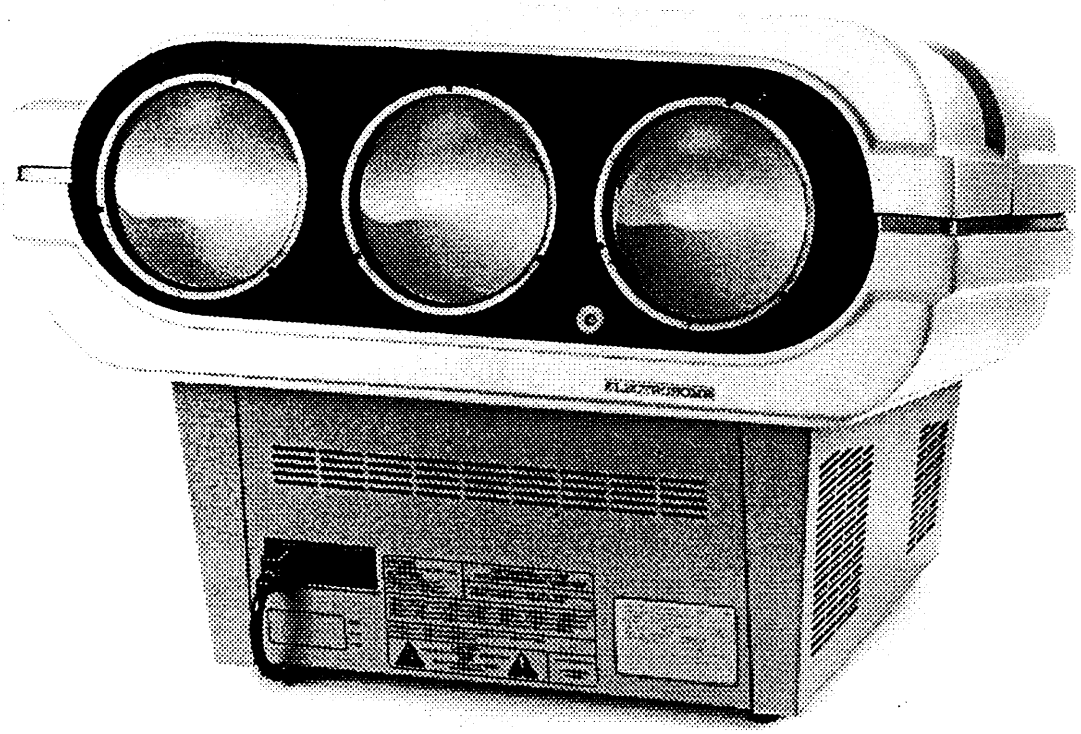
ELECTROHOME

ECP 4100 SERIES PROJECTION SYSTEM



SERVICE MANUAL

DUE TO CONSTANT RESEARCH, THE INFORMATION IN THIS MANUAL IS SUBJECT TO CHANGE WITHOUT NOTICE.

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Printed in Canada/54-7904-03P (06/90)

WARNING

THE ECP 4100 SERIES PROJECTOR GENERATES AND MAY RADIATE RADIO FREQUENCY ENERGY. IF NOT INSTALLED AND USED IN ACCORDANCE WITH THE OWNER S MANUAL, IT MAY CAUSE INTERFERENCE WITH RADIO COMMUNICATIONS.

THE ECP 4100 SERIES PROJECTOR IS TESTED TO AND COMPLIES WITH THE LIMITS FOR CLASS A COMPUTING DEVICE PURSUANT TO SUBPART J OF PART 15 OF FCC RULES, WHICH ARE DESIGNED TO PROVIDE REASONABLE PROTECTION AGAINST RADIO INTERFERENCE IN A COMMERCIAL ENVIRONMENT. WHEN THE ECP 4100 SERIES PROJECTOR IS OPERATED IN A RESIDENTIAL AREA IT MAY CAUSE RADIO INTERFERENCE. IN SUCH A CASE THE USER WILL BE REQUIRED, AT HIS OWN EXPENSE, TO TAKE MEASURES REQUIRED TO CORRECT THE INTERFERENCE.

NOTICE

THIS DIGITAL APPARATUS IS TESTED TO AND COMPLIES WITH THE LIMITS FOR A CLASS A DIGITAL APPARATUS PURSUANT TO THE CANADIAN DEPARTMENT OF COMMUNICATIONS RADIO INTERFERENCE REGULATIONS. THE REGULATIONS ARE DESIGNED TO PROVIDE REASONABLE PROTECTION AGAINST SUCH INTERFERENCE FROM DEVICES OPERATED IN A COMMERCIAL ENVIRONMENT.

AVIS

CET APPAREIL À AFFICHAGE NUMÉRIQUE A ÉTÉ CONTRÔLÉ. IL EST CONFORME AUX LIMITES DES RÈGLEMENTS DE LA CLASSE A D'APPAREILS À AFFICHAGE NUMÉRIQUE ÉTABLIS PAR LE MINISTÈRE DES COMMUNICATIONS DU CANADA EN CE QUI CONCERNE LES INTERFÉRENCES RADIO. CES RÈGLEMENTS ONT ÉTÉ MIS EN PLACE POUR ASSURER UNE PROTECTION RAISONNABLE CONTRE LES INTERFÉRENCES PRODUITS PAR DES APPAREILS UTILISÉS DANS UN ENVIRONNEMENT COMMERCIAL.

WARNING

TO PREVENT FIRE OR ELECTRICAL SHOCK, DO NOT EXPOSE THIS EQUIPMENT TO RAIN OR MOISTURE. DO NOT USE THE POWER CORD WITH EXTENSION CORDS, RECEPTACLES OR OTHER OUTLETS WHICH DO NOT HAVE A GROUND CONNECTION.

WARNING: TO MAINTAIN FCC AND DOC REQUIREMENTS, USE THE 38-800615-71 CABLE FOR 15 KHZ TO 36 KHZ SIGNALS.

WARNING: TO MAINTAIN FCC AND DOC REQUIREMENTS, USE THE 38-800632-71 CABLE FOR 15 KHZ TO 80 KHZ SIGNALS.

WARNING: DO NOT LIFT THE PROJECTOR BY THE TOP COVER.

WARNING: MAKE SURE THE LINE VOLTAGE IS PROPERLY SELECTED BEFORE CONNECTING THE POWER CORD.

CAUTION: DO NOT BLOCK AIR FLOW AROUND THE PROJECTOR. IF THE PROJECTOR IS MOUNTED ON OTHER THAN AN ELECTROHOME CART, MAKE SURE THERE IS AT LEAST ½ INCH (1.25 cm) CLEARANCE BETWEEN THE BOTTOM OF THE PROJECTOR AND THE MOUNTING SURFACE.

CAUTION: KEEP OUT OF DIRECT SUNLIGHT. PROLONGED EXPOSURE TO SUNLIGHT MAY CAUSE PERMANENT DAMAGE.

CAUTION: ACRYLIC LENS. NEVER TOUCH THE LENS WITH FINGERS. CLEAN ONLY WHEN ABSOLUTELY NECESSARY. MOISTEN A SOFT FACIAL TISSUE WITH NON-ABRASIVE WINDOW CLEANER AND RUB VERY GENTLY IN A CIRCULAR MOTION.

CAUTION: IF SHIPPED IN COLD WEATHER, UNPACK THE PROJECTOR AND ALLOW IT TO SIT AT ROOM TEMPERATURE FOR ONE HOUR BEFORE OPERATING. FAILURE TO DO SO MAY RESULT IN CRT BREAKAGE.

CAUTION: RETAIN AND USE THE ORIGINAL PACKING FOR SHIPPING THE PROJECTOR TO ANOTHER LOCATION. THE ORIGINAL PACKING IS CUSTOM DESIGNED.

CAUTION: THE FEET ON THE PROJECTOR MUST BE FULLY RETRACTED PRIOR TO PACKING THE PROJECTOR.

THIS PROJECTOR IS COVERED BY U.S. PATENTS 4414494 AND 4680555. OTHER PATENTS PENDING.

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HOW THIS MANUAL IS ORGANISED

This manual is for use by a service technician to service and maintain an Electrohome ECP 4100 series projection system. Organization of the manual permits easy access to service related information for the system and its serviceable modules. Sections 1 to 7 include servicing information at the system level. All other sections are specific to the system's internal modules.

Individual sections of this manual may be updated or replaced as your projector hardware configuration changes. Appropriate sections will be provided with all new or upgraded components. Initial section titles include:

GENERAL SERVICING:	Section 1	Introduction
	Section 2	System Specifications
	Section 3	Theory of Operation
	Section 4	Servicing Guidelines
	Section 5	Hardware Layout and Disassembly
	Section 6	Troubleshooting
	Section 7	Alignment Procedures
MODULE SERVICING:	Section 8	Power Entry Module
	Section 9	Power Supplies
	Section 10	RGB SYNC 10 PIN Input Module
	Section 11	Remote Control Module
	Section 12	Waveform Module
	Section 13	Convergence Module
	Section 14	Video Control Module
	Section 15	Bias Module
	Section 16	Horizontal Deflection Module
	Section 17	Vertical Deflection & Horizontal Regulation Module
	Section 18	Keystone Module
	Section 19	Power Deflection Module
	Section 20	Video Output Module
	Section 21	Remote Jack Assembly
	Section 22	Fan Filter Assembly
	Section 23	Motherboard Assembly
	Section 24	ACON (Automatic Convergence Option)
APPENDICES:	Appendix A	Computer Communication
	Appendix B	Reverse Scan Installation
	Appendix C	Harness/Wiring Diagram
	Appendix D	Terms/Concepts/Abbreviations
	Appendix E	Interfaces
	Appendix F	Service Replacement Modules and Assemblies
	Warranty	

NOTE: Prior to module servicing, review sections 1 to 7.

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SECTION 1

INTRODUCTION

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LIST OF TABLES

No tables are included in this section.

1.1 SCOPE

This service manual establishes procedures for a qualified service technician to service and maintain an ECP 4100 Series commercial projection system. Sections 1 to 7 include servicing information for projection system. All other sections are specific to each of the ECP 4100 Series internal projector modules.

1.2 REFERENCES

Electrohome ECP 4100 Series Projection System Owner's Manual #54-7582-04P.

1.3 SYSTEM DESCRIPTION

The ECP 4100 Series Projector is a three lens, high resolution, high brightness, video/data projector. Features of the projector include:

- automatic synchronization to a variety of video input sources in the frequency range of 15 KHz to 80 KHz horizontal and 45 Hz to 120 Hz vertical
- focusing on flat, curved or rear screens with allowable projector-to-screen distances from 72 inches to 30 feet (1.83 to 9.14m)
- projector control of a wide range of software functions from either a built-in, wired remote or infrared remote keypad
- microprocessor control of all major projector functions
- nonvolatile memory storage of all projector settings
- modular construction for easy accessibility to module components when servicing is required

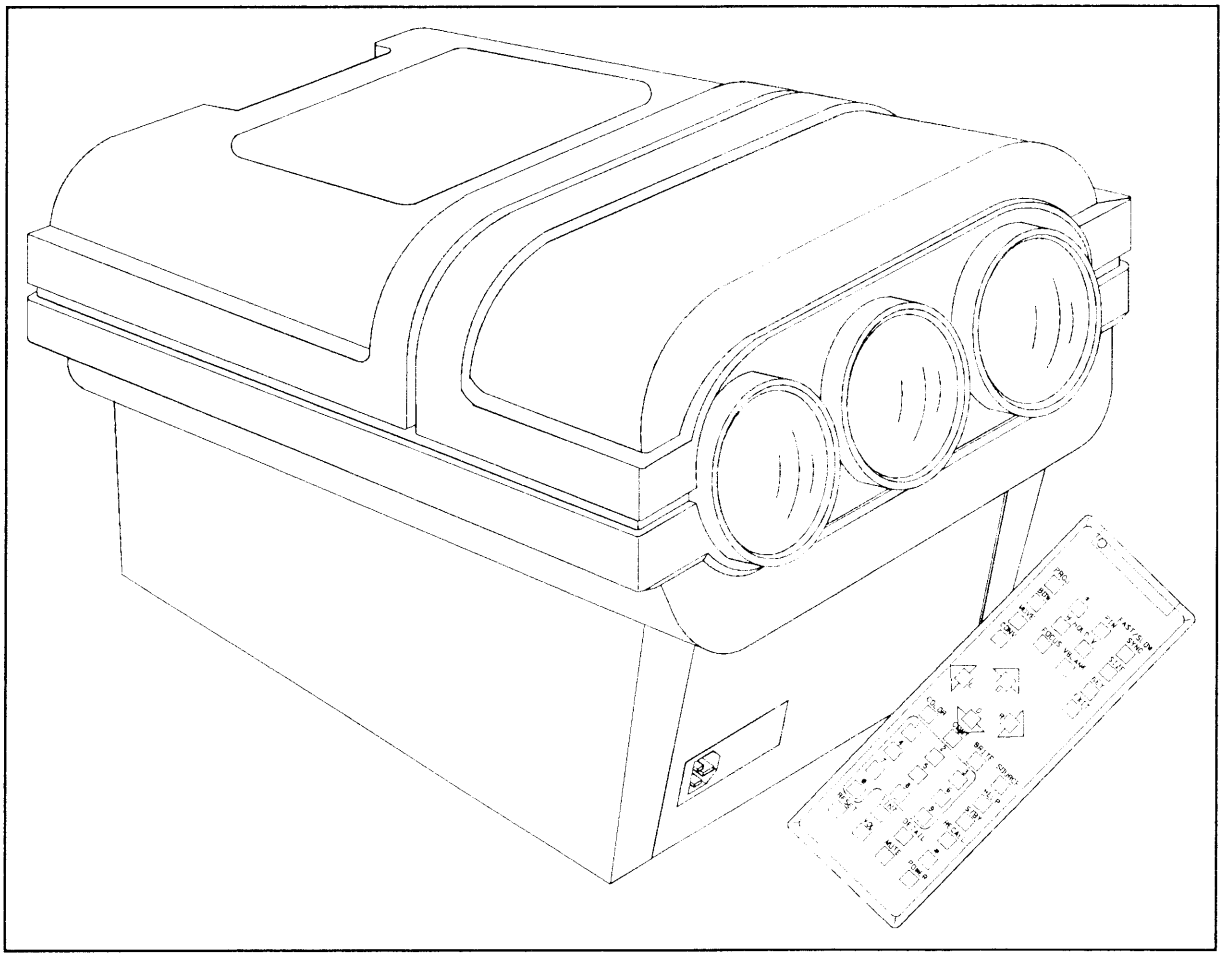

FIGURE 1-1. *The ECP 4100 Series Projector*

SECTION 2

SYSTEM SPECIFICATIONS

ECP 4100 Series Projection System

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No tables are included in this section.

2.1 Specifications

Optics
- High definition F1.0 hybrid lens

Resolution
- Maximum resolution 1280 x 1024 pixels
- 1000 TV lines

Brightness
- 650 lumens peak light output
- 370 foot lamberts on a 6' diagonal 10 gain screen total light output

Focused Data
- 480 lumens peak light output
- 280 foot lamberts on a 6' diagonal 10 gain screen total light output

Display
- Functional 3 lens design allows simple adjustment for flat, curved or rear screens from 5 to 25 feet diagonal
- Electronic pincushion circuitry separately corrects top, bottom and sides for flat, curved or rear screen applications
- Keystone circuitry corrects pictures for angles up to ± 15° vertically from screen axis

Video Circuits
Input
- Input level 0.5 to 2.0 volts p-p, 75 ohms ± 1% terminated
- Automatically switches to separate sync or sync on green
- Separate sync is automatically accepted in either polarity

Frequency Response
- 70 MHz bandwidth ± 3 dB
- Linear non-differential video amplifier accommodates 8 nano-second pixels and digital clock rates over 140 MHz

D.C. Restoration
- Keyed clamp

Gain
- Minimum video gain 40 dB or 100X
- Maximum video output 130 volts p-p drive

Defection Circuits
Vertical Deflection
- Size: automatically regulated over frequency range and adjustable from 20% underscan to 10% overscan
- Frequency Range: automatically locks from 45 Hz to 120 Hz
- Retrace Time: less than 300 microseconds

Horizontal Deflection
- Size: automatically regulated over frequency range and adjustable from 10% underscan to 10% overscan
- Frequency Range: automatically locks from 15 kHz to 80 kHz
- Retrace Time:
  less than 5.0 microseconds at 15-36 kHz
  less than 2.5 microseconds at 36-80 kHz

Geometry Distortion
- Horizontal - less than 1%
- Veritical - less than 2%

Operating and Service Controls
Infrared Remote Control

Primary
- Power
- Contrast
- Brightness
- Color
- Tint
- Detail
- Volume
- Mute
- Standby
- Reset
- Recall
- Help
- Source #

Secondary
- Converge
- Pincushion
- Bow
- Size
- Focus
- Keystone
- Move
- Vert. Blank
- Hor. Hold
- Vert. Hold
- Fast/Slow Sync
- Projector #
- Exit

- Optional remote infrared receiver can be connected to projector for rear screen applications
- On screen menu assists set-up with step-by-step alphanumeric instructions and graphic focus aids

Service Controls
(Screwdriver Adjust)
- RGB Drive Levels
- RGB Screen Controls
- RGB Cut-off Switches
- RGB Electronic Focus
- Vertical Linearity

Indicators
- Power On
- Ready
- Vertical Hold Manual
- Horizontal Hold Manual
- Error
- Vertical Scan Fail
- Horizontal Scan Fail

High Voltage
- 34.0 kV regulated to better than ± 1%

Power Requirements
- 90 VAC to 132 VAC can be externally reconnected for 180 VAC to 264 VAC
- Line frequency 50 to 60 Hz nominal
- Power 450 watts maximum

Inputs
The ECP 4100 Series Projector comes with the RGB SYNC 10 PIN input module installed,

Optional Source Selection
The Electrohome IR Video/Data Switcher allows use of 6 additional input modules for master control of projector

Mounting
- The ECP 4100 Series Projector can be ceiling mounted on its optional yoke or mounted on a desk stand or castered cart for portable applications

Weight
- 99 lbs (45 kg)
- Shipping Weight 124 lbs (57 kg)

Accessories Included
- IR remote control keypad
- User's Manual

Environment
Maximum Operating Range
- Temperature: 0 to 35°C (32 to 95°F)
- Humidity: 0 to 90% non-condensing
- Altitude: 0 to 3000m (0-10,000 ft.)

Storage
- Temperature: -30 to 65°C (-22 to 149 °F)

Regulatory Approvals
- Model #XX-BO9980-XX
- Meets FCC Class A, DHHS and HWC requirements
- CSA certified

One year parts and labour WARRANTY

Due to constant research, specifications are subject to change without notice.
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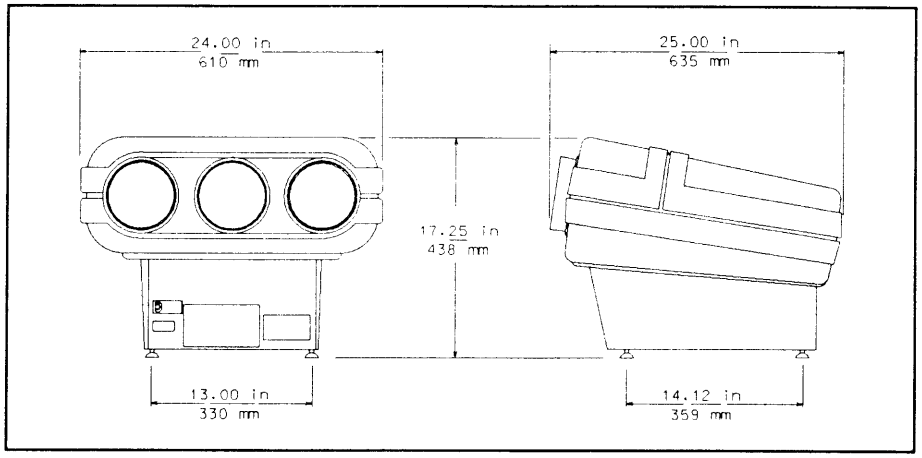

FIGURE 2-1. *ECP 4100 Series Projector Dimensions*

SECTION 3

THEORY OF OPERATION

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LIST OF ILLUSTRATIONS

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No tables are included in this section.

3.1 OPTICAL

The projector uses F1.0, color corrected, hybrid optics. The optics are formed from glass and acrylic aspheric elements. Two stage focusing allows independent focusing of the image center and corners. It also enables the projector to be used with a variety of screen types, e.g., curved, flat, or rear screens.

Each CRT/lens assembly can be mechanically adjusted to accommodate screen sizes ranging from 5 to 25 feet diagonal. Each CRT can be mechanically tilted side to side and top to bottom, with respect to the lens, to optimize screen focus at various projector-to-screen angles.

3.2 MECHANICAL

The chassis of the projector is a wire-frame type with detachable metal side, front, back and bottom panels. The upper front and rear covers are sturdy moulded plastic, which are also detachable. Accessibility to the internal modules is made easy by removal of the these panels and covers.

The projector is designed to accept a variety of electronic modules. A series of card racks (slots) are provided for this purpose at the rear of the projector. The plug-in nature of the modules eliminates time consuming de-soldering and eases serviceability. Most modules plug directly into the Mother PCB, minimizing both harnessing and noise within the projector. Most modules have external status indicator LEDs.

3.3 ELECTRONIC

The projector takes video input signals and processes them through video, sync/deflection, and correction circuits to produce a projected video image. To do this, many individual system modules work together. These modules and their basic functions are explained in the following paragraphs. For more details for any specific module, refer to the appropriate Module Servicing section in this manual. Also refer to Figure 3-1, *ECP 4100 Series Projector Function Block Diagram*.

3.3.1 Power Supply Modules

The power supply circuitry contains the following modules:

a) Power Entry (PEM),
b) Low Voltage Switch Mode Power Supply (SMPS),
c) High Voltage Power Supply,
d) Bias.

Power Entry Module (PEM). The Power Entry Module (PEM) accepts 120V or 240V AC input power for distribution to the projector power supplies. A 120V/240V switch on the Power Entry Module is set to the input voltage in use.

Low Voltage Switch Mode Power Supply (SMPS). The Low Voltage SMPS provides +5, +6.3, ±12, ± 24, +150 and +200 VDC for the logic and control circuitry.

High Voltage Power Supply. The High Voltage Power Supply provides 34 KV to each CRT anode, 11 KV to the focus circuitry and 800 VDC for G2 cut-off.

Bias Module. The Bias module controls electronic and dynamic focus, G2 cut-off, beam limit and blanking. It also includes High Voltage Power Supply shut off circuitry in the event of a scan failure and/or a beam over-current condition.

3.3.2 Remote Control Module

The Remote Control module is the main control center for the projector. It consists of a microprocessor, read only memory, random access memory, input/output expanders and a number of digital-to-analog converters. The module receives user input from the projector's built-in or external keypads, and monitors status and control inputs from the other system modules.

Microprocessor address and data bus lines as well as numerous analog and digital control voltages are distributed from the Remote Control module to control projector functions.

3.3.3 Video Modules

The video circuitry includes the following modules:

a) Input
b) Waveform
c) Video Control
d) Video Output

Video Input Module(s). Video input modules receive input signals from a video source and condition them for use by the projector. The projector comes with a standard 3,4,5 WIRE Input module. Other input modules may also be installed.

The input module directs the video component of the input signal to the Video Control module, and the sync component to the Horizontal Deflection module. Input modules also perform decision making routines such as determining whether or not a signal should be connected to the Mother Board.

Waveform Module. The waveform module provides gain control voltages for the Video Control module. It also provides waveform signals for the Keystone, Power Deflection and Bias modules for geometry correction. (See section 3.3.5, *Correction Circuits*).

Video Control Module. The Video Control module performs two primary functions. It amplifies video input signals by multiplying them by the gain signal from the Waveform module. It provides crosshatch and text generation.

Outputs of the Video Control module are fed to the Video Output module.

Video Output Module. The Video Output module amplifies in-coming video signals from the Video Control module and directs these signals to the cathode of each CRT. There is one Video Output module per CRT.

3.3.4 Sync/Deflection Circuits

The composite sync signal from each input module is fed to the Horizontal Deflection module for processing. Output from the Horizontal Deflection module is used by the Power Deflection and Vertical Deflection & Horizontal Regulation modules.

Horizontal Deflection Module. The Horizontal Deflection module splits the combined sync signal into horizontal and vertical components. The vertical sync pulse is fed to the Vertical Deflection & Horizontal Regulation module. The horizontal sync pulse is used by the auto-frequency lock, bandswitch and horizontal processor circuitry to form a horizontal drive pulse.

The Horizontal Deflection module also produces a regenerated sync pulse which is controlled by the keypad MOVE key to shift the projected image up, down, left and right.

Vertical Deflection & Horizontal Regulation Module. This module uses a vertical processor to derive the vertical drive pulse for use by the Power Deflection modules. The horizontal regulator (or buck convertor) supplies power to the horizontal deflection circuits.

The Vertical Deflection & Horizontal Regulation module also contains vertical auto-lock circuits and an EHT INHIBIT circuit.

Power Deflection Module. Vertical and horizontal deflection amplifiers on the Power Deflection modules control the flow of current through the deflection yokes (and the arising magnetic fields) on each CRT. This control permits movement or scanning of the electron beam and horizontal and vertical centering of the projected image.

3.3.5 Correction Circuits

The correction circuitry provides convergence, geometry, color, and focus correction.

Convergence Module. The Convergence module corrects and compensates for errors in registration between the red, green and blue CRT images. The module uses digital-to-analog converters to continuously generate correction values which are memory-mapped to the CRT raster.

The Convergence module contains the following circuitry:

a) horizontal phase locked-loop (HPLL)
b) vertical phase-locked loop (VPLL)
c) alpha generation
d) RAM bank switching
e) band switch
d) address generation and multiplexing
f) waveform channel

Other functions provided by the Convergence module are: address/data de-multiplexing, address decoding, programmable blanking generation, drive level control and color correction.

Waveform Module. The Waveform module provides geometry correction waveforms to the Keystone, Power Deflection and Bias modules.

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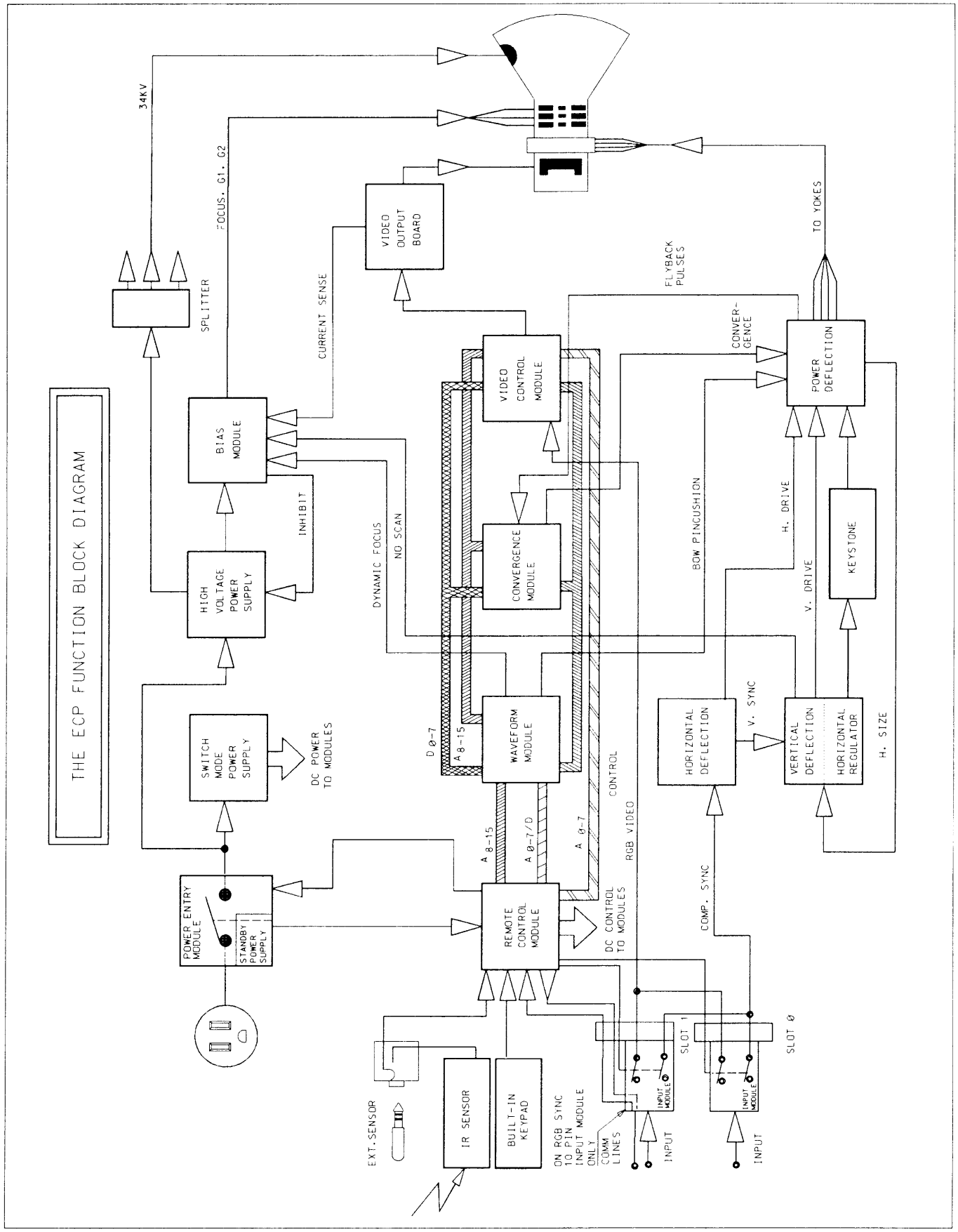

FIGURE 3-1. *ECP 4100 Series Projector Function Block Diagram*

SECTION 4

SERVICING GUIDELINES

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No tables are included in this section.

WARNING

PERFORM SERVICING ONLY AFTER BECOMING THOROUGHLY FAMILIAR WITH THE FOLLOWING SERVICING GUIDELINES. NONCOMPLIANCE INCREASES THE RISK OF POTENTIAL HAZARDS AND INJURY TO THE USER.

CAUTION

DO NOT ATTEMPT MODIFICATION OF ANY CIRCUIT.

4.1 SAFETY PRECAUTIONS AND WARNINGS

4.1.1 High Voltage

High voltages capable of causing DEATH are used in this projector. Observe all precautions necessary for working on HIGH VOLTAGE equipment before servicing either the power supplies or their load components.

To prevent damage to solid state devices, do not arc the picture tube anode lead to chassis or earth ground.

WARNING

This projector employs EHT (34KV) picture tubes.

4.1.2 X-RAY Radiation

This projector can produce soft x-ray radiation. The HIGH VOLTAGE has been factory set to prevent exposure to soft x-ray radiation.

4.1.3 High Voltage Power Supply

Due to critical safety circuitry to prevent x-ray radiation, the High Voltage Power Supply must be serviced at the factory. If the module needs repair, replace it.

4.1.4 CRT Handling

Each picture tube encloses a high vacuum.

WARNING

Bumping or scratching a picture tube may cause it to implode, resulting in personal injury and property damage. Wear shatter-proof goggles while handling a CRT or installing it in the projector. DO NOT handle a CRT by the neck.

4.1.5 Video Output Module

Do not adjust or repair critical safety circuitry within the Video Output Module. It has been designed to prevent x-ray radiation. If components in this circuitry need repair, replace the Video Output module.

Controls R43 and R47 are sealed in epoxy. They **MUST NOT** be adjusted, replaced or defeated.

4.1.6 Ventilation Slots

Do not block any of the projector ventilation slots during operation or servicing. Ventilation slots are located on the rear top cover, side panels and bottom plate.

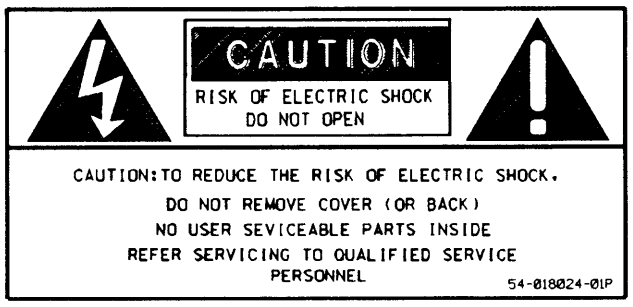

FIGURE 4-1. *Caution Label*

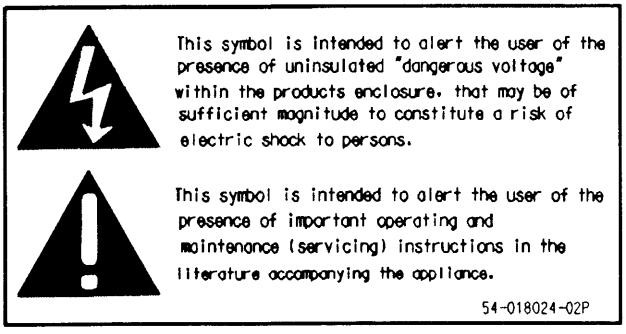

FIGURE 4-2. *Alert Label*

4.2 SERVICING AND REPAIR GUIDELINES

WARNING

THE PROJECTION SYSTEM CONTAINS MANY STATIC SENSITIVE COMPONENTS. ALL SERVICING MUST BE PERFORMED AT A STATIC CONTROLLED WORK STATION.

IMPORTANT: WHEN ORDERING SERVICE REPLACEMENT COMPONENTS, QUOTE THE PROJECTOR MODEL NUMBER, THE SERIAL NO. AND THE DATE OF MANUFACTURE. THIS INFORMATION IS AVAILABLE FROM THE SILVER LICENCE LABEL LOCATED ON THE FRONT BEZEL.

4.2.1 Before servicing, observe the original lead dress. Take extra precaution to maintain the original lead dress, especially in the high voltage circuitry areas. Replace any wire that has damaged insulation.

4.4.2 Replace all components that show signs of overheating. Always use the manufacturer's replacement component.

4.2.3 Check that the high voltage is at its correct value. Use a accurate, calibrated, high voltage meter.

4.2.4 When troubleshooting a projector with a high voltage problem, **DO NOT** operate the projector longer than is necessary to locate the cause of the problem.

WARNING

DO NOT make any adjustments to the High Voltage Power Supply. X-ray radiation may be emitted when excessive high voltage exists.

4.2.5 AC Leakage Test. Perform an AC leakage test on exposed metallic parts after each servicing. This will ensure that the projector is safe to operate without danger of electric shock. To perform the test proceed as follows:

a) Temporarily disable the ground connection of the line cord using a suitable adaptor. **DO NOT** use a line isolation transformer.

b) Connect a 1500 Ω, 10 watt resistor in parallel with a 150nF AC capacitor between a known good earth ground and each exposed metallic part, one at a time. With an AC voltmeter having a minimum sensitivity of 1000 Ω/V, measure the voltage across the 1500 Ω resistor. See Figure 4-3. The rms voltage measured **MUST NOT** EXCEED 0.3V rms (this is equivalent to 0.5mA rms current). Values exceeding this limit are potential shock hazards. Correct immediately!

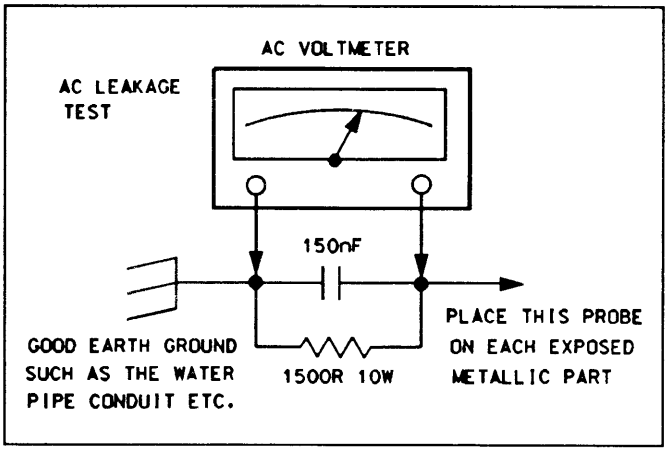

FIGURE 4-3. *AC Leakage Test*

4.2.6 Component Removal. If a component is defective and must be replaced, cut the leads near the body of the component as shown in Figure 4-4.

Grip the lead with needle-nose pliers. Use a soldering iron to melt the solder, securing the lead, on the back of the PCB. Pull gently to remove the lead.

If a component is to be removed for testing, grip the lead with needle-nose pliers. Use a soldering iron to melt the solder while securing the lead on the back of the PCB. Pull gently to remove the lead.

Avoid excessive heating of the component. If a transistor is to be removed, attach an alligator clip or soldering heat sink to the transistor case to provide a temporary heat sink. Clean out all holes. Use a solder sucker, solder brush or solder wick.

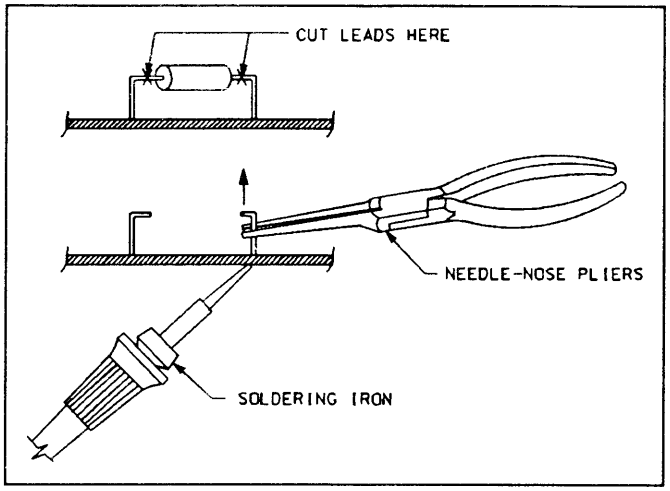

FIGURE 4-4. *Component Removal*

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4.2.7 Repair Cautions.

DO NOT short transistors or ICs during circuit checks.

DO NOT short IC pins.

DO NOT short transistor emitter or collector pins while the projector is operating.

DO NOT short or remove bias resistors while the projector is operating.

DO NOT operate power transistors with heat sinks removed.

DO NOT overload transistors or ICs. Make sure the projector is disconnected from its AC power source before testing, removing, or installing transistors or ICs.

DO NOT operate the projector with parts removed (except covers and track-mounted modules).

DO NOT over-tighten the CRT tilt screws (below front top cover. Severe CRT damage may result.

4.3 CLEANING

Perform cleaning as required after each servicing.

Disconnect AC power from the projector. Remove (blow or wipe) foreign material, e.g., dust, from the projector.

Clean the projector case with a soft cloth and mild commercial cleaner.

Clean dirty lenses using a soft lens tissue moistened with a non-abrasive lens cleaner. Gently wipe the lens using a circular motion.

SECTION 5

HARDWARE LAYOUT AND DISASSEMBLY

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LIST OF ILLUSTRATIONS

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No tables included in this section.

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5.1 HARDWARE LAYOUT

The projector system consists of several modules and components, each located in one of three main serviceable areas:

1) Rear Panel Rack
2) Front Slide-out Rack
3) Projection Head

Modules within each of the serviceable areas are interconnected via cabling and/or the centrally located Mother Board. Refer to Appendix C, *Harness/Wiring Diagram*.

Rear Panel Card Rack. The Rear Panel Card Rack contains the projector's plug-in card type modules, accessible by removing the rear panel. These include:

- Vertical Deflection & Horizontal Regulation Module
- Horizontal Deflection Module
- Remote Control Module
- Waveform Module
- Convergence Module
- Video Control Module
- Auto-Convergence Module (optional)
- Input Module
- Remote Jack Assembly

Front Slide-out Rack. The Front Slide-out Rack is a wire frame module rack which can be temporarily slid away from the front projector base for module servicing. The rack is accessible by removing the projector's lower front panel. Modules contained within this rack include:

- High Voltage Power Supply
- Low Voltage Switch Mode Power Supply (SMPS)
- Power Entry Module
- Fan Filter Assembly
- Standby Power Transformer
- Line Filter
- Keystone Module

Projection Head. The Projection Head includes the system's optical and electro-mechanical components. Accessibility is provided by removing the front and rear top covers. Modules and assemblies within the Projection Head area include:

- Lens/CRT Assemblies (3)
- Power Deflection Modules (3)
- Bias Module
- Splitter
- Keypad
- IR Sensor Assembly

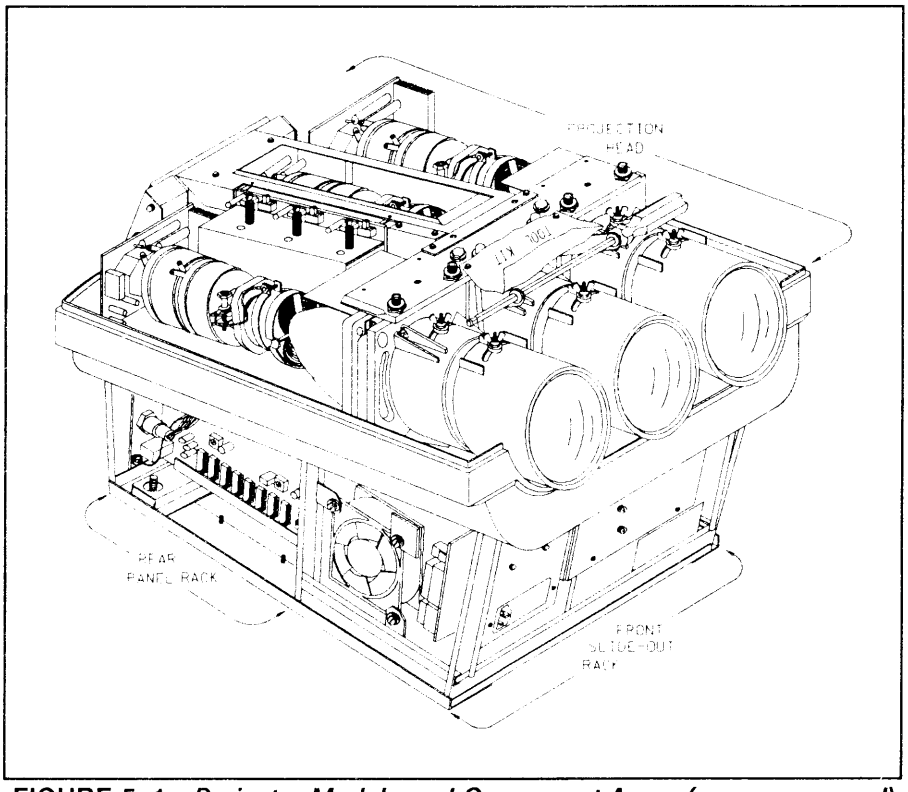

FIGURE 5-1. *Projector Module and Component Areas (covers removed)*

5.2 DISASSEMBLY AND REPLACEMENT

This section includes disassembly and replacement procedures for many of the projector's hardware and electrical components. For modules and components not covered in this section, refer to the appropriate **Module Servicing** section in this manual.

Disassembly/Replacement Procedures included in this section are:

- Front Top Cover Removal (5.2.1)
- Rear Top Cover Removal (5.2.2)
- Side Panel Removal (5.2.3)
- Front Panel Removal/Front Slide-out Rack Mounted Module Access (5.2.4)
- Lower Case Removal (5.2.5)
- Back Panel and Card Rack Module Removal (5.2.6)
- Keypad Removal (5.2.7)
- Keypad Installation (5.2.8)
- Power Transformer Removal (5.2.9)
- Line Filter Removal (5.2.10)
- Lens Removal (5.2.11)
- CRT Removal (5.2.12)
- Lens/CRT Assembly Installation (5.2.13)
- CRT Deflection Assembly Replacement (5.2.14)

Tools & Equipment Required:
- 1/4" hex head socket driver
- Phillips screwdriver

WARNING

IMPORTANT NOTES:

1) **READ SECTION 4, SERVICING GUIDELINES, PRIOR TO THE DISASSEMBLY OR REPLACEMENT OF ANY MODULE OR COMPONENT.**

2) **REMOVE ALL POWER TO THE PROJECTOR PRIOR TO THE DISASSEMBLY OR REPLACEMENT OF PROJECTOR MODULES OR COMPONENTS.**

3) **MANY OF THE PROJECTOR MODULES CONTAIN STATIC SENSITIVE COMPONENTS. SERVICING MUST BE PERFORMED AT A STATIC CONTROLLED WORK STATION.**

5.2.1 Front Top Cover Removal

a) Remove the line cord.

b) The front top cover is snap fit. Remove it by first pulling up the front and then sliding the tabs, on its back edge, out of the slots on the rear top cover. See Figure 5-2.

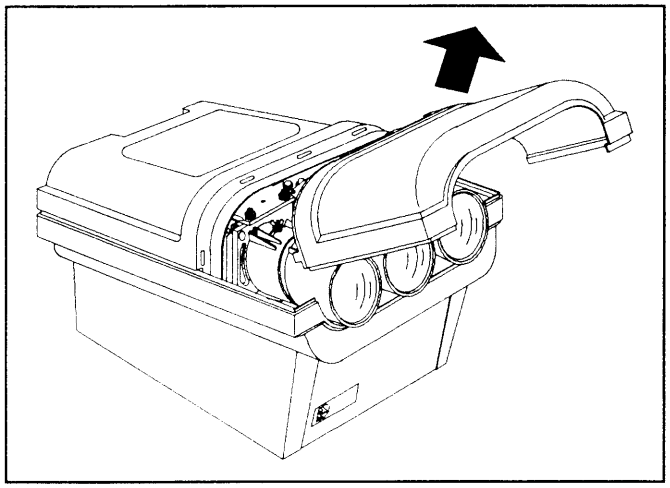

FIGURE 5-2. *Front Top Cover Removal*

5.2.2 Rear Top Cover Removal

a) Remove the 6 Phillips head screws securing the rear top cover to the upper mounting plate.

b) Lift the top rear cover. See Figure 5-3.

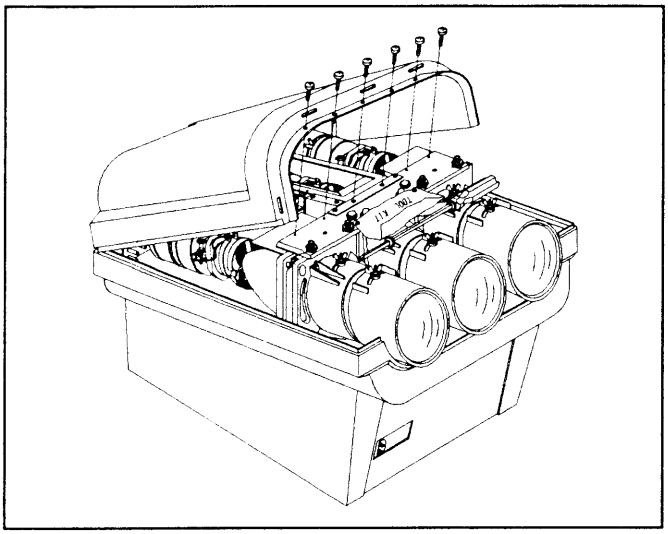

FIGURE 5-3. *Rear Top Cover Removal*

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5.2.3 Side Panel Removal

a) Remove the 3 hex head head screws securing the side panel to the projector frame as shown in Figure 5-4.

b) Pull the side panel down and away from the projector body.

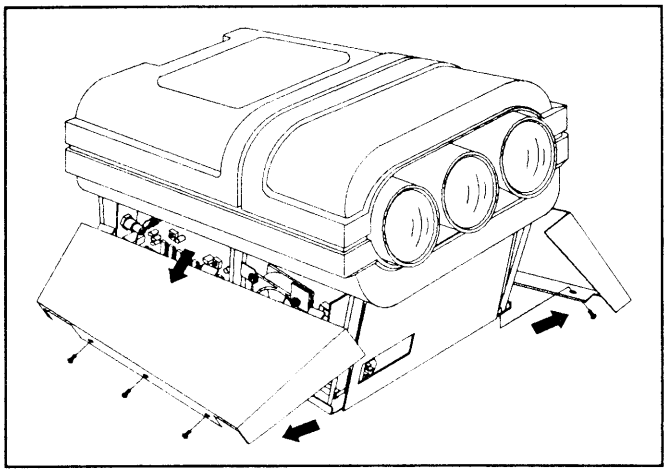

FIGURE 5-4. *Side Panel Removal*

5.2.4 Front Panel Removal/Front Slide-out Rack Mounted Module Access

The following projector modules are mounted in a slide-out rack located in the lower front portion of the projector:

- High Voltage Power Supply
- Low Voltage Switch Mode Power Supply (SMPS)
- Power Entry Module
- Fan Filter Assembly
- LVPS Power Transformer
- Line Filter
- Keystone Module

To access any of the above modules, the projector lower front panel must be removed and the front slide-out rack slid away from the projector body.

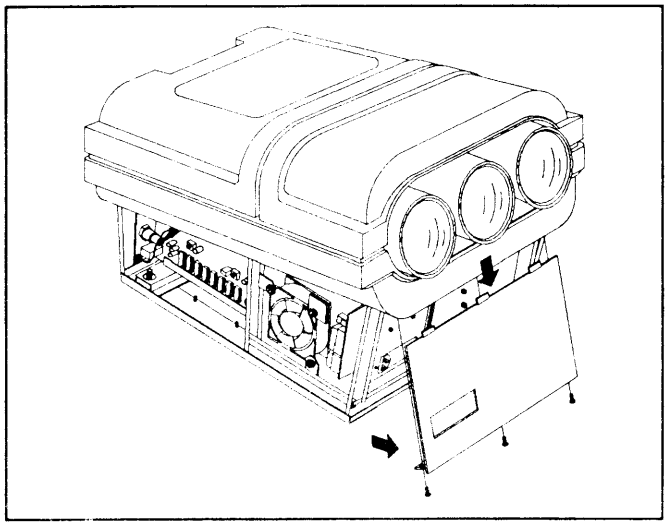

FIGURE 5-5. *Lower Front Panel Removal*

Access the front slide-out rack as follows:

a) Remove the side panels per section 5.2.3.

b) Remove the 3 hex head screws securing the front panel to the projector frame as shown in Figure 5-5. Pull the front panel down and away from the projector body.

Access the Front rack modules as follows:

c) The front rack is positioned behind the front panel and secured by two hex head screws to the projector frame. Remove the screws as shown in Figure 5-6.

d) Notice how the front rack frame rests within guides located on each side of the projector frame. Grip the front rack and gently slide it away (approximately 4") from the projector frame. Closely watch all cables connected to the front rack modules to assure no restrictions or unnecessary strain occurs.

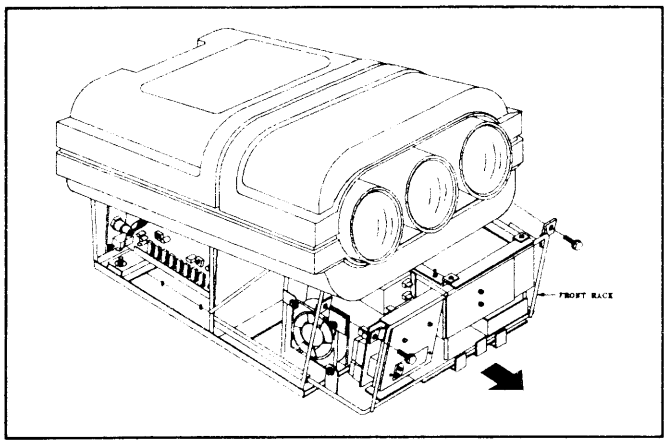

FIGURE 5-6. *Front Slide-out Rack Access*

5.2.5 Lower Case Removal

a) Remove the top, side and front panels as described in sections 5.2.1 to 5.2.4. Do not remove the front slide-out rack from the projector.

b) Remove the 16 Phillips head screws securing the lower case to the chassis. See Figure 5-7.

c) Lower the case away from the chassis.

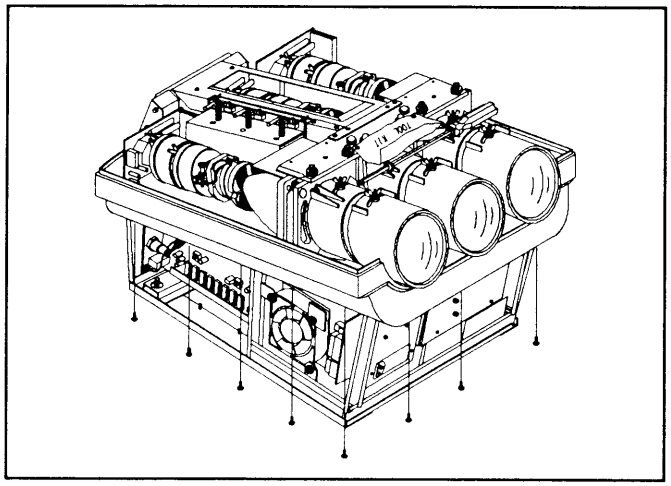

FIGURE 5-7. *Lower Case Removal*

5.2.6 Back Panel and Card Rack Module Removal

The following projector modules are card-rack mounted in the rear panel card rack in the projector:

- Vertical Deflection & Horizontal Regulation Module
- Horizontal Deflection
- Remote Control Module
- Waveform Module
- Convergence Module
- Video Control Module
- Auto-convergence Module (optional)
- Video Input Module

See figure 5-8.

CAUTION

REMOVE AC POWER PRIOR TO MODULE REMOVAL.

WARNING

STATIC SENSITIVE COMPONENTS. PRINTED CIRCUIT BOARD REMOVAL OR REPAIR MUST BE PERFORMED AT A STATIC CONTROLLED WORK STATION.

a) Remove the front top cover. See section 5.2.1.

b) Remove the printed circuit board extractor from the tool holder.

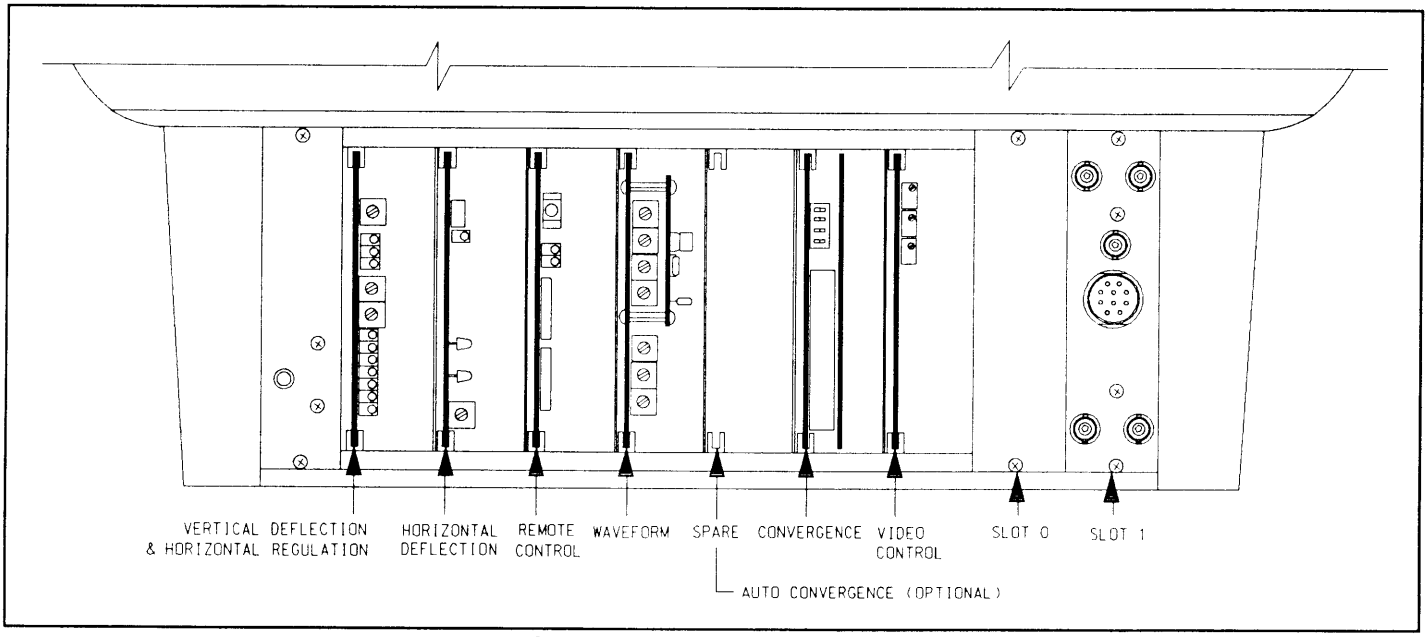

FIGURE 5-8. *Card Rack Modules*

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c) Remove the 6 Phillips head screws securing the back panel to the projector chassis.

d) Remove the back panel as shown in Figure 5-9.

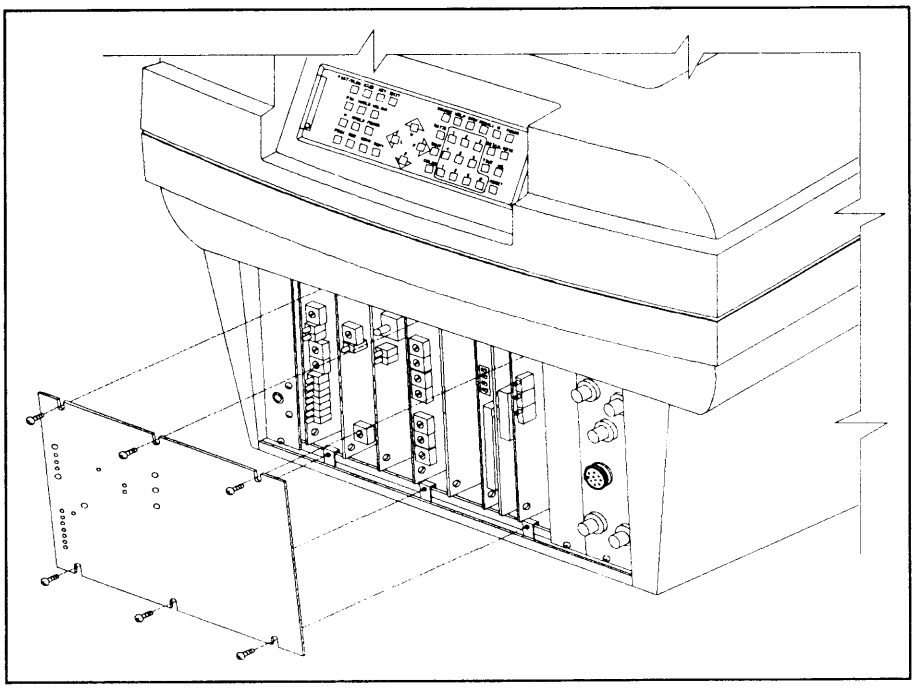

FIGURE 5-9. *Back Panel Removal*

e) Each card rack mounted module has a hole located in its outer top and/or bottom corners. Remove the printed circuit board extractor from the tool pouch located beneath the front top cover. Insert the hook of the extractor into one of the holes of the module to be removed. Refer to Figure 5-10.

f) Pull the module out of the projector.

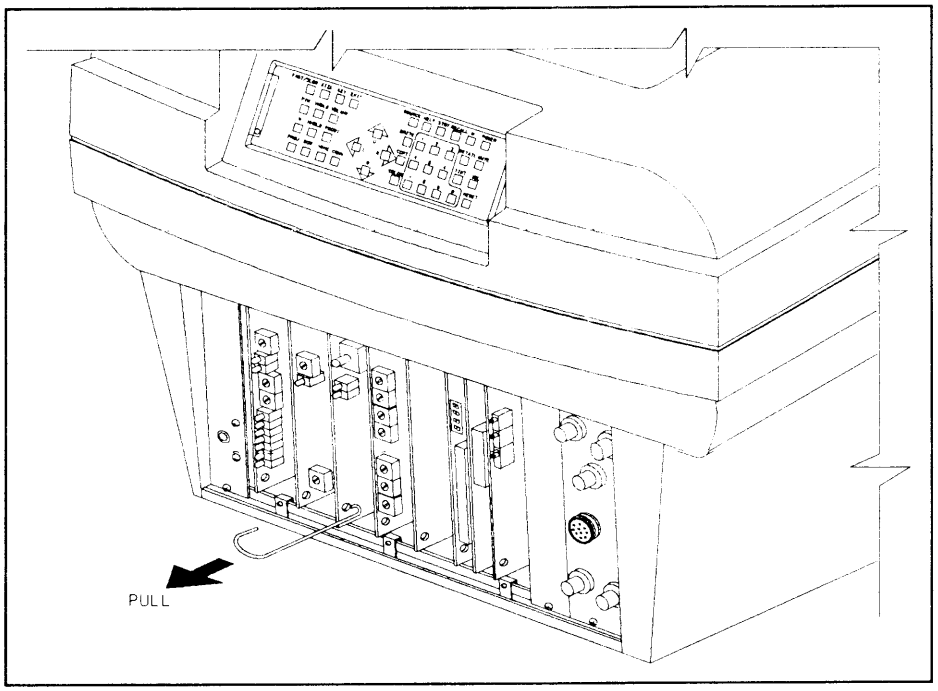

FIGURE 5-10. *Card Rack Module Removal*

5.2.7 Keypad Removal

a) Remove the Rear Top Cover. See section 5.2.2.

b) Remove the Side Panel located next to the remote sensor plug-in at the rear of the projector. Refer to section 5.2.3.

c) With the side panel removed, unplug the keypad cable leading to the keypad input on the Mother Board. Feed the cable away from the Mother Board, back to the Keypad. Refer to Appendix C, *Harness/Wiring Diagram.*

d) Remove the 4 hex head screws which secure the keypad holder to the side brackets. See Figure 5-11, item 1.

e) Remove the top 2 hex head screws which secure the keypad holder to the top bracket as shown (item 2).

f) Remove the keypad assembly from the projector body.

g) If the keypad side brackets must also be removed for ease in accessibility to other modules, remove the 2 side bracket mounting screws (item 3).

NOTE: Item 3 in Figure 5-11 does not require removal if only the keypad is to be removed.

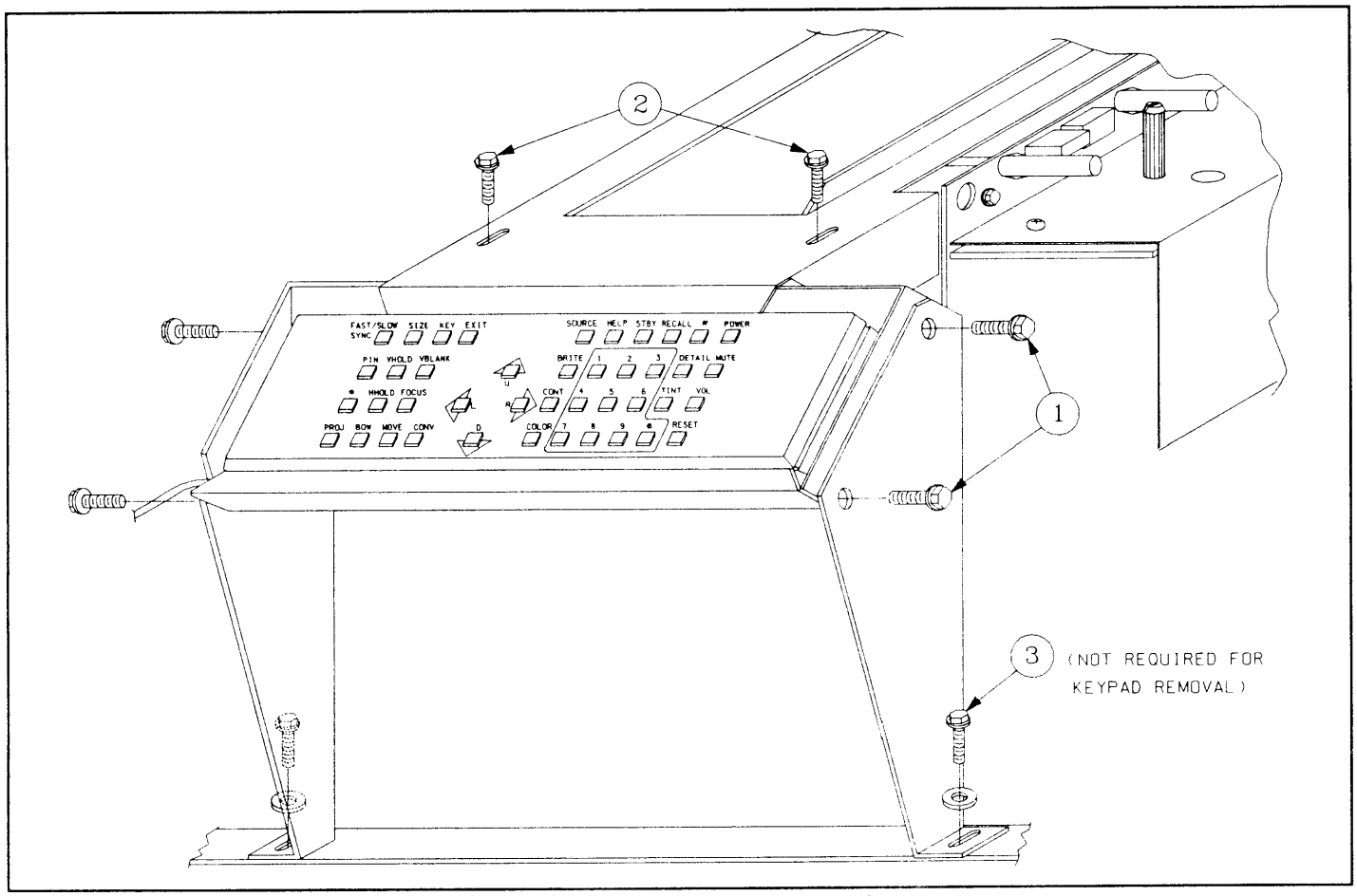

FIGURE 5-11. *Keypad Removal*

5.2.8 Keypad Installation

a) Ensure that the tabs of all brackets are positioned in the grooves of the keypad.

b) Tighten the keypad holder to the top bracket with the 2 screws removed in step e) above.

c) Attach the keypad holder to the side brackets. Use the screws removed in step d) above. NOTE: Adjust the angle of the keypad such that it will penetrate the rear top cover and enable the rear top cover to be secured to the projector.

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5.2.9 Standby Power Transformer Removal

The Standby Power Transformer is mounted within the front slide-out rack.

a) Remove the projector front and side panels and slide the front rack out per section 5.2.4.

b) Unplug connector M18-P5 from the Power Entry module as shown in Figure 5-12 below.

c) Unscrew the two hex head screws which secure the power transformer bracket to the front slide-out rack (item 2 in diagram). Feed the transformer assembly out through the bottom of the rack.

d) Remove the two hex head screws securing the transformer to the bracket.

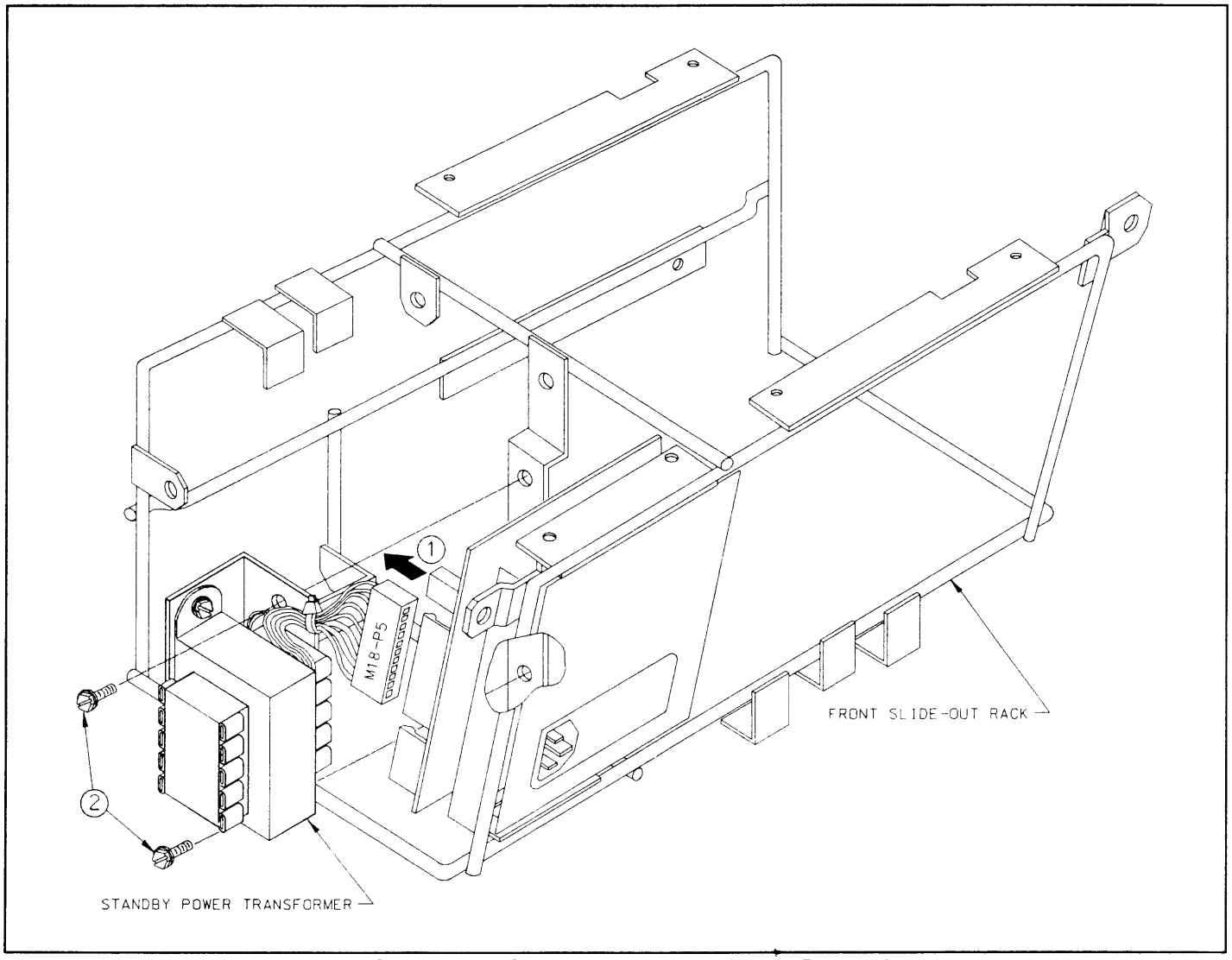

FIGURE 5-12. *Standby Power Transformer Removal*

5.2.10 Line Filter Removal

The Line Filter is mounted within the front slide-out rack.

a) Remove the projector front and side panels and slide the front rack out per section 5.2.4.

b) Unplug connector M18-P4 from the Power Entry module as shown below (item 1).

c) Follow the yellow/green earth grounding wire from the line filter to the grounding point located on the projector frame (item 2 below). Disconnect the ground lead at the grounding point.

d) Remove the two hex head screws (item 3 below) which secure the line filter to the front slide-out rack. Feed the line filter out through the top of the rack.

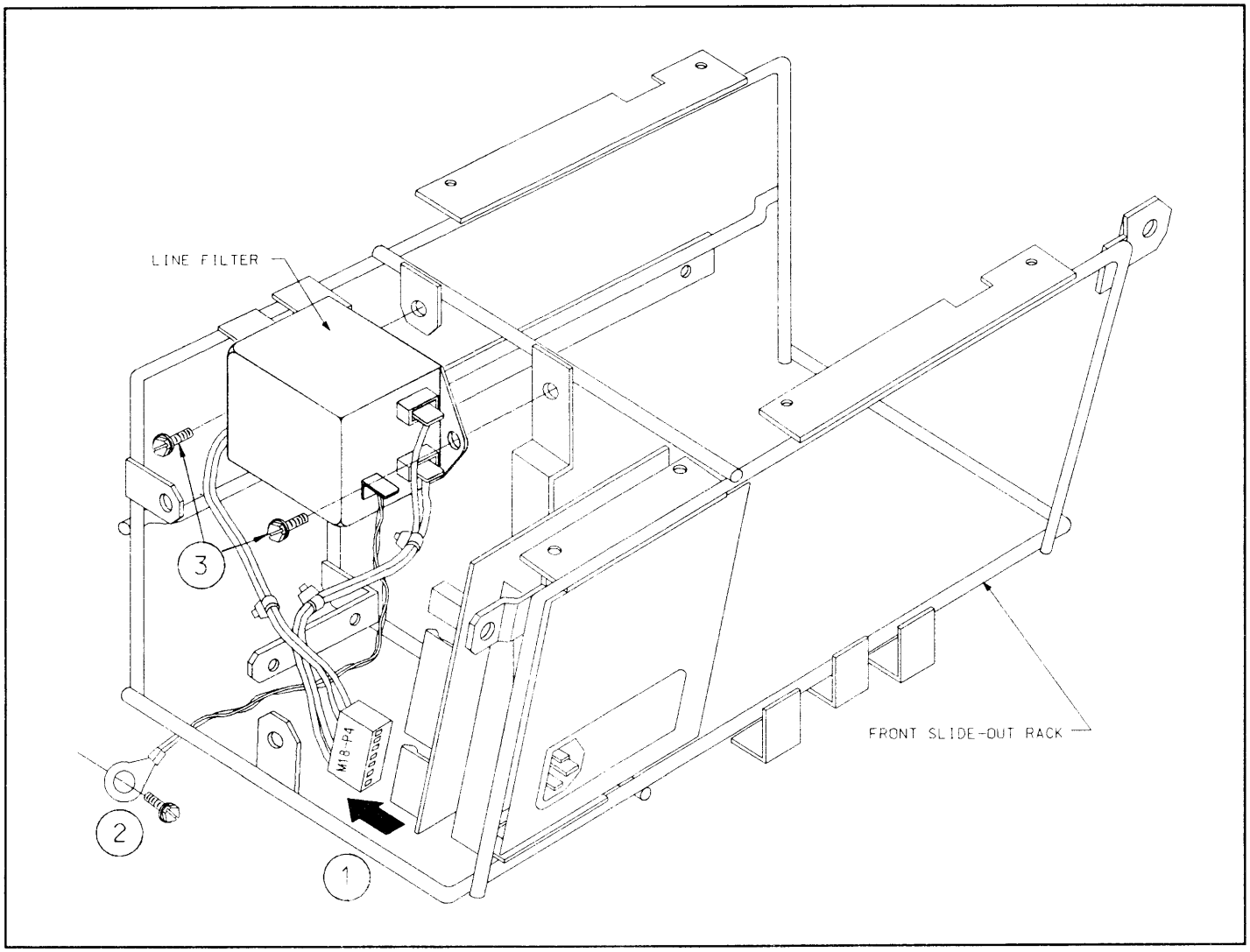

FIGURE 5-13. *Line filter Removal*

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5.2.11 Lens Removal

a) Remove the projector front top cover per section 5.2.1.

b) Remove the foam shield from around the lens.

c) Remove the 4 hex head screws (and washers) securing the lens to the lens mounting plate. See Figure 5-14.

d) Remove the lens from the projector.

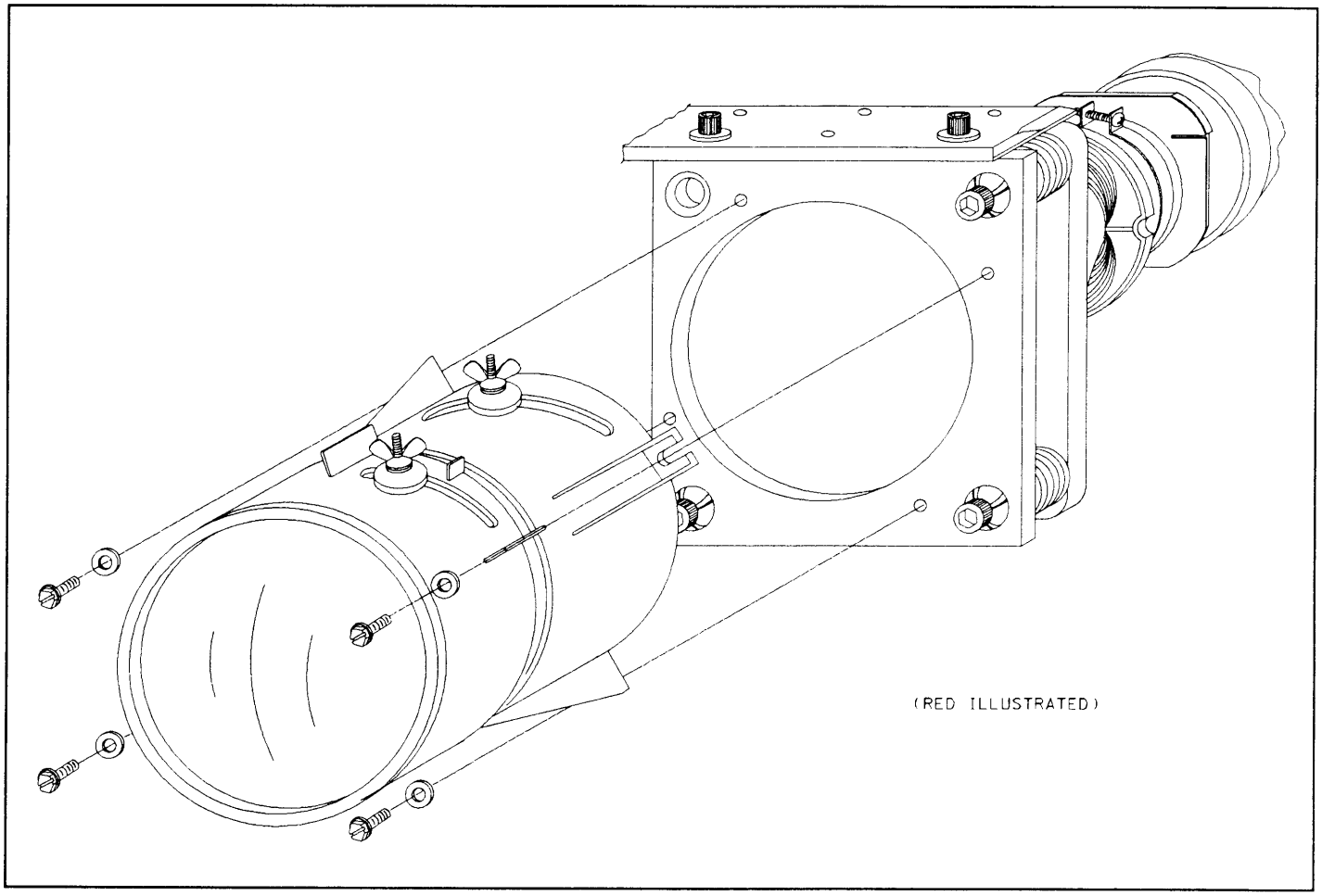

FIGURE 5-14. *Lens Removal*

5.2.12 CRT Removal

Follow this procedure if one or more CRTs require removal.

WARNING

Do not remove or handle the CRTs in any manner unless shatter-proof goggles are worn. People not wearing shatter-proof goggles must be kept away while the CRTs are handled. Keep the CRTs away from the body while handling.

a) Remove the top covers from the projector. See sections 5.2.1 and 5.2.2.

b) If the green (center) CRT is to be removed, remove the keypad assembly per section 5.2.7.
NOTE: disconnection of the keypad cable from the Mother Board is not required.

c) Disconnect the CRT anode lead from the high voltage splitter. Turn the locking ring counter-clockwise to release the plug.

CAUTION

Beware of high voltage discharge from the anode lead. Discharge lead voltage to the chassis ground upon removal.

d) Unplug the ground leads connected to P3 and P10 on the Video Output module.

e) Gently pull the Video Output module away from the CRT. Note: The Video Output module is secured to the CRT by a small amount of hot-melt glue. The joint between the glue and the CRT should break without difficulty. Pull the Video Output module from the CRT.

f) Disconnect the P6, P7 and P8 connectors from the Power Deflection module (located below the Video Output module).

g) This step is dependant on the projector model.

If the projector is a 3100 series:

Loosen the main Deflection assembly clamp which secures the Deflection assembly to the CRT neck. The Deflection assembly (one piece) is similar in appearance, but not exactly as illustrated in Figure 5-15. Slide the Deflection assembly off the neck of the CRT.

If the projector is a 4100 series:

Loosen the Convergence/DC Centering assembly clamp (item 1 in Figure 5-15). Next, loosen the Deflection Yoke clamp (item 2). Slide the Convergence/DC Centering assembly and Deflection Yoke assembly off the neck of the CRT. Retain the grounding wires for future re-assembly.

h) Remove the 6 CRT alignment screws (item 3).

i) Remove the 2 bulkhead securing bolts (item 4).

j) Remove the 4 bulkhead stabilizer bracket screws (item 5) for the two stabilizer brackets (item 6).

k) Remove the 2 bulkhead Bias module mounting bracket screws (item 7).

l) Remove the upper bulkhead mounting plate.

m) Remove the CRT bulkhead/lens assembly from the projector.

n) Remove the lens assembly per section 5.2.11.

o) With the hex head ball-nose driver supplied in the tool pouch, remove the 3 CRT tilt bolts, swivel bushings and tilt springs (items 8,9 and 10 in Figure 5-16).

p) Remove the 6 CRT mount screws (item 11 in Figure 5-16) from the CRT heat sink (item 12 in Figure 5-16).

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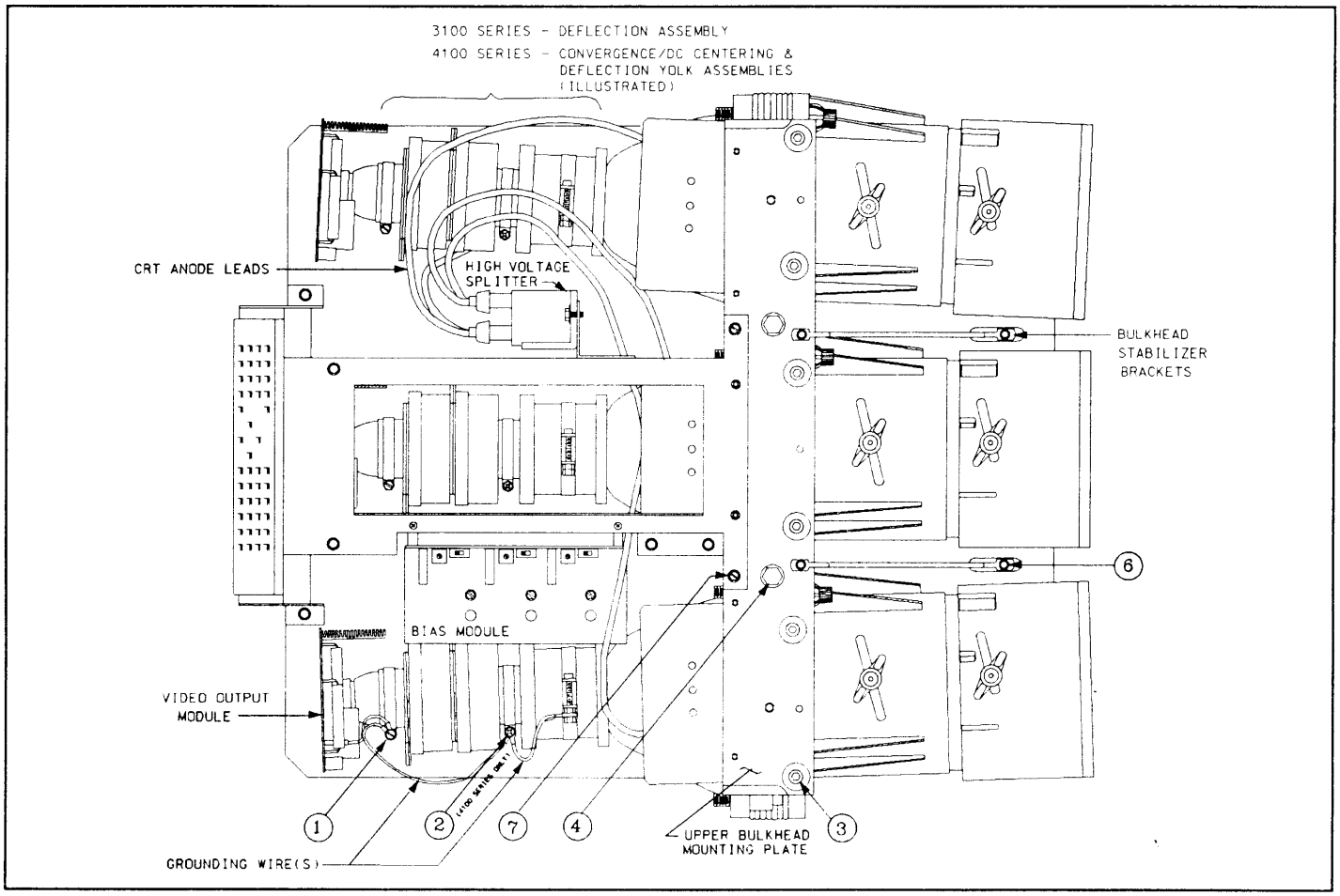


FIGURE 5-15 *CRT Removal (A)*

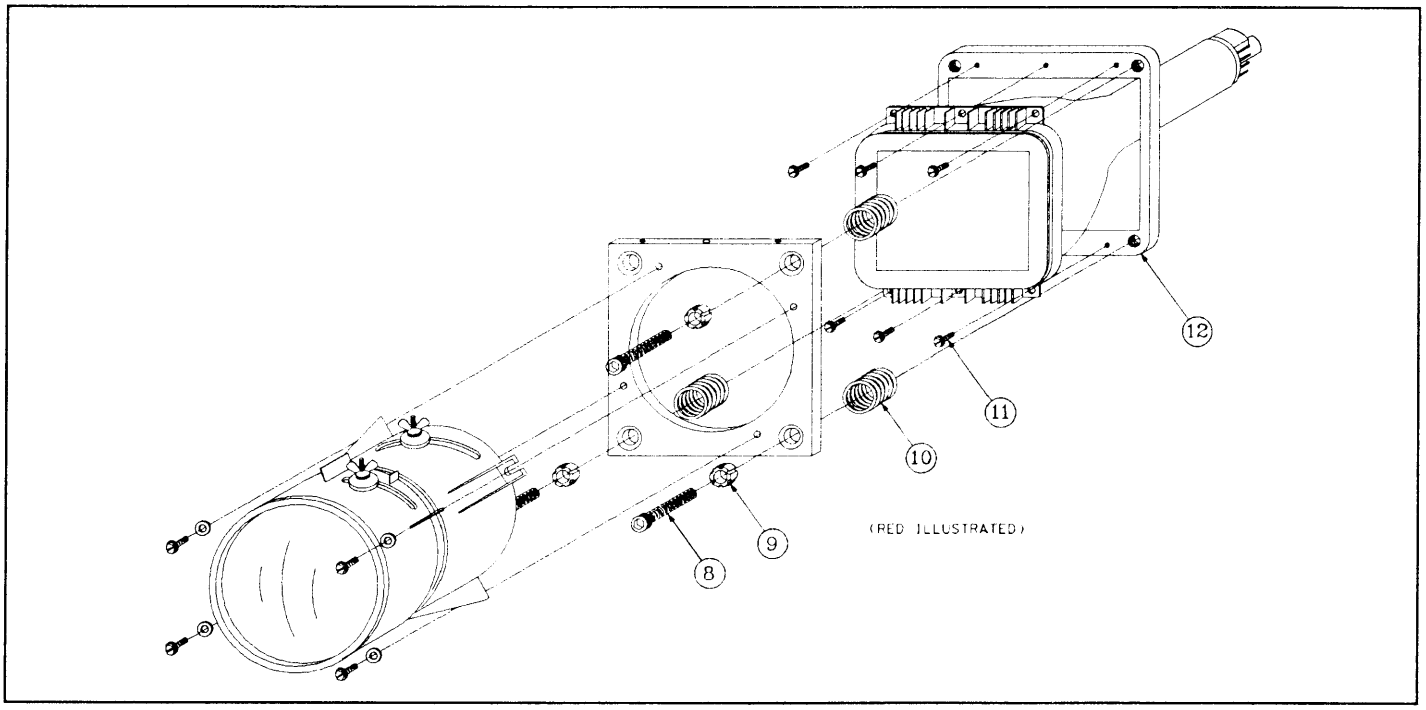


FIGURE 5-16 *CRT Removal (B)*

5.2.13 Lens/CRT Assembly Installation

Follow this procedure if a lens/CRT assembly has previously been removed and a new assembly is to be installed.

WARNING

Shatter-proof goggles MUST be worn when handling CRTs. Keep the CRTs away from the body while handling. People not wearing shatter-proof goggles must be kept away while the CRTs are handled.

a) Mount the CRT heat sink (item 12 in Figure 5-16) to the CRT with the 6 CRT mount screws (item 11).

b) Secure the CRT/bulkhead to the lens mounting plate with the 3 CRT tilt bolts, swivel bushings and tilt springs previously removed (items 8,9 and 10 respectively in Figure 5-16).

NOTE: The tilt springs must not protrude beyond the top or bottom of the bulkhead. The distance from the face of the CRT to the outside of the lens mounting plate must be 0.600" ± 0.002" (15.2mm ± 0.05mm).

c) Secure the lens to the lens mounting plate with the 4 hex head screws and washers previously removed. See Figure 5-13.

d) Add the foam shield around the lens.

e) Install the CRT bulkhead/lens assembly in the projector. Position the pin on the lower mounting plate in the hole of the lens mounting plate bottom.

f) Add the upper bulkhead mounting plate. Position the pin on mounting plate in the hole of the lens mounting plate top.

g) Mount the Bias module mounting bracket with the 2 screws previously removed (item 7 in Figure 5-15).

h) Secure each bulkhead stabilizer bracket with the 4 screws previously removed (item 5 in Figure 5-15).

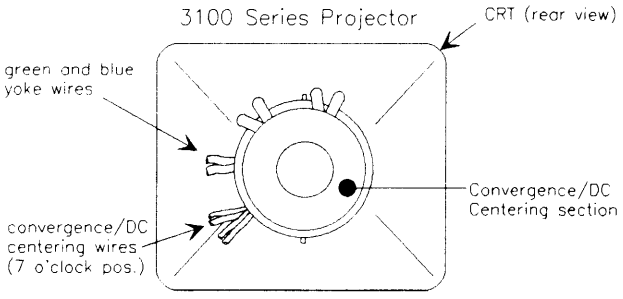
i) Install the 2 bulkhead securing bolts (item 4 in Figure 5-15)

j) Screw in the 6 CRT alignment screws (item 3 in Figure 5-15). Do not tighten fully.

k) This step is dependant on the projector model.

If the projector is a 3100 series:

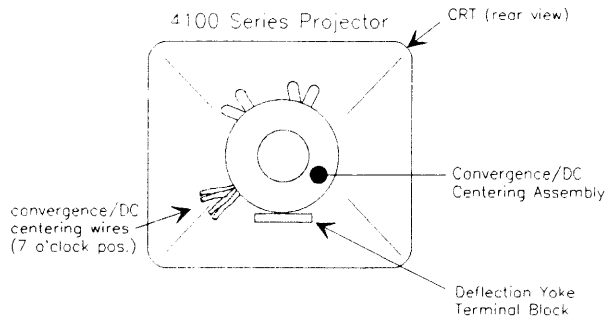
Slide the Deflection assembly as far as possible up the CRT neck. The convergence/DC centering wires from the Convergence/DC Centering section of the assembly should be at the 7 o'clock position when viewing the CRT from behind. Refer to the illustration below.



Tighten the main assembly clamp. Ensure the previously removed grounding wires connected between the Video Output module and the two assembly clamps are in place.

If the projector is a 4100 series:

Slide the Deflection Yoke assembly and the Convergence/DC Centering assembly as far as possible up the CRT neck. The terminal block on the Deflection Yoke assembly should be positioned downward. Refer to the illustration below. Tighten the Deflection Yoke clamp with the grounding wires connected as shown in Figure 5-15.



With the Convergence/DC Centering assembly against the Deflection Yoke assembly, tighten the assembly clamp (item 1 in Figure 5-15). The leads from the Convergence/DC Centering assembly should be at the 7 o'clock position when facing the CRT from behind. Refer to the above illustration. Ensure the previously removed grounding wires are connected as shown in Figure 5-15.

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l) Reconnect the P6, P7 and P8 connectors from the Convergence/DC Centering and Yoke assemblies to the Power Deflection module.

m) Remove the old hot melt glue from the CRT connector on the Video Output module. Connect the Video Output module to the CRT. The CRT connector on the Video Output module is keyed to assure correct hook-up. Apply a small amount of hot melt glue between the CRT connector and the CRT.

n) Connect the braided ground lead from the CRT clamps to the P3 connector on the Video Output Module.

o) Connect the braided ground lead from the CRT grounding spring to the P10 connector on the Video Output Module.

p) Connect the CRT anode lead to the high voltage splitter. Turn the locking ring clockwise to secure the lead to the splitter.

q) Reinstall the keypad assembly if previously removed. Refer to sections 5.2.7 and 5.2.8.

r) Align the CRT/projector using the CRT alignment and spot size adjustment procedures in Sections 7.4 and 7.5.

5.2.14 CRT Deflection Assembly Replacement

Follow this procedure for replacement of the CRT deflection assemblies. For 4100 series projectors, the deflection assemblies consist of a Convergence/DC Centering assembly and a Deflection Yoke assembly. For 3100 series projectors, these components are part of one complete unit designated as the "Deflection Assembly".

a) Remove the top covers from the projector. See sections 5.2.1 and 5.2.2.

b) If the green (center) CRT is to be removed, remove the keypad assembly per section 5.2.7. Disconnection of the keypad cable from the Mother Board is not required.

c) Gently pull the Video Output module away from the CRT. Note: the Video Output module is secured to the CRT by a small amount of hot-melt glue. The joint between the glue and the CRT should break without difficulty. Pull the Video Output module from the CRT.

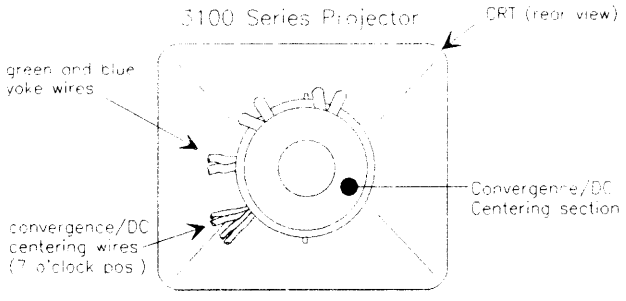
d) Disconnect the P6, P7 and P8 connectors from the Power Deflection module (located below the Video Output module).

e) This step is dependant on the projector model.

If the projector is a 3100 series:

Remove the Deflection assembly clamp screw to release the grounding wire to the P3 connector on the Video Output Module. NOTE: The Deflection assembly is similar in appearance, but not exactly as illustrated in Figure 5-15.

Slide the Deflection assembly away from the CRT. Slide the new Deflection assembly as far as possible up the CRT neck. The convergence/DC centering wires from the Convergence/DC Centering section of the assembly should be at the 7 o'clock position as illustration below.

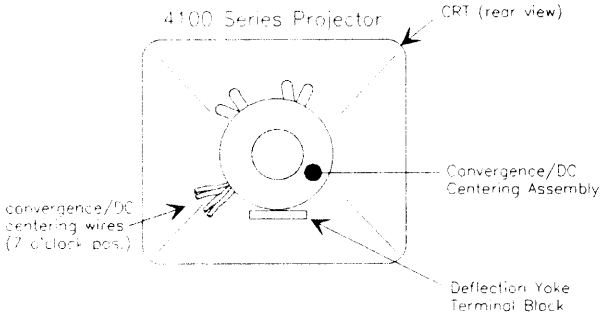


Tighten the main assembly clamp. Ensure the previously removed grounding wires connected between the Video Output module and the two assembly clamps are in place.

If the projector is a 4100 series:

Remove the Convergence/DC Centering assembly clamp screw to release the grounding wire to the P3 connector on the Video Output Module (item 1 in Figure 5-15). If the Yoke requires replacement, loosen the Deflection Yoke clamp (item 2 in Figure 5-15). Slide the Convergence/DC Centering assembly off the neck of the CRT.

If the Deflection Yoke requires replacement, slide the Deflection Yoke assembly off the neck of the CRT and replace. The Deflection Yoke assembly must be as far as possible up the CRT neck with it's terminal block positioned downward. Refer to the illustration below. Tighten the Deflection Yoke clamp with the grounding wires connected as shown in Figure 5-15.



Slide the Convergence/DC Centering assembly over the CRT neck with the leads at the 7 o'clock position (when facing the CRT from behind). Refer to the above illustration. With the Convergence/DC Centering assembly against the Deflection Yoke assembly, tighten the assembly clamp (item 1 in Figure 5-15). Ensure the previously removed grounding wires are connected as shown in Figure 5-15.

f) Reconnect the P6, P7 and P8 connectors from the Convergence/DC Centering and Yoke assemblies to the Power Deflection module.

g) Remove the old hot melt glue from the CRT connector on the Video Output module. Connect the Video Output module to the CRT. The CRT connector on the Video Output module is keyed to assure correct hook-up. Apply a small amount of hot melt glue between the CRT connector and the CRT.

h) Reinstall the keypad assembly if previously removed. Refer to sections 5.2.7 and 5.2.8.

i) Align the CRT/projector following the CRT alignment and spot size adjustment procedures in Section 7.4 and 7.5.

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SECTION 6

TROUBLESHOOTING

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

No tables included in this section.

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6.1 TROUBLESHOOTING GUIDE

This section is to assist the service repair technician when a problem has occurred and troubleshooting is required. Once the full symptoms of the problem have been noted, refer to the diagrams and charts listed below to help locate the defective module. Attempt to locate the defective module directly or by elimination of good modules. For suspect modules, refer to the appropriate module servicing section(s) in this manual. These sections provide technical data (including schematics and component layouts) as well as alignment procedures.

The following diagrams and charts may be useful when trying to pinpoint defective modules or circuits:

- *Function Block Diagram* (Figure 3-1 in Section 3)
- *Troubleshooting Flow Charts* (Figures 6-1 to 6-5)
- *Video Path Block Diagram* (Figure 6-6)

To assist in troubleshooting at the module/circuit board level, try the following:

a) Check all wiring for defects.

b) Visually check resistors, capacitors and other components for defects or abnormalities.

c) For an apparently defective circuit, measure appropriate voltages and waveforms such as:

- collector voltages and waveforms of transistors,
- base to emitter voltages of transistors (0.3 to 1.0V),
- terminal voltages and waveforms of ICs.

d) If an intermittent problem exists, try tapping individual components, e.g., resistors, diodes, transistors, etc. Should this method fail, rapidly heat and cool in-circuit components. Use a portable hair dryer and spray-type circuit coolant.

NOTE: If a component is defective and must be replaced, refer to the component removal instructions in Section 4.2.

6.2 FLOW CHARTS

The following pages contain troubleshooting flow charts which may be used as a guide when troubleshooting. The flow charts are aids to isolating problems at the module level only.

NOTE: Make sure all projector modules are properly installed before troubleshooting.

