power Supply. Bit 1 = -12V Power Supply. Bit 0 = reserved.

			Character 'p': Interface backward alarm status character 1. Bit 6 = 1 always. Bit 5 = reserved. Bit 4 = reserved. Bit 3 = reserved. Bit 2 = reserved. Bit 1 = reserved. Bit 0 = reserved. Character 'q': Interface backward alarm status character 2. Bit 6 = 1 always. Bit 5 = reserved. Bit 4 = reserved. Bit 3 = reserved. Bit 2 = reserved. Bit 1 = reserved. Bit 0 = reserved. Character 'r': Interface Reed-Solomon Unavailable Seconds. Bit 6 = 1 always. Bit 5 = not used. Bit 4 = not used. Bit 3 through Bit 0 = Binary representation (0 to 10) of the number of Reed-Solomon Unavailable Seconds stored faults. Character 's': Outdoor Unit fault status character 1. Bit 6 = 1 always. Bit 5 = Module. Bit 4 = reserved. Bit 3 = reserved. Bit 2 = reserved. Bit 1 = reserved. Bit 0 = reserved.

Change Status	Command: Response:	<add/CS_'cr' >add/CS_x'cr''lf']	This command indicates that a change has or has not occurred on either the BCS_ or the BCSF_ response since the last BCS_ or BCSF_ poll. The 'x' character is defined as follows: '@' = no change since last BCS_ and BCSF_ polls. 'A' = BCS_ response has changed since last BCS_ poll. 'B' = BCSF_ response has changed since last BCSF_ poll. 'C' = Both responses have changed since last BCS_ and BCSF_ polls.
Equipment Type	Command: Response:	<add/ET_'cr' >add/ET_ttttttt_xxx.yyy.zzz'cr''lf']	Where: ttttttt = Equipment type. xxx.yyy.zzz = Software version. This command returns the equipment type and the software version of the addressed device.
Monitor & Control Firmware Information	Command: Response:	<add/MCFI_'cr' >add/MCFI_'cr' VER_xxx.yyy.zzz'cr' FW/nnnnnn-ddr'cr' mm/dd/yy'cr''lf']	Where: xxx.yyy.zzz = Software version number (0.0.0 to 999.999.999). nnnnnn = Firmware number (0 to 999999). dd = Firmware dash number (0 to 99). r = Firmware revision (-, or A to Z).
DATA ROM Firmware Information	Command: Response:	<add/DFI_'cr' >add/DFI_'cr' FW/nnnnnn-ddr'cr' mm/dd/yy'cr''lf']	Where: nnnnnn = Firmware number (0 to 999999). dd = Firmware dash number (0 to 99). r = Firmware revision (-, or A to Z). Note: If Dash number is not used, '-dd' will be reported.
Boot M&C Firmware Information	Command: Response:	<add/BFI_'cr' >add/BFI_'cr' VER_xxx.yyy.zzz'cr' FW/nnnnnn-ddrr'cr' mm/dd/yy'cr''lf']	Where: xxx.yyy.zzz = Software version number (0.0.0 to 999.999.999). nnnnnn = Firmware number (0 to 999999). dd = Firmware dash number (0 to 99). rr = Firmware revision (-, or A to Z).