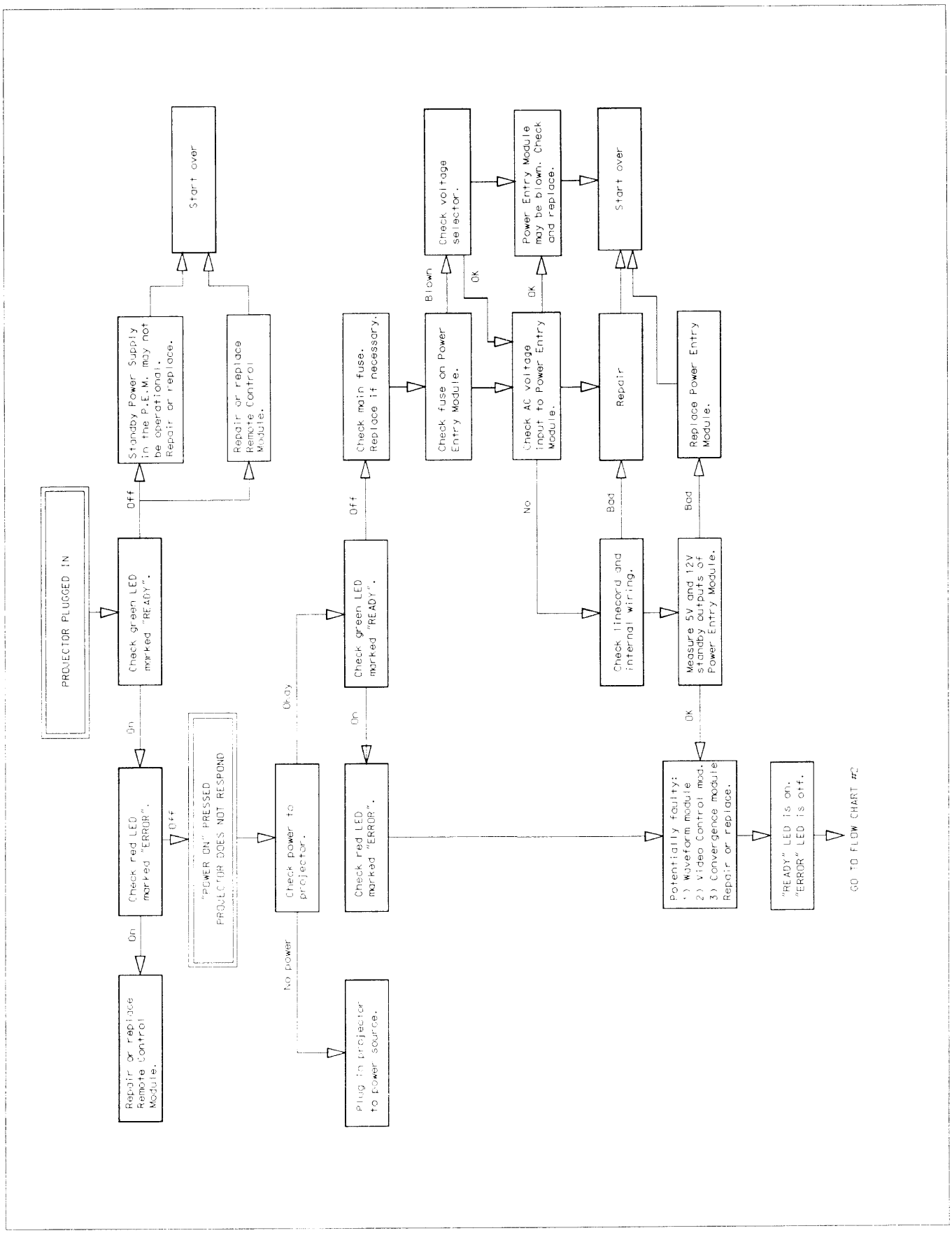

FIGURE 6-1. *Flow Chart #1*

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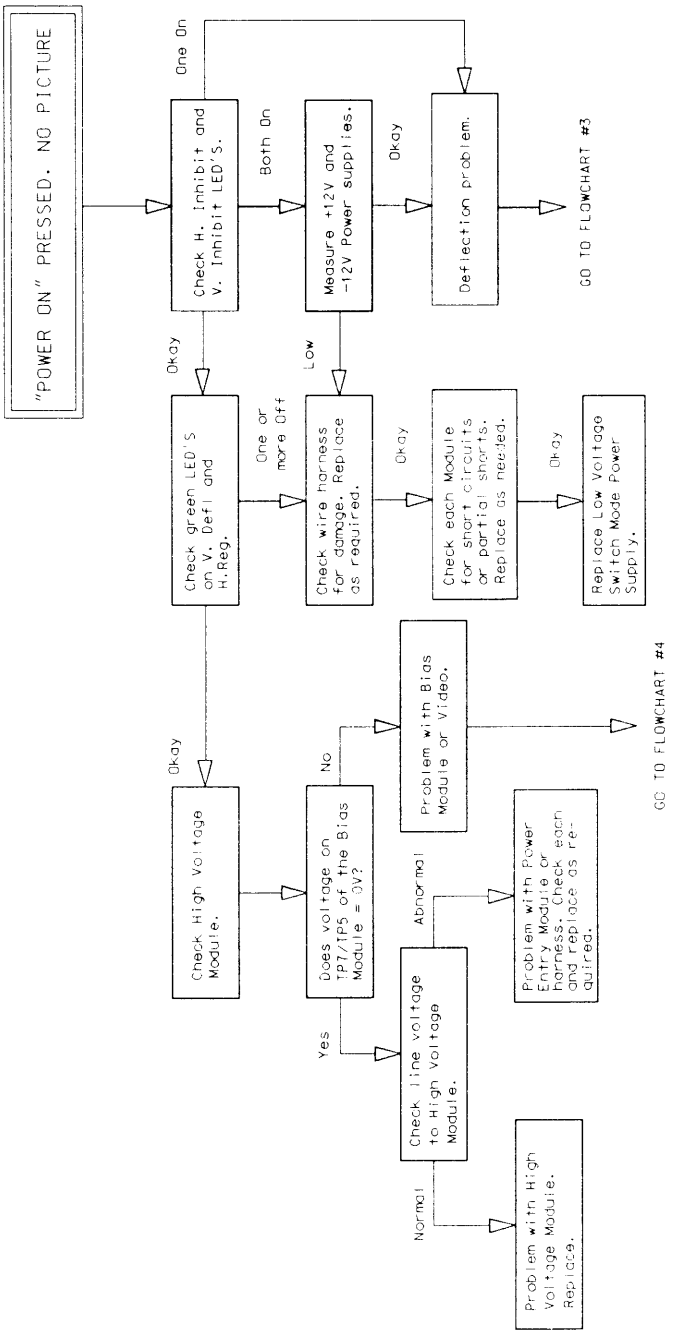


FIGURE 6-2. ***Flow Chart #2***

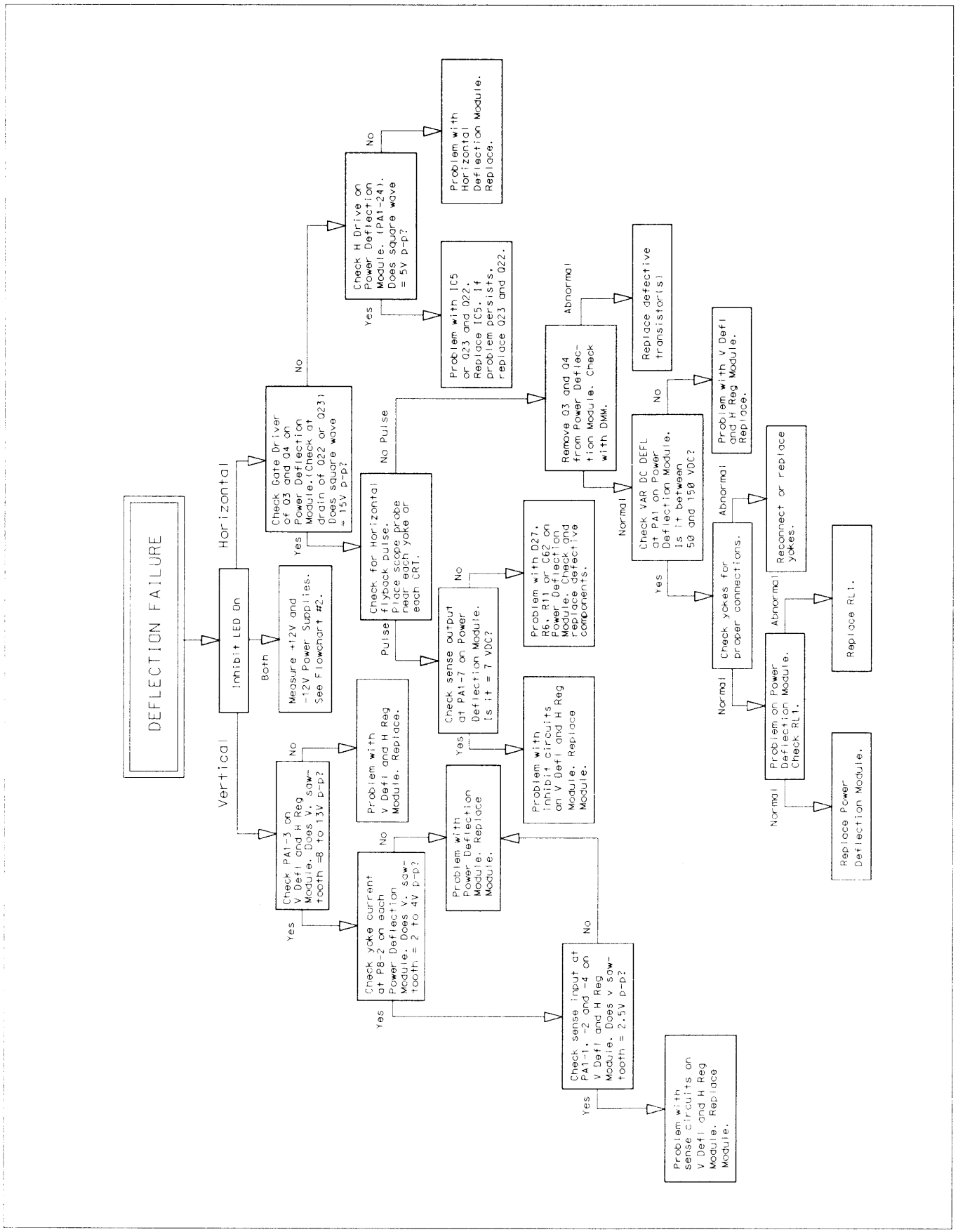


FIGURE 6-3. *Flow Chart #3*

54-7904-02P/54-7904-03P (06/90)

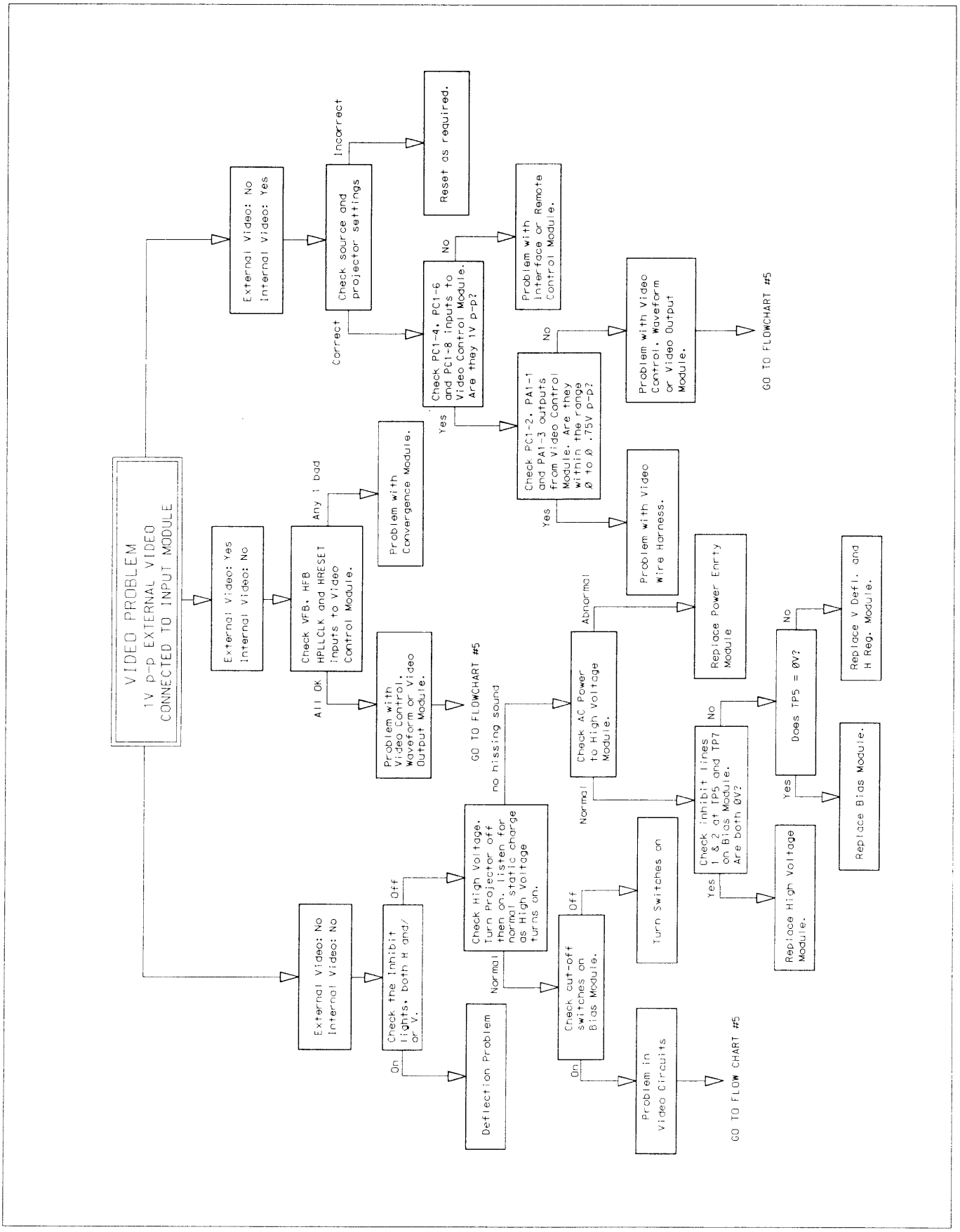
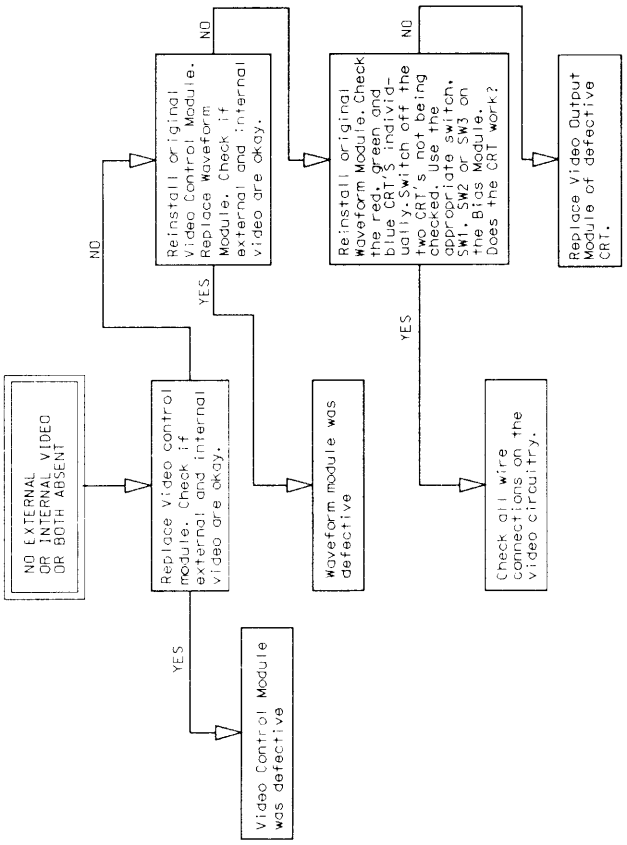


FIGURE 6-4. *Flow Chart #4*



NOTES:

FIGURE 6-5. *Flow Chart #5*

54-7904-02P/54-7904-03P (06/90)

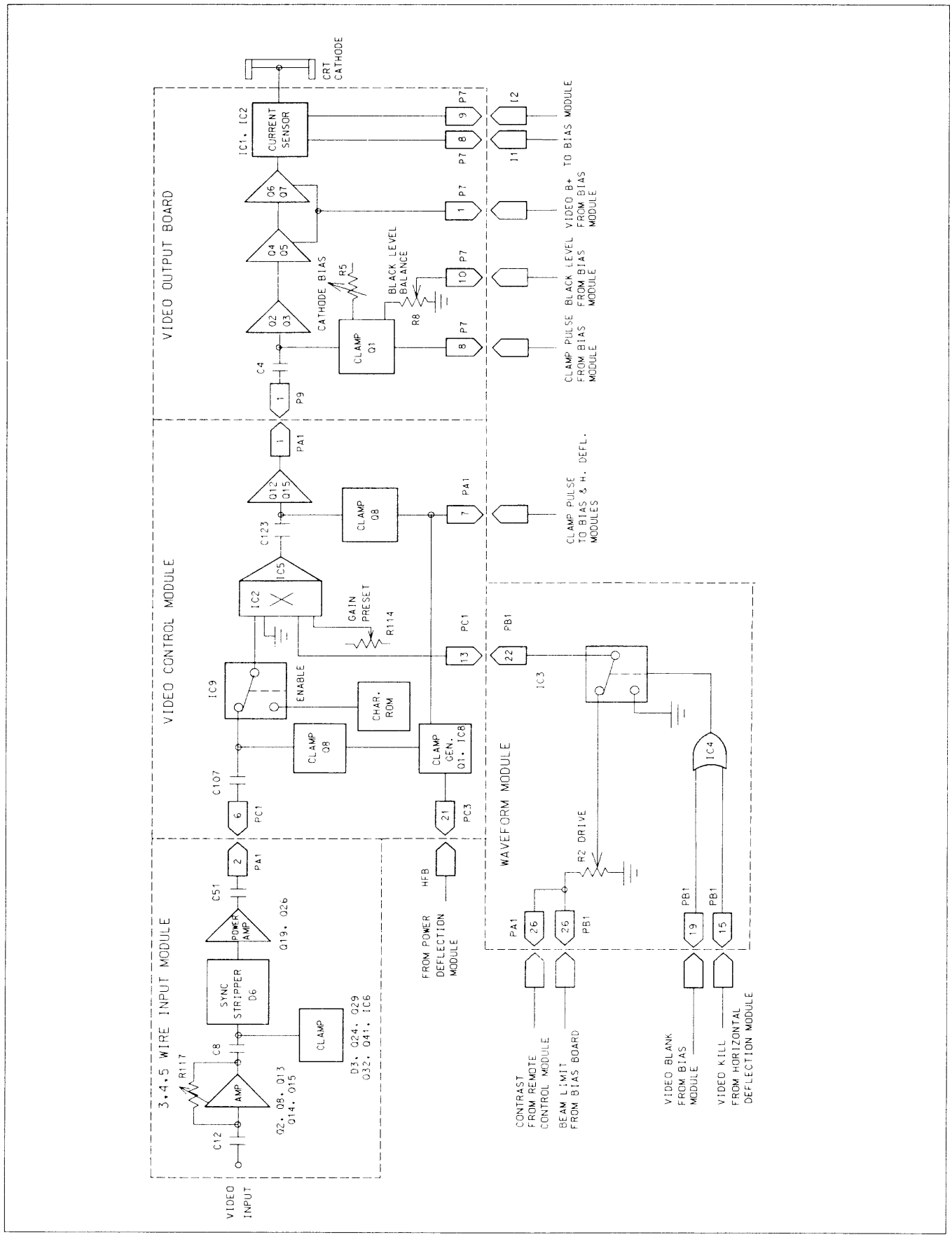


FIGURE 6-6. *Video Path Block Diagram*

SECTION 7

ALIGNMENT PROCEDURES

TABLE OF CONTENTS

Refer to Table 7-1 for a complete listing of alignment procedures which may be performed.

LIST OF ILLUSTRATIONS

LIST OF TABLES

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This section provides projector alignment procedures for use by a service/repair technician. Refer to Table 7-1 for a list of procedures which may be performed. Alignment procedures involving only a single module may be found in the MODULE SERVICING section of this manual.

TABLE 7-1. *Service Alignment List*

Alignment/Setup	Modules affected	Section
Raster Centering	Power Deflection Module Remote Control Module	7.1
Color Balance	Bias Module Video Control Module Waveform Module	7.2
Video Amplifier & Color Balance	Bias Module Video Control Module Video Output Module	7.3
CRT/Lens Assembly Alignment	CRT/Lens Assembly Bias Module Deflection Yoke Converge/DC Centering Assembly	7.4
Spot Size Adjustment	Converge/DC Centering Assembly	7.5
Waveform	Waveform Module	12.2
Convergence (manual)	Convergence Module	13.2
Electronic Focus	Bias Module	15.2
Horizontal Deflection	Horizontal Deflection Module	16.2
Vertical Deflection and Horizontal Regulation	Vertical Deflection & Horizontal Regulation Module	17.2
Power Deflection	Power Deflection Module	19.2

WARNING

DO NOT ATTEMPT ANY SERVICING UNTIL ALL SERVICE WARNINGS IN SECTION 4, *SERVICING GUIDELINES*, ARE UNDERSTOOD.

7.1 RASTER CENTERING

Tools & Equipment Required:

- extender board, Electrohome Part # 03-230330-01P
- printed circuit board extractor
- long shafted, fine tip, insulated slot screwdriver
- dc voltmeter or oscilloscope

Modules affected:

- Power Deflection Module
- Remote Control Module

STEP 1 – Remote Control Module Removal

a) Remove the back panel as described in Section 5.2.

b) Locate the Remote Control module in the rear panel card rack. Using the printed circuit board extractor from the tool pouch, pull the module from the card rack (as described in Section 5.2).

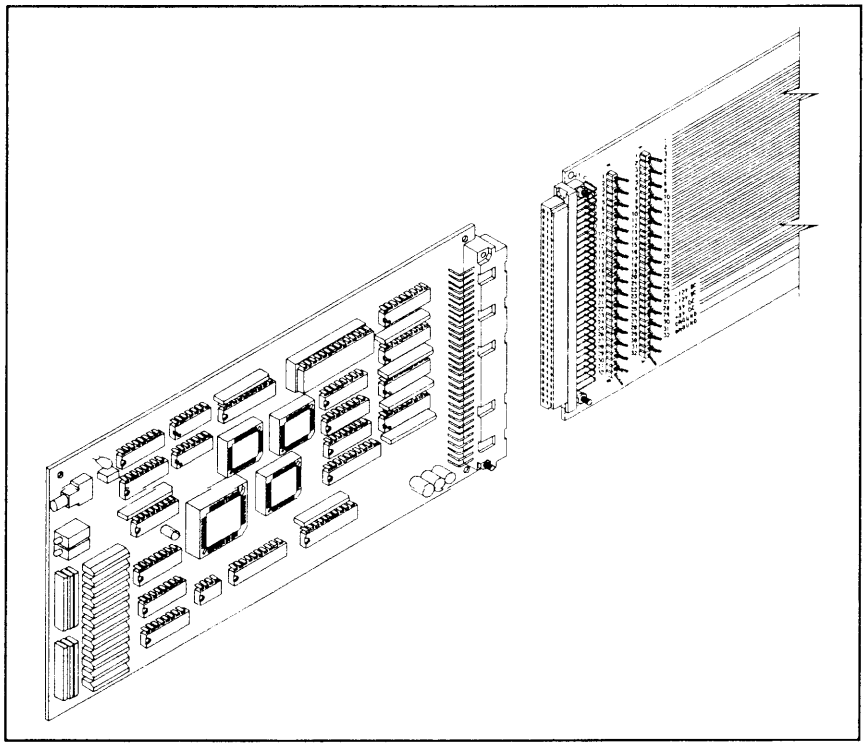

FIGURE 7-1. *Extender Board Use*

STEP 2 – Check DC Voltage on Remote Control Module

a) Insert the extender board into the Remote Control module slot.

b) Put the Remote Control module on the extender board. See Figure 7-1.

c) Locate row A, pin 8 on the extender board. Connect the dc voltmeter or oscilloscope to this pin. Connect the ground lead of the test instrument to pin 31 or 32 on any row.

d) Turn ON the projector. Press CONVERGE, 5, RESET, EXIT and EXIT on the keypad.

e) Press CONVERGE, 5 again then press and hold the L or R arrow key until the voltage on row A, pin 8, is zero.

f) Press EXIT twice. Measure the dc voltage. If it is not zero repeat step e).

NOTE: The above 2 steps eliminate all correction voltages.

g) Press CONVERGE, 2, RESET.

STEP 3 – Alignment

a) Locate trimpot R119 on each Power Deflection module. See Figure 7-2.

b) Use the slot screwdriver to adjust the trimpot. Look into each CRT lens, one at a time, and adjust the trimpot until the crosshatch is centered on the raster as close as possible.

c) Press EXIT, then converge the projector (see Owner's Manual).

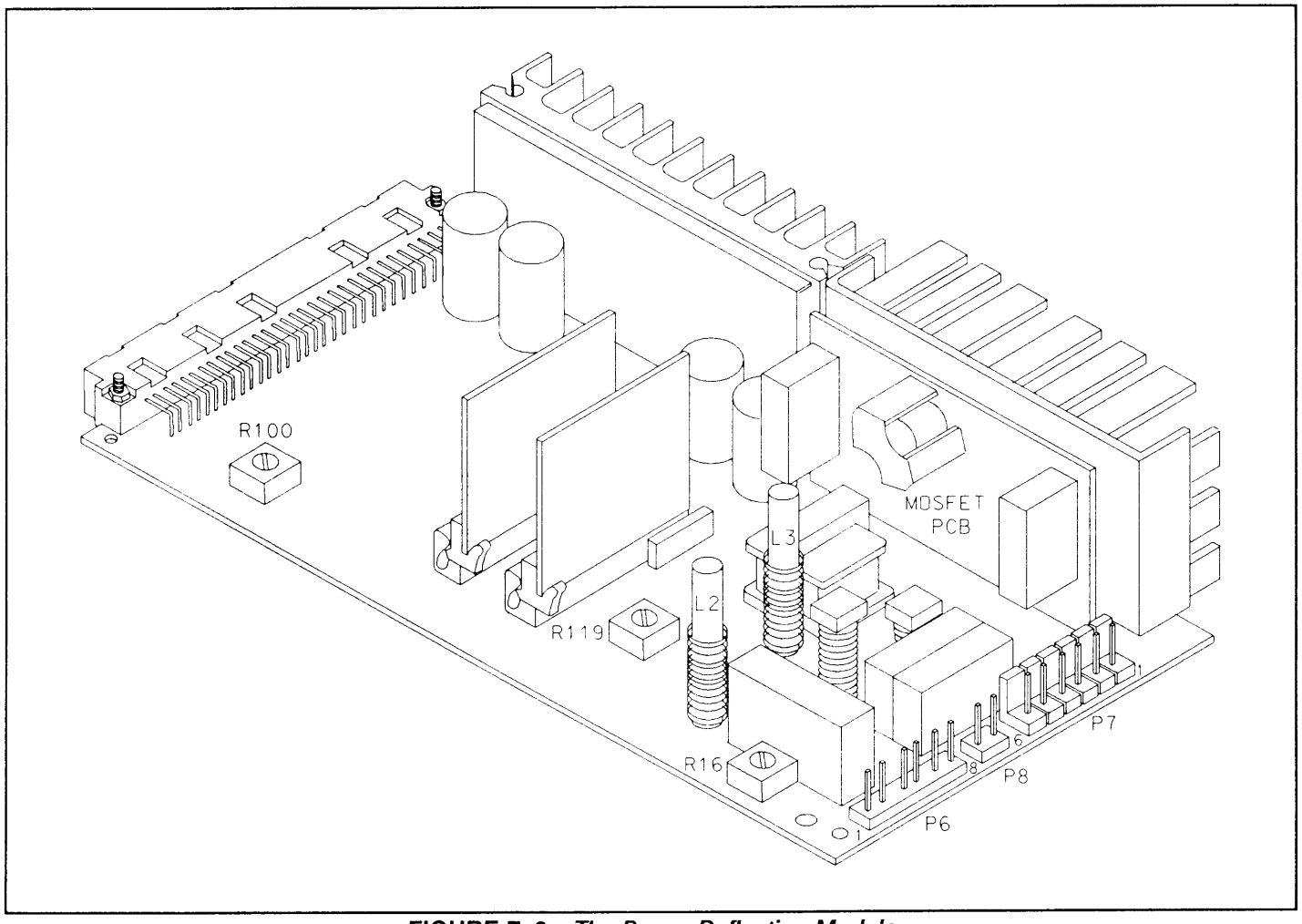

FIGURE 7-2. *The Power Deflection Module*

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7.2 Color Balance Set-up

Tools & Equipment Required:
- white field signal generator
- fine tip slot screwdriver
- Phillips screwdriver

Modules affected:
- Bias Module
- Video Control Module
- Waveform Module

a) Remove the top cover and back panel from the projector. (See Section 5.2.)

b) Connect a 1V p-p, 1% matched, white video signal to the 75Ω input on the interface module (3,4,5 wire family).

c) Turn room lights off. Project an image on the screen.

d) Adjust BRIGHTNESS to 5 on the function bar graph. Adjust CONTRAST to 0. Switch to the internal crosshatch.

e) Adjust the three G2 trim potentiometers (R20, R45, R19) on the Bias module until the raster of each color is visible (see Figure 7-5).

f) Turn OFF two of switches SW1, SW2 and SW3 on the Bias module. Adjust the G2 trimpot of the color still ON until the image just disappears. Repeat for the other colors.

g) Increase BRIGHTNESS to 10. Turn on the red CRT only. Adjust R113 on the Video Control module until the red crosshatch bars disappear. Repeat, for the green and blue CRTs, adjusting R114 and R115 respectively. See Figure 7-3.
NOTE: Observe closely. It is easy to miss the null position and turn through it to positive video.

h) Turn all switches on (SW1, SW2 and SW3). Adjust BRIGHTNESS to 5. Increase CONTRAST to 3. Connect the white field generator. Turn the three trimpot drive controls (red R1, green R2, blue R3) on the Waveform module fully clockwise. Refer to Figure 7-3.

i) Adjust the drive controls until a white image is produced. Reduce R1 if the image appears red. Reduce R2 if the image appears green. Reduce R3 if the image appears blue. Reduce R1 and R2 if the image appears yellow. Reduce R1 and R3 if the image appears reddish-purple. Reduce R2 and R3 if the image appears cyan or light blue.

j) Check step g) and repeat if necessary.

k) Gradually decrease contrast and observe the color on the screen. At low levels the color should be grey, if it is not, adjust one or two of the G2 trimpots on the Bias module until it is.

l) Repeat steps h) through k) until an optimum white is obtained. **NOTE: If all three trimpots were adjusted in step k), repeat steps d) through k).**

m) Proceed to Section 7.3 if performance needs further improvement.

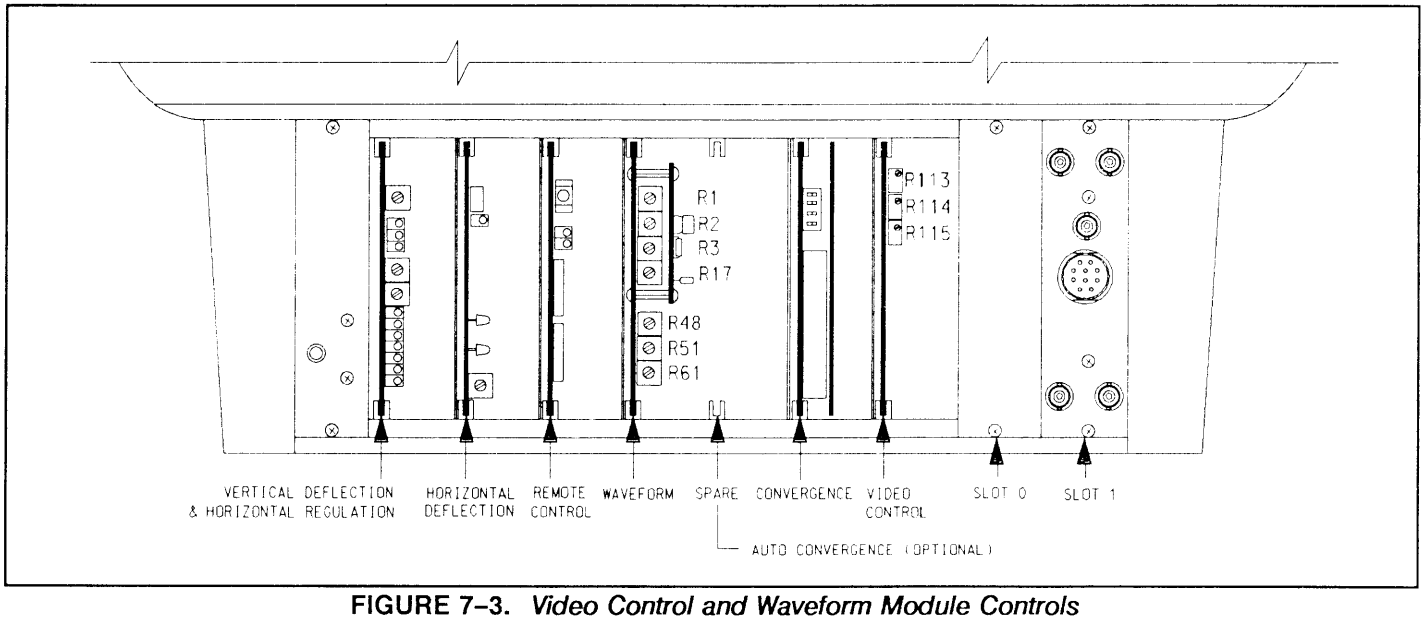

FIGURE 7-3. *Video Control and Waveform Module Controls*

7.3 Video Amplifier Alignment with Color Balance Set-up

Note: Perform this procedure only after Color Balance Set-up per Section 7.2.

Tools & Equipment Required:
- white field signal generator
- fine tip slot screwdriver
- extender board, Electrohome part #03-230330-01P
- Phillips screwdriver

Modules affected:
- Bias Module
- Video Control Module
- Video Output Module

a) Remove the top cover and back panel from the projector. (See Section 5.2)

b) Connect a 1V p-p, 1% matched, white video signal to the 75Ω input on the interface module (3,4,5 wire family).

c) Adjust controls R116, R117 and R115 (red, green, blue) on the interface module until the outputs at C2, C4 and C6 (red, green, blue) are 1V p-p and within 1%.

d) Adjust CONTRAST to 0 on the function bar graph. Switch to the internal crosshatch.

e) Increase BRIGHTNESS to 10. Turn OFF two of switches SW1, SW2 and SW3 on the Bias module.

f) Adjust the appropriate video null trim pot (R113=red, R114=green, R115=blue) on the Video Control module until the crosshatch bars disappear from the image. Repeat for the two remaining CRTs.

g) Turn OFF two of switches SW1, SW2, and SW3. Adjust R8 on the Video Output module of the CRT which is on until maximum brightness is reached. Repeat for the other two CRT's.

h) Turn all switches on (SW1, SW2 and SW3). Set BRIGHTNESS to 5.

i) Connect the digital voltmeter between the cathode (pin K on the Video Output module) and ground.

NOTE: If the raster changes in brightness when the voltmeter is connected, insert a 20K resistor in series with the voltmeter. Keep the body of the resistor close to the cathode pin. See Figure 7-4.

j) Adjust R5 on the Video Output module until the voltmeter reading is 140 VDC ± 0.3V.

k) Adjust the three G2 trim potentiometers (R20, R45, R19) on the Bias module until the raster of each color is just visible.

l) Turn OFF two of switches SW1, SW2 and SW3 and adjust the G2 trim pot of the color still ON until the raster just disappears. Repeat for the other two CRT's.

m) Increase BRIGHTNESS to 10. Decrease CONTRAST to 0. The image should be grey. If it is not, adjust R8 on two of the Video Output modules. Repeat steps h) to m) as needed.

n) Turn all switches ON (SW1, SW2 and SW3). Adjust BRIGHTNESS to 5. Increase CONTRAST to 3. Connect the white field generator. Turn all three trimpot drive controls (red R1, green R2, blue R3) on the Waveform module fully clockwise. Decrease two of the colors until the best white image is produced. Check steps e) and f) and repeat if necessary.

o) Gradually decrease contrast and observe the color on the screen. At low levels the color should be grey; if it is not, adjust one or two of the G2 trimpots on the Bias module until it is.

p) Repeat steps n) through o) until an optimum white is obtained. **NOTE: If all three trimpots were adjusted in step k), repeat steps n) and o).**

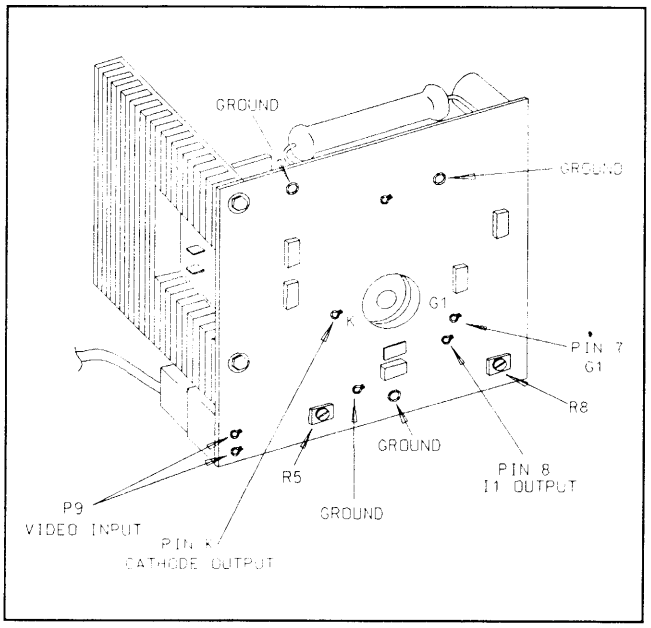

FIGURE 7-4. *Video Output Module (back)*

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7.4 CRT/Lens Assembly Alignment

The following procedure is to be performed after replacement or reassembly of a CRT/Lens assembly. For general focusing and geometry alignment instructions, refer to the **PROJECTOR ALIGNMENT** section in the **Owner's Manual**.

WARNING

The power supplies in the projector are capable of delivering LETHAL quantities of energy. Follow normal HIGH VOLTAGE precautions when working near them.

Tools & Equipment Required:
- hex head ball-nose driver (in tool pouch)
- allen key (in tool pouch)
- combination wrench (in tool pouch)
- adjusting tool (in tool pouch)
- Phillips screwdriver
- fine tip slot screw driver

Modules affected:
- CRT/Lens Assembly
- Bias Module
- Deflection Yoke
- Converge/DC Centering Assembly

a) Remove the top covers as described in Section 5.2.

b) For the newly installed or reassembled CRT, turn on the corresponding CRT switch on the Bias module. Refer to Figure 7-5. With the internal cross hatch selected from the keypad, look into the CRT lens and adjust the G2 and focus controls on the Bias module. Set the controls to roughly match that seen when looking into the other two CRT's (while turned on). Note: If the CRT is exhibiting an extremely bright image (high beam current), reduce with the G2 control.

c) Turn OFF the newly installed CRT and turn ON one of the original CRTs, preferably the green or red. Use the appropriate switch on the Bias module. See Figure 7-5.

d) Press HELP, 1, 2, to enter the set-up routine.

e) Focus the picture optically and mechanically to produce optimum top, center, bottom and corner focus. Refer to the **PROJECTOR ALIGNMENT** section in the **Owner's Manual** for focusing instructions.

f) Switch ON the newly installed lens/CRT assembly. Ideally, the two colors should be converged and in focus.

g) Loosen both yoke clamps. Rotate the yoke clockwise or counter-clockwise until the image best lines up with the image from the reference CRT. Tighten the leading yoke clamp, i.e., the clamp which is nearest to the lens.

h) Follow the spot size adjustment instructions in section 7.5 for the affected CRT.

i) Check the top to bottom focus referring to the **PROJECTOR ALIGNMENT** section in the **Owner's Manual**.

j) Converge the projector referring to the **CONVERGENCE ALIGNMENT** section in the **Owner's Manual**.

k) If color balance is not correct, refer to section 7.2 - *Color Balance Set-up*.

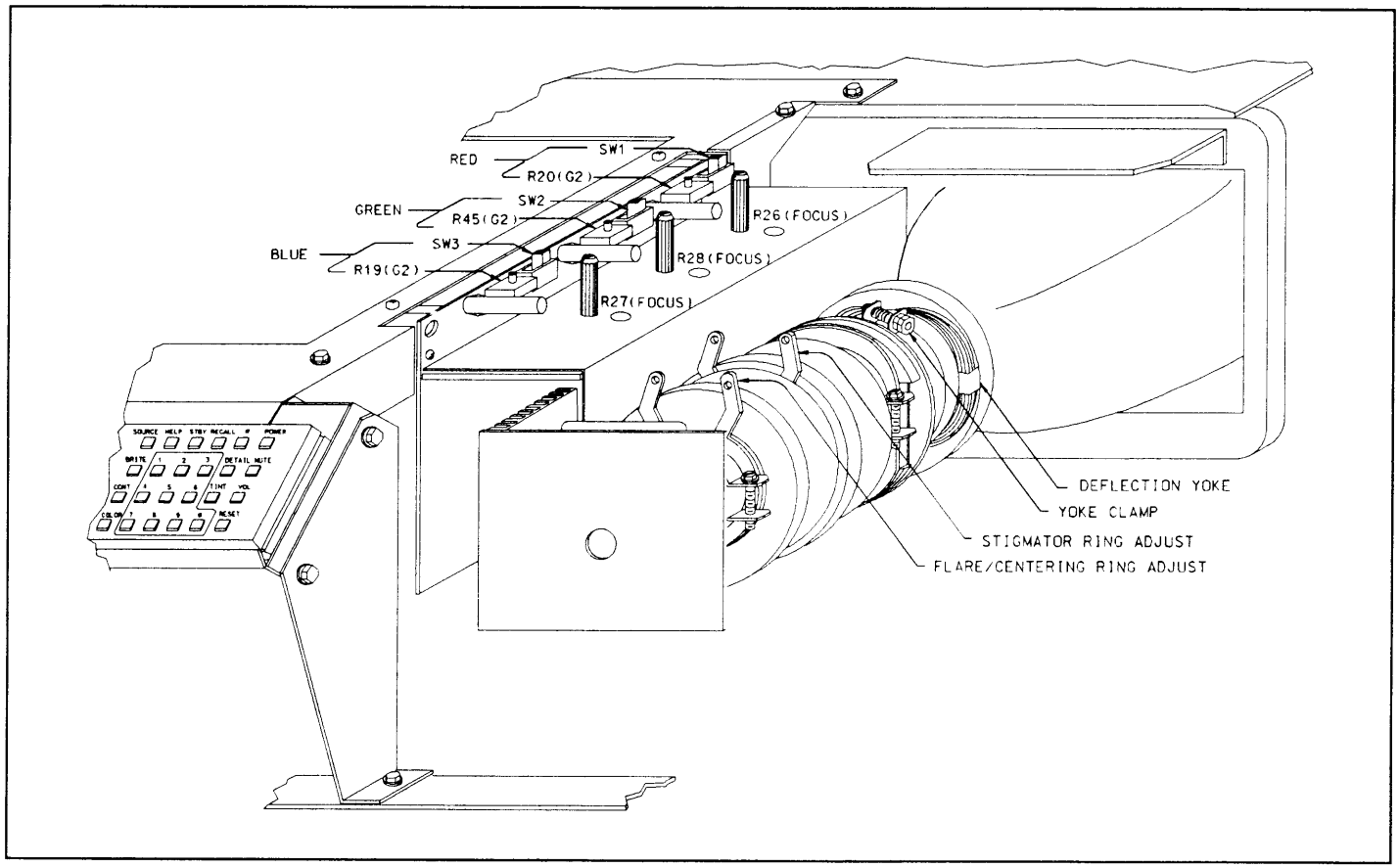

FIGURE 7–5. *Bias Module and CRT Controls*

54-7904-02P/54-7904-03P (06/90)

7.5 Spot Size Adjustment

Tools & Equipment Required:
- Phillips screwdriver
- fine tip slot screwdriver

Modules affected:
- Converge/DC Centering Assembly

a) Remove the projector top covers per section 5.2.

b) Power up the projector.

c) Check optical focus. Re-focus if necessary.

d) Set FOCUS to 5 on the function bar graph.

e) Press CONV, 4 to produce a dot pattern.

NOTE: Do not use interlace signals for these adjustments.

f) Turn OFF the green and blue CRTs using slide switches SW2 and SW3 on the Bias module. Darken the room.

g) Turn the RED focus pot (R26) on the Bias module fully clockwise to produce large, well-defined spots on the screen.

h) View the screen center. Rotate the stigmator rings until the spot becomes round. Refer to Figure 7-5.

WARNING

HIGH VOLTAGE
Follow normal HIGH VOLTAGE precautions.

NOTE: Rotating the rings in opposite directions produces a different effect than does rotating the rings together.

i) Turn the red electronic focus pot fully counter-clockwise to produce small, bright dots surrounded by dim halos on the screen.

j) Rotate the flare rings until the bright spot is in the center of the halo. Refer to Figure 7-5.

k) Repeat steps h) to j) several times until spot/flare geometry looks best. Turn the focus pot until the spot is focused.

l) Turn OFF the red CRT. Turn ON the blue CRT. Use slide switches SW1 and SW3 on the Bias module.

m) Repeat steps h) to k) for the blue CRT. The blue electronic focus pot is R27.

n) Turn OFF the blue CRT. Turn ON the green CRT. Use slide switches SW3 and SW2 on the Bias module.

o) Repeat steps h) to k) for the green CRT. The green electronic focus pot is R28.

p) Turn ON all CRTs.

q) Set CONTRAST to 3. Check focus and adjust the appropriate pot on the Bias module as necessary.

r) Install the projector covers.

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NOTES

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SECTION 8

POWER ENTRY MODULE

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LIST OF ILLUSTRATIONS

LIST OF TABLES

No tables are included in this section.

54-7904-02P/54-7904-03P (06/90)

8.1 TECHNICAL DESCRIPTION

8.1.1 General Description

The Power Entry Module (PEM) accepts 120V or 240V AC input power for distribution to the projector power supplies. A 120V/240V switch located behind the plastic fuse cover on the Power Entry Module is set to the input voltage in use.

As well as the distribution of AC power to the power supplies, the module also includes a +5 and +12 VDC standby power supply. The 5 volt supply is used by the Remote Control module. The 12 volt supply powers the IR sensor and the keypad.

8.2 SERVICING AND ALIGNMENT

8.2.1 Disassembly and Access

Module Location:
- front slide-out rack

Tools & Equipment Required:
- 1/4" hex head socket driver

a) Remove the projector lower front and side panels as described in Section 5-2.

b) Trace the yellow/green grounding wire from the Power Entry Module to the grounding point on the projector chassis. See Figure 8-1 (item 1). Disconnect the grounding wire.

c) Remove the two screws securing the front slide-out rack to the projector chassis. Carefully slide the rack out about 3". Disconnect the M18-P1, M18-P2, M18-P3, M18-P4 and M18-P5 connections from the rear of the module.

d) Remove the two hex head screws (item 2) as shown.

e) Remove the Power Entry Module from the front slide-out rack as shown by the arrows in Figure 8-1.

8.2.2 Alignment

Service alignments are not necessary. If the Power Entry Module becomes faulty and cannot be repaired, the module must be replaced.

8.3 COMPONENT LAYOUT AND SCHEMATICS

Refer to the following pages for component layouts and schematics of the Power Entry module.

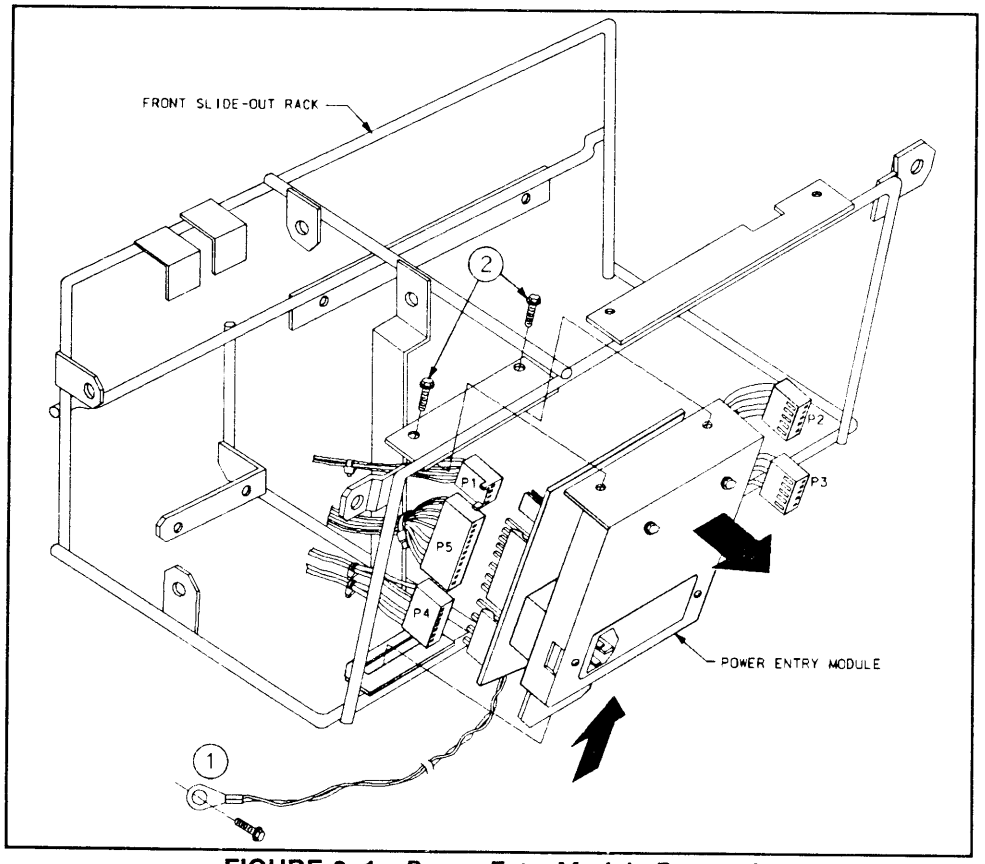
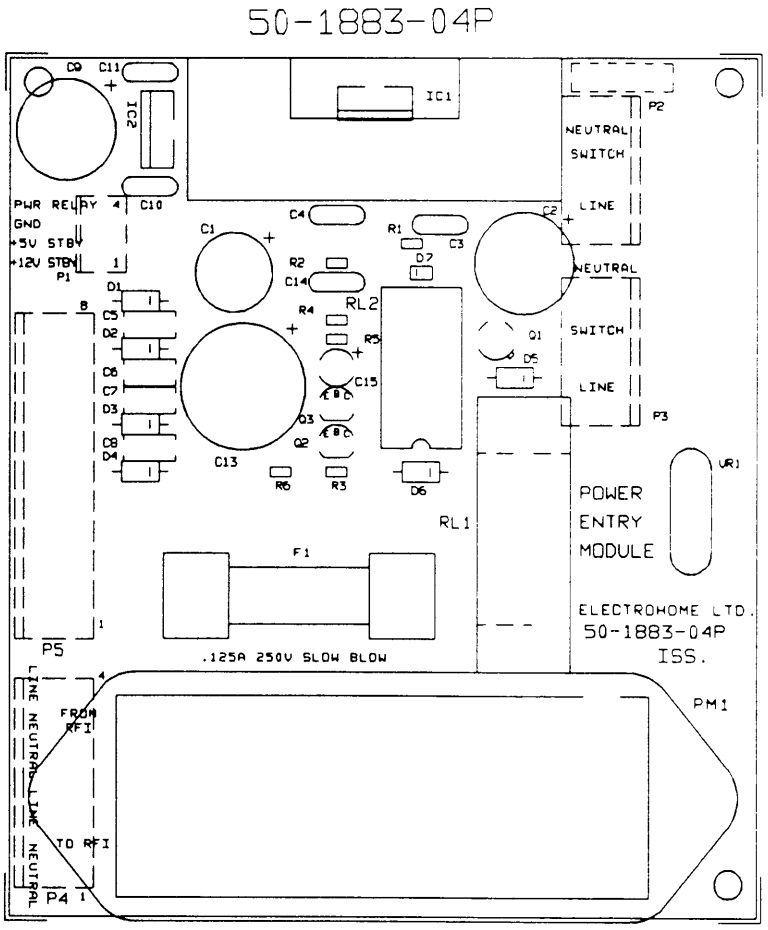
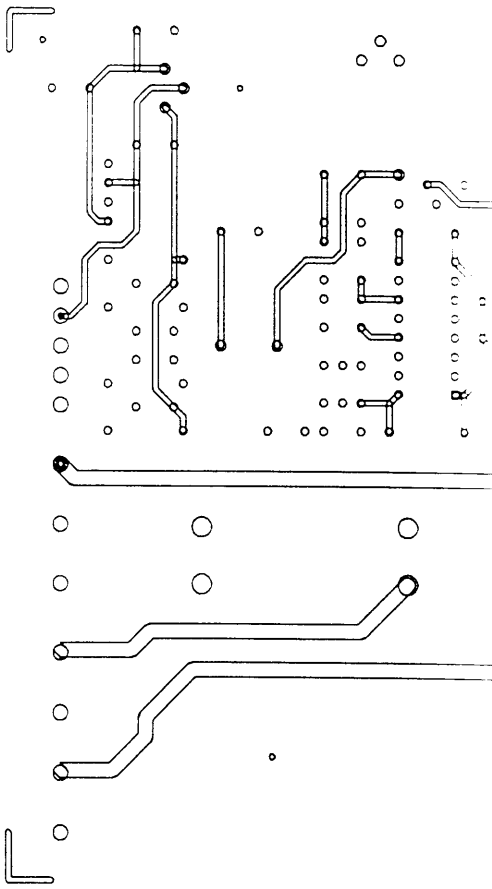


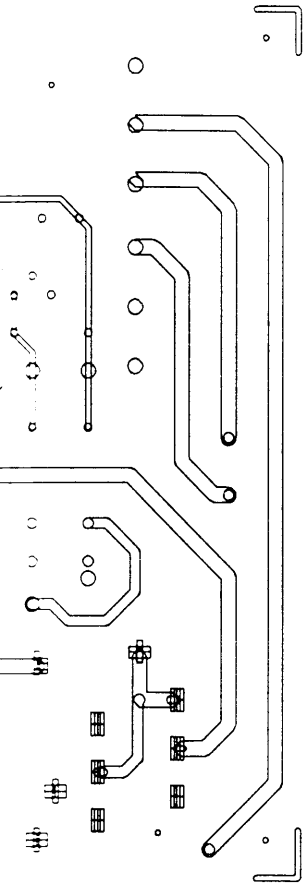
FIGURE 8-1. *Power Entry Module Removal*



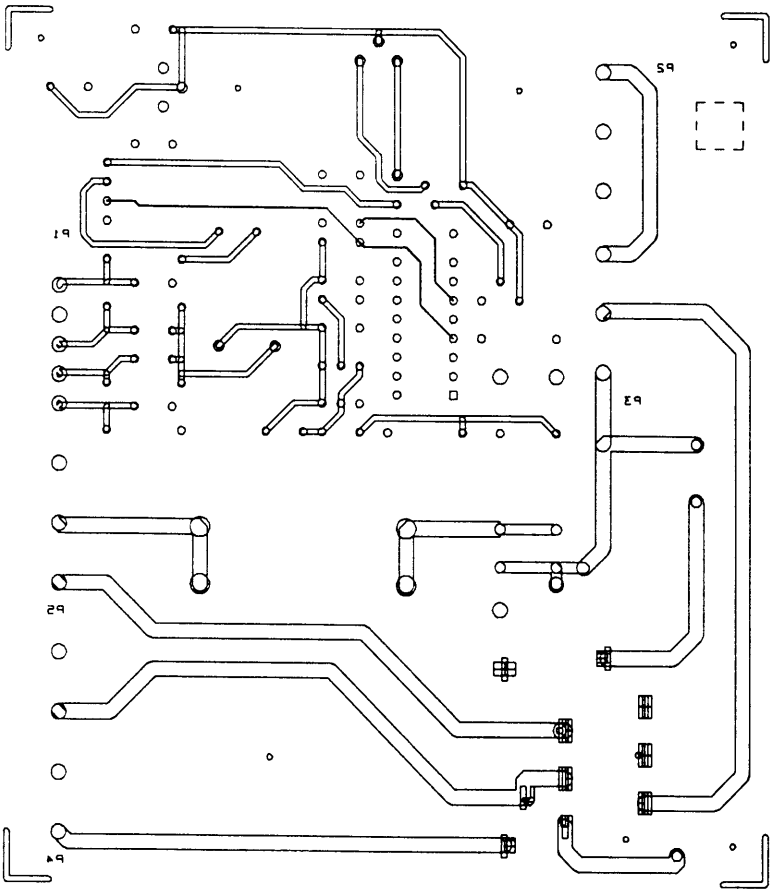
Component Layout



Solder Side
(Viewed from Componer

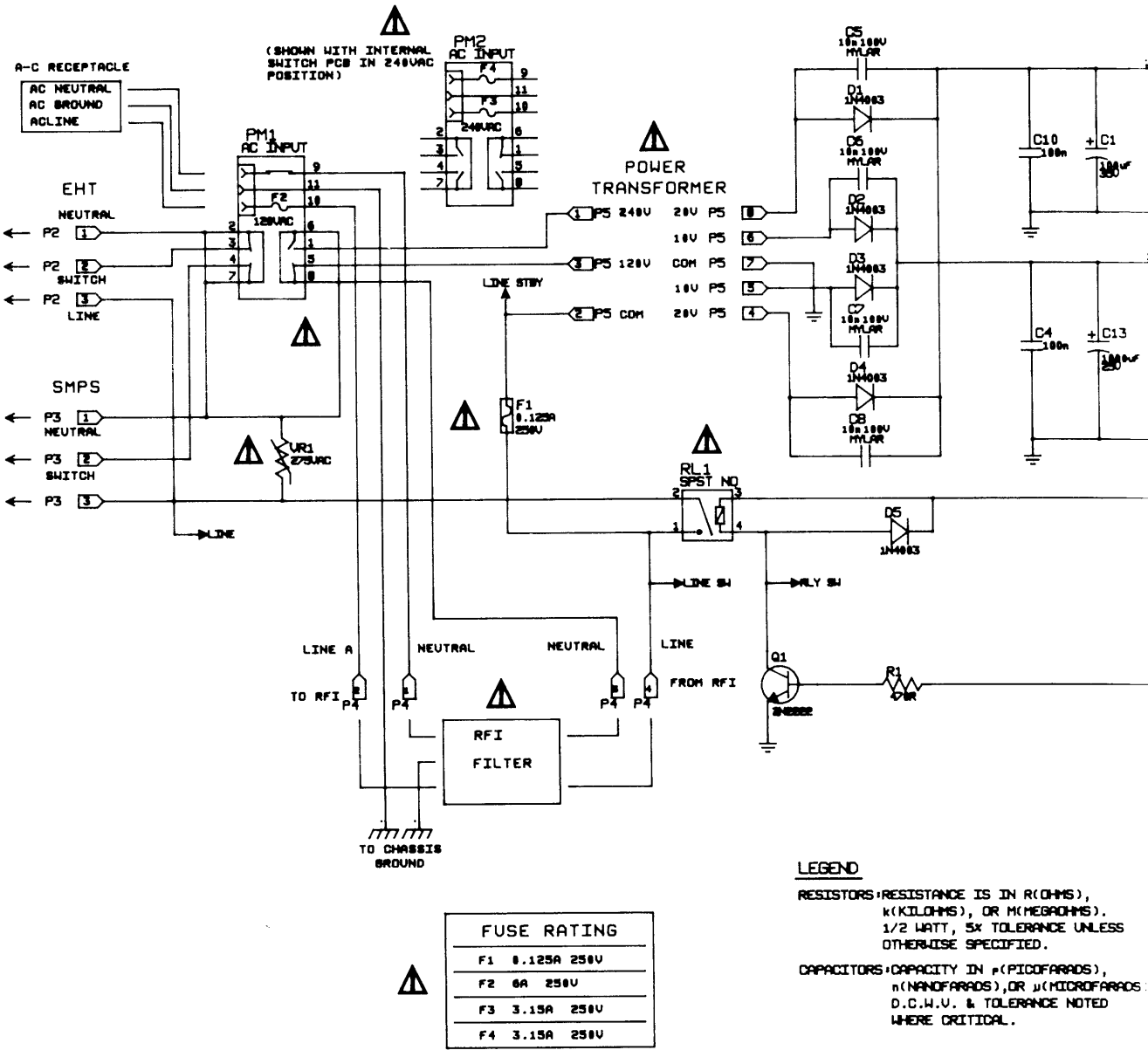


ent Side)



Component Side

FIGURE 8–2.
Power Entry Module Component Layout



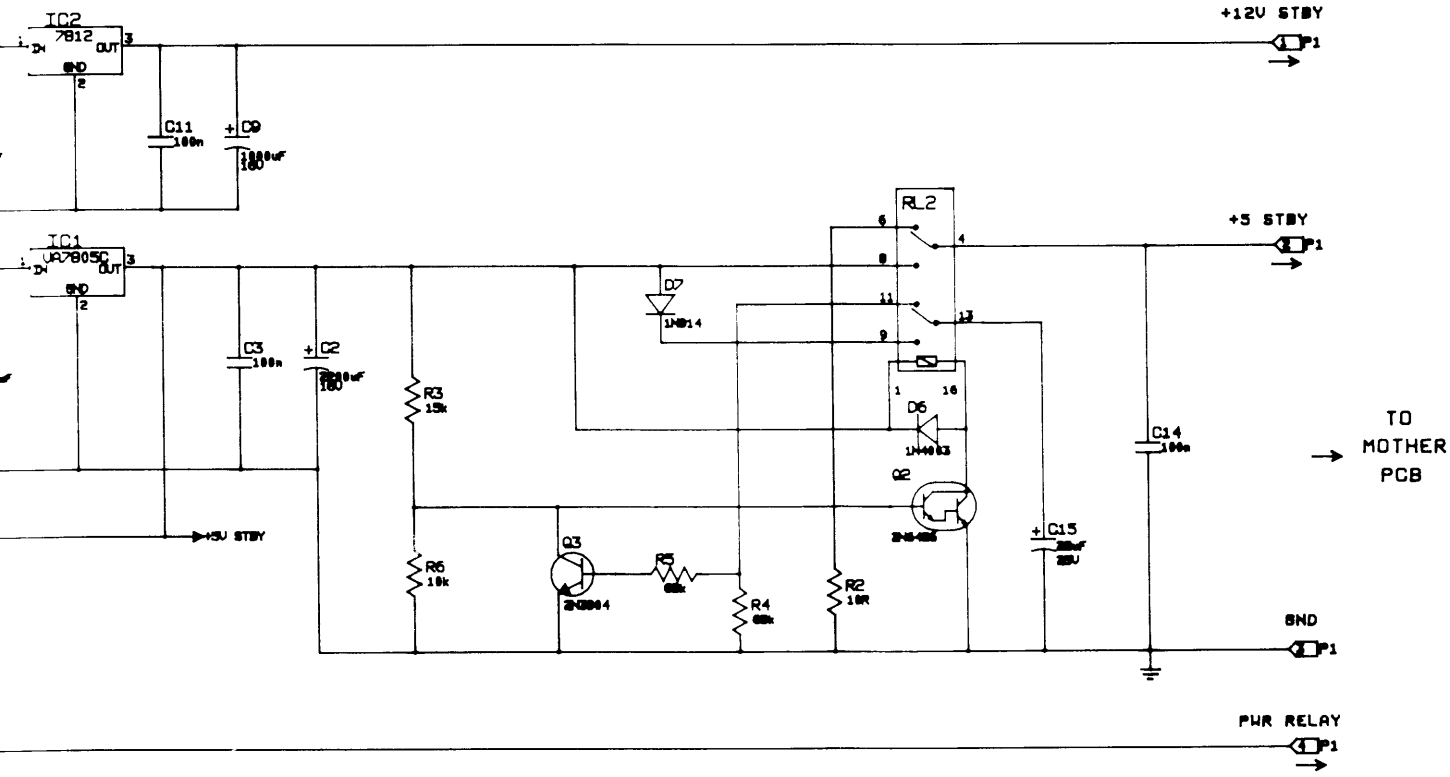
FUSE RATING	
F1	0.125A 250V
F2	6A 250V
F3	3.15A 250V
F4	3.15A 250V

LEGEND

RESISTORS: RESISTANCE IS IN R(OHMS), k(KILOHMS), OR M(MEGAOHMS). 1/2 WATT, 5% TOLERANCE UNLESS OTHERWISE SPECIFIED.

CAPACITORS: CAPACITY IN p(PICOFARADS), n(NANOFARADS), OR μ(MICROFARADS) D.C.W.V. & TOLERANCE NOTED WHERE CRITICAL.

FIGURE 8–3.
Power Entry Module Schematic



CAUTION

FOR CONTINUED SAFETY REPLACE COMPONENTS NOTED BY ⚠ WITH EXACT REPLACEMENT PARTS ONLY. CONSULT SERVICE MANUAL PARTS LIST SECTION "SAFETY COMPONENTS".

8.4 PARTS LIST

	Item Ref.	Part No.	Description
	Integrated Circuits		
	IC1	14-002032-01P	MC7805CT, +5 VDC, fixed linear regulator
	IC2	14-002018-01P	MC7812CT, +12 VDC, fixed linear regulator
	Transistors & Diodes		
	Q1	14-000880-01P	2N2222 A, NPN, 30V, 0.8A, 1/2W
	Q2	14-000990-01P	2N6426, NPN
	Q3	14-000881-06P	2N3904, NPN, 40V, 0.2A, 0.35W
	D1-D6	14-000525-53P	1N4003, rectifier, 1A, 200V,T
	D7	14-000513-01P	1N914, 0.075A, 75V
	Capacitors		
	C1	44-410105-05P	100 μF, 35V
	C2	44-422203-08P	2200 μF, 16V
	C3,C4,C10,C11		
	C14	89-000032-03P	100 nF, 50V
	C5-C8	88-171031-12P	10 nF, 100V, mylar
	C9	44-410203-08P	1000 μF, 16V
	C13	44-410204-09P	1000 μF, 25V
	C15	84-422004-01P	22 μF, 25V
	Resistors		
	R1	80-147005-11P	470R, 1/2W, 5%, metal film
	R2	80-110095-11P	10R, 1/2W, 5%, metal film
	R3	80-115025-11P	15K, 1/2W, 5%, metal film
	R4,R5	80-168025-11P	68K, 1/2W, 5%, metal film
	R6	80-110025-11P	10K, 1/2W, 5%, metal film
	Miscellaneous		
⚠	**F1**	**27-000005-45P**	**1/8A, 250V, slow blow fuse** **SAFETY COMPONENT**
⚠	**F2**	**27-000005-47P**	**6.0A, slow blow fuse** **SAFETY COMPONENT**
⚠	**F3,F4**	**27-000045-05P**	**ET-4A, 3.15A, 250V, fuse** **SAFETY COMPONENT**
⚠	**PM1**	**34-001058-01P**	**AC input module** **SAFETY COMPONENT**
	RL1	25-000104-01P	5 VDC, SPST relay
	RL2	25-000106-02P	C93406, DPDT relay, MT2, 4.5V coil
⚠	**VR1**	**42-000127-01P**	**V275LA20A, metal oxide varistor, 275 VAC** SAFETY COMPONENT

8.5 SPECIFICATIONS

Power Requirements:

Voltage	
120V mode	90 to 132 VAC
240V mode	180 to 264 VAC
Frequency	50 to 60 Hz nominal

Input Fuse (slow blow) Rating:

@ 120V mode	6A
@ 240V mode	4A

Connector P1 Signal Levels:

Pin 4 analog input power relay	
relay turn on voltage	4.5 to 5.5 VDC
Pin 3 ground	
Pin 2 +5V standby	
voltage	4.75 to 5.25 VDC
Pin 1 +12V standby	
voltage	11.4 to 12.6 VDC
ripple at 300 Ma	5 mV

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SECTION 9

POWER SUPPLIES

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LIST OF ILLUSTRATIONS

LIST OF TABLES

No tables are included in this section.

9.1 TECHNICAL DESCRIPTION

9.1.1 General Description

The projection system contains two power supplies; the Low Voltage Switch Mode Power Supply, and the High Voltage Power Supply.

9.1.1.1. Low Voltage (Switch Mode) Power Supply

The Low Voltage Switch Mode Power Supply provides +5, +6.3, ±12, ± 24, +150 and +200 VDC. It has short circuit protection. A short circuit, on any output line, will cause the power supply to switch OFF.

9.1.1.2. High Voltage Power Supply

The High Voltage Power Supply provides 34 KV to each CRT anode, 11 KV to the focus circuitry and 800 VDC for G2 cut-off. The High Voltage Power Supply has short circuit protection. A short circuit on the anode output, will prevent the High Voltage Power Supply from turning ON.

9.2 SERVICING AND ALIGNMENT

9.2.1 Disassembly and Access

Module Location:
- front slide-out rack

Tools & Equipment Required:
- 1/4" hex head socket driver

Low Voltage Switch Mode Power Supply Removal

a) Remove the projector lower front and side panels as described in Section 5.2.

b) Remove the two screws securing the front slide-out rack to the projector chassis. Slide the rack out about 4".

c) Disconnect the M14-P1, M14-P2, M14-P3 and M14-P4 connections from the module. See Figure 9-1.

d) Pull back and lower the Low Voltage Switch Mode Power Supply until removed from the front slide-out rack.

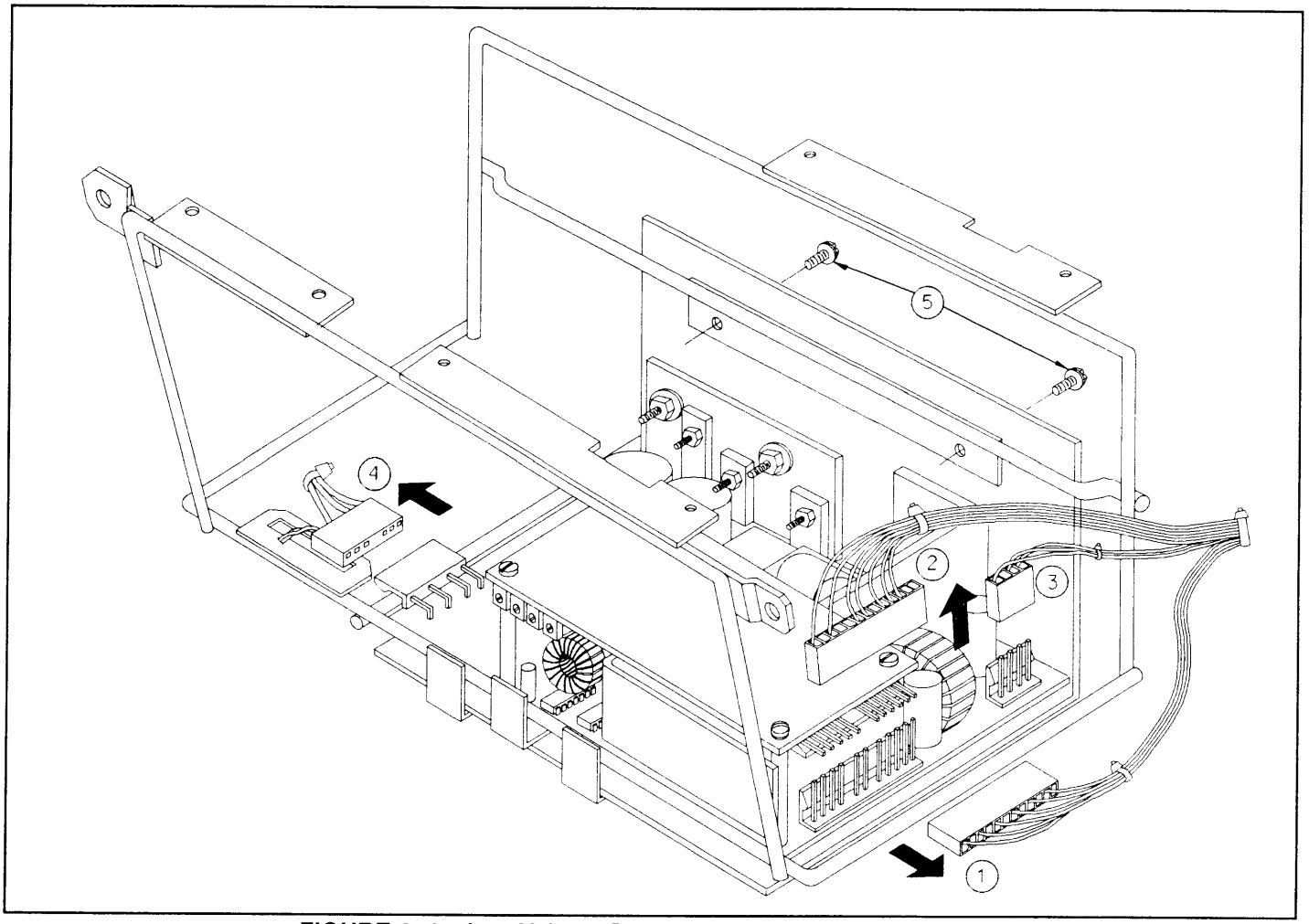

FIGURE 9-1. *Low Voltage Switch Mode Power Supply Removal*

High Voltage Power Supply Removal

a) Remove the projector lower front and side panels as described in Section 5.2.

b) Remove the two screws securing the slide-out rack to the projector chassis. Slide the rack out about 4".

c) Trace the anode lead from the High Voltage Power Supply to the splitter located in the projection head portion of the projector. Disconnect the anode lead from the splitter and route it back to the power supply.
Note: Some cable ties may require removal. If so, record the cable tie positions for future re-assembly.

d) Trace the focus lead from the High Voltage Power Supply to the Bias module located in the projection head portion of the projector. Disconnect the focus lead from the Bias board and route it back to the power supply. Record the positions of any cable ties requiring removal.

e) Disconnect the M24-P1 and M24-P2 connectors from the module as shown.

f) Remove the 4 hex head screws as shown in Figure 9-2. Guide the High Voltage Power Supply out the right side of the front slide-out rack.

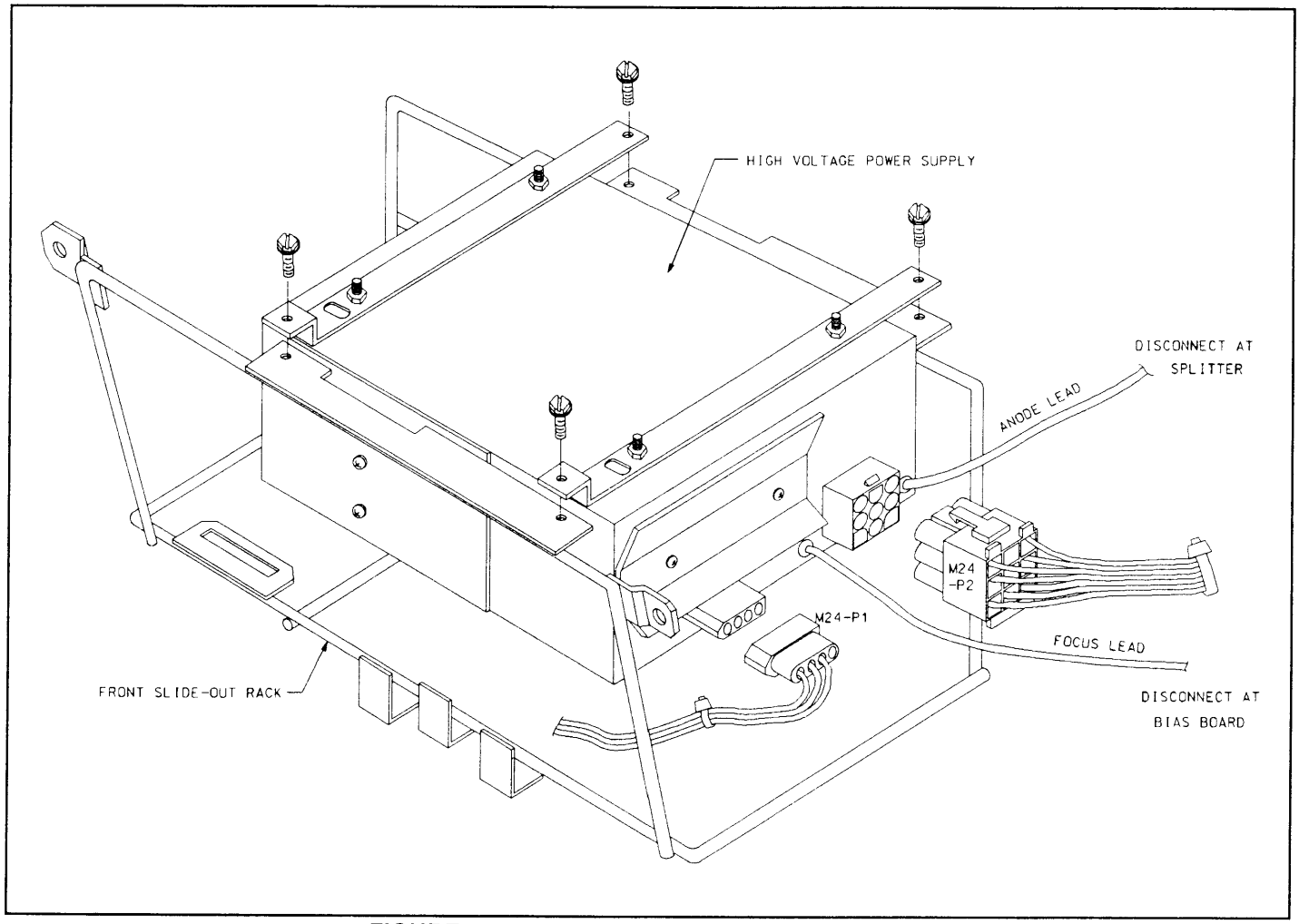

FIGURE 9-2. *High Voltage Power Supply Removal*

9.2.2 Alignment

Service alignments are not necessary. If one of the power supply modules is out of specification, the module must be replaced.

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9.3 SPECIFICATIONS

9.3.1 Switch Mode Power Supply

Power Requirements:

Voltage
120V mode . . . . . 90 to 132 VAC
240V mode . . . . . 180 to 264 VAC

Turn-on Current . . . . . 15A max
Frequency . . . . . 45 to 65 Hz

Power (full load) . . . . . 350W max

+200V Supply:

Regulation (line & load) . . . . . ±3% max
Load Current . . . . . 0.1A to 0.35A
Peak Load Current
(65μs repetition rate) . . . . . 0.4A max
Ripple & Noise (peak load) . . . . . 1.5V p-p max
Over-voltage Shutdown . . . . . 220 to 255VDC

+150V Supply:

Regulation (line & load) . . . . . ±1% max
Load Current . . . . . 0.01A to 0.35A
Peak Load Current
(65μs repetition rate) . . . . . 0.45A max
Ripple & Noise (peak load) . . . . . 0.5V p-p max

+24V Supply:

Regulation (line & load) . . . . . ±5% max
Load Current . . . . . 0.04A to 0.6A
Peak Load Current
(20ms repetition rate) . . . . . 1.5A max
Ripple & Noise (peak load) . . . . . 0.1V p-p max

-24V Supply:

Regulation (line & load) . . . . . ±5% max
Load Current . . . . . 0.04A to 0.6A
Peak Load Current
(20ms repetition rate) . . . . . 1.5A max
Ripple & Noise (peak load) . . . . . 0.1V p-p max

+12V Supply:

Regulation (line & load) . . . . . ±2% max
Regulation (above 3A) . . . . . 5% max
Load Current . . . . . 1.1A to 2.75A
Peak Load Current
(20ms repetition rate) . . . . . 3.5A max
Ripple & Noise (peak load) . . . . . 0.1V p-p max

-12V Supply:

Regulation (line & load) . . . . . ±2% max
Load Current 0.75A
Peak Load Current
(20ms repetition rate) . . . . . 1.25A max
Ripple & Noise (peak load) . . . . . 0.1V p-p max

6.3V Supply:

Regulation (line & load) . . . . . ±3% max
Load Current . . . . . 0.42A to 0.49A

+5V Supply:

Regulation (line & load) . . . . . ±1% max
Load Current . . . . . 1.5A to 4.5A
Peak Load Current(20ms repetition rate) . . . . 5A max
Ripple & Noise (@ peak load) . . . . . 50.0mV p-p max
Over-voltage Limit . . . . . 6.5V max

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9.3.2 High Voltage Power Supply

Power Requirements:

Voltage
120V mode . . . . . 90 to 132 VAC
240V mode . . . . . 180 to 264 VAC

Turn-on Current . . . . . 25A max
Frequency . . . . . 50 to 60 Hz

Power (full load) . . . . . 140W typ.

Anode Supply:

Voltage adjustment range . . . . . .34V nom

Current level . . . . . 3mA max

Static load regulation
(no load to full load) . . . . . 0.2% max
thermal drift . . . . . 200ppm/° C max
Dynamic load regulation
(900pF load capacitance):
0 to 3mA . . . . . 150V p-p max

Line regulation . . . . . 0.1% max
ripple & noise
(3mA, 900pF load) . . . . . 6.6V max

Focus Supply:

Terminal Voltage . . . . . 10.5KV ± 10%
17KV Multiplier Tap Resistor 35.5MΩ, 1%
temperature coefficient . . . . . 100ppm/ ° C max

G2 Supply:

Voltage . . . . . 800VDC ± 5%
Current . . . . . 1mA max
Dynamic load regulation
(no load to full load) . . . . . 16V p-p max
Line regulation . . . . . 0.8V p-p max
Cross regulation (anode switched
no load to full load) . . . . . 16V p-p max
ripple (1mA load) . . . . . 5V p-p max

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SECTION 10

RGB SYNC 10 PIN INPUT MODULE

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

No tables are included in this section.

54-7904-02P/54-7904-03P (06/90)

10.1 TECHNICAL DESCRIPTION

10.1.1 General Description

The RGB SYNC 10 PIN input module is located in the rear panel card rack of the projector, normally occupying slot 1.

The module has two analog video inputs. Input #1 accepts composite sync or sync on green (3 wire or 4 wire). Input #2 accepts sync on green, separate composite sync or separate horizontal and vertical sync (3,4 or 5 wire). All inputs are permanently terminated to 75Ω.

10.2 SERVICING AND ALIGNMENT

10.2.1 Disassembly and Access

WARNING

STATIC SENSITIVE COMPONENTS
STATIC CONTROLLED WORK STATION REQUIRED

Module Location:
- rear panel card rack

Tools & Equipment Required:
- Phillips screw driver

a) Remove the upper and lower mounting screws from the module. See Figure 10-1.

b) Using the BNC connectors, pull the module straight out from the card rack.

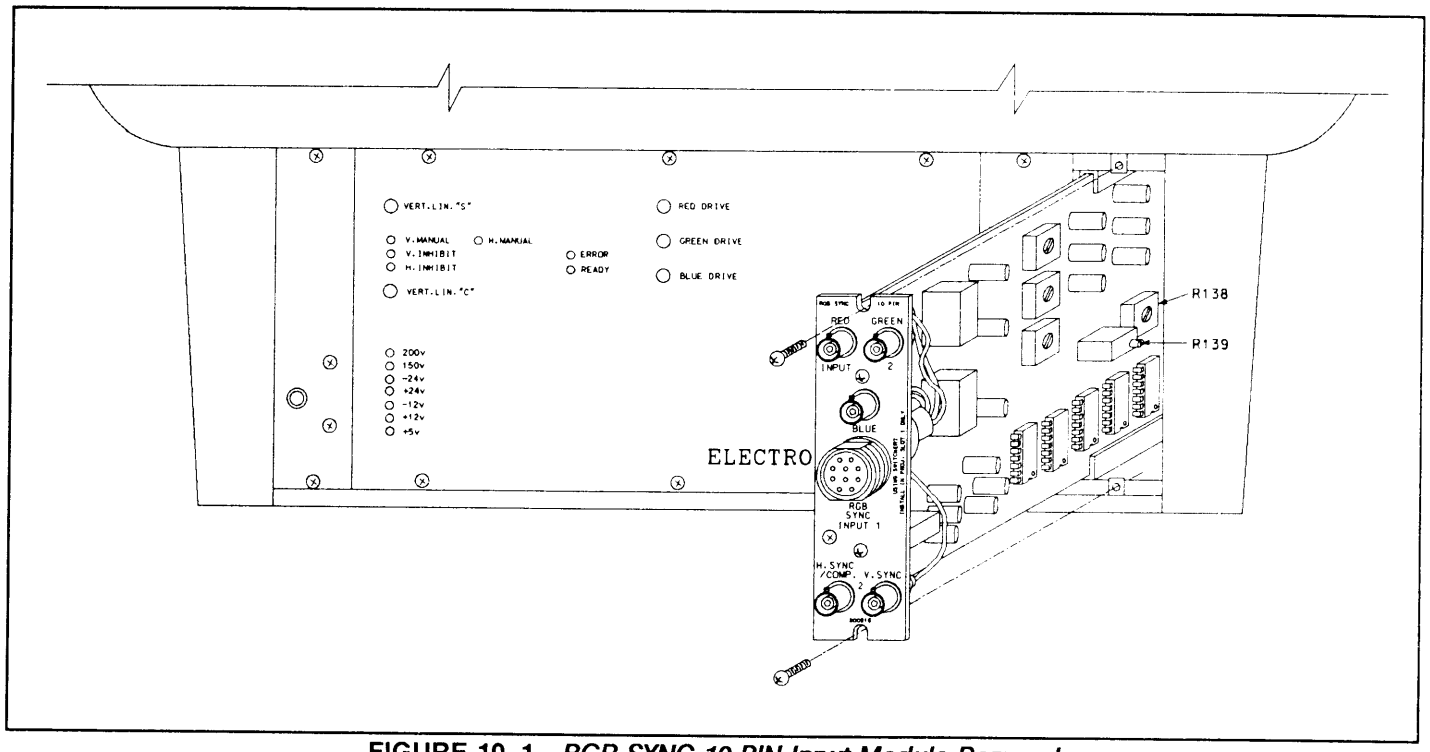


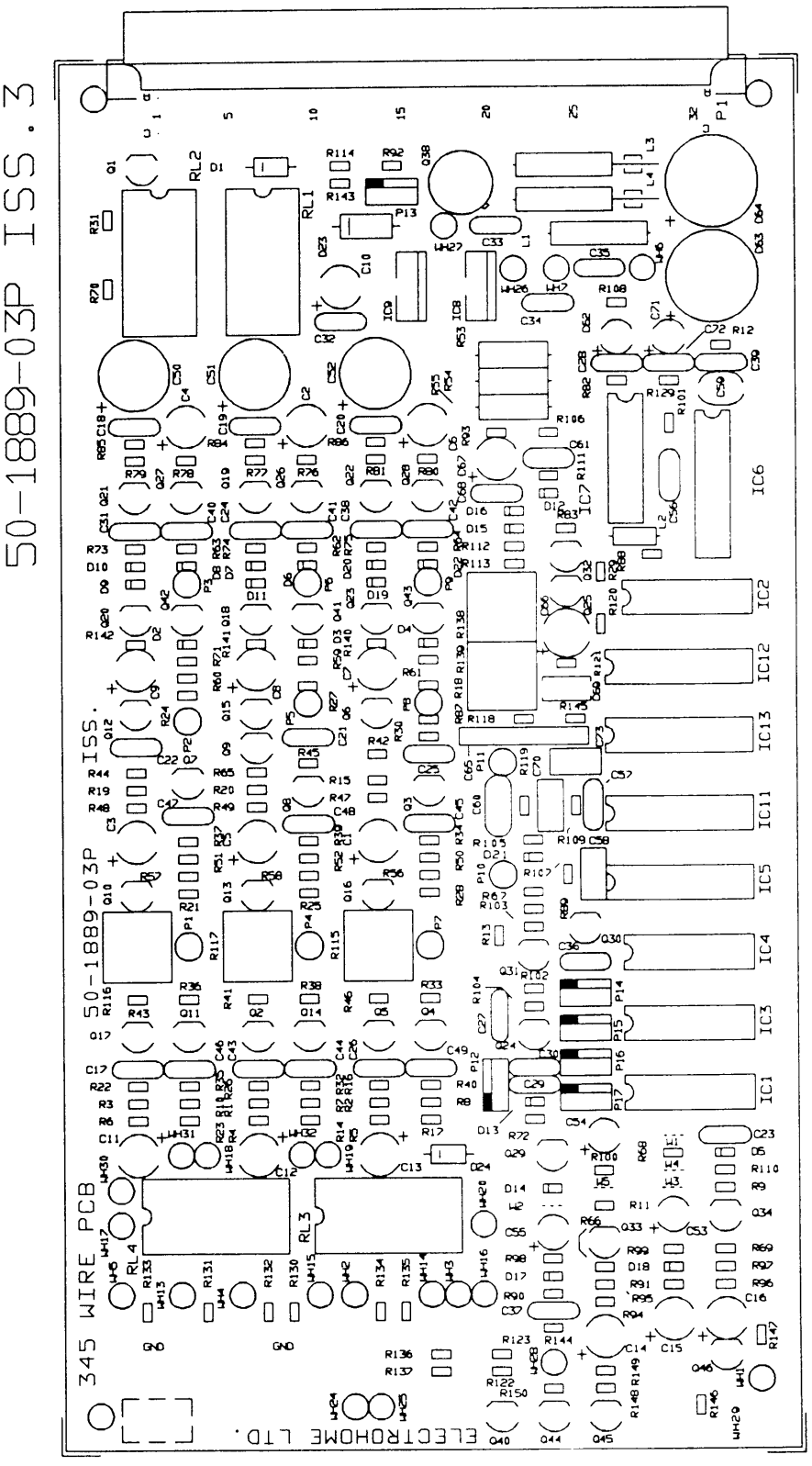
FIGURE 10-1. *RGB SYNC 10 PIN Input Module Removal*

10.2.2 Alignment and Adjustments

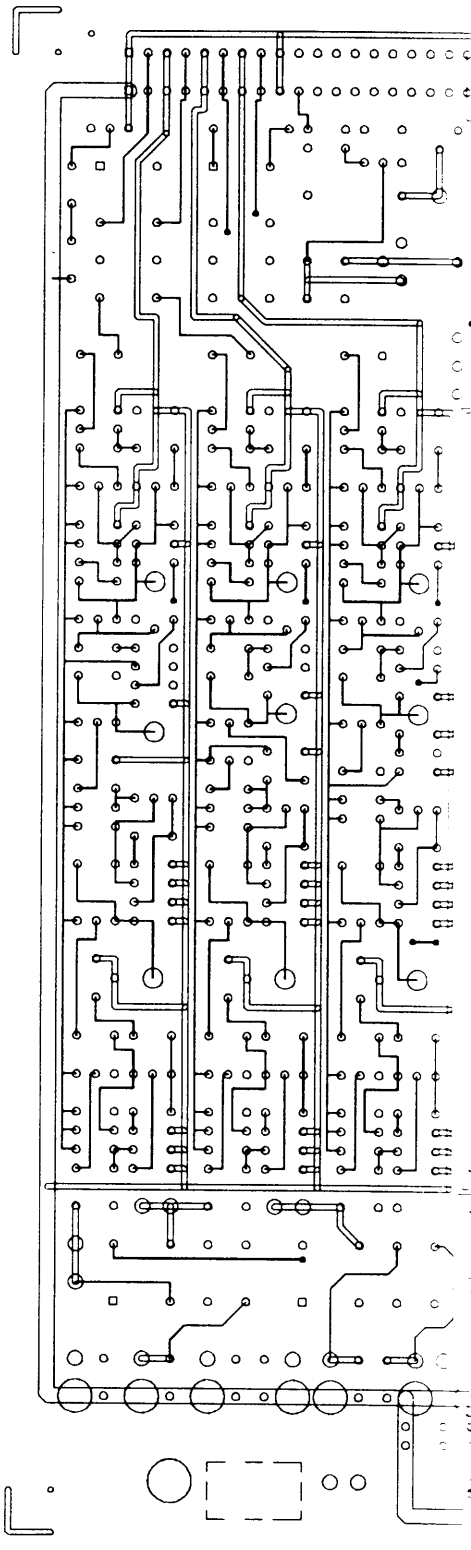
R139 is the horizontal shift adjust. R138 is the vertical shift adjust. All other trimpots must be left in their factor set positions.

10.3 COMPONENT LAYOUT AND SCHEMATICS

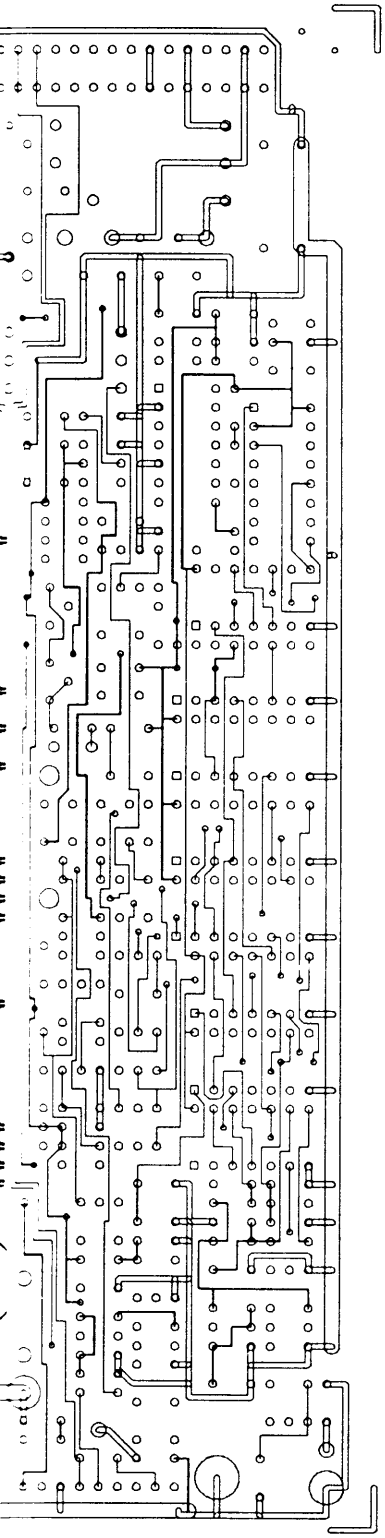
Refer to the following pages for component layouts and schematics of the RGB SYNC 10 PIN input module.



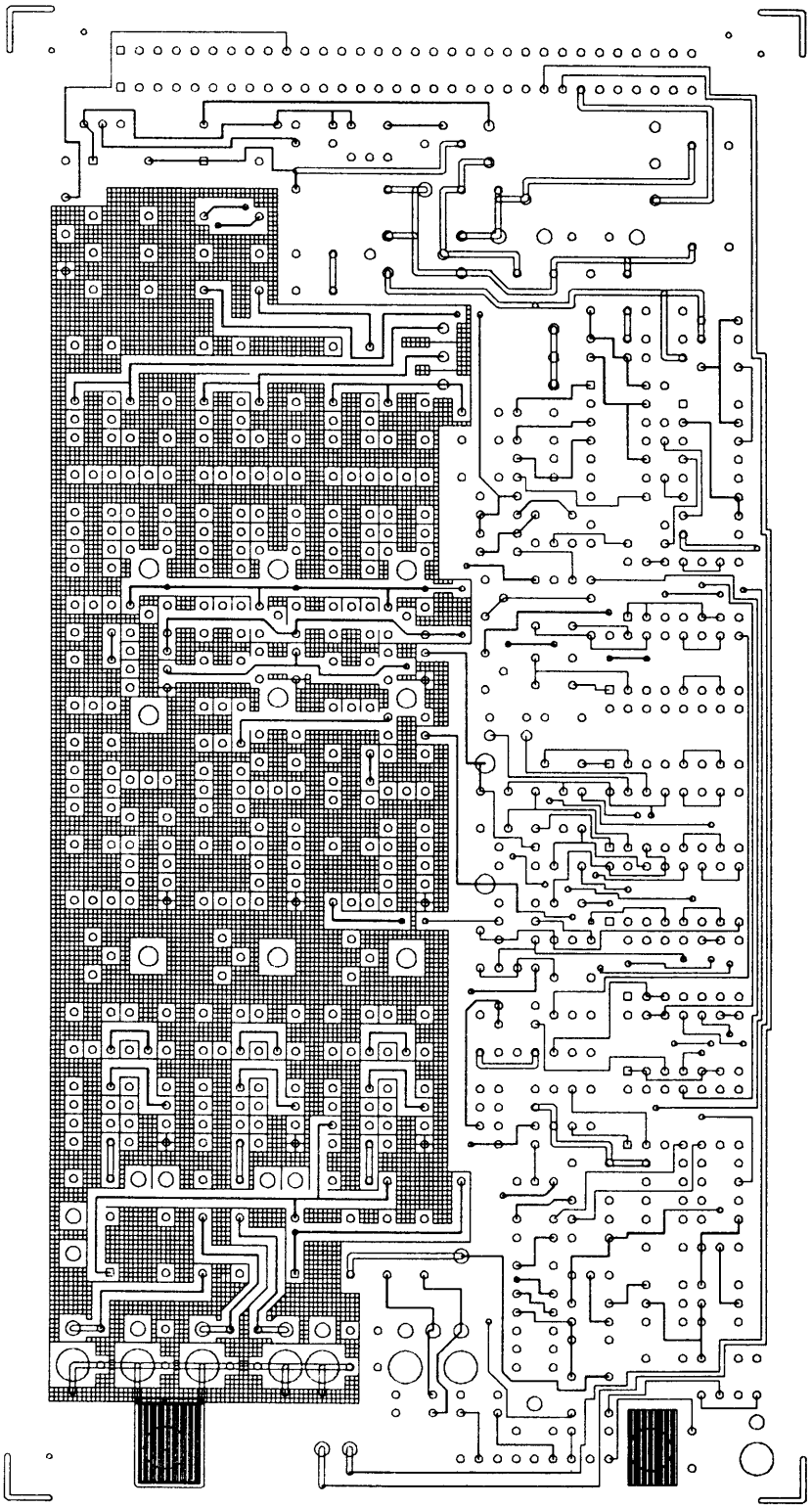
Component Layout



Solder Sid
(Viewed from Compo

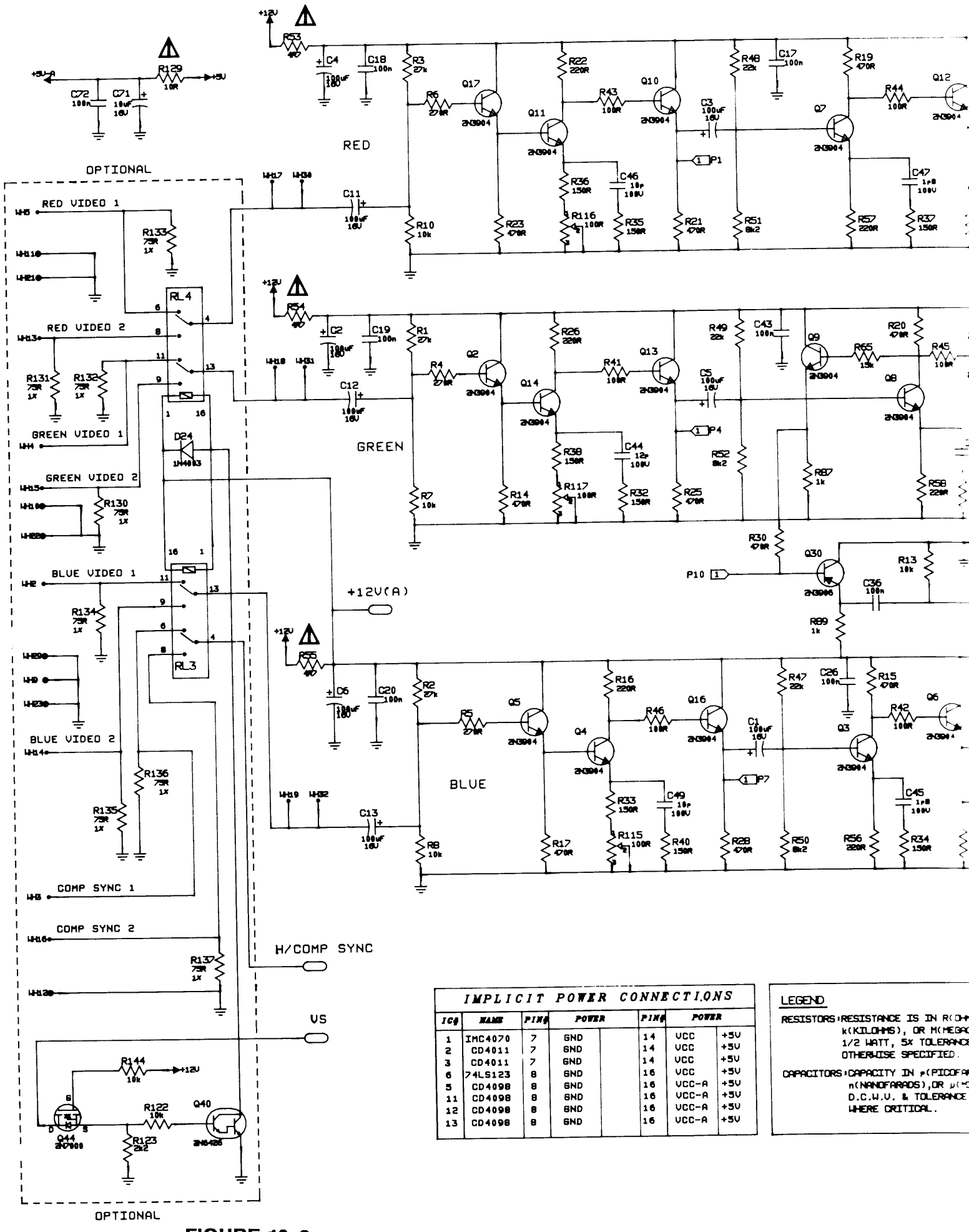


ide
ponent Side)



Component Side

FIGURE 10–2.
RGB SYNC 10 Pin Component Layout



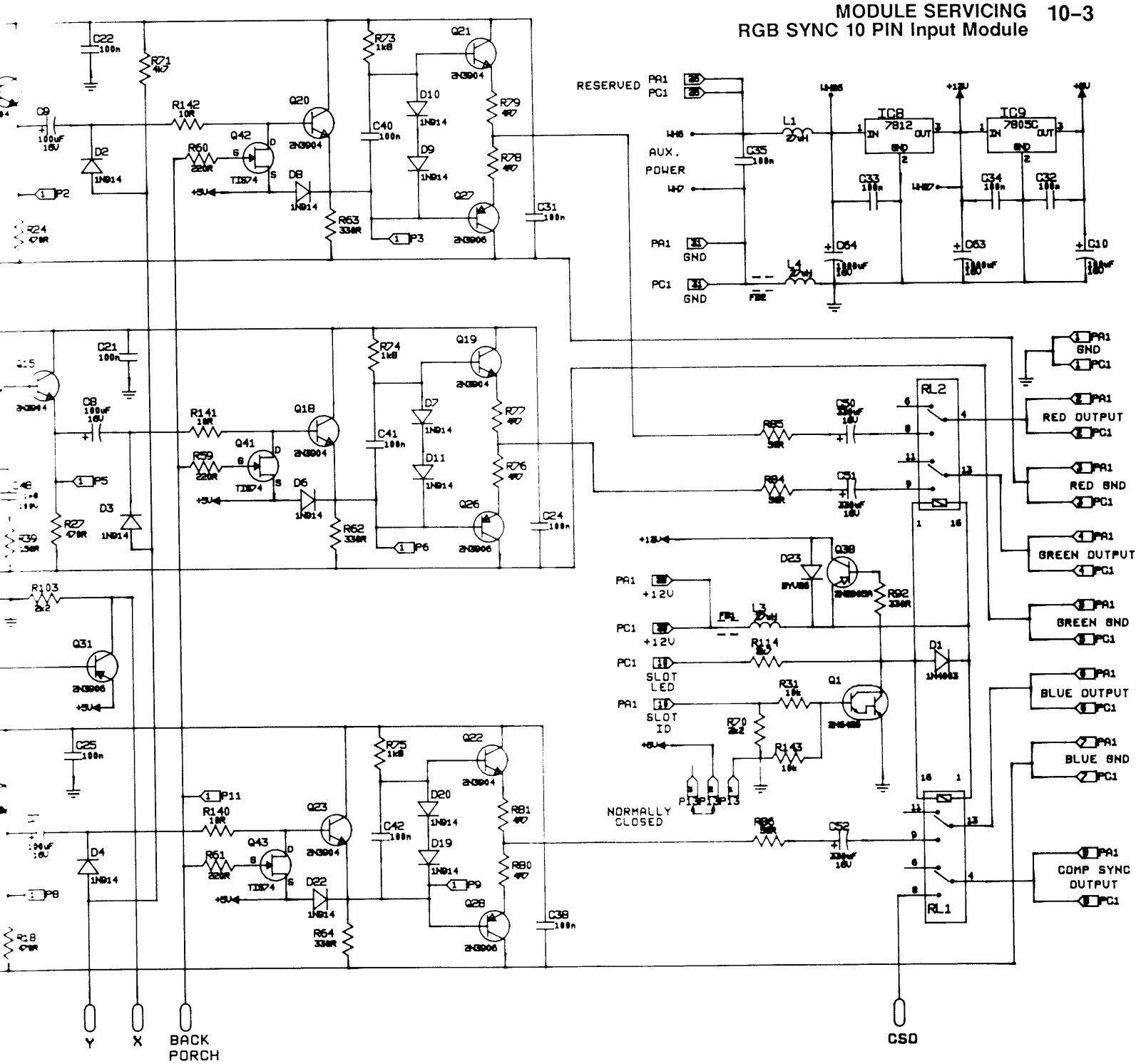
IMPLICIT POWER CONNECTIONS							
IC#	NAME	PIN#	POWER		PIN#	POWER	
1	IMC4070	7	GND		14	VCC	+5V
2	CD4011	7	GND		14	VCC	+5V
3	CD4011	7	GND		14	VCC	+5V
6	74LS123	8	GND		16	VCC	+5V
5	CD4098	8	GND		16	VCC-A	+5V
11	CD4098	8	GND		16	VCC-A	+5V
12	CD4098	8	GND		16	VCC-A	+5V
13	CD4098	8	GND		16	VCC-A	+5V

LEGEND

RESISTORS: RESISTANCE IS IN R(OHMS), k(KILOHMS), OR M(MEGAOHMS), 1/2 WATT, 5% TOLERANCE UNLESS OTHERWISE SPECIFIED.