Modem Options/ Misc. Information	Command: Response:	<add/MOI_'cr' >add/MOI_'cr' s,HGH_PWR'cr' s,HGH_STAB'cr' s,ASLT'cr' s,VIT'cr' s,SEQ'cr' s,SR'cr' s,LVR'cr' s,FVR'cr' s,CARD_1_PCB'cr' s,CARD_2_PCB'cr' s,CARD_3_PCB'cr''lf']	 (0 or +) High Power (0 or +) High Stability (- or +) Asymmetrical Loop Timing (- or +) Viterbi Encoder/Decoder (- or +) Sequential Encoder/Decoder (- or +) Single Code/Data Rate (- or +) Low Variable Rate (- or +) Full Variable Rate (x or +) Card #1 Installed (x or +) Card #2 Installed (x or +) Card #3 Installed Where: s = 0 (Not Installed, Not Upgradable), - (Not Installed, FAST Upgradable), + (Installed), X (Not Installed, Field Upgradable).
Card #1 Type Information	Command: Response:	<add/C1TI_'cr' >add/C1TI_'cr' ttttt'cr''lf']	Where: ttttt = type (OH_01, MUX_01, or NOT_INSTALLED).
Card #2 Type Information	Command: Response:	<add/C2TI_'cr' >add/C2TI_'cr' tttt'cr''lf']	Where: tttt = type (RS_02, RS_03 or NOT_INSTALLED).
Card #3 Type Information	Command: Response:	<add/C3TI_'cr' >add/C3TI_'cr' tttt'cr''lf']	Where: tttt = type (RS_02, RS_03 or NOT_INSTALLED).
Card #1 Options/ Misc. Information Card #1 installed only	Command: Response:	<add/C1OI_'cr' >add/C1OI_'cr' OH_01 list: s,G.703'cr' s,IBS'cr' s,ASYNC_AUPC'cr' s,D&I'cr' s,IDR'cr''lf']	Where: s = - (Not Installed, FAST Upgradable), + (Installed). (- or +) (- or +) (- or +) (- or +) (- or +)
Card #2 Options/ Misc. Information Card #2 installed only	Command: Response:	<add/C2OI_'cr' >add/C2OI_'cr' RS_02 list: s,INTELSAT'cr''lf'] RS_03 list: s,INTELSAT'cr''lf']	Where: s = - (Not Installed, FAST Upgradable), + (Installed). (- or +) (- or +)
Card #3 Options/ Misc. Information Card #3 installed only	Command: Response:	<add/C3OI_'cr' >add/C3OI_'cr' RS_02 list: s,INTELSAT'cr''lf'] RS_03 list: s,INTELSAT'cr''lf']	Where: s = - (Not Installed, FAST Upgradable), + (Installed). (- or +) (- or +)
Serial Number	Command: Response:	<add/SNUM_'cr' >add/SNUM_'cr' MODEM_xxxxxxxxx'cr' CARD_1_xxxxxxxxx'cr' (Note 1) CARD_2_xxxxxxxxx'cr' (Note 2) CARD_3_xxxxxxxxx'cr''lf'] (Note 3)	Where: xxxxxxxxx = Serial number 000000000 to 999999999. Notes: 1. Data is only returned if Card #1 is installed. 2. Data is only returned if Card #2 is installed. 3. Data is only returned if Card #3 is installed.

Built In Self Test	Command:
	Response:
	
	Response:
	
	Status:
	Response:
		<add/BIST_xxxx'cr'
		for (OFF):
		>add/BIST_xxx'cr''lf']
		
		for (RUN):
		>add/BIST_xxx'cr'
		ST_xxx'cr''lf']
		
		<add/BIST_xxx'cr'
		>add/BIST_xxx'cr''lf']
			Where: xxx = OFF (self test disabled), RUN (run self test now).
			
			Self Test (OK/FLT)
			
			Note: Allow 35 Seconds for response to RUN the Self Test.

LCP Data Bits Command	Command: Response:	<add/DAT8_dddd'cr' >add/DAT8_z'cr''lf']	Where: Dddd = duct Device Number: ASCII hexadecimal values representing the device number to erase. These values should be copied directly from the <DN> field from the initialization file. This is ignored for multiple paged memory schemes, but needed for single paged schemes. Z= Status: One byte binary value (0x00 - 0xFF) pertaining to the execution of the previous command. Valid status values returned: LCP_FAILURE, LCP_SUCCESS. Each letter represents 1 byte.
State Of Product	Command: Response:	<add/SOP_'cr' >add/SOP_'cr' add'cr' abc'cr' rrrrr bps'cr' <var-string1>'cr' <var-string2>'cr''lf']	 Product Address Data format Baud Rate Comm Type abc = Explained below. a = Number of data bits (7) b = Parity type (O, E, N) c = Number of stop bits (1) rrrr = baud rate ('150', '300', '600', ' 200', '2400', '4800', '9600', '14.4K', '19.2K'). <var-string1> = Variable length strings explaining communication hardware type 'RS-485, 2 wire', 'RS-485, 4 wire' 'RS-232'. <var_string2> = Variable length strings explaining the intention of the product. 'Under normal system operation', 'REFLASH of BULK firmware required', 'REFLASH of M&C firmware required'.

Glossary

The following is a list of acronyms and abbreviations that may be found in this manual.