CAPACITORS: CAPACITY IN p(PICOFARADS), n(NANOFARADS), OR µ(MICROFARADS), D.C.W.V. & TOLERANCE WHERE CRITICAL.

FIGURE 10–3.
RGB SYNC 10 Pin Schematic (Sheet 1 of 2)



CAUTION

FOR CONTINUED SAFETY REPLACE COMPONENTS NOTED BY ⚠ WITH EXACT REPLACEMENT PARTS ONLY. CONSULT SERVICE MANUAL PARTS LIST SECTION "SAFETY COMPONENTS".

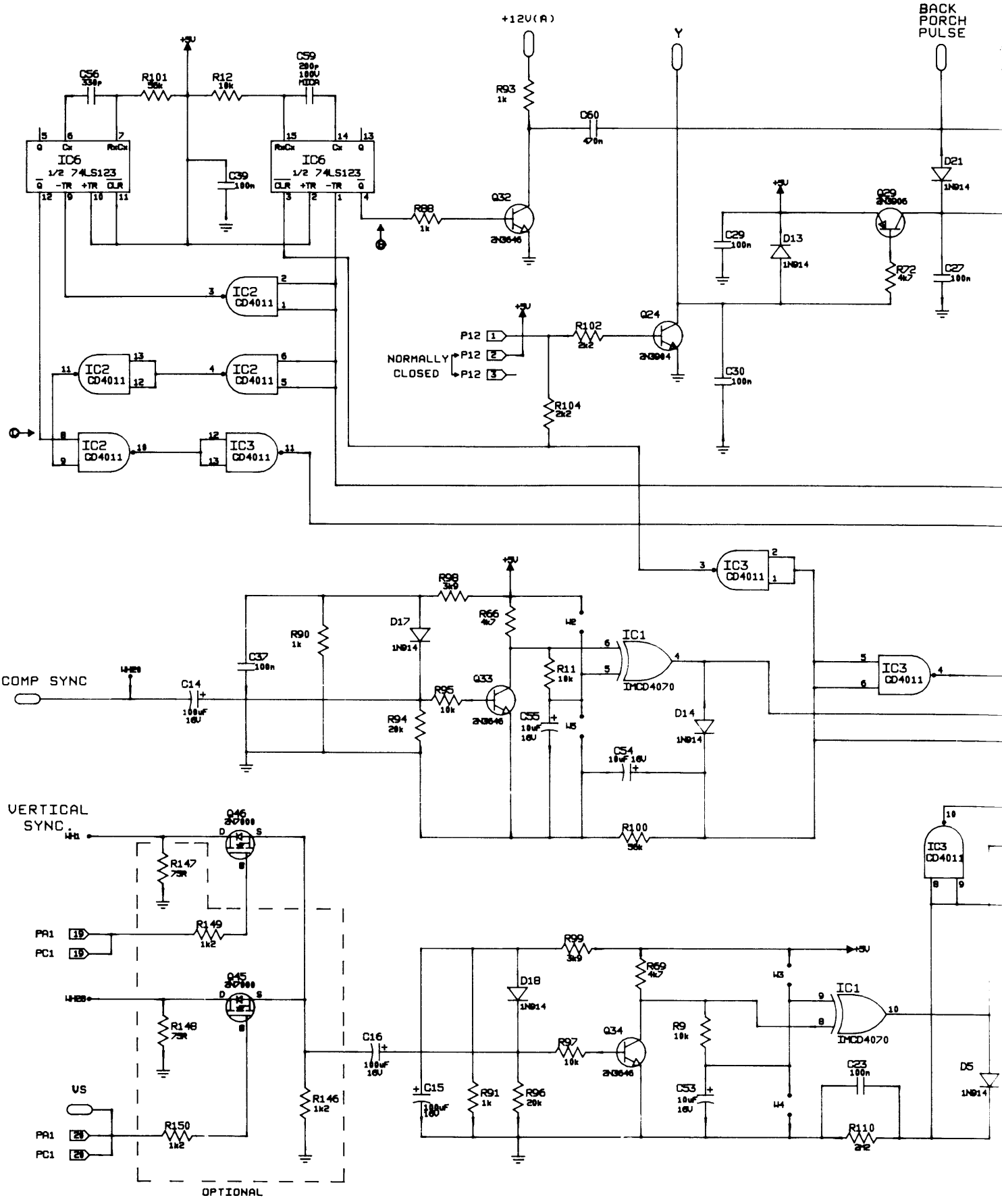
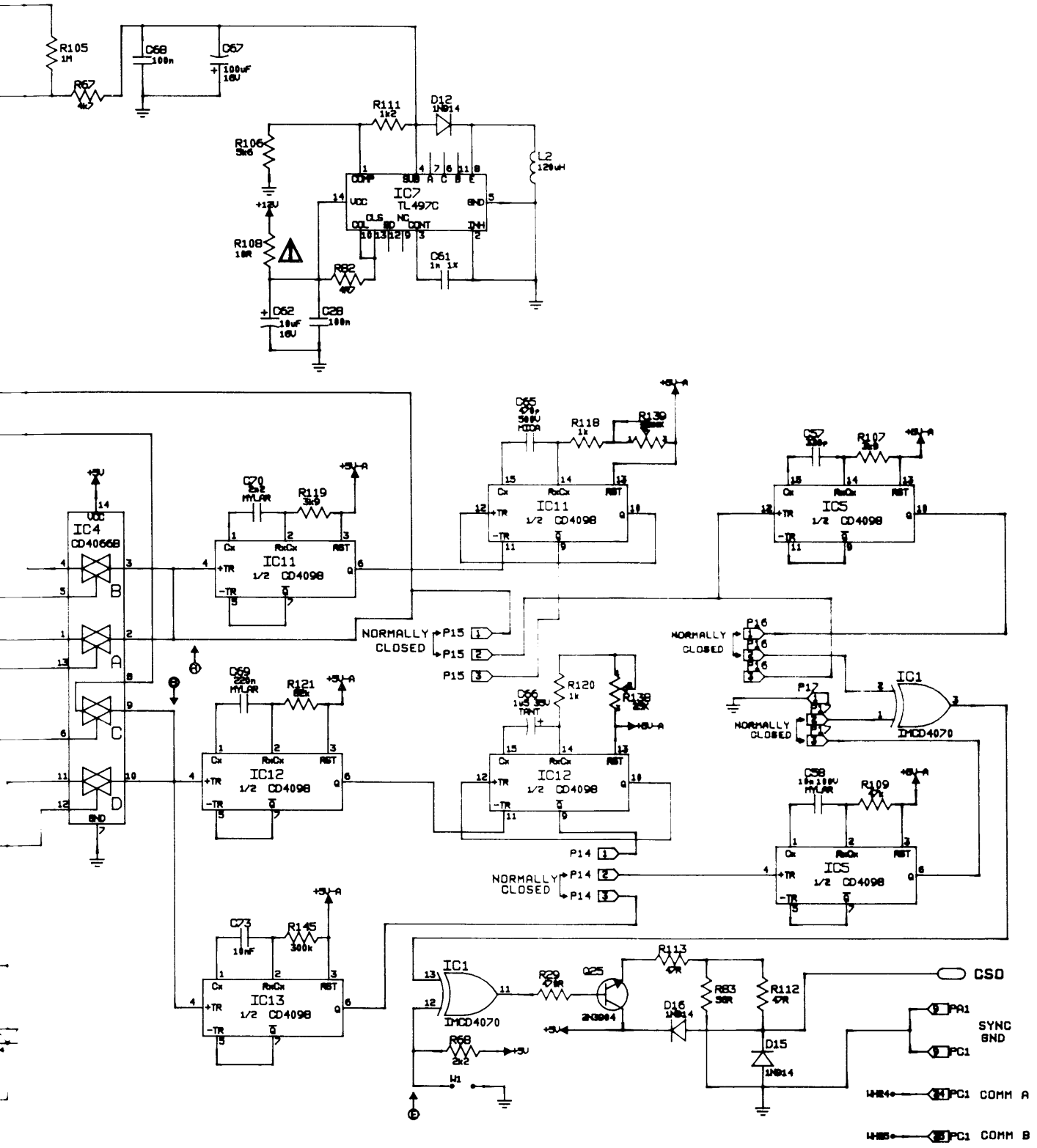


FIGURE 10–4.
RGB SYNC 10 Pin Schematic (Sheet 2 of 2)



10.4 PARTS LIST

Item Ref.	Part No.	Description
Integrated Circuits		
IC1	14-A04024-01P	CD4070BE, quad EXOR gate
IC2,IC3	14-A04027-01P	CD4011BE, 20V CMOS NAND gate
IC5,IC11,IC12,IC13	14-A04021-01P	CD4098BE, CMOS dual mono multivibrator
IC4	14-A03008-02P	CD4066B, (RCA or Motorola ONLY)
IC6	14-004670-02P	74LS123, dual mono multivibrator
IC7	14-002834-01P	TL497C, voltage regulator
IC8	14-002018-01P	MC7812CT, fixed +V linear regulator
IC9	14-002032-01P	MC7805CT, fixed +V linear regulator
Transistors and Diodes		
Q1,Q40	14-000990-01P	2N6426, NPN
Q2-Q25	14-000881-06P	2N3904, NPN, 40V, 0.2A, 0.35W
Q26-Q31	14-000873-82P	2N3906, small signal
Q32-Q34	14-000880-05P	MPS3646, NPN, 15V, 0.3A, 1W
Q38	14-000984-02P	2N2905A
Q41-Q43	14-000720-13P	TIS74, FET, 30V, 0.05A, 0.36W
D1,D24	14-000525-53P	1N4003, diode, 1A, 200V
D2-D22	14-000513-01P	1N914, diode, 0.075A, 75V
D23	14-000525-07P	BYV26, diode, 0.5A, 350V
Capacitors		
C1-C16,C67	84-410104-03P	100 μF, 25V
C17-C43,C68,C72	89-000032-03P	100 nF, 50V
C44	46-612031-04P	12 pF, 100V, 2%
C45,C47,C48	86-618711-04P	1.8 pF, $\pm$0.25pF, NPO, 100V
C46,C49	46-610031-04P	10 pF, 100V, NPO
C50-C52	44-433103-05P	330 μF, 16V
C53-C55,C62,C71	84-410004-01P	10 μF, 25V
C56,C57	89-000033-06P	330 pF, 5%, NPO
C58	88-171031-02P	10 nF, 100V, 10%, mylar
C59	47-052012-16P	200 pF, 2%, mica, 100V
C60	89-000032-02P	0.47 μF, 50V, $\pm$20%
C61	89-000033-02P	1.0 nF, 50V, 1%
C63,C64	44-410203-08P	1000 μF, 16V
C65	47-044715-03P	470 pF, $\pm$5%, mica, 500V
C66	84-215476-01P	1.5 μF, 35V, 20%, tantalum
C69	88-172240-02P	220 nF, 50V, 10%
C70	88-172220-02P	2.2 nF, 50V, $\pm$10%
C73	89-000032-04P	10 nF, 50V, 20%, mylar
Resistors		
R1-R3	80-127025-11P	27K, 1/2W, 5%, metal film
R4-R6	80-127005-11P	270R, 1/2W, 5%, metal film
R7-R13,R31,R95, R97,R122,R143, R144	80-110025-11P	10K, 1/2W, 5%, metal film

10.4 PARTS LIST (cont.)

	Item Ref.	Part No.	Description
	Resistors (cont.)		
	R14,R15,R17-R21, R23-R25,R27-R30	80-147005-11P	470R, 1/2W, 5%, metal film
	R16,R22,R26, R56-R61	80-122005-11P	220R, 1/2W, 5%, metal film
	R32-R40	80-115005-11P	150R, 1/2W, 5%, metal film
	R41-R46	80-110005-11P	100R, 1/2W, 5%, metal film
	R47-R49	80-122025-11P	22K, 1/2W, 5%, metal film
	R50-R52	80-182015-11P	8.2K, 1/2W, 5%, metal film
⚠	**R53-R55**	**42-000063-57P**	**4.7R, 1/2W, 5% SAFETY COMPONENT**
	R62-R64,R92	80-133005-11P	330R, 1/2W, 5%, metal film
	R65	80-115025-11P	15K, 1/2W, 5%, metal film
	R66,R67,R69, R71,R72	80-147015-11P	4.7K, 1/2W, 5%, metal film
	R68,R70, R102-R104,R123	80-122015-11P	2.2K, 1/2W, 5%
	R73-R75	80-118015-11P	1.8K, 1/2W, 5%, metal film
	R76-R82	80-147085-11P	4.7R, 1/2W, 5%, metal film
	R83-R86	80-156095-11P	56R, 1/2W, 5%, metal film
	R87-R91,R93, R118,R120	80-110015-11P	1K, 1/2W, 5%, metal film
	R94,R96	80-120025-11P	20K, 1/2W, 5%, metal film
	R98,R99,R107, R119	80-139015-11P	3.9K, 1/2W, 5%, metal film
	R110	40-122255-31P	2.2M, 1/4W, 5%
	R111	80-112015-11P	1.2K, 1/2W, 5%, metal film
	R105	80-110045-11P	1M, 1/2W, 5%, metal film
	R106	80-156015-11P	5.6K, 1/2W, 5%, metal film
⚠	R108,R129, **R140-R142**	**80-110095-11P**	**10R, 1/2W, 5%, metal film SAFETY COMPONENT**
	R109	80-147025-11P	47K, 1/2W, 5%, metal film
	R100,R101	80-156025-11P	56K, 1/2W, 5%, metal film
	R112,R113	80-147095-11P	47R, 1/2W, 5%, metal film
	R114	80-127015-11P	2.7K, 1/2W, 5%, metal film
	R115-R117	41-000344-04P	100R carbon trim pot
	R121	80-182025-11P	82K, 1/2W, 5%, metal film
	R130-R137	82-375091-29P	75R, 1/3W, 1%
	R138	41-000344-12P	25K, carbon trim pot
	R139	41-000345-11P	200K, 20 turn trim pot
	R145	80-130035-11P	300K, 1/2W, 5%, metal film

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10.4 PARTS LIST (cont.)

Item Ref.	Part No.	Description
Coils and Transformers		
L1	21-001400-10P	27 μH, RF choke
L2	21-001185-38P	120 μH, coil
L3,L4	21-001400-25P	27 μH, RF choke
Miscellaneous		
RL1,RL2	25-000106-01P	DPDT relay, MT2, 12V coil

10.5 SPECIFICATIONS

Power Requirements:

Voltage
in projector or switcher . . . . . +12 VDC ± 5%
in sleeve . . . . . +15 VDC ± 5%
Current . . . . . 350 Ma max

Input Signal Requirements:

RGB Video . . . . . 1V nom. ± 6 dB (0.5 to 2V p-p)
RGB Sync on Green . . . . . 1V nom. ± 6 Db (0.5 to 2V p-p)
Separate Sync . . . . . 0.5 to 4V p-p
Composite Sync . . . . . 0.5 to 4V p-p

Input Impedance:

Video
terminated . . . . . R = 75Ω ± 1%, C = 18pF - 50%
open . . . . . R = 7.3KΩ +20%, C = 18pF - 50%

Sync
terminated . . . . . R = 75Ω ± 1%, C = 18pF - 50%
open . . . . . R = 10KΩ +20%, C = 18pF - 50%

Output Signal Level:

RGB Video (into 75Ω) . . . . . 1V p-p nom. ± 10%
Composite Sync
(neg. going into 75Ω) . . . . . 1V p-p nom. ± 10%
RGB Gain Balance . . . . . ± 1%
RGB Input/Output
Frequency Response . . . . . 90 MHz - 3 Db
Input Crosstalk . . . . . -40 Db

On-board Sync Delay:

Horizontal
fixed delay . . . . . 12 μs ± 10%
variable delay . . . . . 1 to 55 μs ± 10%

Vertical
fixed delay . . . . . 7 ms ± 10%
variable delay . . . . . 9 to 29 ms ± 10%

Regenerated Sync Output:

Horizontal
range . . . . . 15 to 80 KHz ± 10%
duration . . . . . 3.0 μs ± 10%

Vertical
range . . . . . 40 to 120 Hz ± 10%
duration . . . . . 225 μs ± 10%

3-Pin Jumper Plug Functions and Settings:

Plug P12
function . . . . . forced back porch clamp
NOTE: – shorting pins 1 & 2 forces the back porch clamp ON
– shorting pins 2 & 3 enables sync-on-green only

Plug P14
function . . . . . vertical sync delay
NOTE: – shorting pins 1 & 2 turns the delay ON and activates R138
– shorting pins 2 & 3 turns the delay OFF (normal condition)

Plug P15
function . . . . . horizontal sync delay
NOTE: – shorting pins 1 & 2 turns the delay OFF (normal condition)
– shorting pins 2 & 3 turns the delay ON and activates R139

Plug P16
horizontal regenerated sync control
NOTE: – shorting pins 1 & 2 enables sync regeneration (normal condition)
– shorting pins 2 & 3 shorted by-passes sync regeneration

Plug P17
vertical regenerated sync control
NOTE: – shorting pins 1 & 2 by-passes sync regeneration
– shorting pins 2 & 3 enables sync regeneration (normal condition)

NOTE: The combination, P15 pins 1 & 2 shorted, P16 pins 2 & 3 shorted and P17 pins 2 and 3 shorted, can be used to pass input composite sync directly through the module without regenerating sync internally.

The incoming sync must be of proper timing and duration. If not, the image could be displaced.

54-7904-02P/54-7904-03P (06/90)

SECTION 11

REMOTE CONTROL MODULE

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

No tables are included in this section.

54-7904-02P/54-7904-03P (06/90)

11.1 TECHNICAL DESCRIPTION

11.1.1 General Description

The Remote Control module is located in the rear panel card rack. It includes most of the projectors system logic and control. The module consists of a microprocessor, read only memory, random access memory, input/output expanders and digital-to-analog converters. See Figure 11-1.

External inputs to the Remote Control module are: the projector's built-in keypad, a wired remote keypad, an infrared remote keypad or an IR Switcher's built-in keypad. Internal inputs include input module status.

Outputs from the Remote Control module are the microprocessor address and data buses, and analog and digital control voltages to control projector functions.

The microcontroller powers up when the +5 V standby power supply goes high. Power-on reset circuitry holds the microcontroller in the reset mode while the power supply and crystal oscillators stabilize.

In the reset mode, the microcontroller retrieves settings stored in memory and uses them in the initial set-up sequence. The microcontroller then enters a user-input monitoring mode. A POWER command from a keypad, will cause the microcontroller to turn the projector ON.

When the projector is ON, the microcontroller monitors all keypads and fault sensors. During normal operation, the microcontroller leaves monitoring mode when it receives a keypad command. The microcontroller returns to the monitoring mode within 10 seconds.

Each time the microcontroller enters the monitoring mode it starts a watchdog timer. The timer resets the microcontroller if monitoring does not begin within 45 seconds.

A POWER command, received during projector operation, causes the microcontroller to load the current projector settings into memory and turn the projector OFF.

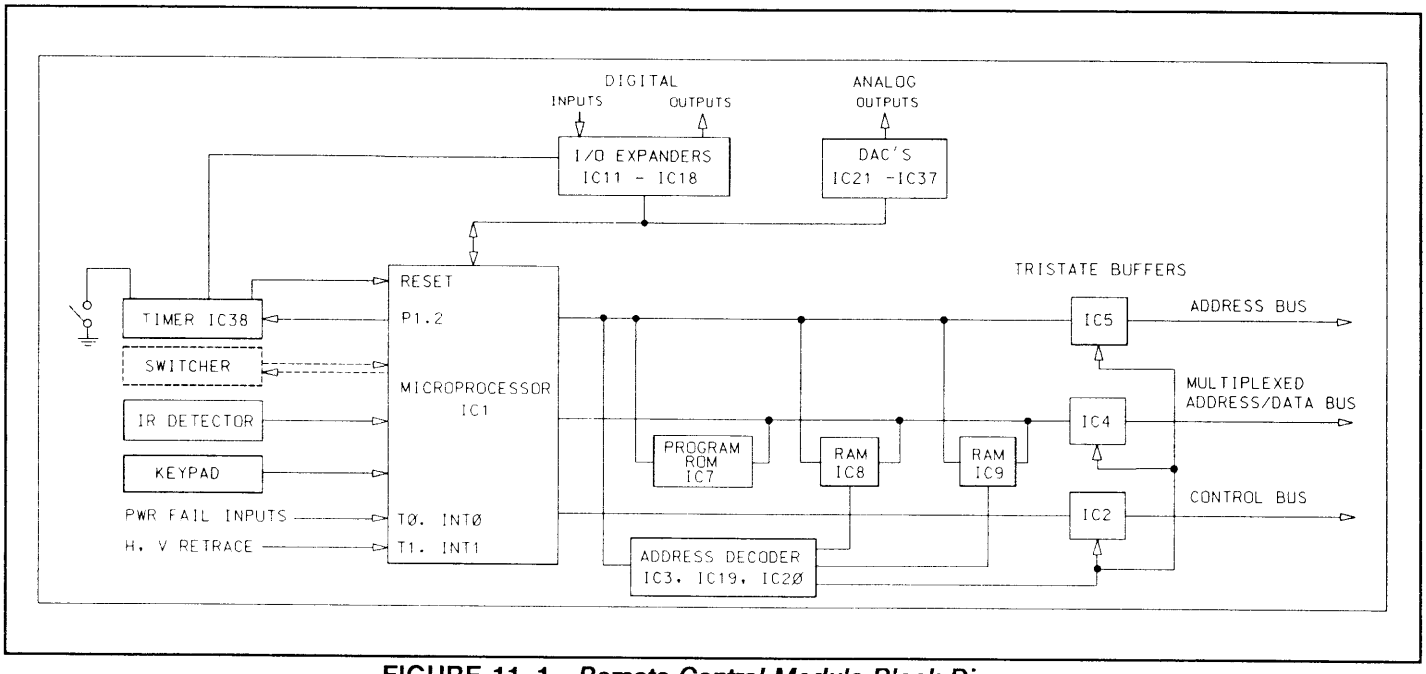

FIGURE 11-1. *Remote Control Module Block Diagram*

11.1.2 Circuit Description

11.1.2.1 Microcontroller.

When the projector is connected to AC power, the +5V standby power supply powers all critical microcontroller circuitry.

Reset Input.

a) During normal operation the reset input, pin 21 of edge connector PB1, is high.

b) IC22 provides power-on reset. Upon connection to AC, IC22 holds the reset input on IC21 high for about 1 second. During this period the microcontroller initializes.

c) IC21 continuously monitors the built-in keypad and the IR detector. An input from either device causes IC21 to leave the monitoring loop. It decodes and executes the command received, then returns to the monitoring loop.

d) During normal operation, the program is out of the monitoring loop for less than 10 seconds. A pulse from P1.2, pin 4, triggers timer IC13A each time the input monitor loop starts. IC13 is set for a 45 second delay, its output will remain high and the output of IC13B will remain low. If the program does not return to the monitoring loop, (i.e., the program crashes), IC13A does not trigger. Its output goes low, triggering IC13B. IC13B produces a 20 ms long inverted pulse and IC22 resets IC21.

e) A reset input for future expansion is provided on pin 21, row B.

External Interrupt Inputs

a) INT1, pin 15, monitors the vertical flyback. During vertical retrace, the vertical retrace pulse, connected to INT1 via tri-state buffer IC28, pulls INT1 low. This enables data transfer routines. During vertical scan, INT1 remains high and data transfer does not take place.

Timer Inputs

a) T0 monitors the +5 V supply line.

b) T1 input synchronizes the writing of the screen display characters to video memory and is used to measure vertical frequency.

Read and Write Strobes

a) The read strobe output connects to the 5 V standby supply through pull-up resistor RN9. Normally, it is high. During a data read, the read strobe goes low. This enables the data output lines of RAM ICs 26 and 29.

b) The read strobe also connects to pin 4 of bidirectional octal buffer IC28. During a data read, IC28 is set to receive data from the mother board. Side A is output and side B is input. During a data write, IC28 is set to send data to the bus. Side A is input and side B is output. The read strobe outputs to the mother board at pin 17, row B, through tri-state buffer IC28.

ALE Output

a) The ALE (address line enable) output and IC23 (tri-state octal latch) separate the lower 8 bits of address from the data on the address/data lines of IC21.

b) The ALE output connects to the system bus on the mother board through IC28 at pin 18, row B.

PSEN Output

a) The PSEN (program store enable) output enables the outputs of program ROM IC24 and IC25.

Address/Data Lines

a) Port 0 of IC21 is an 8 bit, bi-directional port. It connects to RN8, an external pull-up resistor network.

b) During data transfer, Port 0 either outputs the lower 8 bits of address, or receives or sends data. The ALE output indicates if Port 0 has address or data.

c) Port 2 of IC21, outputs the higher 8 bits of address. It connects directly to the address bus.

Serial I/O Port

a) The projector can communicate with an IR Switcher through the serial I/O port. The RXD input at pin 1 is the receive line. The TXD output at pin 11 is the transmit line. IC27 buffers the port.

Interface Port

a) Port 1 is the main interface to the projector.

b) P1.7 monitors the IR receiver. The IR receiver is connected to it through inverter IC27. P1.6 monitors the keypad via inverter IC27.

c) P1.5 is a serial clock output. The port expanders and the DACs use it. Serial data input, P1.4, connects the port expanders to the DACs.

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d) Output P1.2, provides pulses for the watchdog timer.

e) P1.0, programmed as an output, enables the MENU.

11.1.2.2 Memories

The remote control module contains 4 memories: IC24, IC25, IC26 (64K byte EPROMs) and IC29 (a 32K byte static CMOS RAM). IC24 and IC25 store the system program. IC26 stores the menu data. IC29 (32K battery-backed DS1235Y) stores projector settings when the projector is turned OFF.

11.1.2.3 Memory Address Space Allocation

The PSEN output of microcontroller IC21 enables program ROM (IC24 and IC25) during read cycles.

ICs 19, 20 and 27 are the address decoder. It enables the battery-backed RAM (IC29) if the address location is 0 to 24K. It selects the mother board address bus if the address location is 24K to 64K.

11.1.2.4 I/O Expanders

I/O expanders IC14, IC30, IC31 and IC32 communicate with the microcontroller through the SDA (serial data access) line. The SDA connects to P1.4 on IC21. Clock pulses from the microcontroller, received at the SCL (serial clock) input, cause data to transfer between the I/O expanders and IC21.

I/O expanders are address encoded using the A0, A1 and A2 inputs. IC30 encodes as #4, IC31 as #5, IC32 as #6 and IC14 as #7. The address of an expander and it's mode of operation are serially transferred on the SDA line.

IC30 and IC31, along with inverting bi-directional buffers IC35 and IC36, monitor the status of the seven input slots. They determine slots occupied by input cards.

IC31 outputs the horizontal and vertical automatic/ manual locking control functions. The DAC output from IC30 provides projector identification. IC32 and inverting buffer IC33, output seven digital control voltages. IC32 also outputs direction control to IC35 and IC36.

11.1.2.5 Digital-to-Analog Converters (DACs)

Digital-to-analog converters IC15, IC16, IC17 and IC18 receive digital information from the SDA line of the system bus. DAC select, DAC output select, and data signals from microcontroller IC21 are serially transmitted to each DAC. The A0, A1 and A2 lines on the system bus encode IC15 as #3, IC16 as #2, IC18 as #1 and IC17 as #0. The DACs provide control voltages for the projector.

The eight outputs of IC15 are paired, loaded by resistors, and amplified by non-inverting operational amplifiers IC1 and IC5. The HORIZ HOLD output has a range of 0 to 10 V, all other outputs have a range of ± 10 V.

Six outputs of IC16 are paired. IC3, IC4 and IC6 weigh and amplify each pair. The pairs provide double precision analog outputs with a ± 10 V range. IC6 buffers the remaining two outputs. These outputs provide single precision (64 step) analog outputs with a 0 to 10 V range.

IC2, IC3, IC6, IC9, IC10, IC11 and IC12 amplify the outputs of IC17 and IC18. They provide single precision analog outputs. The range of BOW, KEYSTONE, PIN TOP, PIN BOT, PIN SIDE and DACOUT outputs is ± 10V. The range of the remaining outputs is from 0 to 10V.

All analog outputs connect to the mother board.

11.2 SERVICING AND ALIGNMENT

11.2.1 Disassembly and Access

WARNING

STATIC SENSITIVE COMPONENTS
STATIC CONTROLLED WORK STATION REQUIRED

Module Location:
- rear panel card rack

Tools & Equipment Required:
- Phillips screw driver

a) Remove the back panel as described in Section 5.

b) Locate the Remote Control module in the rear panel card rack. Using the printed circuit board extractor from the tool pouch, pull the module from the card rack (as described in Section 5).

11.2.2 Alignment

The Remote Control Module is adjusted/aligned during the Raster Centering procedure. Refer to Section 7.1.

11.3 COMPONENT LAYOUT AND SCHEMATICS

Refer to the following pages.

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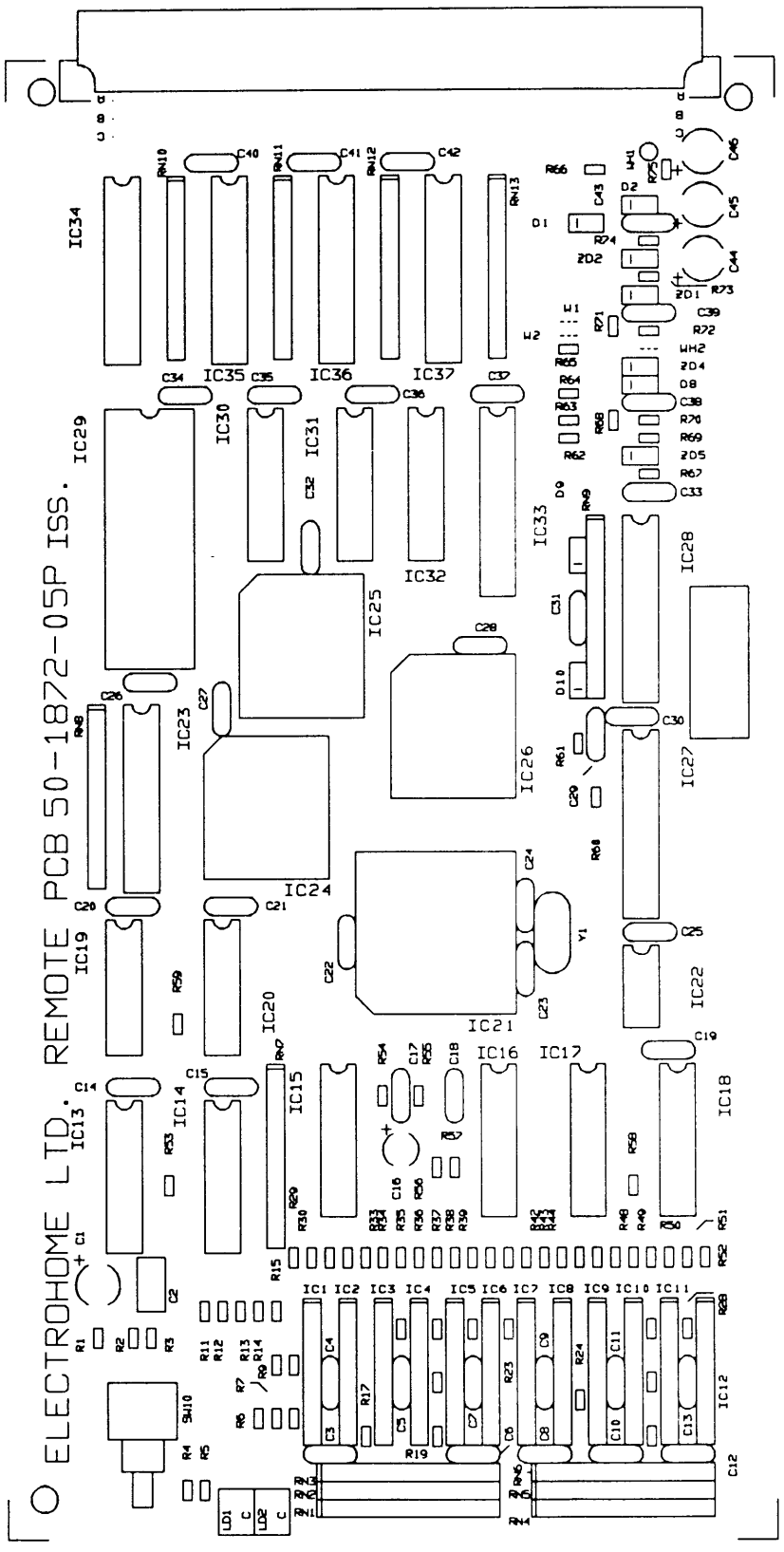
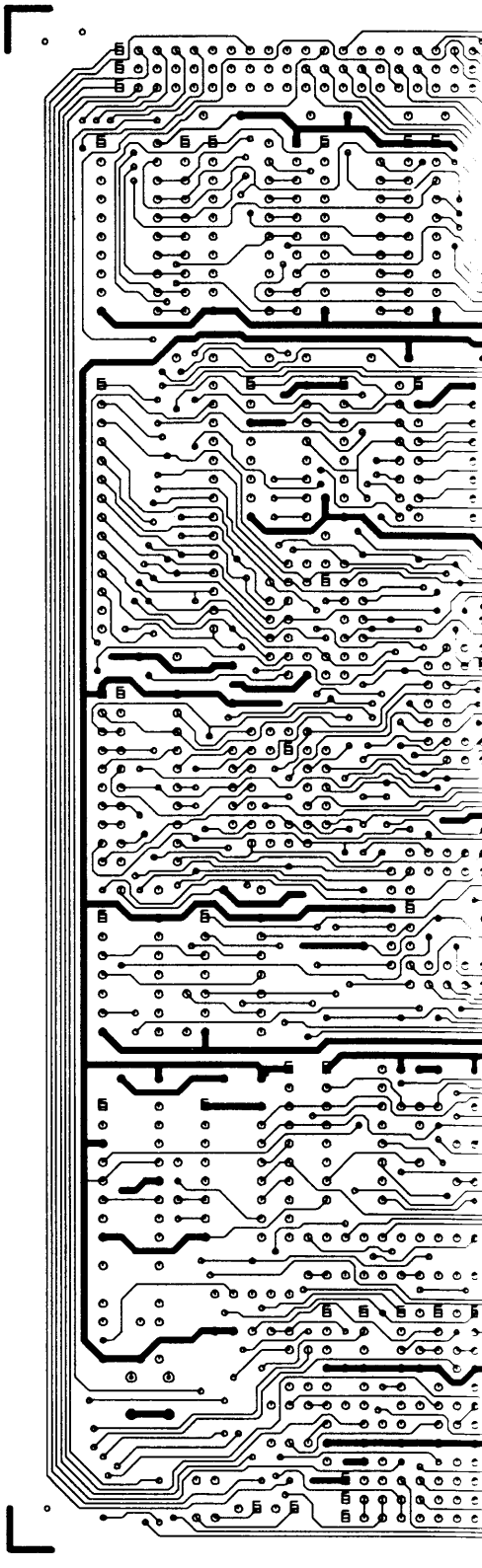
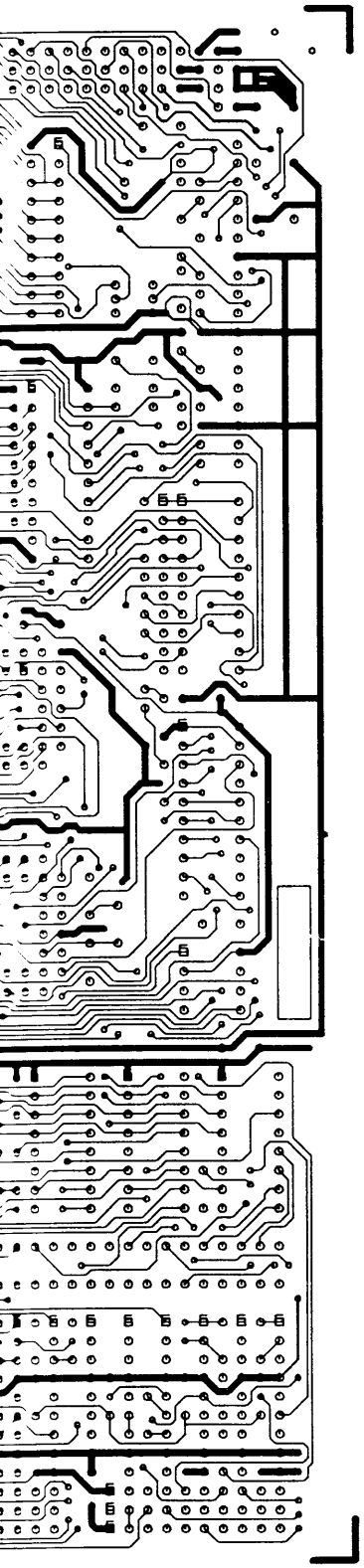


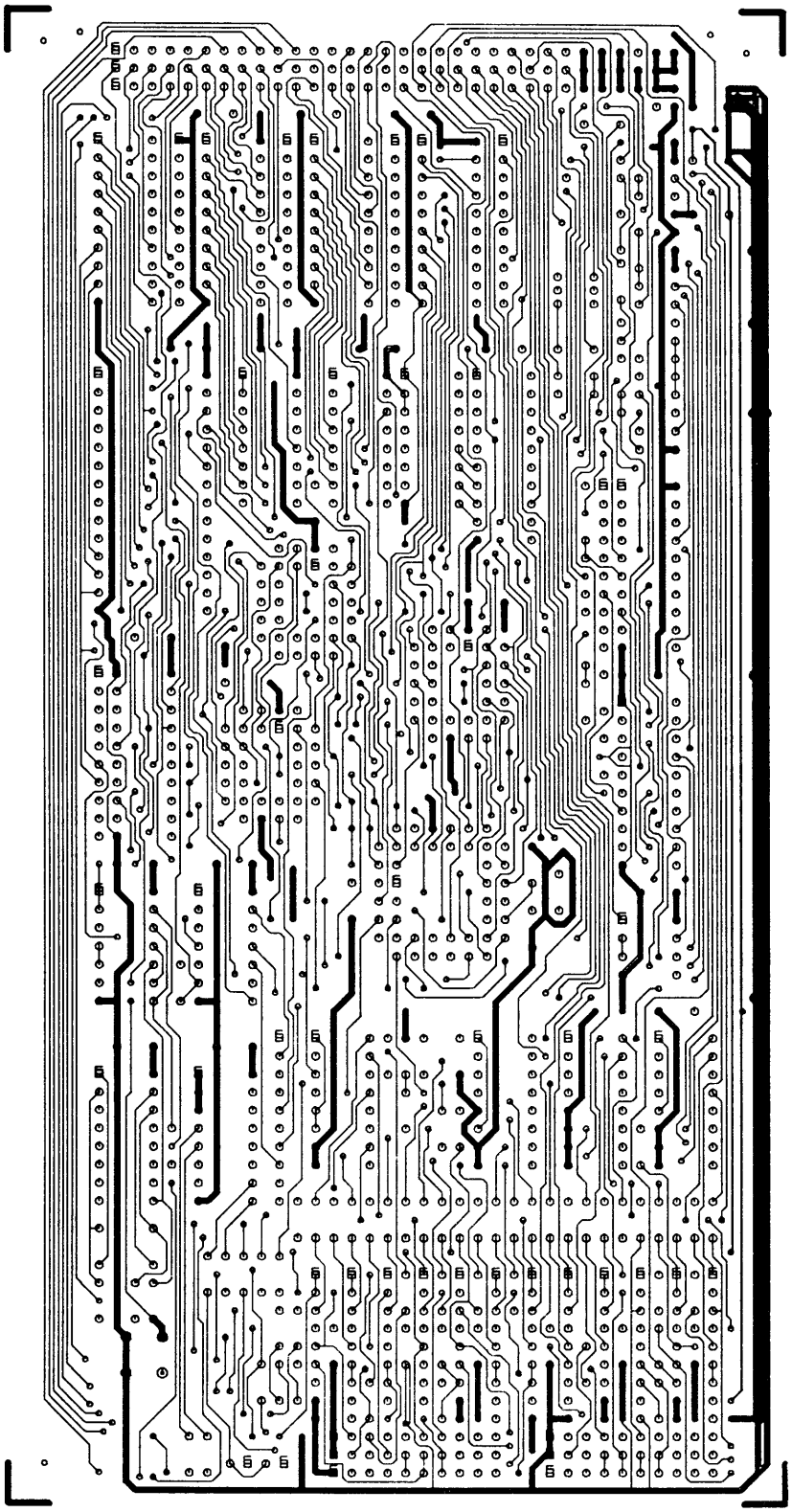
Component Layout



Solder Sid
(Viewed from Compo

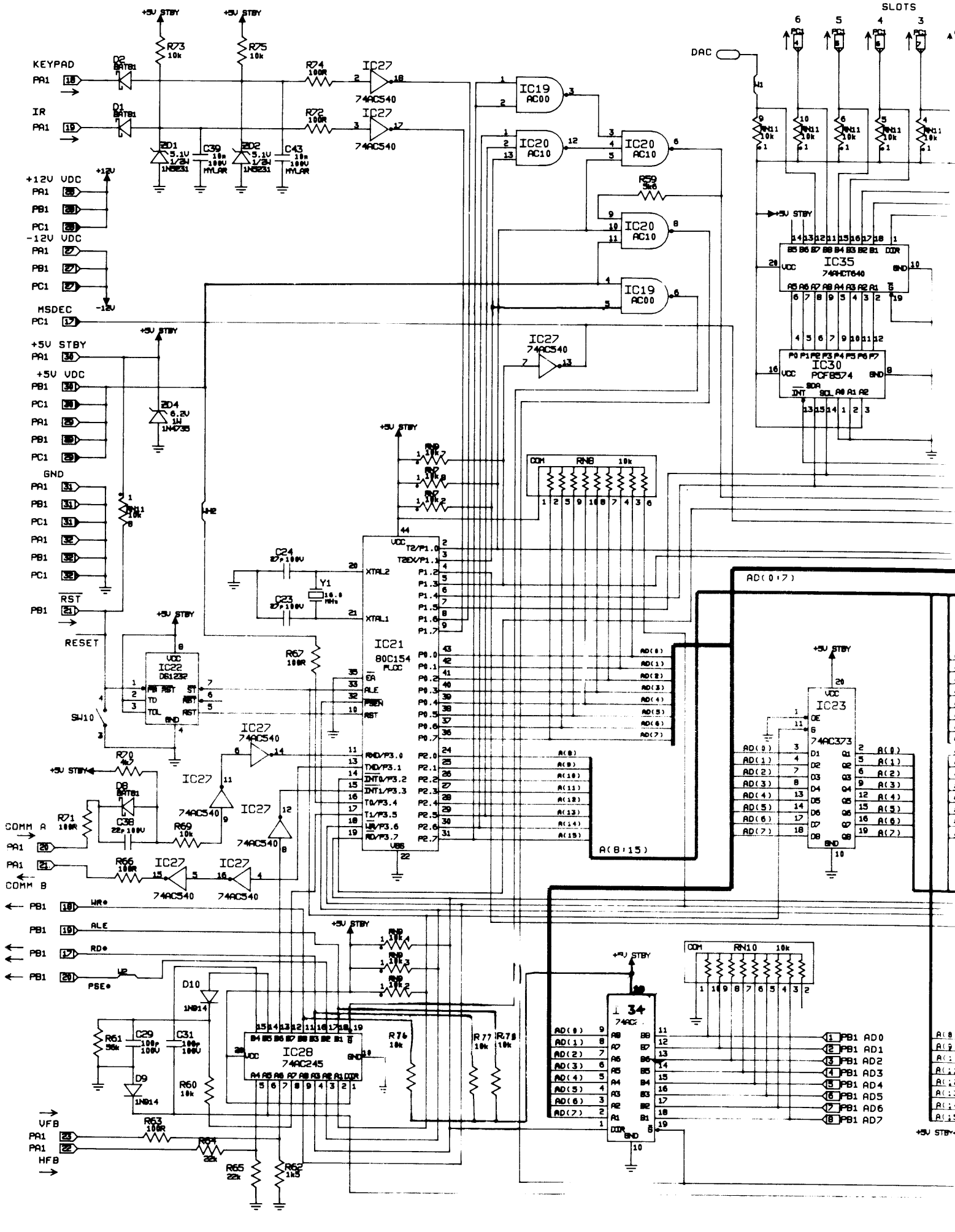


ide
nponent Side)



Component Side

FIGURE 11-2.
Remote Control Module Component Layout


SLOTS
KEYPAD
IR
+12V VDC
-12V VDC
MSDEC
+5V STBY
+5V VDC
GND
RST
RESET
DAC
IC21
80C154
IC35
74AHCT640
IC30
PCF8574
IC23
74AC373
IC28
74AC245
74AC540
AD(0:7)
A(8:15)
COMM A
COMM B
VFB
HFB
WR*
ALE
RD*
PSE*

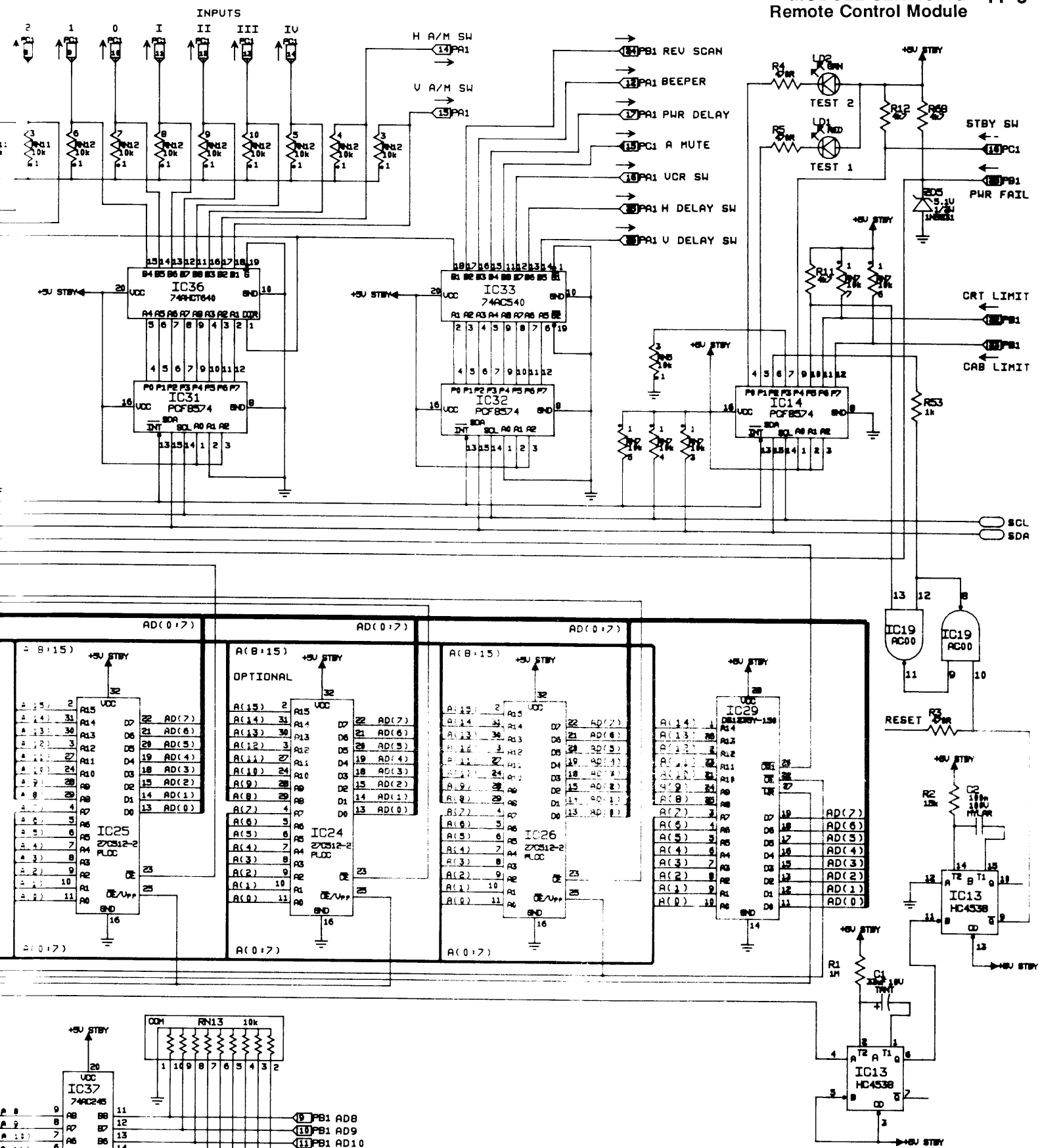


FIGURE 11-3.
Remote Control Module Schematic (Sheet 1 of 2)

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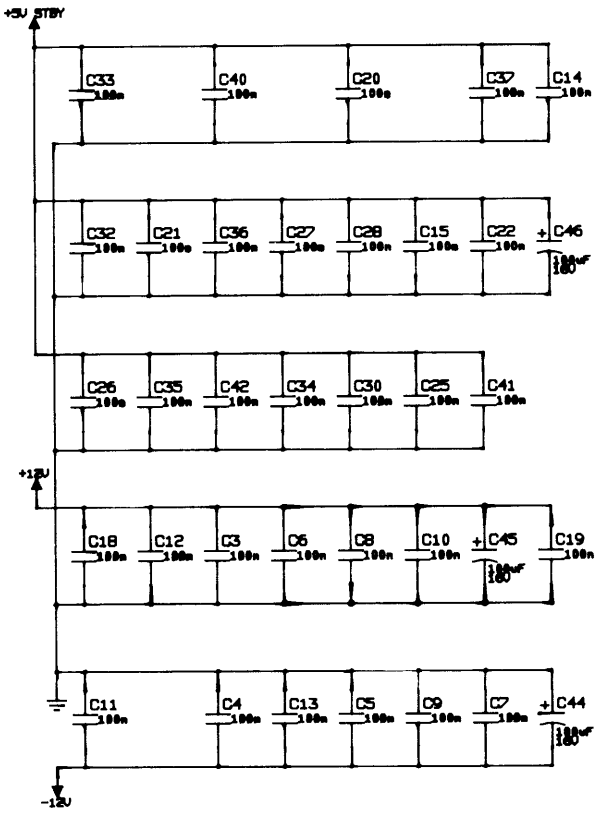

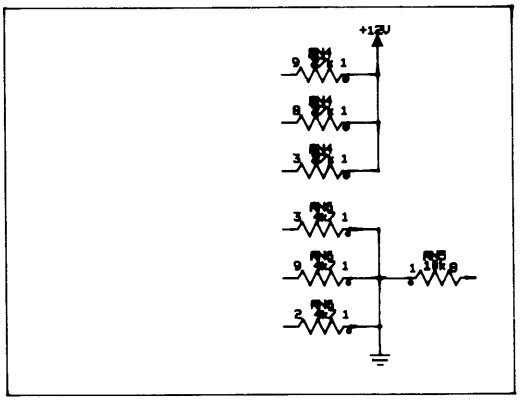

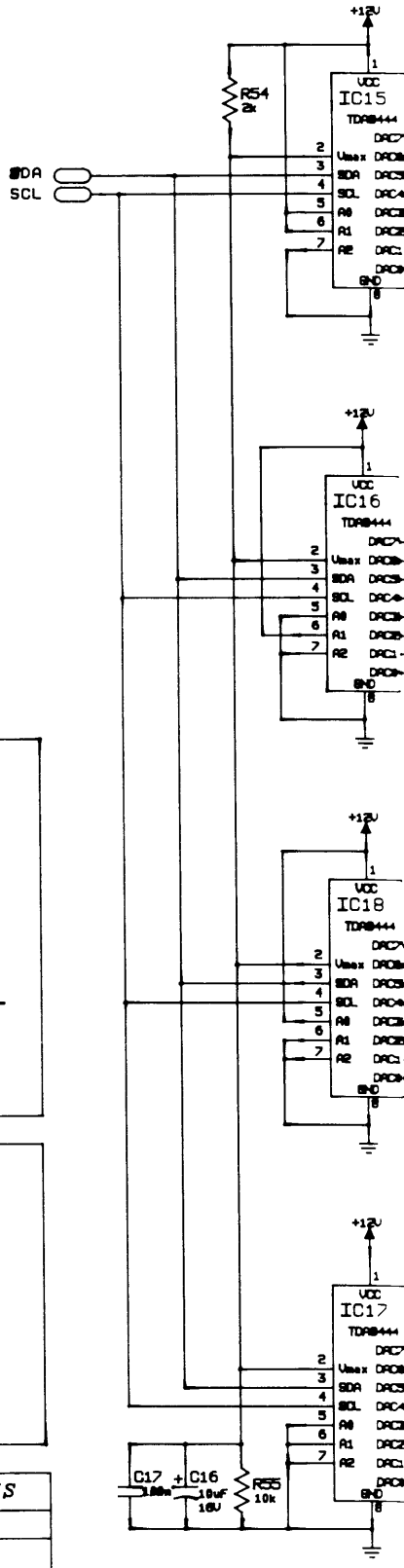

LEGEND

RESISTORS: RESISTANCE IS IN R(OHMS), k(KILOHMS), OR M(MEGAOHMS). 1/2 WATT, 5% TOLERANCE UNLESS OTHERWISE SPECIFIED.

CAPACITORS: CAPACITY IN p(PICOFARADS), n(NANOFARADS), OR μ(MICROFARADS) D.C.W.V. & TOLERANCE NOTED WHERE CRITICAL.

CAUTION

FOR CONTINUED SAFETY REPLACE COMPONENTS NOTED BY ⚠ WITH EXACT REPLACEMENT PARTS ONLY. CONSULT SERVICE MANUAL PARTS LIST SECTION "SAFETY COMPONENTS".

IMPLICIT POWER CONNECTIONS

IC#	NAME	PIN#	POWER	PIN#	POWER
1	M5216L	4	-12V	8	+12V
2	M5216L	4	-12V	8	+12V
3	M5216L	4	-12V	8	+12V
4	M5216L	4	-12V	8	+12V
5	M5216L	4	-12V	8	+12V
6	M5216L	4	-12V	8	+12V
7	M5216L	4	-12V	8	+12V
8	M5216L	4	-12V	8	+12V

IMPLICIT POWER CONNECTIONS

IC#	NAME	PIN#	POWER	PIN#	POWER
9	M5216L	4	-12V	8	+12V
10	M5216L	4	-12V	8	+12V
11	M5216L	4	-12V	8	+12V
12	M5216L	4	-12V	8	+12V
13	74HC4538	8	GND	16	+5V STBY
19	74AC00	7	GND	14	+5V STBY
20	74AC10	7	GND	14	+5V STBY
27	74AC540	10	GND	20	+5V STBY

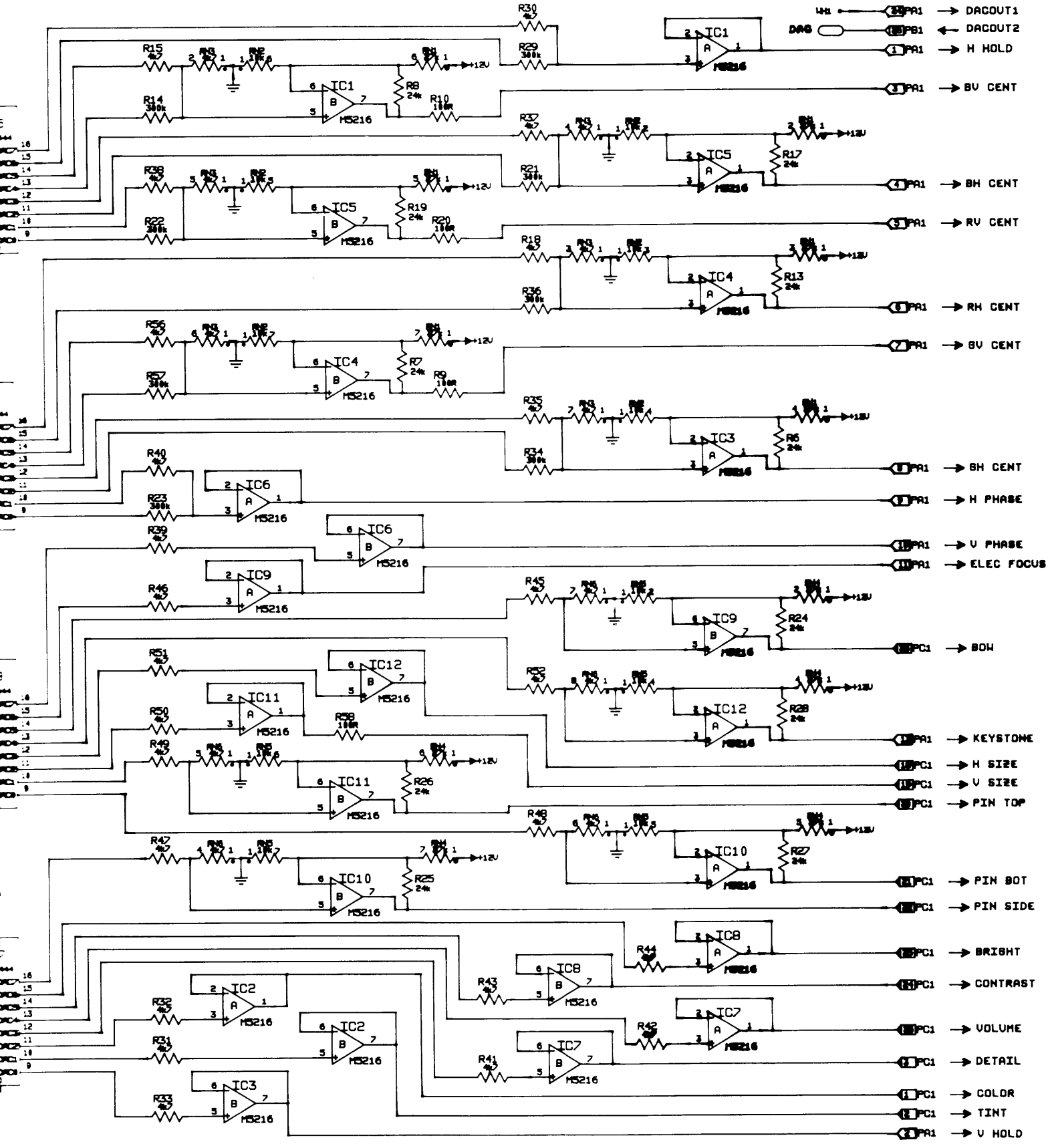

FIGURE 11-4.
Remote Control Module Schematic (Sheet 2 of 2)

11.4 PARTS LIST

Item Ref.	Part No.	Description
Integrated Circuits		
IC1-IC12	14-002836-01P	M5216L, dual op-amp
IC13	14-A04041-01P	MM74HC4538, cmos multi-vibrator
IC14,IC30-IC32	14-A03036-01P	PCF8574, 8-bit I/O expander
IC15-IC18	14-A03037-01P	TDA8444, octal 6 bit DAC
IC19	14-A04074-02P	74AC00, 2 input nand
IC20	14-A04085-01P	74AC10, 3 input nand
IC21	14-A06011-01P	80C154, 16MHz microcontroller
IC22	14-004702-01P	DS1232, micro monitor
IC23	14-A04010-02P	74AC373, octal latch
IC25	14-A05034-09P	27C512-170FM, 64K EPROM (programmed)
IC27,IC33	14-A04065-02P	74AC540, octal tri-state inverter/driver
IC28,IC34,IC37	14-A04055-02P	74AC245, octal bi-directional transceiver
IC29	14-A05045-02P	DS 1235Y-150, S-RAM
IC35,IC36	14-A04076-01P	74AHCT, octal bus
Transistors & Diodes		
D1,D2,D8	14-000533-01P	BAT81, SCHOTTKY
D9,D10	14-000513-01P	1N914, .075A, 75V
LD1	14-001005-01P	LED, RED, 3V, .09A
LD2	14-001005-02P	LED, GREEN, 3V, .09A
ZD1,ZD2,ZD5	14-000515-98P	1N5231C, 5.1V ZENER, 2%, .5W
ZD4	14-000531-38P	1N4735A, 6.2V ZENER, 5%, 1W
Capacitors		
C1	84-233138-01P	33 μF, 10V, tantalum
C2	88-171041-02P	100nF, 100V, 10%
C3-C15,C17-C22, C211-C28,C30, C32-C37,C40-C42	89-000032-03P	100nF, 50V
C16	84-410004-01P	10 μF, 25V
C23,C24	86-627032-04P	27pF, 100V
C29,C31	86-610134-04P	100pF, NPO, 100V
C38	86-622032-04P	22pF, 100V
C39,C43	88-171031-12P	10nF, 100V, mylar
C44-C46	84-410104-03P	100 μF, 25V
Resistors		
R1	80-1100411-11P	1M, 1/2W, 5%, metal film
R2	80-1150211-11P	15K, 1/2W, 5%, metal film
R3-R5	80-1470011-11P	470R, 1/2W, 5%, metal film
R6-R8,R13,R17,R19 R24-R28	80-1240211-11P	24K, 1/2W, 5%, metal film

11.4 PARTS LIST (cont.)

Item Ref.	Part No.	Description
Resistors (cont.)		
R9,R10,R20,R58, R63,R66,R67,R71, R72,R74	80-1100011-11P	100R, 1/2W, 5%, metal film
R11,R12,R15,R18, R30-R33,R35,R37-R52, R56,R68,R70	80-1470111-11P	4.7K, 1/2W, 5%, metal film
R14,R21-R23,R29 R34,R36,R57	80-1300311-11P	300K, 1/2W, 5%, metal film
R54	80-1200111-11P	2K, 1/2W, 5%, metal film
R53	80-1100111-11P	1K, 1/2W, 5%, metal film
R59	80-1560111-11P	5.6K, 1/2W, 5%, metal film
R61	80-1560211-11P	56K, 1/2W, 5%, metal film
R62	80-1150111-11P	1.5K, 1/2W, 5%, metal film
R55,R60,R64,R65 R69,R73,R75,R77, R78,R79	80-1100211-11P	10K, 1/2W, 5%, metal film
RN1,RN4	43-000053-03P	27K, 10 pin, resistor network
RN2,RN5, RN7-RN13	43-000053-02P	10K, 10 pin, resistor network
RN3,RN6	43-000053-01P	4.7K, 10pin, resistor network
Miscellaneous		
SW1	26-000343-01P	momentary contact switch, normally open
Y1	37-000020-04P	16.0MHz, crystal

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11.5 SPECIFICATIONS

Connector P1, Row A:

Pin 1 . . . . . analog output, **H HOLD**
signal level . . . . . 0 to 10 VDC ± 10%
NOTE: 12 bit signal

Pin 2 . . . . . analog output, **V HOLD**
signal level . . . . . 0 to 10 VDC ± 10%
NOTE: 6 bit signal

Pin 3 . . . . . analog output, **BV CENT**
signal level . . . . . -10 to 10 VDC ± 10%
NOTE: 12 bit signal

Pin 4 . . . . . analog output, **BH CENT**
signal level . . . . . -10 to 10 VDC ± 10%
NOTE: 12 bit signal

Pin 5 . . . . . analog output, **RV CENT**
signal level . . . . . -10 to 10 VDC ± 10%
NOTE: 12 bit signal

Pin 6 . . . . . analog output, **RH CENT**
signal level . . . . . -10 to 10 VDC ± 10%
NOTE: 12 bit signal

Pin 7 . . . . . analog output, **GV CENT**
signal level . . . . . -10 to 10 VDC ± 10%
NOTE: 12 bit signal

Pin 8 . . . . . analog output, **GH CENT**
signal level . . . . . -10 to 10 VDC ± 10%
NOTE: 12 bit signal

Pin 9 . . . . . analog output, **H PHASE**
signal level . . . . . 0 to 10 VDC ± 10%
NOTE: 12 bit signal

Pin 10 . . . . . analog output, **V PHASE**
signal level . . . . . 0 to 10 VDC ± 10%
NOTE: 6 bit signal

Pin 11 . . . . . analog output, **ELEC FOCUS**
signal level . . . . . 0 to 10 VDC ± 10%
NOTE: 6 bit signal

Pin 12 . . . . . digital output, **BEEPER**
signal level . . . . . 0 to 5 VDC ± 10%
NOTE: 6 bit signal

Pin 14 . . . . . analog output, **H A/M SW**
signal level . . . . . 0 to 5 VDC ± 10%

Pin 15 . . . . . analog output, **V A/M SW**
signal level . . . . . 0 to 5 VDC ± 10%

Pin 16 . . . . . analog output, **VCR SW**
signal level . . . . . 0 to 5 VDC ± 10%

Pin 17 . . . . . output, **PWR RELAY**
signal level . . . . . 0 to 5 VDC ± 10%

Pin 18 . . . . . digital input, **KEYPAD**
signal level . . . . . 0 to 12V ± 10%

Pin 19 . . . . . digital input, **IR**
signal level . . . . . 0 to 12V ± 10%

Pin 20 . . . . . digital input, **COMM A**
signal level . . . . . 0 to 5V

Pin 21 . . . . . digital output, **COMM B**
signal level . . . . . 0 to 5V ± 10%

Pin 22 . . . . . digital input, **HFB**
signal level . . . . . 0 to 12V

Pin 23 . . . . . digital input, **VFB**
signal level . . . . . 0 to 5V

Pin 24 . . . . . output, **DACOUT1**
signal level . . . . . -10 to 10 VDC ± 10%
NOTE: 6 bit signal

Pin 25 . . . . . digital output, **H DELAY SW**
signal level . . . . . 0 to 5 VDC ± 10%

Pin 26 . . . . . digital output, **V DELAY SW**
signal level . . . . . 0 to 5 VDC ± 10%

Pin 27 . . . . . -12V power supply **-12VDC**
current level . . . . . 300 mA max

Pin 28 . . . . . +12V power supply **+12VDC**
current level . . . . . 350 mA max

Pin 29 . . . . . +5V power supply **+5VDC**
current level . . . . . 80 μA max

Pin 30 . . . . . +5V power supply **+5V STBY**
current level . . . . . 300 mA max

Connector P1, Row B:

NOTE: pins 1 through 7 are multiplexed data/ lower byte address bus

Pin 1 . . . . . digital in/output, **AD(0)** LSB
Pin 2 . . . . . digital in/output, **AD(1)**
Pin 3 . . . . . digital in/output, **AD(2)**
Pin 4 . . . . . digital in/output, **AD(3)**
Pin 5 . . . . . digital in/output, **AD(4)**
Pin 6 . . . . . digital in/output, **AD(5)**
Pin 7 . . . . . digital in/output, **AD(6)**
Pin 8 . . . . . digital in/output, **AD(7)** MSB

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Connector P1, Row B: (cont.)

NOTE: pins 9 through 16 are the upper byte address bus
Pin 9 . . . . . digital input, **AD(8)** LSB
Pin 10 . . . . . digital input, **AD(9)**
Pin 11 . . . . . digital input, **AD(10)**
Pin 12 . . . . . digital input, **AD(11)**
Pin 13 . . . . . digital input, **AD(12)**
Pin 14 . . . . . digital input, **AD(13)**
Pin 15 . . . . . digital input, **AD(14)**
Pin 16 . . . . . digital input, **AD(15)** MSB

Pin 17 . . . . . digital input, **$\overline{RD}$**
NOTE: Read Signal

Pin 18 . . . . . digital input, **$\overline{WR}$**
NOTE: Write Signal

Pin 19 . . . . . digital input, **ALE**
NOTE: Address Latch Enable

Pin 20 . . . . . digital output, **$\overline{PSE}$**

Pin 21 . . . . . digital output, **RST**
Pin 22 . . . . . digital input, **CRT LIMIT**
Pin 23 . . . . . digital input, **CAB LIMIT**
Pin 24 . . . . . digital output, **REV SCAN**
Pin 25 . . . . . digital input, **PWR FAIL**
Pin 26 . . . . . digital output, **DACOUT2**

Connector P1, Row C:

Pin 1 . . . . . analog output, **COLOR**
signal level . . . . . 0 to 10 VDC ± 10%
NOTE: 6 bit signal

Pin 2 . . . . . analog output, **TINT**
signal level . . . . . 0 to 10 VDC ± 10%
NOTE: 6 bit signal

Pin 3 . . . . . analog output, **DETAIL**
signal level . . . . . 0 to 10 VDC ± 10%
NOTE: 6 bit signal

Pin 4 . . . . . digital output, **SLOT 6**
signal level . . . . . 0 to 5 VDC ± 10%

Pin 5 . . . . . digital output, **SLOT 5**
signal level . . . . . 0 to 5 VDC ± 10%

Pin 6 . . . . . digital output, **SLOT 4**
signal level . . . . . 0 to 5 VDC ± 10%

Pin 7 . . . . . digital output, **SLOT 3**
signal level . . . . . 0 to 5 VDC ± 10%

Pin 8 . . . . . digital output, **SLOT 2**
signal level . . . . . 0 to 5 VDC ± 10%

Pin 9 . . . . . digital output, **SLOT 1**
signal level . . . . . 0 to 5 VDC ± 10%

Pin 10 . . . . . digital output, **SLOT 0**
signal level . . . . . 0 to 5 VDC ± 10%

Pin 11 . . . . . digital output, **INPUT I**
signal level . . . . . 0 to 5 VDC ± 10%

Pin 12 . . . . . digital output, **INPUT II**
signal level . . . . . 0 to 5 VDC ± 10%

Pin 13 . . . . . digital output, **INPUT III**
signal level . . . . . 0 to 5 VDC ± 10%

Pin 14 . . . . . digital output, **INPUT IV**
signal level . . . . . 0 to 5 VDC ± 10%

Pin 15 . . . . . digital output, **A MUTE**
signal level . . . . . 0 to 5 VDC ± 10%

Connector P1, Row C (cont.):

Pin 18 . . . . . analog output, **H SIZE**
signal level . . . . . 0 to 10 VDC ± 10%
NOTE: 6 bit signal

Pin 19 . . . . . analog output, **V SIZE**
signal level . . . . . 0 to 10 VDC ± 10%
NOTE: 6 bit signal

Pin 20 . . . . . analog output, **PIN TOP**
signal level . . . . . -10 to 10 VDC ± 10%
NOTE: 6 bit signal

Pin 21 . . . . . analog output, **PIN BOT**
signal level . . . . . -10 to 10 VDC ± 10%
NOTE: 6 bit signal

Pin 22 . . . . . analog output, **PIN SIDE**
signal level . . . . . -10 to 10 VDC ± 10%
NOTE: 6 bit signal

Pin 23 . . . . . analog output, **BOW**
signal level . . . . . -10 to 10 VDC ± 10%
NOTE: 6 bit signal

Pin 24 . . . . . analog output, **CONTRAST**
signal level . . . . . 0 to 10 VDC ± 10%
NOTE: 6 bit signal

Connector P1, Row C: (cont.)

Pin 25 . . . . . analog output, **BRIGHT**
signal level . . . . . 0 to 10 VDC ± 10%
NOTE: 6 bit signal

Pin 26 . . . . . analog output, **VOLUME**
signal level . . . . . 0 to 10 VDC ± 10%
NOTE: 6 bit signal

54-7904-02P/54-7904-03P (06/90)

SECTION 12

WAVEFORM MODULE

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

54-7904-03P (06/90)

12.1 TECHNICAL DESCRIPTION

12.1.1 General Description

The Waveform Module forms part of the video circuitry. It's main function is to provide the necessary gain control voltages to the Video Control module. It also provides geometry correction waveform signals to the Keystone, Power Deflection and Bias modules.

12.1.2 Circuit Description

12.1.2.1 Address/Data De-multiplexing

The Waveform module receives data via address and data buses from the Remote Control Module. The data and 8 least-significant address bits use lines AD(0) to AD(7). They are de-multiplexed by IC10 and IC22. The 8 most significant address bits use lines A(8) to A(15) and are latched by IC16, a 74HC373 transparent latch. The latch functions only when enabled; when disabled, it allows the flow of data.

The ALE signal from the Remote Control module goes high when the address is valid. This enables latches IC10 and IC16. IC22, a 74HC245 bi-directional buffer, allows data transfer only when RD or WR is low, i.e., when data is present on AD(0) to AD(7).

12.1.2.2 Address Decoding

IC5, a 74HC138, 3-to-8 line decoder, performs address decoding. IC5's binary select inputs A, B and C are tied to A(10), A(11) and A(12) respectively. This divides the 8K byte address space into eight 1K byte spaces. References to addresses in one of these 8 ranges cause the corresponding SEL line to go low for the duration of the RD or WR strobe. Address decoding is summarized in Table 12-1.

TABLE 12-1. *Address Decoding*

I/O	ADDRESS	MODULE	FUNCTION
SEL0	6000 TO 63FF	CONVERGENCE	RAM BANK SELECT
SEL1	6400 TO 64FF	VIDEO CONTROL	VIDEO RAM ADDRESSING
SEL2	6800 TO 6BFF	VIDEO CONTROL	MODE CONTROL SIGNALS
SEL3	6C00 TO 6FFF	WAVEFORM	TOP VERTICAL BLANKING
SEL4	7000 TO 73FF	WAVEFORM	BOTTOM VERTICAL BLANKING
SEL5	7400 TO 77FF	WAVEFORM	RGB BLANKING
SEL6	7800 TO 7BFF	SPARE	FUTURE USE
SEL7	7C00 TO 7FFF	SPARE	FUTURE USE

12.1.2.3 Programmable Blanking Generation

The Waveform module generates two types of blanking -- vertical blanking (top and bottom) and full screen RGB blanking.

Vertical Blanking.

IC26 (a 74HC74 flip-flop), IC27 (a 74HC688 digital comparator), IC28 and IC34 (74HC373 latches) and IC33 (a 74HC688 digital comparator) generate the vertical blanking waveform. SEL3 and SEL4 enable IC28 and IC34 respectively.

The microprocessor loads IC28 and IC34 with 8-bit values, representing the top and bottom positions of the un-blanked raster. IC20 (a 74HC4040 vertical counter) provides an ascending 8-bit count. IC27 and IC33 compare this value to the values in latches IC28 and IC34. The comparators control the state of IC26, producing the desired vertical blanking waveform.

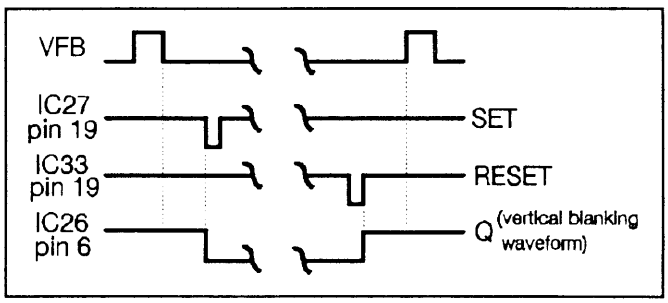

FIGURE 12-1. *Vertical Blanking Waveforms*

RGB Blanking

The red, green and blue drive levels can be blanked individually. SEL5 latches data bits D0, D1 and D2 to IC9 (a 74HC175 quad flip-flop). IC9's outputs are ORed with the composite blanking waveform. The resulting signals feed the A, B and C SELECT lines of IC3 (a 74HC4053 triple 2-input analog multiplexer). A high on SELECT A blanks red, a high on SELECT B blanks green, and a high on SELECT C blanks blue.

12.1.2.4 Drive Level Control

Drive levels derive from the CONTRAST voltage. The CONTRAST voltage is limited to a safe level by the BEAM LIMIT line. Trimpots R1, R2 and R3 adjust the red, green and blue drive levels respectively.

12.1.2.5 Waveform Generation

The Waveform module generates horizontal and vertical rate geometry correction waveforms. Counter IC2 is clocked by HPLLCLK (256 counts per active line) and reset by HRESET (during horizontal retrace). It sends an 8-bit address to IC7 (a 256 x 8 bit PROM, programmed to define a $y=x^2$ parabola) which feeds IC17.

The REVERSE SCAN signal, from the Remote Control module, selects either a normally ascending count from IC2 or a descending count for reverse scan applications.

IC20 (a 74HC4040 counter) is clocked by VPLLCLK and reset by VRESET (during vertical retrace). It sends an 8-bit ascending address to IC15 (a TBP28L22 PROM, programmed to define a $y=x^2$ parabola). IC15 feeds IC13 (multiplying digital-to-analog converter) to produce vertical dynamic focus. The address, without data, feeds IC25 (multiplying digital-to-analog converter) to produce keystone (a sawtooth waveform).

12.1.2.6 Dynamic Focus

Trimpot R48 sets the size of the horizontal rate parabola produced by IC17. Trimpot R17 sets the size of the vertical rate parabola produced by IC13. Op-amp IC12 adds the two parabolas together and outputs them as a composite signal -- DYNAMIC FOCUS.

12.1.2.7 Pincushion PCB

The Pincushion PCB is piggyback mounted to the Waveform module via connector .The circuitry consists of a vertical section that provides modulation for top and bottom pincushion and bow centering, and a horizontal section that generates the parabola needed to correct each line for pincushion. See Figure 12-3, *Pincushion Waveform and Function Diagram*.

Vertical Section

The prime functions of the vertical section are:

1) generation of a constant amplitude ramp whose frequency tracks VFB

2) algebraic manipulation of the d.c. control voltages (TOP PIN DC, BOT PIN DC, BOW DC) and the ramp (TOP PIN RAMP, BOT PIN RAMP)

Ramp Generation. IC4B generates a square wave pulse output whose period is equal to that of VFB. The duration of this pulse is fixed at 4 milliseconds from the rising edge of VFB. R24 and C2 form a frequency to voltage converter. They integrate the output of IC4B to provide a voltage proportional to the frequency of VFB.

IC9C and associated components add gain and improve integration. The voltage appearing at pin 8 of IC9C is -1.8 V at 40 Hz and -5.4 V at 120 Hz. R23 carries a current of 11 mA at 40 Hz and 34 mA at 120 Hz. The current charges C14 and generates a constant peak amplitude voltage ramp at pin 7 of IC2B. Q1 discharges C14 during the VFB pulse. C1 AC-couples the ramp and IC2A, with associated circuitry, rectifies it. The precision rectifiers output 2.6V half period ramps. The positive ramp is TOP PIN RAMP. The negative ramp is BOT PIN RAMP. Their respective peaks represent the top and bottom of the image.

Vertical Modulation. Vertical modulation is provided by IC13A, IC13B, IC2D, IC9D, IC1, IC13 and associated components. Vertical modulation is based on the equation:

0.086 x [(BOT PIN RAMP x BOT PIN DC)
+ (BOT PIN RAMP x BOW DC)
- (TOP PIN RAMP x TOP PIN DC)
- (TOP PIN RAMP x BOW DC)
+ (2.6 x BOW DC)]

BOW DC controls the image at center (BOT PIN RAMP = TOP PIN RAMP = 0V). At the top and bottom of the image (TOP PIN RAMP = +2.6V and BOT PIN RAMP = -2.6V) the BOW DC terms cancel. Top and bottom pincushion and center bow are adjusted independent of each other.

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Horizontal Section

The horizontal section is responsible for generating the horizontal ramp and horizontal parabola. The horizontal section operates over the range of 15 KHz to 80 KHz.

Horizontal Ramp. IC4A, IC14A and associated components produce a voltage ramp. The voltage appearing at pin 1 of IC14A is -1V at 15.75 KHz and -5V at 80 KHz. R55 carries a current of 45 mA at 15.75KHz and 230 mA at 80KHz. Tne current charges C34 and generates a 3.4V 0-peak voltage ramp (H.RAMP) at pin 7 of IC14B. In a similar manner, a 3.0V 0-peak ramp is generated at pin 14 of IC14D. IC11A produces a 600 nanosecond pulse referenced to the falling edge of HFB. See Figure 12-2. The pulse turns on Q3, discharging C32. Resistors R72, R73, R74 and R78 produced a reference voltage proportional to frequency plus a constant ($V_{ref} = kf + c$). The ramp drives the output of comparator IC16 high when ramp voltage is less than the reference voltage on pin 2 of IC16. The square wave at pin 7 of IC16 can be used to trigger IC11 to output a 600 nanosecond pulse which resets H. RAMP.

H. RAMP is squared after it is applied to the inputs of IC14 and IC15. The new ramp is averaged and the result is applied to the offset of the multiplier, resulting in H PAR.

Modulation. VERT. MODULATION and H PAR are multiplied by IC17, IC9B and associated components. Output voltage is +6V maximum and -6V minimum.

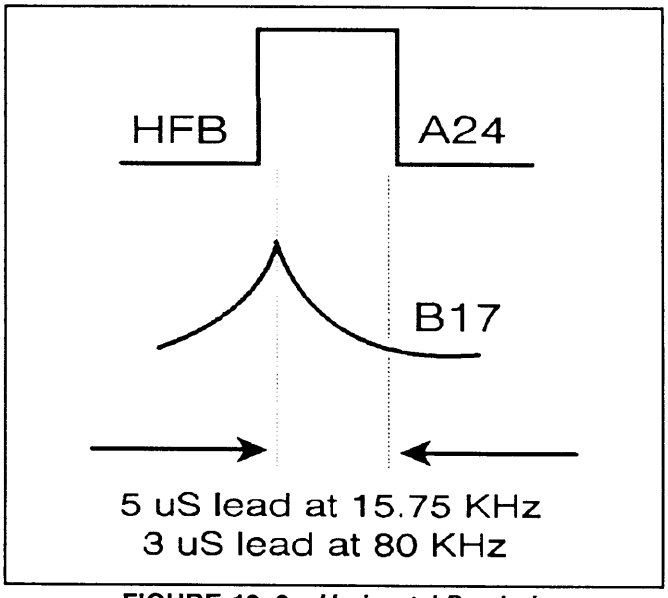

FIGURE 12-2. *Horizontal Parabola*

12.1.2.8 Color Correction PCB

The color correction circuitry is on a piggy back PCB that attaches to the waveform PCB via connector P2. It compensates the red, green and blue colors for the side to side color shifts caused by the lens shift.

IC5, a 28L22 (256 x 8 bit bipolar PROM), provides a waveform which results in a uniform red luminosity across the projected image. IC5 is addressed by the 8 bit count from the horizontal counter IC2 on the waveform module. Output goes to IC1, a TLC7524 DAC, where it is multiplied by the red drive level and sent back to the Waveform module as a color corrected signal.

The green projected image is color corrected in the same manner by IC6 and IC2 on the Color Correction PCB. Similarly, the blue projected image is color corrected by IC7 amd IC3.

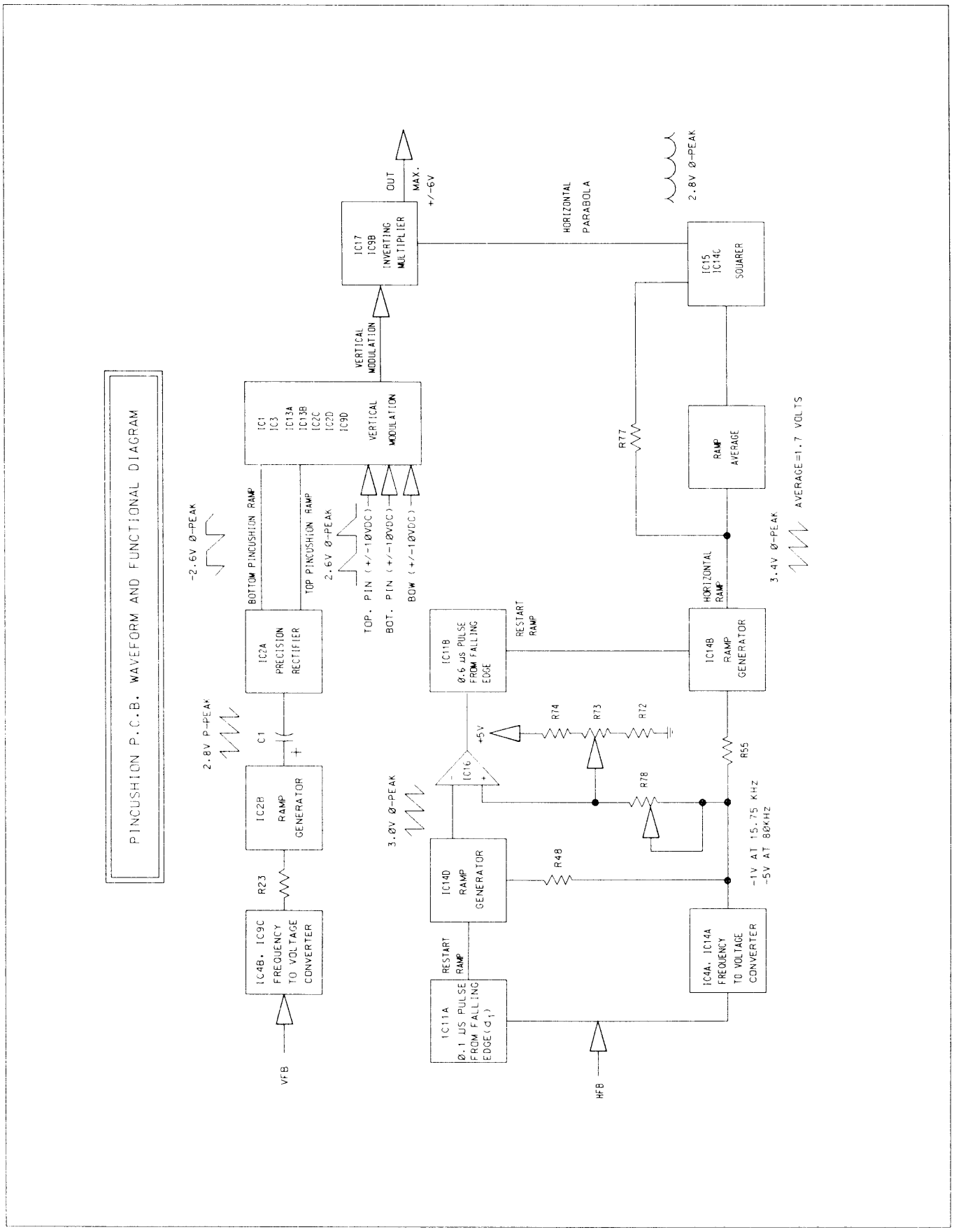

FIGURE 12-3. *Pincushion Waveform and Function Diagram*

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12.2 SERVICING AND ALIGNMENT

12.2.1 Disassembly and Access

CAUTION

STATIC SENSITIVE COMPONENTS
STATIC CONTROLLED WORK STATION REQUIRED

Module Location:
- rear panel card rack

Tools & Equipment Required:
- Phillips screw driver

a) Remove the back panel as described in Section 5.

b) Locate the Waveform Module in the rear panel card rack. Using the printed circuit board extractor from the tool pouch, pull the module from the card rack as described in Section 5.

NOTE: To remove the Pincushion or Color Correction PCB from the Waveform PCB, refer to Figure 12-4.

12.2.2 Alignment

This section contains full set-up procedures for the Waveform Module.

NOTE: Optical and electronic focusing must be performed before this procedure.

Reference Figure 12-4.

Tools & Equipment Required:
- printed circuit board extractor
- extender board, Electrohome Part # 03-230330-01P
- fine tip slot screwdriver
- oscilloscope
- video source (15.7 KHz horizontal, 45.0 Hz vertical)

STEP 1 – Remove projector top covers

STEP 2 – Remove Waveform Module

a) Pull the module out of its slot. Insert the extender board into the Waveform module slot. Connect the Waveform module to the extender board.

STEP 3 – Horizontal Dynamic Focus

a) Press # on the keypad. This produces a crosshatch pattern on the screen.

b) Connect the oscilloscope to TP6 on the Bias module.

c) Adjust R17 until a 250V horizontal parabola is produced.

STEP 4 – Vertical Dynamic Focus

a) Press # on the keypad. Adjust R48 until a 360 V p-p parabola is produced (250V horizontal plus 110V vertical components).

STEP 5 – Verify Dynamic Focus

a) Electrically de-focus the projector until the crosshatch lines are thick. Observe the thickness of a horizontal line across center and a vertical line across center. The horizontal line should be equal thickness from left through center to right. If it is not, adjust R17.

b) The vertical line should be equal thickness from top through center to bottom. If it is not, adjust R48.

STEP 6 – Keystone Offset

a) Connect an oscilloscope probe to row B, pin 14 on the extender board (KEY WFM). Press KEY on the keypad. Press the U or D arrow key until KEY WFM is zero.

b) Adjust R61 until KEY WFM reads 0 volts.

STEP 7 – Keystone Amplitude

a) Connect the video source to the projector. Set source horizontal rate to 15.7 KHz and vertical rate to 45.0 Hz.

b) Press KEY on the keypad. Press the U key for maximum keystone.

c) Adjust R51 until either a) distortion or jitter appears on the image, or b) image sides appear straight when the projection angle is 15°.

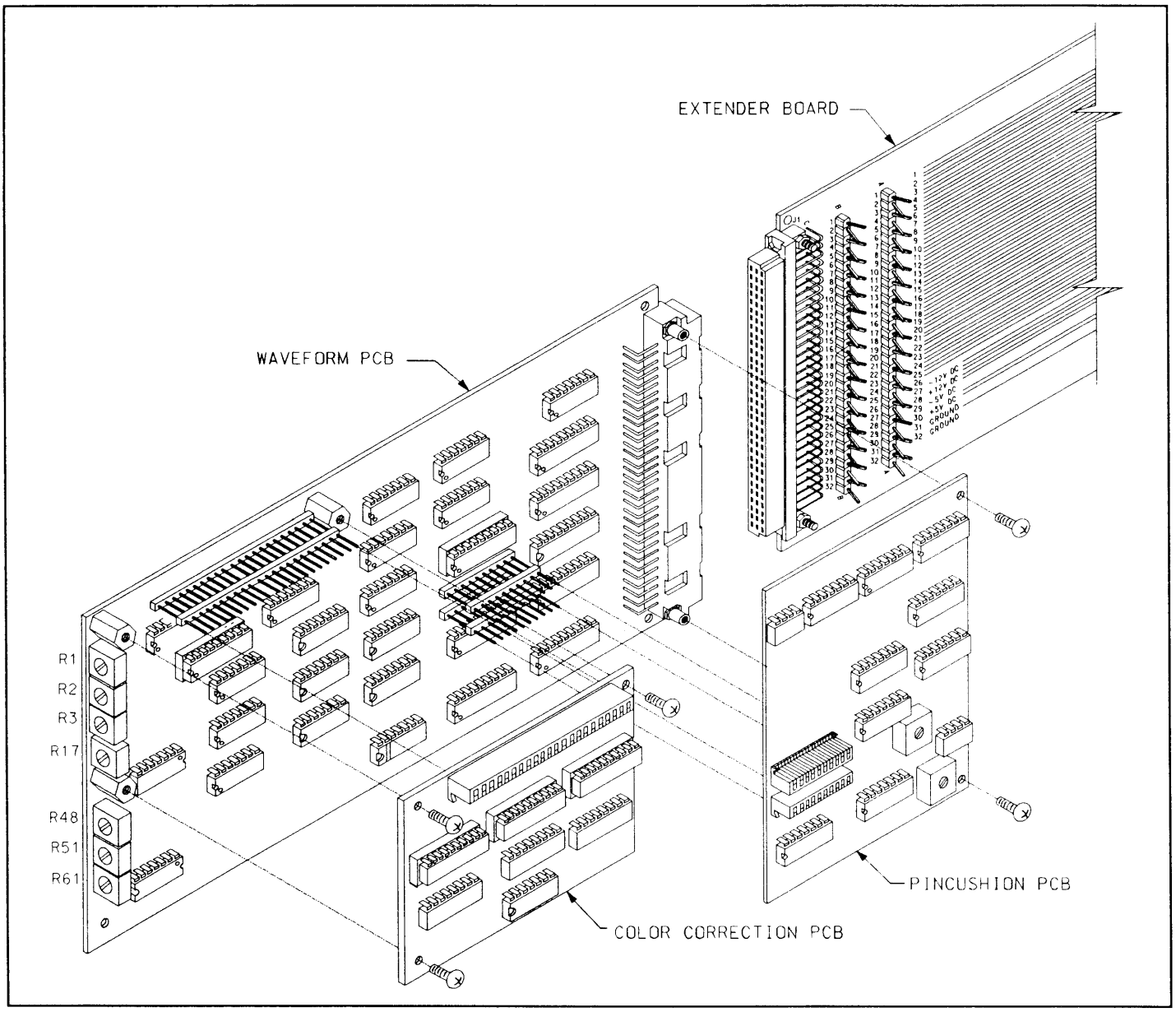

FIGURE 12-4. ***Waveform Module Alignment/Daughter PCB Removal***

12.3 COMPONENT LAYOUT AND SCHEMATICS

Refer to the following pages for component layouts and schematics of the Waveform module.