Acronym/ Abbreviation	Definition
Ω	Ohms
A	Ampere
AC	Alternating Current
ADC	Analog-to-Digital Converter
ADJ	Adjust
AGC	Automatic Gain Control or Auxiliary Ground Connector
AIS	Alarm Indication Signal
ALRM	Alarm
AMI	Alternate Mark Inversion
ASC	Add-Select-Compare
ASCII	American Standard Code for Information Interchange
ASK	Amplitude Shift Keying
ASLT	Asymmetrical Loop Timing
ATTEN	Attenuation
AUX 1	Auxiliary 1
BER	Bits Error Rate
bit/s	bits per second
BPF	Band Pass Filter
BPSK	Bi-Phase Shift Keying
C	Celsius
C5	C-Band Satellite Terminal System
CCITT	International Telephone and Telegraph Consultative Committee
CEQ	Common Equipment
CL	Carrier Loss
CLK	Clock
Codec	Coder/Decoder
COM	Common
Config	Configuration
CORR	Correction
CP	Coaxial Plug

Acronym/ Abbreviation	Definition
CS	Clear to Send
CSC	Comstream Compatible
CTS	Clear to Send
CW	Continuous Wave
D	Depth
dB	Decibels
dBc	Decibels referred to carrier
dBm	Decibels referred to 1.0 milliwatt
DC	Direct Current
DCE	Data Circuit Terminating Equipment
DDS	Direct Digital Synthesis
DEMOD	Demodulator
DEMUX	Demultiplexer
Diff	Differential Encoder
DM	Data Mode
DSI	Digital Speech Interpolation
DSR	Data Signal Rate
DTS	Data Test Set
E_b/N_0	Bit Energy-to-Noise Ratio
EFD	EFData
EMC	Electro-Magnetic Compatibility
ESC	Engineering Service Channel
ESD	Electrostatic Discharge
etc	Et Cetera
EXT	External Reference Clock
EXT_CLK	External Reference Clock
FAST	Fully Accessible System Topology
FDMA	Frequency Division Multiple Access
FEC	Forward Error Correction
FIFO	First in/First Out
FW	Firmware
GND	Ground
H	Height
Hz	Hertz (cycle per second)
IDU	Indoor Unit
i.e.	In Example
I/O	Input/Output
I/Q	In-Phase and Quadrature
IESS	INTELSAT Earth Station Standards
IF	Intermediate Frequency
INS	Insert
INT	Internal
INTELSAT	International Telecommunications Satellite Organization
ISD	Insert Send Data
KΩ	kilo-ohms
K1 K3	Ku-Band Satellite Terminal System
kbit/s	Kilobits per second (10^3 bits per second)
kHz	Kilohertz (10^3 Hertz)
ks/s	Kilosymbols Per Second (10^3 symbols per second)
LCD	Liquid Crystal Display
LED	Light-Emitting Diode
LNA	Low Noise Amplifier
LPF	Low Pass Filter

Acronym/ Abbreviation	Definition
M&C or MC	Monitor and Control
mA	Milliamperes
Max	Maximum
Mbit/s	Megabits per second
MHz	Megahertz (10^6 Hertz)
Min	Minimum or Minute
MOD	Modulator
ms	Millisecond (10^{-3} second)
Ms/s	Megasymbols per second
MUX	Multiplexer
NC	No Connection or Normally Closed
NO	Normally Open
ODU	Outdoor Unit
OPT	Option
PCB	Printed Circuit Board
PK	Peak
PL	EFData Part Number Prefix
PLL	Phase-Locked Loop
PPM	Parts Per Million
PSK	Phase Shift Keying
QPSK	Quadrature Phase Shift Keying
RAM	Random Access Memory
RD	Receive Data
REF	Reference
RF	Radio Frequency
RLSD	Receive Line Signal Detect
RR	Receiver Ready
RS	Ready to Send
RT	Receive Timing
RTS	Request to Send
RU	Rack Unit
RX	Receive (Receiver)
RXCLK	Receive Clock
s	Second
SAT	Satellite
SCR	Serial Clock Receive
SCT	Serial Clock Transmit
SCTE	Serial Clock Transmit External
SD	Send Data
sec	Second
SHLD	Shield
SIGGND	Signal Ground
SSPA	Solid-State Power Amplifier
ST	Send Timing
STAB	Stability
SW	Software
syn	Synchronous
TBD	To Be Determined
TCXO	Temperature-Compensated Crystal Oscillator
Terr	Terrestrial
TRF	Transmit Reject Filter
TT	Terminal Timing
TTL	Transistor-Transistor Logic
TX	Transmit (Transmitter)

Acronym/ Abbreviation	Definition
UART	Universal Asynchronous Receiver/Transmitter
UNAVAL	Unavailable
V	Volts
VAC	Volts, Alternating Current
VB	Video Bandwidth
VCO	Voltage-Controlled Oscillator
VDC	Volts, Direct Current
Ver	Version
VCXO	Voltage Controlled Crystal Oscillator
W	Watt or Width

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