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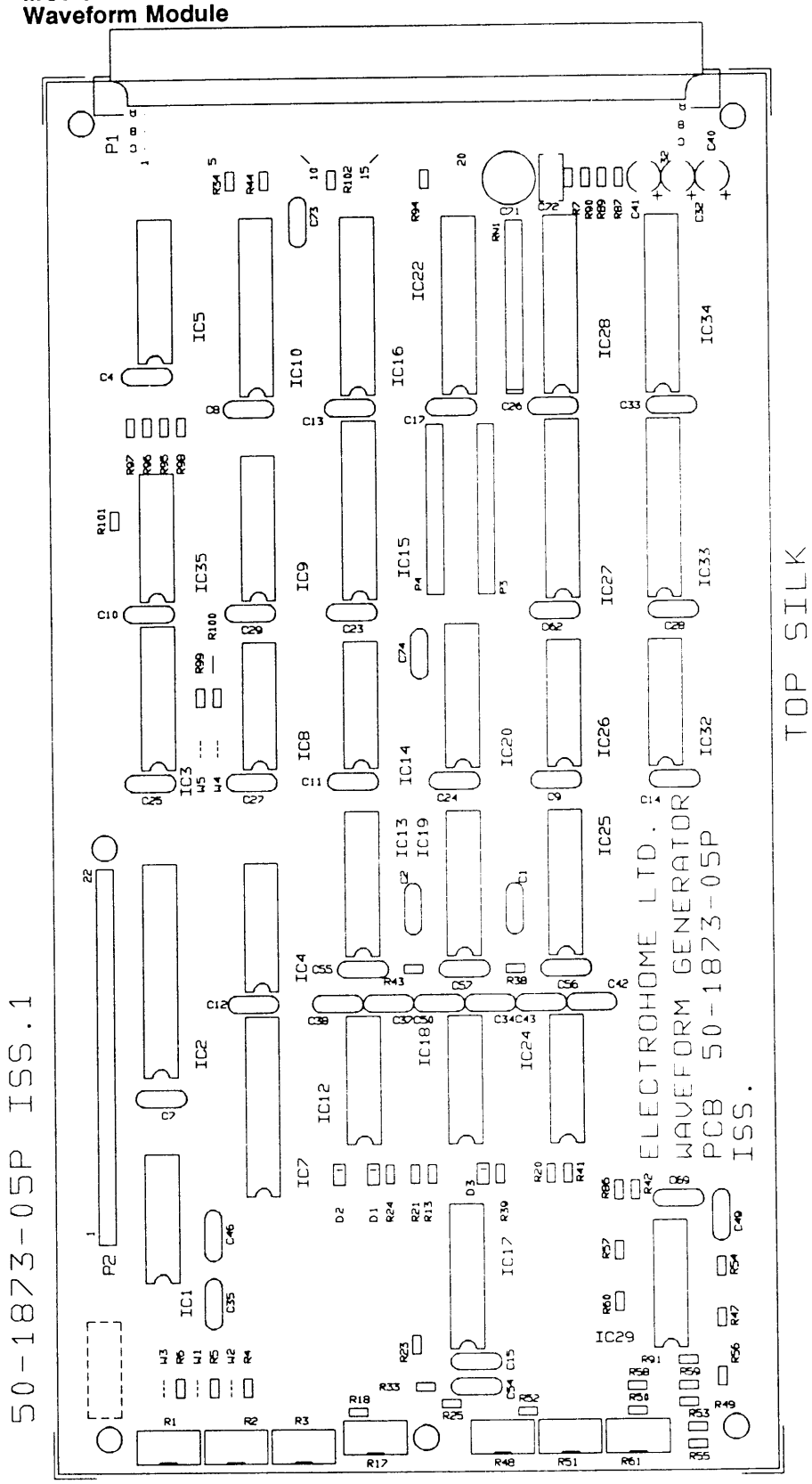
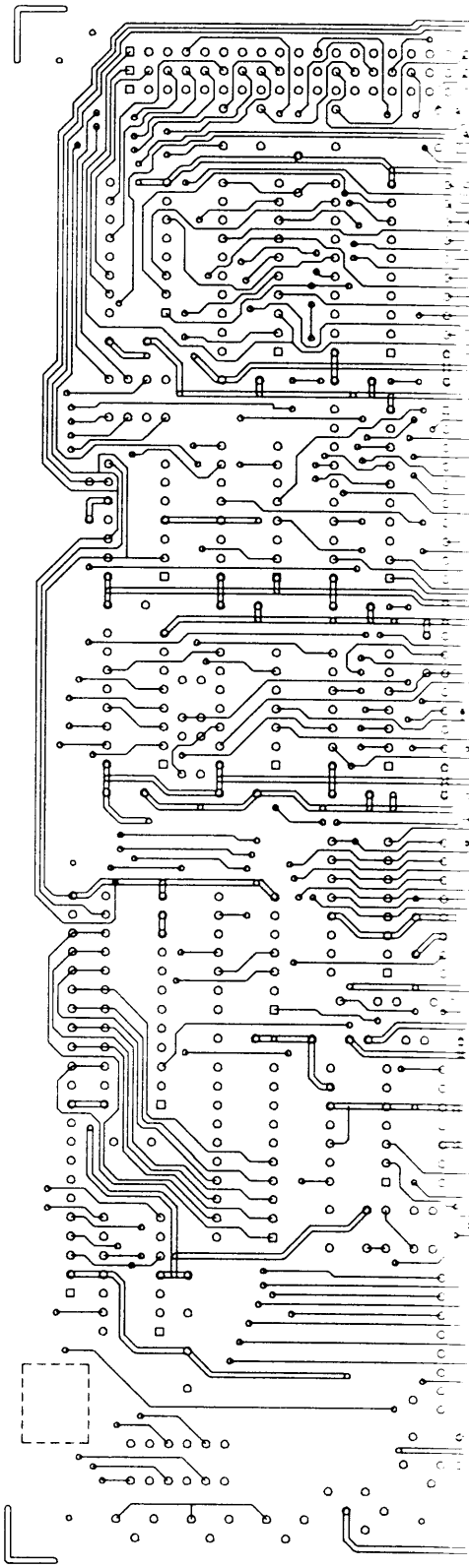


Component Layout



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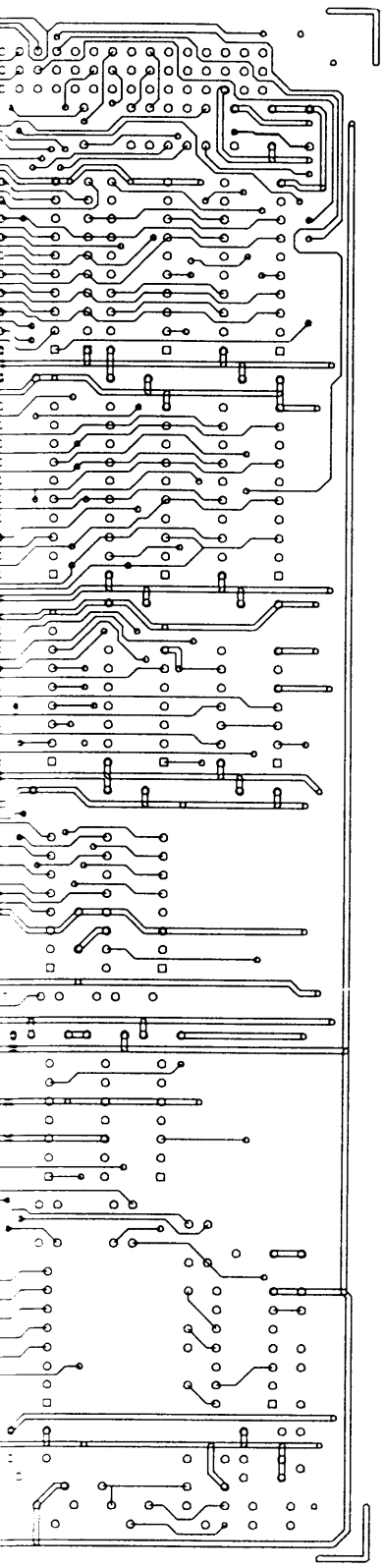
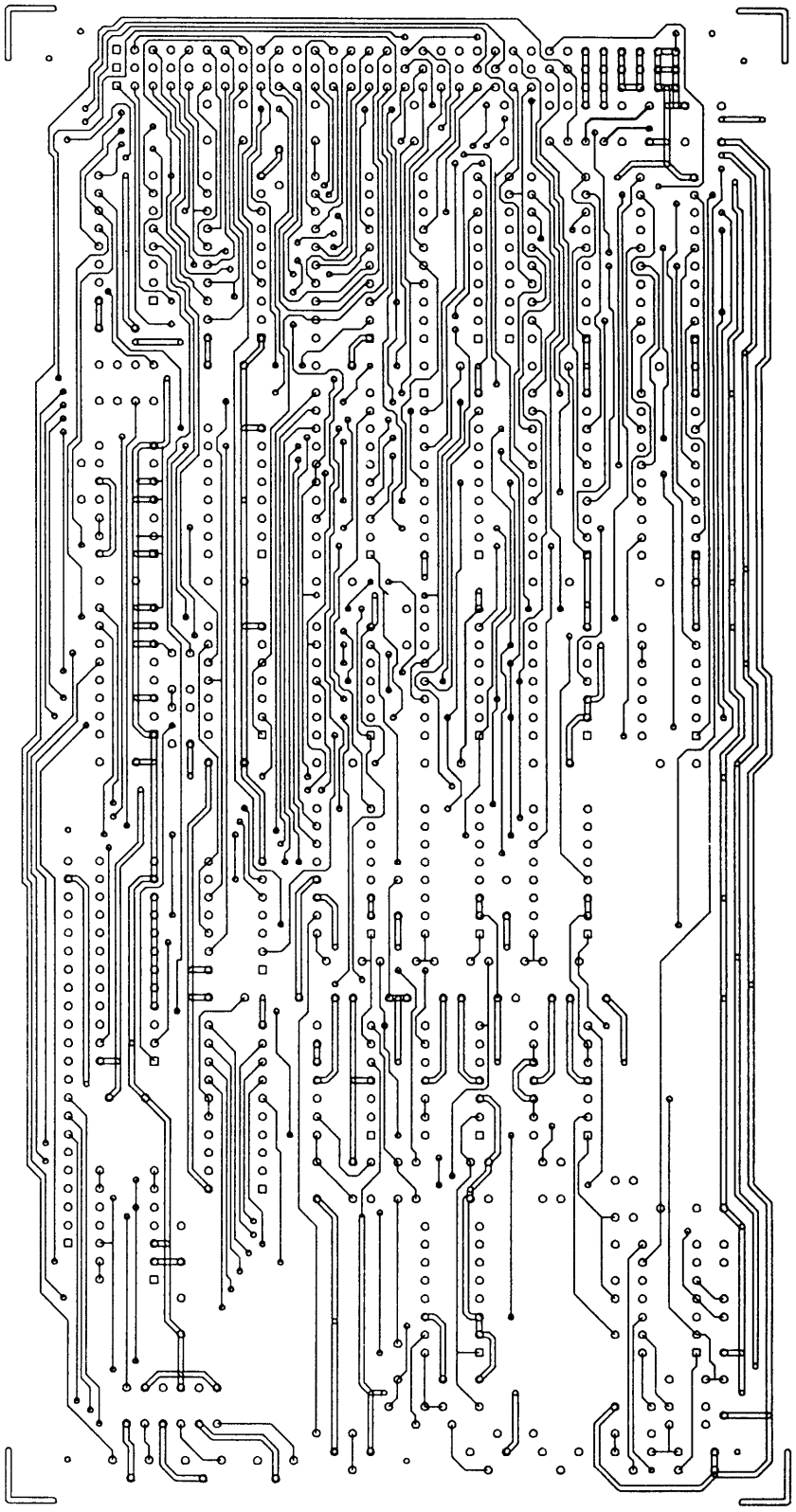
(Viewed from Com

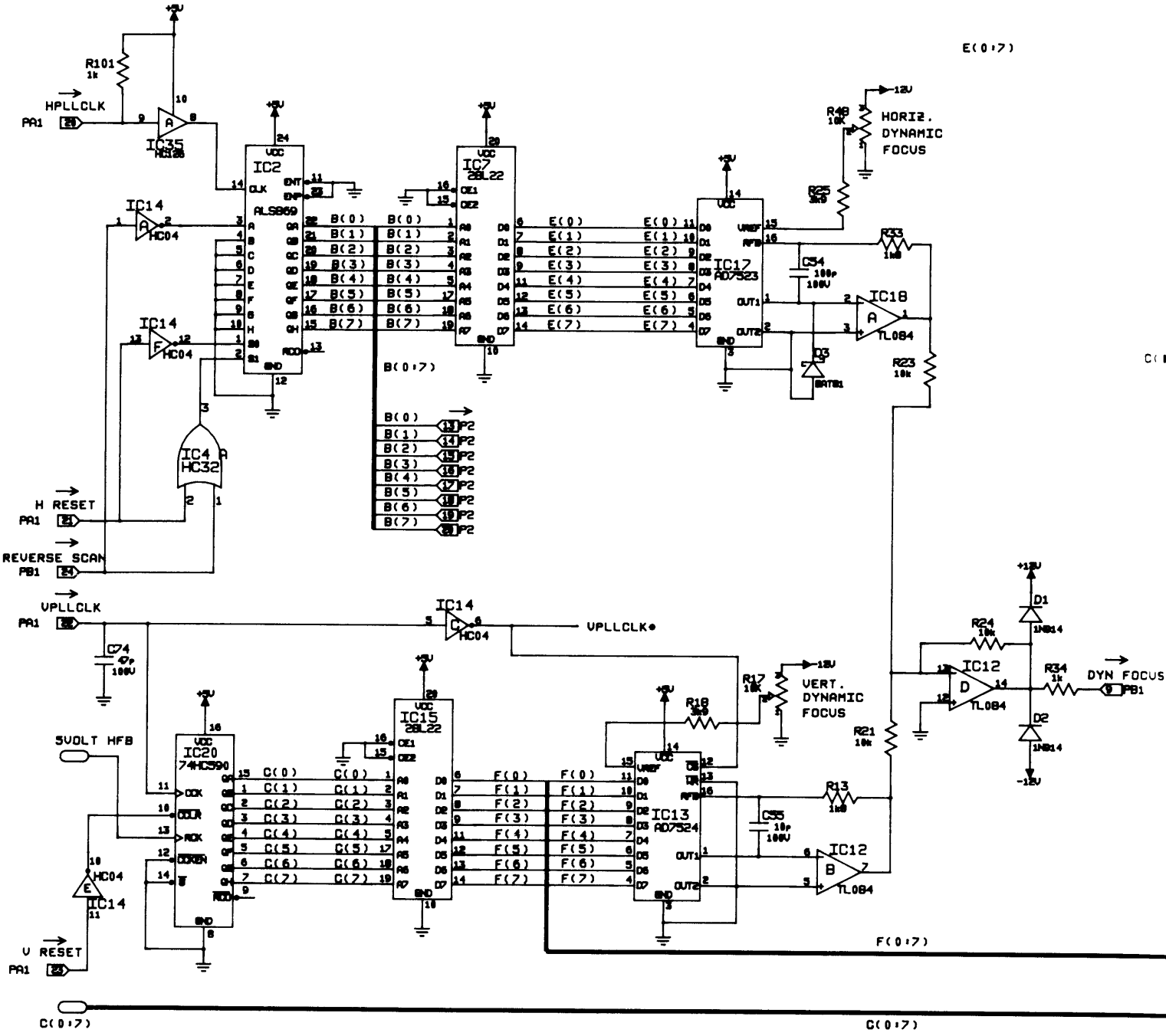


Side
omponent Side)



Component Side

FIGURE 12–5.
Waveform Module Component Layout



IMPLICIT POWER CONNECTIONS							
IC#	NAME	PIN#	POWER		PIN#	POWER	
IC1	TL084	4		+12V	11		-12V
IC4	74HC32	14	VCC	+5V	7		GND
IC8	74HC32	14	VCC	+5V	7		GND
IC12	TL084	4		+12V	11		-12V
IC14	74HC04	14	VCC	+5V	7		GND
IC18	TL084	4		+12V	11		-12V
IC24	TL084	4		+12V	11		-12V
IC26	74HC74	14	VCC	+5V	7		GND
IC32	74HC00	14	VCC	+5V	7		GND

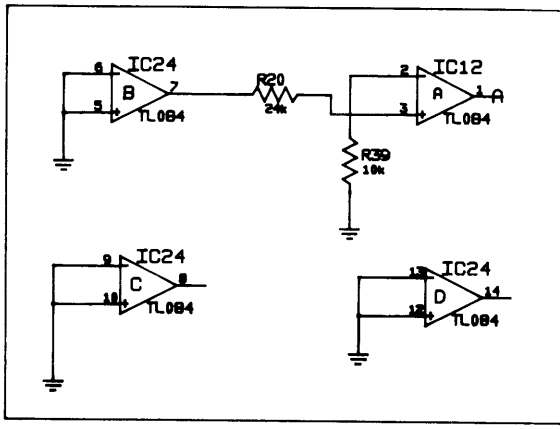
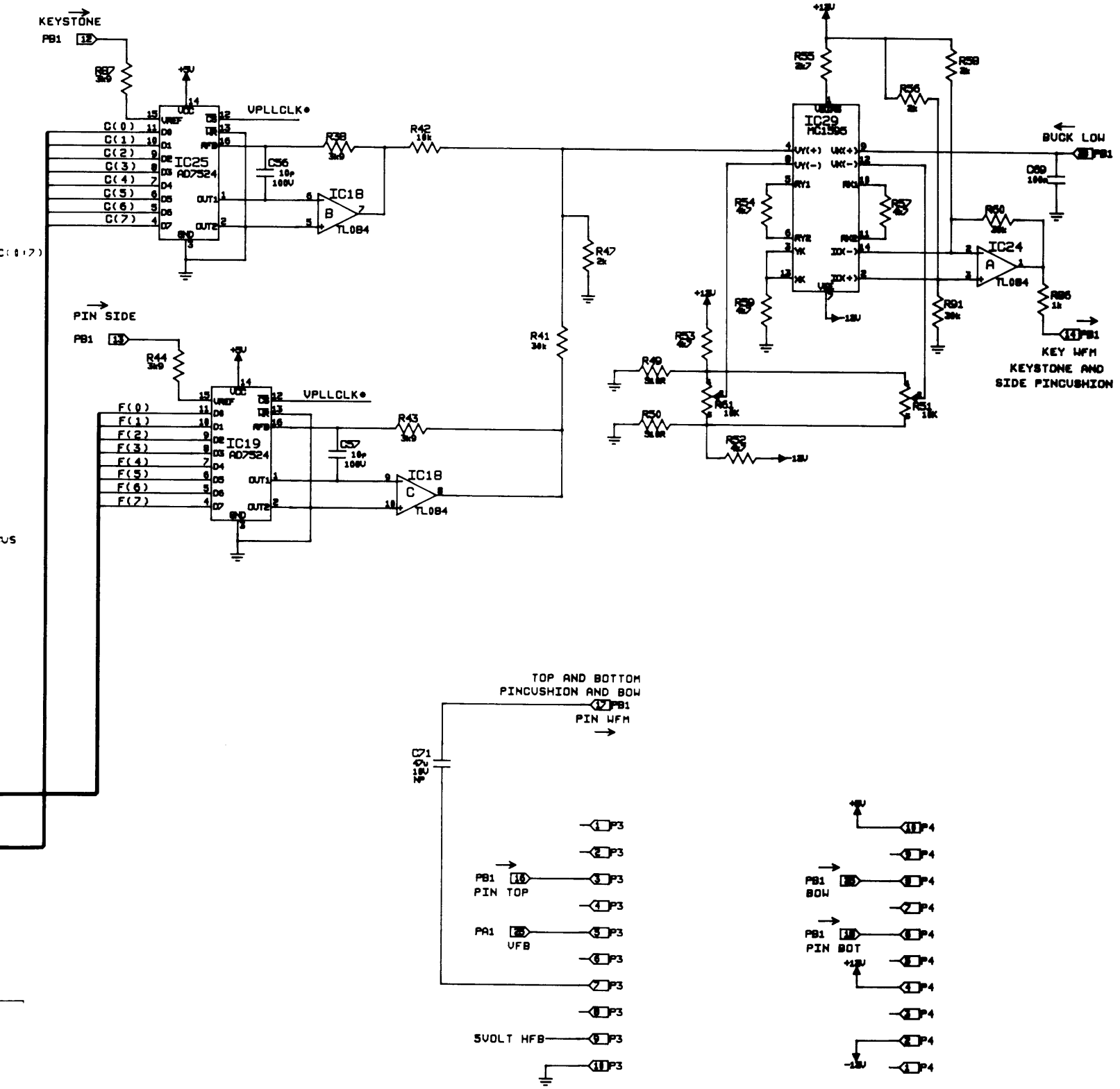
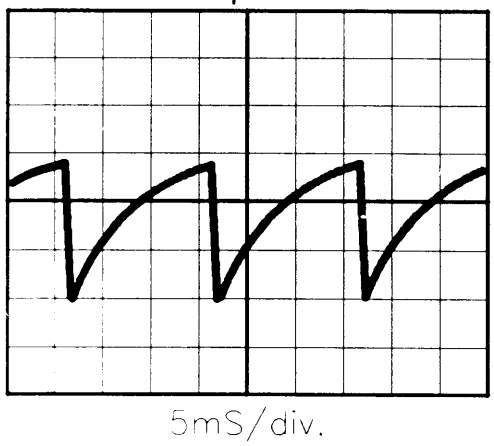


FIGURE 12–6.
Waveform Module Schematic (Sheet 1 of 2)

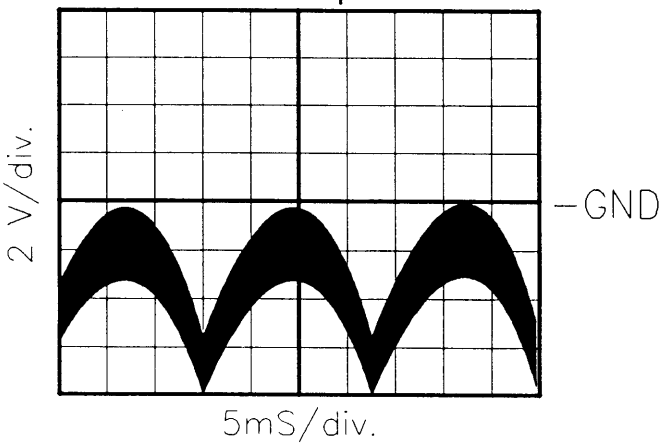


SCHEMATIC REFERENCE

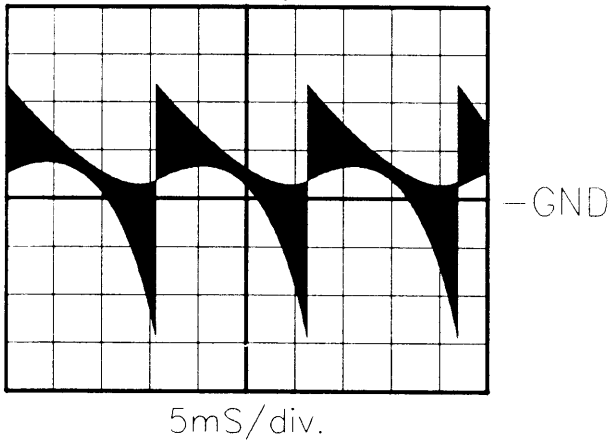
KEY WFM at point **PB1<14**



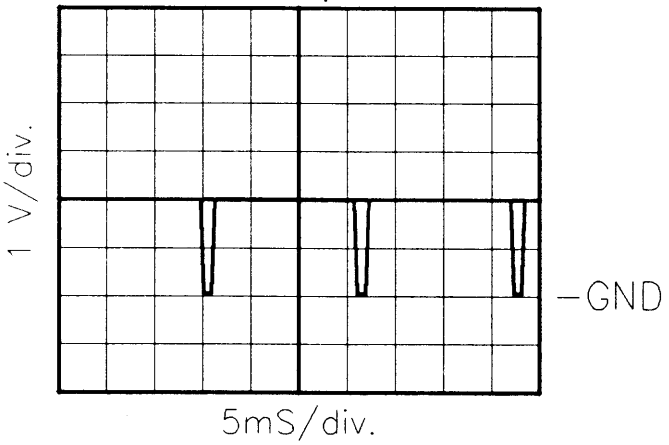
KEY WFM at point **PB1<14**



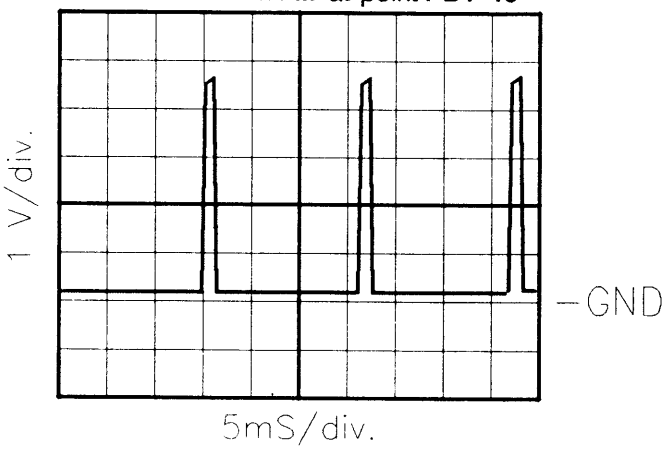
PIN WFM at point **PB1<17**



R GAIN at point **PB1<21**



BLANK WFM at point **PB1<19**



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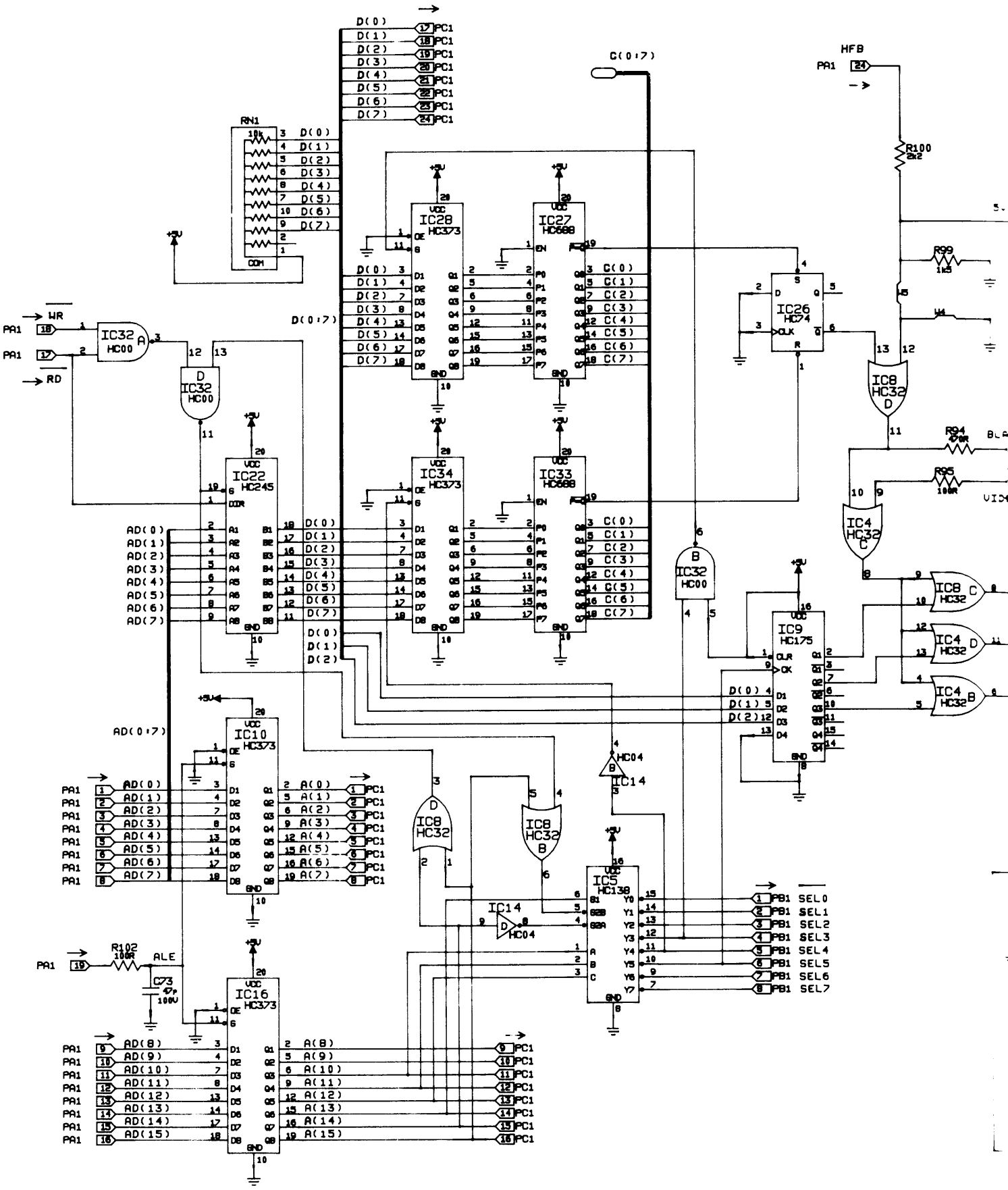
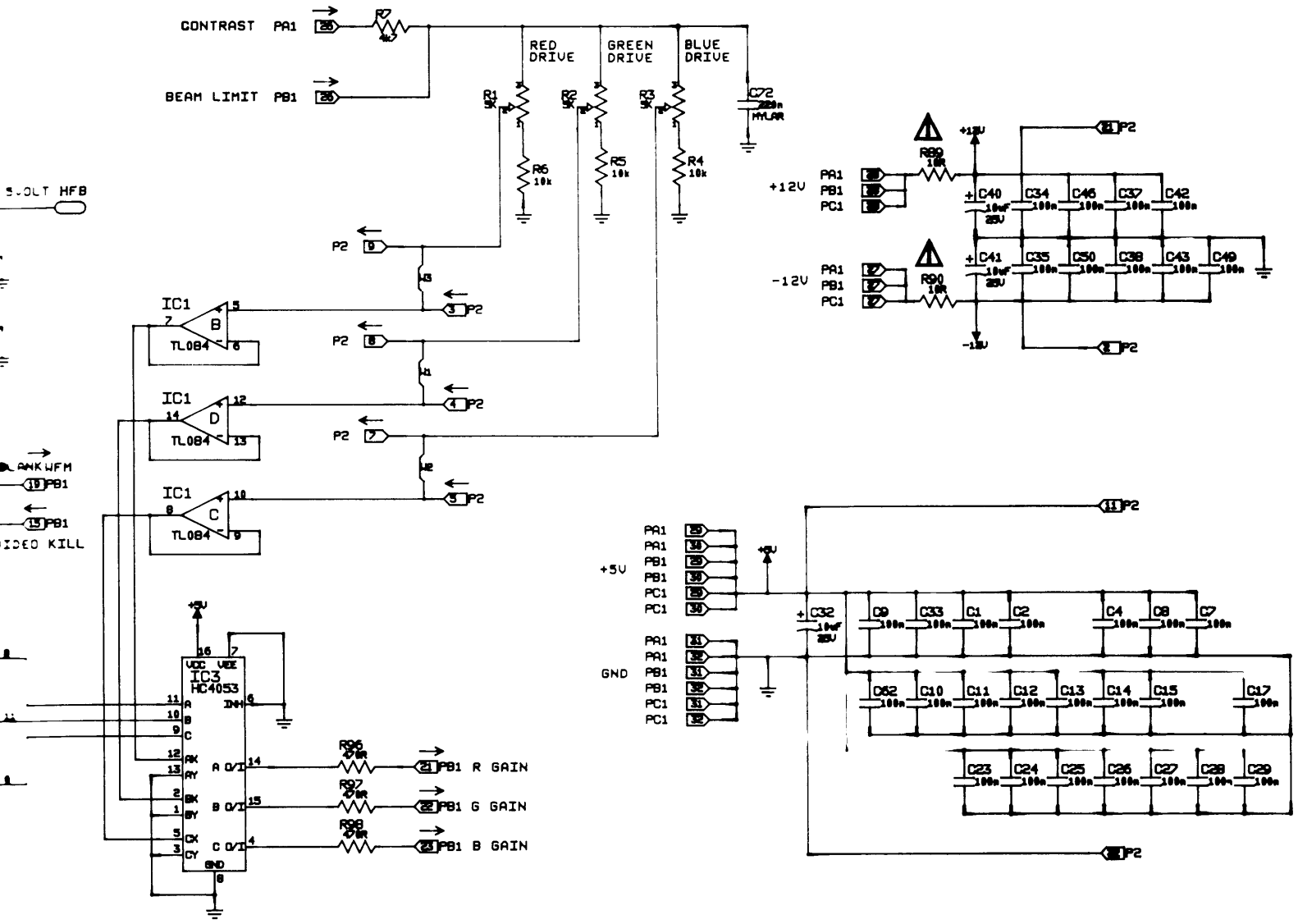
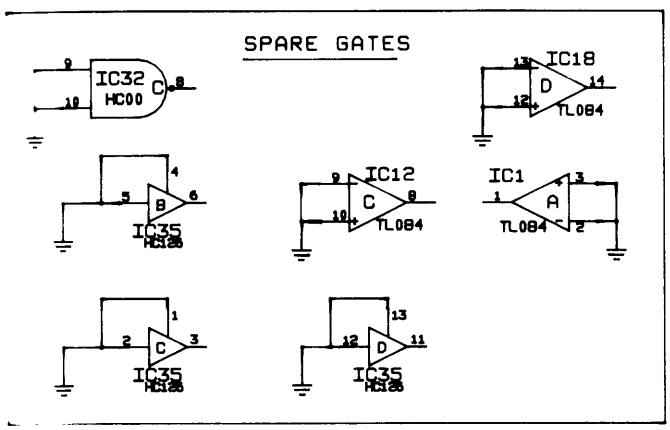


FIGURE 12–7.
Waveform Module Schematic (Sheet 2 of 2)





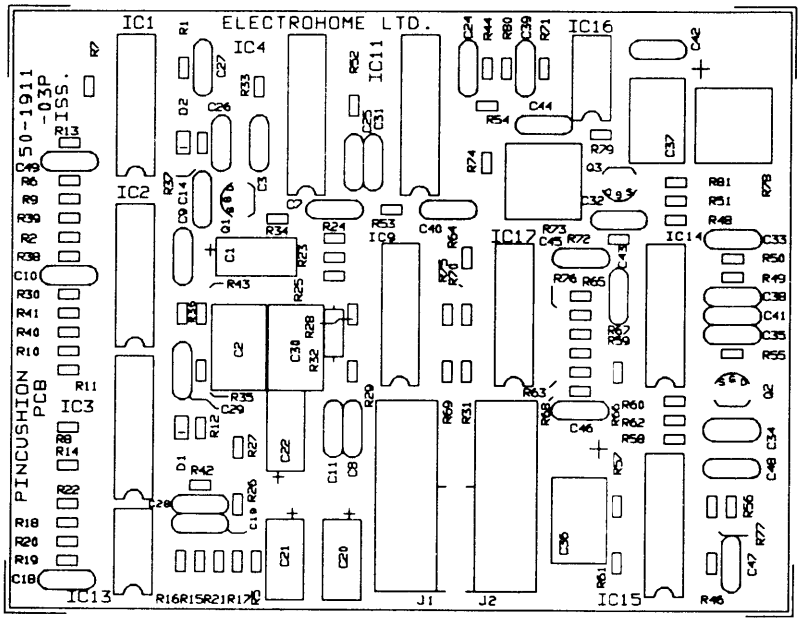
LEGEND

RESISTORS: RESISTANCE IS IN R(OHMS), k(KILOHMS), OR M(MEGAOHMS). 1/4 WATT, 5% TOLERANCE UNLESS OTHERWISE SPECIFIED.

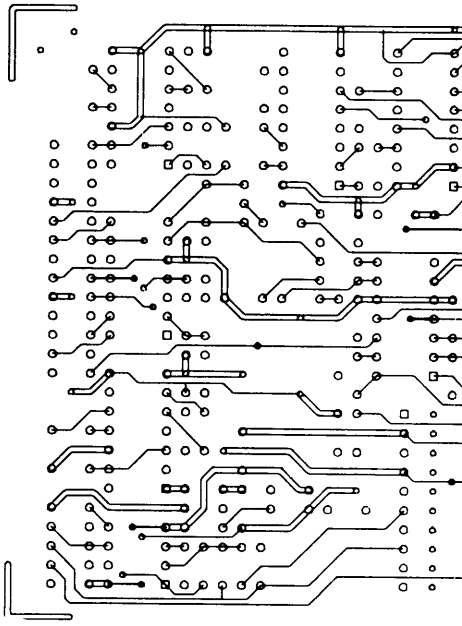
CAPACITORS: CAPACITY IN p(PICOFARADS), n (NANOFARADS), OR u(MICROFARADS) D.C.W.V. & TOLERANCE NOTED WHERE CRITIDAL.

CAUTION

FOR CONTINUED SAFETY REPLACE COMPONENTS NOTED BY ⚠ WITH EXACT REPLACEMENT PARTS ONLY. CONSULT SERVICE MANUAL PARTS LIST SECTION "SAFETY COMPONENTS".

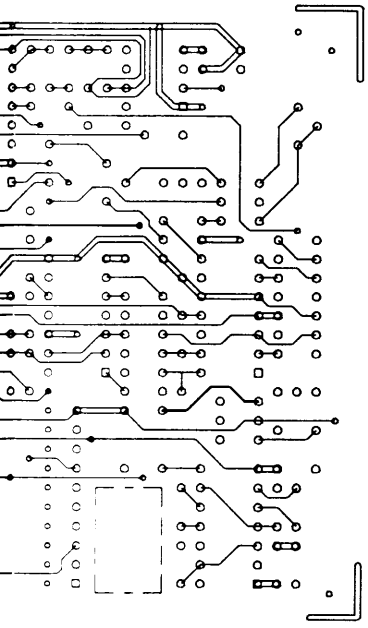


Component Layout



Solder Side
(Viewed from Compo

54-7904-03P (06/90)



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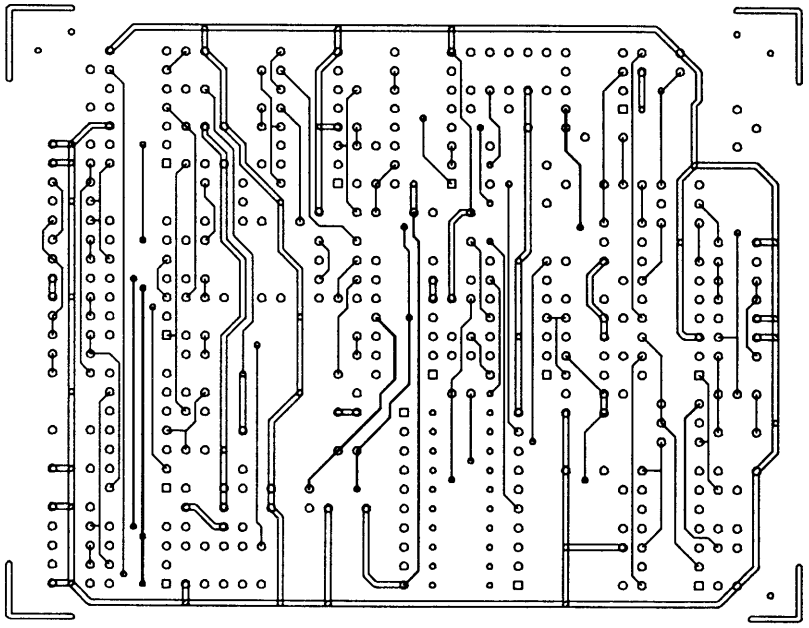
ponent Side)



Component Side

FIGURE 12-8.
Pincushion PCB Component Layout

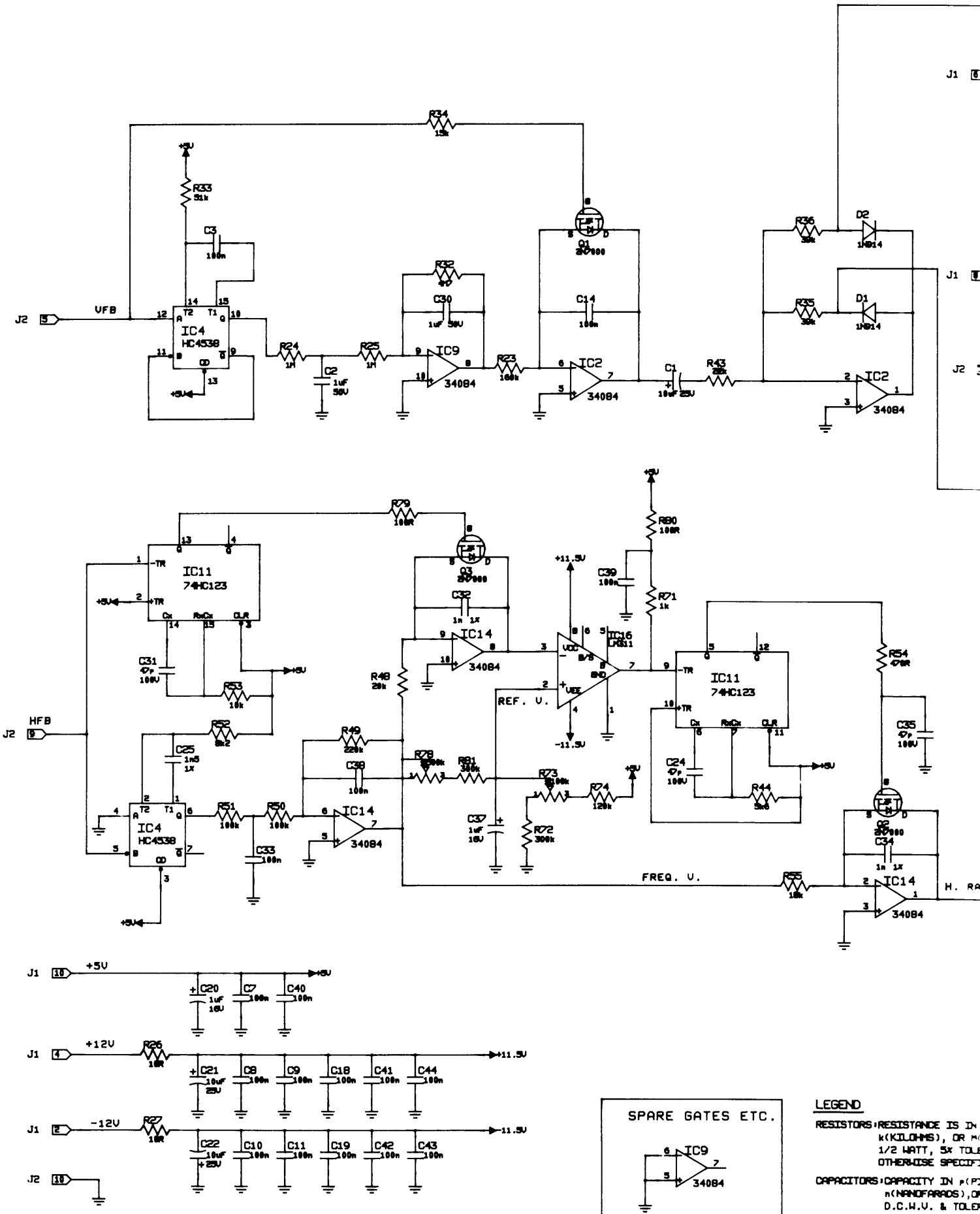
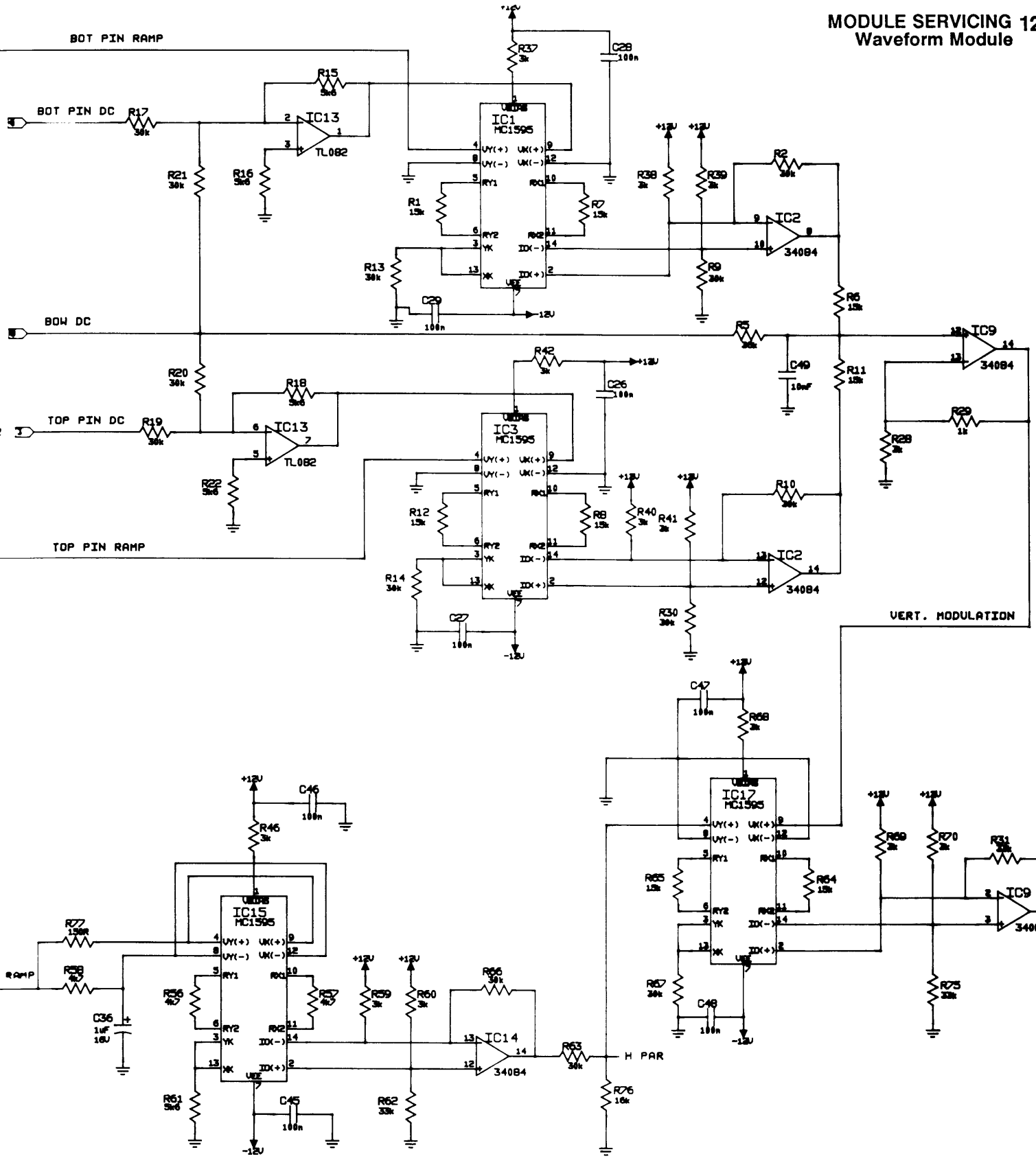


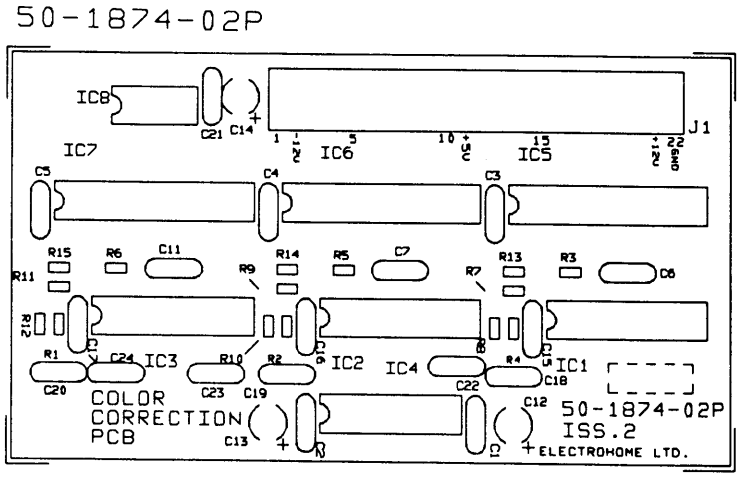
FIGURE 12–9.
Pincushion PCB Schematic



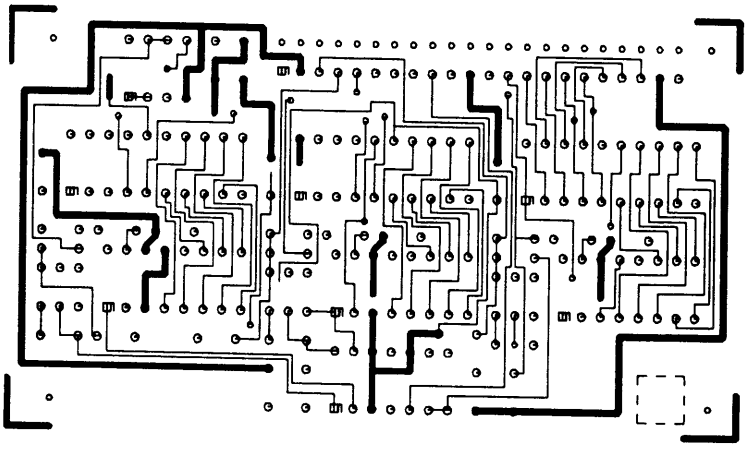
IMPLICIT POWER CONNECTIONS						
IC#	NAME	PIN#	POWER		PIN#	POWER
2	MC34084	4	+11.5V		11	-11.5V
4	74HC4538	16	+5V		8	GND
9	MC34084	4	+11.5V		11	-11.5V
11	74HC123	16	+5V		8	GND
13	TL082	8	+11.5V		4	-11.5V
14	MC34084	4	+11.5V		11	-11.5V

IN R(OHMS),
M(MEGAOHMS).
TOLERANCE UNLESS
CIFIED.
P(PICOFARADS),
N,OR µ(MICROFARADS)
OLERANCE NOTED
L.

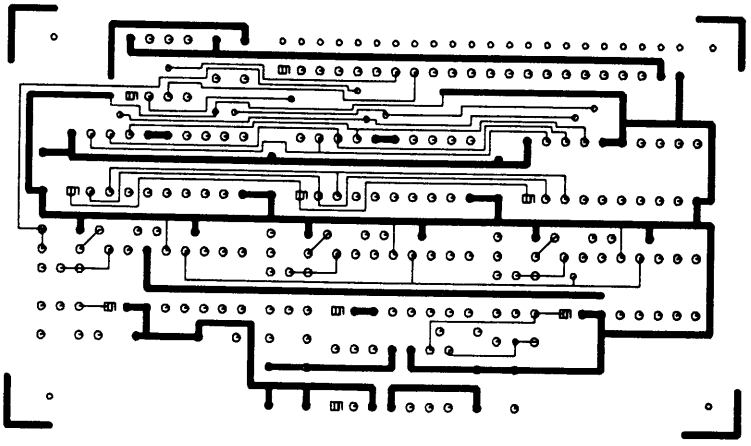
54-7904-03P (06/90)



Component Layout



Solder Side
(Viewed from Component Side)



Component Side

FIGURE 12-10.
Color Correction PCB Component Layout

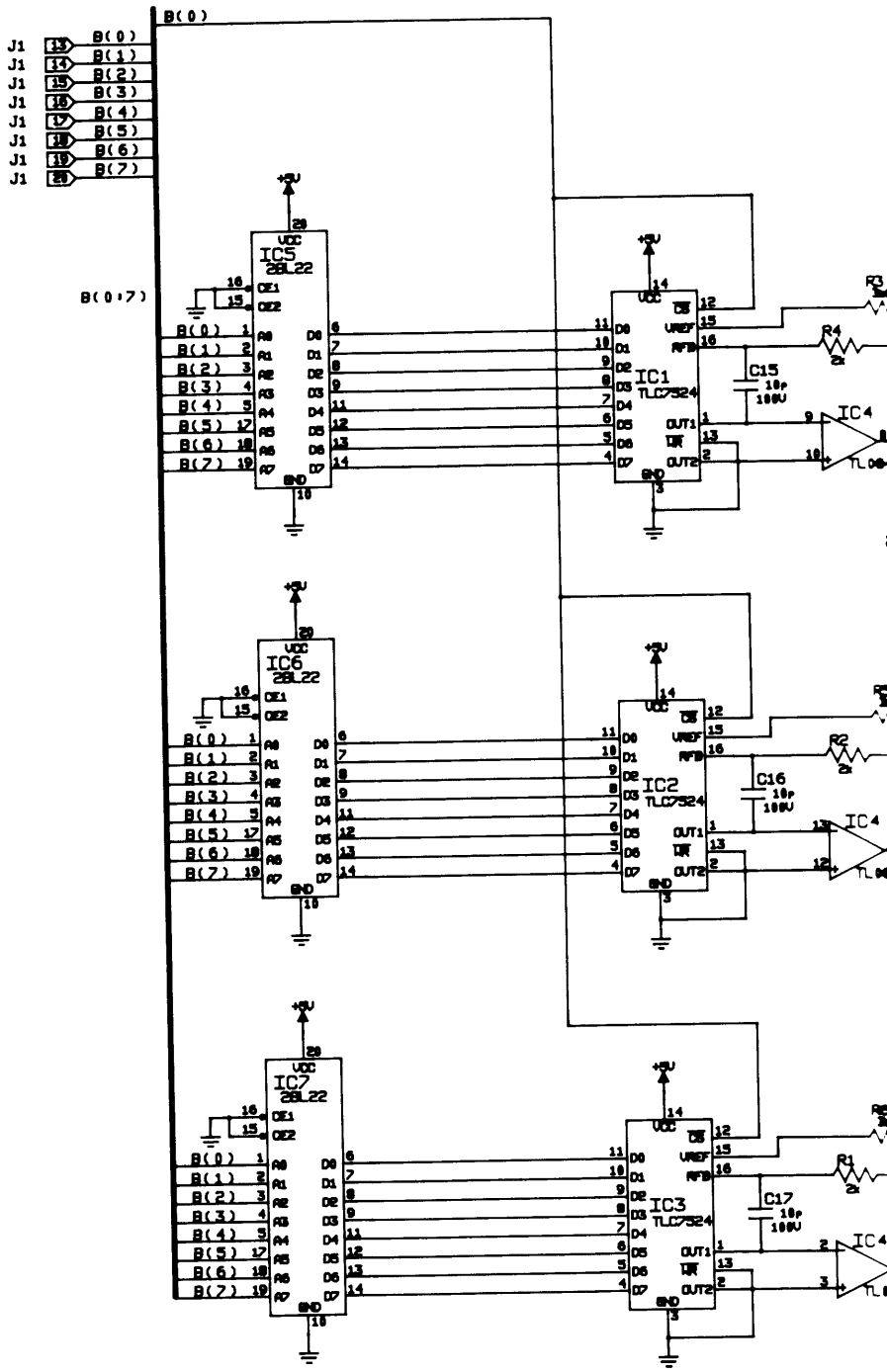
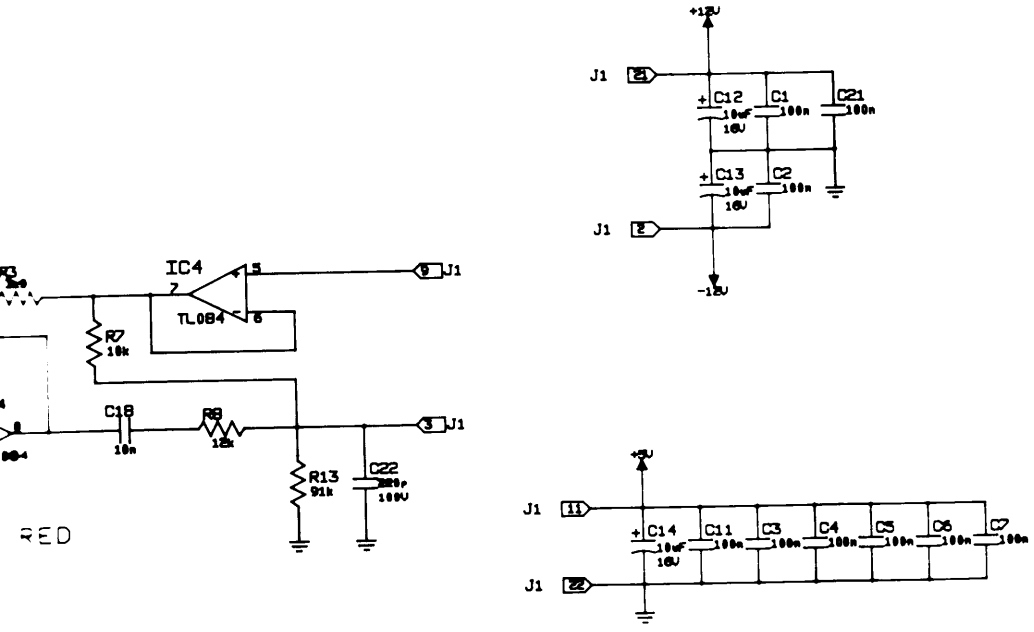


FIGURE 12–11.
Color Correction PCB Schematic



LEGEND

RESISTORS: RESISTANCE IS IN R(OHMS), k(KILOHMS), OR M(MEGAOHMS). 1/4 WATT, 5% TOLERANCE UNLESS OTHERWISE SPECIFIED.

CAPACITORS: CAPACITY IN p(PICOFARADS), n (NANOFARADS), OR u(MICROFARADS) D.C.W.V. & TOLERANCE NOTED WHERE CRITICAL.

12.4 PARTS LIST

12.4.1 Waveform PCB Assembly

Item Ref.	Part No.	Description
Integrated Circuits		
IC1,IC12,IC18,IC24	14-002104-01P	TL084CN, quad biFET op-amp
IC2	14-004686-02P	74ALS869, 8 bit up/down counter
IC3	14-A04052-01P	74HC4053, triple 2-input analog multiplexer
IC4,IC8	14-A04005-01P	74HC32, quad 2-input OR gate
IC5	14-A04045-01P	74HC138, demultiplexer
IC7,IC15	14-A05039-01P	28L22, 256 x 8 bit fast bi-polar PROM
IC9	14-A04031-01P	74HC175, quad flip-flop
IC10,IC16,IC28, IC34	14-A04010-01P	74HC373, H-CMOS transparent octal latch
IC13,IC19,IC25	14-A03031-01P	AD7524, 8 bit multiplying DAC
IC14	14-A04003-01P	74HC04, H-CMOS hex inverter
IC17	14-A03032-01P	AD7523, 8 bit CMOS multiplying DAC
IC20	14-A04067-01P	74HC590, 8 bit vertical binary counter
IC22	14-A04042-01P	74HC245, bidirectional buffer
IC26	14-A04007-01P	74HC74, H-CMOS dual flip-flop
IC27,IC33	14-A04053-01P	74HC688, 8 bit digital comparator
IC29	14-002095-01P	MC1595L, analog multiplier
IC32	14-A04001-01P	74CH00, quad 2-input NAND gate
IC35	14-A04077-01P	74HC126, tri-state non-inverting buffer
Transistors & Diodes		
D1,D2	14-000513-01P	1N914, diode, 0.075A, 75V, T
D3	14-000533-01P	BAT81, Schottky barrier diode
Capacitors		
C1-C3,C7-C15,C17, C23-C29,C333-C35,C37, C38,C42,C43,C46,C49, C50,C62,C69	89-000032-03P	100 nF, 50V
C32,C40,C41	84-710003-02P	10 μF, 25V, "super mini"
C54	86-610134-04P	100 pF
C55-C57	86-610031-04P	10 pF
C71	84-000210-05P	47 μF, 10V
C72	88-172240-12P	220 nF, 63V
C73,C74	86-647033-04P	47 pF
Resistors		
R1-R3	41-000344-39P	5K, carbon trim pot
R4-R6,R21,R23,R24, R39,R42	80-110025-11P	10K, 1/2W, 5%, metal film

12.4 PARTS LIST (cont.)

12.4.1 Waveform PCB Assembly (cont.)

	Item Ref.	Part No.	Description	
	Resistors (cont.)			
	R7,R52-R54,R57, R59	80-147015-11P	4.7K, 1/2W, 5%, metal film	
	R13,R33	80-118015-11P	1.8K, 1/2W, 5%, metal film	R18,R25,R38,
	R18,R25,R38,R43, R44,R87	80-139015-11P	3.9K, 1/2W, 5%, metal film	
	R17,R48,R51,R61	41-000344-40P	10K, carbon trim pot	
	R20	80-124025-11P	24K, 1/2W, 5%, metal film	
	R34,R86,R101	80-110015-11P	1K, 1/2W, 5%, metal film	
	R41,R60,R91	80-130025-11P	30K, 1/2W, 5%	
	R47,R56,R58	80-120015-11P	2K, 1/2W, 5%, metal film	
	R49,R50	80-151005-11P	510R, 1/2W, 5%, metal film	
	R55	80-127015-11P	2.7K, 1/2W, 5%, metal film	
⚠	**R89,R90**	**80-110095-11P**	**10R, 1/2W, 5%, metal film SAFETY COMPONENT**	
	R94,R96-R98	80-147005-11P	470R, 1/2W, 5%, metal film	
	R95,R102	80-110005-11P	100R, 1/2W, 5%, metal film	
	R99	80-115015-11P	1.5K, 1/2W, 5%, metal film	
	R100	80-122015-11P	2.2K, 1/2W, 5%	
	RN1	43-000053-02P	10K, 10 pin, resistor network	

12.4.2 Pincushion PCB Assembly (supplied as part of Waveform module)

Integrated Circuits		
IC2,IC9,IC14	14-002164-01P	MC34084, op amp
IC4	14-A04041-01P	MM74HC4538, CMOS multivibrator
IC11	14-A04062-01P	74HC123, dual monostable multivibrator
IC13	14-002813-09P	TL082BC, linear op amp
IC16	14-002165-01P	ML311, bi-polar digital voltage comparator
Transistors and Diodes		
Q1-Q3	14-A00705-01P	2N7000, TMOS, 60V, 0.2A, 4W
D1,D2	14-000513-01P	1N914, 0.075A, 75V
Capacitors		
C1,C21,C22	84-410004-01P	10 μF, 25V
C2,C30	88-171053-12P	1 μF, 50V
C3,C7-C11,C14, C18,C19,C212-C29, C33,C38-C48	89-000032-03P	100 nF, 50V

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12.4 PARTS LIST (cont.)

12.4.2 Pincushion PCB Assembly (cont.)

Item Ref.	Part No.	Description
Capacitors (cont.)		
C20,C36,C37	84-410506-01P	1 μF, 50V
C24,C31,C35	86-647033-04P	47 pF, 100V, NPO
C25	89-000033-04P	1.5 nF, 50V, 1%
C32,C34	89-000033-02P	1.0 nF, 50V, 1%
C49	89-000032-04P	10 nF, 50V, 20%
Resistors		
R1,R12-R8,R11, R12,R34,R64, R65	80-115025-11P	15K, 1/2W, 5%, metal film
R2,R9,R10,R13,R14, R17,R19-R21,R30, R63,R66,R67	80-130025-11P	30K, 1/2W, 5%
R5	80-136025-11P	36K, 1/2W, 5%, metal film
R15,R16,R18,R22, R44,R61	80-156015-11P	5.6K, 1/2W, 5%, metal film
R23	80-116035-11P	160K, 1/2W, 5%, metal film
R24,R25	80-110045-11P	1M, 1/2W, 5%, metal film
R26,R27	80-110095-11P	10R, 1/2W, 5%, metal film
R28,R37-R42,R46, R59,R60,R68-R70	80-130015-11P	3K, 1/2W, 5%, metal film
R29,R71	80-110015-11P	1K, 1/2W, 5%, metal film
R31,R62,R75	80-133025-11P	33K, 1/2W, 5%, metal film
R32	40-124755-31P	4.7M, 1/4W, 5%
R33	80-151025-11P	51K, 1/2W, 5%, metal film
R35,R36	80-139025-11P	39K, 1/2W, 5%, metal film
R43	80-122025-11P	22K, 1/2W, 5%, metal film
R48	80-120025-11P	20K, 1/2W, 5%, metal film
R49	80-122035-11P	220K, 1/2W, 5%, metal film
R50,R51	80-110035-11P	100K, 1/2W, 5%, metal film
R52	80-182015-11P	8.2K, 1/2W, 5%, metal film
R53	80-110025-11P	10K, 1/2W, 5%, metal film
R54	80-147005-11P	470R, 1/2W, 5%, metal film
R55	80-118025-11P	18K, 1/2W, 5%, metal film
R512-R58	80-147015-11P	4.7K, 1/2W, 5%, metal film
R72,R81	80-130035-11P	300K, 1/2W, 5%, metal film
R73	41-000344-14P	100K, carbon trim pot.
R74	80-112035-11P	120K, 1/2W, 5%, metal film
R76	80-116025-11P	16K, 1/2W, 5%, metal film
R77	80-115005-11P	150R, 1/2W, 5%, metal film
R78	41-000344-17P	500K, carbon trim pot.
R79,R80	80-110005-11P	100R, 1/2W, 5%, metal film

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12.4 PARTS LIST (cont.)

12.4.3 Color Correction PCB (supplied as part of Waveform module)

Item Ref.	Part No.	Description
Integrated Circuits		
IC1-IC3	14-A03032-02P	TLC7524, CMOS 8-bit multiplying DAC
IC4	14-002104-01P	TL084CN, quad bifet linear op amp
IC5-IC7	14-A05039-01P	28L22, 256 x 8 bit fast bi-polar PROM
IC8	14-002813-09P	TL082BC, linear op amp
Capacitors		
C1-C7,C11,C21	89-000032-03P	100 nF, 50V
C12-C14	84-210145-01P	10 μF, 16V
C15-C17	46-610031-04P	10 pF, 100V, NPO
C18-C20	89-000032-04P	10 nF, 50V, 20%
C22,C23,C24	86-622151-02P	220 pF, 100V, 10%
Resistors		
R1,R2,R4	80-120015-11P	2K, 1/2W, 5%, metal film
R3,R5,R6	80-139015-11P	3.9K, 1/2W, 5%, metal film
R7,R9,R11	80-110025-11P	10K, 1/2W, 5%, metal film
R8,R10.R12	80-112025-11P	12K, 1/2W, 5%, metal film
R13-R15	80-191025-11P	91K, 1/2W, 5%, metal film

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12.5 SPECIFICATIONS

Connector P1, Row A:

NOTE: pins 1 through 7 are multiplexed data/ lower byte address bus

Pin 1 . . . . . digital in/output, **AD(0)** LSB
Pin 2 . . . . . digital in/output, **AD(1)**
Pin 3 . . . . . digital in/output, **AD(2)**
Pin 4 . . . . . digital in/output, **AD(3)**
Pin 5 . . . . . digital in/output, **AD(4)**
Pin 6 . . . . . digital in/output, **AD(5)**
Pin 7 . . . . . digital in/output, **AD(6)**
Pin 8 . . . . . digital in/output, **AD(7)** MSB

NOTE: pins 9 through 16 are the upper byte address bus

Pin 9 . . . . . digital input, **AD(8)** LSB
Pin 10 . . . . . digital input, **AD(9)**
Pin 11 . . . . . digital input, **AD(10)**
Pin 12 . . . . . digital input, **AD(11)**
Pin 13 . . . . . digital input, **AD(12)**
Pin 14 . . . . . digital input, **AD(13)**
Pin 15 . . . . . digital input, **AD(14)**
Pin 16 . . . . . digital input, **AD(15)** MSB

Pin 17 . . . . . digital input, $\overline{\textbf{RD}}$
NOTE: read signal from Remote Control module

Pin 18 . . . . . digital input, $\overline{\textbf{WR}}$
NOTE: write signal from Remote Control module

Pin 19 . . . . . digital input, **ALE**
NOTE: address latch enable from Remote Control module

Pin 20 . . . . . digital input, **HPLLCLK**
signal level . . . . . 0 to 5V
NOTE: see Convergence module

Pin 21 . . . . . digital input, **H RESET**
signal level . . . . . 0 to 5V
NOTE: see Convergence module

Pin 22 . . . . . digital input, **VPLLCLK**
signal level . . . . . 0 to 5V
NOTE: see Convergence module

Pin 23 . . . . . digital input, **V RESET**
signal level . . . . . 0 to 5V
NOTE: see Convergence module

Pin 24 . . . . . digital input, **HFB**
signal level . . . . . 0 to 12V
NOTE: see Power Deflection module

Pin 25 . . . . . digital input, **VFB**
signal level . . . . . 0 to 5V
NOTE: see Power Deflection module

Pin 26 . . . . . analog input, **CONTRAST**
signal level . . . . . 0 to 10 VDC
NOTE: DC control voltage from Remote Control module

Pin 27 . . . . . -12V power supply -12 VDC
current . . . . . 54mA max

Pin 28 . . . . . +12V power supply +12 VDC
current . . . . . 54mA max

Pin 29 . . . . . +5V power supply +5 VDC
current . . . . . 410 Ma max

Pin 30 . . . . . connected to Pin 29 +5 VDC

Pin 31 . . . . . ground **GND**

Pin 32 . . . . . connected to Pin 31 **GND**

Connector P1, Row B:

NOTE: pins 1 through 8 are active low, address-decoded I/O select strobes

Pin 1 . . . . . digital output, $\overline{\textbf{SEL0}}$

Pin 2 . . . . . digital output, $\overline{\textbf{SEL1}}$

Pin 3 . . . . . digital output, $\overline{\textbf{SEL2}}$

Pin 4 . . . . . digital output, $\overline{\textbf{SEL3}}$

Pin 5 . . . . . digital output, $\overline{\textbf{SEL4}}$

Pin 6 . . . . . digital output, $\overline{\textbf{SEL5}}$

Pin 7 . . . . . digital output, $\overline{\textbf{SEL6}}$

Pin 8 . . . . . digital output, $\overline{\textbf{SEL7}}$

Pin 9 . . . . . analog output, **DYN FOCUS**
composite parabola . . . . . 10V p-p min
vertical parabola . . . . . 0 to 5V p-p
horizontal parabola . . . . . 0 to 5V p-p

Pin 12 . . . . . analog input, **KEYSTONE**
DC keystone control . . . . . -10 to 10 VDC

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Connector P1, Row B (cont.):

Pin 13 . . . . . analog input, **PIN SIDE**
DC side pincushion control . . . . . -10 to 10 VDC

Pin 14 . . . . . analog output, **KEY WFM**
NOTE: vertical sawtooth multiplied by parabola
vertical sawtooth (without parabola) . . . . . 0 to 4V p-p
vertical parabola (without sawtooth) . . . . . 0 to 4V p-p

Pin 15 . . . . . digital input, **VIDEO KILL**
signal level . . . . . 0 to 5V

Pin 16 . . . . . digital input, **PIN TOP**
top pincushion control . . . . . -10 to 10 VDC

Pin 17 . . . . . analog output, **PIN WFM**
NOTES: All waveforms are AC-coupled. Top/bottom pincushion & bow parabolic waveforms are symmetric

constant amplitude
(BOW=10,PIN TOP=0,PIN BOT=0)
signal level . . . . . 0 to 5V p-p

constant amplitude
(BOW=-10,PIN TOP=0,PIN BOT=0)
signal level . . . . . 0 to 5V p-p

linearly decreasing to center at middle of scan
(BOW=0,PIN TOP=10,PIN BOT=0)
signal level . . . . . 0 to 5V p-p ± 10%

linearly decreasing to center at middle of scan
(BOW=0,PIN TOP=-10,PIN BOT=0)
signal level . . . . . 0 to 5V p-p ± 10%

linearly increasing from center at middle of scan
(BOW=0,PIN TOP=0,PIN BOT=10)
signal level . . . . . 0 to 5V p-p ± 10%

linearly increasing from center at middle of scan
(BOW=0,PIN TOP=-10,PIN BOT=0)
signal level . . . . . 0 to 5V p-p ± 10%

Pin 18 . . . . . analog input, **PIN BOT**
bottom pincushion control -10 to 10 VDC

Pin 19 . . . . . digital output, **BLANK WFM**
composite blanking pulse . . . . . 0 to 5V ± 10%
horizontal pulse width . . . . . 2 µs ± 10%

Pin 20 . . . . . analog input, **BUCK LOW**
NOTE: DC voltage proportional to BUCK OUT, see Keystone module

NOTE: measurements for Pins 21, 22 & 23 are made with CONTRAST = 10V; R1, R2 & R3 adjusted to maximum and no color correction

Pin 21 . . . . . analog output, **R GAIN**
signal level . . . . . 0 to 5V

Pin 22 . . . . . analog output, **G GAIN**
signal level . . . . . 0 to 5V

Pin 23 . . . . . analog output, **B GAIN**
signal level . . . . . 0 to 5V

Pin 24 . . . . . digital input, **REV SCAN**
signal level . . . . . 0 to 5V ± 10%
NOTE: high reverses horizontal scan

Pin 25 . . . . . analog input, **BOW**
DC bow control . . . . . -10 to 10 VDC

Pin 26 . . . . . analog input, **BEAM LIMIT**
NOTE: clamp line, see Bias module

Connector P1, Row C:

NOTE: pins 1 to 9 are the lower byte of address bus
Pin 1 . . . . . digital output, **A(0)**
Pin 2 . . . . . digital output, **A(1)**
Pin 3 . . . . . digital output, **A(2)**
Pin 4 . . . . . digital output, **A(3)**
Pin 5 . . . . . digital output, **A(4)**
Pin 6 . . . . . digital output, **A(5)**
Pin 7 . . . . . digital output, **A(6)**
Pin 8 . . . . . digital output, **A(7)**
Pin 9 . . . . . digital output, **A(8)**

NOTE: pins 10 to 16 are the upper byte of address bus
Pin 10 . . . . . digital output, **A(9)**
Pin 11 . . . . . digital output, **A(10)**
Pin 12 . . . . . digital output, **A(11)**
Pin 13 . . . . . digital output, **A(12)**
Pin 14 . . . . . digital output, **A(13)**
Pin 15 . . . . . digital output, **A(14)**
Pin 16 . . . . . digital output, **A(15)**

NOTE: pins 17 through 24 are the data bus
Pin 17 . . . . . output, **D(0)**
Pin 18 . . . . . digital output, **D(1)**
Pin 19 . . . . . digital output, **D(2)**
Pin 20 . . . . . digital output, **D(3)**
Pin 21 . . . . . digital output, **D(4)**
Pin 22 . . . . . digital output, **D(5)**
Pin 23 . . . . . digital output, **D(6)**
Pin 24 . . . . . digital output, **D(7)**

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SECTION 13

CONVERGENCE MODULE

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LIST OF ILLUSTRATIONS

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13.1 TECHNICAL DESCRIPTION

13.1.1 General Description

The Convergence module corrects and compensates errors in registration between the red, green and blue CRT images. The module uses digital-to-analog converters to continuously generate correction values which are memory-mapped to the CRT raster.

The Convergence module contains the following circuitry:

a) horizontal phase locked loop (HPLL)
b) vertical phase-locked loop (VPLL)
c) alpha generation
d) RAM bank switching
e) band switch
d) address generation and multiplexing
f) waveform channel

13.1.2 Circuit Description

13.1.2.1 Horizontal Phase Locked Loop

The HPLL is a closed, single loop, control system. It locks itself onto the Horizontal Flyback Pulse (HFP) over the range of 15KHz to 80KHz, then synthesises a high frequency clock (HPLLCLK) that is slightly more than 256 times the HFB frequency.

The HPLL is located on the piggy-back sub-convergence board. The Horizontal PLL consists of a phase detector (IC19), a low pass filter (IC16B), a voltage controlled oscillator (VCO) (IC15), an ECL to TTL translator (IC 14), a divide-by-256 counting section (IC4), a divide-by-*n* counting section, a phase lead circuit (IC2), and a phase lead look-up table.

The phase detector (IC19) has both an analog and digital output. The outputs are combined and filtered to produce an error voltage which controls the frequency of the VCO (IC15) and biases the network which includes varactor diode D1. The output of the VCO is at ECL logic levels and the ECL to TTL translator (IC14) is used to supply the clock signal, HPLLCLK, to the rest of the module.

HPLLCLK is used to clock the divide-by-256 and divide-by-n counting sections. The divide by 256 counting section generates the Horizontal Zone (time slot) addresses B(0) to B(5) and HPLLCKK/2, HPLLCLK/2* and HPLLCLK/4. The divide-by-n counting section generates the H_LEAD and HRESET signals. At the end of the 256 count, a ripple carry signal disables the divide-by-256 counting section and enables the divide-by-n counting section.

A programmable gate array (PGA) integrates the divide-by-*n* counting section and phase lead circuitry. An initialization pulse, HPLL RESET, enables the internal circuitry to determine the number of HPLLCLK/2 pulses that occur in the HFB pulse width. This value, *n* (Q(0) to Q(5)), is stored and used to load the divide-by-*n* counter for insertion into the PLL counting loop.

The analog phase detector (IC19) provides a fixed phase lead of approximately 1.2μS between the HFB reference and the H_LEAD signal. For modules requiring the HRESET signal to be in phase and sync with the HFB pulse, another programmable divide-by-*n* counting section (in the PGA) provides delay from the divide-by-*n* counting section in the main loop.

The Q(0) to Q(5) values are sent to the phase lead look-up table. This table contains phase lead values to keep HRESET in phase and sync with HFB. These values are loaded into a third programmable counter in the PGA which delays the start of HRESET by an integer multiple of the HPLLCLK/2 clock.

13.1.2.2 Vertical Phase Locked Loop (Vertical PLL)

The vertical PLL section consists of IC29, IC31, and IC27b. The VPLL locks onto the vertical flyback pulse (VFB) and divides the period into 256 segments. A clock signal, VPLLCLK, is generated at 256 times the VFB frequency and is buffered by IC32a. The vertical PLL operates over a VFB range of 40 to 120 Hz. A vertical reset pulse, VRESET, is generated at the end of each 256 count by IC27b.

13.1.2.3 Alpha Generation

The alpha generation circuitry generates an alpha (α) value for every scan line. The alpha value represents the weighting factor required to perform linear interpolation in the vertical direction. It does this independent of the horizontal frequency using a patented method based on horizontal line counting and a look-up table. The alpha generation circuitry consists of IC6, IC7, IC8,IC9 IC27a and IC28.

In implementing vertical interpolation, the raster is divided into 8 vertical zones. Each zone contains an equal integer number of scan lines. This is done by evenly dividing the total number of scan lines in a raster by eight (IC28). This value, *n*, indicates the size of the vertical zone and is stored (IC9). The value *n* forms the MSB address of the look-up table (IC8). The value *n*-1 (IC6) loads a programmable down counter (IC7). The output of down counter forms the LSB address of the look-up table. The LSB address counts down from *n*-1 to 0 at the horizontal rate addressing the alpha values stored for a particular vertical zone size. When the down counter

reaches zero, it increments (SCLK) the vertical zone counter (IC26) and reloads itself. The alpha value from the look-up table is output to a selectable invertor/multiplexer which selects between α and $1-\alpha$ (IC24).

13.1.2.4 RAM Bank Switching

The Convergence module contains 12K of high speed static RAM configured as six banks of 2K x 8 bytes. The banks are mapped into the 8000H to 9FFFH address range of the system's external data memory. The bank switching circuitry (IC20,IC28) allows the microprocessor to individually write/read data to/from any of the six RAM banks. The microprocessor selects a RAM bank by writing to the I/O port SEL0*. This active low signal latches the data for bank selection in IC20. All data memory access into the convergence address space will be referenced to the selected bank until a new bank is selected. See Table 13-1 for RAM bank selection.

13.2.1.5 Band Switch Circuit

The Band Switch Select circuit determines if the projector is operating in the low band or high band. This is done by sensing the horizontal flyback pulse (HFB) which changes from 5.0μS in the low band to 2.5μS in the high band. The circuit consists of IC10 and IC11a. A 3.0μS reference pulse (IC11a) is compared with the HFB pulse which sets the flip-flop (IC10a). The result is stored in flip-flop IC10b.

TABLE 13-1. *Ram Bank Selection*

DATA								DESCRIPTION	LOCATION
D7	D6	D5	D4	D3	D2	D1	D0		
X	X	X	X	X	0	0	0	Blue Vertical RAM	8000H-9FFFH
X	X	X	X	X	0	0	1	Blue Horizontal RAM	8000H-9FFFH
X	X	X	X	X	0	1	0	Green Vertical RAM	8000H-9FFFH
X	X	X	X	X	0	1	1	Green Horizontal RAM	8000H-9FFFH
X	X	X	X	X	1	0	0	Red Vertical RAM	8000H-9FFFH
X	X	X	X	X	1	0	1	Red Horizontal RAM	8000H-9FFFH
X	X	X	X	X	1	1	0	Not Used	
X	X	X	X	X	1	1	1	Not Used	

13.2.1.6. Address Generation and Multiplexing

The Convergence module uses two address sources:

a) - address lines A(0) to A(9), and A(13) to A(15) (generated by the microprocessor)

b) - address lines B(0) to B(5) (Horizontal Zone Address)
- address lines B(6) to B(9) (Vertical Zone Address)

Addresses A(0) to A(9) are isolated (IC13, IC32c, IC32d) from addresses B(0) to B(9) and from the convergence RAM. Normally, address lines B(0) to B(9) are presented to the convergence RAM. When the microprocessor accesses the convergence RAM it takes higher priority over the Convergence Module. The signal, ADDRSEL, forces the B(0) to B(9) address lines tristate and enables A(0) to A(9) to the convergence RAM.

The vertical zone address counter (IC26) internally contains two counters with multiplexed outputs (R and C). The R counter contains the current vertical zone address (N) while the C counter contains the next vertical zone address (N+1).

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13.2.1.7 Waveform Channel

There are six waveform channels physically located on the Subconvergence PCB. These channels generate the waveforms that are output by the module. The channels are: Blue Vertical, Blue Horizontal, Green Vertical, Green Horizontal, Red Vertical and Red Horizontal. The channels are identical; each consists of:

- **(1) 2K x 8 static RAM** (IC41, IC43, IC45, IC47, IC49, IC51)
- **(1) 74HC245 octal bus transceiver** (IC40, IC42, IC44, IC46, IC48, IC50)
- **(1) 7545 12-bit multiplying DAC with latch** (IC57, IC61, IC64, IC67, IC71, IC73)
- **(1) MC34082 biFET op-amp** (IC56, IC60, IC63, IC66, IC68, IC70)
- **(1/6) 74HC04 Invertor** (IC58)

Each channel has a potentiometer (R168, R176, R184, R192, R200, R208) which adjusts the reference voltage to the DAC. It is adjusted such that the convergence output waveform is 0V when the convergence RAM is reset (filled with 00H).

The user adjustable convergence points are interpolated by the microprocessor into 9 rows of 64 values for each color and axis. Between any two rows, interpolated values are calculated according to the equation:

$$P = (1-\alpha) \times (HADRR,VADDR) + \alpha \times (HADDR,VADDR+1)$$

The 9 rows of interpolated values correspond to the boundaries of the 8 vertical zones. Each vertical zone contains an equal number of scan lines. Each scan line receives a unique value of α depending on its position within the vertical zone. The horizontal address (B(0) to B(5)) divide the active horizontal scan line time into 64 equal time slots. Each time slot is divided into 2 by HPLLCLK/4 and divided into 4 by HPLLCK/2 and HPLLCLK/2*.

Consider one HADDR time slot:

In the first quarter of the time slot, HPLLCLK/2 is low, HPLLCLK/2* is high and HPLLCLK/4 is low. With HPLLCLK/4 low, VADDR+1 (IC26) is multiplexed to the RAM and α is inverted (IC24) to give $1-\alpha$. The two values are presented to the X and Y inputs of the MAC and clocked in on the rising edge of HPLLCLK/2.

In the second quarter of the time slot, HPLLCLK/2 is high, HPLLCLK/2* is low and HPLLCLK/4 is low. During this time period the multiplication of (HADDR,VADDR+1) and $(1-\alpha)$ is performed and the result is clocked out on the rising edge of HPLLCLK/2*. Since the ACC pin on the MAC is low the product generated is stored into the output registers.

In the third quarter of the time slot, HPLLCLK/2 is low, HPLLCLK/2* is high and HPLLCLK/4 is high. With HPLLCLK/4 high, VADDR is multiplexed to the RAM and α is not inverted. The two values are presented to the X and Y inputs of the MAC and clocked in on the rising edge of HPLLCLK/2.

In the forth quarter of the time slot, HPLLCLK/2 is high, HPLLCLK/2* is low and HPLLCLK/4 is high. During this time period the multiplication of (HADDR,VADDR) and α is performed and added to the product (HADDR,VADDR+1) x $(1-\alpha)$ since the ACC input of the MAC is high. The result is clocked out on the rising edge of HPLLCLK/2*.

During the next first half of the next time slot, HPLLCLK/4 is low. The WR* pin of the 7545 DAC is low and the newly calculated value for HADDR = 1 time slot is converted to an analog value. During the second half of the next time slot HPLLCLK/4 is high. The WR* pin of the 7545 DAC is high and the value for the HADDR = 1 time slot is latched for the rest of the time slot.

This is repeated for each horizontal time slot of each scan line in each vertical zone.

13.2 SERVICING AND ALIGNMENT

13.2.1 Disassembly and Access

CAUTION

STATIC SENSITIVE COMPONENTS
STATIC CONTROLLED WORK STATION REQUIRED

Module Location:
- rear panel card rack

Tools & Equipment Required:
- Phillips screw driver

a) Remove the back panel as described in Section 5.

b) Locate the Convergence module in the rear panel card rack. Using the printed circuit board extractor from the tool pouch, pull the module from the card rack as described in Section 5.2.

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13.2.2 Alignment

If the projector convergence cannot be performed adequately with the keypad, or it is desired to readjust the on board convergence settings, proceed as follows:

Tools & Equipment Required:
- printed circuit board extractor
- extender board, Electrohome Part # 03-230330-01P
- oscilloscope
- fine tip slot screwdriver

STEP 1 – Remove Convergence Module

a) Hook the printed circuit board extractor into the hole in the bottom outside corner of the Convergence module. Pull the module out of its slot.

b) Insert the extender board into the Convergence module slot. Put the Convergence module on the extender board. See Figure 13-1.

STEP 2 – Reset Convergence to 0

a) Press **CONVERGE** and **2** on the keypad. Press and hold **RESET** for 2 seconds minimum.

STEP 3 – Null Colors

a) With the oscilloscope probe and the fine tip screwdriver, make the following adjustments:
- Adjust R168 until extender board row C, pin 1 = 0V.
- Adjust R176 until extender board row C, pin 2 = 0V.
- Adjust R184 until extender board row C, pin 3 = 0V.
- Adjust R192 until extender board row C, pin 4 = 0V.
- Adjust R200 until extender board row C, pin 5 = 0V.
- Adjust R208 until extender board row C, pin 6 = 0V.

b) Press **EXIT**.

13.3 COMPONENT LAYOUT AND SCHEMATICS

Refer to the following pages for component layouts and schematics of the Convergence module.

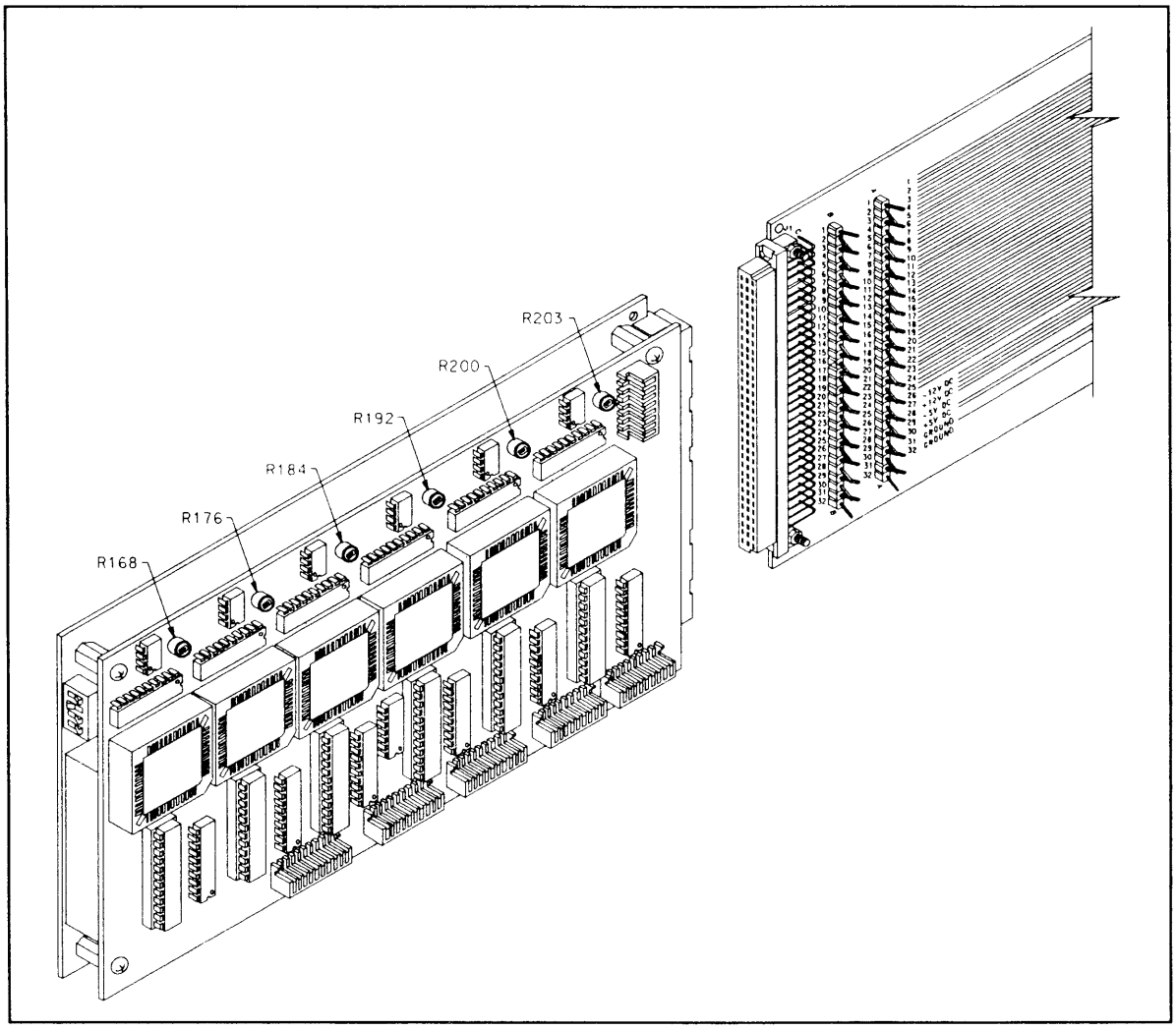

FIGURE 13-1. *Convergence Module Alignment*

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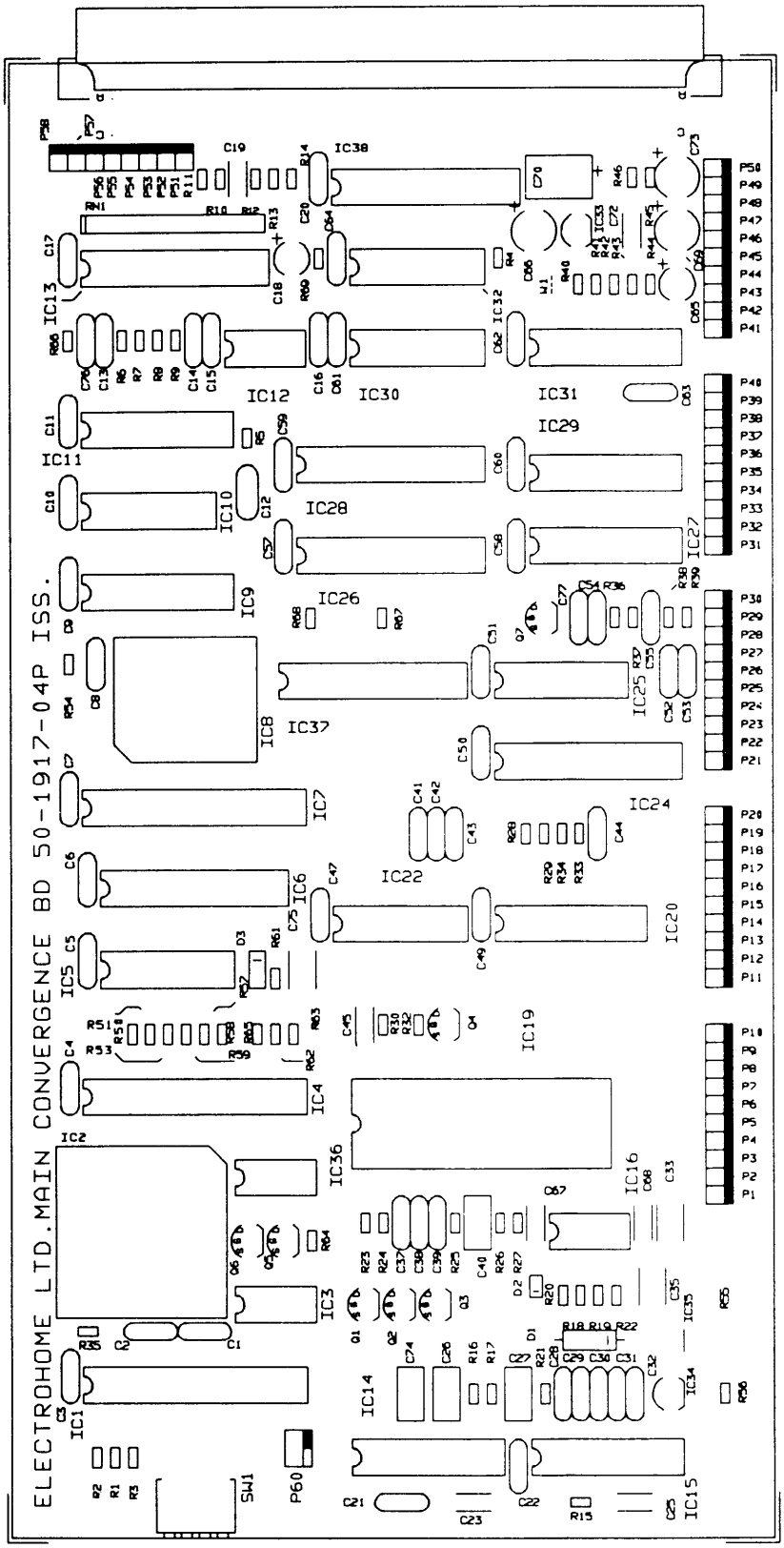
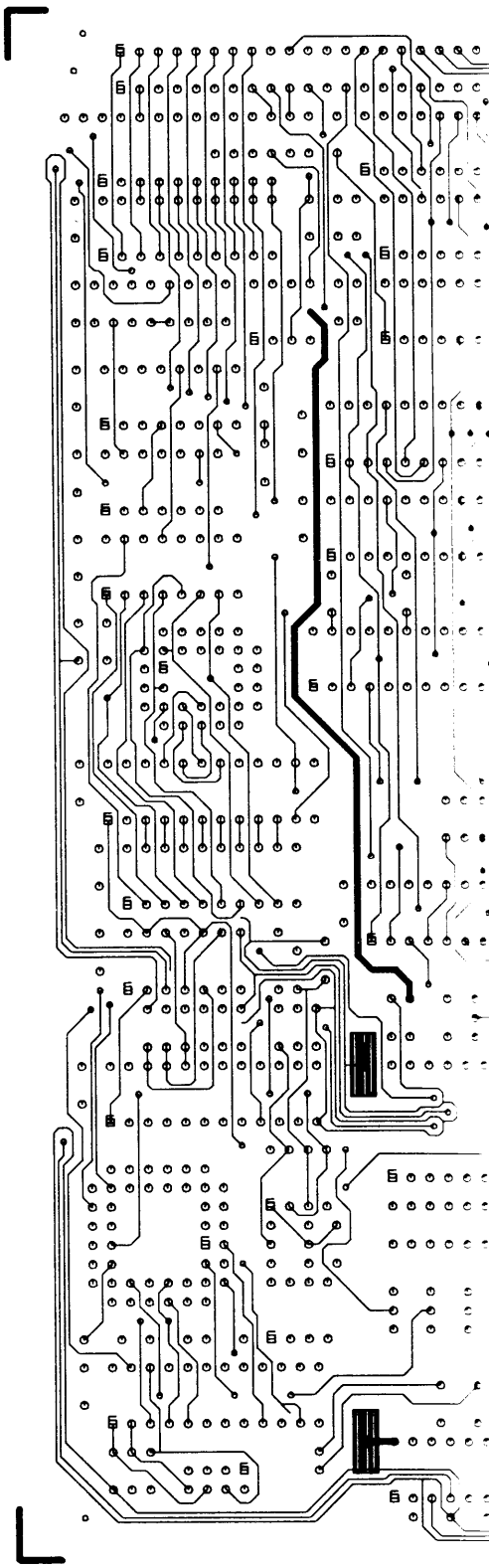
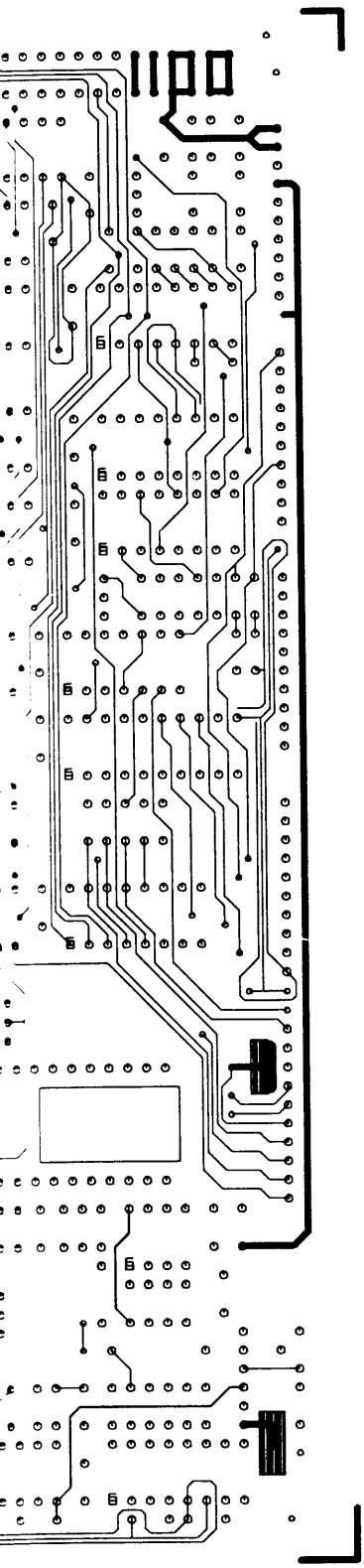


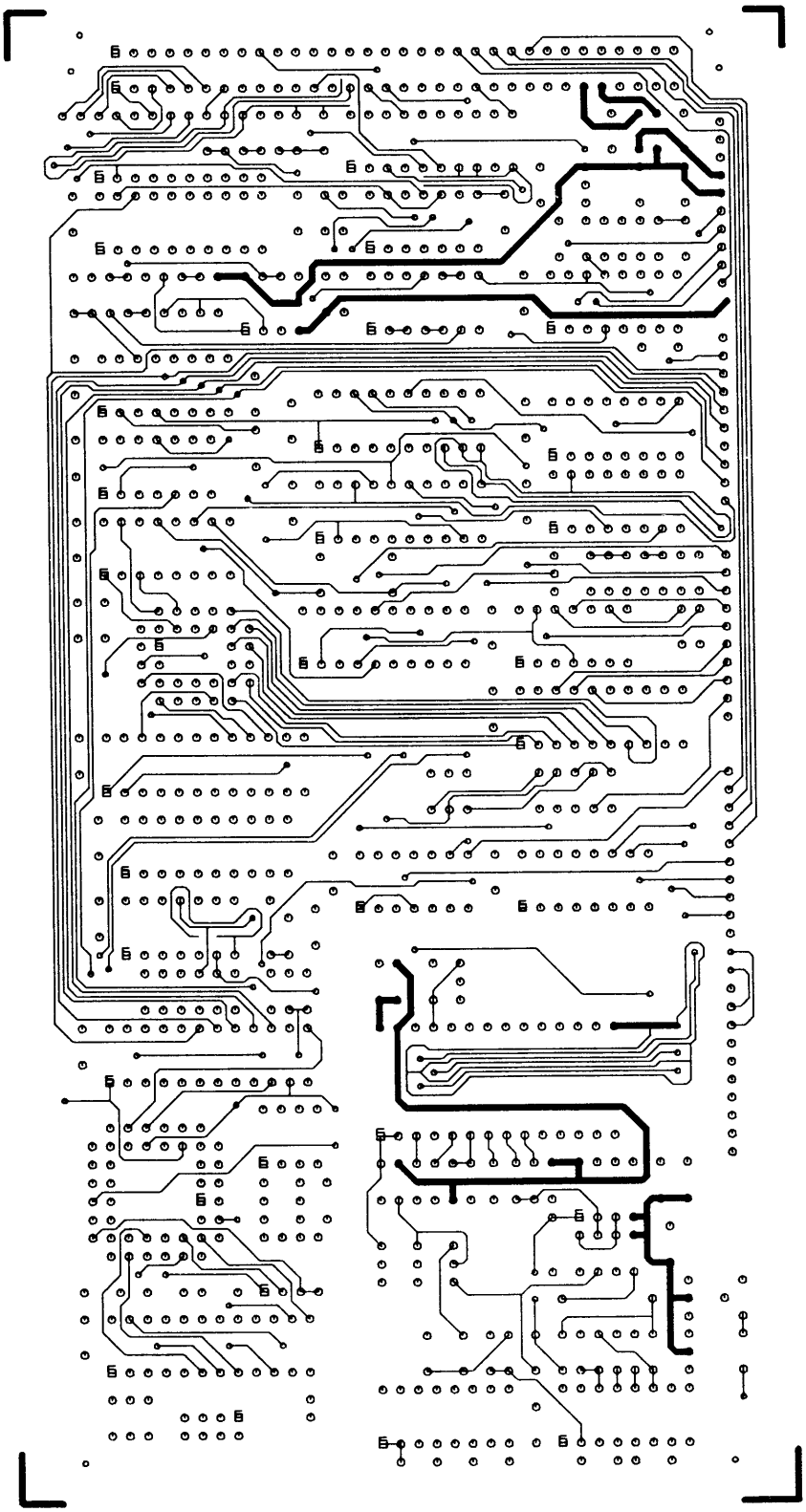
Component Layout



Solder Side
(Viewed from Compon



e
onent Side)



Component Side

FIGURE 13–2.
Convergence PCB Component Layout

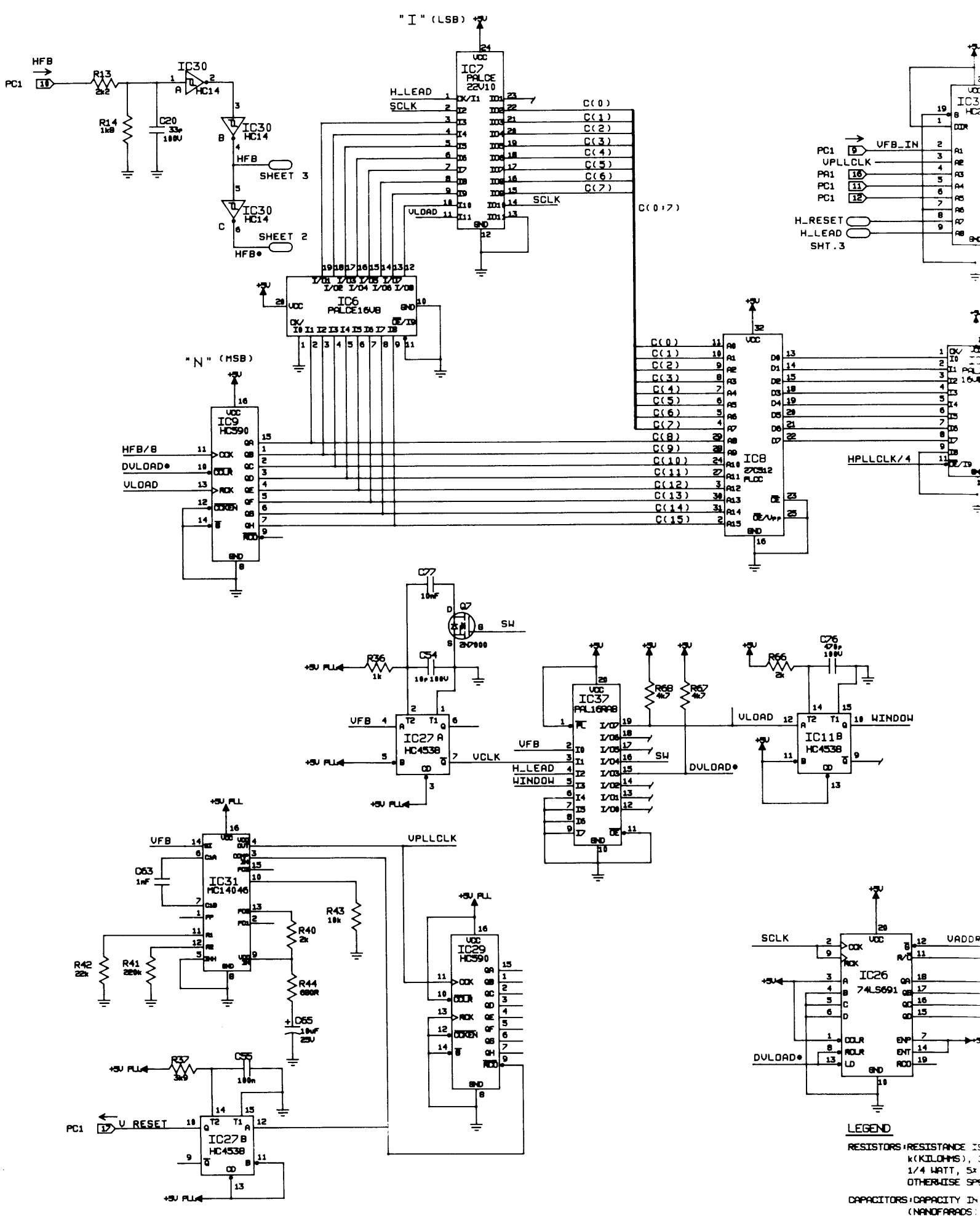
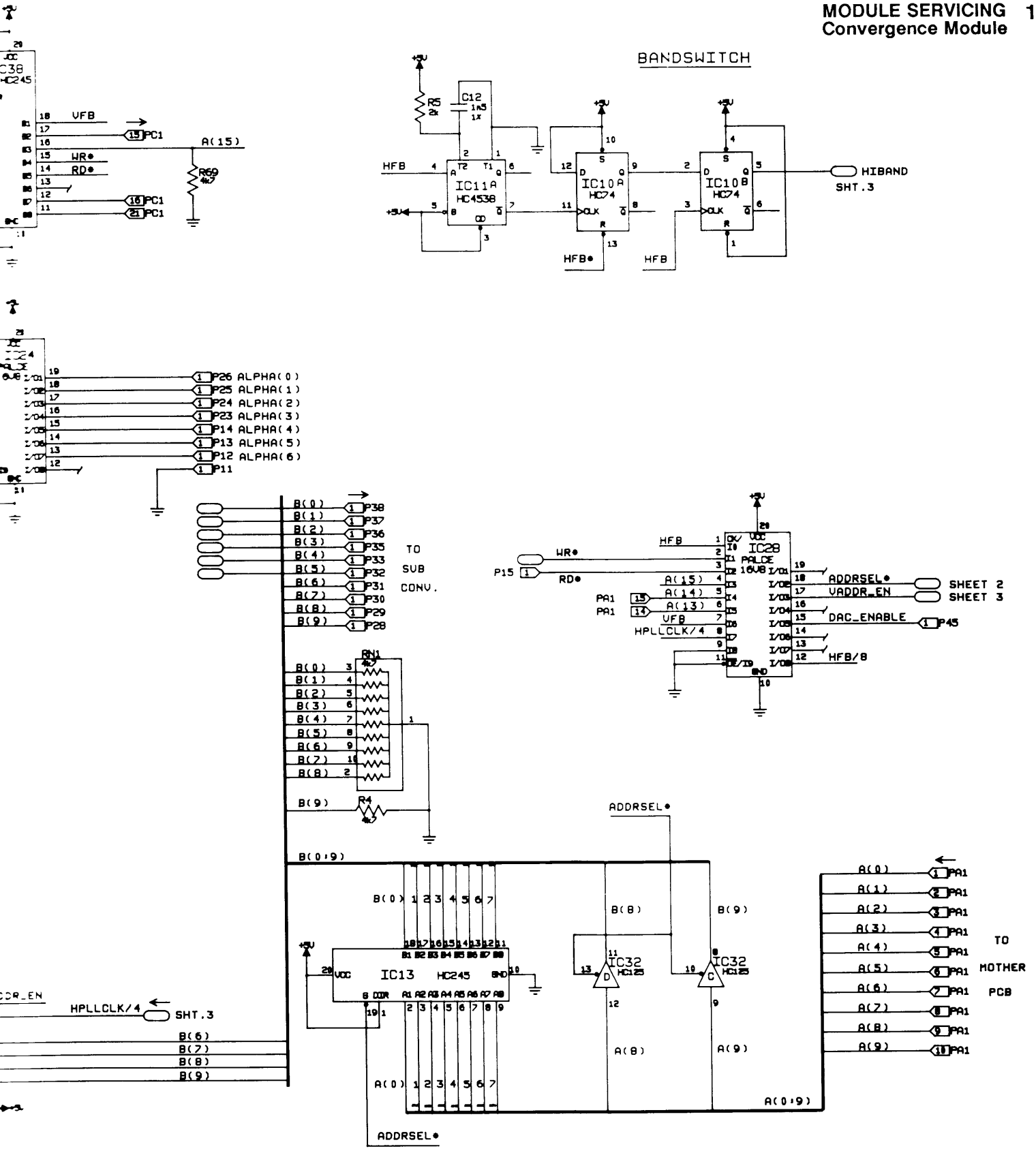


FIGURE 13–3.
Convergence PCB Schematic (Sheet 1 of 3)

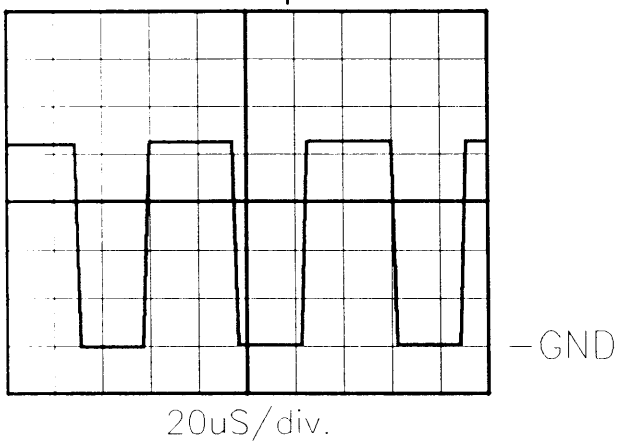


CAUTION

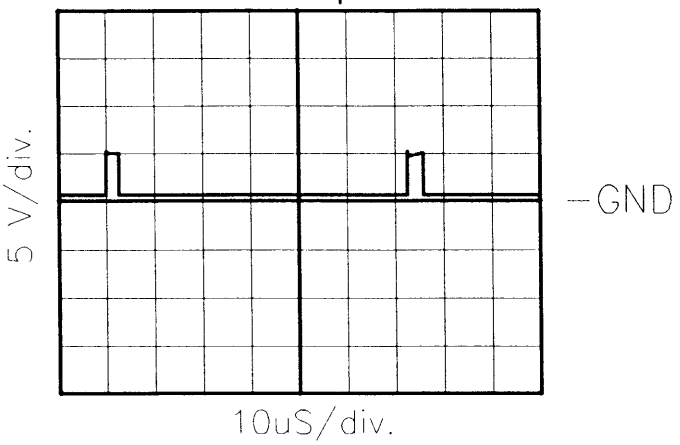
FOR CONTINUED SAFETY REPLACE COMPONENTS NOTED BY ⚠ WITH EXACT REPLACEMENT PARTS ONLY. CONSULT SERVICE MANUAL PARTS LIST SECTION "SAFETY COMPONENTS".

SCHEMATIC REFERENCE

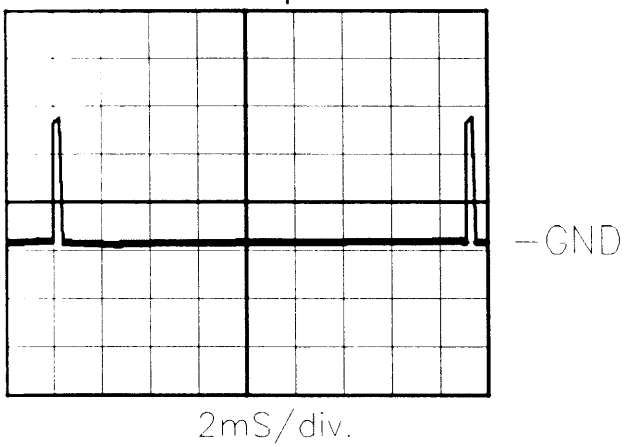
VPLLCLK at point **PC1<15**



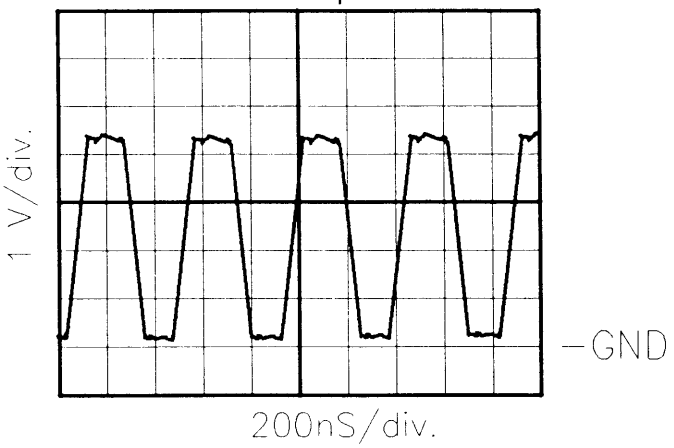
H RESET at point **PB1<16**



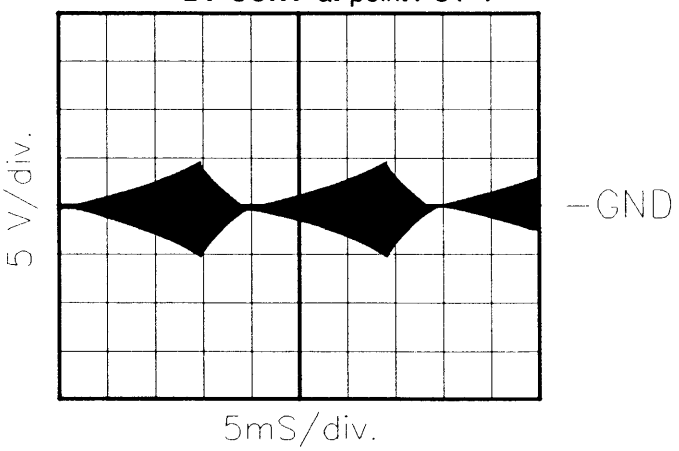
V RESET at point **PB1<17**



HPLLCLK at point **PC1<14**



BV CONV at point **PC1<1**



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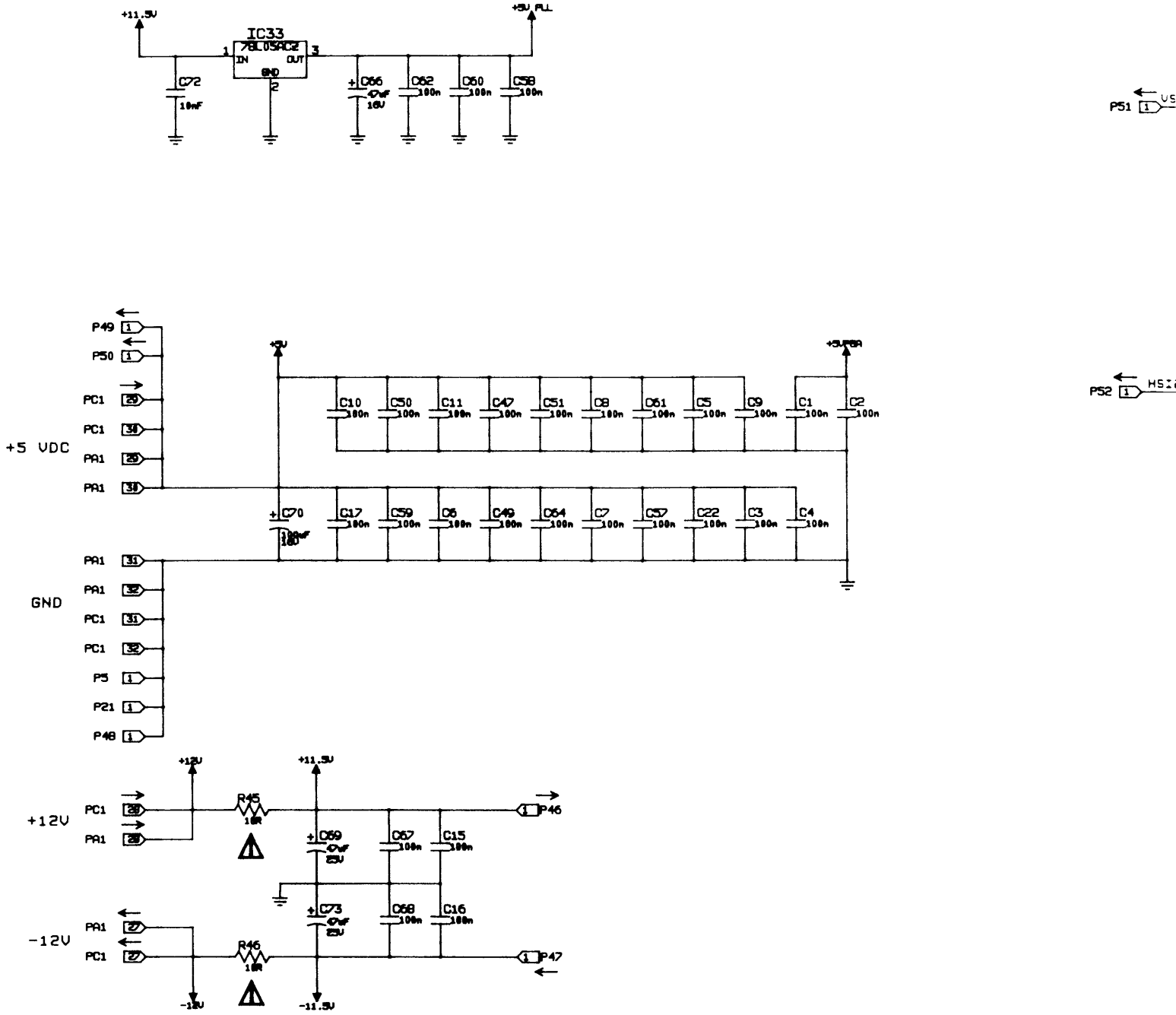
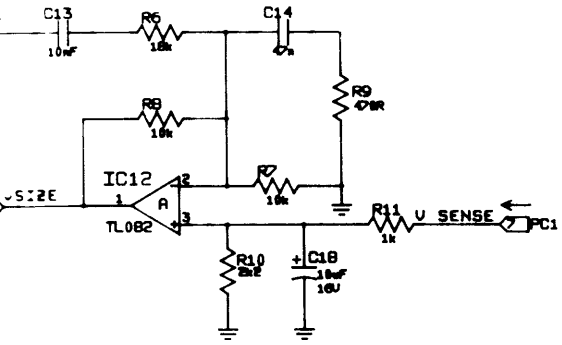
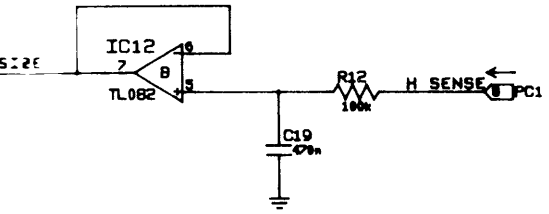
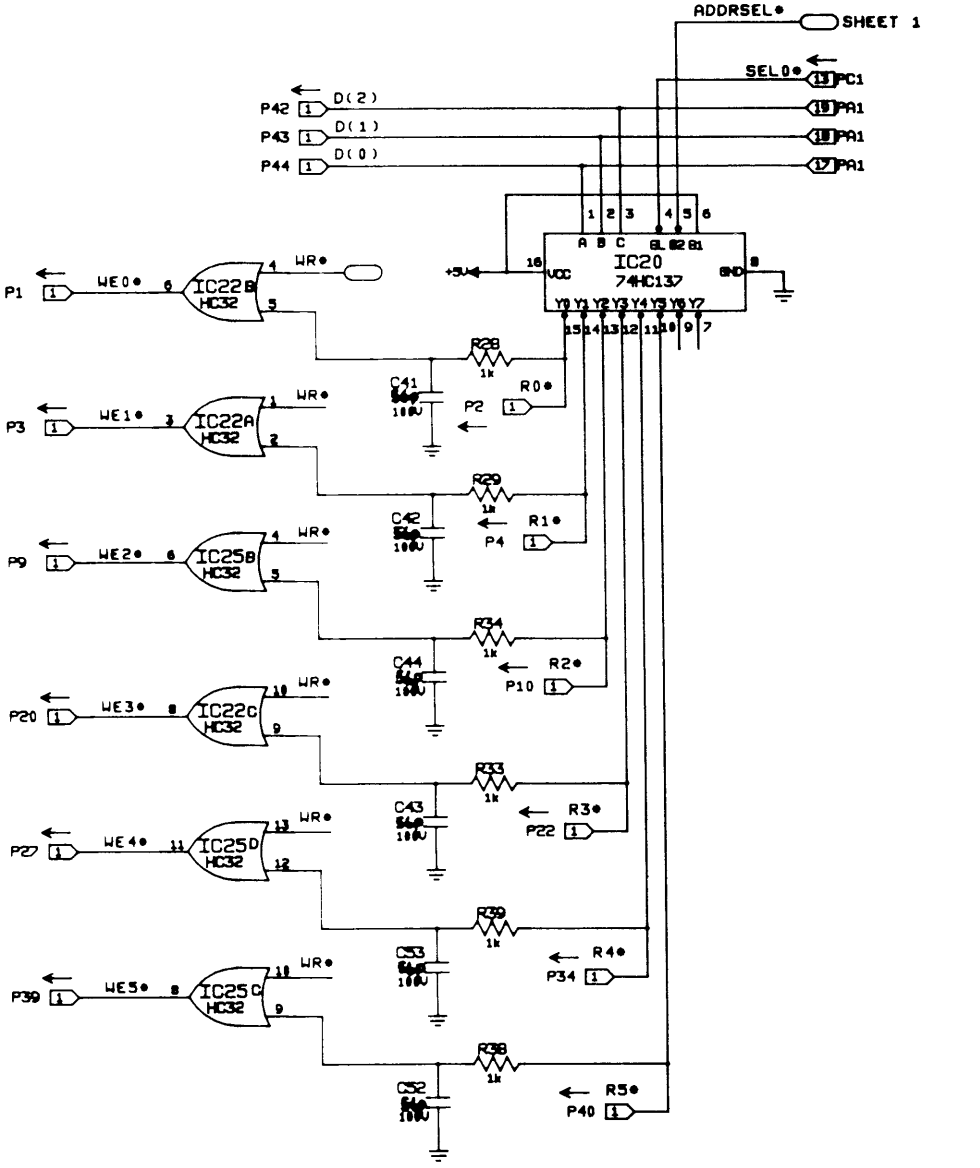
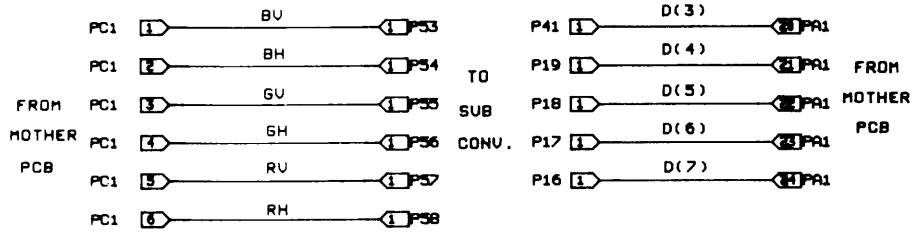


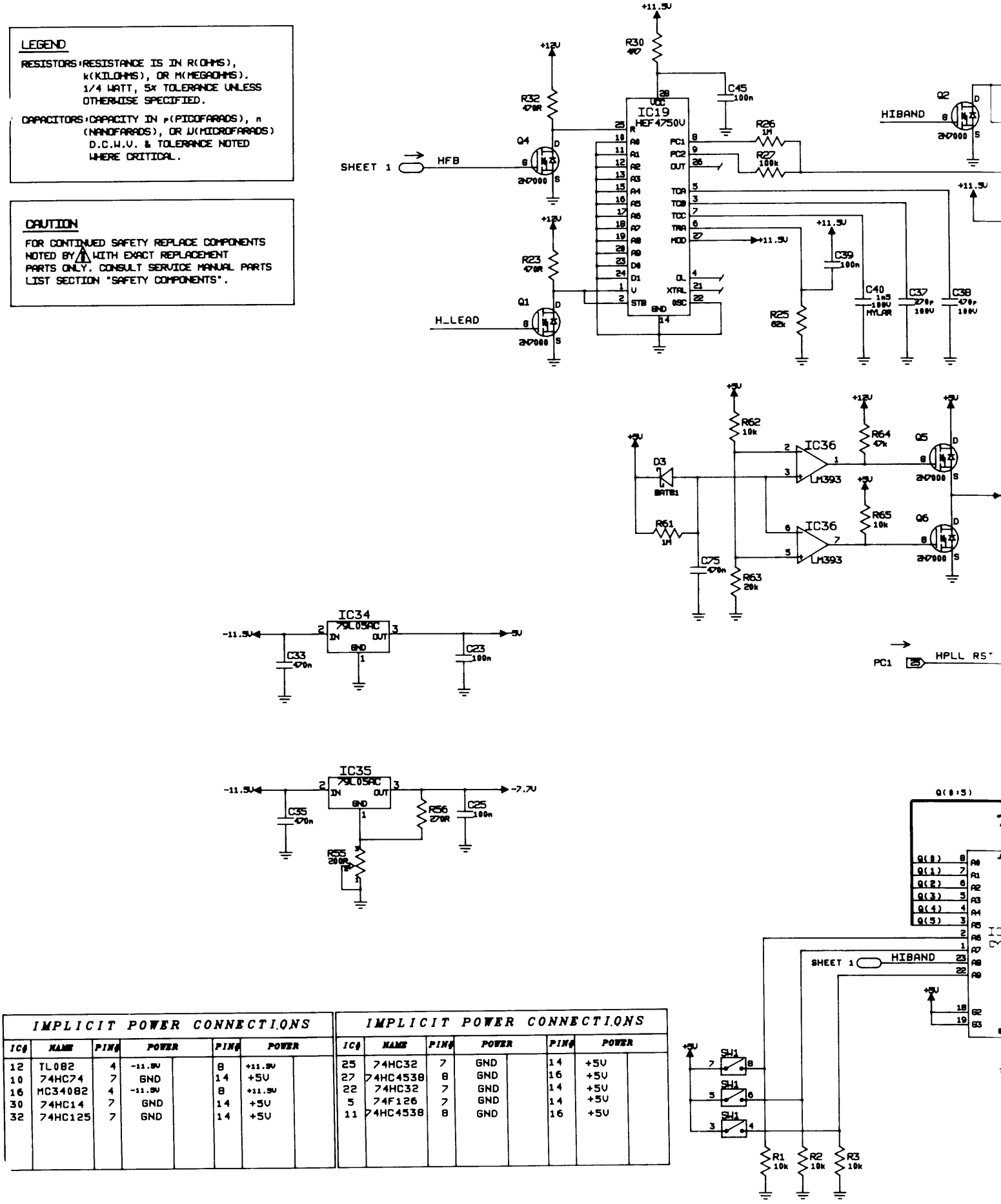
FIGURE 13–4.
Convergence PCB Schematic (Sheet 2 of 3)







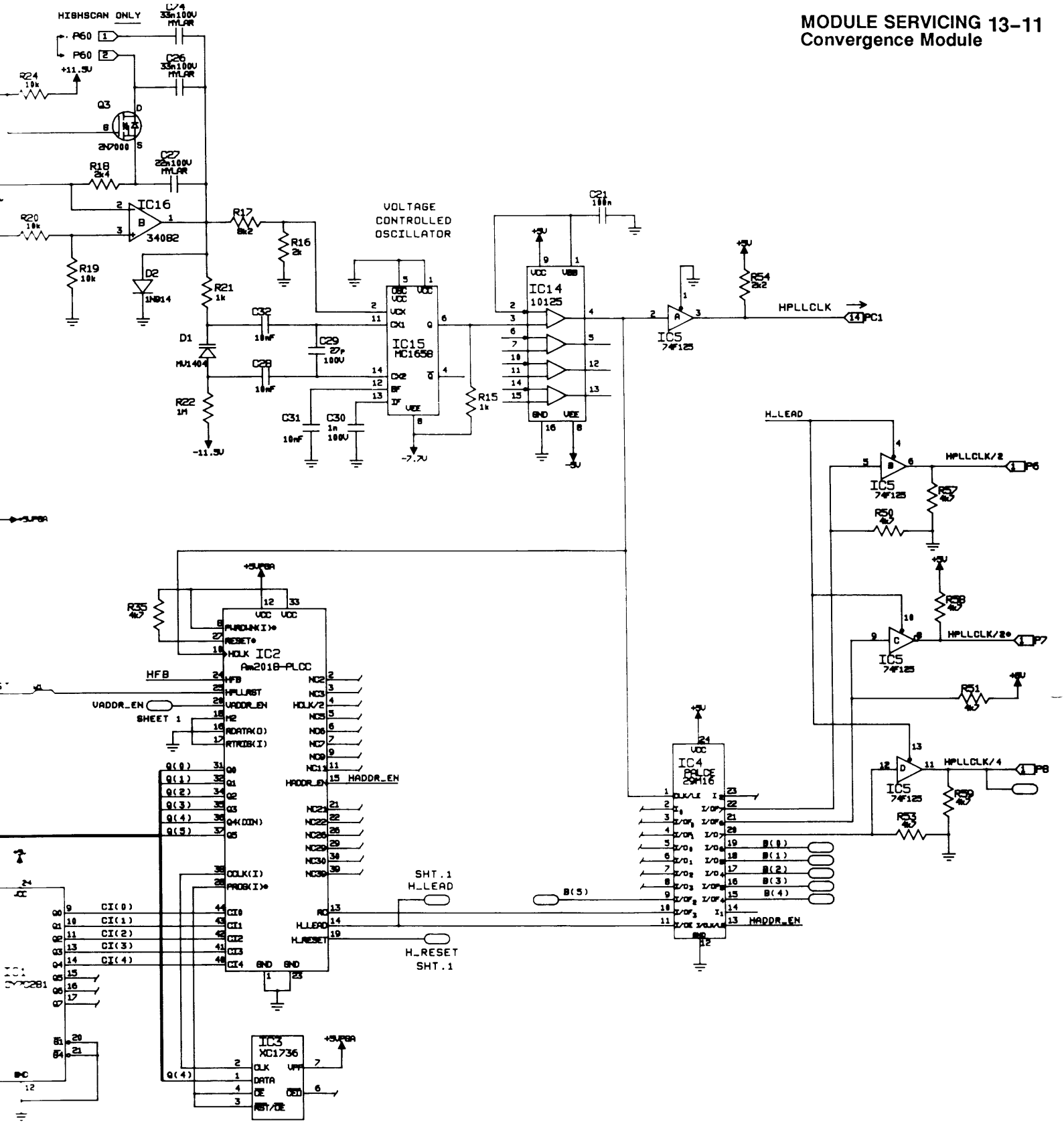


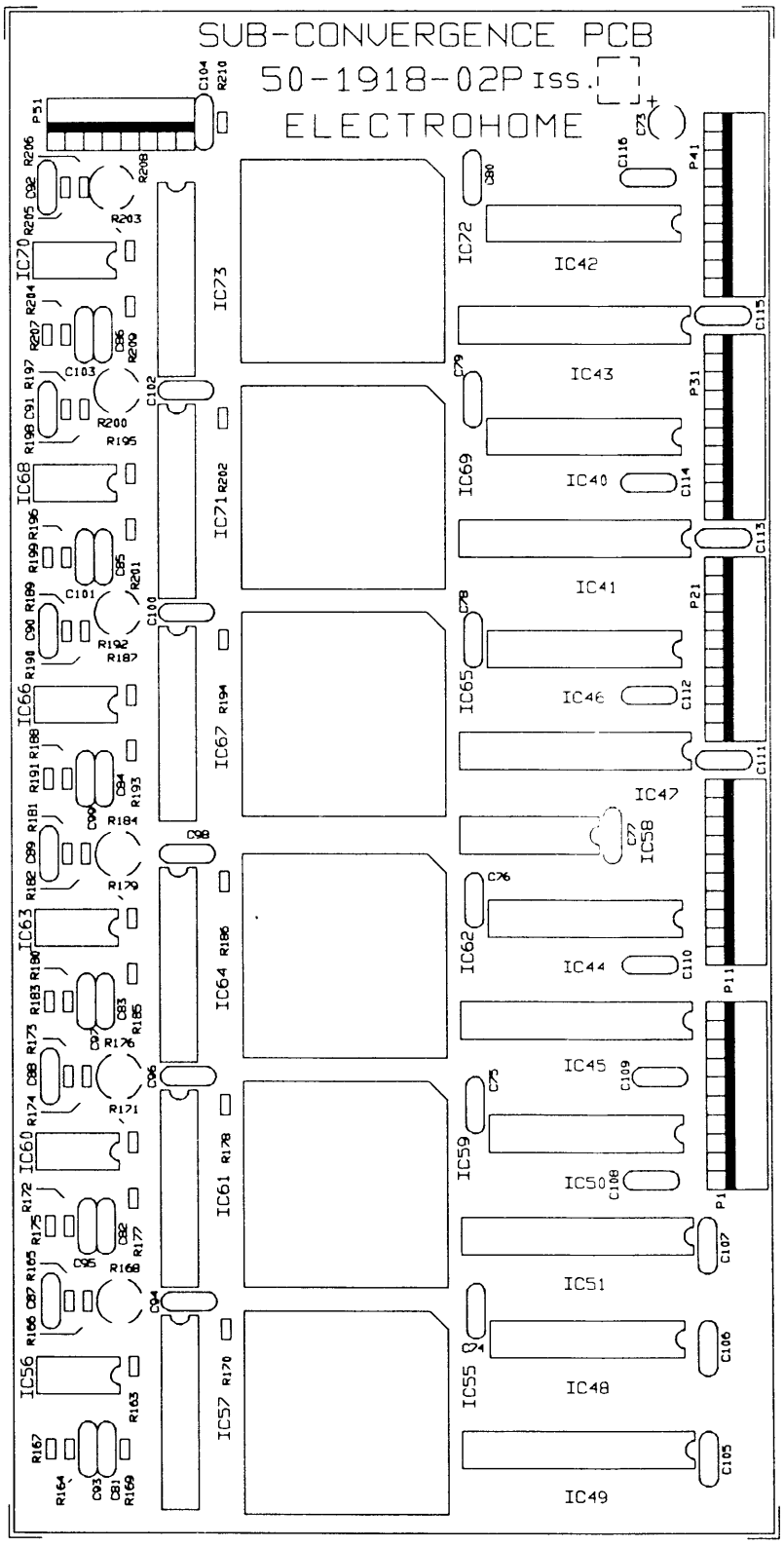


IMPLICIT POWER CONNECTIONS						
IC#	NAME	PIN#	POWER		PIN#	POWER
12	TL082	4	-11.5V		8	+11.5V
10	74HC74	7	GND		14	+5V
16	MC34082	4	-11.5V		8	+11.5V
30	74HC14	7	GND		14	+5V
32	74HC125	7	GND		14	+5V

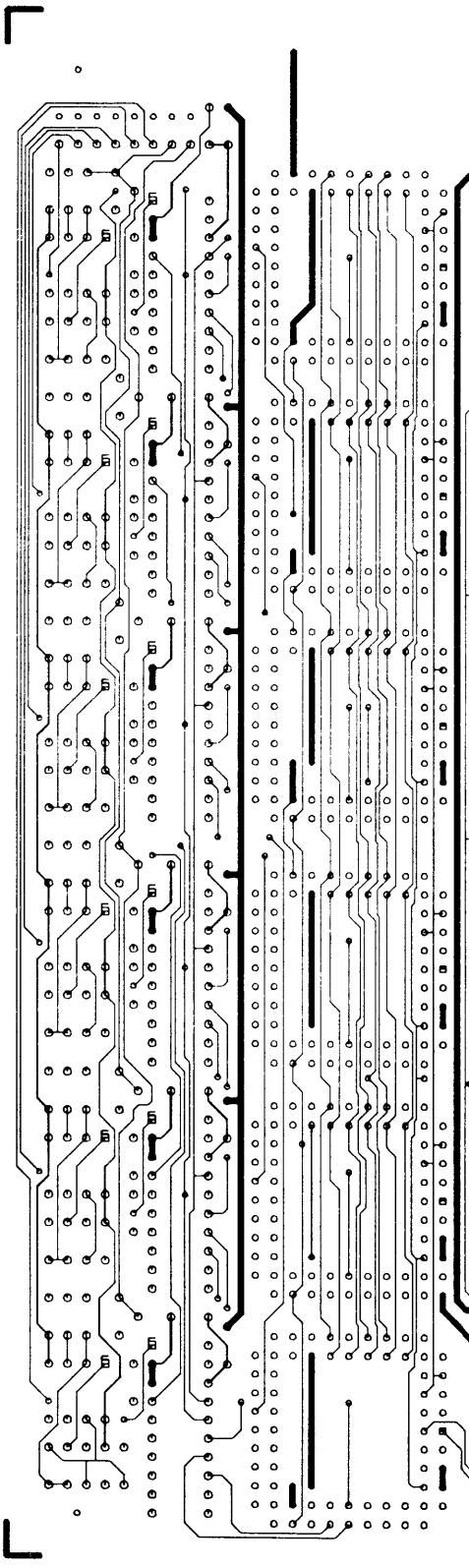
IMPLICIT POWER CONNECTIONS						
IC#	NAME	PIN#	POWER		PIN#	POWER
25	74HC32	7	GND		14	+5V
27	74HC4538	8	GND		16	+5V
22	74HC32	7	GND		14	+5V
5	74F126	7	GND		14	+5V
11	74HC4538	8	GND		16	+5V

FIGURE 13–5.
Convergence PCB Schematic (Sheet 3 of 3)

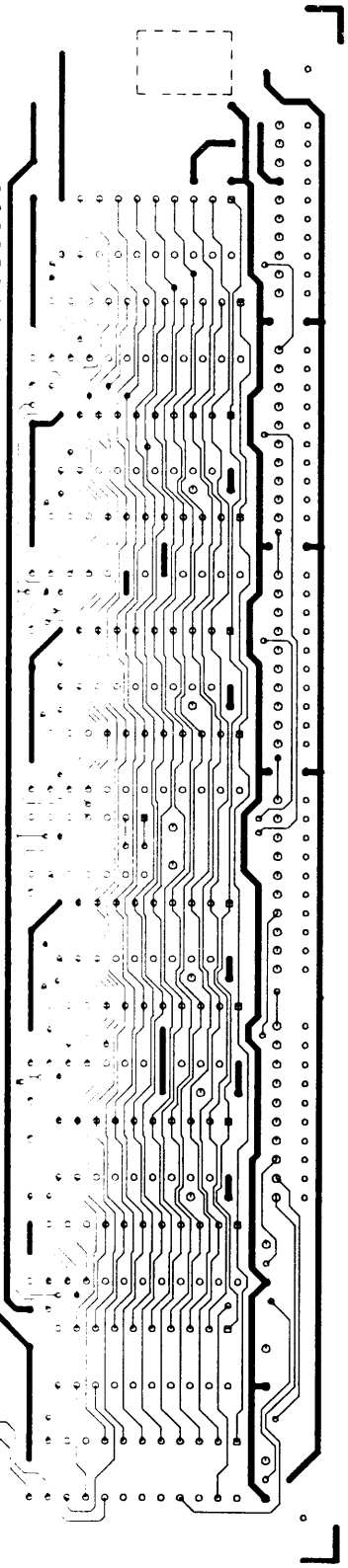




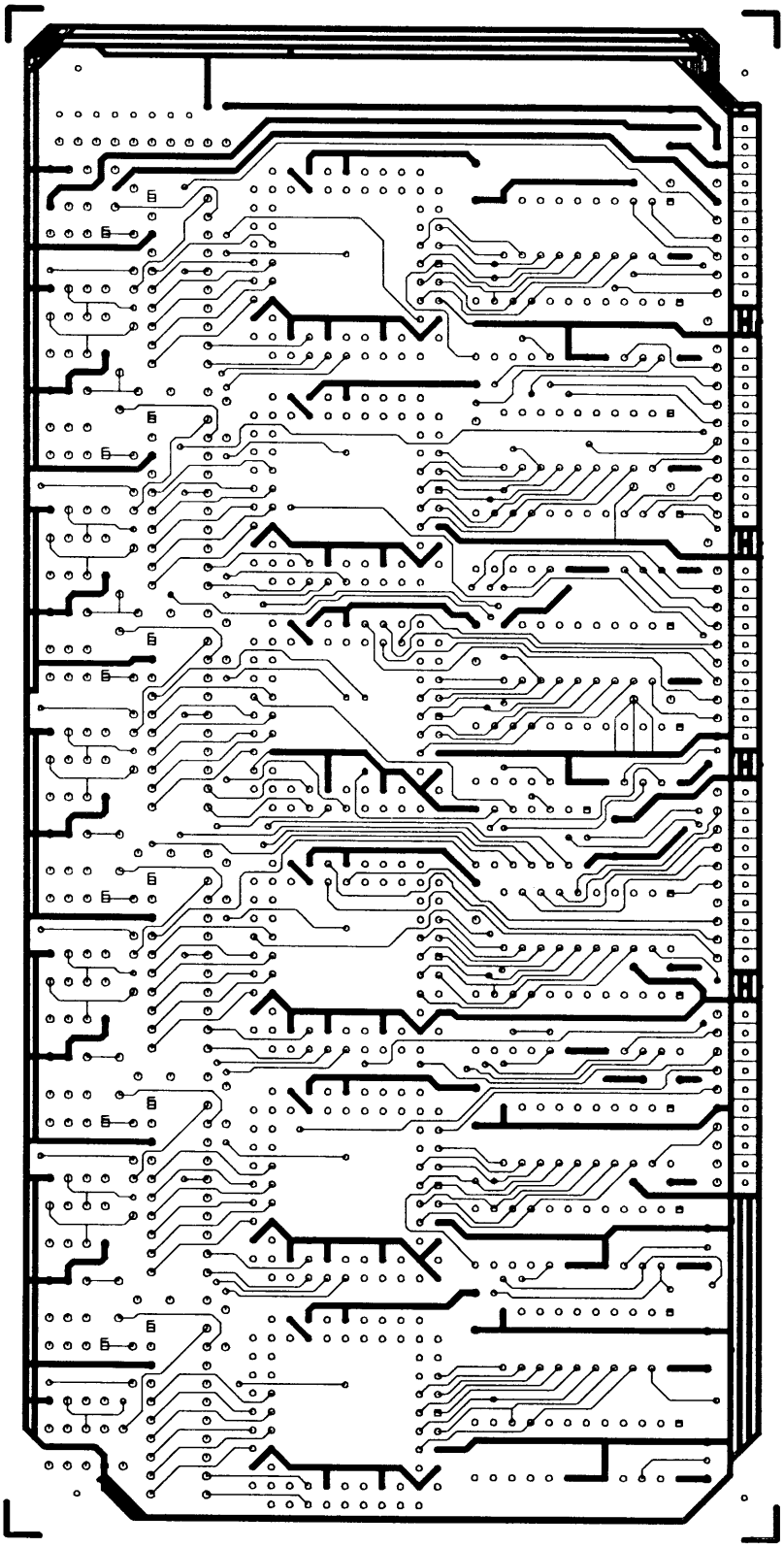
Component Layout



Solder Side
(Viewed from Componer



ent Side)



Component Side

FIGURE 13-6.
Sub-Convergence PCB Component Layout

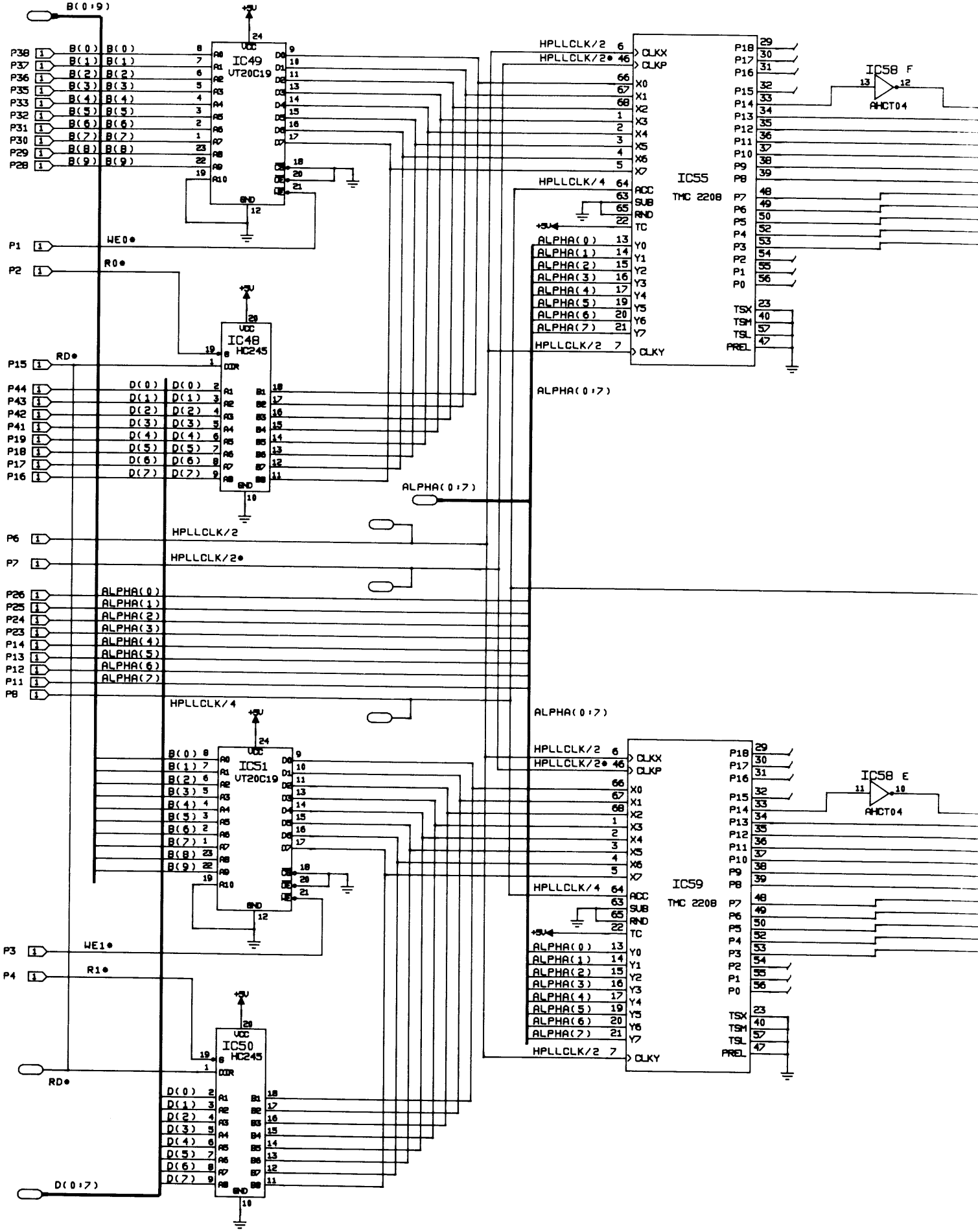
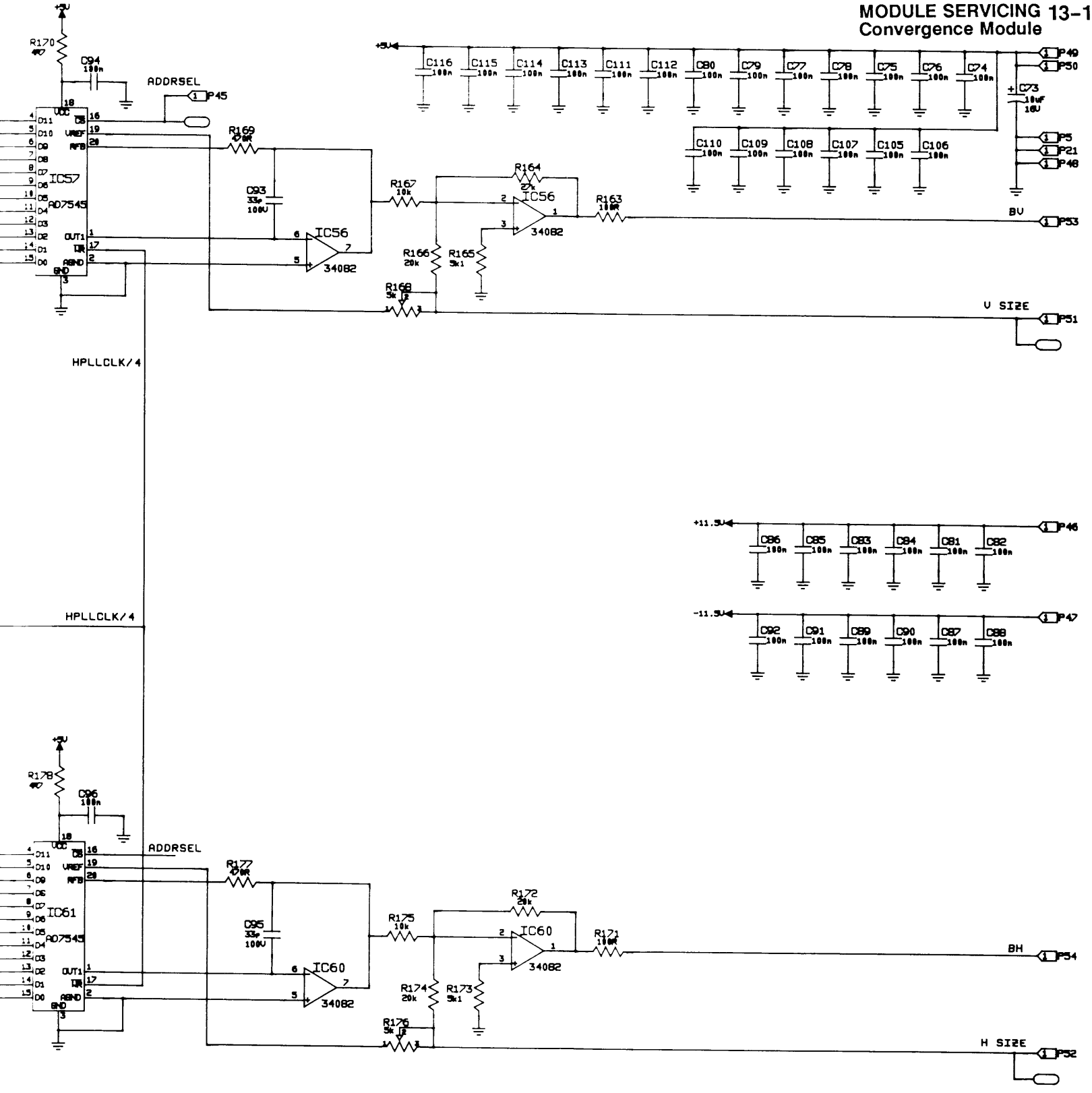


FIGURE 13–7.
Sub–Convergence PCB Schematic (Sheet 1 of 3)



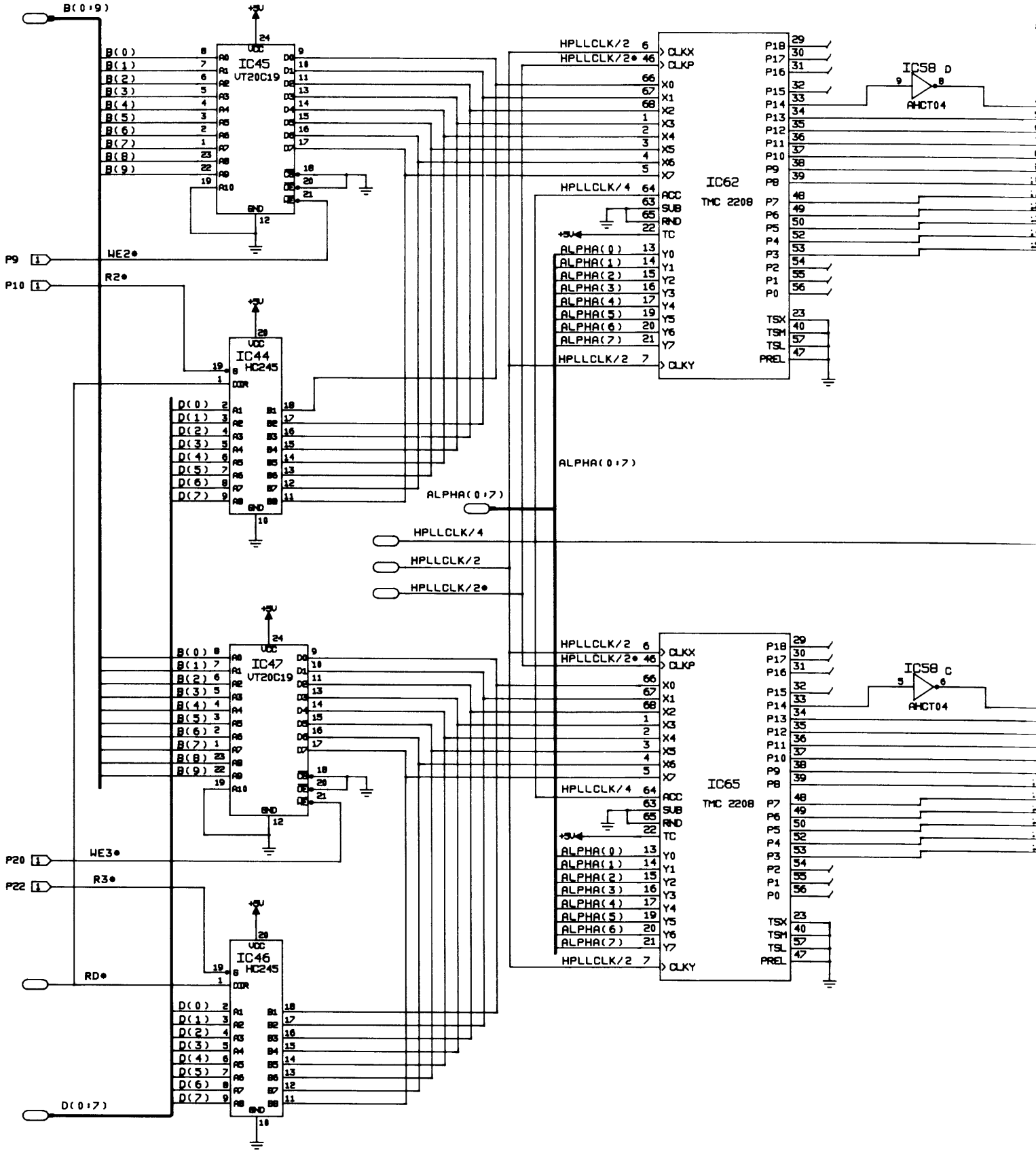
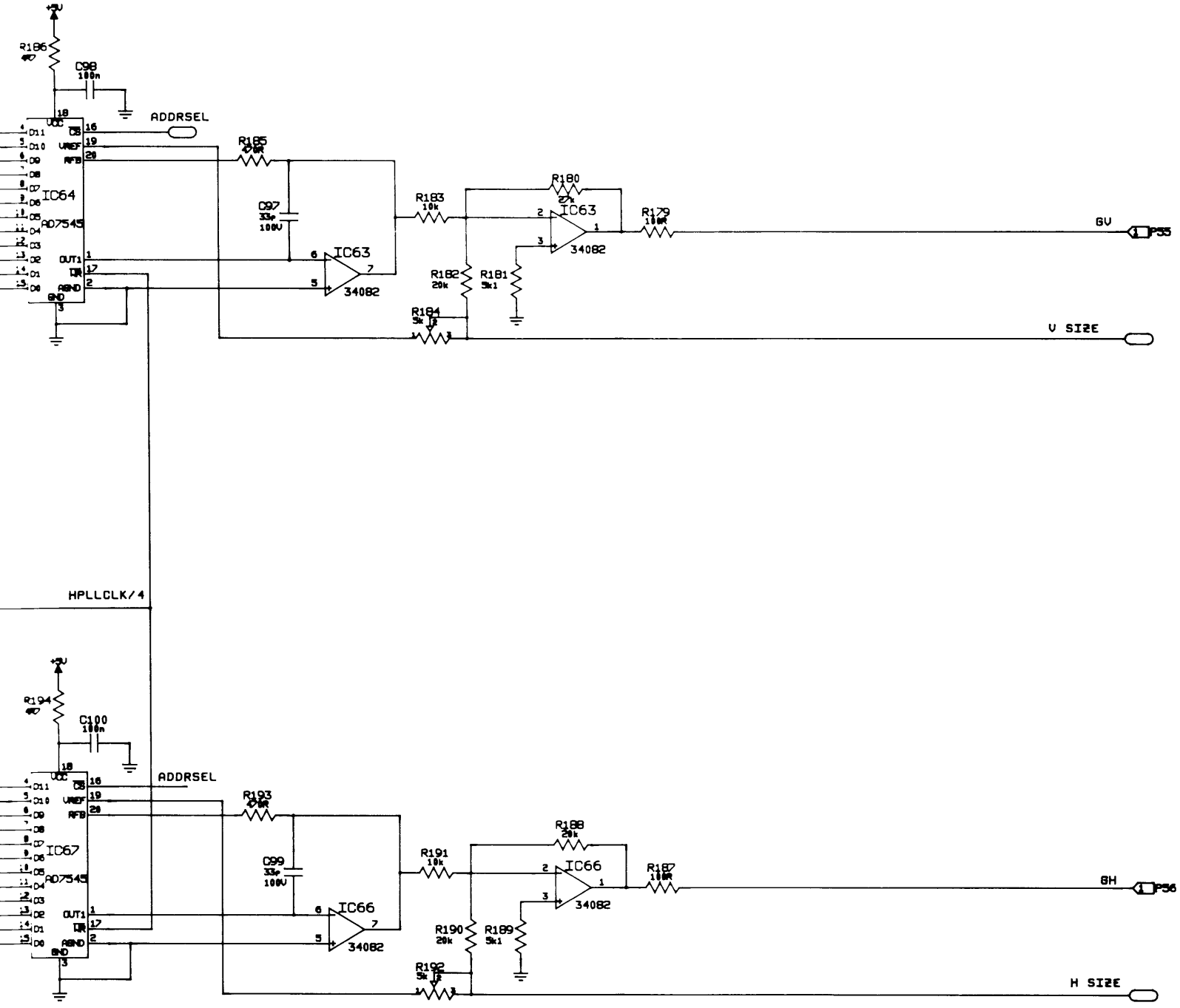


FIGURE 13–8.
Sub–Convergence PCB Schematic (Sheet 2 of 3)



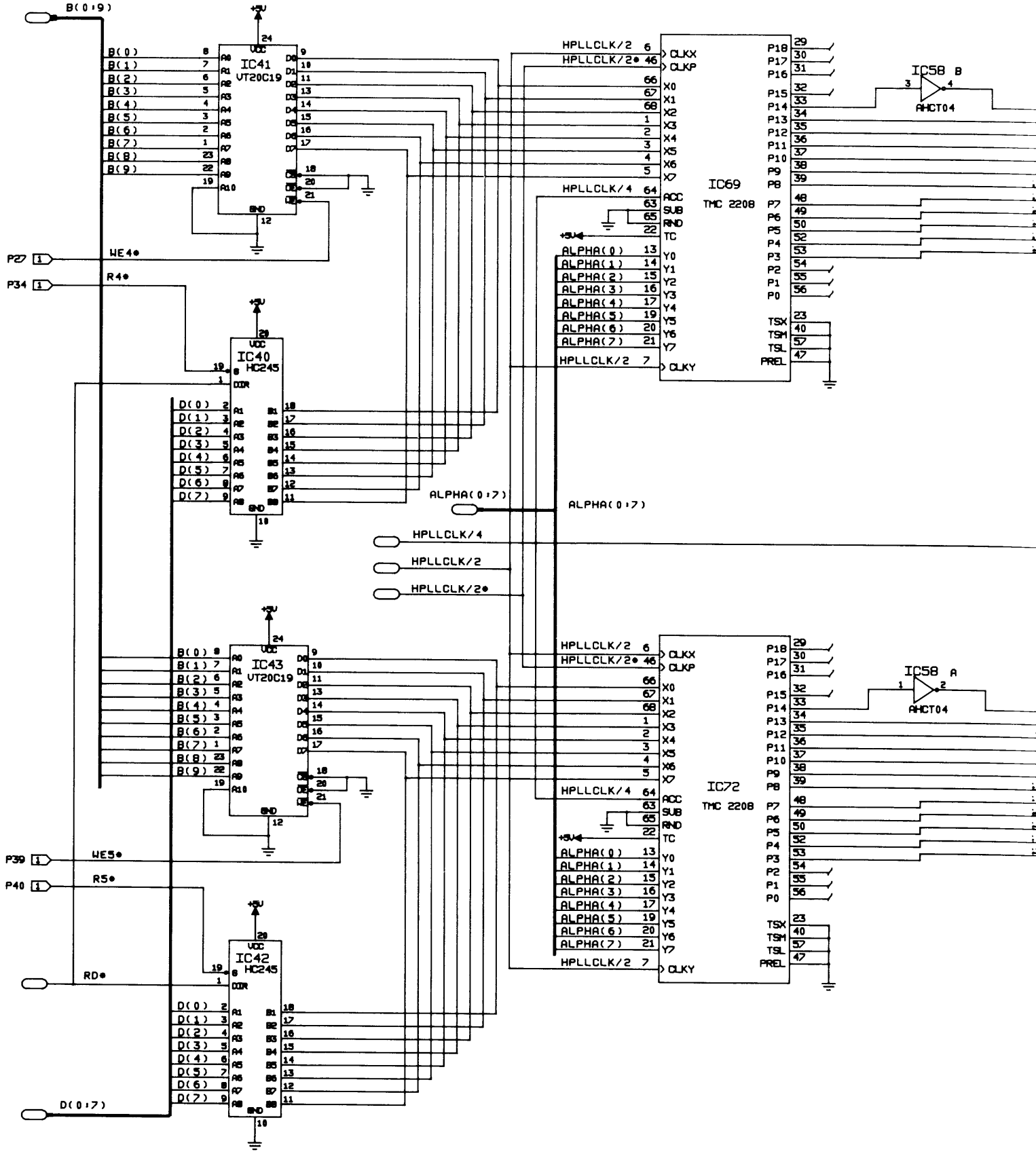
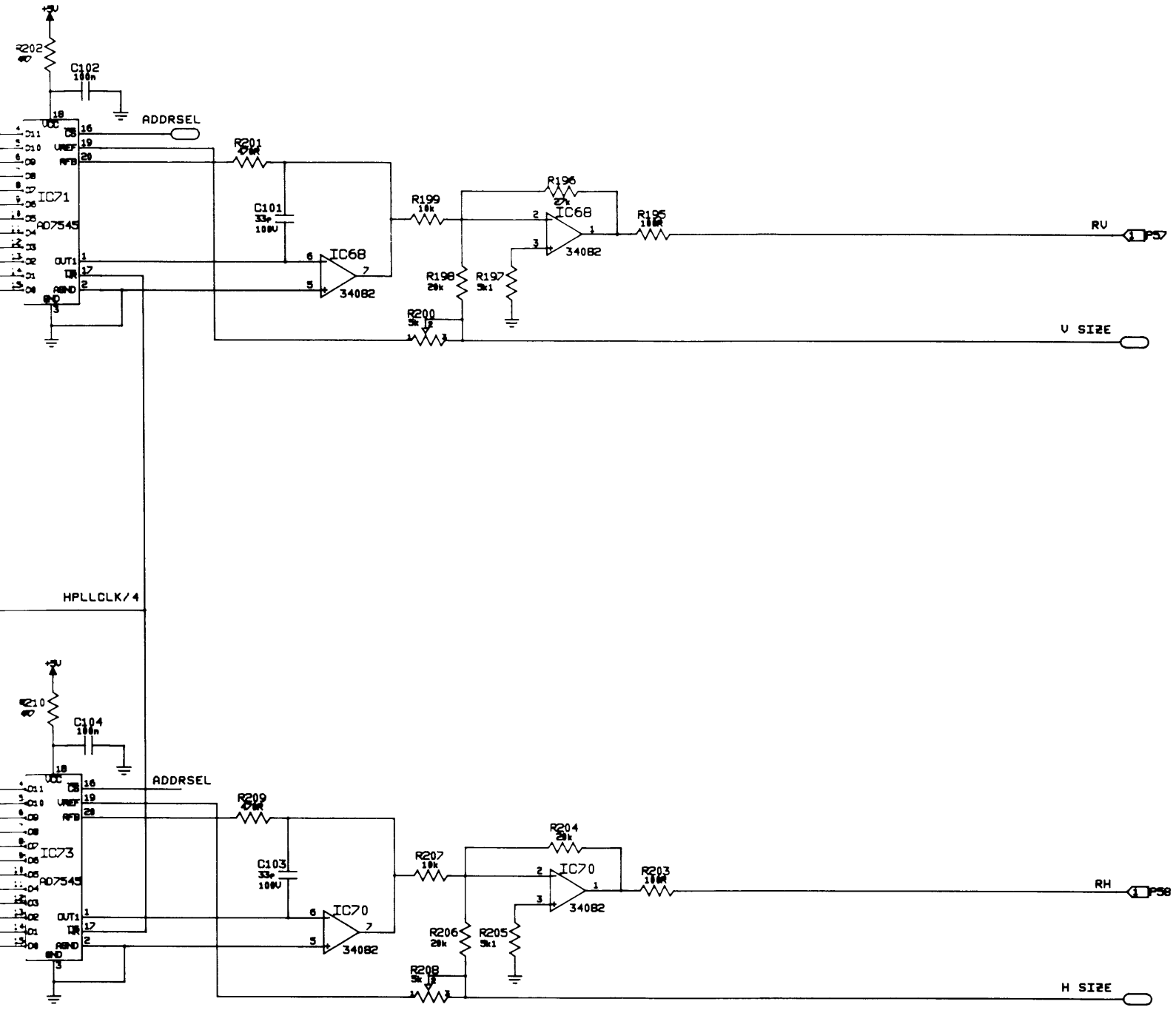


FIGURE 13–9.
Sub–Convergence PCB Schematic (Sheet 3 of 3)



13.4 PARTS LIST

13.4.1 Convergence PCB

Item Ref.	Part No.	Description
Integrated Circuits		
IC1	14-P05041-11P	CY7C281, 1024 X 8 bit PROM
IC2	14-A05049-01P	M2018-100JC-044, PGA
IC3	14-P05047-01P	XC1736, I/F serial conf. PROM
IC4	14-P04093-01P	PALCE29M16, PAL, programmed
IC5	14-004703-01P	74F126, tri-state non-inverting buffer
IC6	14-P04092-01P	PALCE16V8, PAL, programmed
IC7	14-P04082-01P	CE22V10H-25CNS, PAL, programmed
IC8	14-P05034-06P	27C512-170FM, 64K X 8 UV EPROM, programmed
IC9,IC29	14-A04067-01P	74HC590, 8 bit binary counter
IC10	14-A04007-01P	74HC74, H-CMOS dual D flip flop
IC11,IC27	14-A04041-01P	MM74HC4538, CMOS multivibrator
IC12	14-002813-09P	TL082BC, linear op amp
IC13,IC38	14-A04042-01P	74HC245, octal bus transceiver
IC14	14-003053-01P	MC10125, quad MCCL TO TTL translator
IC15	14-004701-01P	SP1658, digital multivibrator voltage control
IC16	14-002164-02P	MC34082, dual linear j-fet op-amp
IC19	14-A04088-01P	HEF4750V, frequency synthesizer
IC20	14-A04044-01P	74HC137, 3-8 line dec. demultiplexer
IC22,IC25	14-A04005-01P	74HC32, quad 2-input OR gate
IC24	14-P04092-02P	PALCE16V8, PAL, programmed
IC26	14-004697-01P	74LS691, sync controller
IC28	14-P04092-03P	PALCE16V8, PAL, programmed
IC30	14-A04073-01P	74HC14, hex Schmitt trigger inverter
IC31	14-A02006-02P	MC14046, CMOS phase lock loop
IC32	14-A04078-01P	74HC125, digital quad bus buffer
IC33	14-002814-02P	LM78L05ACZ, +5V regulator
IC34,IC35	14-002844-01P	MC79L05AC, negative voltage regulator
IC36	14-002835-01P	LM393N, dual comparator
IC37	14-P04103-01P	PALCE16RA8, PAL, programmed
Transistors and Diodes		
Q1-Q4,Q5, Q6,Q7	14-A00705-01P	2N7000, TMOS transistor, 60V, 0.2A, 4W
D1	14-000519-02P	MV1404, varactor, 120pF
D2	14-000513-01P	1N914, 0.075A, 75V
D3	14-000533-01P	BAT81, Schottky barrier diode
Capacitors		
C1-C11,C15-C17, C21-C23,C25,C39, C45,C47,C49-C51, C55,C57-C62,C64, C67,C68	89-000032-03P	100 nF, 50V, 20%

54-7904-02P/54-7904-03P (06/90)

13.4 PARTS LIST (cont.)

13.4.1 Convergence PCB (cont.)

Item Ref.	Part No.	Description
Capacitors (cont.)		
C12	89-000033-04P	1.5 nF, 1%, NPO
C13,C28,C31,C32,C77	89-000032-04P	10 nF, 50V, 20%
C14	89-000032-09P	4.7 nF, 50V, 20% Z5U
C18,C65	84-710003-02P	10 μF, 25V, "super mini"
C19,C33,C35,C75	89-000032-02P	0.47 uF, 50V, ±20%
C20	86-633032-04P	33 pF
C26,C74	88-173331-01P	33 nF, 100V mylar
C27	88-172231-02P	22 nF, 100V
C29	86-627032-04P	27 pF
C30	86-610252-02P	1 nF, 100V
C37	86-627151-02P	270 pF, 100V, 10%
C38,C76	86-647151-02P	470 pF
C40	88-171521-01P	1.5 nF, 100V, 20%
C41-C44,C52,C53	86-656032-04P	56 pF, 100V
C54	86-610031-04P	10 pF
C63	89-000032-05P	1 nF, 50V, 20%
C66,C69,C73	84-747002-03P	47 μF, 16V, "super mini"
C70	84-410104-03P	1000 μF, 25V
C72	88-171031-12P	10 nF, 100V box type
Resistors		
R1-R3,R7,R8,R19, R20,R24,R43,R62, R65	80-110035-11P	100K, 1/2W, 5%
R4,R35,R50,R51, R53,R57,R58,R59, R67,R68,R69	80-147015-11P	4.7K, 1/2W, 5%, metal film
R6	80-118025-11P	18K, 1/2W, 5%, metal film
R9,R23,R32	80-147005-11P	470R, 1/2W, 5%, metal film
R10,R13,R54	80-122015-11P	2.2K, 1/2W, 5%, metal film
R11,R15,R21,R28, R29,R33,R34,R36, R38,R39	80-110015-11P	1K, 1/2W, 5%, metal film
R12,R27	80-110035-11P	100K, 1/2W, 5%, metal film
R14	80-118015-11P	1.8K, 1/2W, 5%, metal film
R5,R16,R40,R66	80-120015-11P	2K, 1/2W, 5%, metal film
R17	80-182015-11P	8.2K, 1/2W, 5%, metal film
R18	80-124015-11P	2.4K, 1/2W, 5%, metal film
R22,R26,R61	80-110045-11P	1M, 1/2W, 5%, metal film
R25	80-162025-11P	62K, 1/2W, 5%, metal film
R30	80-147085-11P	4.7R, 1/2W, 5%, metal film
R37	80-139015-11P	3.9K, 1/2W, 5%, metal film
R41	80-122035-11P	220K, 1/2W, 5%, metal film
R42	80-122025-11P	22K, 1/2W, 5%, metal film

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13.4 PARTS LIST (cont.)

13.4.1 Convergence PCB (cont.)

Resistors (cont.)

R44	80-168005-11P	680R, 1/2W, 5%, metal film
R45,R46	80-110095-11P	10R, 1/2W, 5%, metal film
R55	80-116005-11P	160R, 1/2W, 5%, metal film
R56	80-127005-11P	270R, 1/2W, 5%, metal film
R63	80-120025-11P	20K, 1/2W, 5%, metal film
R64	80-147025-11P	47K, 1/2W, 5%, metal film
RN1	43-000053-01P	4.7K, 10 pin, resistor network

13.4.2 Sub–convergence PCB

Item Ref.	Part No.	Description
Integrated Circuits		
IC40,IC42,IC44, IC46,IC48,IC50	14-A04042-01P	74HC245, octal bus transceiver
IC41,IC43,IC45, IC47,IC49,IC51	14-A05046-02P	VT20C19-20NS, high speed SRAM
IC55,IC59,IC62, IC65,IC69,IC72	14-A04087-01P	TMC2208, multiplier accumulator
IC56,IC60,IC63, IC66,IC68,IC70	14-002164-02P	MC34082, linear dual JFET op amp
IC57,IC61,IC64, IC67,IC71,IC73	14-A03040-01P	HDAC7545A, buffered multiplying DAC
IC58	14-A04003-02P	74AC04, hex inverter
Capacitors		
C73	84-410004-01P	10 μF, 25V
C74-C92,C94,C96, C98,C100,C102, C104-C116	89-000032-03P	100 nF, 50V
C93,C95,C97, C99,C101,C103	86-633032-04P	33 pF
Resistors		
R163,R171,R179, R187,R195,R203	80-110005-11P	100R, 1/2W, 5%, metal film
R164,R180,R196	80-127025-11P	27K, 1/2W, 5%, metal film

54-7904-02P/54-7904-03P (06/90)

13.4 PARTS LIST (cont.)

13.4.2 Sub-convergence PCB

Resistors (cont.)

R165,R173,R181, R189,R197,R205	80-151015-11P	5.1K, 1/2W, 5%, metal film
R166,R172,R174, R182,R188,R170, R198,R204,R206	80-120025-11P	20K, 1/2W, 5%, metal film
R167,R175,R183, R191,R199,R207	80-110025-11P	10K, 1/2W, 5%, metal film
R169,R177,R185, R193,R201,R209	80-147005-11P	470R, 1/2W, 5%, metal film
R170,R178,R186, R194,R202,R210	80-147085-11P	4.7R, 1/2W, 5%, metal film

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13.5 SPECIFICATIONS

Connector P1, Row A:

Pin 1 . . . . . digital input, address line **A(0)**
Pin 2 . . . . . digital input, address line **A(1)**
Pin 3 . . . . . digital input, address line **A(2)**
Pin 4 . . . . . digital input, address line **A(3)**
Pin 5 . . . . . digital input, address line **A(4)**
Pin 6 . . . . . digital input, address line **A(5)**
Pin 7 . . . . . digital input, address line **A(6)**
Pin 8 . . . . . digital input, address line **A(7)**
Pin 9 . . . . . digital input, address line **A(8)**
Pin 10 . . . . . digital input, address line **A(9)**
Pin 11 . . . . . digital input, address line **A(10)**
Pin 12 . . . . . digital input, address line **A(11)**
Pin 13 . . . . . digital input, address line **A(12)**
Pin 14 . . . . . digital input, address line **A(13)**
Pin 15 . . . . . digital input, address line **A(14)**
Pin 16 . . . . . digital input, address line **A(15)**

Pin 17 . . . . . digital in/output, data line **D(0)**
Pin 18 . . . . . digital in/output, data line **D(1)**
Pin 19 . . . . . digital in/output, data line **D(2)**
Pin 20 . . . . . digital in/output, data line **D(3)**
Pin 21 . . . . . digital in/output, data line **D(4)**
Pin 22 . . . . . digital in/output, data line **D(5)**
Pin 23 . . . . . digital in/output, data line **D(6)**
Pin 24 . . . . . digital in/output, data line **D(7)**

Pin 27 . . . . . -12V power supply **-12 VDC**
current . . . . . 100 Ma max

Pin 28 . . . . . +12V power supply **+12 VDC**
current . . . . . 225 mA max

Pin 29 . . . . . +5V power supply **+5 VDC**
current . . . . . 450 mA max

Pin 30 . . . . . connected to Pin 29 **+5 VDC**

Pin 31 . . . . . ground **GND**

Pin 32 . . . . . connected to Pin 31 **GND**

Connector P1, Row C:

Pin 1 . . . . . analog output **BV CONV**
signal level . . . . . -8 to 8V peak

Pin 2 . . . . . analog output **BH CONV**
signal level . . . . . -8 to 8V peak

Pin 3 . . . . . analog output **GV CONV**
signal level . . . . . -8 to 8V peak

Pin 4 . . . . . analog output **GH CONV**
signal level . . . . . -8 to 8V peak

Pin 5 . . . . . analog output **RV CONV**
signal level . . . . . -8 to 8V peak

Pin 6 . . . . . analog output **RH CONV**
signal level . . . . . -8 to 8V peak

Pin 7 . . . . . analog input **FBK V SIZE**
signal level . . . . . 2 to 3VDC

Pin 8 . . . . . analog input **H SENSE G**
NOTE: see Power Deflection module

Pin 9 . . . . . digital input **VFB**
signal . . . . . 5V square wave

Pin 10 . . . . . digital input **HFB**
signal . . . . . 12V square wave

Pin 11 . . . . . digital input **$\overline{\text{WR}}$**
write signal . . . . . TTL

Pin 12 . . . . . digital input **$\overline{\text{RD}}$**
read signal . . . . . TTL

Pin 13 . . . . . digital input **SEL0**
input/output select 0 . . . . . TTL

Pin 14 . . . . . digital output **HPLLCLK**
256 x HFB square wave
signal . . . . . 5V ± 10% square wave
load . . . . . 220 pF
rise time . . . . . 10.2 ns

Pin 15 . . . . . digital output **VPLLCLK**
256 x VFB
signal . . . . . 5V ± 10% square wave

Pin 16 . . . . . digital output **HRESET**
signal . . . . . 5V ± 10% square wave
pulse width . . . . . 2 to 5 μs ± 10%

Pin 17 . . . . . digital output **VRESET**
signal . . . . . 5V square wave
pulse width . . . . . 300 μs ± 10%

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SECTION 14

VIDEO CONTROL MODULE

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

54-7904-02P/54-7904-03P (06/90)

14.1 TECHNICAL DESCRIPTION

14.1.1 General Description

The Video Control module performs two primary functions. It amplifies video input signals by multiplying them by the gain signal from the Waveform module. It provides crosshatch and text generation.

Outputs of the Video Control module are fed to the Video Output module.

14.1.2 Circuit Description

14.1.2.1 Clamp Pulse Generator

The 5V HFB signal, generated by IC39, provides the clamp pulse. Q23 amplifies and inverts the HFB signal. C125 and R211 differentiate the collector pulse of Q23; this generates a negative-going spike coincident with the leading edge of the HFB signal. The spike signal feeds the trigger input of monostable multivibrator IC12. When triggered, the output of IC12 goes high for about 2 μS. The pulse is distributed on the module. It is also sent to the video output modules via PA1<7.

14.1.2.2 Clamping

In the video control module, the clamp pulse is AC-coupled to the gates of Q8, Q9, Q10, Q17, Q18 and Q19. During scan, the gate-to-source voltage of each FET is about -10V; the drain-to-source channel is open. AC-coupled video is allowed to pass unimpeded. During the clamp pulse the gate-to-source voltage goes positive, causing the drain-to-source channel to turn ON. Video AC-coupled capacitors charge or discharge accordingly to establish the proper black level bias point.

14.1.2.3 Video Switch

IC11 is the video switch. It contains a 3 pole, double throw switch. Video signal levels at IC11's input are about 300 mV p-p. The ENABLE signal (TTL) controls the switch. The -12V supply and shunt regulator IC10 provide the -5V used to operate IC11.

14.1.2.4 Multipliers

The 3 multipliers permit independent gain control of the red, green and blue video signals. Gain signals provided by the waveform module vary from 0 to 5V. Each multiplier reduces the gain range to 0 to 2V at pin 4. A differential output current is provided between pins 2 and 14. The output current develops a signal across the resistor pairs connected to the filtered and regulated 10V supply (R135 & R136, R134 & R140 and R141 & R142). The small signal generated has to be amplified. Red, green and blue null (R113, R114 & R115) are set to zero contrast for an even raster.

14.1.2.5 High Gain Video Amplifier

Wide band video amplifier, NE592, raises the signal generated across resistor pairs R135 & R136, R134 & R140 and R141 & R142 to 1V p-p. The input to NE592 is biased midway between ground and the 10V supply. The output of NE592 is internally biased.

14.1.2.6 75Ω Buffer

The output of NE592 is AC-coupled to a two transistor, emitter-follower output stage. This buffer has a gain of 1.5 when terminated with a 75 Ω load. The input to the buffer is clamped to prevent the video duty cycle from adversely affecting its bandwidth.

14.1.2.7 Digital Section

The Video Control module generates all internal video. It also switches external and internal video.

The Video Control module contains two internal video generators, a test pattern generator and a character generator. The test pattern generator provides dot and crosshatch capabilities. These are used during projector set-up. The character generator is used to produce menus and bar charts.

Test Pattern Generator

The test pattern generator circuitry produces horizontal and vertical lines with a dot pattern superimposed.

Vertical line counter, IC32, divides the number of vertical field scan lines by 32. The resulting value is stored in IC34. It is used to load IC23 and IC33 (interval counter). The interval counter uses this value to count down the horizontal crosshatch lines generated by IC29. IC31 (a 74LS593 counter) divides HPLLCLK by 16. Its output is used by IC29 to generate the vertical lines of the crosshatch.

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Character Generator

The character generator creates a 32 by 32 character display. The character set, stored in IC26 (a 1K x 8 bit ROM), contains 128 characters. The characters are based on the standard ASCII set. Characters are defined as 5 by 7 bit patterns in 8 by 8 matrices.

The projector display is memory mapped into a 1K address space in IC30 (video RAM). Text can be shown anywhere on the projector display. The generator can also switch external and internal video for any or all memory-mapped locations.

The microprocessor addresses the video RAM through buffers IC38 and IC39. The buffers isolate the external address (A(0) to A(9)) from the character generator address (B(0) to B(9)). IC31 generates the horizontal character count address, B(0) to B(4). IC32 divides the number of scan lines in a vertical frame by 256. The result is the vertical character count address, B(5) to B(9), in IC25.

The value is stored in IC28 and used to load IC22 (line width counter). Line insertion between character rows is performed by IC27 (a programmable logic device) to keep the display uniform. This operation is performed when the number of scan lines is not an integer multiple of 256.

IC30 receives cycling horizontal and vertical count addresses. It outputs the ASCII character code corresponding to the address. This code is latched by IC28. The latched code is the look-up address for IC26 (character PROM). Addresses C(0) to C(2) are the character row count. They select the row in the character's bit pattern. The row of the character's bit pattern is output from PROM storage to IC24 (parallel-in, serial-out shift register), and shifted out by HPLLCLK*.

Video Selection

The test pattern generator and character generator are microprocessor selectable. Select functions are processed by writing data to the external data address (IOSEL2). See Table 14-1.

TABLE 14-1. *VIDEO SELECTION*

DATA BIT			ACTION
D0	D1	D2	
–	0	0	test pattern/character generator disabled
–	0	1	character generator enabled
0	1	0	dot pattern enabled
0	1	1	dot pattern & char. generator enabled
–	0	0	test pattern/character generator disabled
–	0	1	character generator enabled
1	1	0	crosshatch enabled
1	1	1	crosshatch & char. generator enabled

14.2 SERVICING AND ALIGNMENT

14.2.1 Disassembly and Access

WARNING

STATIC SENSITIVE COMPONENTS
STATIC CONTROLLED WORK STATION REQUIRED

Module Location:
- rear panel card rack

Tools & Equipment Required:
- Phillips screw driver

a) Remove the back panel as described in Section 5.2.

b) Locate the Video Output module in the rear panel card rack. Using the printed circuit board extractor from the tool pouch, pull the module from the card rack as described in Section 5.2.

14.2.2 Alignment and Adjustments

Refer to Section 7, *Alignment Procedures*, for Video Amplifier Alignment and Color Balance Set-up.

14.3 COMPONENT LAYOUT AND SCHEMATICS

Refer to the following pages for component layouts and schematics of the Video Control Module.

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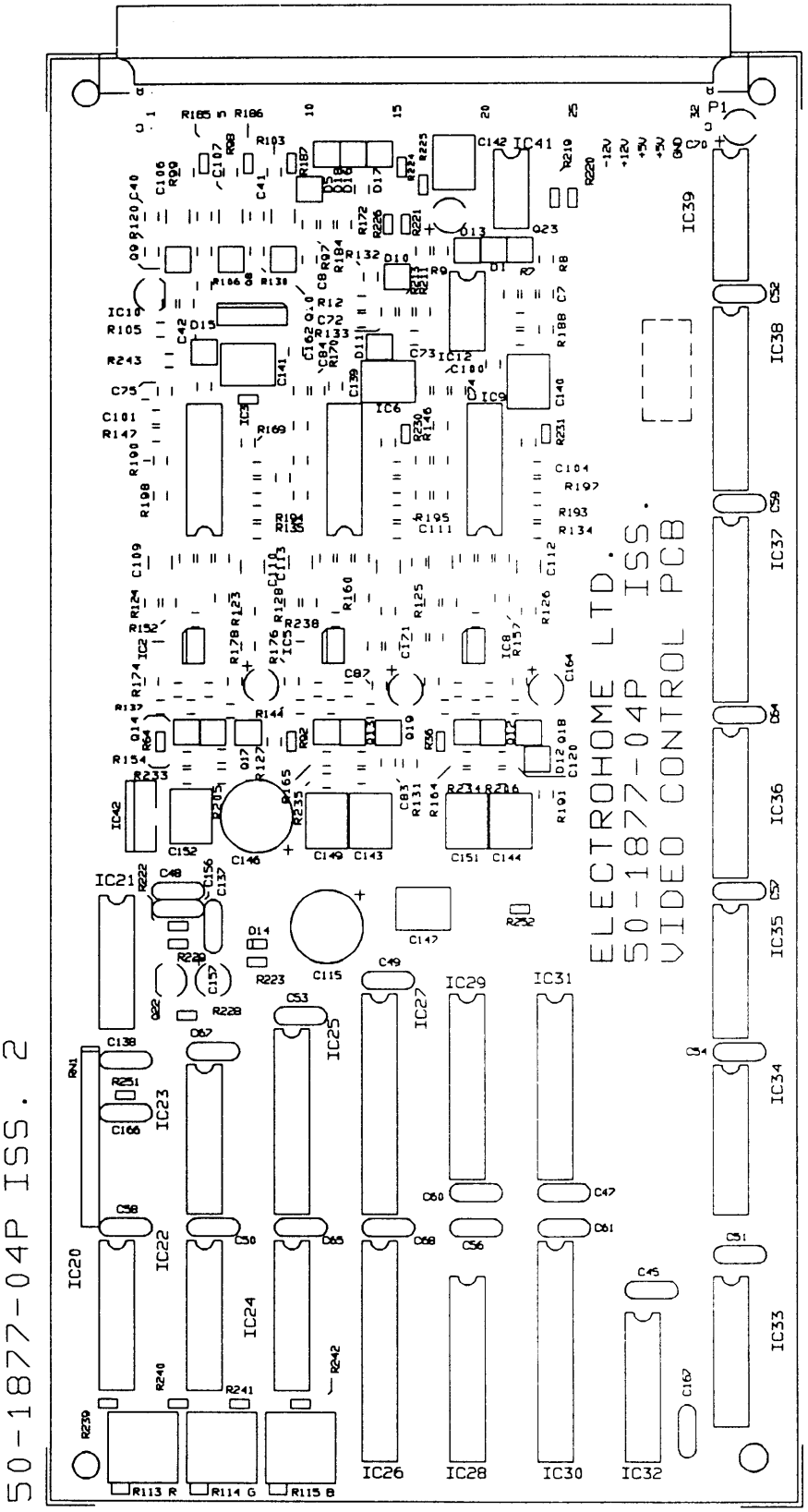
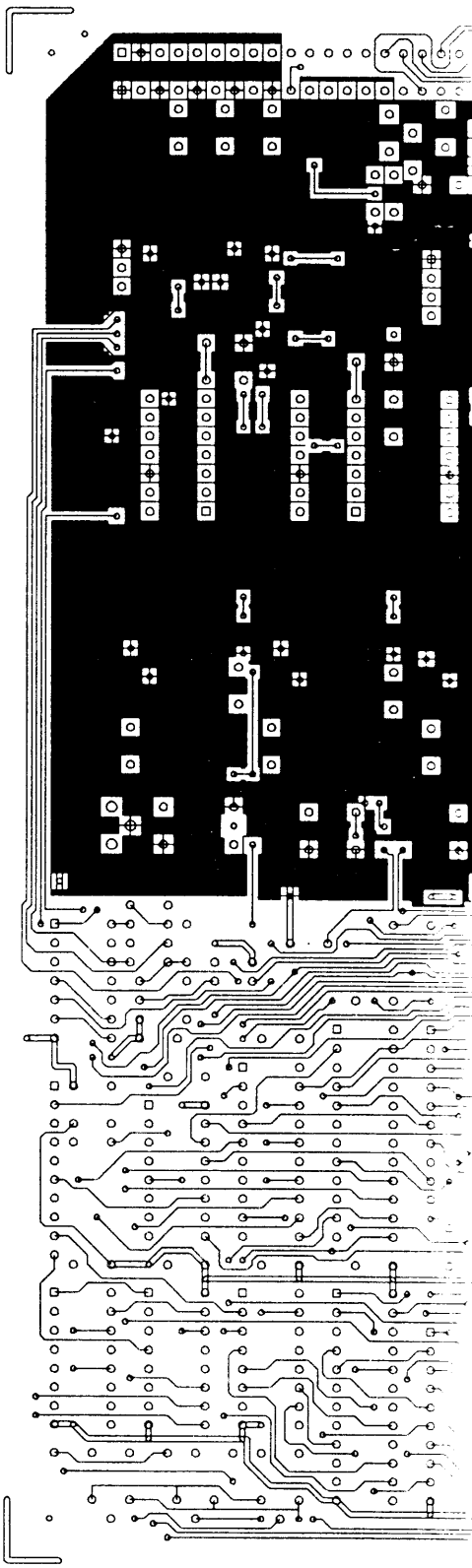
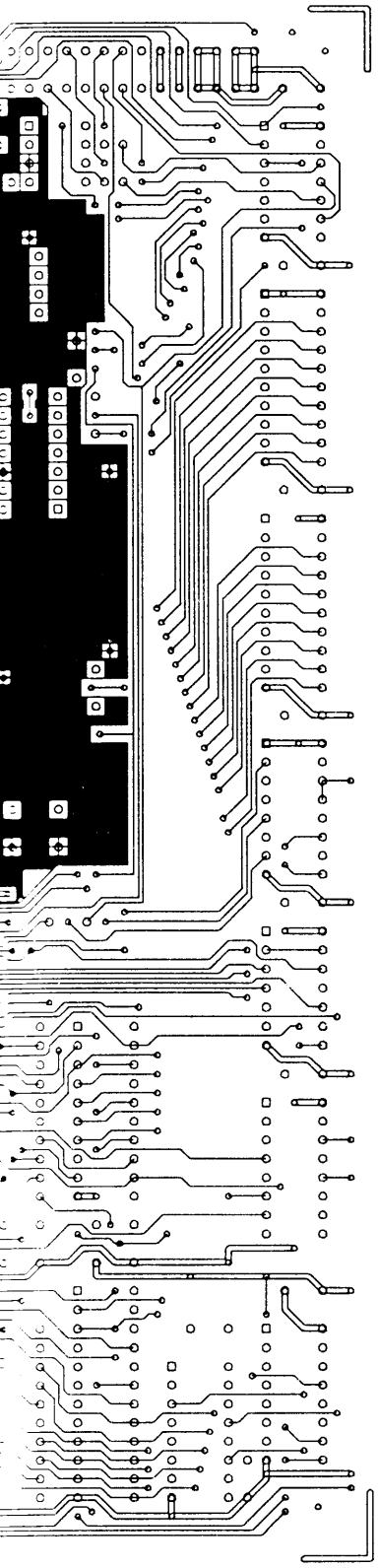


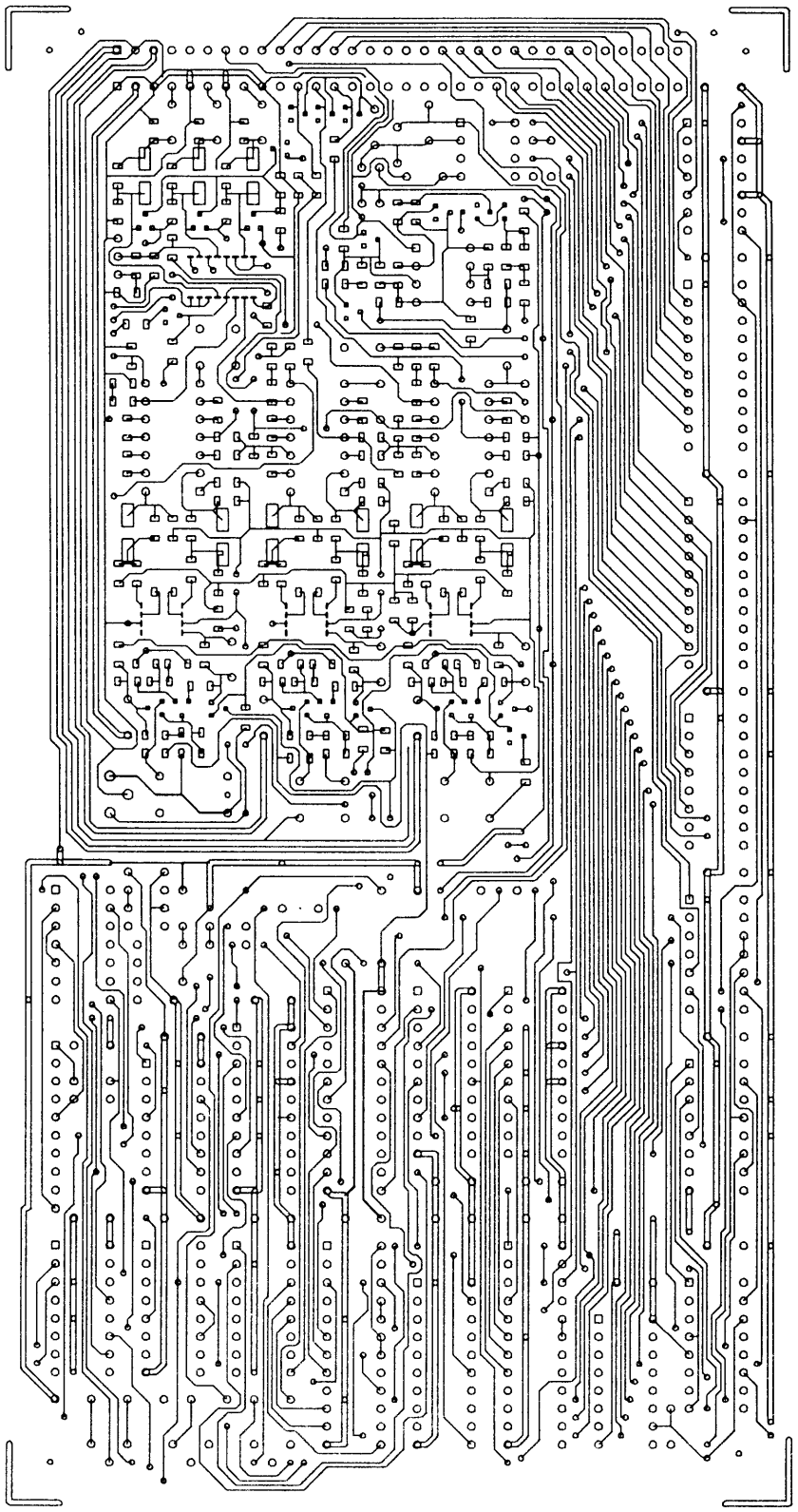
Component Layout



Solder Side
(Viewed from Compo



de
oonent Side)



Component Side

FIGURE 14–1.
Video Control Module Component Layout

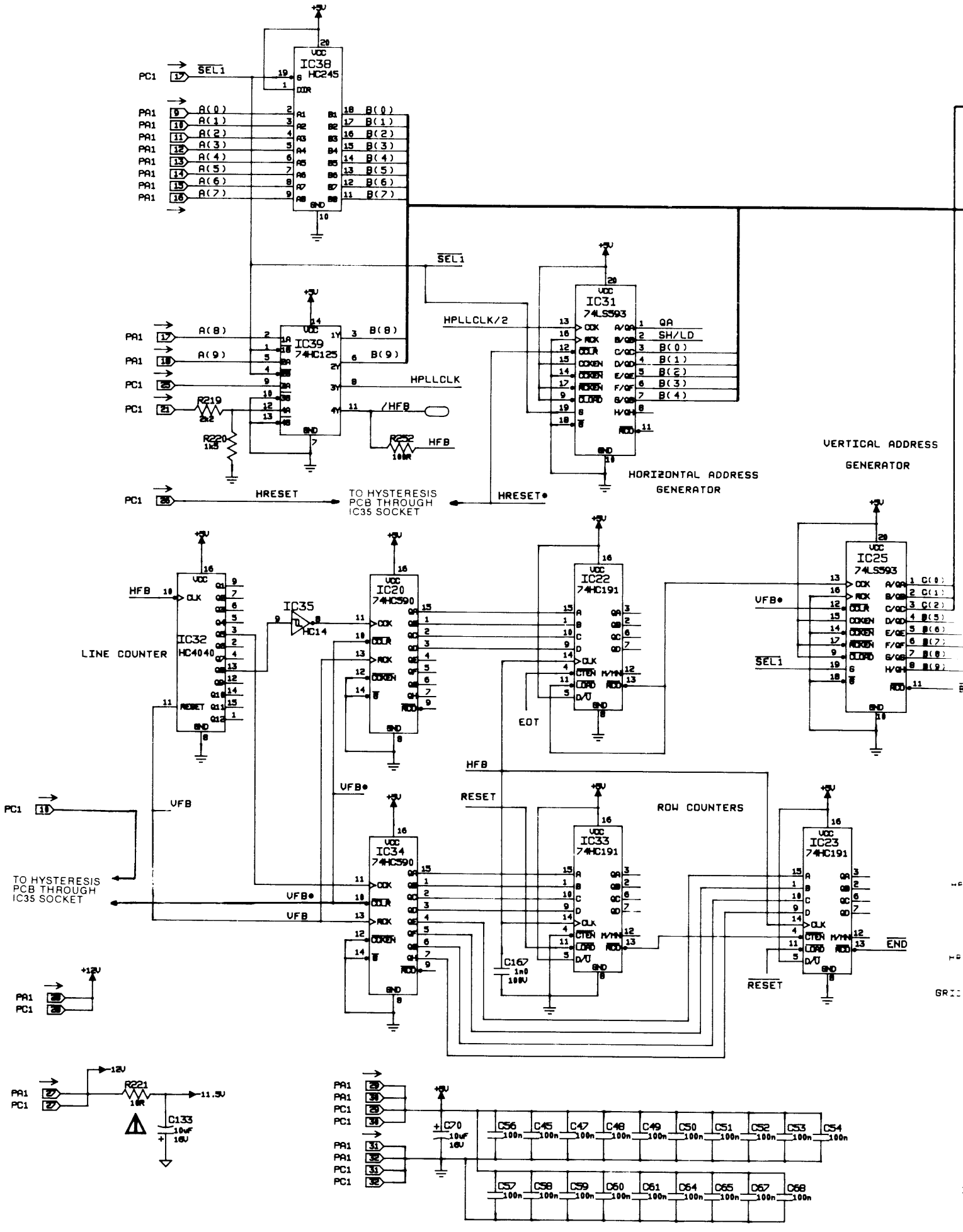
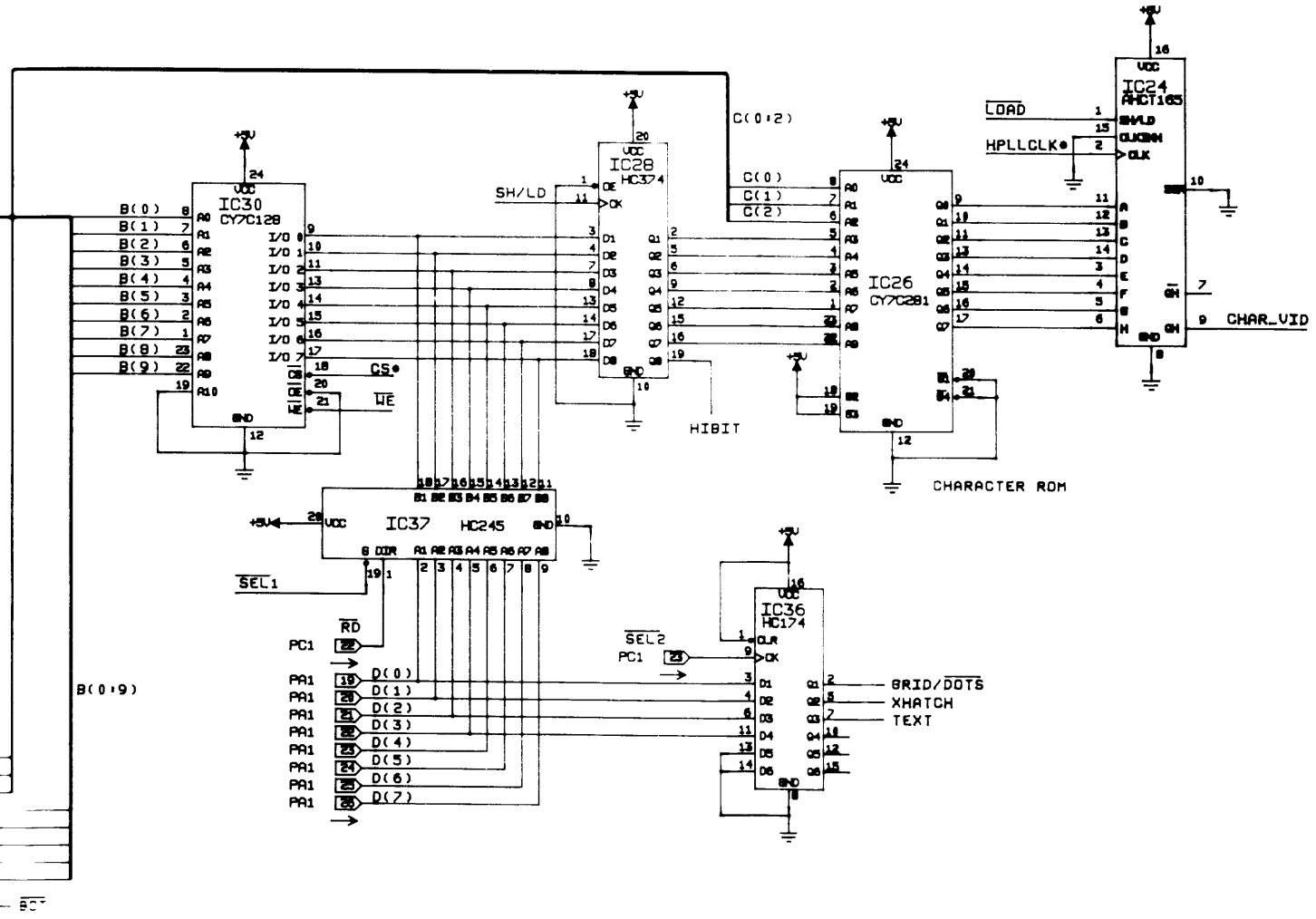
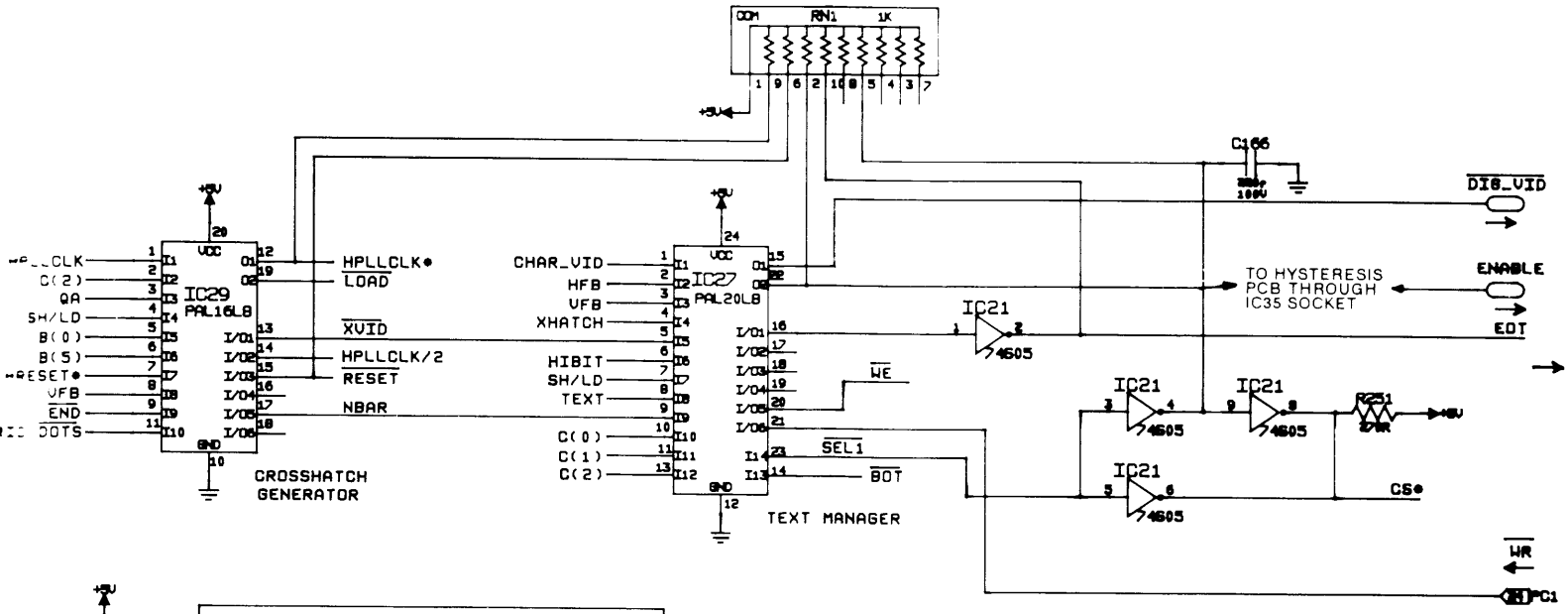
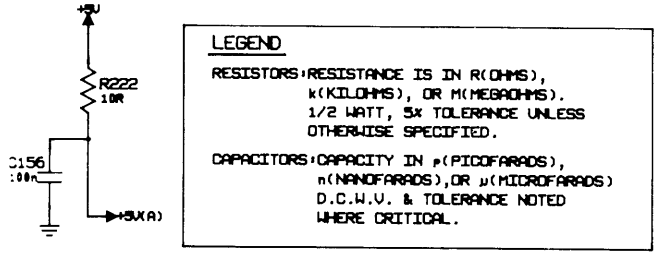


FIGURE 14–2.
Video Control Module Schematic (Sheet 1 of 2)







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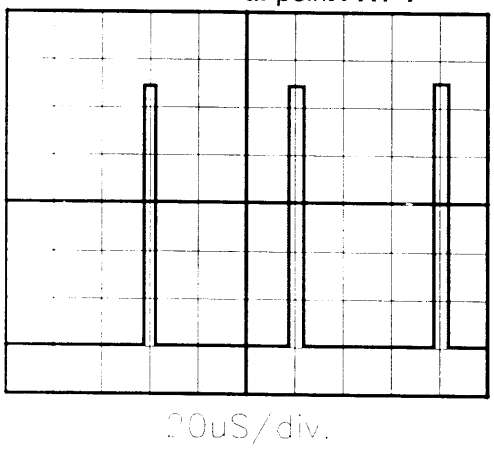
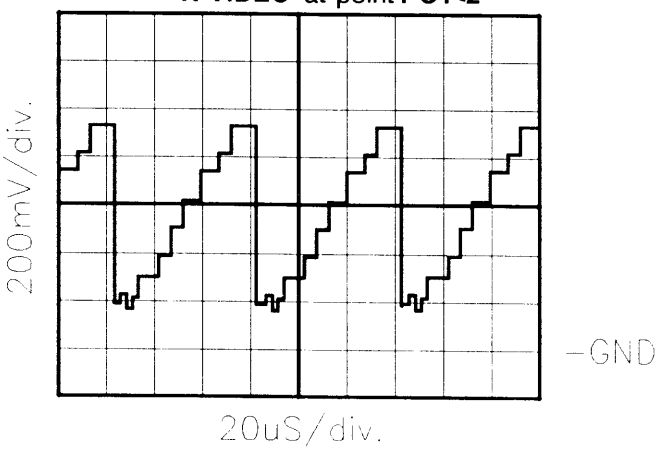
SCHEMATIC REFERENCE

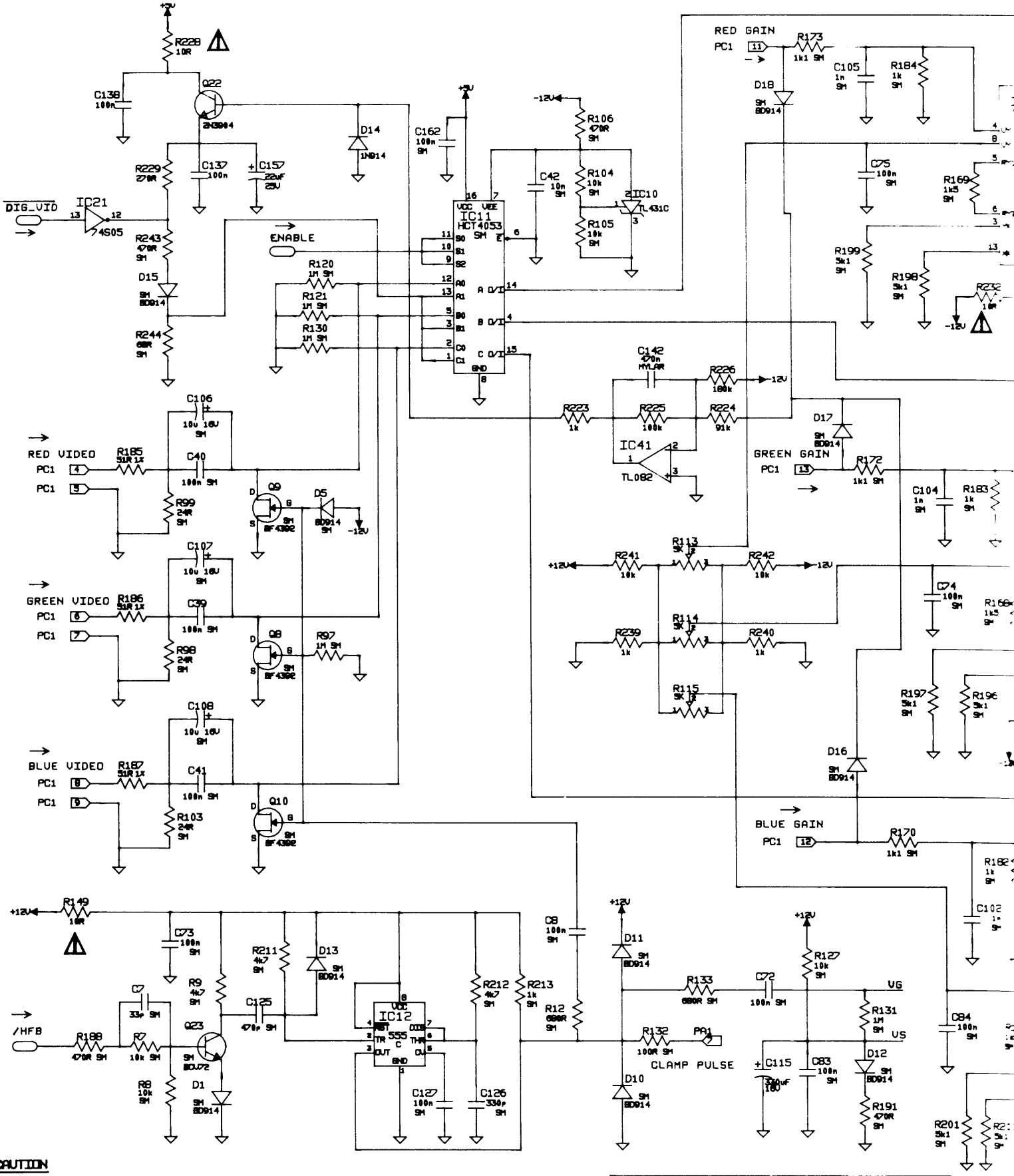
CLAMP at point **PA1<7**



R VIDEO at point **PC1<2**



54-7904-02P/54-7904-03P (06/90)



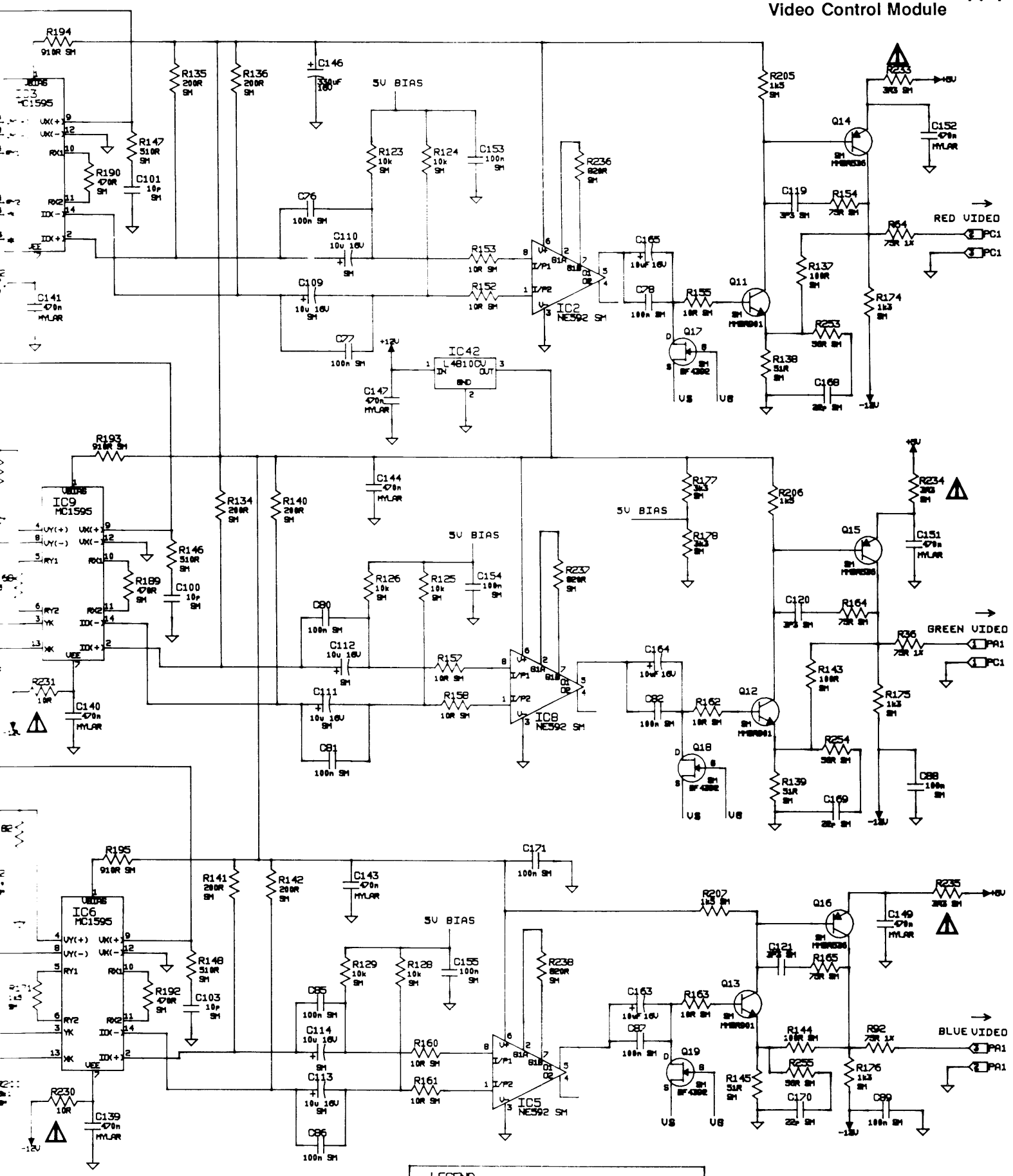
CAUTION

FOR CONTINUED SAFETY REPLACE COMPONENTS NOTED BY ⚠ WITH EXACT REPLACEMENT PARTS ONLY. CONSULT SERVICE MANUAL PARTS LIST SECTION "SAFETY COMPONENTS".

IMPLICIT POWER CONNECTIONS

IC#	NAME	PIN#	POWER		PIN#	POWER	
21	74S05	7	CIRCUIT	GND	14	+5V(A)	
35	74HC14	7	GND		14	VCC	+5V
41	TL082	4	-11.5V		8	+12V	

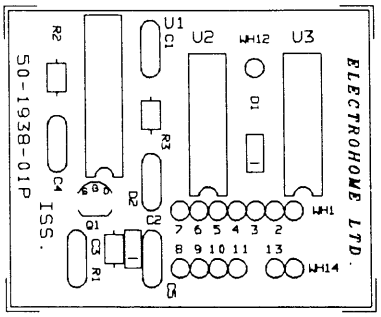
FIGURE 14–3.
Video Control Module Schematic (Sheet 2 of 2)



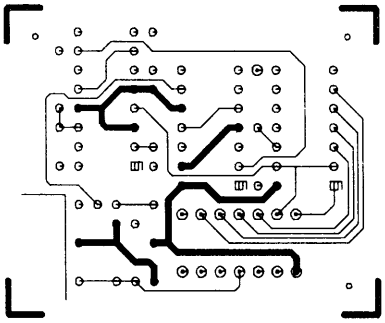
LEGEND

RESISTORS: RESISTANCE IS IN R(OHMS), k(KILOHMS), OR M(MEGAOHMS). 1/2 WATT, 5% TOLERANCE UNLESS OTHERWISE SPECIFIED.

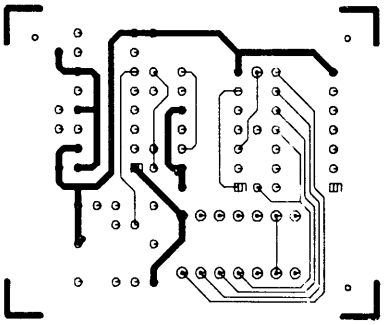
CAPACITORS: CAPACITY IN p(PICOFARADS), n(NANOFARADS), OR μ(MICROFARADS) D.C.W.V. & TOLERANCE NOTED WHERE CRITICAL.



Component Layout



Solder Side
(Viewed from Component Side)



Component Side

FIGURE 14-4. *Hysteresis PCB Component Layout*

54-7904-02P/54-7904-03P (06/90)

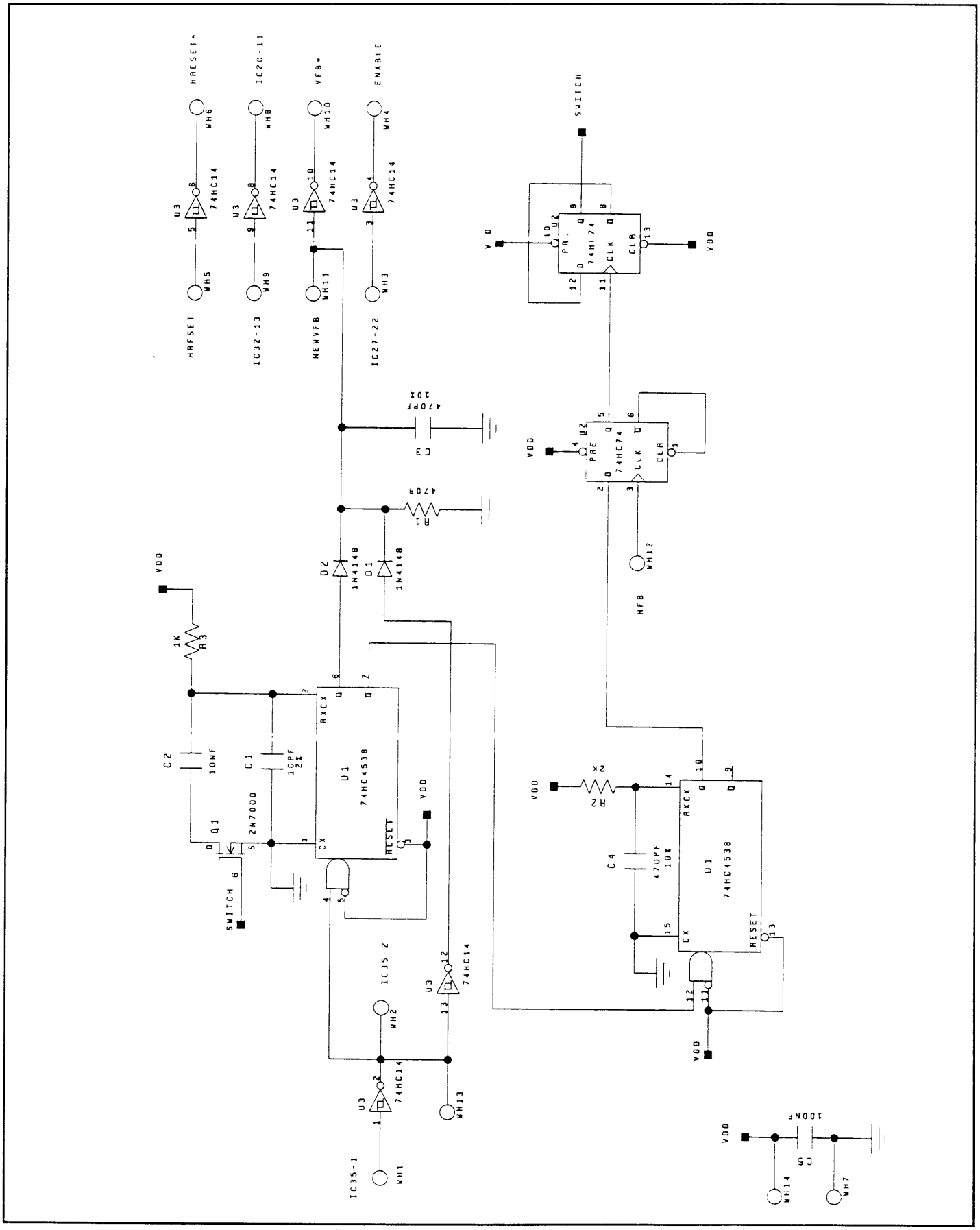


FIGURE 14-5. *Hysteresis PCB Schematic*

14.4 PARTS LIST

14.4.1 Video Control PCB

Item Ref.	Part No.	Description
Integrated Circuits		
IC2,IC5,IC8	72-002002-02P	NE592D8, differential video amplifier
IC3,IC6,IC9	14-002095-01P	MC1595L, linear arithmetic 4-quad multiplexer
IC10	14-002833-01P	TL431C, precision shunt regulator
IC11	72-A04001-01P	74HC4053, high speed logic
IC12	14-A04069-01P	TLC555C, CMOS timing delay
IC20,IC34	14-A04067-01P	74HC590, 8-bit binary counter
IC21	14-004696-01P	74S05, hex inverter
IC22,IC23,IC33	14-A04066-01P	74HC191, 4 bit sync up/down counter
IC24	14-A04043-02P	74AHCT165, 8 bit shift register
IC25,IC31	14-004689-01P	74LS593, 8 bit counter
IC26	14-A05041-02P	CY7C281, 1024 x 8 bit PROM (programmed)
IC27	14-004699-01P	20L8A, PAL, digital TTL
IC28	14-A04011-01P	74HC374, octal flip flop
IC29	14-004693-02P	16L8B, PAL, digital TTL
IC30	14-A05037-02P	CY7C128 2Kx8 CMOS static ram
IC32	14-A04040-01P	MM74HC4040, CMOS ripple counter
IC36	14-A04047-01P	74HC174, hex D flip flops
IC37,IC38	14-A04042-01P	74HC245, octal bus transceiver
IC39	14-A04078-01P	74HC125, quad bus buffer
IC41	14-002813-09P	TL082BC, linear op-amp
IC42	14-002845-01P	L4810CV, regulator
Transistors and Diodes		
D1,D5,D10-D13, D15-D18	72-000513-01P	MMBD914, surface mount
D14	14-000513-01P	1N914, .075A, 75V
Q8-Q10,Q17-Q19	72-000701-01P	MMBF4392, N channeL FET, surface mount
Q11-Q13	72-000561-02P	MMBR901, NPN RF transistor, surface mount
Q14-Q16	72-000561-01P	MMBR536, RF transistor, surface mount
Q22	14-000881-06P	2N3904, NPN, 40V, 0.2A, 0.35W
Q23	72-000561-04P	BCV72, surface mount
Capacitors		
C7	66-433031-05P	33pF, 50V, 2% NPO
C8,C39-C41, C72-C78,C80-C89, C127,C153-C155, C162,C171	66-310411-05P	100nF, 50V, surface mount
C42	66-310311-05P	10nF, 50V, 10%, surface mount

14.4 PARTS LIST (cont.)

14.4.1 Video Control PCB (cont.)

Item Ref.	Part No.	Description
Capacitors		
C45,C47-C54, C56-C61,C64,C65, C67,C68,C137, C138,C156	89-000032-03P	100nF,50V
C70,C133, C163-C165	84-410004-01P	10 μF, 25V
C100,C101,C103	66-410041-05P	10 pF, 50V, 5%, NPO, surface mount
C102,C104,C105	66-410231-05P	1 nF, 50V, 2%, NPO
C106-C114	64-210134-11P	10 μF, 16V, tantalum, surface mount
C115,C146	44-433103-05P	330 μF, 16V
C119-C121	66-433801-05P	3.3 pF
C125	66-447141-05P	470 pF, 50V, NPO, surface mount
C126	66-433141-05P	330 pF, 50V, 5%, NPO, surface mount
C157	84-422004-01P	22 μF, 25V
C139-C144,C147, C149,C151,C152	88-174740-12P	470 nF, 63V, 10%, mylar
C166	86-622151-02P	220 pF, 100V, 10%
C167	86-610252-02P	1 nF, 100V
C168-C170	66-422041-05P	22 pF, 50V, 5%, NPO, surface mount
Resistors		
R7,R8,R104,R105, R123-R129	70-710023-21P	10K, 1/4W, 5%, surface mount
R9,R211,R212	70-747013-21P	4.7K, 1/4W, 5%, surface mount
R12,R133	70-768003-21P	680R, 1/4W, 5%, surface mount
R36,R64,R92	82-375091-29P	75R, 1/3W, 1%
R97,R120,R121,R130, R131	70-710043-21P	1M, 1/4W, 5%, surface mount
R98,R99,R103	70-724093-21P	24R, 1/4W, 5%, surface mount
R106,R188-R192, R243	70-747003-21P	470R, 1/4W, 5%, surface mount
R113-R115	41-000345-05P	5K trimpot, 20 turn
R132,R137,R143, R144	70-710003-21P	100R, 1/4W, 5%, surface mount
R182-R184,R213	70-710013-21P	1K, 1/4W, 5%, surface mount

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14.4 PARTS LIST (cont.)

14.4.1 Video Control PCB (cont.)

	Item Ref.	Part No.	Description
	Resistors (cont.)		
	R134-R136, R140-R142	70-720003-21P	200R, 1/4W, 5%, surface mount
	R138,R139,R145	70-751093-21P	51R, 1/4W, 5%, surface mount
	R146-R148	70-751003-21P	510R, 1/4W, 5%, surface mount
	R149,R152,R153, R155,R157,R158,		
⚠	**R160–R163**	**70–710093–21P**	**10R, 1/4W, 5%, surface mount SAFETY COMPONENT**
	R154,R164,R165	70-775093-21P	75R, 1/4W, 5%, surface mount
	R168,R169,R171, R205-R207	70-715013-21P	1.5K, 1/4W, 5%, surface mount
	R170,R172,R173	70-711013-21P	1.1K, 1/4W, 5%, surface mount
	R174-R176	70-713013-21P	1.3K, 1/4W, 5%, surface mount
	R177,R178	70-733013-21P	3.3K 1/4W, 5%, surface mount
	R185-R187	82-351191-29P	51.1R, 1/3W, 1%
	R193-R195	70-791003-21P	910R, 1/4W, 5%, surface mount
	R196-R201	70-751013-21P	5.1K, 1/4W, 5%, surface mount
	R219	80-122015-11P	2.2K, 1/2W, 5%, metal film
	R220	80-115015-11P	1.5K, 1/2W, 5%, metal film
⚠	**R221,R222,R228, R230–R232**	**80–110095–11P**	**10R, 1/2W, 5%, metal film SAFETY COMPONENT**
	R223,R239,R240	80-110015-11P	1K, 1/2W, 5%, metal film
	R224	80-191025-11P	91K, 1/2W, 5%, metal film
	R225	80-110035-11P	100K, 1/2W, 5%, metal film
	R226	80-118035-11P	180K, 1/2W, 5%, metal film
	R229,R251	80-127005-11P	270R, 1/2W, 5%, metal film
⚠	**R233–R235**	**70–733083–21P**	**3.3R, 1/4W, 5%, surface mount SAFETY COMPONENT**
	R236-R238	70-782003-21P	820R, 1/4W, 5%, surface mount
	R241,R242	80-110025-11P	10K, 1/2W, 5%, metal film
	R244	70-768093-21P	68R, 1/4W, 5%, surface mount
	R252	80-110005-11P	100R, 1/2W, 5%, metal film
	R253-R255	70-756093-21P	56R, 1/4W, 5%, surface mount
	RN1	43-000053-04P	1K resistor network

14.4 PARTS LIST (cont.)

14.4.2 Hysteresis PCB

Note: **The Hysteresis PCB mounts in the IC35 socket on the Video Control PCB.**

Item Ref.	Part No.	Description
Integrated Circuits		
IC1	14-A04041-01P	MM74HC4538, CMOS multi-vibrator
IC2	14-A04007-01P	74HC74, H-CMOS dual D flip flop
IC3	14-A04073-01P	74HC14, hex schmitt trigger inverter
Transistors and Diodes		
D1,D2	14-000513-01P	1N914, .075A, 75V
Q1	14-A00705-01P	2N7000, TMOS, 60V, 0.2A, 4W
Capacitors		
C1	86-610031-04P	10pF
C2	89-000032-04P	10nF, 50V, 20%
C3,C4	86-647135-11P	470pF, 100V, 2%
C5	89-000032-03P	100pF, 50V
Resistors		
R1	80-147005-11P	470R, 1/2W, 5%, metal film
R2	80-120015-11P	2K, 1/2W, 5%, metal film
R3	80-110015-11P	1K, 1/2W, 5%, metal film

54-7904-02P/54-7904-03P (06/90)

14.5 SPECIFICATIONS

Connector P1, Row A:

Pin 1 . . . . . analog output **G VIDEO**
amplitude into 75Ω . . . . . 1V p-p ± 10%
frequency response . . . . . 60 MHz - 3 dB

Pin 2 . . . . . ground **GND**

Pin 3 . . . . . analog output **B VIDEO**
amplitude into 75Ω . . . . . 1V p-p ± 10%

Pin 4 . . . . . ground **GND**

Pin 7 . . . . . analog input **CLAMP**
back porch clamping pulse . . . . . 5 to 10V peak
pulse width . . . . . 1.6 to 2.0 μS

Pin 9 . . . . . digital input, address line **A(0)**
Pin 10 . . . . . digital input, address line **A(1)**
Pin 11 . . . . . digital input, address line **A(2)**
Pin 12 . . . . . digital input, address line **A(3)**
Pin 13 . . . . . digital input, address line **A(4)**
Pin 14 . . . . . digital input, address line **A(5)**
Pin 15 . . . . . digital input, address line **A(6)**
Pin 16 . . . . . digital input, address line **A(7)**
Pin 17 . . . . . digital input, address line **A(8)**
Pin 18 . . . . . digital input, address line **A(9)**

Pin 19 . . . . . digital in/output, data line **D(0)**
Pin 20 . . . . . digital in/output, data line **D(1)**
Pin 21 . . . . . digital in/output, data line **D(2)**
Pin 22 . . . . . digital in/output, data line **D(3)**
Pin 23 . . . . . digital in/output, data line **D(4)**
Pin 24 . . . . . digital in/output, data line **D(5)**
Pin 25 . . . . . digital in/output, data line **D(6)**
Pin 26 . . . . . digital in/output, data line **D(7)**

Pin 27 . . . . . -12V power supply **-12 VDC**

Pin 28 . . . . . +12V power supply **+12 VDC**

Pin 29 . . . . . +5V power supply **+5 VDC**

Pin 30 . . . . . connected to Pin 29 **+5 VDC**

Pin 31 . . . . . ground **GND**

Pin 32 . . . . . connected to Pin 31 **GND**

Connector P1, Row C:

Pin 1 . . . . . ground **GND**

Pin 2 . . . . . analog output **R VIDEO**
amplitude into 75Ω . . . . . 1V p-p ± 10%
frequency response . . . . . 60 Mhz - 3 Db

Pin 3 . . . . . ground **GND**

Pin 4 . . . . . analog input **RED VID**
amplitude . . . . . 1V p-p

Pin 5 . . . . . ground **GND**

Pin 6 . . . . . analog input **GRN VID**
amplitude . . . . . 1 V p-p

Pin 7 . . . . . ground **GND**

Pin 8 . . . . . analog input **BLU VID**
amplitude . . . . . 1V p-p

Pin 10 . . . . . digital input **VFB**
signal level . . . . . 0 to 12V

Pin 11 . . . . . analog input **R GAIN**
contrast control voltage . . . . . 0 to 5V

Pin 12 . . . . . analog input **B GAIN**
contrast control voltage . . . . . 0 to 5V

Pin 13 . . . . . analog input **G GAIN**
contrast control voltage . . . . . 0 to 5V

Pin 17 . . . . . digital input **SEL1**
input/output select 1 . . . . . TTL

Pin 21 . . . . . digital input **HFB**
horizontal flyback pulse . . . . . 0 to 12V

Pin 22 . . . . . digital input $\overline{\textbf{RD}}$
read signal . . . . . TTL

Pin 23 . . . . . digital input $\overline{\textbf{SEL2}}$
input/output select 2 . . . . . TTL

Pin 24 . . . . . digital input $\overline{\textbf{WR}}$
write signal . . . . . TTL

Pin 25 . . . . . digital input **HPLLCLK**
horizontal phase lock loop . . . . . 0 to 5V

Pin 26 . . . . . digital input **HRESET**
horizontal reset pulse . . . . . 0 to 5V

54-7904-02P/54-7904-03P (06/90)

SECTION 15

BIAS MODULE

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

No tables are included in this section.

54-7904-02P/54-7904-03P (06/90)

15.1 TECHNICAL DESCRIPTION

15.1.1 General Description

The Bias module controls each CRT and their operating voltages via the Power Deflection and Video Output modules. Circuit functions include: beam limiter, over-current trip, G1 control, G2 bias, static focus, and dynamic focus.

15.1.2 Circuit Description

15.1.2.1 Beam Limiter

By overriding the contrast signal, the beam limit circuit limits the average beam current on each CRT to a safe level. The I1 current sense signals from the three video boards are ORed together by D19 through D21 and compared to a 4 volt reference (IC3) by IC4. D22 pulls the beam limit line low to reduce contrast if any I1 inputs rise above 4.3V.

15.1.2.2 Over Current Trip Circuit

The over current trip circuit shuts off the high voltage module outputs if the beam limit circuit fails. Comparator IC5 compares the three I2 signals (from the video modules) to a 6.4V reference (IC2). If any input goes above the 6.4V reference, the collector output of IC5 opens and the High Voltage module is disabled.

15.1.2.3 G1 Circuit

The G1 circuit provides biasing, blanking, and spot kill. The G1 is biased to -10.5V by D13 and D14. The blanking waveform is amplified by Q10 to approximately $22V_{p-p}$ and coupled to the G1 output through C56.

The spot kill circuit provides a -160V bias to the CRTs whenever the power or deflection circuits are disabled. C50 is charged to 150V through D13 on power-up. When EHT inhibit 1 goes open, Q1 turns on pulling the positive side of C50 to ground. The negative side of C50 then goes to -160V, dragging the G1 (through D14) with it.

15.1.2.4 G2 Circuit

The G2 circuit consists of a set of potentiometers which derive the G2 supply voltage from the 800V supply. The potentiometer outputs connect to switches which allow the G2 of each CRT to be turned off for set-up.

15.1.2.5 Static Focus

The static focus circuit provides an adjustable (8.9KV to 10.4KV) focus voltage to the CRTs from a 17KV tap in the High Voltage module. Potentiometers R26 through R28 of the focus board provide individual adjustment of the focus voltage for each CRT. IC4B, Q6, Q7, Q8, Q9, Q13 and Q14 form a 2kV shunt regulator for fine master focus. The regulator is controlled by the 0-10V electronic focus signal from the Remote Control module.

15.1.2.6 Dynamic Focus

A dynamic focus voltage is generated by two amplifiers to supply the parabolic voltage required between the center and edge of the raster. Q12, Q13 and Q16 form a low frequency amplifier which amplifies the vertical rate parabola of the dynamic focus signal. Amplifier gain is approximately 65. Q11, Q14 and Q15 amplify the horizontal parabola approximately 40 times to drive T2. T2 steps up the horizontal parabola approximately 1.7 times and combines the output with the vertical parabola, generating a composite parabola of roughly $400V_{p-p}$. The output is then coupled to the G4 of each CRT (through C27, C28 and C29). SG1 and SG2 are 250V spark gaps which protect the amplifiers from high voltage arcs.

15.2 SERVICING AND ALIGNMENT

15.2.1 Disassembly and Access

WARNING

STATIC SENSITIVE COMPONENTS
STATIC CONTROLLED WORK STATION REQUIRED

Module Location:
- projection head

Tools & Equipment Required:
- Phillips screw driver
- 1/4" hex head socket

a) Remove the front and rear top covers as described in Section 5.2.

b) Locate the Bias module and disconnect the P1, P2, P3, P4, P5, P6, P7, P8, P9, P10, P11, and P12 connectors. (Refer to Appendix C, *Harness/Wiring Diagram* for reconnection.)

c) Remove the 2 hex head screws securing the Bias module to the top bracket as shown below.

e) Lift the Bias module from the projector.

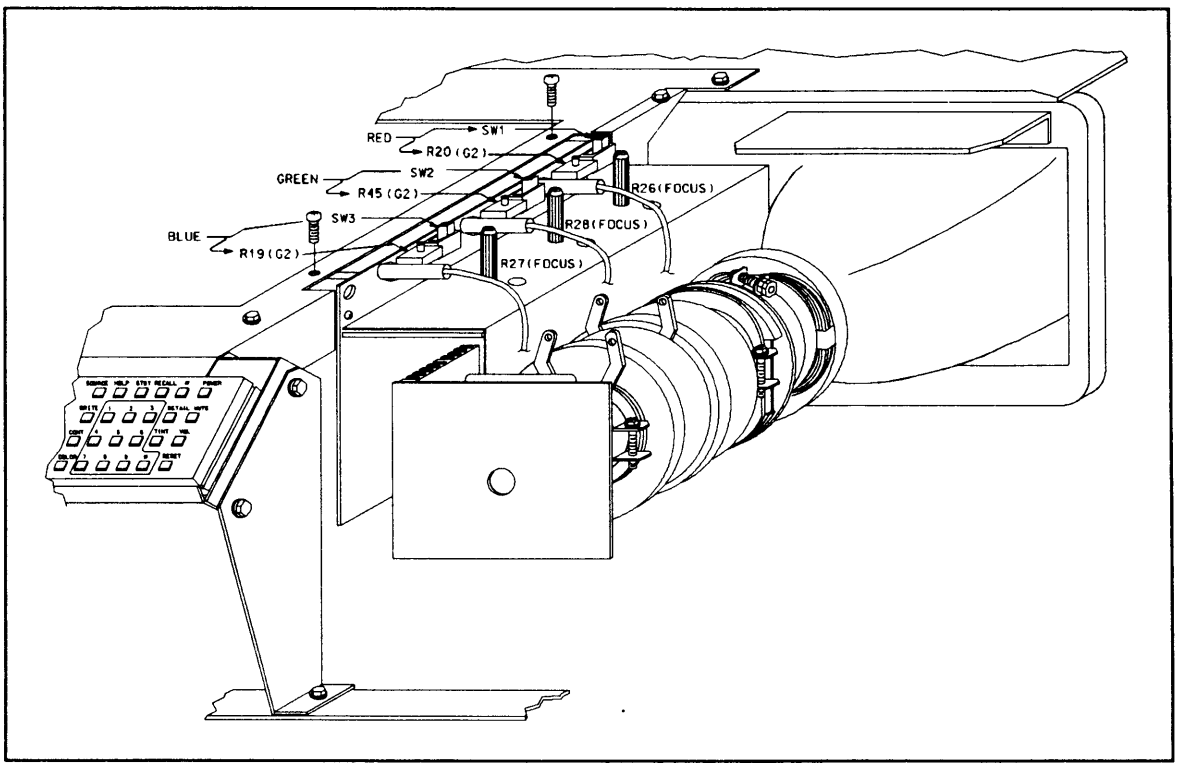

FIGURE 15-1. ***Bias Module Removal/Alignment***

15.2.2 Alignment

Set-up of the electronic focusing circuitry may be performed via adjustments to the Bias module as follows:

NOTE: The projector must be optically focused before performing this procedure.

Reference Figure 15-1.

Tools & Equipment Required:
- fine tip slot screwdriver
- Phillips screw driver

STEP 1

a) Turn the room lights off. Project an image on the screen.

STEP 2 – Adjust Red Focus

a) Turn OFF the green and blue CRTs by moving slide switches, SW2 and SW3, down. The projected image should be red.

b) Adjust BRIGHTNESS and CONTRAST to 3 on the function bar graph.

c) Adjust R26 until the focus at the center of the picture appears best.

STEP 3 – Adjust Green Focus

a) Turn OFF the red CRT by moving slide switch SW1 down. Turn on the green CRT by moving SW2 up. SW3, should be in the down position. The projected image should be green.

b) Adjust R28 until the focus at the center of the picture appears best.

STEP 4 – Adjust Blue Focus

a) Turn OFF the green CRT by moving SW2 down. Turn ON the blue CRT by moving SW3 up. Slide switch, SW1, should be in the down position. The projected image should be blue.

b) Adjust R27 until the focus at the center of the picture appears best.

STEP 5 – Completion

a) Turn ON all 3 CRTs by moving SW1, SW2 and SW3 to the up position.

15.2 COMPONENT LAYOUT AND SCHEMATICS

Refer to the following pages for component layouts and schematics of the Bias module.

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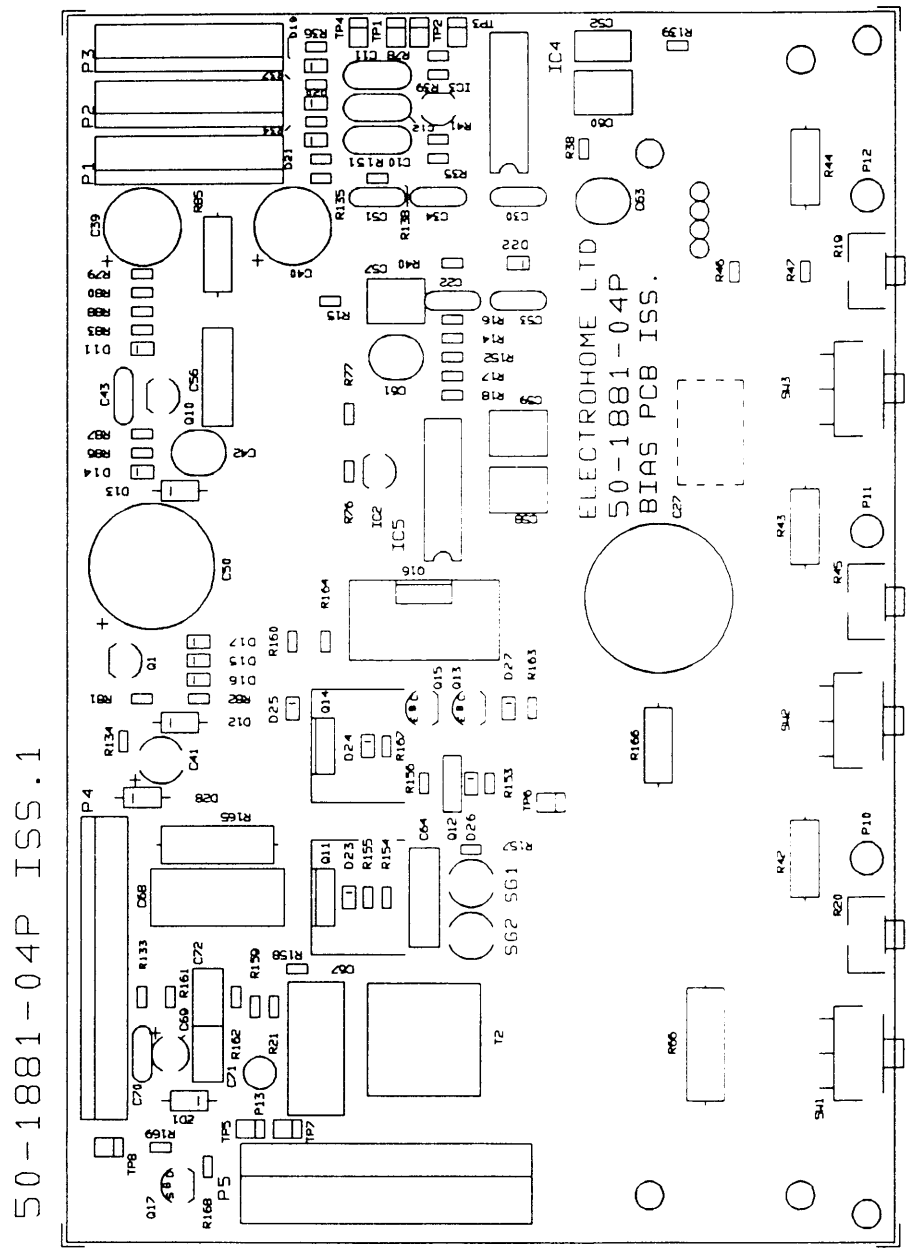
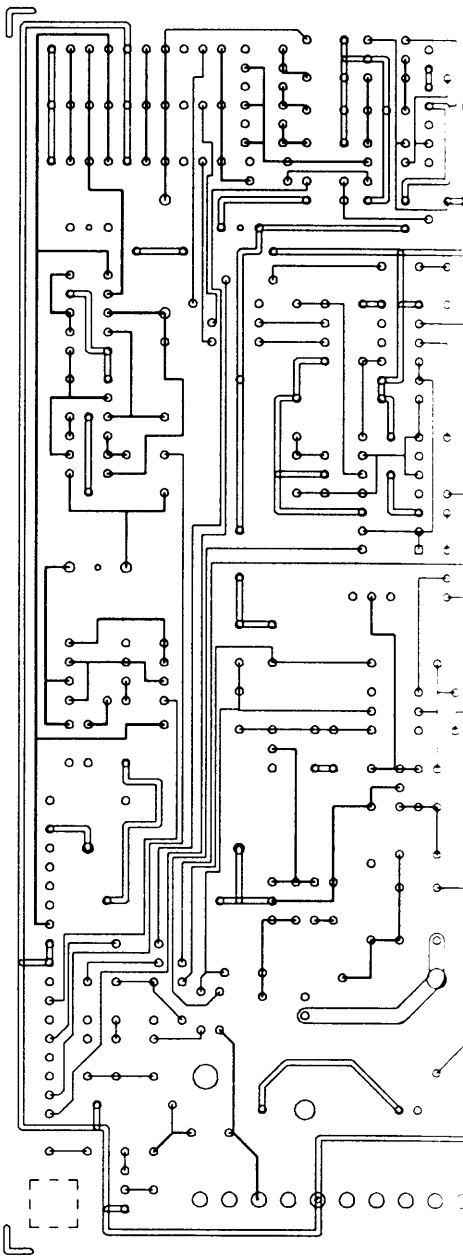
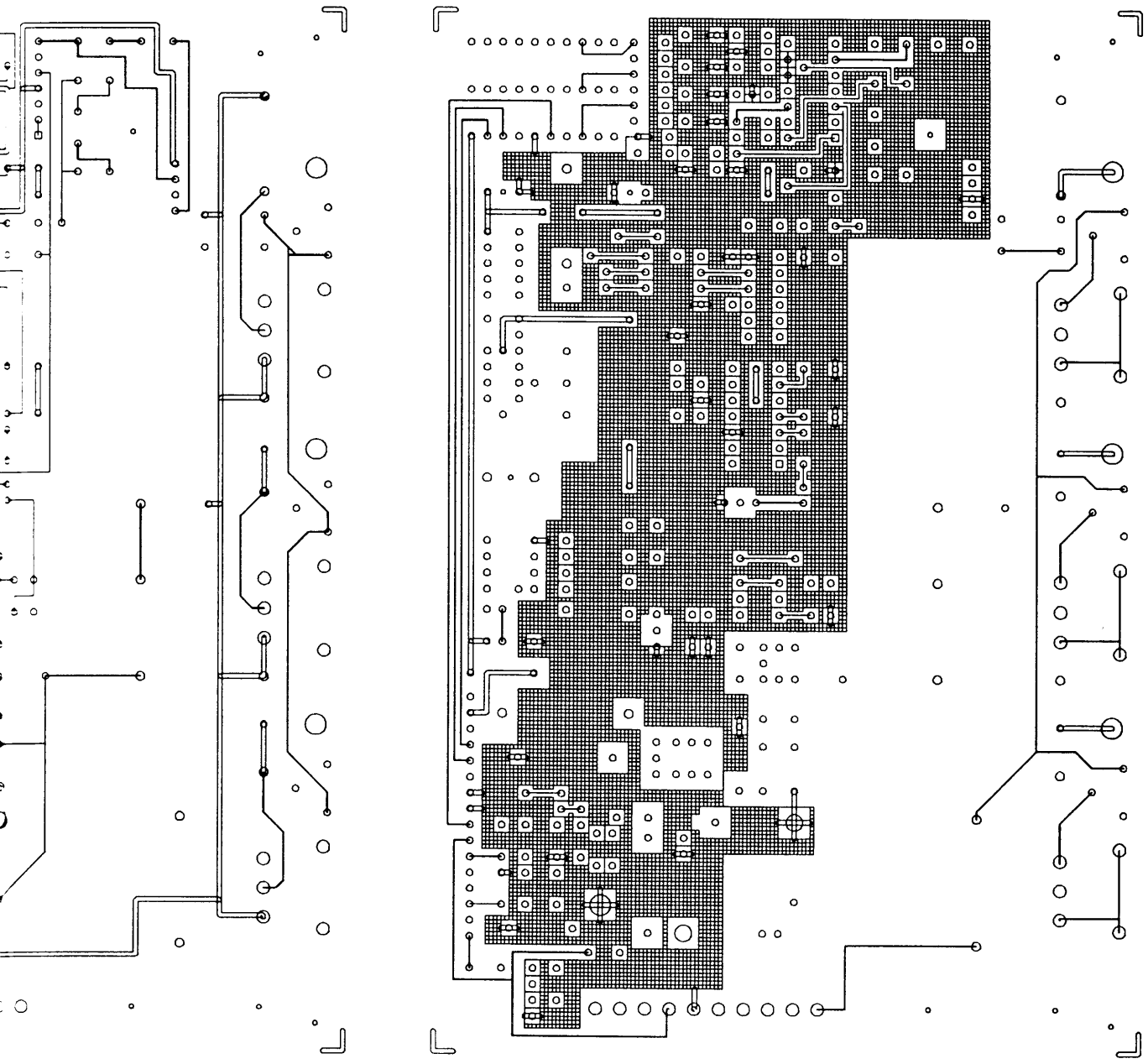


Component Layout



Solder S
(Viewed from Con



r Side
omponent Side)

Component Side

FIGURE 15-2.
Bias PCB Component Layout

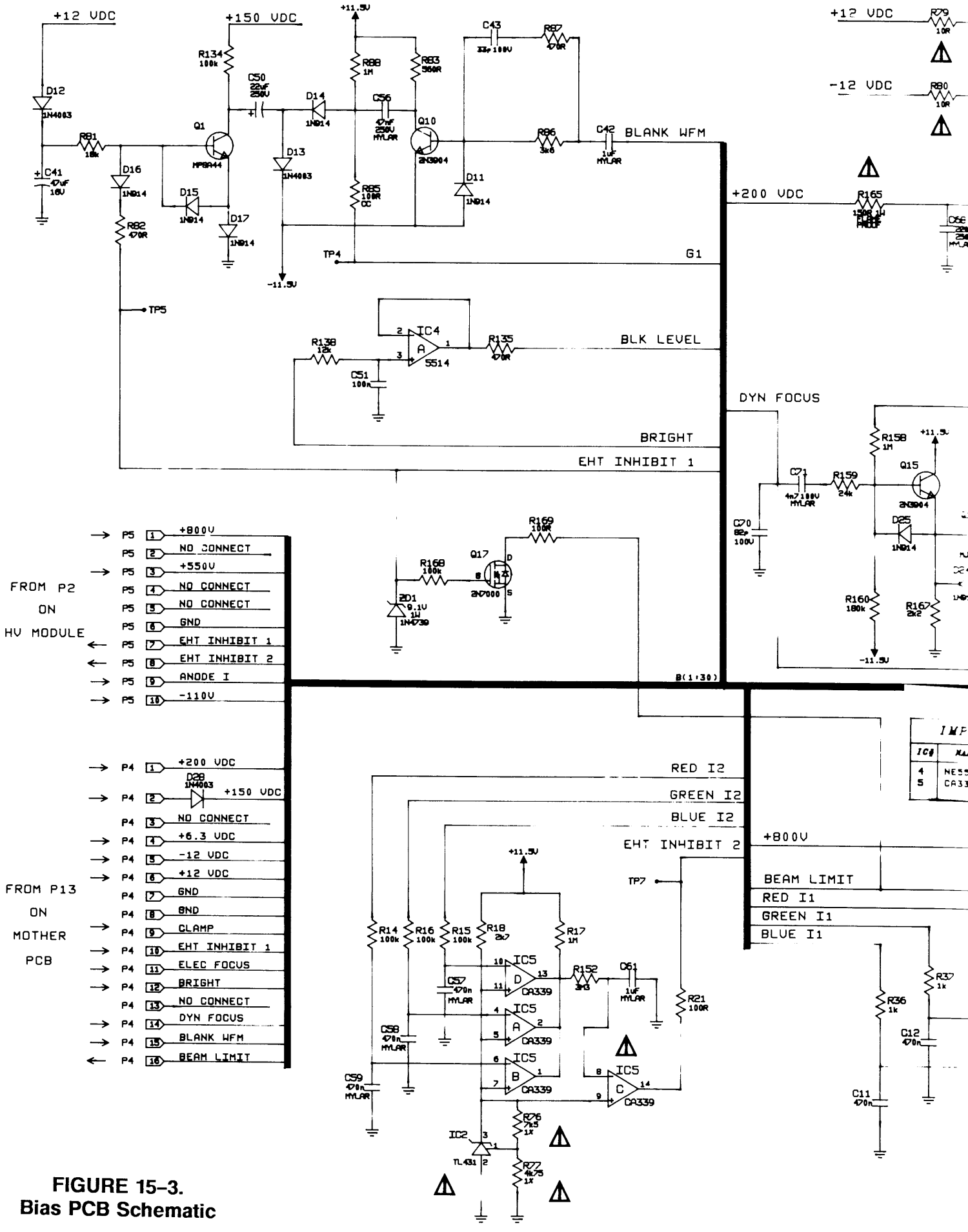
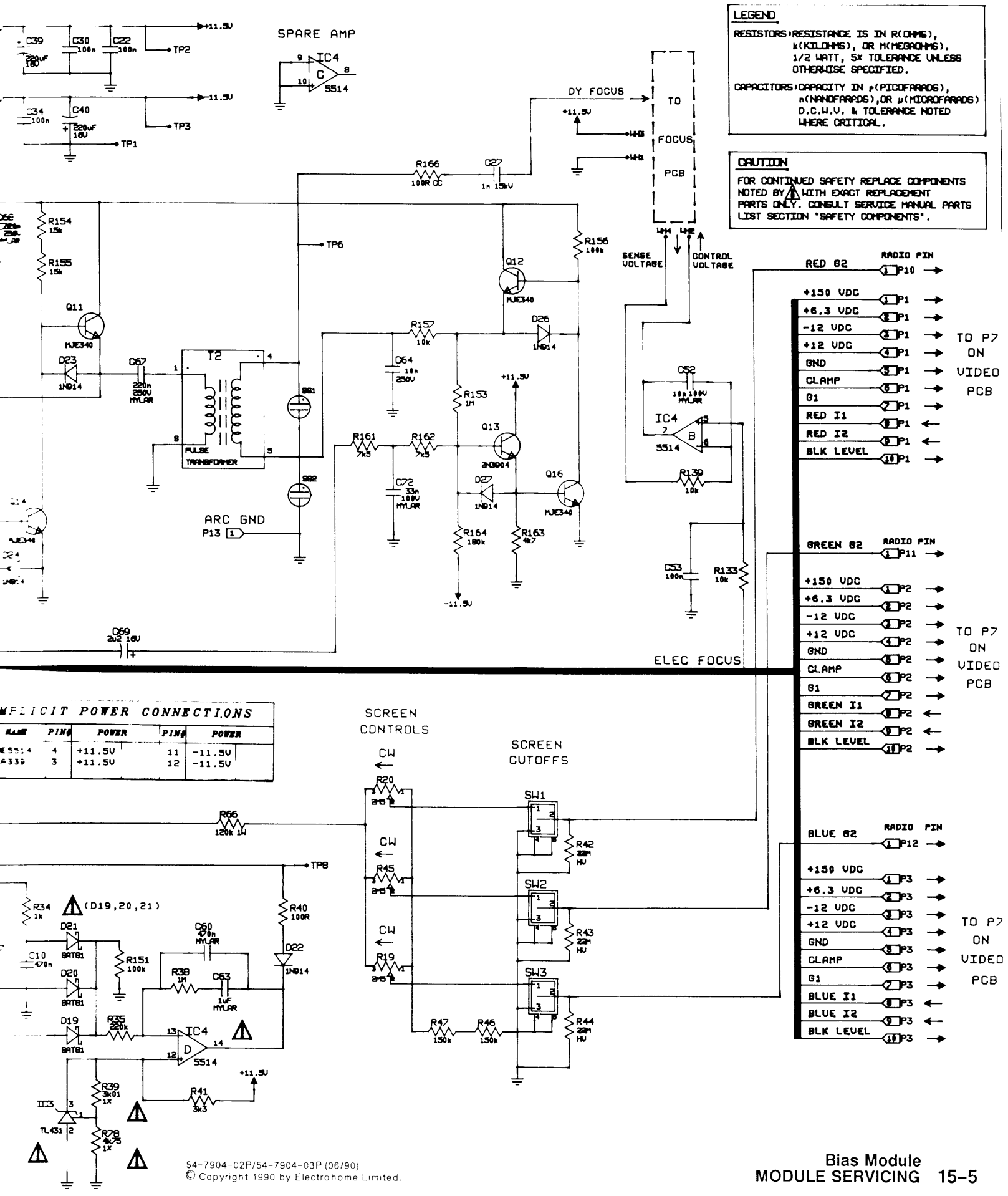


FIGURE 15–3.
Bias PCB Schematic

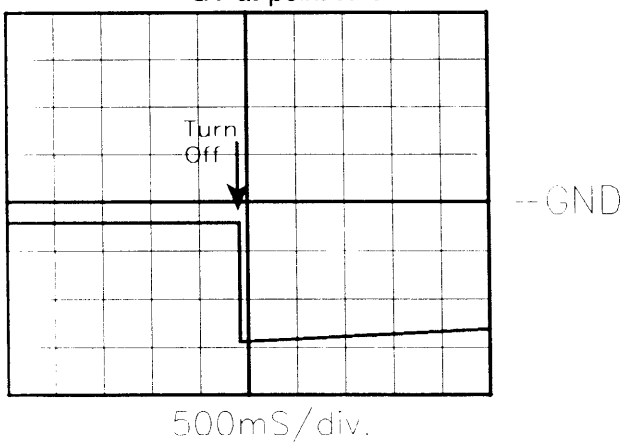


IMPLICIT POWER CONNECTIONS

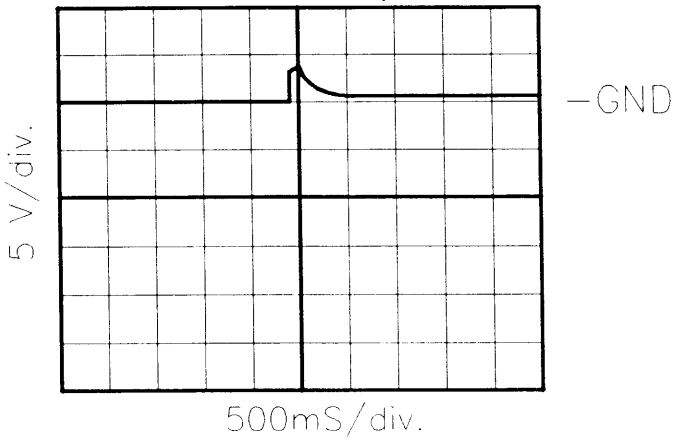
NAME	PIN#	POWER	PIN#	POWER
IC5514	4	+11.5V	11	-11.5V
IC4339	3	+11.5V	12	-11.5V

SCHEMATIC REFERENCE

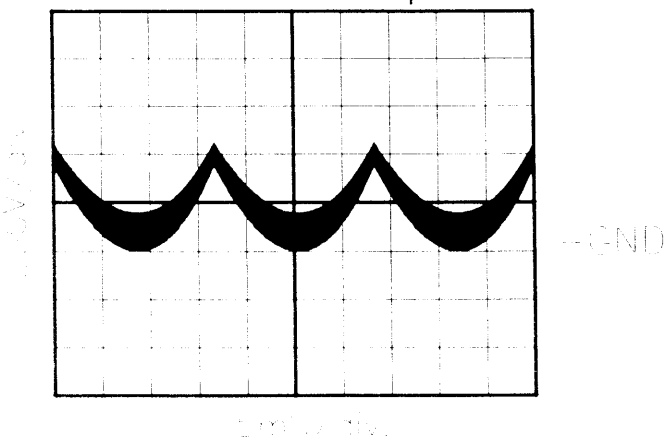
G1 at point **TP4**



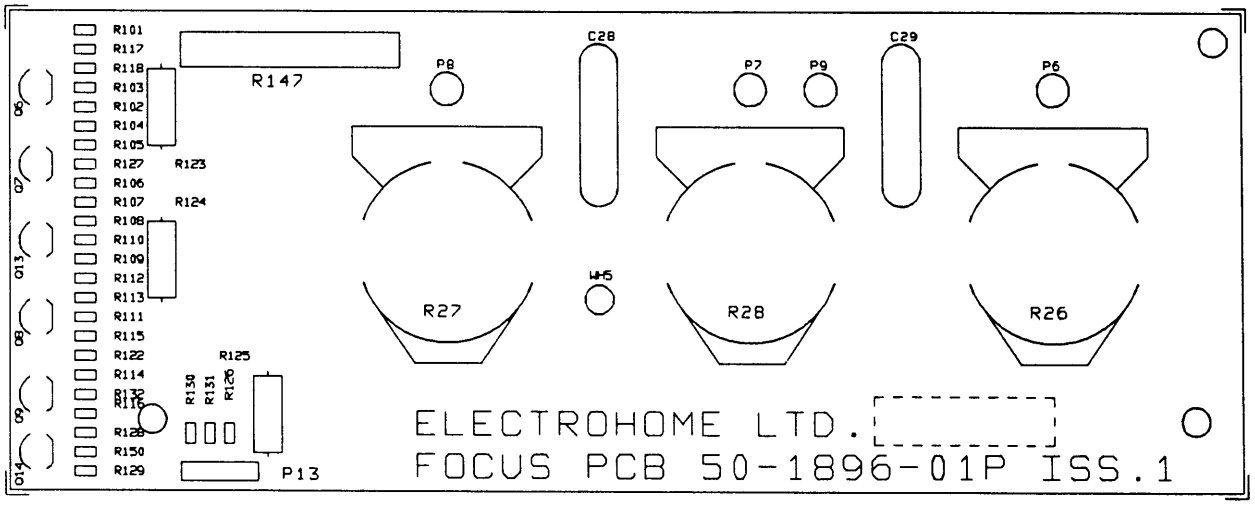
EHT INHIBIT at point **TP5**



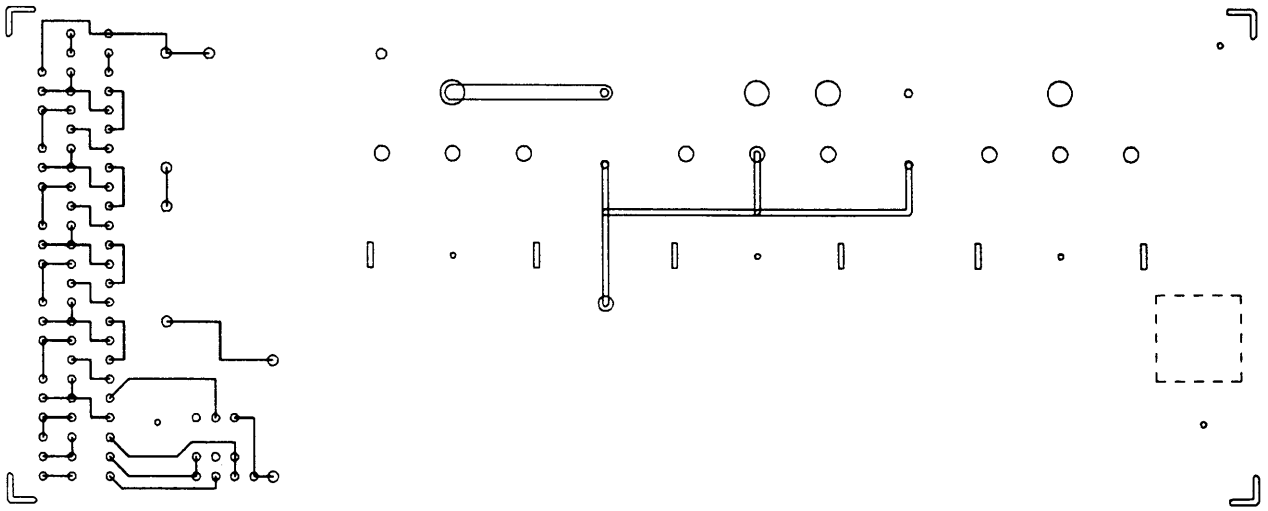
DYNAMIC FOCUS at point **TP6**



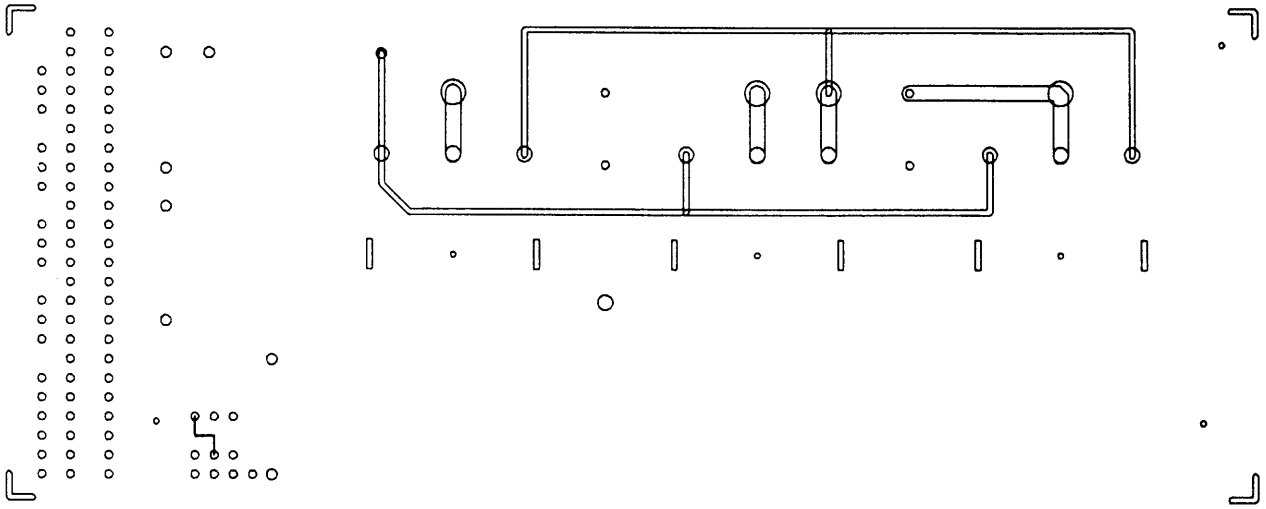
54-7904-02P/54-7904-03P (06/90)



Component Layout



Solder Side
(Viewed from Component Side)



Component Side

FIGURE 15-4. *Focus PCB Component Layout*

54-7904-02P/54-7904-03P (06/90)

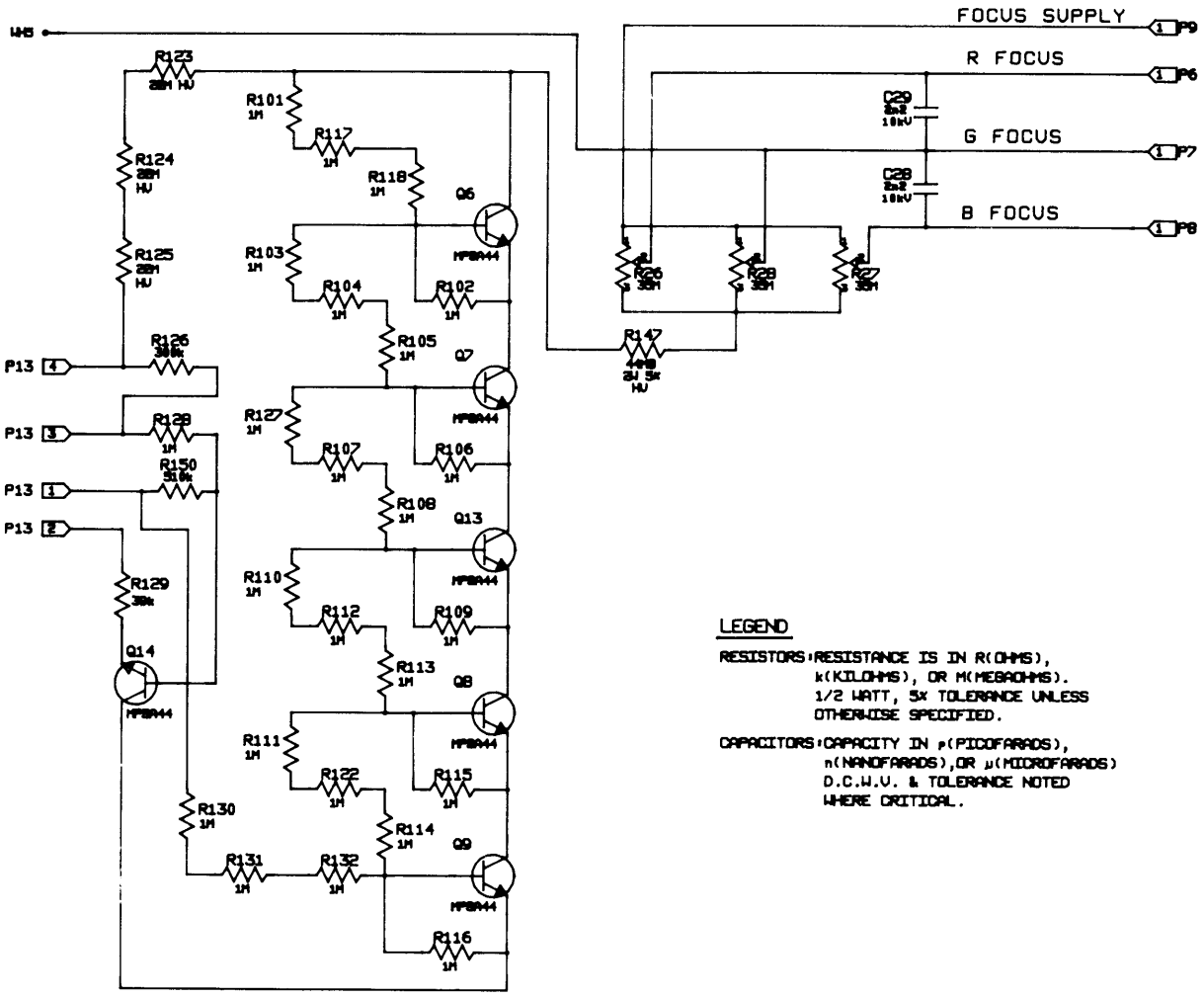


FIGURE 15-5. *Focus PCB Schematic*

15.4 PARTS LIST

15.4.1 Bias PCB Assembly

	Item Ref.	Part No.	Description
	Integrated Circuits		
⚠	**IC2,IC3**	**14-002833-01P**	**TL431C, precision shunt regulator SAFETY COMPONENT**
⚠	**IC4**	**14-002813-08P**	**NE5514, quad linear amplifier SAFETY COMPONENT**
⚠	**IC5**	**14-002154-01P**	**CA339, quad linear voltage comparator SAFETY COMPONENT**
	Transistors & Diodes		
	Q1	14-000889-01P	MPSA44, small signal NPN, 400V, 0.3A, 0.6W
	Q10,Q13,Q15	14-000881-06P	2N3904, NPN, 40V, 0.2A, 0.35W
	Q11,Q12,Q14,Q16	14-000986-03P	MJE340, NPN, 300V, 0.5A, 20W
	Q17	14-A00705-01P	2N7000, TMOS, 60V, 0.2A, 4W
	D11,D14-D17, D22-D27	14-000513-01P	1N914, diode, 0.075A, 75V
	D12,D13,D28	14-000525-53P	1N4003, rectifier diode, 1A, 200V
⚠	**D19,D20,D21**	**14-000533-01P**	**BAT81, Schottky barrier diode SAFETY COMPONENT**
	ZD1	14-000531-39P	1N4739A, zener diode, 9.1V, 1W
	Capacitors		
	C10,C11,C12	89-000032-02P	0.47 μF, 50V, ± 20%
	C22,C30,C34, C51,C53	89-000032-03P	100 nF, 50V
	C27	46-500002-02P	1 nF, 15KV, HV
	C39,C40	84-422103-03P	220 μF, 16V
	C41	84-447003-02P	47 μF, 16V
	C42,C61,C63	88-171053-12P	1 μF, 50V, mylar
	C43	46-633031-10P	33 pF, 100V, N750
	C50	44-422010-09P	22 uF, 250V
	C52	88-171031-02P	10 nF, 100V, 10%
	C56	48-174732-02P	47 nF, 250V, 10%, mylar
	C57-C60	88-174740-12P	470 nF, 63V, 10%
	C64	48-171032-02P	10 nF, 250V, 10%
	C67,C68	48-172242-02P	220 nF, 250V, ± 10%
	C69	84-422506-01P	2.2 μF, 50V, 20%, electrolytic
	C70	86-682034-04P	82 pF, 2%, 100V
	C71	88-174721-02P	4.7 nF, 100V, 10%, mylar
	C72	88-173331-01P	33 nF, 100V, mylar

15.4 PARTS LIST (cont.)

15.4.1 Bias PCB Assembly (cont.)

	Item Ref.	Part No.	Description
	Resistors		
	R14-R16,R134, R151,R156,R168	80-110035-11P	100K, 1/2W, 5%, metal film
	R17,R38,R88, R153,R158	80-110045-11P	1M, 1/2W, 5%, metal film
	R18	80-127015-11P	2.7K, 1/2W, 5%, metal film
	R19,R20,R45	41-000371-01P	2.5M, HV potentiometer
	R21,R40,R169	80-110005-11P	100R, 1/2W, 5%,metal film
	R34,R36,R37	80-110015-11P	1K, 1/2W, 5%, metal film
	R35	80-122035-11P	220K, 1/2W, 5%
⚠	**R39**	**82-330111-29P**	**3.01K, 1/3W, 1% SAFETY COMPONENT**
	R41	80-133015-11P	3.3K, 1/2W, 5%, metal film
	R42-R44	80-222055-23P	22M, 1/2W, 5%, HV, metal glaze
	R46,R47	80-115035-11P	150K, 1/2W, 5%, metal film
	R66	40-424735-01P	47K, 1W, 5%
⚠	**R76**	**82-375011-29P**	**7.5K, 1/4W, 1% SAFETY COMPONENT**
⚠	**R77,R78**	**82-347511-29P**	**4.75K, 1/3W, 1% SAFETY COMPONENT**
⚠	**R79,R80**	**80-110095-11P**	**10R, 1/2W, 5%, metal film SAFETY COMPONENT**
	R81	80-118025-11P	18K, 1/2W, 5%, metal film
	R82,R87,R135	80-147005-11P	470R, 1/2W, 5%, metal film
	R83	80-156005-11P	560R, 1/2W, 5%, metal film
	R85,R166	40-221015-37P	100R, 1/2W, 5%, carbon
	R86	80-136015-11P	3.6K, 1/2W, 5%, metal film
	R133,R139,R157	80-110025-11P	10K, 1/2W, 5%, metal film
	R138	80-112025-11P	12K, 1/2W, 5%, metal film
	R152	40-123355-31P	3.3M, 1/4W, 5%
	R154,R155	80-115025-11P	15K, 1/2W, 5%, metal film
	R159	80-124025-11P	24K, 1/2W, 5%, metal film
	R160,R164	80-118035-11P	180K, 1/2W, 5%, metal film
	R161,R162	80-175015-11P	7.5K, 1/2W, 5%, metal film
	R163	80-147015-11P	4.7K, 1/2W, 5%, metal film
⚠	**R165**	**42-000136-01P**	**150R, 1W, 5% SAFETY COMPONENT**
	R167	80-122015-11P	2.2K, 1/2W, 5%
	Coils, Transformers and Miscellaneous		
	T2	24-170003-01P	dynamic focus transformer
	SW1-SW3	26-000340-01P	right angle slide switch
	SG1,SG2	27-000011-09P	argon lamp (spark gap)

54-7904-02P/54-7904-03P (06/90)

15.4 PARTS LIST (cont.)

15.4.2 Focus PCB Assembly (included as part of Bias module)

Item Ref.	Part No.	Description
Transistors and Diodes		
Q6-Q9,Q13,Q14	14-000889-01P	MPSA44, small signal NPN, 400V, 0.3A, 0.6W
Capacitors		
C28,C29	46-500004-01P	2200 pF, 10KV
Resistors		
R26-R28	41-000251-11P	35M, ± 10%, potentiometer
R101-R118,R122, R127,R128, R130-R132	80-110045-11P	1M, 1/2W, 5%, metal film
R123-R125	80-222055-23P	22M, 1/2W, 5%, metal film
R126	80-130035-11P	300K, 1/2W, 5%, metal film
R129	80-139025-11P	39K, 1/2W, 5%, metal film
R147	42-000128-01P	44.8M, 2W, 5%, high voltage
R150	80-151035-11P	510K, 1/2W, 5%, metal film

15.5 SPECIFICATIONS

Beam Limiter Circuit:

Plugs 1, 2 & 3 pin 8 . . . . . **RGB I1** inputs
Signal Levels
(to Video Output modules) . . . . . 0 to 6VDC
Input Resistance . . . . . 100KΩ min

Plug 4, pin 16 . . . . . **BEAM LIMIT** output
(P1, 2 & 3 pin 8 connected to +6VDC;
2.2KΩ resistor between +5V and P4, pin 16)
Signal . . . . . 0.9VDC max
Output Impedance (+ve current) 100Ω
Output Impedance (-ve current) . . . . . ∞

Beam Over-Current Circuit:

Plugs 1, 2 & 3 pin 9 . . . . . **RGB I2** inputs
Signal Levels
(to Video Output modules) . . . . . 0 to 6VDC
Input Resistance . . . . . 100KΩ min

Plug 5, pin 8 . . . . . **EHT INHIBIT 2** output
(P1, or 2 or 3 pin 9 grounded; 4.7KΩ resistor between +5V and P5, pin8)
Signal . . . . . 0.5VDC max
(P1, or 2 or 3 pin 9 connected to 6.6VDC; 4.7KΩ resistor between +5V and P5, pin8)
Signal . . . . . 4.5VDC min

Brightness Circuit:

Plug 4, pin 12 . . . . . **BRIGHTNESS** input
Signal Level . . . . . 0 to 10VDC
Input Resistance . . . . . 12KΩ min

Plugs 1 & 2, pin 10 . . . . . **BLK LEVEL** output
(0 to 10V applied to P4, pin 12)
Signal Level . . . . . 0 to 7.5VDC ± 5%
Output Resistance . . . . . 470Ω nom
Load Impedance 1.6KΩ

Dynamic Focus Amplifier Circuit:

Plug 4, pin 14 . . . . . **DYNAMIC FOCUS** input
Parabolic Waveform Level . . . . . 0 to 10V p-p
Input Resistance . . . . . 16KΩ min
Plugs 6, 7 & 8, pin 1 . . . . . **RGB FOCUS** output

WARNING

HIGH VOLTAGE!

Parabola Output at TP6
amplifier bias point . . . . . 198 to 242VDC
Clipping Levels w.r.t. Vertical Parabola
bottom of parabola . . . . . 80V max
top of parabola . . . . . 450V min

NOTE: For version 02P, the following apply:
TP6 bias . . . . . 72VDC nom.
vertical parabola . . . . . 160v p-p nom.
horizontal parabola . . . . . 240V p-p nom.

Electrical Focus Circuit:

Plug 4, pin 11 . . . . . **ELECTRICAL FOCUS** input
Signal Level . . . . . 0 to 10VDC
Input Resistance . . . . . 10KΩ min

Plugs 6, 7 & 8 . . . . . **RGB FOCUS** output
(master focus set to center)
Signal Level . . . . . 8.9 to 10.4KV
(individual controls set at minimum master focus range)
Signal Level . . . . . 800V min

G1 Circuit:

Plug 4, pin 10 . . . . . **EHT INHIBIT 1** input
pin 15 . . . . . **COMP BLANKING** input
HC Level . . . . . 0 to 5V

Plugs 1 & 2, pin 7 . . . . . G1 grid 1 bias out
no blanking,
spot kill OFF . . . . . -11 to -10V
blanking @ min . . . . . -35 to -30V
connection to EHT INHIBIT 1 opened,
momentary G1 level . . . . . -160V max
(exponential decay to 0 after 22 s)

blanking dynamic response
rise time . . . . . 200 ns max
fall time . . . . . 100 ns max

vertical pulse
2.5 ms pulse width,
18 ms period 5V

spot killer dynamic response
rise time . . . . . 20 s min
fall time . . . . . 150 μs max

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G2 Circuit:

Input Controls R19,R20,R45,SW1,SW2,SW3

Output . . . . . RGB G2
Output Level . . . . . 210V to 760V

Power Supplies:

Plug 9 . . . . . Focus supply
Level . . . . . 170 μA nom

Plug 5, pin 1 . . . . . 800V ± 5%
Load Current . . . . . 0.5mA nom

Plug 5, pin 3 . . . . . +550V ± 5%
Load Current . . . . . 9mA nom
NOTE: This pin is not required on version 02P.

Plug 4, pin 2 . . . . . Video B, +150V
Load Current . . . . . 3mA max

Plug 4, pin 6 . . . . . +12VDC
Load Current 30mA

Plug 4, pin 5 . . . . . -12VDC
Load Current 30mA

SECTION 16

HORIZONTAL DEFLECTION MODULE

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

No tables are included in this section.

16.1 TECHNICAL DESCRIPTION

16.1.1 General Description

The Horizontal Deflection module splits the incoming composite sync video signal into horizontal and vertical components. The vertical sync pulse is fed to the Vertical Deflection & Horizontal Regulation module. The horizontal sync pulse is used by the auto-frequency lock, bandswitch and horizontal processor circuitry to form a horizontal drive pulse. This pulse, H DRIVE, is fed to the Power Deflection modules.

The Horizontal Deflection module also produces a regenerated sync pulse which is used by the MOVE key on the keypads to shift the projected image up, down, left and right.

16.2 SERVICING AND ALIGNMENT

16.2.1 Disassembly and Access

WARNING

STATIC SENSITIVE COMPONENTS
STATIC CONTROLLED WORK STATION REQUIRED

Module Location:
- rear panel card rack

Tools & Equipment Required:
- Phillips screw driver

a) Remove the back panel as described in Section 5.

b) Locate the Horizontal Deflection Module in the rear panel card rack. Using the printed circuit board extractor (from the tool pouch), pull the module from the card rack as described in Section 5.

16.2.2 Alignment

Tools & Equipment Required:
- printed circuit board extractor
- extender board, Electrohome Part # 03-230330-01P
- digital voltmeter
- dual channel oscilloscope
- video source

STEP 1 – Remove Horizontal Deflection

a) Hook the printed circuit board extractor into the hole in the outside corner of the Horizontal Deflection module. Pull the module out of its slot.

b) Insert the extender board into the Horizontal Deflection module slot. Connect the Horizontal Deflection module to the extender board.

STEP 2 – Regulation Adjust

a) Connect the digital voltmeter between ground and test point P7. Adjust R93 to produce a reading of 12.4± 0.15 VDC.

STEP 3 – Move Circuitry Temperature Compensation

a) Remove jumper P8. Connect the digital voltmeter between test point TP11 (or the cathode pin of IC25) and ground. Adjust R139 to produce a reading of 8.25 VDC. Replace jumper P8.

STEP 4 – Move Circuitry Alignment

Connect channel 1 of the oscilloscope to pin 10 of IC1. Connect channel 2 of the oscilloscope to test point TP10 or pin 6 of IC7. Adjust R130 until the falling edges of both waveforms are 1.4 μS apart.

STEP 5 – Autolock Alignment (High Band)

Note: If the high band lock-in range is functional, ignore this step and proceed to Step 6.

a) Connect the voltmeter between test point P6 and ground.

b) Apply a 24 KHz signal to the projector. Adjust R87 until the image is locked in. Observe the voltmeter reading.

c) Adjust R87 until the voltmeter reading drops by 0.2 to 0.3 VDC.

d) Apply a 54 KHz signal to the projector.

e) Adjust R67 to lock in the image. Observe the voltmeter reading.

f) Adjust R67 until the voltmeter reading drops by 0.2 to 0.3 VDC.

NOTE: R87 and R67 are interactive controls. It may be necessary to switch between the above frequencies and adjust the controls accordingly until autolock is achieved.

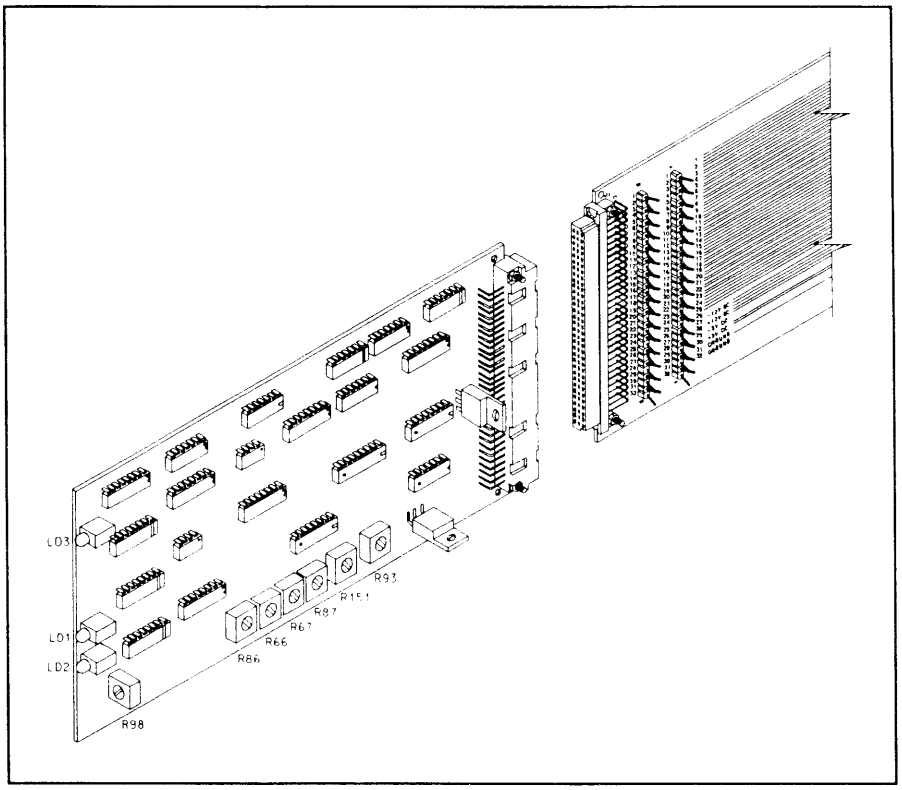

FIGURE 16-1. *Horizontal Deflection Module Alignment*

STEP 6 – Autolock Alignment (Low Band)

NOTE: If the low band lock-in range is functional, ignore this section and proceed to the reference voltage adjust section.

a) Connect the voltmeter between test point P6 and ground.

b) Apply a 15.72 KHz signal to the projector.

c) Adjust R86 to lock in the image. Observe the voltmeter reading.

d) Adjust R86 until the voltmeter reading drops by 0.2 to 0.3 VDC.

e) Apply a 35 KHz signal to the projector.

f) Adjust R66 to lock in the image. Observe the voltmeter reading.

g) Adjust R66 until the voltmeter reading drops by 0.2 to 0.3 VDC.

NOTE: R66 and R86 are interactive controls. Repeat the above steps several times until autolock is achieved at both frequencies.

STEP 7 – Reference Voltage Adjust

a) Remove the short between test points P3 and P4 on the Horizontal Deflection module. See Figure 6-29.

b) Apply a 27 KHz signal to the projector.

c) Adjust R98 until the green (LD1) and red (LD2) LEDs are lit and at equal brightness.

NOTE: If the projector is to be used with a 27 KHz computer source, it may be necessary to offset the R98 adjustment.

d) Replace the short between test points P3 and P4.

16.3 COMPONENT LAYOUT AND SCHEMATICS

Refer to the following pages for component layouts and schematics of the Horizontal Deflection module.

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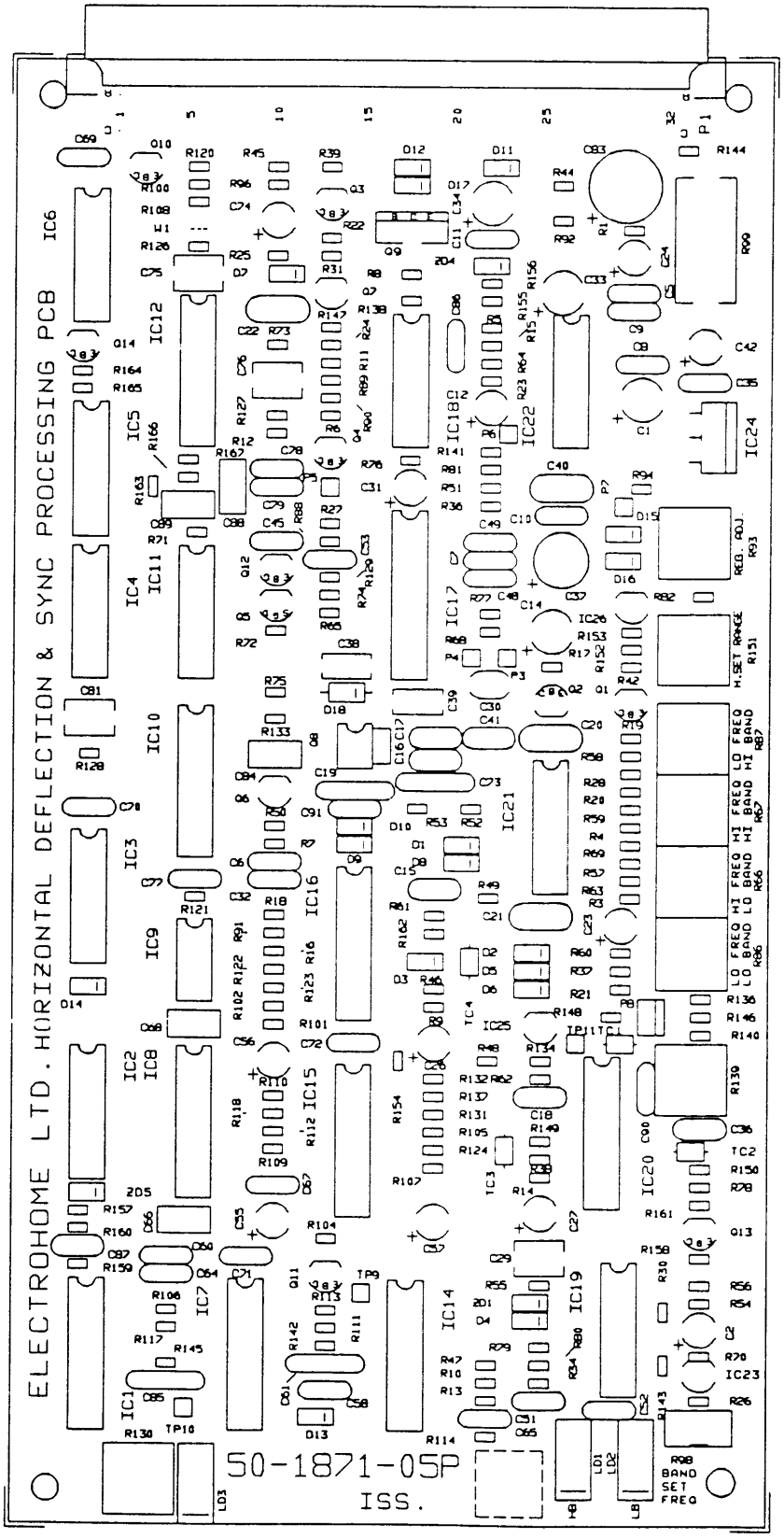
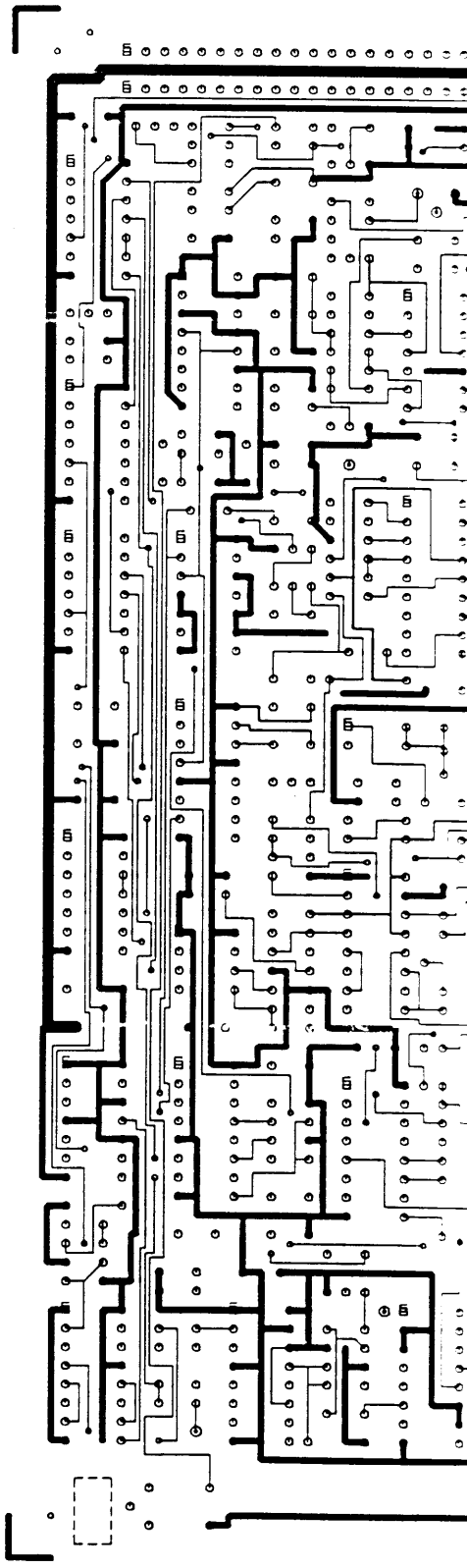
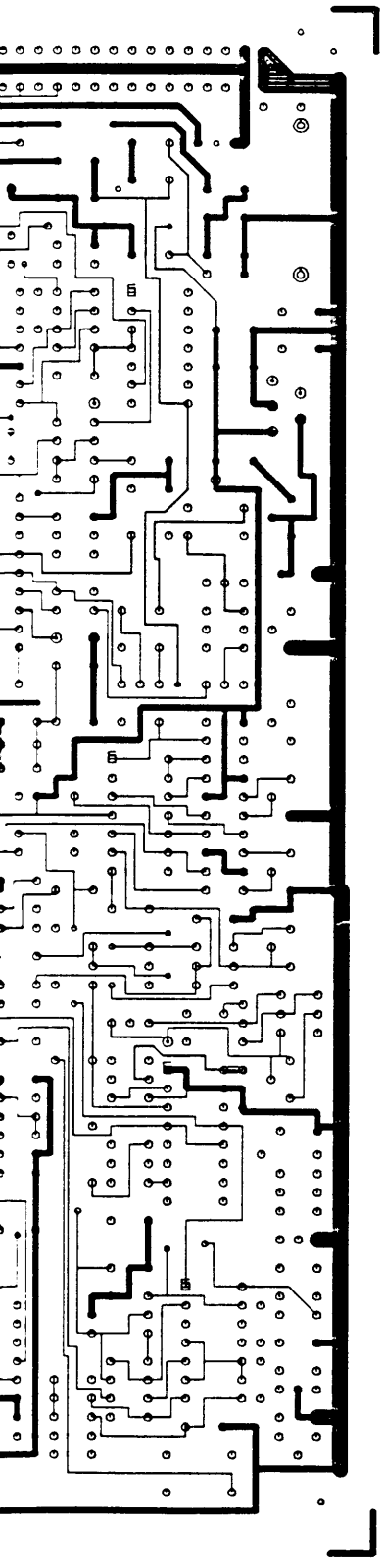


Component Layout

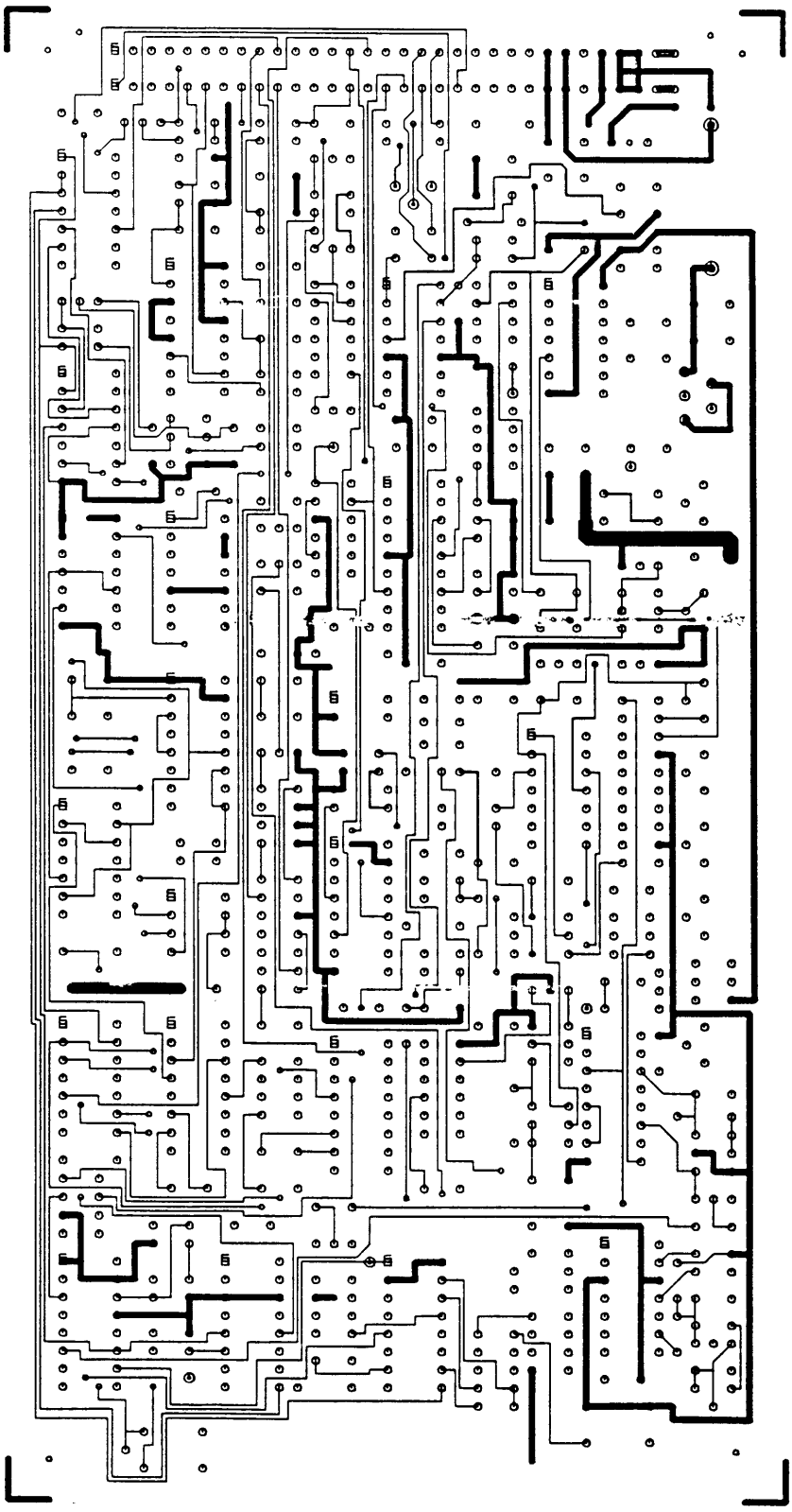


Solder Sid
(Viewed from Comp

54-7904-03P (06/90)

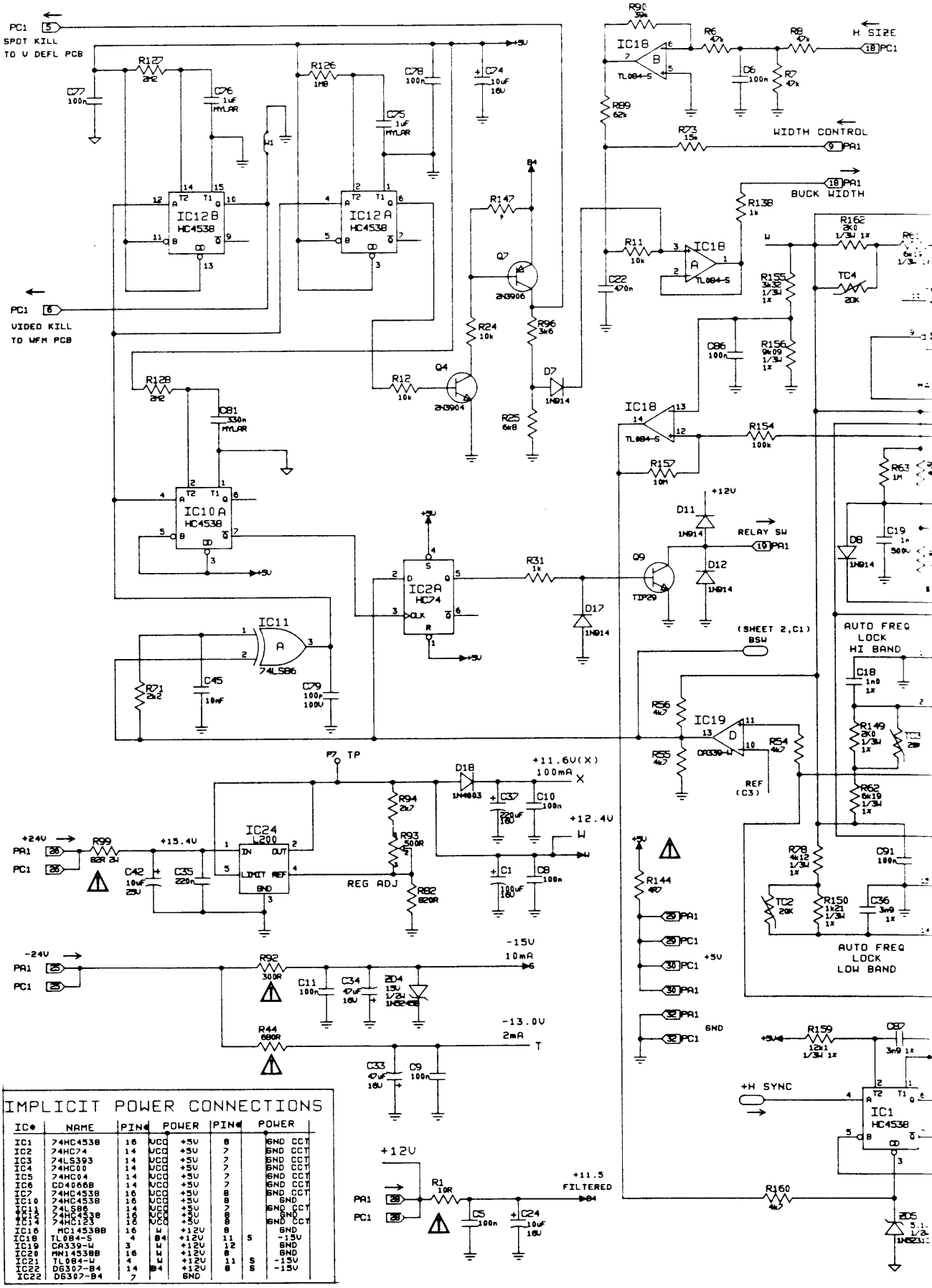


Side
mponent Side)



Component Side

FIGURE 16–2.
Horizontal Deflection Module Component Layout



IMPLICIT POWER CONNECTIONS

IC#	NAME	PIN#	POWER		PIN#	POWER	
IC1	74HC4538	16	VCC	+5V	8	GND	CCT
IC2	74HC74	14	VCC	+5V	7	GND	CCT
IC3	74LS393	14	VCC	+5V	7	GND	CCT
IC4	74HC00	14	VCC	+5V	7	GND	CCT
IC5	74HC04	14	VCC	+5V	7	GND	CCT
IC6	CD4066B	14	VCC	+5V	7	GND	CCT
IC7	74HC4538	16	VCC	+5V	8	GND	CCT
IC10	74HC4538	16	VCC	+5V	8	GND	
IC11	74LS86	14	VCC	+5V	7	GND	CCT
IC12	74HC4538	16	VCC	+5V	8	GND	
IC14	74HC123	16	VCC	+5V	8	GND	CCT
IC16	MC14538B	16	W	+12V	8	GND	
IC18	TL084-S	4	B4	+12V	11	S	-15V
IC19	CA339-W	3	W	+12V	12	GND	
IC20	MM14538B	16	W	+12V	8	GND	
IC21	TL084-W	4	W	+12V	11	S	-15V
IC22	D6307-B4	14	B4	+12V	8	S	-15V
IC22	D6307-B4	7		GND			

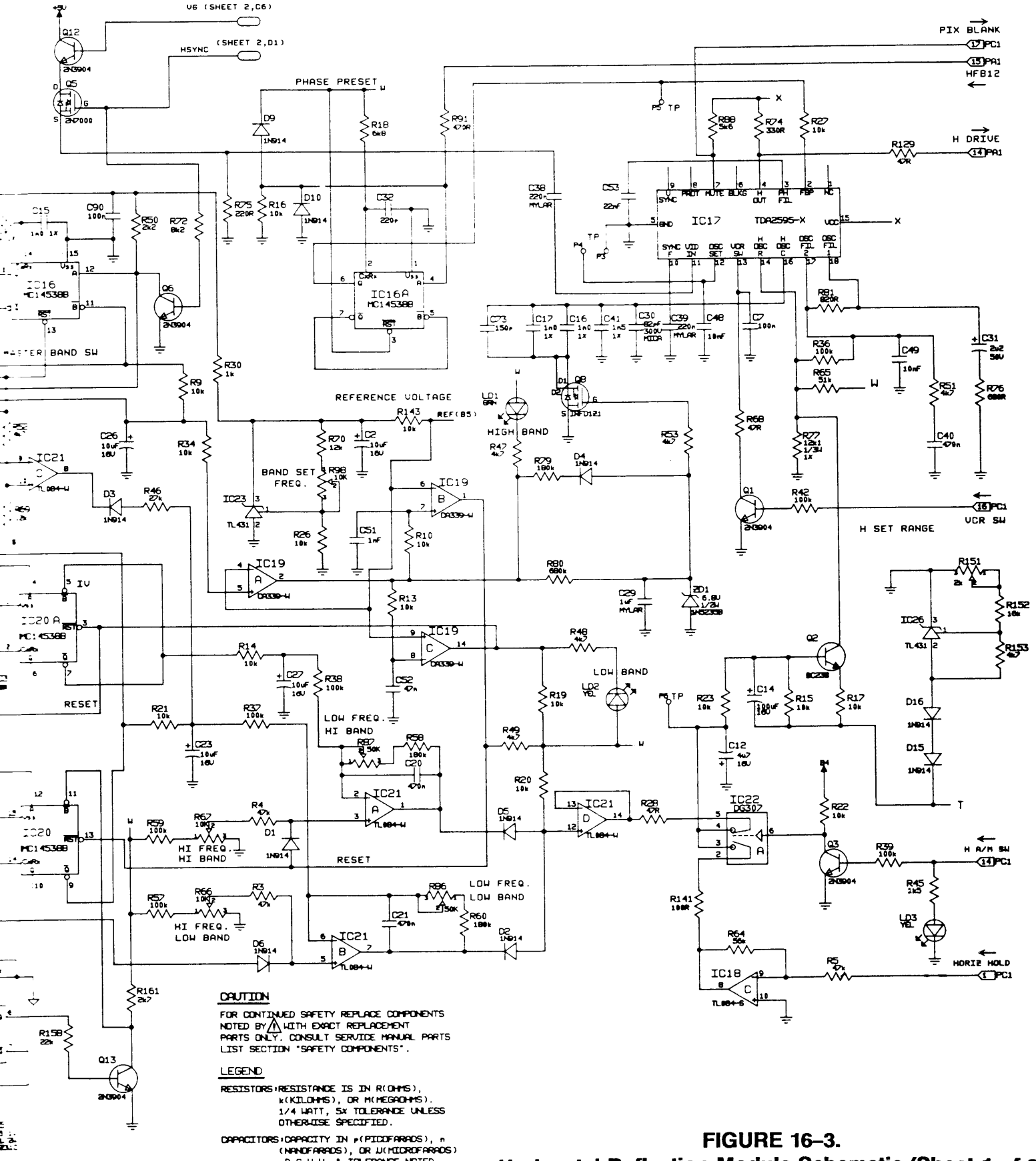
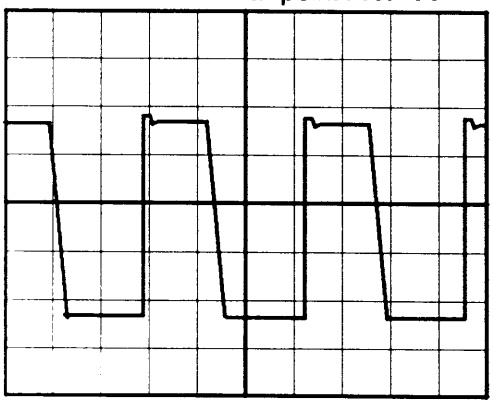


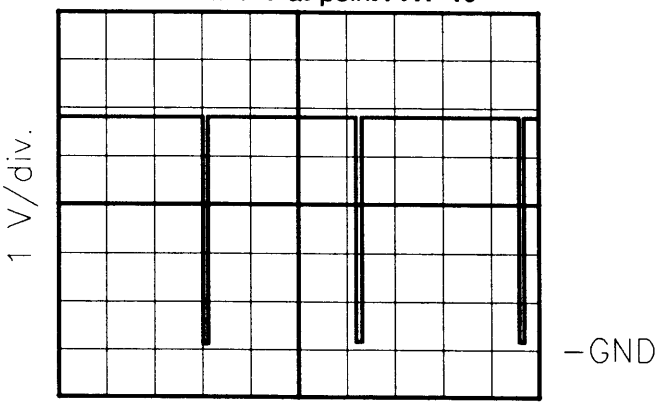
FIGURE 16–3.
Horizontal Deflection Module Schematic (Sheet 1 of 2)

SCHEMATIC REFERENCE

H DRIVE at point **PA1<14**



VERT 1 at point **PA1<10**



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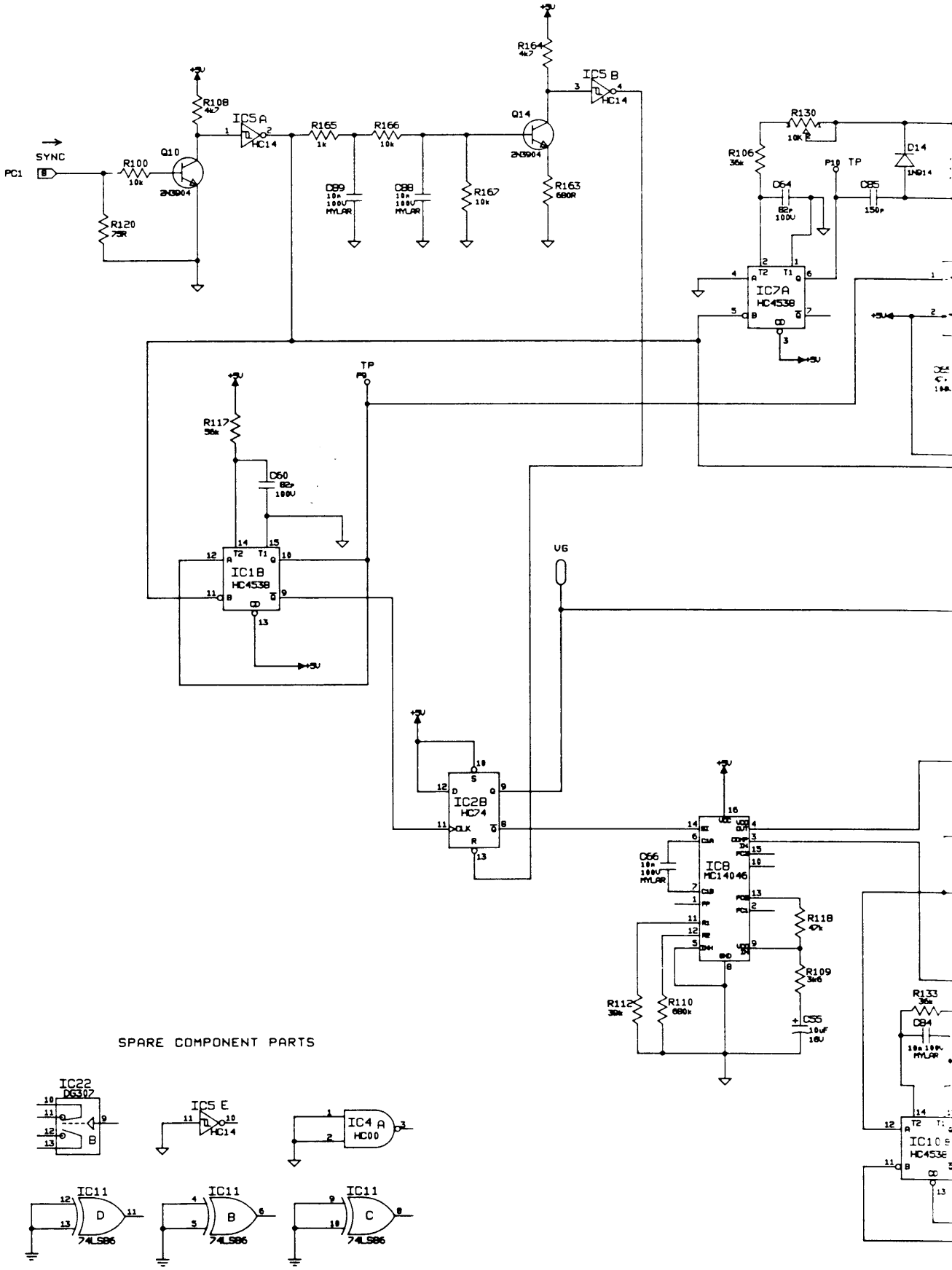

SPARE COMPONENT PARTS

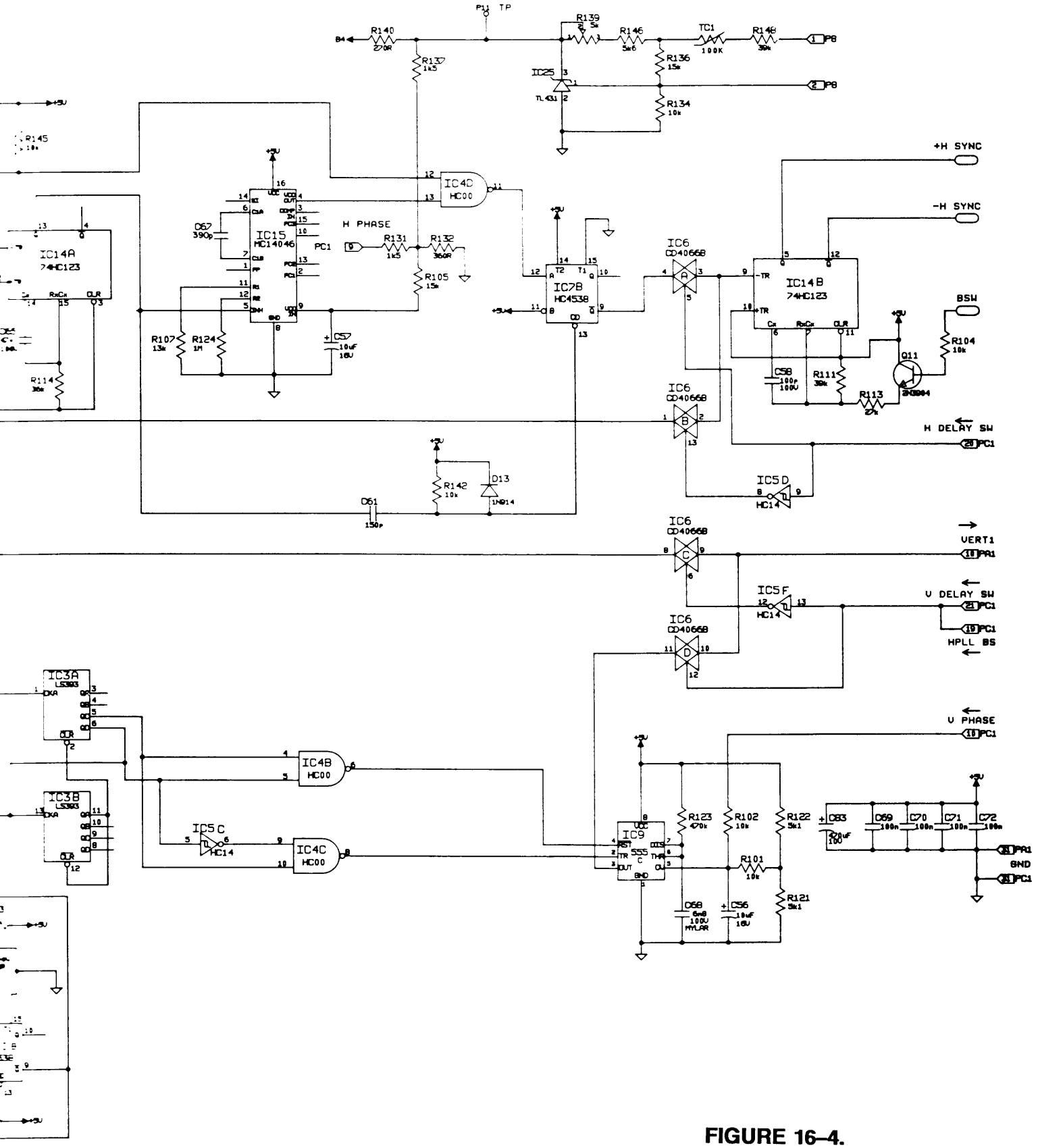

FIGURE 16–4.
Horizontal Deflection Module Schematic (Sheet 2 of 2)

16.4 PARTS LIST

Item Ref.	Part No.	Description
Integrated Circuits		
IC1,IC7,IC10,IC12	14-A04041-01P	MM74HC4538, CMOS multivibrator
IC2	14-A04007-01P	74HC74, H-CMOS, dual D flip flop
IC3	14-004688-01P	74LS393, dual 8 bit digital TTL
IC4	14-A04001-01P	74HC00, quad 2-input NAND gate
IC5	14-A04073-01P	74HC14, hex Schmitt trigger inverter
IC6	14-A03008-01P	CD4066BM, I/F CMOS quad biFET latch
IC8	14-A02006-02P	MC14046, CMOS phase lock loop
IC9	14-A04069-01P	TLC555C, CMOS digital timer
IC11	14-004620-01P	74LS86, quad EXOR gate
IC14	14-A04062-01P	74HC123, dual monostable multivibrator
IC15	14-A02006-03P	MC14046, select phase lock loop
IC16,IC20	14-A04041-01P	MC14538B, precision dual monostable
IC17	14-002824-01P	TDA2594
IC18,IC21	14-002104-01P	TL084CN, quad biFET linear op amp
IC19	14-002154-01P	CA339, quad linear voltage comparator
IC22	14-A03009-01P	DG307CJ, I/F analog CMOS gate switch
IC23,IC25,IC26	14-002833-01P	TL431C, precision shunt regulator
IC24	14-002088-01P	L200, linear adjust voltage regulator
Transistors and Diodes		
Q1,Q3,Q4,Q6, Q10-Q14	14-000881-06P	2N3904, NPN, 40V, 0.2A, 0.35W
Q2	14-000723-01P	BC238B, NPN transistor
Q5	14-A00705-01P	2N7000, TMOS, 60V, 0.2A, 4W
Q7	14-000873-82P	2N3906, PNP, small signal
Q8	14-A00700-01P	1RFD1Z0, hex FET, 100V
Q9	14-000966-23P	TIP29B, NPN transistor, 80V, 1A 2W
D1-D7	14-000513-01P	1N914, 0.075A, 75V
D18	14-000525-53P	1N4003, rectifier, 1A, 200V, T
LD1	14-001005-02P	LED, 3V, 0.09A, green
LD2,LD3	14-001005-03P	LED, 3V, 0.06A, yellow
ZD1	14-000531-32P	1N5235B, zener diode, 6.8V, 5%, 1/2W
ZD4	14-000530-38P	1N5245B, zener diode, 15V, 1/2W
ZD5	14-000515-98P	1N5231, zener diode, 5.1V, 1/2W, 2%, T
Capacitors		
C1,C14	84-410104-03P	100 μF, 25V
C2,C23,C24,C26, C27,C42,C55-C57, C74	84-410004-01P	10 μF, 25V
C5-C11,C69-C72, C77,C78,C86,C90, C91	89-000032-03P	100 nF, 50V

16.4 PARTS LIST (cont.)

Item Ref.	Part No.	Description
Capacitors		
C12	84-447506-01P	4.7 µF, 50V
C15-C18	89-000033-02P	1.0 nF, 50V, 1%
C19	86-310213-02P	1 nF, 500V, 10%, Z5P
C20-C22,C40	89-000032-02P	0.47 µF, 50V, ± 20%
C29,C75,C76	88-171053-12P	1 µF, 50V
C30	47-048205-01P	82 pF, 5%. mica
C31	84-422506-01P	2.2 µF, 50V, 20% electrolytic
C32	89-000033-07P	220 pF, 100V, 5%, NPO
C33,C34	84-447003-02P	47 µF, 16V
C35	89-000032-01P	0.22 µF, 50V
C36,C87	89-000033-05P	3.9 nF, 1%, NPO
C37	84-422103-03P	220 µF, 16V
C38,C39	88-172240-02P	220 nF, 50V, 10%
C41	89-000033-04P	1.5 nF, 1%, NPO
C45,C48,C49	89-000032-04P	10 nF, 50V, 20%
C51	89-000032-05P	1 nF, 50V, 20%
C52	89-000032-09P	47 nF, 50V, 20%, Z5U
C53	89-000032-10P	22 nF, 50V, 20%
C58,C79	86-610134-04P	100 pF, NPO
C60,C64	86-682034-04P	82 pF, 2%
C61,C85	86-315113-51P	150 pF, 40V, Z5P
C65	86-647033-04P	47 pF, 100V, NPO
C66,C84,C88,C89	88-171031-02P	10 nF, 100V, 10%
C67	89-000033-06P	330 pF
C68	88-176821-03P	6800 pF, 100V, ± 5%
C73	89-000033-03P	150 pF, 50V, 5%
C81	88-173340-02P	330 nF, 63V, 10%
C83	44-447102-05P	470 µF, 10V
Resistors		
R1	80-110095-11P	10R, 1/2W, 5%, metal film
R3-R8,R118	80-147025-11P	47K, 1/2W, 5%, metal film
R9-R17,R19-R24, R27,R34,R51,R70, R100-R102,R104, R134,R142,R143, R145,R166,R167	80-110025-11P	10K, 1/2W, 5%, metal film
R18,R25	80-168015-11P	6.8K, 1/2W, 5%, metal film
R26,R72	80-182015-11P	8.2K, 1/2W, 5%, metal film
R28,R68,R129	80-147095-11P	47R, 1/2W, 5%, metal film
R30,R31,R138 R165	80-110015-11P	1K, 1/2W, 5%, metal film
R36-R39,R42,R57, R59,R154	80-110035-11P	100K, 1/2W, 5%, metal film
R44,R76,R163	80-168005-11P	680R, 1/2W, 5%, metal film

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16.4 PARTS LIST (cont.)

Item Ref.	Part No.	Description
Resistors		
R45,R131,R137	80-115015-11P	1.5K, 1/2W, 5%, metal film
R46,R113	80-127025-11P	27K, 1/2W, 5%, metal film
R47-R49,R52-R56, R108,R153,R160, R164	80-147015-11P	4.7K, 1/2W, 5%, metal film
R50,R71	80-122015-11P	2.2K, 1/2W, 5%, metal film
R58,R60,R79	80-118035-11P	180K, 1/2W, 5%, metal film
R61,R62	82-361911-29P	6.19K, 1/3W, 1%, metal film
R63,R124	80-110045-11P	1M, 1/2W, 5%, metal film
R64,R111,R117	80-156025-11P	56K, 1/2W, 5%, metal film
R65	80-151025-11P	51K, 1/2W, 5%, metal film
R66,R67,R130	41-000344-10P	10K, carbon trim pot.
R69,R70	80-112025-11P	12K, 1/2W, 5%, metal film
R72	80-182015-11P	8.2K, 1/2W, 5%, metal film
R73,R105,R136	80-115025-11P	15K, 1/2W, 5%, metal film
R74	80-133005-11P	330R, 1/2W, 5%, metal film
R75	80-122005-11P	220R, 1/2W, 5%, metal film
R77,R159	82-312121-29P	12.1K, 1/3W, 1%, metal film
R78	82-341211-29P	4.12K, 1/3W, 1%, metal film
R80,R110	80-168035-11P	680K, 1/2W, 5%, metal film
R81,R82	80-182005-11P	820R, 1/2W, 5%, metal film
R86,R87	41-000344-13P	50K, carbon trim pot.
R88,R146	80-156015-11P	5.6K, 1/2W, 5%, metal film
R89	80-162025-11P	62K, 1/2W, 5%, metal film
R90,R112, R148	80-139025-11P	39K, 1/2W, 5%, metal film
R91	80-147005-11P	470R, 1/2W, 5%, metal film
R92	80-130005-11P	300R, 1/2W, 5%, metal film
R93	41-000344-06P	500R, carbon trim pot.
R94,R161	80-127015-11P	2.7K, 1/2W, 5%, metal film
R96,R109	80-136015-11P	3.6K, 1/2W, 5%, metal film
R98	41-000344-40P	10K, carbon trim pot.
R99	42-000134-04P	82R, 2W, 5%, CS
R106,R114,R133	80-136025-11P	36K, 1/2W, 5%, metal film
R107	80-113025-11P	13K, 1/2W, 5%, metal film
R120	80-175095-11P	75R, 1/2W, 5%, metal film
R121,R122	80-151015-11P	5.1K, 1/2W, 5%, metal film
R123	80-147035-11P	470K
R126	40-121855-31P	1.8M, 1/4W
R127,R128	40-122255-31P	2.2M, 1/4W, 5%, metal film
R132	80-136005-11P	360R, 1/2W, 5%, metal film
R139	41-000344-09P	5K, carbon trim pot.
R140	80-127005-11P	270R, 1/2W, 5%, metal film
R141	80-110005-11P	100R, 1/2W, 5%, metal film
R144	80-147085-11P	4.7R, 1/2W, 5%, metal film
R147	80-151025-11P	51K, 1/2W, 5%, metal film

16.4 PARTS LIST (cont.)

Item Ref.	Part No.	Description
Resistors		
R149,R162	82-320011-29P	2.0K, 1/3W, 1%, metal film
R150	82-312111-29P	1.21K, 1/3W, 1%, metal film
R151	41-000344-08P	2K, carbon trim pot.
R152	80-116025-11P	16K, 1/2W, 5%, metal film
R155	82-333211-29P	3.32K, 1/3W, 1%, metal film
R156	82-390911-29P	9.09K, 1%
R157	40-121065-31P	10M, 1/4W, 5%, metal film
R158	80-122025-11P	22K, 1/2W, 5%, metal film
TC1	42-000079-08P	100K, precision thermistor
TC2-TC4	42-000079-10P	20K, thermistor, 2%

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16.5 SPECIFICATIONS

Connector P1, Row A:

Pin 9 ..... analog input **WIDTH**
NOTE: horizontal size control voltage from Power Deflection module

Pin 10 ..... analog output **VERT1**
NOTE: +ve going vertical sync pulse
signal level ..... 0 to 5V ± 10%

Pin 14 ..... analog output **H DRIVE**
NOTE: horizontal drive pulse from IC17
signal level (500Ω load) ..... 5V peak ± 10%

Pin 15 ..... analog input **HFB**
NOTE: see Power Deflection module
signal level ..... 0 to 12V

Pin 18 ..... analog output **BUCK WIDTH**
NOTE: control voltage for horizontal regulator
normal condition ..... 3.5 to 3.9V
during bandswitch ..... 5.4V max

Pin 19 ..... analog output **RELAY SW**

Pin 25 ..... -24V power supply **-24 VDC**
current level ..... 40 mA max

Pin 26 ..... +24V power supply **+24 VDC**
current level ..... 100 mA max

Pin 27 ..... -12V power supply **-12 VDC**
current level ..... 5 mA max

Pin 28 ..... +12V power supply **+12 VDC**
current level ..... 10 mA

Pin 29 ..... +5V power supply **+5 VDC**
total current ..... 35 mA max

Pin 30 ..... connected to Pin 29 **+5 VDC**

Connector P1, Row C:

Pin 1 ..... analog input **H HOLD**
horizontal oscillator lock-in range
manual mode @ SW = 5V
low band ..... 15.7 to 35 KHz
high band ..... 24 to 54 KHz
auto mode @ SW = 0V
lock-in range ..... 15.7 to 54 Hz
pull-in range ..... 500 Hz min

Pin 5 ..... analog output **SPOT KILL**

Pin 6 ..... analog output **VIDEO KILL**

Pin 8 ..... analog input **SYNC**
composite -ve sync ..... 1V peak min

Pin 9 ..... analog input **H PHASE**
horizontal phase delay control ..... 0 to 10VDC

Pin 10 ..... analog input **V PHASE**
vertical phase delay control ..... 0 to 10VDC

Pin 14 ..... analog input **H A/M SW**
NOTE: horizontal auto/manual switch
signal level ..... 0 to 5V

Pin 16 ..... analog input **VCR SW**
NOTE: fast/slow time base switching signal
signal level ..... 0 to 5VDC

Pin 18 ..... analog input **H SIZE**
NOTE: size control from Remote Control module
signal level ..... 0 to 10VDC

Pin 20 ..... analog input **H DELAY SW**
NOTE: turns horizontal phase delay circuit ON or OFF
signal level ..... 0 to 5VDC

Pin 21 ..... analog input **V DELAY SW**
NOTE: turns vertical phase delay circuit ON or OFF
signal level ..... 0 to 5VDC

SECTION 17

VERTICAL DEFLECTION & HORIZONTAL REGULATION MODULE

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

No tables are included in this section.

54-7904-02P/54-7904-03P (06/90)

17.1 TECHNICAL DESCRIPTION

17.1.1 General Description

The Vertical Deflection & Horizontal Regulation module generates vertical drive pulses for the Power Deflection modules and supplies regulated current to the deflection yokes. The module also includes vertical auto-lock circuitry and an EHT INHIBIT circuit.

17.1.2 Circuit Description

17.1.2.1 Vertical Frequency-to-Voltage Converter

The vertical frequency-to-voltage converter consists of an integrator, one shot multivibrator (IC2B) and op amp IC1C.

IC2B is triggered by incoming vertical pulses (VERT 1) at edge connector PC1-10. The 300 μs (approximate) wide pulse leaving pin #10 of IC2B, is applied to the integrating network R69 and C25. The voltage at the junction of R69 and C25 is positive.

The integrated voltage produced is directly proportional to VERT 1 frequency and inversely proportional to vertical period, i.e., a shorter period or a higher frequency will produce a higher DC output. The voltage is applied to pin 10 of op amp IC1C. R122 (U.F. SET) presets a regulated negative voltage at its center tap. Feedback resistor R10 (L.F. SET), is the gain control for IC1C. The voltage at pin 10 should be 0 or higher. The voltage at pin 9 should be negative. The output at pin 8 should be positive.

17.1.2.2 Vertical Auto/Manual Switch

In the automatic mode, the sync pulse voltage appearing at edge connector PC1-15 is low. This makes the base of Q4 low and forces Q4's collector high. The output voltage, from Q4, is applied to pin 6 of IC7 (analog switch). A low voltage on pin 6 connects the output of IC1C to IC7 switch outputs, pins 3 and 4. A high voltage on pin 6 connects the output of IC1C to RC network R89 and C10. The network's output, combined with the output voltage of the analog switch, set the vertical oscillator frequency. In the event of an incoming sync pulse failure, voltage is applied to the oscillator network via R41. In the manual mode, the DC voltage appearing at edge connector PC1-15 is high. Q4 is turned ON and its collector goes low. The auto circuit is de-activated and the manual circuit becomes active.

V HOLD (IN), a variable, positive voltage present at edge connector PC1-2, is applied to the base of Q9. Q9's emitter voltage is set to 0.6 V above its base voltage. this alters the voltage at the junction of R63, R108 and R147. The voltage is applied to the analog switch , via R147. It is adjusted until the oscillator frequency locks to the incoming sync. In the event of sync failure, the oscillator will run free, maintaining vertical deflection.

17.1.2.3 Vertical Ramp Circuit

IC3 (a TDA1170S differential amplifier) generates the vertical deflection ramp. In the auto mode, the ramp frequency is determined by the values of C10, R89 and the output voltage from IC7.

In the manual mode, the ramp frequency is determined by the values of C10, R89 and the effective resistance of R63, R108 and R147.

The ramp generator consists of a current generator and the capacitors between pin 12 of IC3 and ground. Size control circuitry regulates the current generator. Capacitors C6 and C9 and resistors R111, R121, R2 and R107 use buffered RAMP GEN to produce a ramp curve. This curve is independent of height and size regulation. Series R107 and R2 adjusts linearity. Series R111 and R121 corrects tilt.

NOTE: The removal or absence of R111, R121, R2 and R107 will result in a linear ramp. At low impedance levels, this ramp will also appear at pin 1 of IC3.

17.1.2.4 Vertical Height Control

The vertical ramp is fed to op amp IC10C. The output from IC10C goes to edge connector PA1-3. The output also drives the height control circuit. The output of IC1D is rectified. The resulting DC output is applied to the non-inverting input of IC1B.

An increase in the output of IC10C will increase the output of IC1D, the rectified DC voltage and the output of IC1B. This will produce an increase in the voltage at pin 7 (height adjust) of IC3 and decrease the gain, i.e., gain remains constant. R118 (size limit control) adjusts the gain of IC1D. Increased gain reduces ramp output level.

17.1.2.5 Vertical Boost Pulse

The vertical boost pulse is generated by IC10C. It triggers the vertical boost circuit. The leading edge of the pulse is also a reference in the convergence circuit.

The output of IC10C is coupled to the base of Q16 through C66 and R139. The negative-going transitions of the ramp waveform are passed by C66. D28 limits the

negative values to -0.6V. Q16, which is normally ON, is cut-off by the negative-going pulse at its base.

A corresponding positive going pulse at the collector of Q16 is coupled to the positive trigger input of one shot IC2A. The positive going output pulse from IC2A is coupled to output PAI-5 via emitter follower Q15. The pulse width is approximately 200μS. R146 and C70 at IC10C pin 10, and R140 and C71 in the collector circuit of Q16, act as filters to reduce interference from the buck converter section.

17.1.2.6 Scan Fail

IC4 and IC5 (CA339 quad comparator), with open collector outputs, indicate scan failure and initiate EHT inhibit. The negative inputs of both ICs, except IC4D, are tied to reference ZD1 and D4. The non-inverting input of IC4D is also tied to this reference.

Pin D of IC5 senses the 200V supply level.

A spot kill signal enters at edge connector PCI-5 and feeds pin D of IC4. This signal is normally low. The comparator outputs will be high, provided all other sensing signals are higher than the reference voltage. All LED indicators will be OFF, diodes D17 and D18 will be back biased and Q1 (inhibit transistor) will be ON and the EHT will operate normally.

In the event of a decrease from the 12V supply, diode D16 keeps C28 from discharging until the 12V line drops sufficiently to keep Q1 OFF. The charging of C28 permits the inhibit transistor to fully shut OFF.

17.2 SERVICING AND ALIGNMENT

17.2.1 Disassembly and Access

WARNING

STATIC SENSITIVE COMPONENTS
STATIC CONTROLLED WORK STATION REQUIRED

Module Location:
- rear panel card rack

Tools & Equipment Required:
- Phillips screw driver

a) Remove the back panel as described in Section 5.2.

b) Locate the Vertical Deflection & Horizontal Regulation module in the rear panel card rack. Using the printed circuit board extractor (from the tool pouch), pull the module from the card rack as described in Section 5.2.

17.2.2 Alignment

The following procedure provides instructions for general setup of the Vertical Deflection & Horizontal Regulation Module.

Reference Figure 17-1.

Tools & Equipment Required:
- printed circuit board extractor
- extender board, Electrohome Part # 03-230330-01P
- video source (45 to 120 Hz sync range)
- fine tip slot screwdriver
- oscilloscope

STEP 1 - Remove Vertical Deflection & Horizontal Regulation Module

a) Hook the printed circuit board extractor into the hole in the bottom outside corner of the Vertical Deflection & Horizontal Regulation module. Pull the module out of its slot.

b) Insert the extender board into the Vertical Deflection & Horizontal Regulation module slot. Put the Vertical Deflection & Horizontal Regulation module on the extender board. NOTE: The module may produce video noise when mounted on the extender board.

STEP 2 - LF & UF Set

a) Connect the video source to the projector.

b) Adjust R122 2/3 clockwise from its zero position.

c) Set vertical sync on the source to 45 Hz. Adjust R10 for lock-in.

d) Set vertical sync on the source to 120 Hz. Adjust R122 for lock-in.

e) Repeat the c) and d) above until both frequencies automatically lock in.

STEP 3 - Size Limit

a) Connect the oscilloscope to row A, pin 3 of the extender board (V DRIVE).

b) Press **SIZE**, then press **U** on the keypad for maximum vertical size.

c) Adjust R118 until the raster fills the face of the CRT.

d) Make sure V DRIVE is not clipped.

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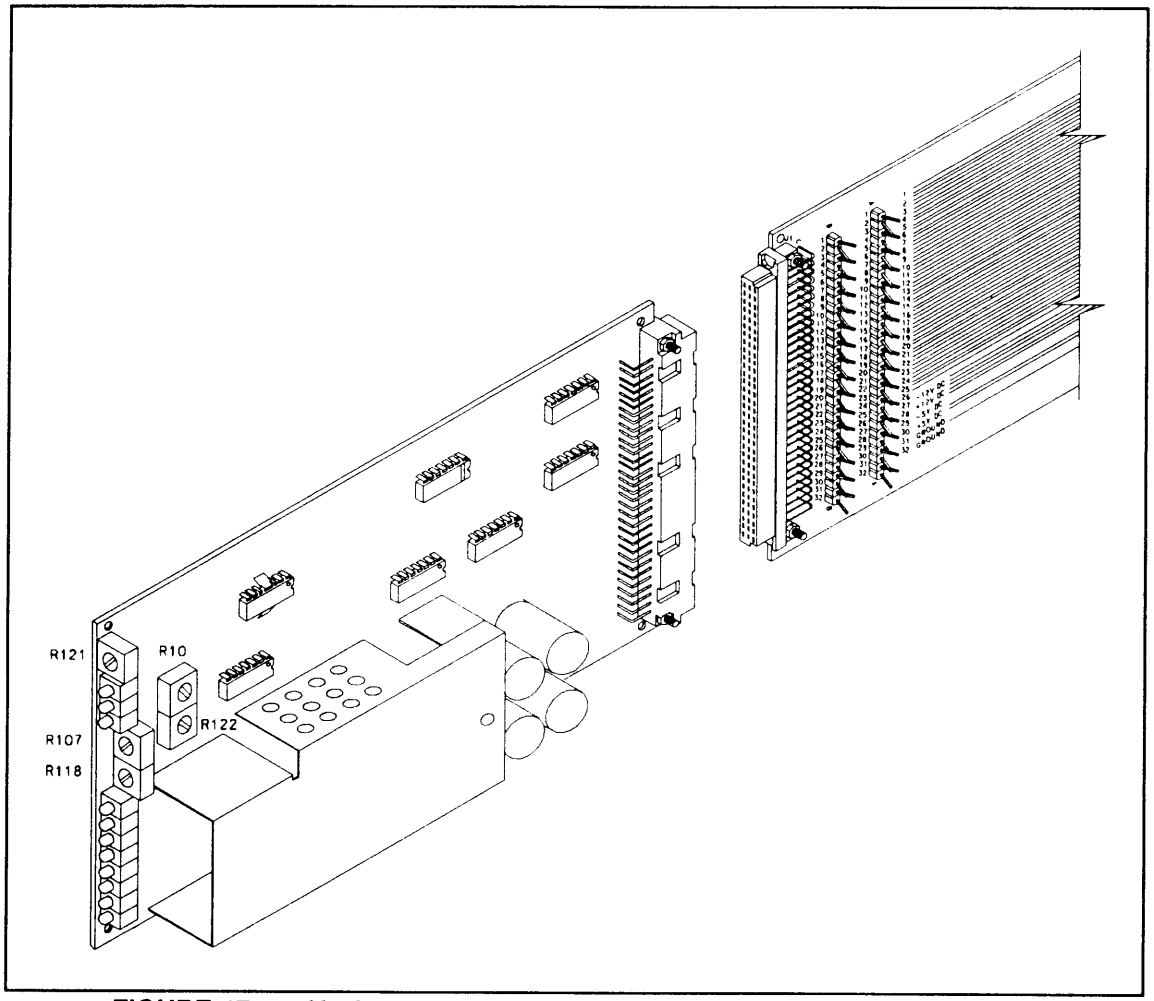


FIGURE 17-1. *Vertical Deflection & Horizontal Regulation Module Alignment*

STEP 4 - Vertical Linearity

a) Press the # key on the keypad to produce a crosshatch.

b) Adjust R107 and R121 until the top-to-bottom linearity looks good and the crosshatch lines appear evenly spaced.

STEP 5 - Current Shut Down

CAUTION

DO NOT USE THE EXTENDER BOARD FOR THIS PROCEDURE! R135 adjustment will require physical removal and insertion of the module.

a) Press the **SIZE** key on the keypad.

b) Press the **U** key for maximum vertical size, then the **R** key for maximum horizontal size.

c) Connect a 15.7 KHz source to the projector.

d) Press KEY then press U on the keypad for maximum keystone.

e) Turn the projector OFF.

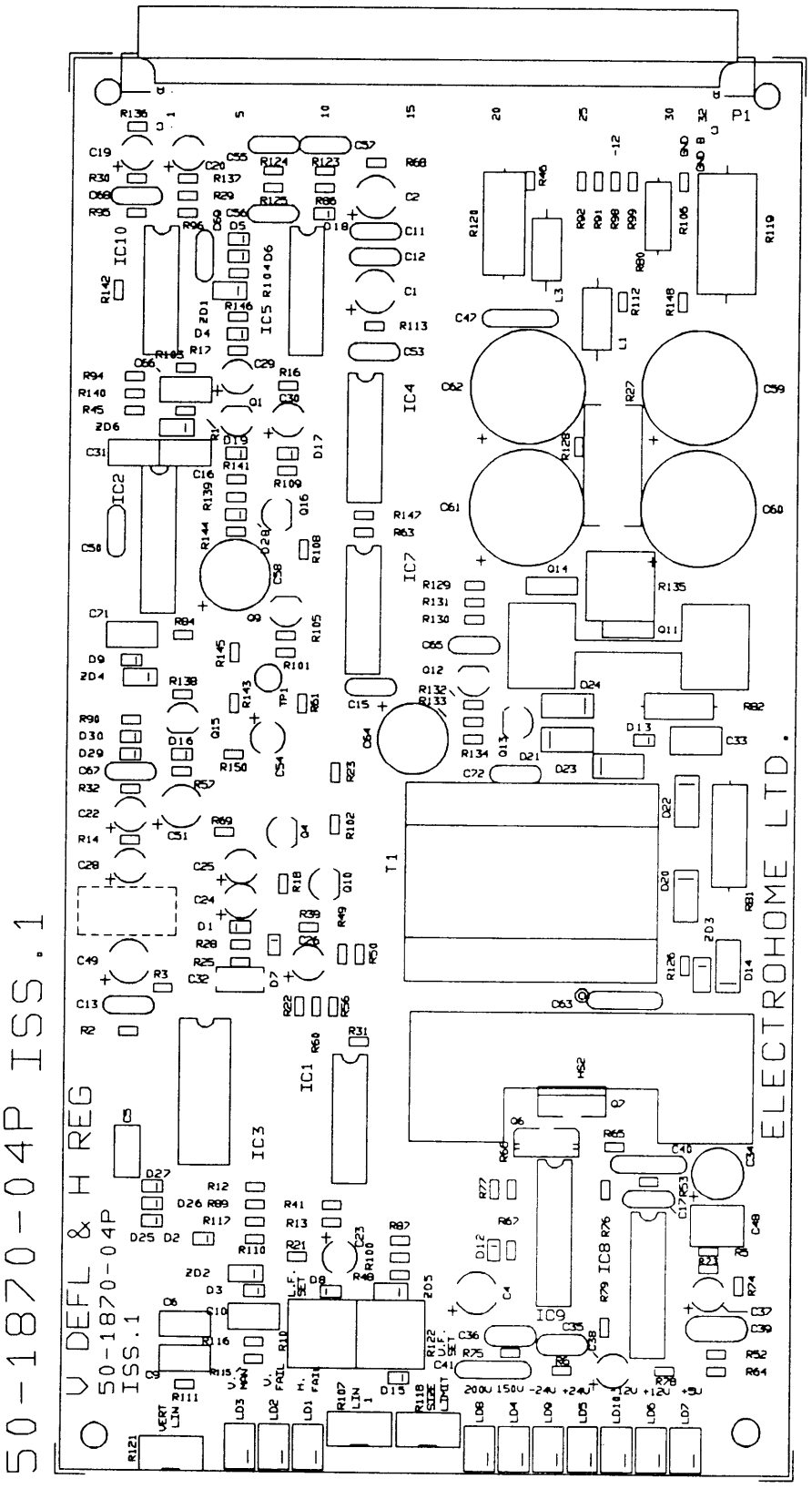
f) Turn the projector ON. Check the H INHIBIT LED. If the LED is OFF, then the procedure is complete. If the LED is ON, turn the projector OFF.

g) Adjust R135 slightly clockwise.

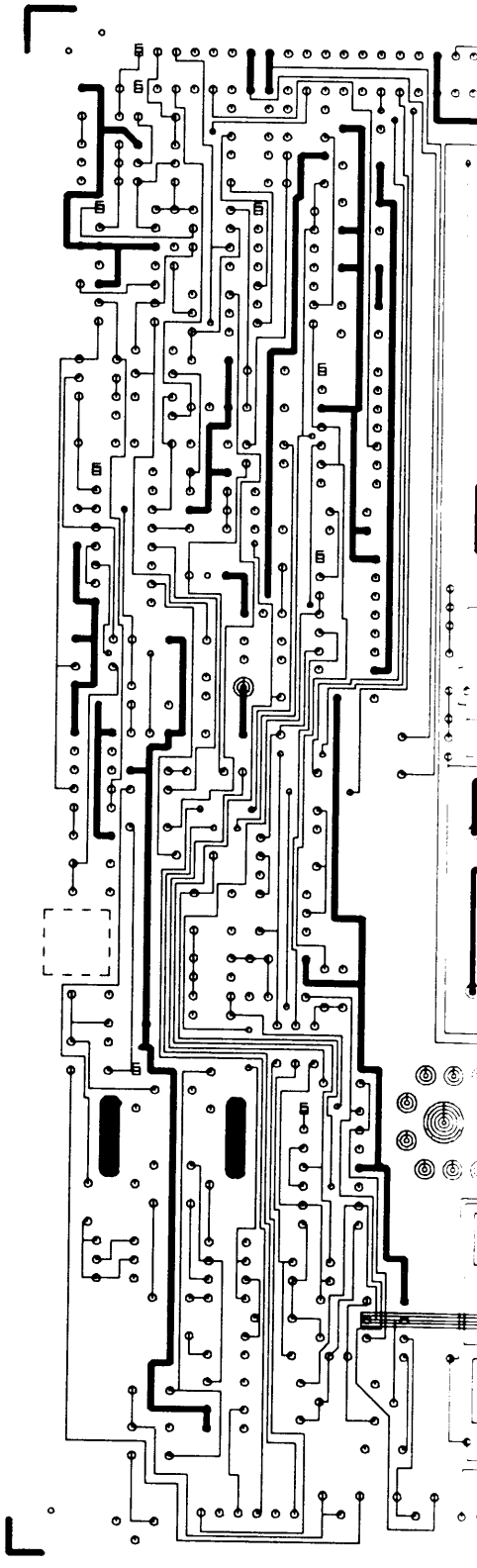
h) Repeat steps 6 and 7 until the LED is OFF.

17.3 COMPONENT LAYOUT AND SCHEMATICS

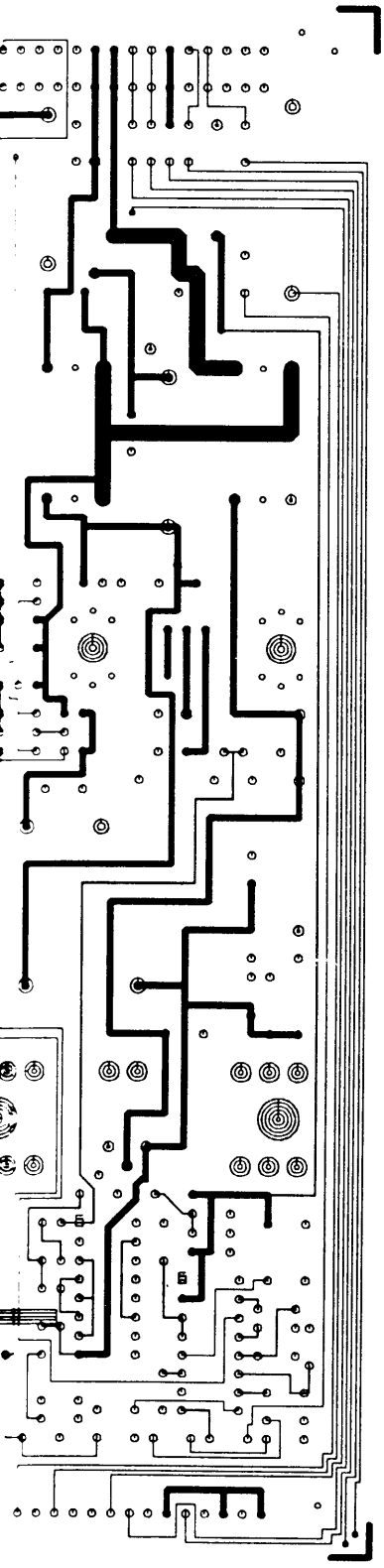
Refer to the following pages for component layouts and schematics of the Vertical Deflection & Horizontal Regulation module.



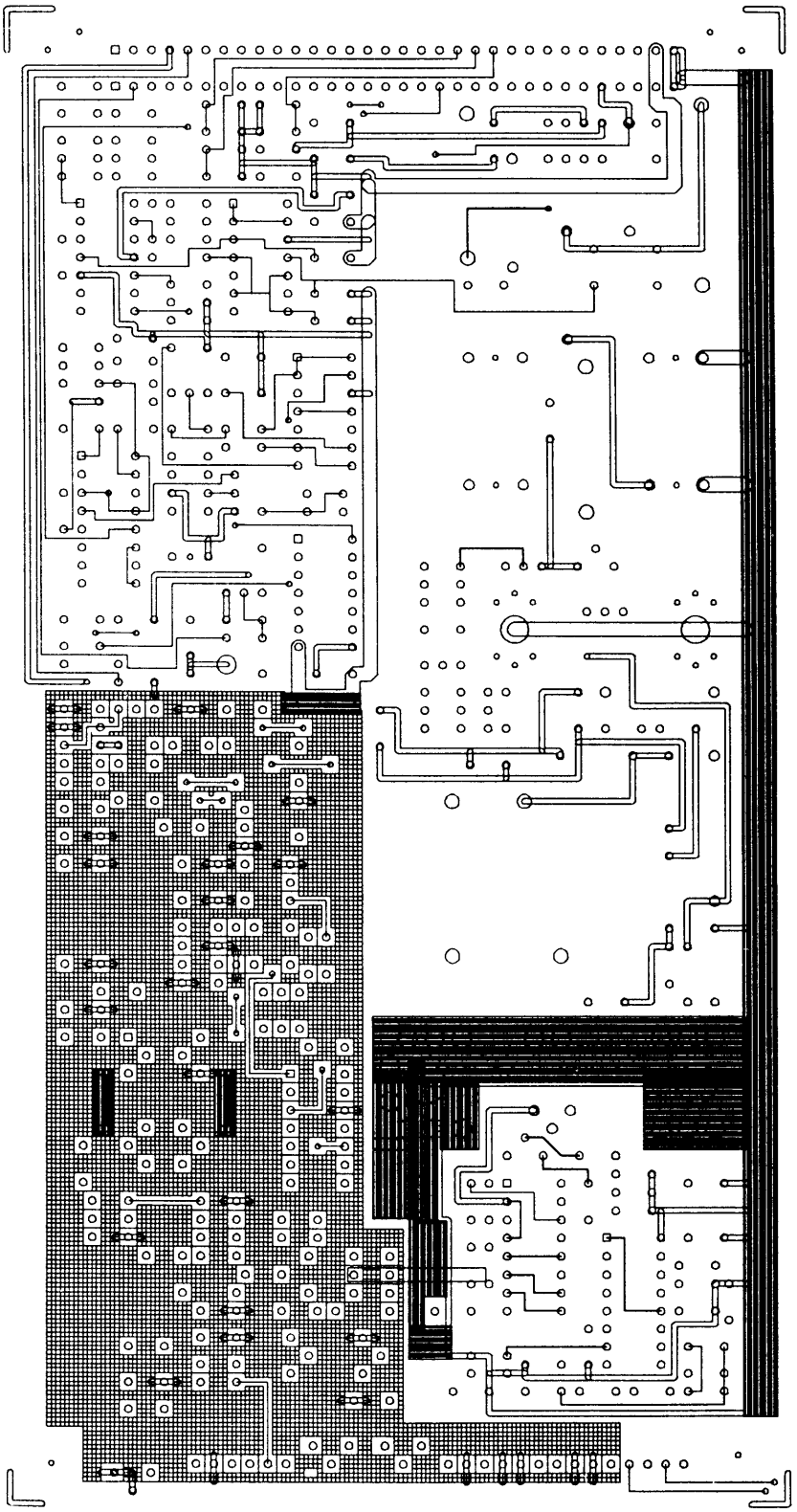
Component Layout



Solder Side
(Viewed from Compon

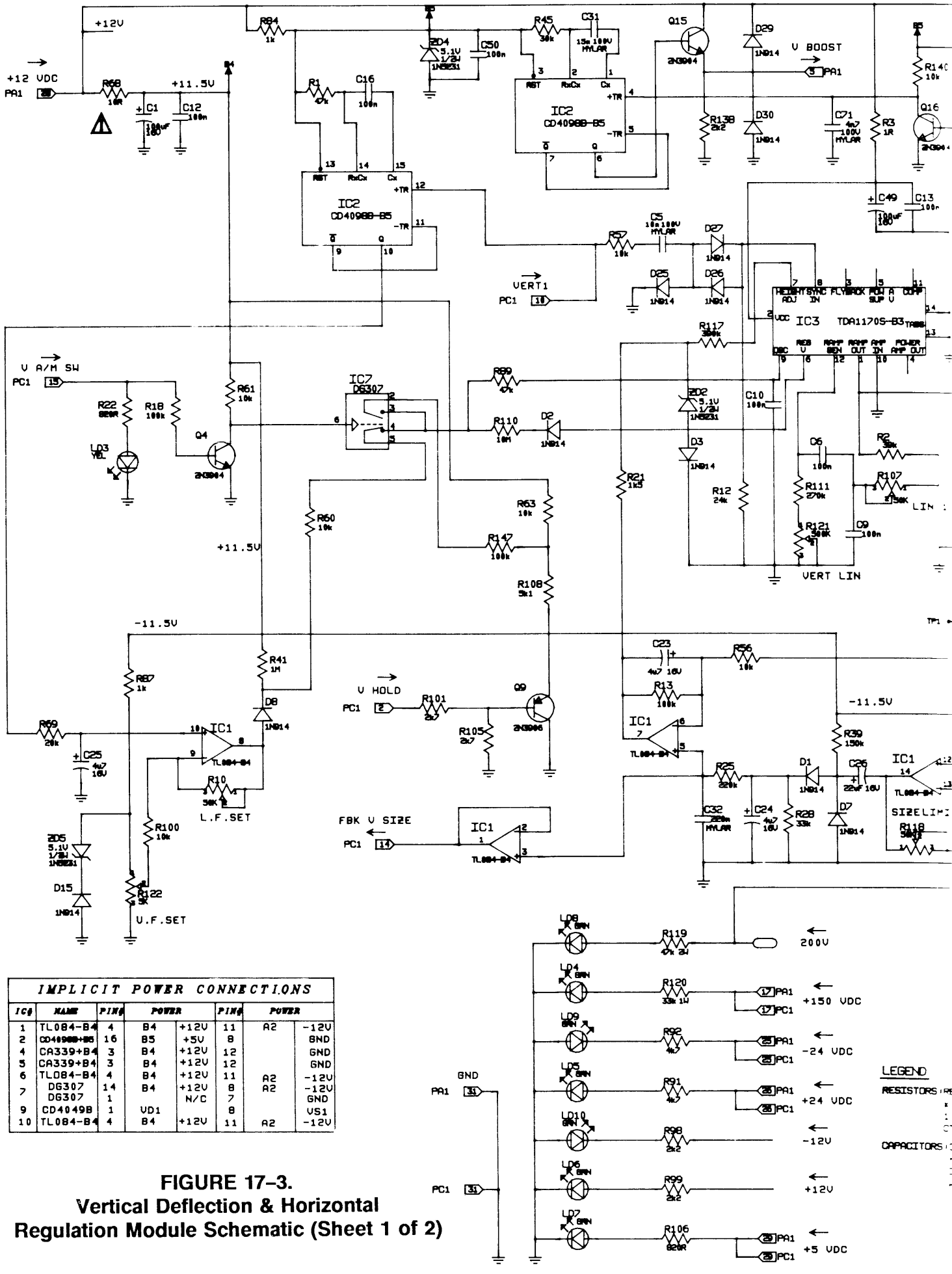


de
onent Side)



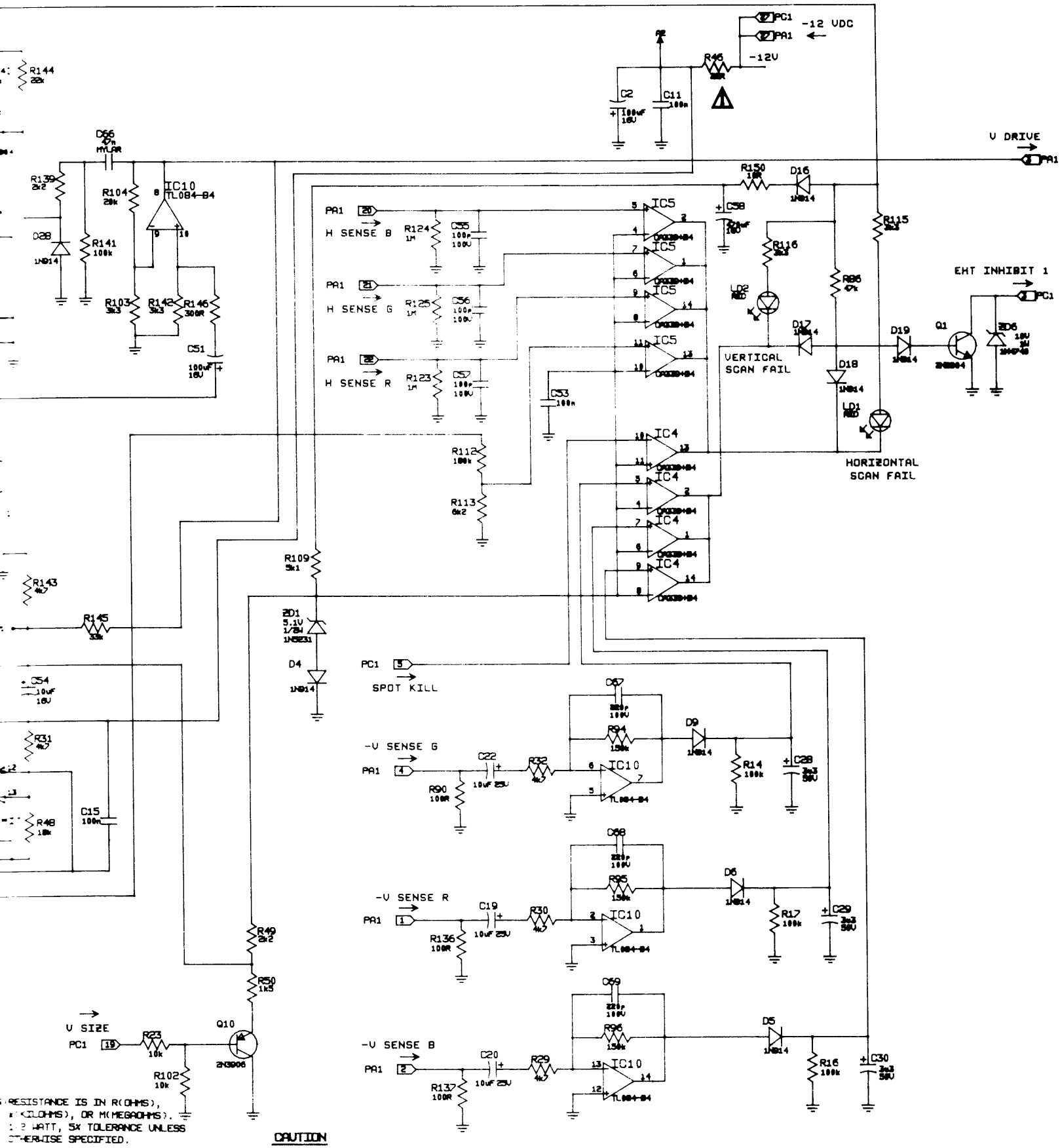
Component Side

FIGURE 17–2.
Vertical Deflection & Horizontal Regulation Module Component Layout



IMPLICIT POWER CONNECTIONS							
IC#	NAME	PIN#	POWER		PIN#	POWER	
1	TL084-B4	4	B4	+12V	11	A2	-12V
2	CD4098B-B5	16	B5	+5V	8		GND
4	CA339+B4	3	B4	+12V	12		GND
5	CA339+B4	3	B4	+12V	12		GND
6	TL084-B4	4	B4	+12V	11	A2	-12V
7	DG307	14	B4	+12V	8	A2	-12V
	DG307	1		N/C	7		GND
9	CD4049B	1	VD1		8		VS1
10	TL084-B4	4	B4	+12V	11	A2	-12V

FIGURE 17–3.
Vertical Deflection & Horizontal Regulation Module Schematic (Sheet 1 of 2)



RESISTANCE IS IN R(OHMS), K(KILOHMS), OR M(MEGAOHMS). 1/2 WATT, 5% TOLERANCE UNLESS OTHERWISE SPECIFIED.

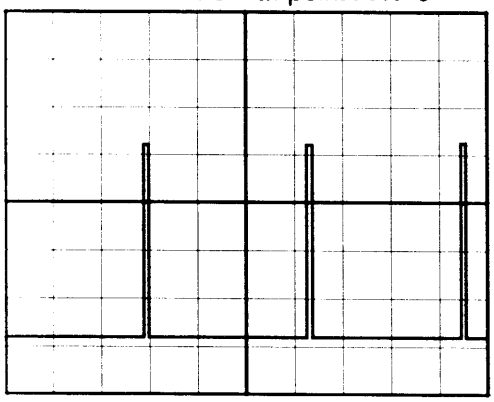
CAPACITY IN p(PICOFARADS), n(NANOFARADS), OR µ(MICROFARADS) D.C.W.V. & TOLERANCE NOTED WHERE CRITICAL.

CAUTION

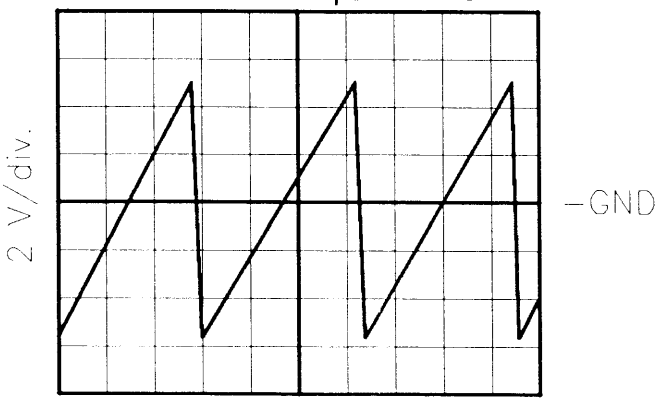
FOR CONTINUED SAFETY REPLACE COMPONENTS NOTED BY ⚠ WITH EXACT REPLACEMENT PARTS ONLY. CONSULT SERVICE MANUAL PARTS LIST SECTION "SAFETY COMPONENTS".

SCHEMATIC REFERENCE

V BOOST at point **PA1<5**



V DRIVE at point **PA1<3**



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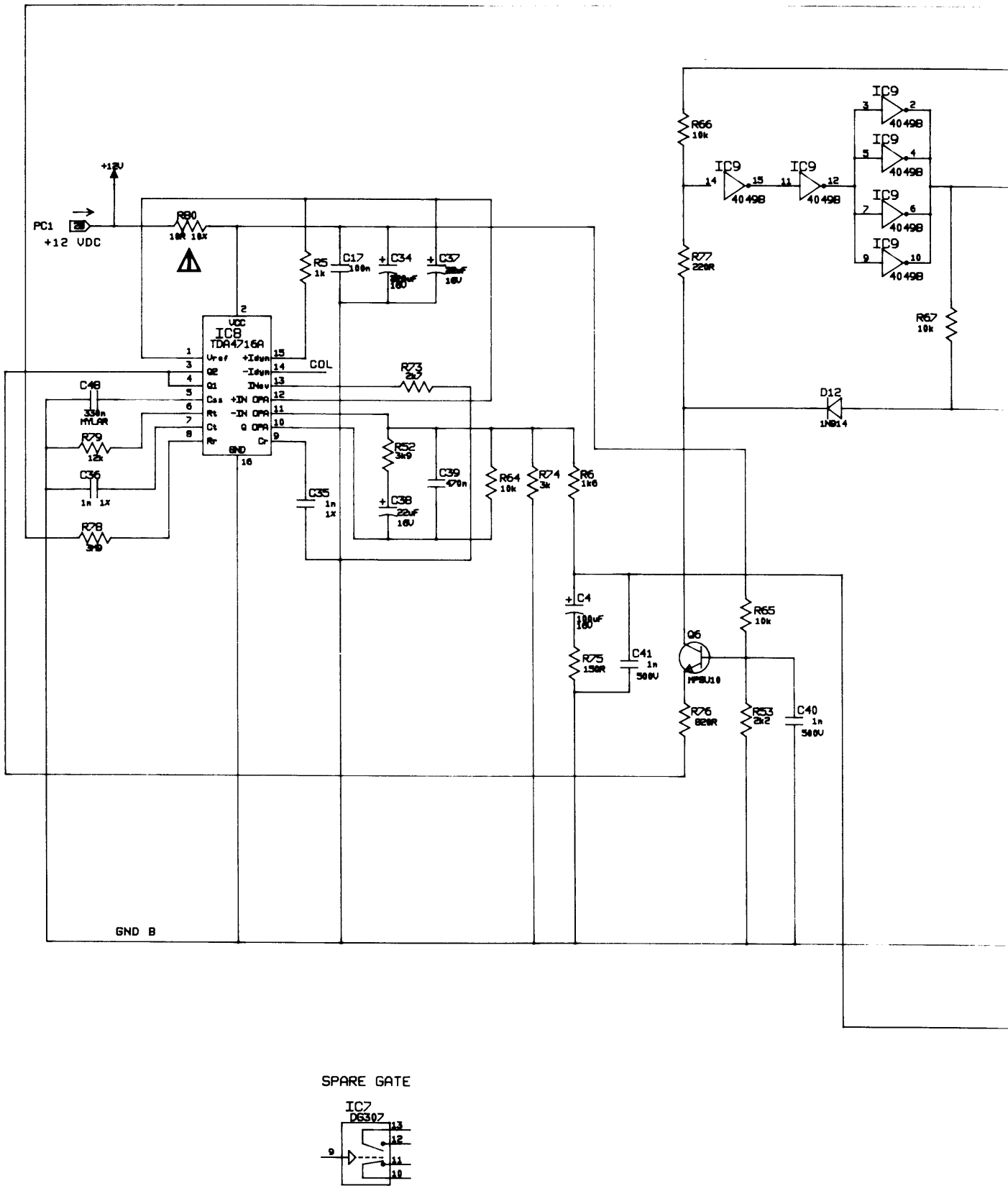
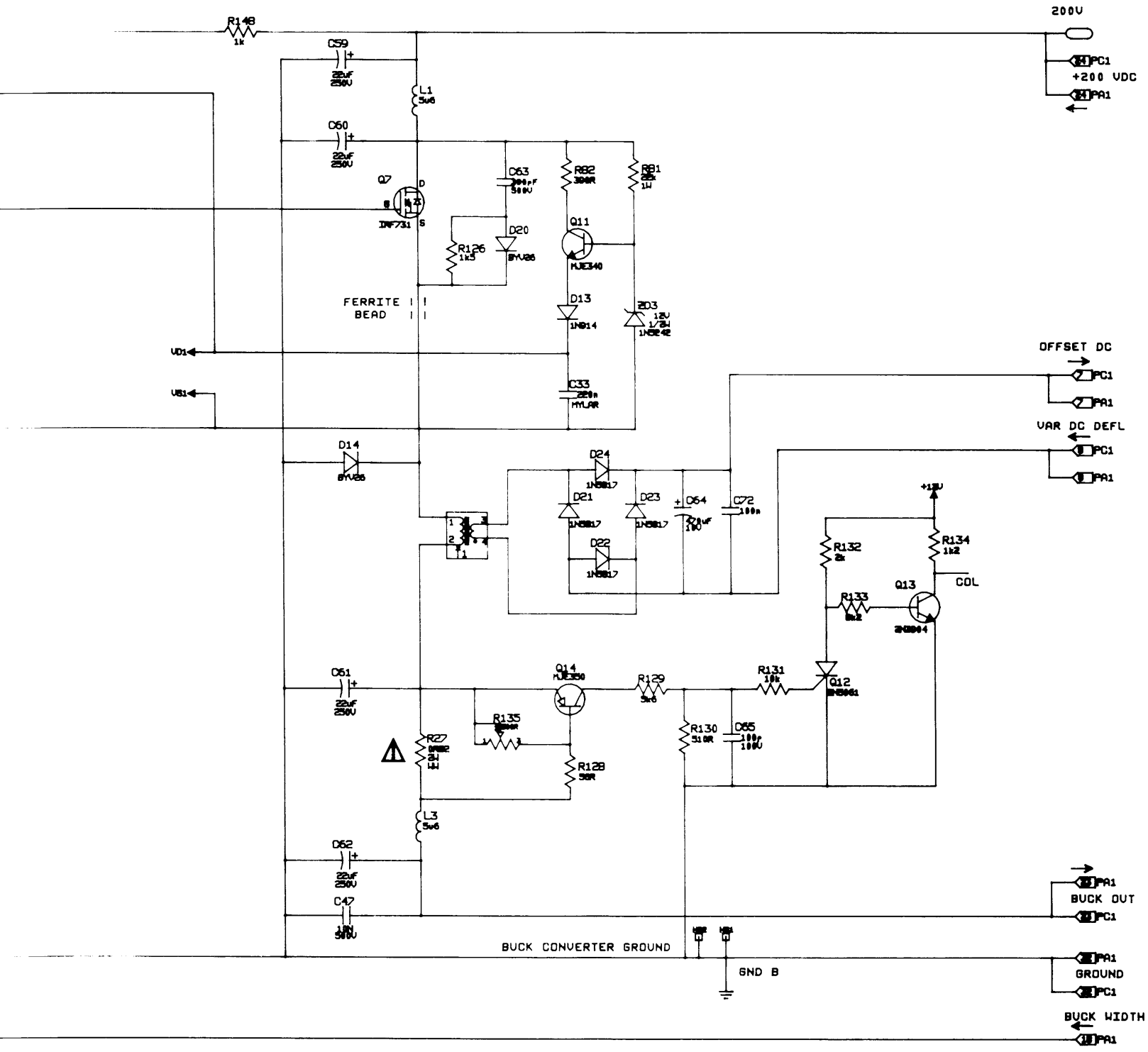


SPARE GATE

FIGURE 17–4.
Vertical Deflection & Horizontal Regulation Module Schematic (Sheet 2 of 2)



17.4 PARTS LIST

Item Ref.	Part No.	Description
Integrated Circuits		
IC1,IC10	14-002104-01P	TL084CN, quad biFET linear op amp
IC2	14-A04021-01P	CD4098BE, CMOS dual mono multivibrator
IC3	14-002084-02P	SGS TDA1170S, linear vertical deflector
IC4,IC5	14-002154-01P	CA339, quad linear voltage comparator
IC7	14-A03009-01P	DG307CJ, I/F analog CMOS gate switch
IC8	14-002830-01P	TDA4716A, SMPS controller
IC9	14-A03014-01P	MC14049UB, I/F logic CMOS buffer
Transistors & Diodes		
Q1,Q4,Q13, Q15,Q16	14-000881-06P	2N3904, NPN, 40V, 0.2A, 0.35W
Q6	14-000982-14P	MPSU10, NPN, 300V, 0.5A, 1W
Q7	14-A00704-01P	1RF731, hex FET, 350V
Q9,Q10	14-000873-82P	2N3906, small signal
Q11	14-000986-03P	MJE340, NPN, 300V, 0.5A, 20W
Q12	14-000566-01P	2N5061, SCR thyristor
Q14	14-000986-04P	MJE350, PNP, 300V, 0.5A, 20W
D1-D9,D12,D13, D15-D19,D25-D30	14-000513-01P	1N914A, diode, 0.075A, 75V, T
D14,D20	14-000525-07P	BYV26, rectifier, O.5A, 350V, T
D21-D24	14-000533-02P	1N5817, Schottky barrier diode
LD1,LD2	14-001016-02P	LED, 3V, 0.09A, red
LD3	14-001016-03P	LED, 3V, 0.06A, yellow
LD4-LD10	14-001016-01P	LED, 3V, 0.09A, green
ZD1,ZD2,ZD4,ZD5	14-000515-98P	1N5231C, zener diode, 5.1V, 1/2W, 2%, T
ZD3	14-000531-35P	1N5242, zener diode, -12V, 5%
ZD6	14-000515-83P	1N4740, zener diode, 10V, 1W, 2%, T
Capacitors		
C1,C2,C4,C49,C51	84-410104-03P	100 μF, 25V
C5	88-171030-02P	10 nF, 50V, 10%, mylar
C6,C9,C10,C16	88-171041-02P	100 nF, 100V, 10%
C11-C13,C15,C17, C50,C53,C72	89-000032-03P	100 nF, 50V
C19,C20,C22,C54	84-410004-01P	10 μF, 25V
C23-C25	84-447506-01P	4.7 μF, 50V
C26,C37,C38	84-422004-01P	22 μF, 25V
C28-C30	84-433506-01P	3.3 μF, 50V
C31	88-171531-01P	15 nF, 100V, mylar
C32,C33	88-172240-02P	220 nF, 50V, 10%
C34	84-422103-03P	220 μF, 16V
C35,C36	89-000033-02P	1.0 nF, 50V, 1%
C39	89-000032-02P	0.47 μF, 50V, $\pm$20%
C40,C41	86-310213-02P	1 nF, 500V, 10%, Z5P

17.4 PARTS LIST (cont.)

Item Ref.	Part No.	Description
Capacitors (cont.)		
C47	46-310313-11P	10 nF, 500V, 10%, Z5P
C48	88-173340-02P	330 nF, 63V, 10%
C55-C57,C65	86-610134-04P	100 pF, NPO
C58	44-447103-06P	470 μF, 16V
C59-C62	44-422010-09P	22 μF, 250V
C63	86-339113-02P	390 pF, 500V, 10%
C64	44-447102-05P	470 μF, 10V
C66	88-174730-02P	47 nF, mylar
C67-C69	86-622151-02P	220 pF, 100V, 10%
C71	88-174721-02P	4.7 nF, 100V, 10%, mylar
Resistors		
R1,R86,R89	80-147025-11P	47K, 1/2W, 5%, metal film
R2	80-139025-11P	39K, 1/2W, 5%, metal film
R3	82-310085-29P	1R, 1/3W, 5%
R5,R84,R87,R148	80-110015-11P	1K, 1/2W, 5%, metal film
R6	80-116015-11P	1.6K, 1/2W, 5%
R10	41-000344-13P	50K, carbon trim pot
R12	80-124025-11P	24K, 1/2W, 5%, metal film
R13,R14,R16-R18, R141,R147	80-110035-11P	100K, 1/2W, 5%, metal film
R21,R50,R126	80-115015-11P	1.5K, 1/2W, 5%, metal film
R22,R76,R106	80-182005-11P	820R, 1/2W, 5%, metal film
R23,R56,R57,R60, R61,R63-R67,R100, R102,R131,R140	80-110025-11P	10K, 1/2W, 5%, metal film
R25	80-122035-11P	220K, 1/2W, 5%
⚠ **R27**	**42-000134-01P**	**0.82R, 2W, 5% SAFETY COMPONENT**
R28,R145	80-133025-11P	33K, 1/2W, 5%, metal film
R29-R32,R91, R92,R143	80-147015-11P	4.7K, 1/2W, 5%, metal film
R39,R94-R96	80-115035-11P	150K, 1/2W, 5%, metal film
R41,R123,R124, R125	80-110045-11P	1M, 1/2W, 5%, metal film
R45	80-130025-11P	30K, 1/2W, 5%
⚠ **R46**	**80-122095-11P**	**22R, 1/2W, 5%, metal film SAFETY COMPONENT**
R48	80-118025-11P	18K, 1/2W, 5%, metal film
R49,R53,R98,R99, R138,R139	80-122015-11P	2.2K, 1/2W, 5%
R52	80-139015-11P	3.9K, 1/2W, 5%, metal film

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17.4 PARTS LIST (cont.)

	Item Ref.	Part No.	Description
	Resistors (cont.)		
⚠	**R68,R150**	**80-110095-11P**	**10R, 1/2W, 5%, metal film SAFETY COMPONENT**
	R69,R104	80-120025-11P	20K, 1/2W, 5%, metal film
	R73,R101,R105	80-127015-11P	2.7K, 1/2W, 5%, metal film
	R74	80-130015-11P	3K, 1/2W, 5%, metal film
	R75	80-115005-11P	150R, 1/2W, 5%, metal film
	R77	80-122005-11P	220R, 1/2W, 5%, metal film
	R78	40-123955-31P	3.9M, 1/4W, 5%
	R79	80-112025-11P	12K, 1/2W, 5%, metal film
⚠	**R80**	**42-000125-10P**	**10R, 1/4W, 5%, TC SAFETY COMPONENT**
	R81	42-000108-03P	22K, 1W, 5%
	R82	42-000125-11P	390R, 1/4W, 5%, TC
	R90,R136,R137	80-110005-11P	100R, 1/2W, 5%, metal film
	R103,R115,R116, R142	80-133015-11P	3.3K, 1/2W, 5%, metal film
	R107,R118	41-000344-43P	50K, carbon trim pot
	R108,R109	80-151015-11P	5.1K, 1/2W, 5%, metal film
	R110	40-121065-31P	10M, 1/4W, 5%
	R111	80-127035-11P	270K, 1/2W, 5%, metal film
	R112	80-118035-11P	180K, 1/2W, 5%, metal film
	R113	80-162015-11P	6.2K, 1/2W, 5%, metal film
	R117	80-139035-11P	390K, 1/2W, 5%, metal film
	R119	40-624735-01P	47K, 2W, 5%
	R120	40-423335-01P	33K, 1W, 5%
	R121	41-000344-47P	500K, carbon trim pot
	R122	41-000344-09P	5K, carbon trim pot
	R128	80-156095-11P	56R, 1/2W, 5%, metal film
	R129	80-156015-11P	5.6K, 1/2W, 5%, metal film
	R130	80-151005-11P	510R, 1/2W, 5%, metal film
	R132	80-120015-11P	2K, 1/2W, 5%, metal film
	R133	80-182015-11P	8.2K, 1/2W, 5%, metal film
	R134	80-112015-11P	1.2K, 1/2W, 5%, metal film
	R135	41-000344-06P	500R, carbon trim pot
	R144	80-122025-11P	22K, 1/2W, 5%, metal film
	R146	80-130005-11P	300R, 1/2W, 5%, metal film
	Coils & Transformers		
	L1	21-001400-09P	5.6 μH, RF choke
	L3	21-001400-24P	5.6 μH, choke
	T1	24-161012-01P	deflection choke power supply

17.5 SPECIFICATIONS

Connector P1, Row A:

Pin 1 . . . . . analog input **-V SENSE R**
NOTE: **see Power Deflection module**

Pin 2 . . . . . analog input **-V SENSE B**
NOTE: **see Power Deflection module**

Pin 3 . . . . . analog output **V DRIVE**

no load, V SIZE = 5V
adjust R118 such that the minimum to
maximum voltage is 6 to 21V p-p ± 10%

adjust R118 to produce 10V p-p
set V SIZE = 10V
signal level . . . . . **12V** p-p ± 10%

set V SIZE = 0V
signal level . . . . . **7V** p-p ± 10%

Pin 4 . . . . . analog input **-V SENSE G**
NOTE: **see Power Deflection module**

Pin 5 . . . . . analog output **V BOOST**
vertical pulse, +ve going . . . . . **5V** peak ± 10%
pulse width . . . . . 300 μs ± 10%

Pin 7 . . . . . analog **OFFSET DC**

Pin 8 . . . . . analog **VAR DC DEFL**

Pin 17 . . . . . +150V power supply **+150 VDC**
LED (LD4) indicator . . . . . 5 mA max

Pin 18 . . . . . analog input **BUCK WIDTH**
NOTE: **see Power Deflection module**

Pin 20 . . . . . analog input **H SENSE B**
NOTE: **see Power Deflection module**

Pin 21 . . . . . analog input **H SENSE G**
NOTE: **see Power Deflection module**

Pin 22 . . . . . analog input **H SENSE R**
NOTE: **see Power Deflection module**

Pin 23 . . . . . analog output **BUCK OUT**
Horizontal Regulator output, measure with pin A-18
adjusted for output current of:
203 mA . . . . . 115V ± 2%
308 mA . . . . . 152V ± 2%
760 mA . . . . . 47V ± 2%

Pin 24 . . . . . +200V power supply **+200 VDC**
current range . . . . . 128 to 300 mA

Pin 25 . . . . . -24V power supply **-24 VDC**
(for LD9) current level . . . . . 5 mA max

Pin 26 . . . . . +24V power supply **+24 VDC**
(for LD5) current level . . . . . 5 mA max

Pin 27 . . . . . -12V power supply **-12 VDC**
current level . . . . . 45 mA max

Pin 28 . . . . . +12V power supply **+12 VDC**
current level . . . . . 160 mA

Pin 29 . . . . . +5V power supply **+5 VDC**
(for LD7) current level . . . . . 5 mA max

Pin 30 . . . . . connected to Pin 29 **+5 VDC**

Pin 31 . . . . . ground **GND**

Pin 32 . . . . . connected to Pin 31 **GND**

Connector P1, Row C:

Pin 2 . . . . . analog input **V HOLD**
signal level . . . . . 0 to 10VDC
vertical oscillator lock-in range
manual mode @ SW = 5V
lock-in range . . . . . 45 to 120 Hz
pull-in range . . . . . +10/-0 Hz min
auto mode @ SW = 0V
lock-in range . . . . . 45 to 120 Hz

Pin 3 . . . . . analog output **EHT INHIBIT 1**
NOTE: collector output is open when inhibit is active

Pin 5 . . . . . analog input **SPOT KILL**
NOTE: **see Horizontal Deflection module**

Pin 7 . . . . . **OFFSET DC**
NOTE: connected to Row A, Pin 7

Pin 8 . . . . . **VAR DC DEFL**
NOTE: connected to Row A, Pin 8

Pin 10 . . . . . analog input **VERT1**
positive vertical sync . . . . . 0 to 5V

Pin 14 . . . . . analog output **FBK V SIZE**
measure with no load on V DRIVE, V SIZE set to 5V
R118 @ min . . . . . 4VDC ± 10%
R118 @ max . . . . . 3.6VDC ± 10%

Pin 15 . . . . . analog input **V A/M SW**
vertical auto/manual switch . . . . . 0 to 5VDC

Pin 19 . . . . . analog input **V SIZE**
vertical size control . . . . . 0 to 10VDC
NOTE: **from Remote Control module**

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SECTION 18

KEYSTONE MODULE

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

No tables are included in this section.

18.1 TECHNICAL DESCRIPTION

18.1.1 General Description

Correction for keystone effects are provided by the Keystone module located in the front slide-out rack.

18.2 SERVICING AND ALIGNMENT

18.2.1 Disassembly and Access

Module Location:
- front slide-out rack

Tools & Equipment Required:
- 1/4" hex head socket driver

a) Remove the projector lower front and side panels as described in Section 5.

b) Remove the two screws securing the front slide-out rack to the projector chassis. Slide the rack out about 4".

c) Disconnect connector M15-P1 from the keystone module (item 1 below).

d) Remove the two screws at the bottom of the keystone board (item 2).

e) Lower the Keystone module from the slide-out rack.

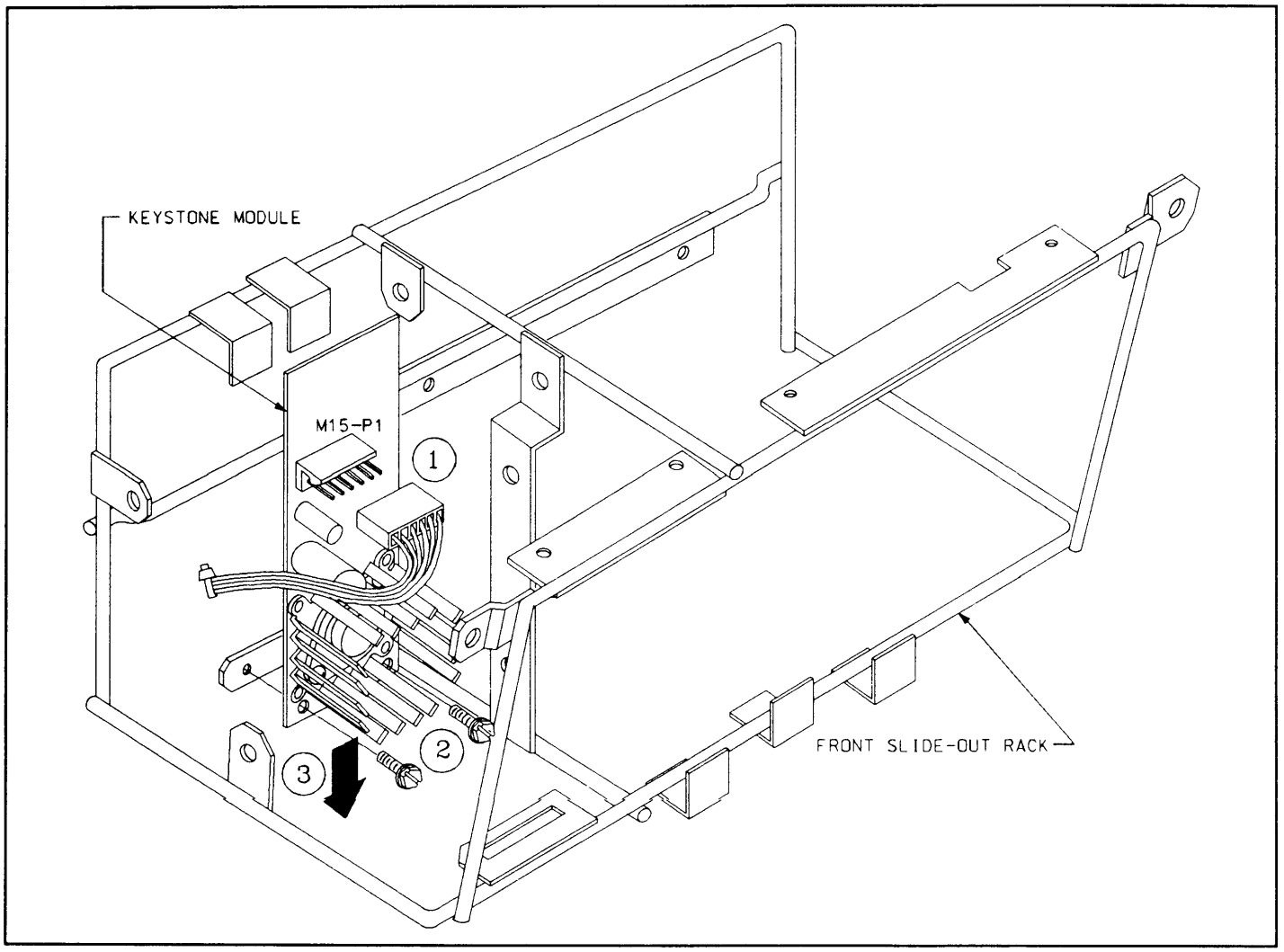


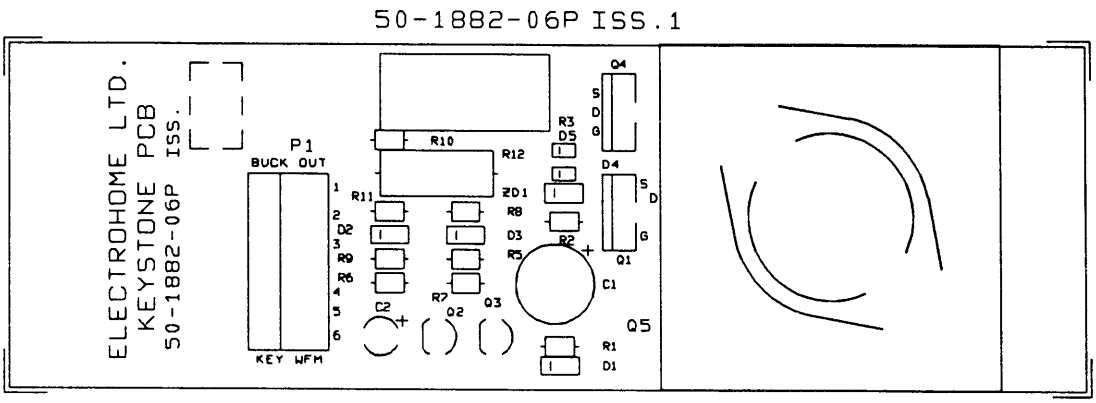
FIGURE 8-1. *Keystone Module Removal*

18.2.2 Alignment

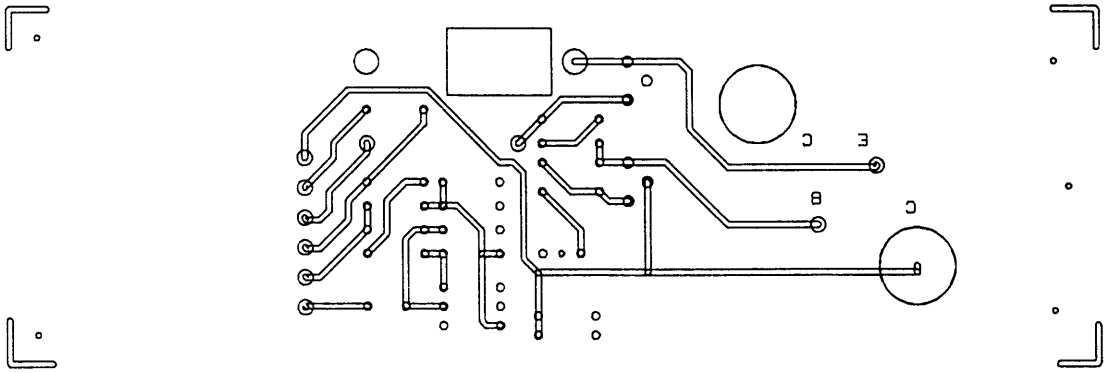
There are no serviceable adjustments required for the Keystone module.

18.3 COMPONENT LAYOUT AND SCHEMATICS

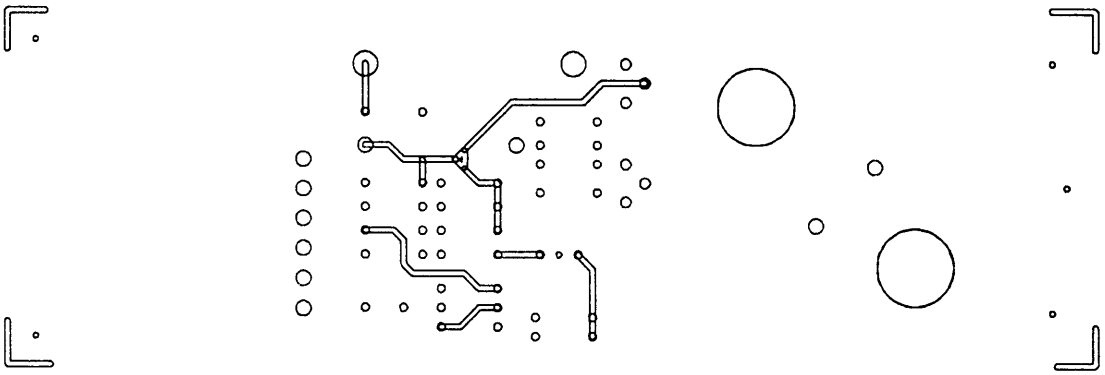
Refer to the following pages for component layouts and schematics of the Keystone module.



Component Layout



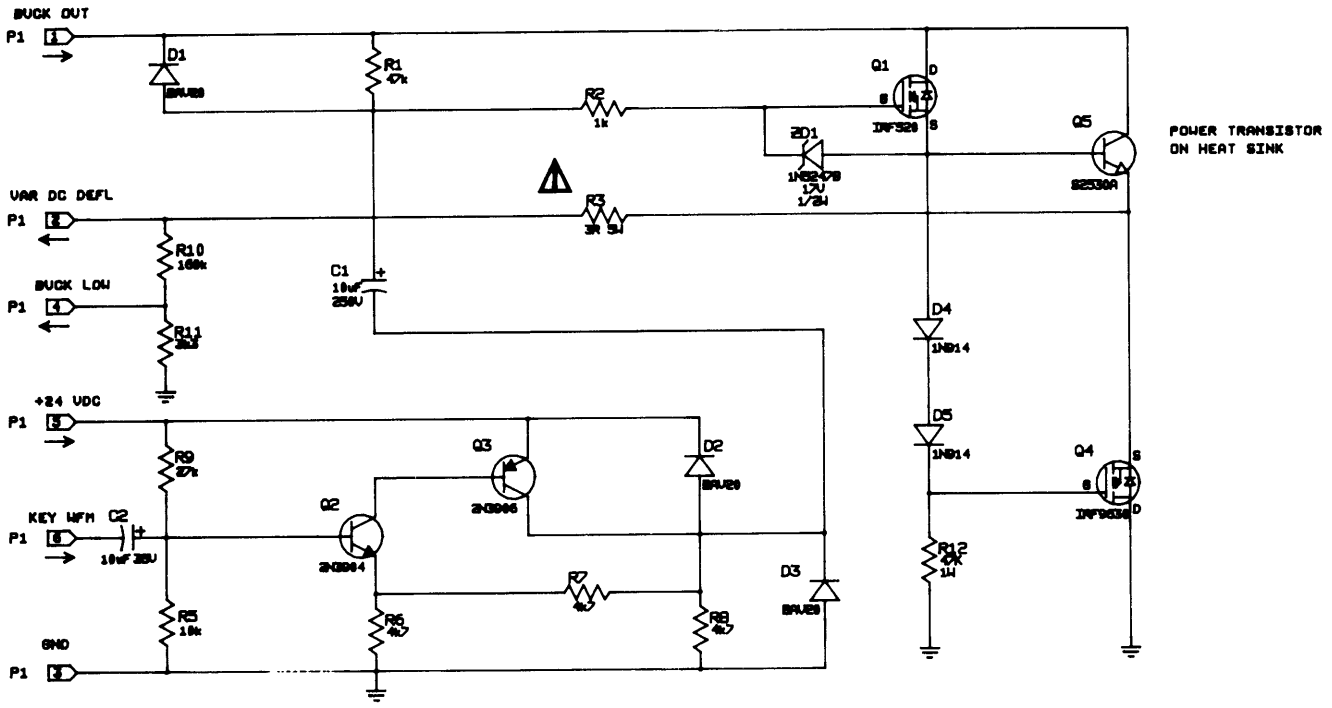
Solder Side
(Viewed from Component Side)



Component Side

FIGURE 18-2. ***Keystone Module Component Layout***

54-7904-02P/54-7904-03P (06/90)



LEGEND

RESISTORS: RESISTANCE IS IN R(OHMS), k(KILOHMS), OR M(MEGAOHMS). 1/2 WATT, 5% TOLERANCE UNLESS OTHERWISE SPECIFIED.

CAPACITORS: CAPACITY IN p(PICOFARADS), n(NANOFARADS), OR μ(MICROFARADS) D.C.W.V. & TOLERANCE NOTED WHERE CRITICAL.

FIGURE 18-3. *Keystone Module Schematic*

18.4 PARTS LIST

	Item Ref.	Part No.	Description
	Transistors and Diodes		
	Q1	14-A00701-01P	1RF520, hex FET, 100V
	Q2	14-000881-06P	2N3904, NPN, 40V, 0.2A, 0.35W
	Q3	14-000873-82P	2N3906, PNP, small signal
	Q4	14-A00706-01P	1RF9630, hex FET, 200V
	Q5	14-000674-10P	S2530A, npn, 400V, 100W
	D1-D3	14-000513-10P	BAV20, diode, 0.25mA, 150V
	D4,D5	14-000513-01P	1N914, diode, 0.075A, 75V
	ZD1	14-000531-37P	1N5247, zener diode, 17V, 5W, 5%
	Capacitors		
	C1	44-410010-08P	10 μF, 250V
	C2	84-410005-01P	10 μF, 35V
	Resistors		
	R1	80-147025-11P	47K, 1/2W, 5%, metal film
	R2	80-110015-11P	1K, 1/2W, 5%, metal film
⚠	**R3**	**42-113075-02P**	**3R, 5W, 5%, NI SAFETY COMPONENT**
	R5	80-110025-11P	10K, 1/2W, 5%, metal film
	R6-R8	80-147015-11P	4.7K, 1/2W, 5%, metal film
	R9	80-127025-11P	27K, 1/2W, 5%, metal film
	R10	80-116035-11P	160K, 1/2W, 5%, metal film
	R11	80-133015-11P	3.3K, 1/2W, 5%, metal film
	R12	40-424735-01P	47K, 1/2W, 5%, metal film

18.5 SPECIFICATIONS

Connector Signal Levels:

Pin 1 . . . . . analog input **BUCK OUT**
output of H. Regulator . . . . . 47 to 152VDC

Pin 2 . . . . . analog output **VAR DC DEFL**
BUCK OUT DC voltage drop 13VDC

Pin 3 . . . . . ground **GND**

Pin 4 . . . . . analog output **BUCK LOW**
= 0.01(VAR DC DEFL) . . . . . ±5%

Pin 5 . . . . . **+24VDC**
voltage range . . . . . 23 to 25VDC

Pin 6 . . . . . analog input **KEY WFM**
keystone waveform
(from Waveform module) . . . . . 8V p-p

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SECTION 19

POWER DEFLECTION MODULE

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

No tables included in this section.

19.1 TECHNICAL DESCRIPTION

19.1.1 General Description

The Power Deflection module controls the flow of current through the deflection yokes (and the arising magnetic fields) on each CRT. Convergence amplifiers, which drive the horizontal and vertical convergence yokes, are located on this module. There is one Power Deflection module for each CRT.

19.1.2 Circuit Description

19.1.2.1 Convergence Amplifiers

The convergence yokes have a 60 μH inductance and 0.3 Ω winding resistance. They are driven by current sensing, voltage feedback, transconductance type amplifiers.

19.1.2.2 Input Stage

Q1 and Q2 form the input stage. It is a differential input, single-ended output inverting amplifier. Bias current is 3mA. The DC operating current through matched pair Q1 and Q2 is 1.5mA when Vin=0. The DC operating voltage, measured after R13, is -10.4 volts.

The stage has a voltage gain, Av=67. Temperature stability is provided by R30 and R31. C3 suppresses high frequency oscillations.

19.1.2.3 Driver Stage

The driver consists of Q3, a single transistor inverting amplifier. Gain is 27, DC emitter voltage is -11.5 volts, collector current is 5.6 mA and collector voltage is -0.5 volt.

The output of the stage is biased at 0 by D1 and D4. D2 prevents the transistor from saturating. The parallel combination of C5 and D3 provide high frequency stability and reduce thermal drift.

19.1.2.4 Output Stage

The output stage for each amplifier is a push-pull, super emitter follower. The horizontal output consists of Q4, Q26 and Q30, the vertical output is Q5, Q24 and Q28. The stage has a gain of about 1. The average output current is kept below 1.88A by safety resistors R15 and R16 which act as fuses, causing SCRs Q6, Q7, Q8 and Q9 to trigger. R18 is a current sense resistor. R17 provides damping.

19.1.2.5 General

The equivalent circuit for the vertical and horizontal amplifiers is shown in Figure 19-1. NOTE: The pincushion input network appears on the vertical amplifier only.

The pincushion input voltage is the sum of the pincushion and bow voltages. It has a maximum value of 5.5 volts. Because it is AC coupled to the amplifier, the peak pincushion input voltage is 2/3 times 5.5 volts or 3.7 volts.

The peak amplitude of the convergence input voltage is 10 volts. The peak current in the vertical amplifier is 1.5 A maximum. The peak current in the horizontal amplifier is 0.7 A maximum.

Let pincushion input voltage = Vp and convergence input voltage=Vc. The closed loop output current of the vertical amplifier is:

$$Iv = 0.25Vp + 0.061Vc$$

The output current of the horizontal amplifier is:

$$Ih = 0.067Vc$$

Damping resistor, R17, delays the yoke current by 13° at 50kHz. C11 causes the pincushion input voltage to lead approximately 10° at 50kHz.

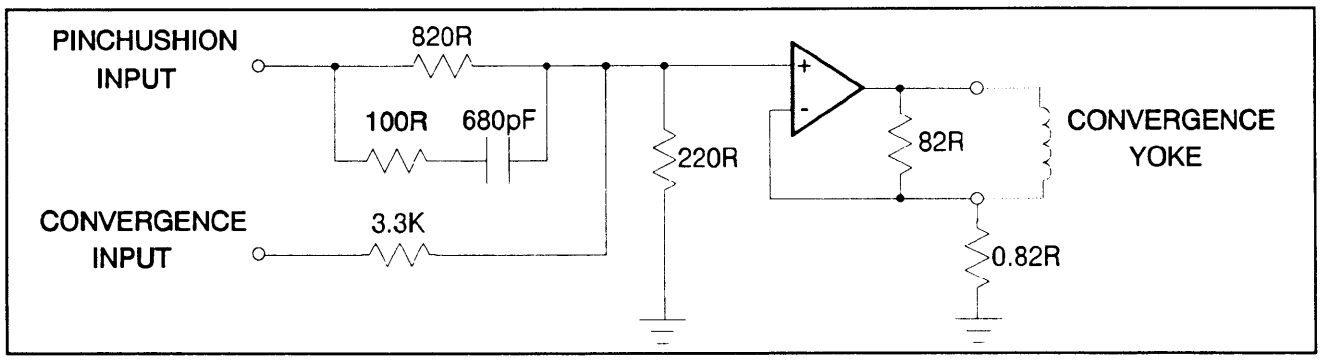

FIGURE 19-1. *Convergence Amplifier Equivalent Circuit*

19.2 SERVICING AND ALIGNMENT

19.2.1 Disassembly and Access

Module Location:
- projection head

Tools & Equipment Required:
- Phillips screw driver
- 3/16" hex head socket

a) Refer to Section 5.2. Remove the following covers and panels:
- front top cover
- rear top cover
- lower case

b) If the Power Deflection module for the green (center) CRT is to be removed, remove the keypad assembly from the projection head as instructed per Section 5.2. NOTE: disconnection of the keypad cable from the Mother Board is not required.

c) Locate the Power Deflection module to be removed. Disconnect the P6, P7, and P8 connectors from the module.

d) Gently pull the Video Output module away from the CRT. Note: the Video Output module is secured to the CRT by a small amount of hot melt glue. The joint between the glue and the CRT should break without difficulty. Once free, rest the board above the CRT.

e) Remove the two Phillips screws securing the Power Deflection module to the upper rear extrusion as shown below.

e) Carefully pull the Power Deflection Module out from the projector. The side modules (red and blue) may exit from the side of the projector. The center module must exit from the back.

NOTE: Prior to reassembly, pull or scrape off the hardened hot melt glue from the Video Output Module CRT connector. Re-connect the Video Output module to the CRT and apply the same amount of hot melt glue between the CRT connector and the CRT connector terminals.

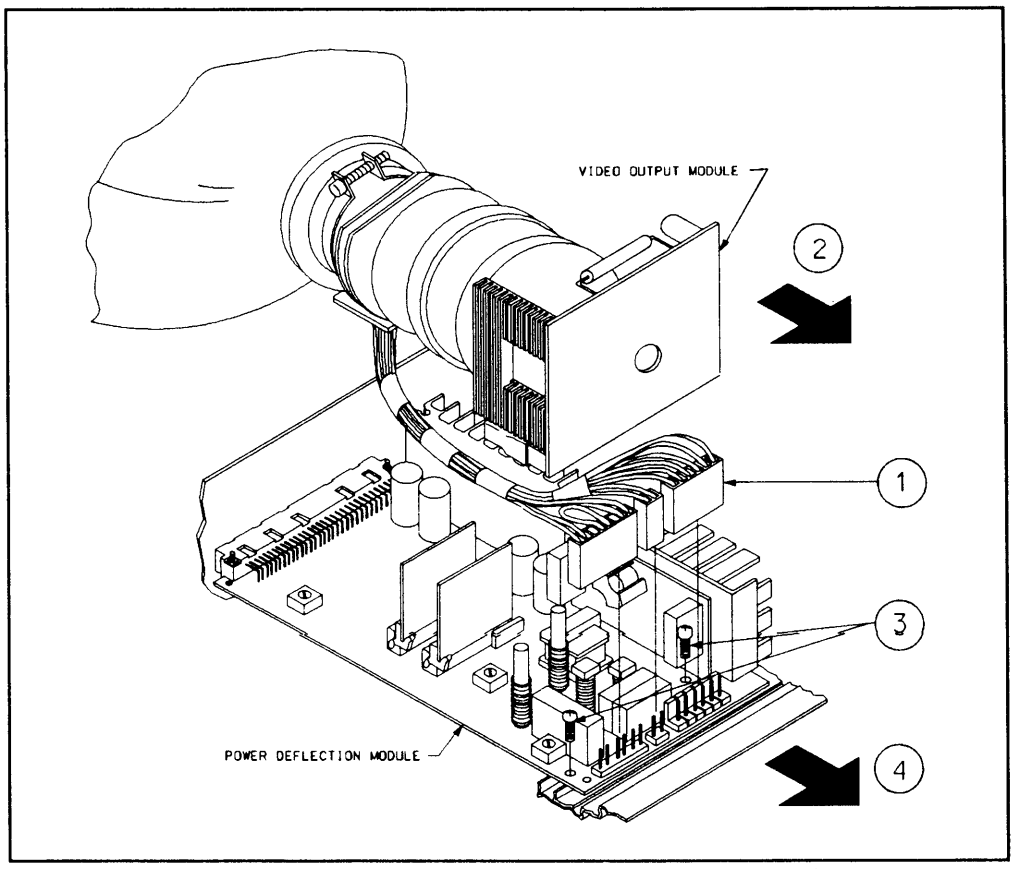

FIGURE 19-2. *Power Deflection Module Removal*

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19.2.2 Alignment and Adjustments

The following procedures provide instructions for adjusting the vertical height preset, width preset and raster width on the Power Deflection module.

Reference Figure 19-3.

Tools & Equipment Required:
- video source (24 KHz)
- fine tip slot screwdriver
- 3/32" plastic or nylon Allen key
- oscilloscope and 100X probe

STEP 1 – Vertical Height Preset

a) Press the # key on the keypad for a crosshatch pattern.

b) Press CONVERGE, 2 , RESET. Converge, center only, red to green and blue to green. DO NOT press EXIT.

c) Adjust R100 until the height of all colors matches.

STEP 2 – Width Preset

NOTE: This procedure is to be used on the GREEN Power Deflection Module only.

a) Connect the 100X probe of the oscilloscope to the drain of Q4. Q4 is located on the MOSFET printed circuit board.

c) Connect a 15.7 KHz source to the projector.

d) Adjust the image for maximum horizontal size.

e) Adjust R16 to produce 1260 V p-p at the drain of Q4 on the MOSFET PCB.

STEP 3 – Adjust Raster Width

a) Connect the video source to the projector. Set the horizontal frequency to 24 KHz.

b) Adjust L3 until raster width matches for all colors as close as possible.

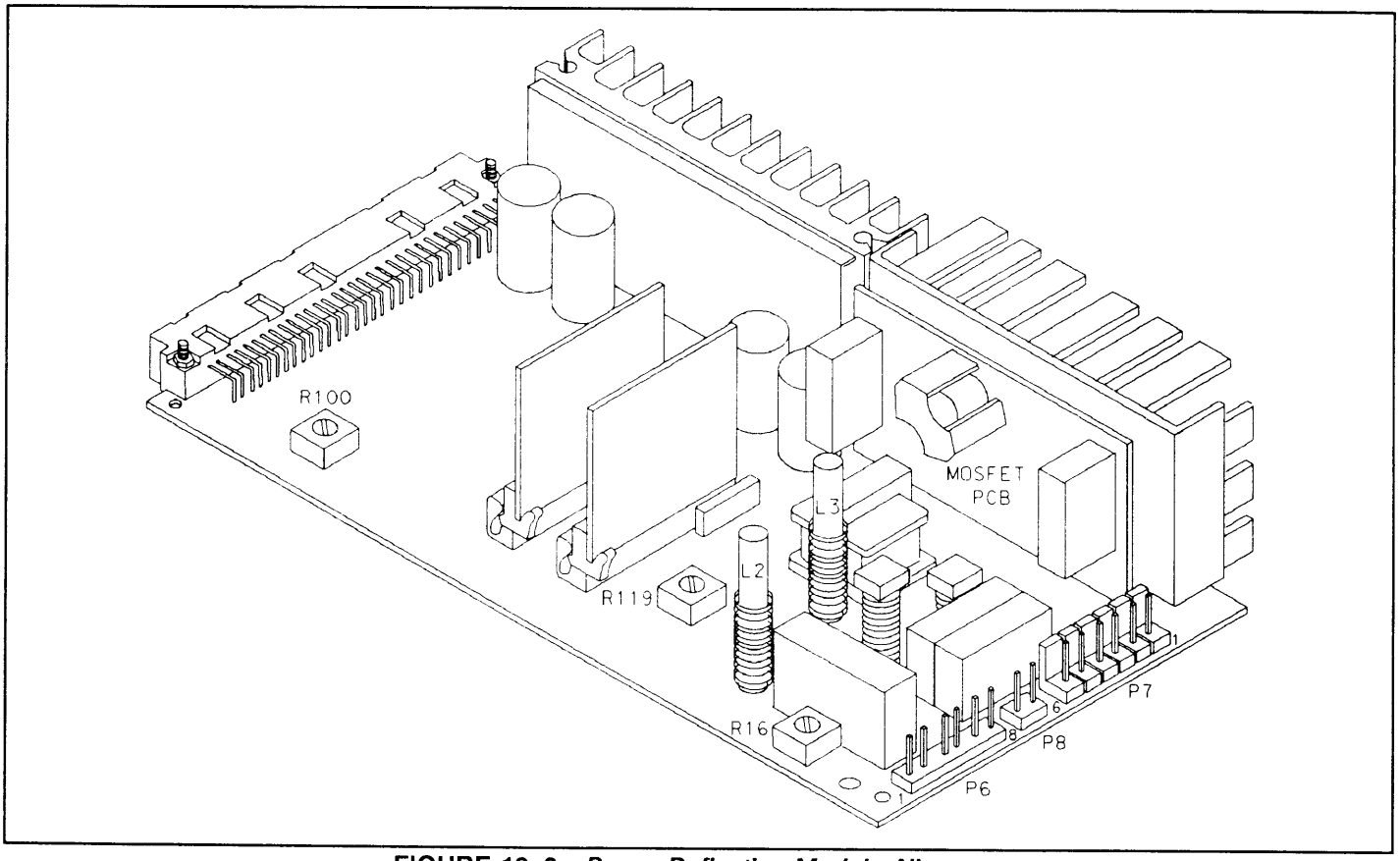
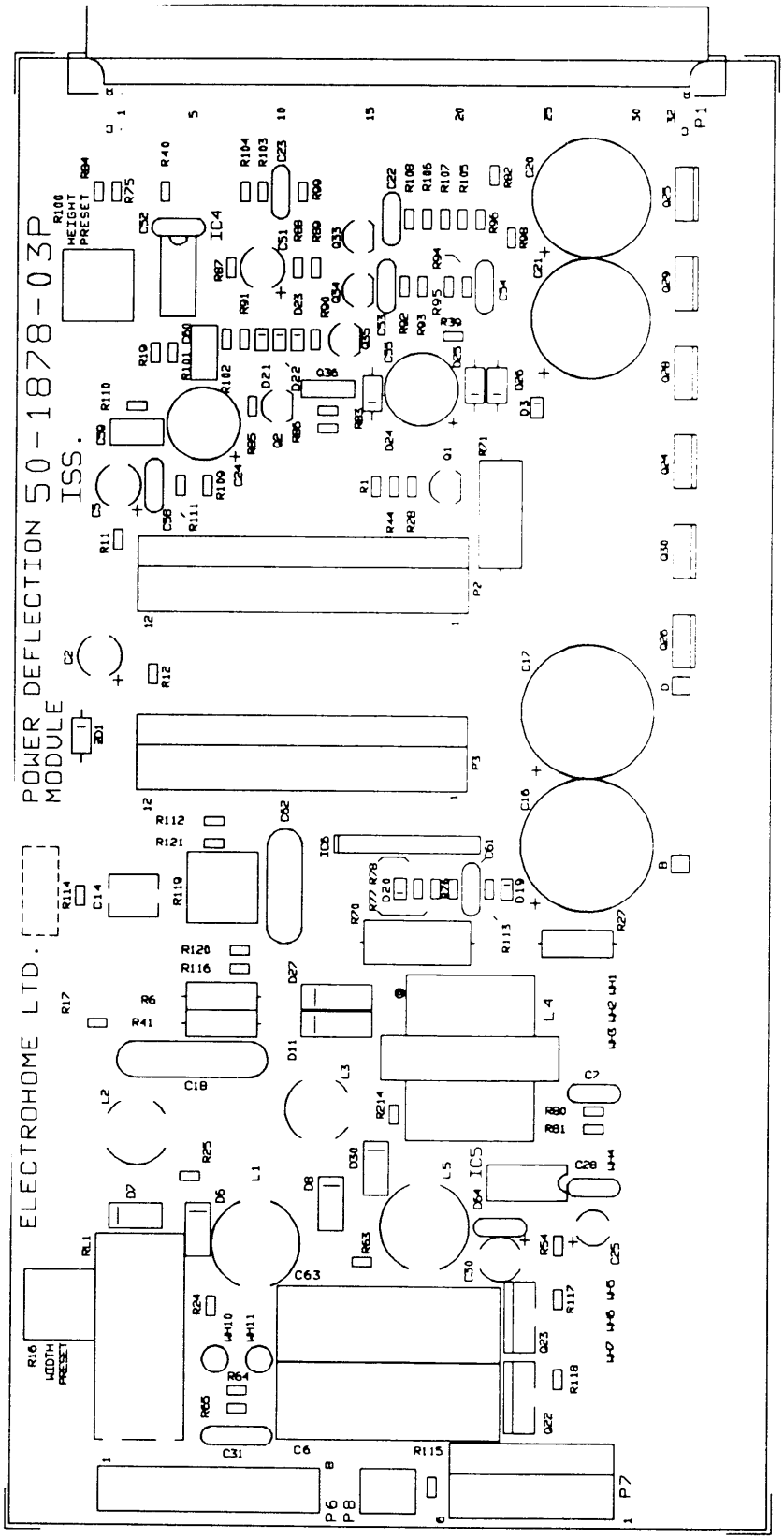


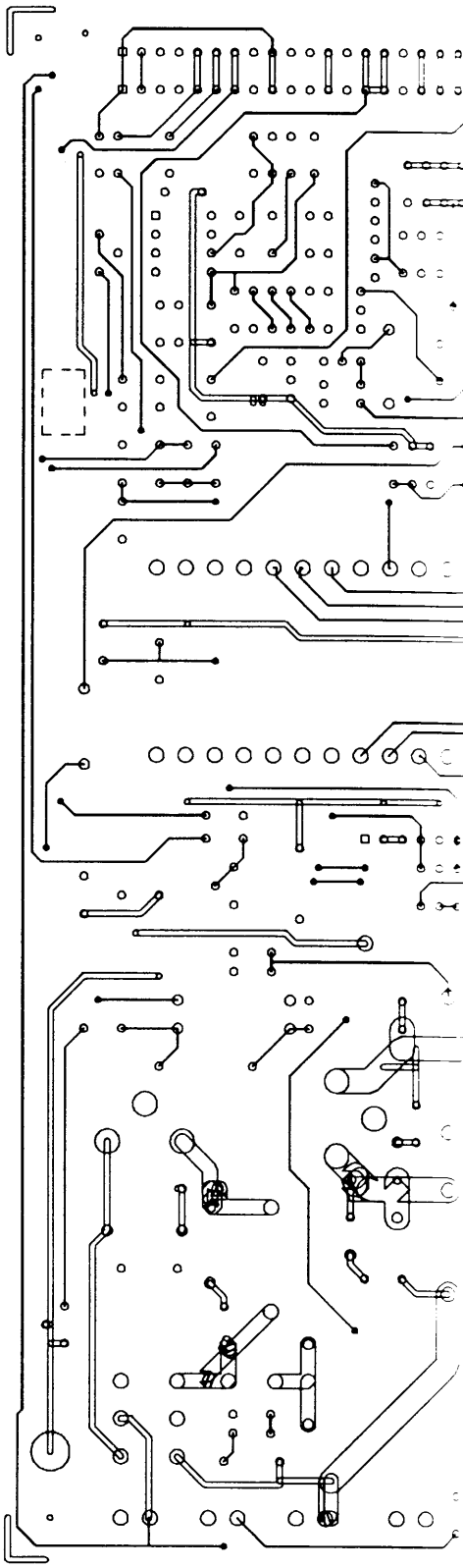
FIGURE 19–3. *Power Deflection Module Alignment*

19.3 COMPONENT LAYOUT AND SCHEMATICS

Refer to the following pages for component layouts and schematics of the Power Deflection Module.

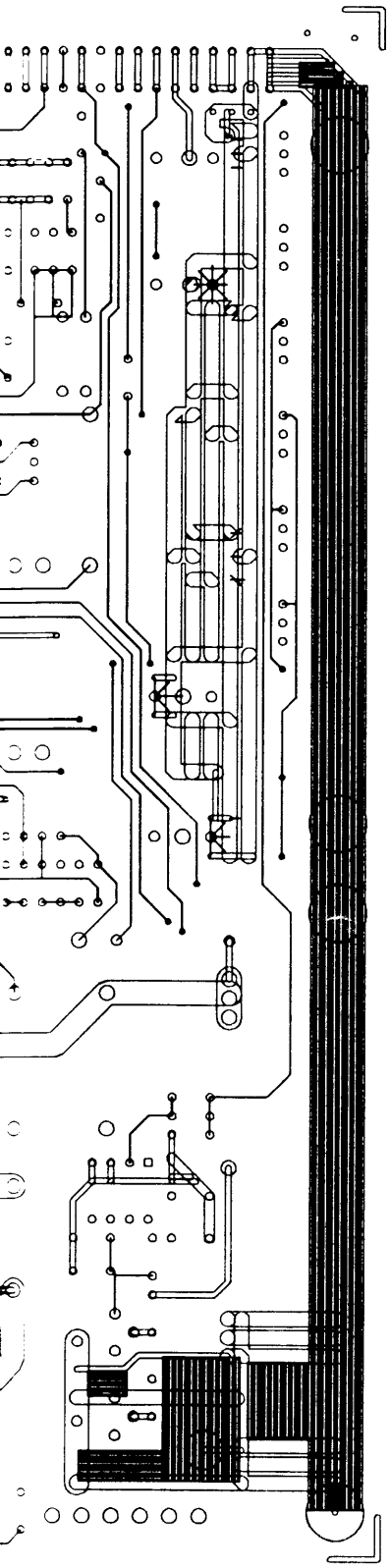


Component Layout

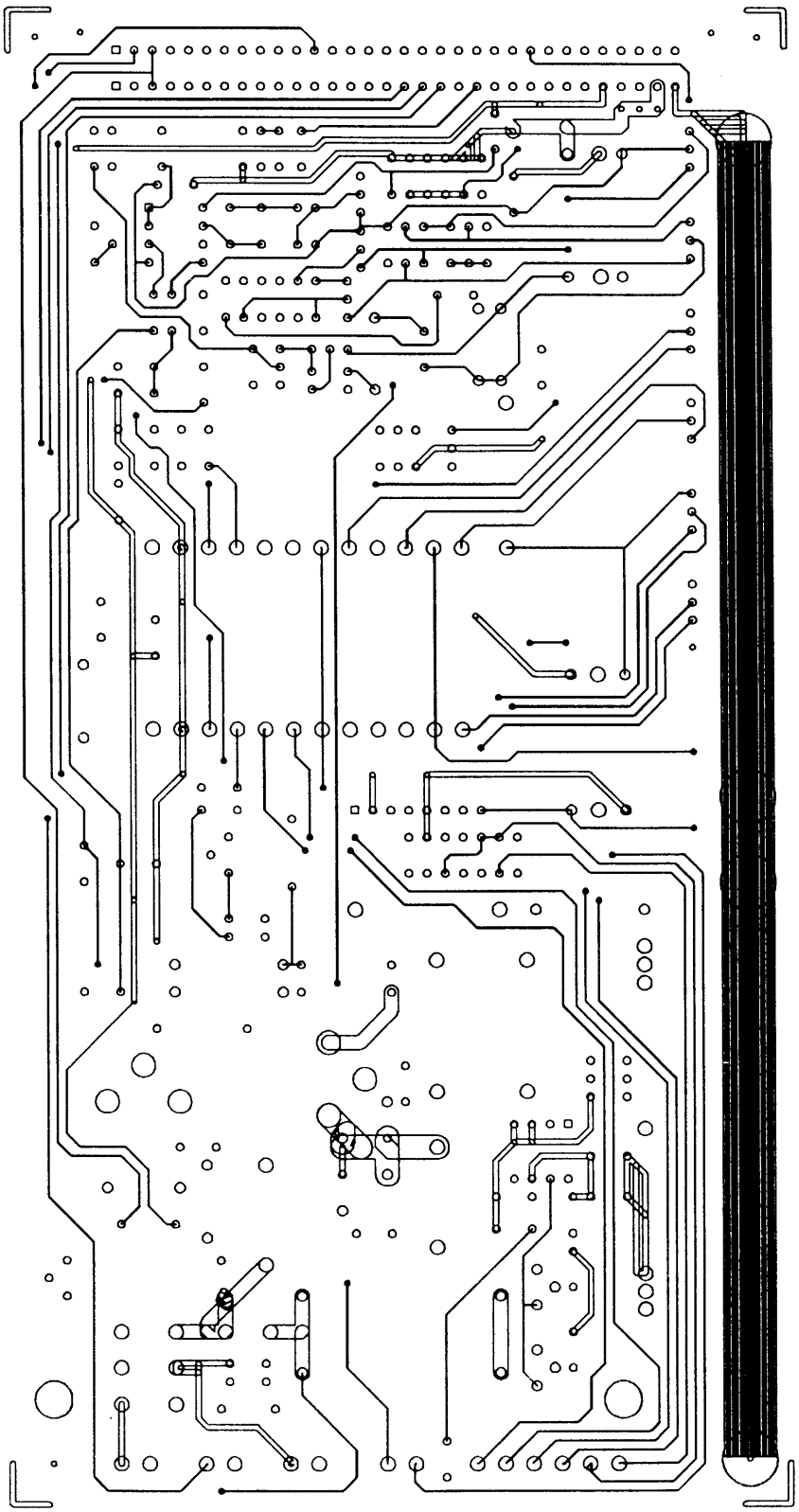


Solder Sid
(Viewed from Compo

54-7904-03P (06/90)



ide
ponent Side)



Component Side

FIGURE 19–4.
Power Deflection Module Component Layout

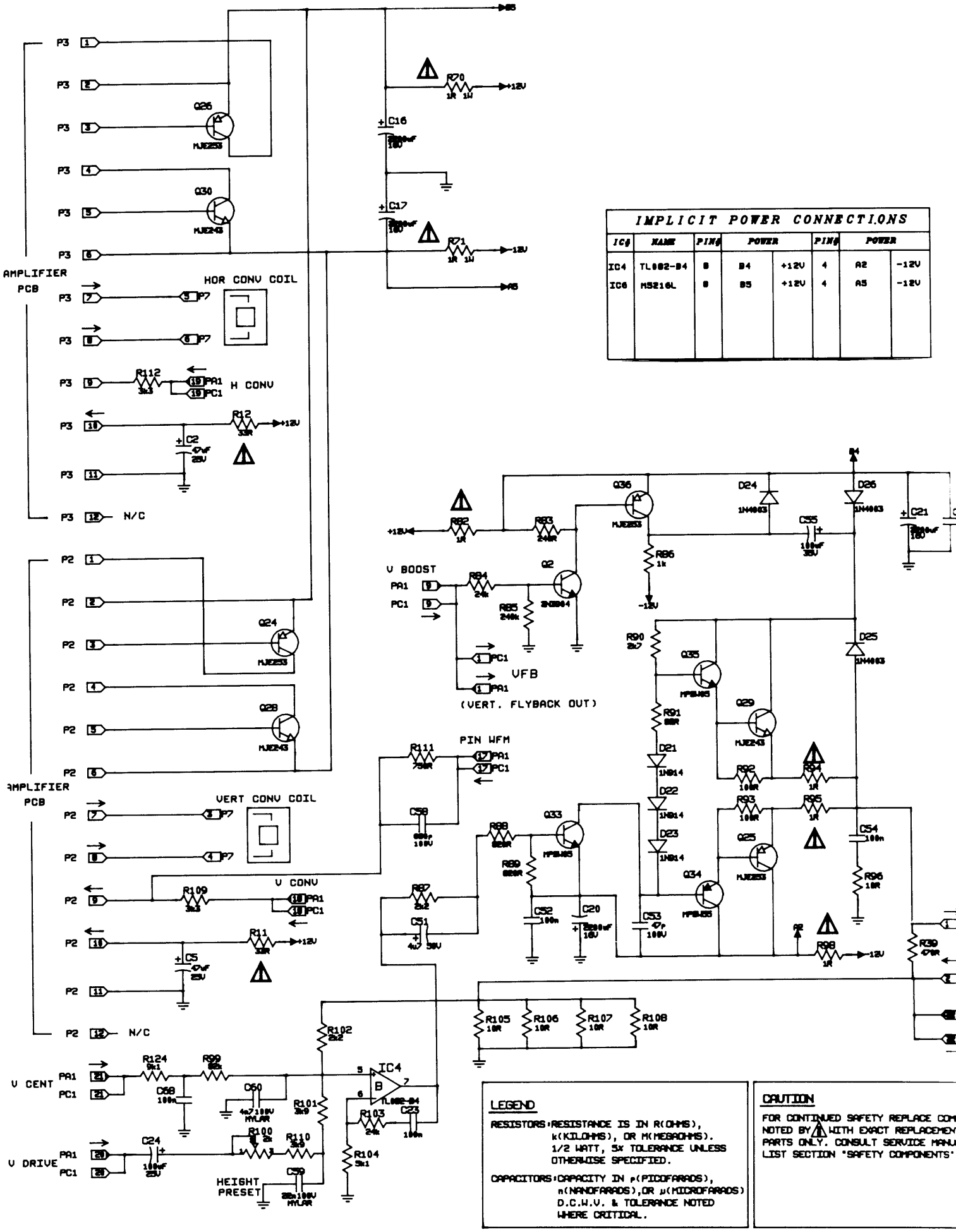
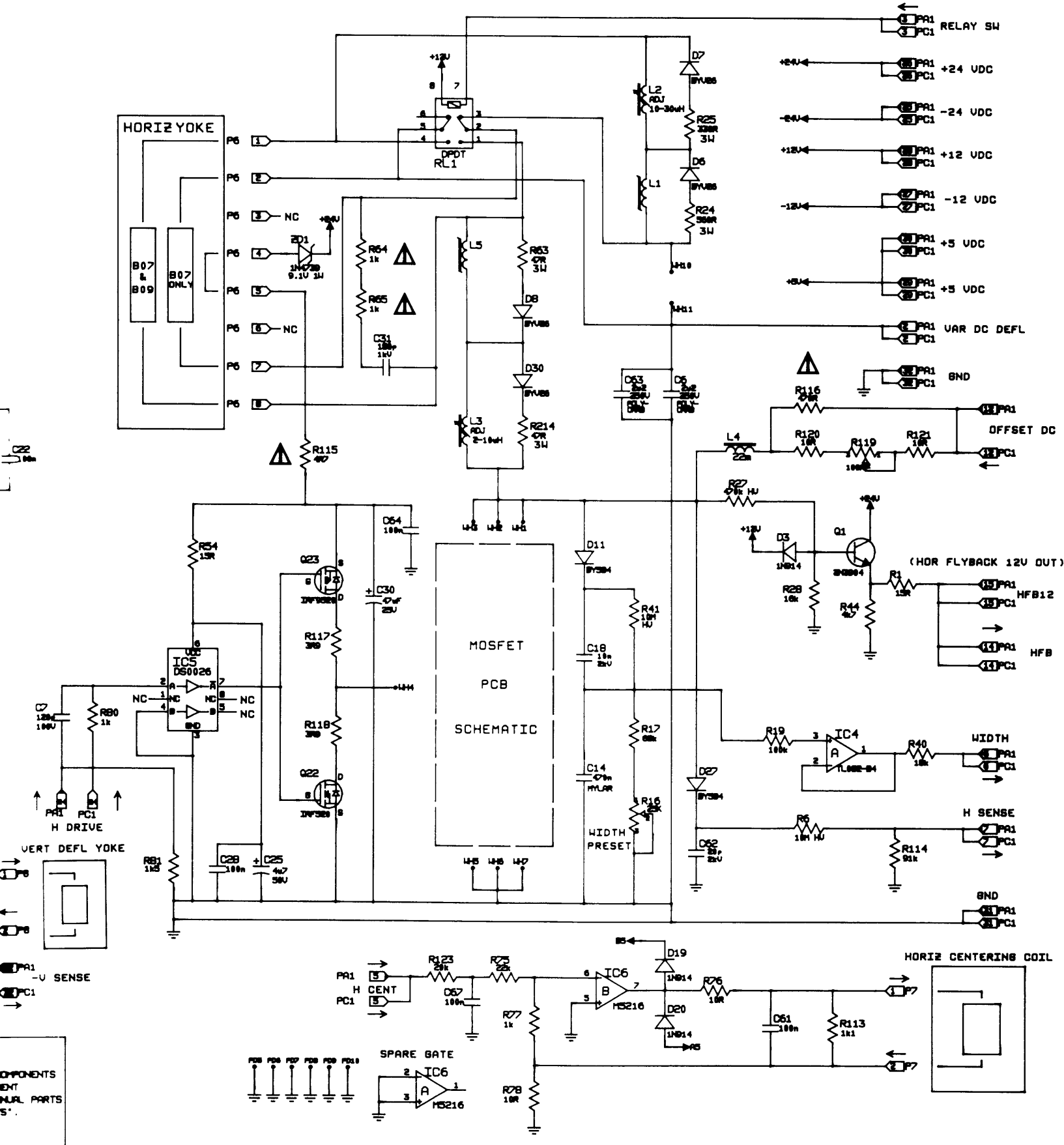
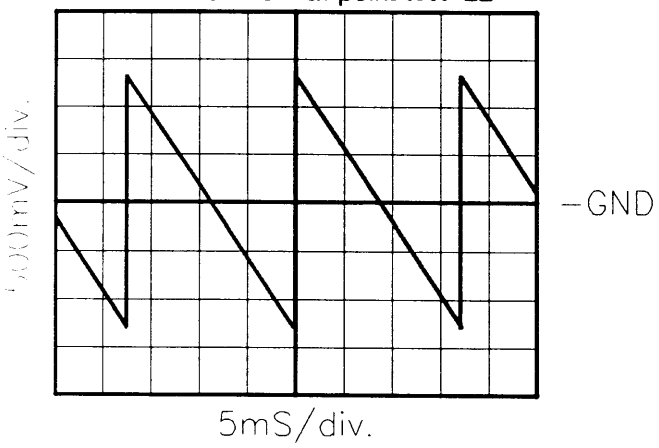


FIGURE 19–5.
Power Deflection Module Schematic

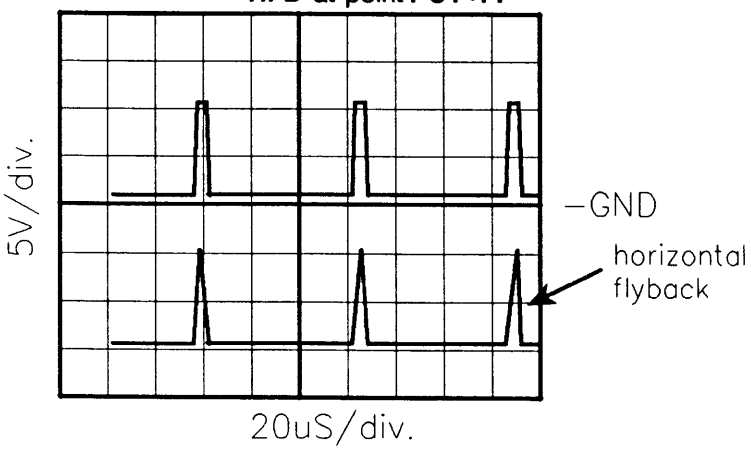


DEFLECTION PCB SCHEMATIC REFERENCE

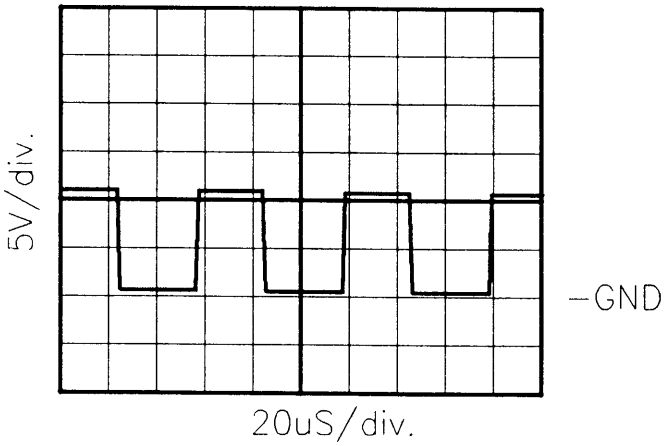
-V SENSE at point **TA1<22**



HFB at point **PC1<14**



GATE DRIVE at **Q22** or **Q23 drain**



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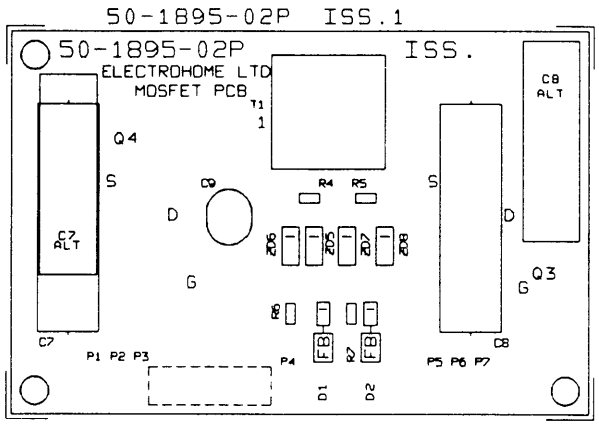
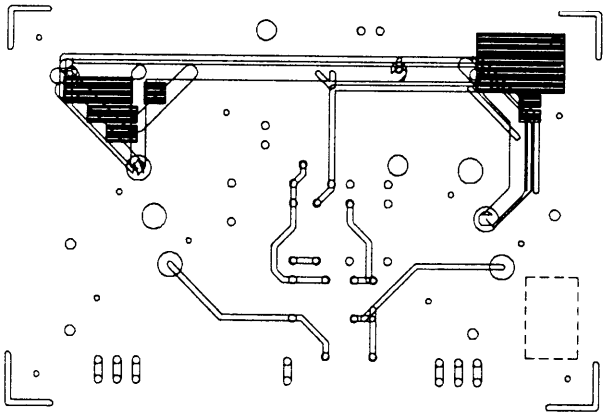
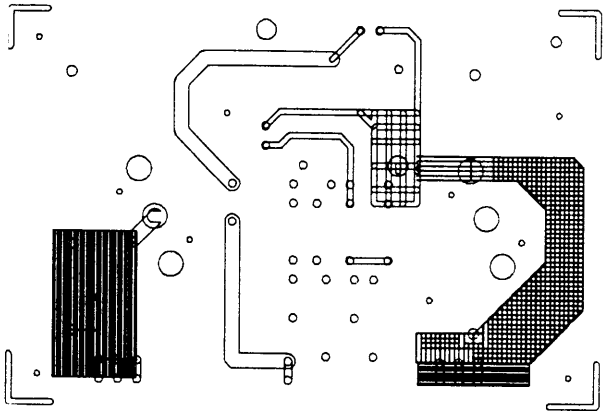


Component Layout



Solder Side
(Viewed from Component Side)



Component Side

FIGURE 19-6. *MOSFET PCB Component Layout*

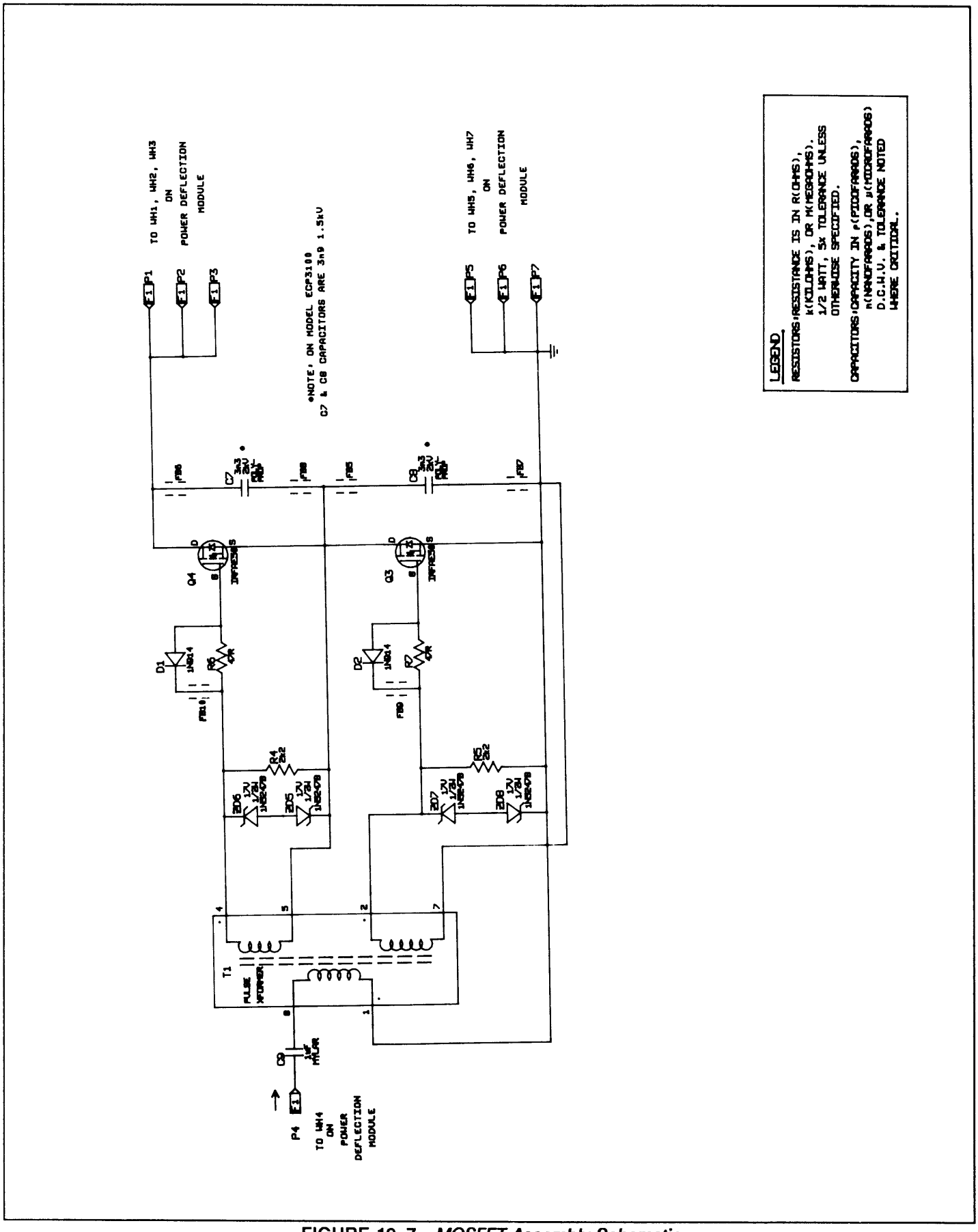
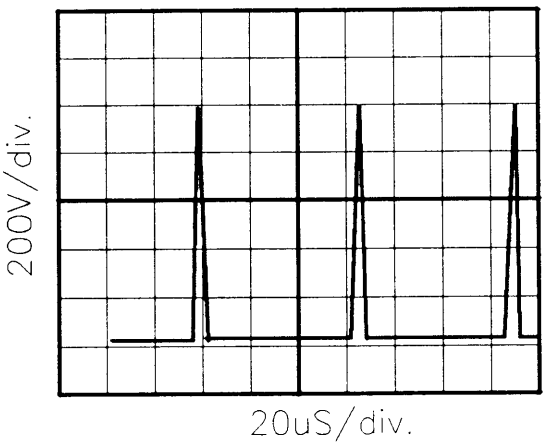


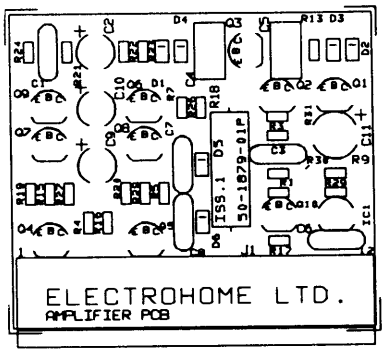
FIGURE 19-7. *MOSFET Assembly Schematic*

54-7904-03P (06/90)

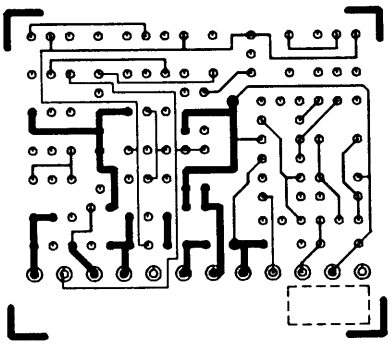
MOSFET PCB SCHEMATIC REFERENCE

FLYBACK PULSE at **Q4 drain**

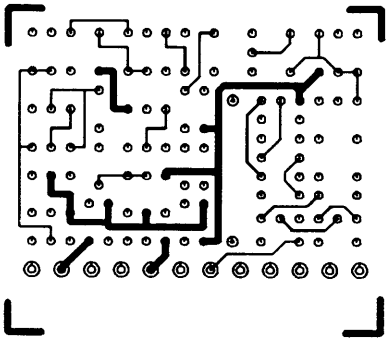




Component Layout



Solder Side
(Viewed from Component Side)



Component Side

FIGURE 19–8. *Amplifier PCB Component Layout*

54-7904-03P (06/90)

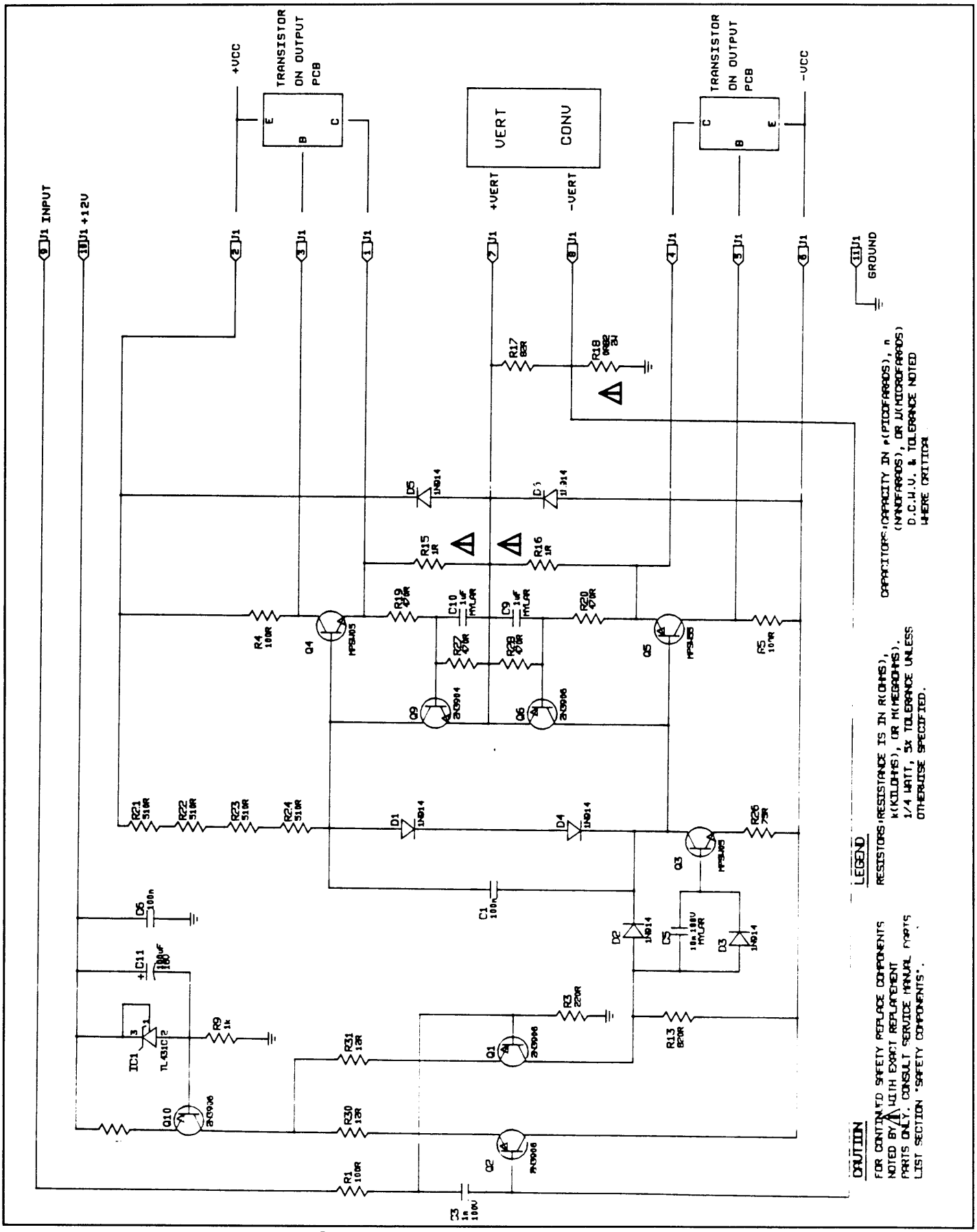


FIGURE 19-9. *Amplifier Assembly Schematic*

19.4 PARTS LIST

19.4.1 Power Deflection PCB

Item Ref.	Part No.	Description
Integrated Circuits		
IC4	14-002813-09P	TL082BC, linear amplifier
IC5	14-003050-01P	DS0026, 5 MHz 2 phase MOS (closed) driver
IC6	14-002836-01P	M5216L, dual large current op amp
Transistors and Diodes		
Q1,Q2	14-000881-06P	2N3904, NPN, 40V, 0.2A, 0.35W
Q22	14-A00701-01P	1RF520, hex FET, 100V
Q23	14-A00703-01P	1RF9520, hex FET, 100V
Q24-Q26,Q36	14-000988-02P	MJE253, PNP
Q28-Q30	14-000988-01P	MJE243, NPN
Q33,Q35	14-000887-01P	MPSW05, NPN
Q34	14-000887-02P	MPSW55, PNP
D3,D19-D23	14-000513-01P	1N914, diode, 0.075A, 75V
D6-D8,D30	14-000525-07P	BYV26, rectifier, 0.5A, 350V
D11,D27	14-000513-03P	BY184, diode, 0.002A, 1800V
D24-D26	14-000525-53P	1N4003, rectifier, 1A, 200V
ZD1	14-000531-39P	1N4739A, zener diode, 9.1V, 1W
Capacitors		
C2,C5,C30	84-447004-02P	47 μF, 25V
C6,C63	49-000019-38P	2.2 μF, 250V, 10%
C7	86-612132-04P	120 pF, 2%, NPO
C14	88-174740-13P	470 nF, 63V, 5%, mylar
C16,C17,C20		
C21	44-422203-09P	2200 μF, 16V
C18	46-500003-01P	10 nF, 2000V, 20%, Z5U
C22,C23,C28, C52,C54,C61, C64,C67,C68	89-000032-03P	100 nF, 50V
C24	84-410104-03P	100 μF, 25V
C25,C51	84-447506-01P	4.7 μF, 50V
C31	46-518121-72P	180 pF, 1000V, 20%
C53	86-647033-04P	47 pF, 100V, NPO
C55	84-410105-04P	100 μF, 35V
C58	86-668151-02P	680 pF, 100V, 10%, 45ppm/°C
C59	88-172231-02P	22 nF, 100V

19.4 PARTS LIST (cont.)

19.4.1 Power Deflection PCB (cont.)

	Item Ref.	Part No.	Description
	Capacitors (cont.)		
	C60	88-174721-02P	4.7 nF, 100V, 10%
	C62	46-520012-30P	20 pF, 2KV
	Resistors		
	R1,R54	80-115095-11P	15R, 1/2W, 5%, metal film
	R6,R41	80-210055-23P	10M, 1/2W, 5%
⚠	**R11,R12**	**80-133095-11P**	**33R, 1/2W, 5%, metal film SAFETY COMPONENT**
	R16	41-000344-12P	25K, carbon trim pot
	R17	80-168025-11P	68K, 1/2W, 5%, metal film
	R19	80-110035-11P	100K, 1/2W, 5%, metal film
	R24	42-105615-01P	560R, 3W, 5%
	R25	42-103315-01P	330R, 3W
	R27	80-247035-23P	470K, 1/2W, 5%, high voltage
⚠	**R28**	**80-116025-11P**	**16K, 1/2W, 5%, metal film SAFETY COMPONENT**
	R39,R116	80-147005-11P	470R, 1/2W, 5%, metal film
	R40	80-118025-11P	18K, 1/2W, 5%, metal film
	R44	80-147015-11P	4.7K, 1/2W, 5%, metal film
	R63,R214	42-104705-01P	47R, 3W, 5%
⚠	**R64,R65**	**42-000125-12P**	**1.0K, 1/2W, 5% SAFETY COMPONENT**
⚠	**R70,R71**	**42-000108-02P**	**1R, 1W, 5% SAFETY COMPONENT**
	R76,R78,R96, R105-R108,R120, R121	80-110095-11P	10R, 1/2W, 5%, metal film
	R77,R80,R86	80-110015-11P	1K, 1/2W, 5%, metal film
	R81	80-115015-11P	1.5K, 1/2W, 5%, metal film
⚠	**R82,R94,R95,R98**	**80-110085-11P**	**1R, 1/2W, 5% SAFETY COMPONENT**
	R83	80-124005-11P	240R, 1/2W, 5%
	R84,R103	80-124025-11P	24K, 1/2W, 5%, metal film
	R85	80-124035-11P	240K, 1/2W, 5%, metal film
	R87,R102	80-122015-11P	2.2K, 1/2W, 5%
	R88,R89	80-182005-11P	820R, 1/2W, 5%, metal film
	R90	80-127015-11P	2.7K, 1/2W, 5%, metal film
	R91	80-182095-11P	82R, 1/2W, 5%, metal film
	R92,R93	80-110005-11P	100R, 1/2W, 5%, metal film
	R99	80-182025-11P	82K, 1/2W, 5%, metal film
	R100	41-000344-08P	2K, carbon trim pot
	R101,R110	80-139015-11P	3.9K, 1/2W, 5%, metal film

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19.4 PARTS LIST (cont.)

19.4.1 Power Deflection PCB (cont.)

	Item Ref.	Part No.	Description
	Resistors (cont.)		
	R104	80-151015-11P	5.1K, 1/2W, 5%, metal film
	R109,R112	80-133015-11P	3.3K, 1/2W, 5%, metal film
	R111	80-175005-11P	750R, 1/2W, 5%, metal film
	R113	80-111015-11P	1.1K, 1/2W, 5%
	R114	80-191025-11P	91K, 1/2W, 5%, metal film
⚠	**R115**	**80-147085-11P**	**4.7R, 1/2W, 5%, metal film SAFETY COMPONENT**
	R117,R118	80-139085-11P	3.9R, 1/2W, 5%, metal film
	R119	41-000344-04P	100R, carbon trim pot
	R123	80-120025-11P	20K, 1/2W, 5%, metal film
	R124	80-191015-11P	9.1K, 1/2W, 5%, metal film
	Coils and Transformers		
	L1	21-001432-01P	linearity lo band coil
	L2	21-001429-02P	10 to 30μH width coil
	L3	21-001429-01P	2 to 10μH width coil
	L4	24-161007-03P	SMPS choke, 22 mH
	L5	21-001431-01P	linearity hi band coil
	Miscellaneous		
	RL1	25-000105-01P	DPDT relay, 12V coil

19.4.2 MOSFET PCB (included as part of Power Deflection Module)

Item Ref.	Part No.	Description
Transistors and Diodes		
Q3,Q4	14-A00603-01P	1RFAE50, power MOSFET
D1,D2	14-000513-01P	1N914, diode, 0.075A, 75V, T,
ZD5-ZD8	14-000531-37P	1N5247, zener diode, 17V, 5W, 5%
Capacitors		
C7,C8	49-000038-14P	3.3 nF, 2000V
C9	88-171053-12P	1 μF, 50V, mylar
Resistors		
R4,R5	80-122015-11P	2.2K, 1/2W, 5%
R6,R7	80-147095-11P	47R, 1/2W, 5%, metal film
Coils and Transformers		
T1	24-161005-01P	64KHz pulse transformer

19.4 PARTS LIST (cont.)

19.4.3 Amplifier PCB (included as part of Power Deflection Module)

	Item Ref.	Part No.	Description
	Integrated Circuits		
	IC1	14-002833-01P	TL431C, precision shunt regulator
	Transistors and Diodes		
	Q1,Q2,Q6,Q10	14-000873-82P	2N3906, PNP, small signal
	Q3,Q4	14-000887-01P	MPSW05, NPN
	Q5	14-000887-02P	MPSW55, PNP
	Q9	14-000881-06P	2N3904, NPN, 40V, 0.2A, 0.35W
	D1-D6	14-000513-01P	1N914, diode, 0.075A, 75V,
	Capacitors		
	C1,C6	89-000032-03P	100 nF, 50V
	C3	46-610252-02P	1 nF, 100V
	C5	88-171031-02P	10 nF, 100V, 10%
	C9,C10	84-422004-01P	22 μF, 25V
	C11	84-410104-03P	100 μF, 25V
	Resistors		
	R1,R4,R5	80-110005-11P	100R, 1/2W, 5%, metal film
	R3	80-122005-11P	220R, 1/2W, 5%, metal film
	R9	80-110015-11P	1K, 1/2W, 5%, metal film
	R13	80-111015-11P	1.1K, 1/2W, 5%
⚠	**R15,R16**	**80-110085-11P**	**1R, 1/2W, 5% SAFETY COMPONENT**
	R17	80-175095-11P	82R, 1/2W, 5%, metal film
⚠	**R18**	**42-000134-01P**	**0.82R, 2W, 5% SAFETY COMPONENT**
	R19,R20	80-147015-11P	4.7K, 1/2W, 5%, metal film
	R21-R24	80-151005-11P	510R, 1/2W, 5%, metal film
	R26	80-175095-11P	75R, 1/2W, 5%, metal film
	R27,R28	80-122015-11P	2.2K, 1/2W, 5%
	R29	80-168005-11P	680R, 1/2W, 5%, metal film
	R30,R31	80-112095-11P	12R, 1/2W, 5%

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11.5 SPECIFICATIONS

Connector P1, Rows A & C:

Pin 1 . . . . . analog output **VFB**
signal level . . . . . 5V peak
NOTE: vertical boost signal from V Deflection & H Regulation module

Pin 2 . . . . . input **VAR DC DEFL**
NOTE: see Keystone module

Pin 3 . . . . . analog input **RELAY SW**
NOTE: from open collector output
measured in low band . . . . . 12VDC min

Pin 5 . . . . . analog input **H CENT**
signal level . . . . . -10 to 10VDC
NOTE: from Remote Control module

Pin 6 . . . . . analog output **WIDTH**
NOTE: width control voltage

Pin 7 . . . . . output **H SENSE**
NOTE: VDC proportional to scan size

Pin 9 . . . . . input **V BOOST**
signal level . . . . . to 5V
NOTE: vertical boost signal from V Deflection & H Regulation module

Pin 12 . . . . . **OFFSET DC**
measure with respect to:
VAR DC DEFL . . . . . 3.5 to 4.5VDC

Pin 14 . . . . . digital output **HFB**
NOTE: horizontal flyback pulse
amplitude . . . . . peak ± 10%
leading edge of HFB pulse coincident with trailing edge of flyback pulse to within 250 ns

Pin 15 . . . . . digital output **HFB12**
NOTE: same as HFB

Pin 17 . . . . . analog input **PIN WFM**
NOTE: see Waveform module

Pin 18 . . . . . analog input **V CONV**
vert. convergence waveform -8 to 8V peak

Pin 19 . . . . . analog input **H CONV**
hor. convergence waveform -8 to 8V peak

Pin 20 . . . . . analog input **V DRIVE**
NOTE: from Vertical Deflection & Horizontal Regulation module
vertical sawtooth . . . . . 6 to 13V p-p

Pin 21 . . . . . analog input **V CENT**
NOTE: from Remote Control module
vertical DC voltage . . . . . -10 to 10VDC

Pin 22 . . . . . analog output **-V SENSE**
vertical sawtooth . . . . . yoke current x 2.5

Pin 24 . . . . . analog input **H DRIVE**
NOTE: see Horizontal Deflection module

Pin 25 . . . . . -24V power supply **-24 VDC**

Pin 26 . . . . . +24V power supply **+24 VDC**

Pin 27 . . . . . -12V power supply **-12 VDC**

Pin 28 . . . . . +12V power supply **+12 VDC**

Pin 29 . . . . . +5V power supply **+5 VDC**

Pin 30 . . . . . connected to Pin 29 **+5 VDC**

Pin 31 . . . . . ground **GND**

Pin 32 . . . . . connected to Pin 32 **GND**

Connector P6: . . . . . Horizontal Yoke

NOTE: Yoke 21-000160-01P or equivalent. Measure current with current probe.

Pin 8
H SIZE @ 10VDC, R16 @ full deflection
signal level . . . . . 4.5A p-p min
H SIZE @ 0VDC, R16 @ minimum deflection
signal level . . . . . 3.7A p-p max
retrace pulse amplitude . . . . . 1200V peak
frequency 50KHz
retrace time (AC-coupled) . . . . . 3.7 μs ± 5%

Connector P7: . . . . . Horizontal Centering Yoke

NOTE: Yoke 21-000160-01P or equivalent. Measure current with current probe.

Pin 2
H CENT set to 10V
signal level . . . . . 19mA min
H CENT set to . . . . . -10V
signal level . . . . . 19mA min

Connector P7: . . . . . Convergence Yoke

Pin 4 . . . . . vertical
V CONV . . . . . 0 to 1.2A p-p max
H CONV . . . . . 0 to 0.6A p-p max

Pin 6 . . . . . horizontal
V CONV . . . . . 0 to 1.2A p-p max
H CONV . . . . . 0 to 0.6A p-p max

Connector P8: . . . . . Yoke
NOTE: Yoke 21–000160–01P or equivalent. Measure current with current probe.

Pin 2
R100 shorted, V DRIVE @ . . . . . 11V p-p
signal level . . . . . 1.2A p-p
retrace time . . . . . 300 μs min

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SECTION 20

VIDEO OUTPUT MODULE

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

No tables are included in this section.

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20.1 TECHNICAL DESCRIPTION

20.1.1 General Description

The Video Output module amplifies the video signals for output to the cathode of each CRT. There is one Video Output module per CRT; each feeding the G1, G2 and heater voltages. The module consists of a push-pull output stage, driven by a driver stage and a pre-driver stage. The module also permits DC black level biasing of each CRT. The DC operating point is maintained by a keyed sync tip clamp circuit.

20.1.2 Circuit Description

20.1.2.1 Sync Tip Clamp Circuit

The sync tip clamp circuit is built around FET Q1. Resistors R4, R5, R6, R7, R8, R52 and TC3 set the source voltage of the FET. Specifically, trimpot R5 is adjusted to produce a source voltage between 1.3V and 1.6V at 25 ° C.

The CLAMP input is fed by 10V peak amplitude, 1.8 μs duration, clamp pulses, originating from the Video Control module. These clamp pulses cause capacitor C1 to charge to 8.5V, and gate voltage of Q1 to increase 0.6V above Q1 source voltage. Q1 turns ON and drain-to-source resistance drops to 2 ohms. This resistance drop allows input capacitor C4 to charge to a value between 1.1V and 1.4V.

During active line time, the zero volts on the CLAMP input keeps D2 reverse biased and gate voltage of Q1 at -8.5V. The FET is OFF and the dc voltage across C4 remains constant.

Other components in the clamp circuit function as follows:

a) D1 protects the circuit against excessive input voltages,
b) R2 provides a discharge path for C1,
c) D4 and TC3 provide temperature compensation, and
d) R3 compensates the video tilt.

20.1.2.2 Input Amplifier

Input amplifier, Q1 and Q2, is a non-inverting, low output impedance stage. Q2 is a constant current source, Q3 is a varying current source. Q2 base voltage determines the current through R12 and R13, and the output voltage at the collector of Q3.

Zener diode ZD1 with R14, C5 and C7, set Q3's emitter voltage to 6V and base voltage to 5.4V. This sets the collector current of Q2 to a constant value.

The base voltage of Q2 is between 1.0V and 1.4V, its emitter voltage is between 0.5V and 0.8V. The current through R13 is between 5.0mA and 9.0mA. 1mA of this current is supplied by Q2. The output voltage at the collector of Q3, established by the voltage drop across R12, is between 0.8V and 1.3V.

Diode D14 protects the base-emitter junction of Q3. Series RC, R11 and C6, across the base and collector of Q3, prevents high frequency oscillations.

20.1.2.3 Driver Amplifier

The driver stage consists of common emitter amplifier Q4, driving common base high voltage amplifier Q5. The base of Q5 is biased at 6V via ZD2. Its emitter voltage is 5.4V and the current through R18 is 16mA.

The base voltage of Q4 is between 0.8V and 1.3V. Its emitter voltage is between 0.2V and 0.6V. The emitter current through Q4 is between 17mA and 50mA. 16mA are supplied through R18. Up to 30.2mA are supplied by Q5. The voltage at the collector of Q5 is between 150V and 100V.

20.1.2.4 Output Amplifier

The output amplifier is a push-pull stage. It consists of Q6 and Q7.

The stage is dc biased, just OFF, by diode D7. The load is the cathode of the CRT connected through beam current sensors, IC1 and IC2. Trimpot R5 sets the dc voltage on the cathode to 140V when BRIGHTNESS is set to 5 on the function bar graph.

20.1.2.5 Response to Video Input

A video input increase to 0.8V causes the emitter voltage of Q2 to increase to 1.4V. This increases the current in Q5 to 130mA and decreases the voltage at the cathode to 20V.

A video input increase to 1.0V causes the driver stage to just enter saturation. This reduces the cathode voltage to a minimum.

The total voltage gain of all stages is 140.

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20.1.2.6 Beam Current Sensors

IC1 and IC2 monitor CRT beam current. They provide outputs I1 and I2 respectively. These outputs are the voltage equivalent of beam current and are used as inputs to the beam current limiter.

WARNING

DO NOT repair the beam current circuitry. X-ray radiation may be emitted when excessive high voltage exists.

20.2 SERVICING AND ALIGNMENT

20.2.1 Disassembly and Access

Module Location:
- projection head

Tools & Equipment Required:
- Phillips screw driver
- 1/4" hex head socket

a) Remove the front and rear top covers as instructed in Section 5.2.

b) If the Video Output module for the green (center) CRT is to be removed, remove the keypad assembly from the projection head as instructed in Section 5.2.
NOTE: disconnection of the keypad cable from the Mother Board is not required.

c) Locate the Video Output module to be removed. Gently pull the Video Output module away from the CRT. Note: the Video Output module is secured to the CRT by a small amount of hot melt glue. The joint between the glue and the CRT should break from the CRT without difficulty.

d) Disconnect the following connectors and leads from the Video Output module:

- focus lead (to Bias module)
- P3 (ground)
- P10 (ground)
- G2 (to Bias module)
- P8
- P9 (video input)

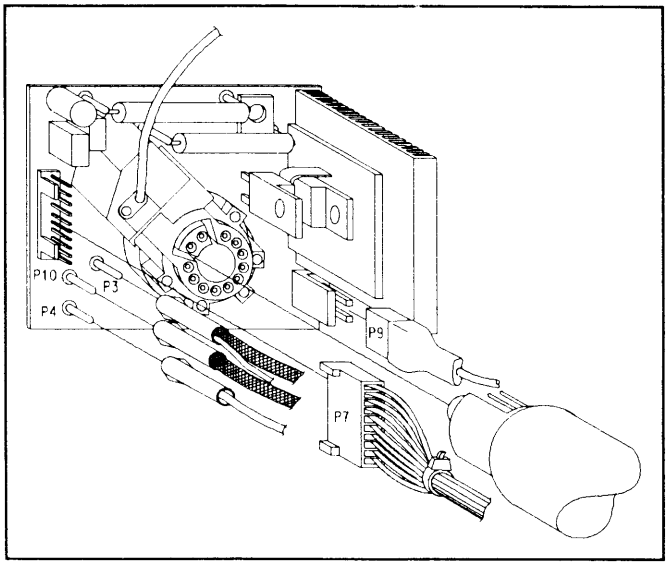

FIGURE 20-1. *Video Output Module Removal*

NOTE: Prior to reassembly, pull or scrape off the hardened hot melt glue from the Video Output Module CRT connector. Re-connect the Video Output module to the CRT and apply the same amount of hot melt glue between the CRT connector and the CRT connector terminals.

20.2.2 Alignment and Adjustments

The Video Output module is adjusted during Color Balance Set-up. Refer to Section 7 for the Color Balance set-up procedure.

20.3 COMPONENT LAYOUT AND SCHEMATICS

Refer to the following pages for component layouts and schematics of the Video Output Module.

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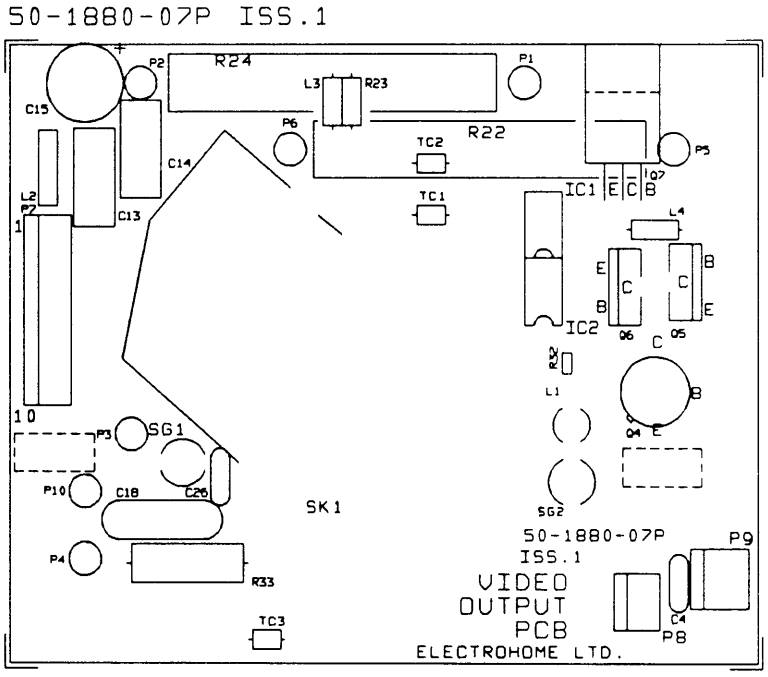
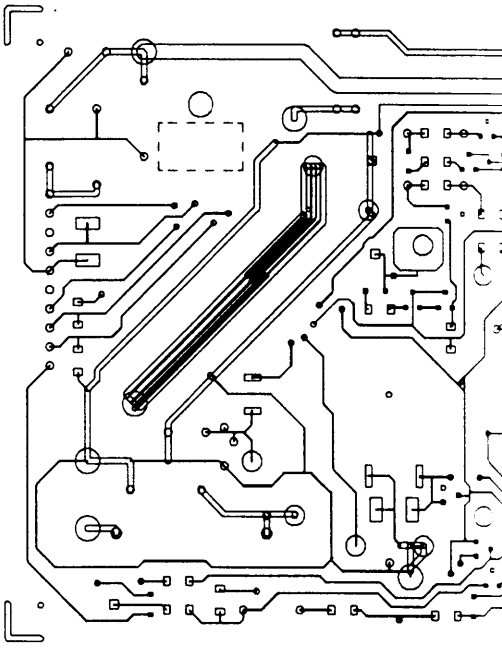
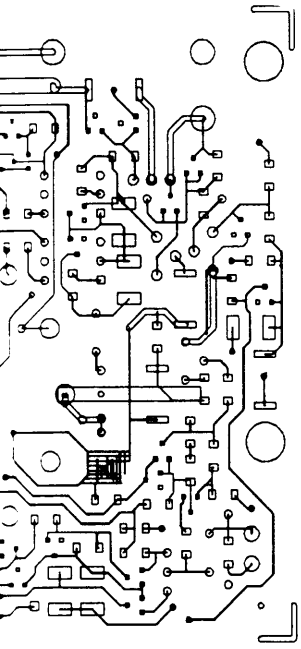


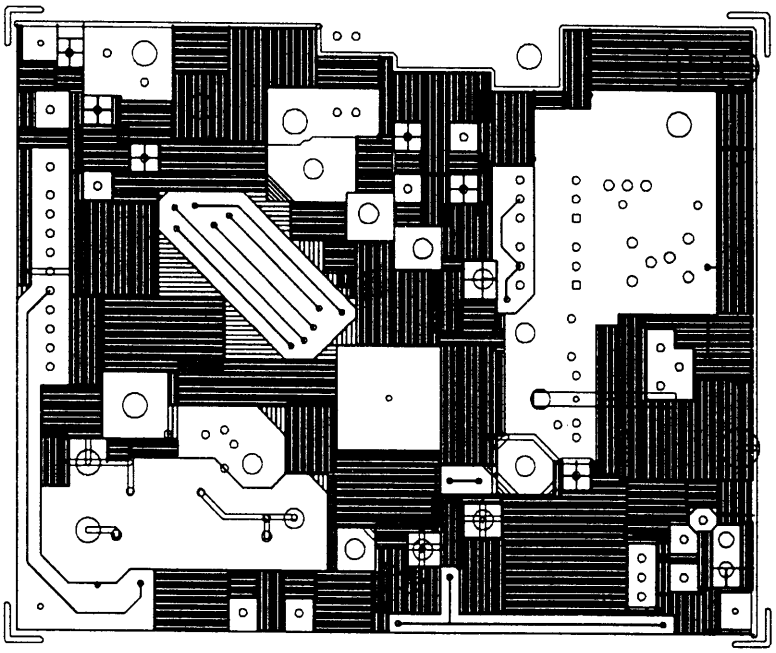
Component Layout



Solder Side
(Viewed from Compone



nent Side)



Component Side

FIGURE 20–2.
Video Output Module Component Layout

LEGEND

RESISTORS: RESISTANCE IS IN R(OHMS), k(KILOHMS), OR M(MEGAOHMS). 1/2 WATT, 5% TOLERANCE UNLESS OTHERWISE SPECIFIED.

CAPACITORS: CAPACITY IN p(PICOFARADS), n(NANOFARADS), OR μ(MICROFARADS) D.C.W.V. & TOLERANCE NOTED WHERE CRITICAL.

CAUTION

FOR CONTINUED SAFETY REPLACE COMPONENTS NOTED BY ⚠ WITH EXACT REPLACEMENT PARTS ONLY. CONSULT SERVICE MANUAL PARTS LIST SECTION "SAFETY COMPONENTS".

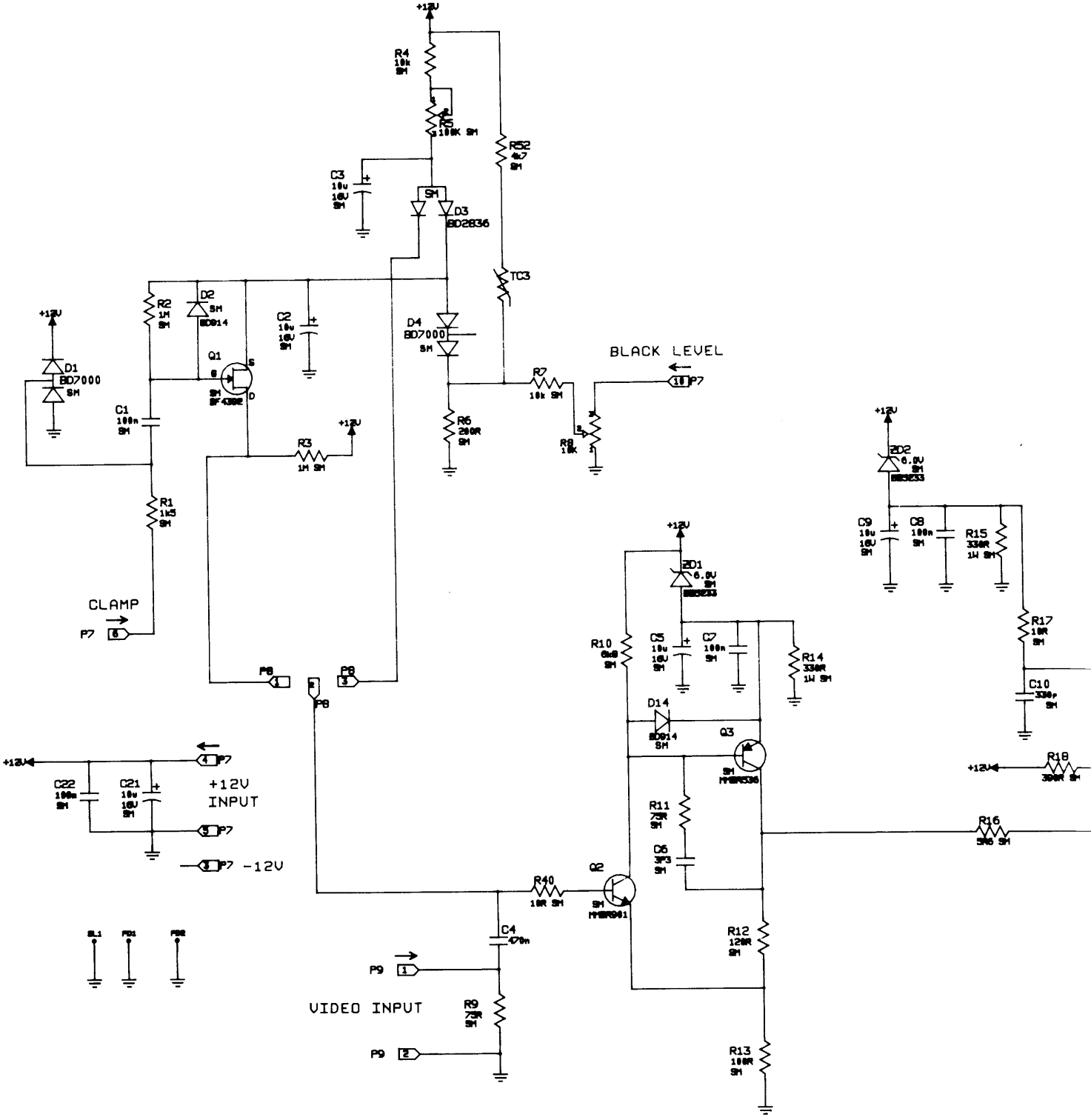
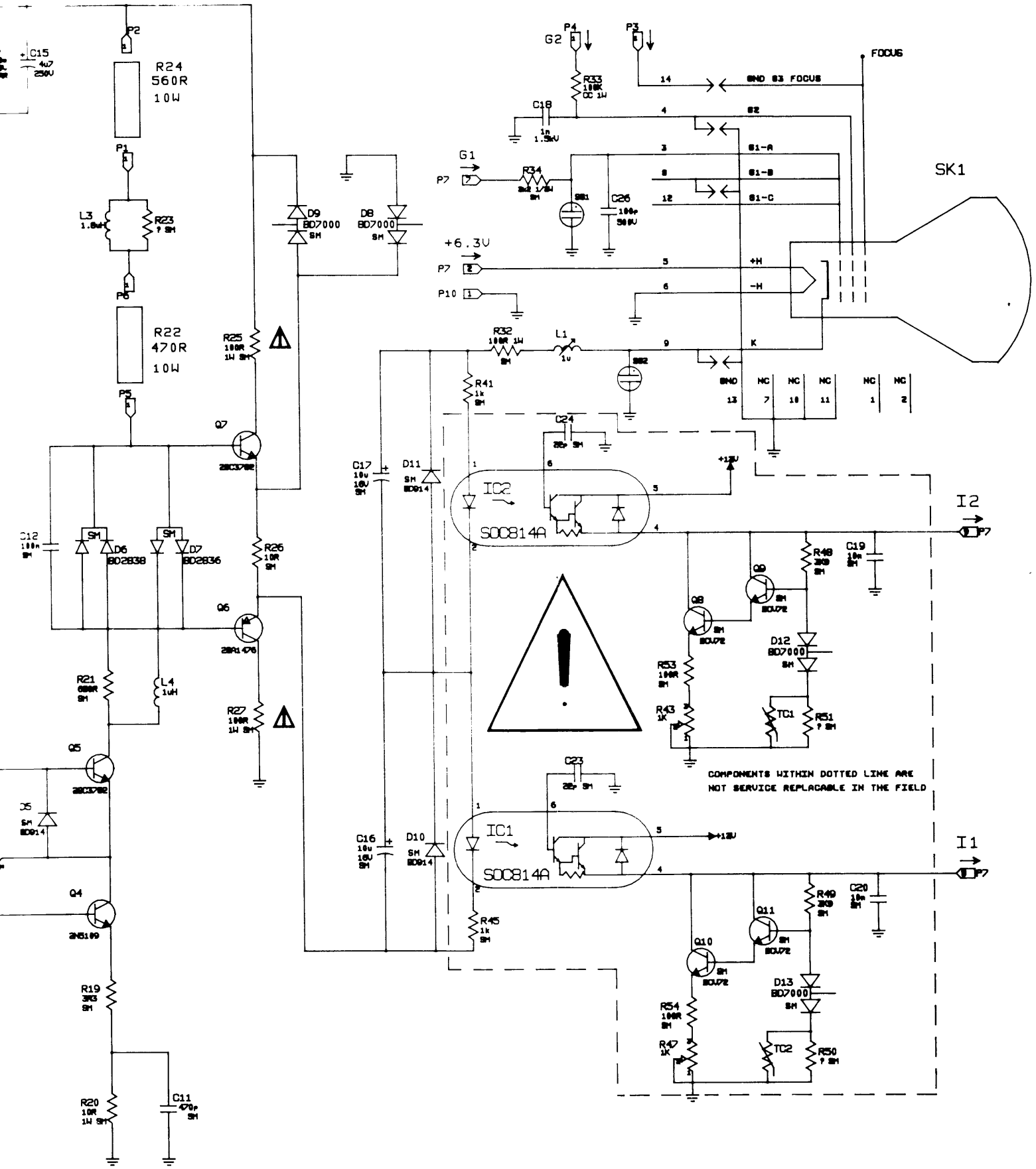
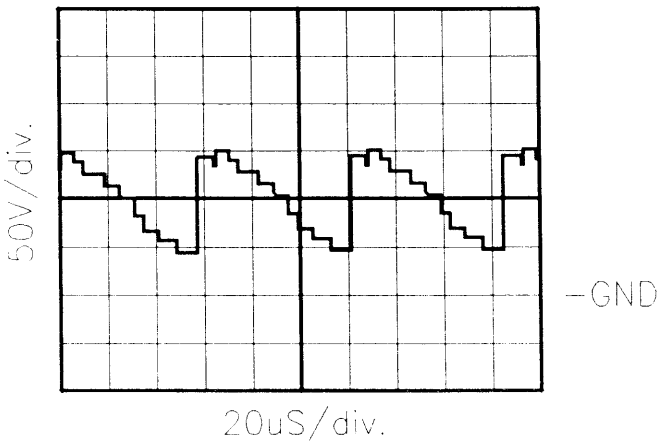


FIGURE 20–3.
Video Output Module Schematic



SCHEMATIC REFERENCE

CATHODE at POINT K



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20.4 PARTS LIST

Item Ref.	Part No.	Description
Transistors and Diodes		
Q1	72-000701-01P	MMBF4392, FET transistor surface mount, NCH, -5V
Q2	72-000561-02P	MMBR901, RF NPN transistor, surface mount
Q3	72-000561-01P	MMBR536, RF PNP transistor, surface mount
Q4	14-000562-02P	2N5109, NPN, 20V, .4A, 2.5W
Q5,Q7	14-000564-06P	2SC3782, NPN
Q6	14-000564-07P	2SA1476, PNP
D1,D4,D8,D9	72-000513-04P	MMBD7000, switching diode, surface mount
D2,D5,D10,D11, D14	72-000513-01P	MMBD914, switching diode, surface mount
D3,D7	72-000513-02P	MMBD2836, switching diode, surface mount
D6	72-000513-03P	MMBD2838, switching diode, surface mount
ZD1,ZD2	72-000531-01P	MMBZ5233, SOT-23, zener diode, 6V, 5%, 1/2W
Capacitors		
C1,C7,C8,C12,C22	66-310411-05P	100 nF, 50V, 10%, X7R, surface mount
C2,C3,C5, C9,C16,C17,C21	64-210134-11P	10 μF, 16V, surface mount
C4	89-000032-02P	0.47 μF, 50V, $\pm$20%
C6	66-433801-05P	3.3 pF, 50V
C10	66-433141-05P	330 pF, 50V, 5%, NPO, surface mount
C11	66-447141-05P	470 pF, 50V, NPO, surface mount
C13,C14	48-171042-02P	100 nF, 200V, 10%, mylar
C15	44-447510-06P	4.7 μF, 250V
C18	46-510228-74P	1 nF, 1500V, 20%, Z5U
C26	46-310113-02P	100 pF, 500V, 10%, Z5P
Resistors		
R1	70-715013-21P	1.5K, 1/4W, 5%, surface mount
R2,R3	70-710043-21P	1M, 1/4W, 5%, surface mount
R4	70-756013-21P	5.6K, 1/4W, 5%, surface mount
R5	71-011043-02P	100K, 25%, pot surface mount
R6	70-720003-21P	200R, 1/4W, 5%, surface mount
R7,R52	70-747013-21P	4.7K, 1/4W, 5%, surface mount
R8	71-011033-02P	10K, 25%, pot surface mount
R9,R11	70-775093-21P	75R, 1/4W, 5%, surface mount
R10	70-768013-21P	6.8K, 1/4W, 5%, surface mount
R12	70-712003-21P	120R, 1/4W, 5%, surface mount
R13	70-710003-21P	100R, 1/4W, 5%, surface mount
R14,R15	70-933003-24P	330R, 1W, 5%, surface mount
R16	70-756083-21P	5.6R, 1/4W, 5%, surface mount
R17,R26,R40	70-710093-21P	10R, 1/4W, 5%, surface mount
R18	70-739003-21P	390R, 1/4W, 5%, surface mount

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20.4 PARTS LIST (cont.)

	Item Ref.	Part No.	Description
	Resistors (cont.)		
	R19	70-733083-21P	3.3R, 1/4W, 5%, surface mount
	R20	70-910093-24P	10R, 1W, 5%, surface mount
	R21	70-768003-21P	680R, 1/4W, 5%, surface mount
	R22	42-144715-02P	470R, 10W, 5%
	R24	42-145615-02P	560R, 10W, 5%
⚠	**R25,R27**	**70-910003-24P**	**100R, 1W, 5%** **SAFETY COMPONENT**
	R32	40-221015-37P	100R, 1/2W, 5%
	R33	40-421045-07P	100K, 1W
	R34	70-822013-23P	2.2K, 1/2W, 5%, surface mount
	R41	70-710013-21P	1K, 1/4W, 5%, surface mount
	Coils and Transformers		
	L1	21-001512-01P	0.5 to 1.1 μH tuneable coil
	L2	21-011212-02P	120 μH 10% peaking coil
	L3	21-001185-16P	1.8 μH inductor
	L4	21-001185-13P	1 μH inductor
	Miscellaneous		
	SG1,SG2	27-000011-09P	argon lamp (spark gap)
	TC3	42-000079-08P	100K precision thermistor

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20.5 SPECIFICATIONS

contact K: . . . . . CRT cathode

Connector P7:

Pin 1 . . . . . **150 VDC** supply
current range . . . . . 0 to 140mA
typical current 90mA

Pin 2 . . . . . Heater supply
signal level . . . . . 6.3VDC min

Pin 3 . . . . . **–12 VDC** supply
NOTE: not used

Pin 4 . . . . . **+12 VDC** supply
current level . . . . . 80mA max
typical current 60mA

Pin 5 . . . . . **+12 VDC** supply
current level . . . . . 80mA max
typical current 60mA

Pin 6 . . . . . analog input **CLAMP**

Pin 7 . . . . . **G1**
NOTE: see Bias module

Pin 8 . . . . . analog output **I1**
signal level . . . . . 5.94 to 6.06 VDC

Pin 9 . . . . . analog output **I2**
signal level . . . . . 5.94 to 6.06 VDC

Pin 10 . . . . . analog input **BLK LEVEL**
signal level . . . . . 0 to 7.2 VDC

Connector P9:

Pin 1 . . . . . analog input **VIDEO INPUT**
NOTE: 1V p–p into 75Ω max

Connector P4:

Pin 1 . . . . . **G2**
NOTE: see Bias module

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SECTION 21

REMOTE JACK ASSEMBLY

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LIST OF ILLUSTRATIONS

LIST OF TABLES

No tables are included in this section.

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21.1 TECHNICAL DESCRIPTION

21.1.1 General Description

The Remote Jack Assembly accepts input from an optional wired remote keypad. Use of this jack disables the use of the IR remote keypad.

21.2 SERVICING AND ALIGNMENT

21.2.1 Disassembly and Access

Module Location:
- rear panel card rack

Tools & Equipment Required:
- Phillips screw driver

a) Locate the Remote Jack Assembly (to the left side of the rear panel). Remove the two Phillips screws from the Remote Jack back plate.

b) Move the Remote Jack back plate about 2" away from the projector and disconnect the M23-P1 connector. The assembly (with the back plate) may be removed.

c) Remove the two screws securing the Remote Jack Assembly from the back plate.

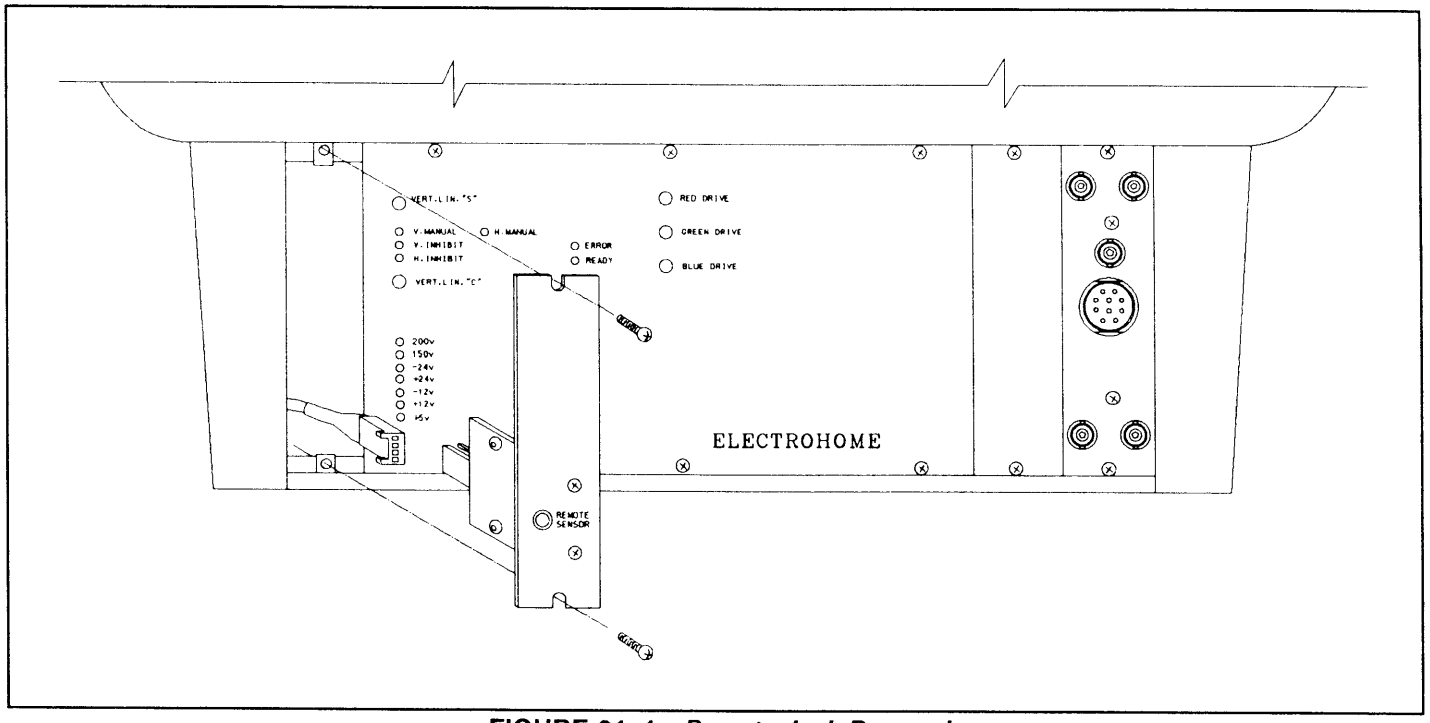

FIGURE 21-1. ***Remote Jack Removal***

21.2.2 Alignment and Adjustments

The Remote Jack Assembly does not require alignment.

21.3 COMPONENT LAYOUT AND SCHEMATICS

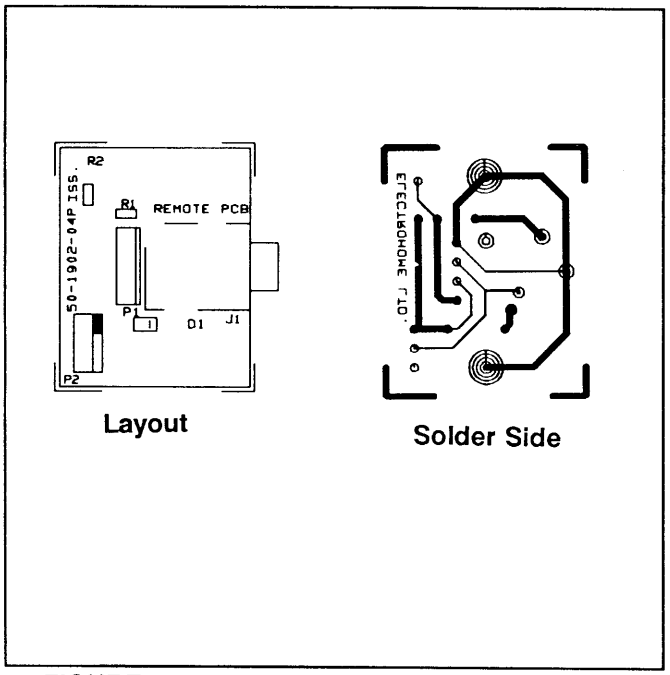

FIGURE 21-2. *Remote Jack Component Layout*

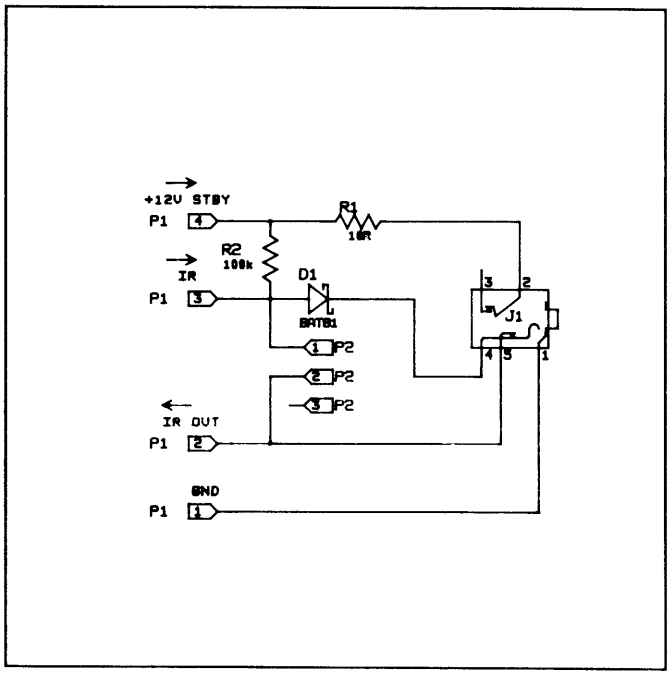

FIGURE 21-3. *Remote Jack Schematic*

21.4 PARTS LIST

Item Ref.	Part No.	Description
Transistors and Diodes		
D1	14-000533-01P	BAT81, Schottky barrier diode
Resistors		
R1	80-110095-11P	10R, 1/2W, 5%, metal film
R2	80-110035-11P	100K, 1/2W, 5%, metal film

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SECTION 22

FAN FILTER ASSEMBLIES

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

No tables are included in this section.

54-7904-02P/54-7904-03P (06/90)

22.1 TECHNICAL DESCRIPTION

22.1.1 General Description

The projector fans keep the projector electronics cool during operation. A passive filter to prevent electrical noise from entering the video and control circuitry is mounted to the upper corner of each fan.

22.2 SERVICING AND ALIGNMENT

22.2.1 Disassembly and Access

22.2.1.1 Front Slide-out Rack Fan

Module Location:
- front slide-out rack

Tools & Equipment Required:
- 1/4" hex head socket driver

a) Remove the projector lower front and side panels as described in Section 5.2.

b) Carefully slide the front slide-out rack out about 4".

c) Locate the fan and filter printed circuit board. Disconnect connector P1 from the circuit board.

d) Remove the two screws securing the fan to the front slide-out rack.

e) Remove the Fan and Fan Filter Assembly from the front rack.

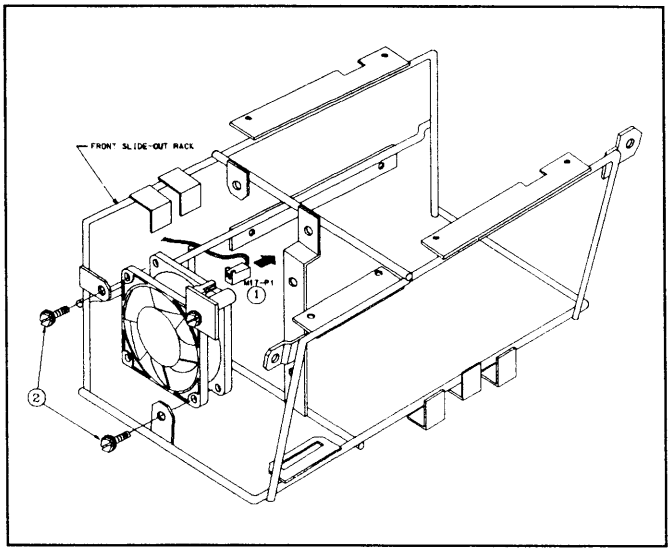

FIGURE 22-1. *Front Slide-out Rack Fan Removal*

22.2.1.1 Rear Panel Card Rack Fan

Module Location:
- rear panel card rack

Tools & Equipment Required:
- 1/4" hex head socket driver

a) Remove the left side panel next to the Remote Jack Assembly as described in Section 5.2.

b) Locate the fan and filter printed circuit board. Disconnect connector P1 from the circuit board.

c) Remove the two screws securing the fan to the rear frame as shown.

d) Remove the Fan and Fan Filter Assembly from the rear frame.

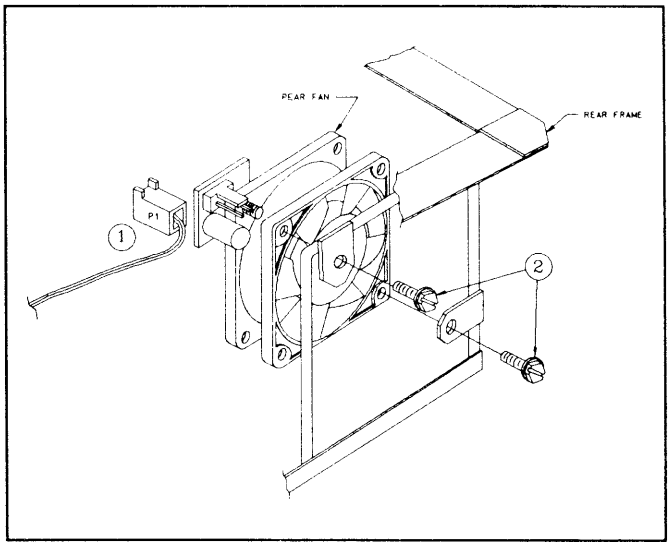

FIGURE 22-2. *Rear Panel Card Rack Fan Removal*

22.2.2 Alignment and Adjustments

The Fan Filter does not require alignment.

22.3 COMPONENT LAYOUT AND SCHEMATICS

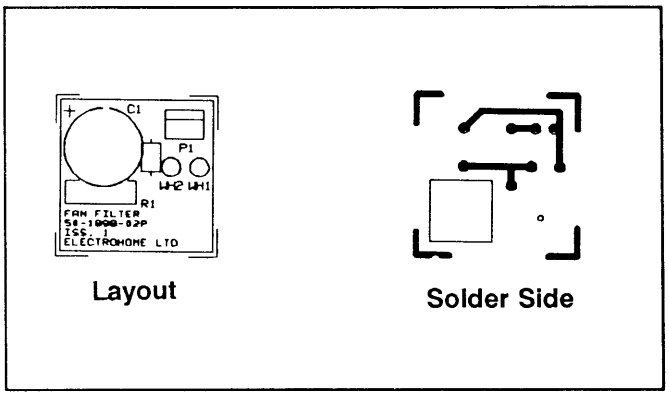

FIGURE 22-3. *Fan Filter Component Layout*

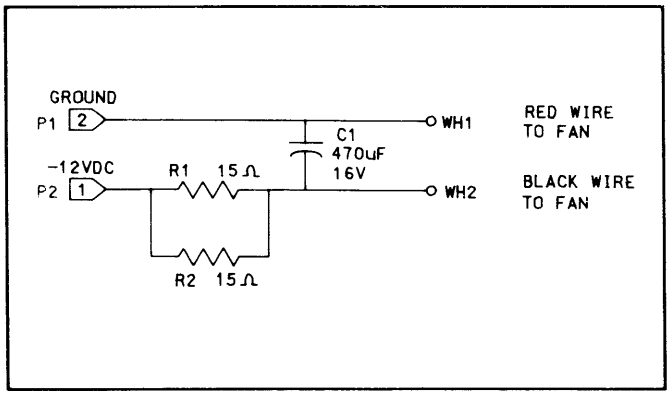

FIGURE 22-4. *Fan Filter Schematic*

21.4 PARTS LIST

Item Ref.	Part No.	Description
Capacitors		
C1	44-447103-06P	470 μF, 16V
Resistors		
R1,R2	80-115095-11P	15R, 1/2W, 5%, metal film

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SECTION 23

MOTHER BOARD ASSEMBLY

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LIST OF ILLUSTRATIONS

LIST OF TABLES

No tables are included in this section.

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23.1 GENERAL DESCRIPTION

The Mother Board Assembly includes a mother board and shielding backplane. The mother board is the communications interface between most of the projector modules; primarily the card rack mounted modules. The Mother Board does not contain any electronic components, only card edge and harness connectors.

23.2 SERVICING

23.2.1 Disassembly and Access

Assembly Location:
- central

Tools & Equipment Required:
- Phillips screw driver
- 1/4" hex head socket

a) Referring to Section 5, remove the following covers and panels:

- front top cover
- rear top cover
- both side panels
- lower case
- rear panel

b) From the rear panel card rack, remove all plug-in modules. These include:

- Video Input Module
- Video Control Module
- Convergence Module
- Auto-Convergence Module (optional)
- Waveform Module
- Remote Control Module
- Horizontal Deflection
- Vertical Deflection & Horizontal Regulation Module
- Remote Jack Assembly

c) From the rear panel card rack, remove each of the upper and lower snap-in type card slides and module shields. Note: Record the slot position for removed shields. For ease, it is recommended to remove slides and shields beginning from the right side to the left side of the card rack.

d) Unplug connectors P13, P14, P15, P16, P17, P18, P21, P22 and P23 from the Mother Board.

e) Remove each of the Power Deflection Modules. Refer to Section 19 for instructions.

f) Remove the hex head screws securing the projector bottom plate to the projector frame. See Figure 23-1.

g) With the bottom plate removed, remove the two side screws which secure the Mother Board backplane to the projector frame.

h) The Mother Board Assembly can then be removed through the bottom of the projector frame.

23.3 TERMINAL LAYOUT AND SCHEMATIC

Refer to the following pages for the Mother Board terminal layout and schematic.

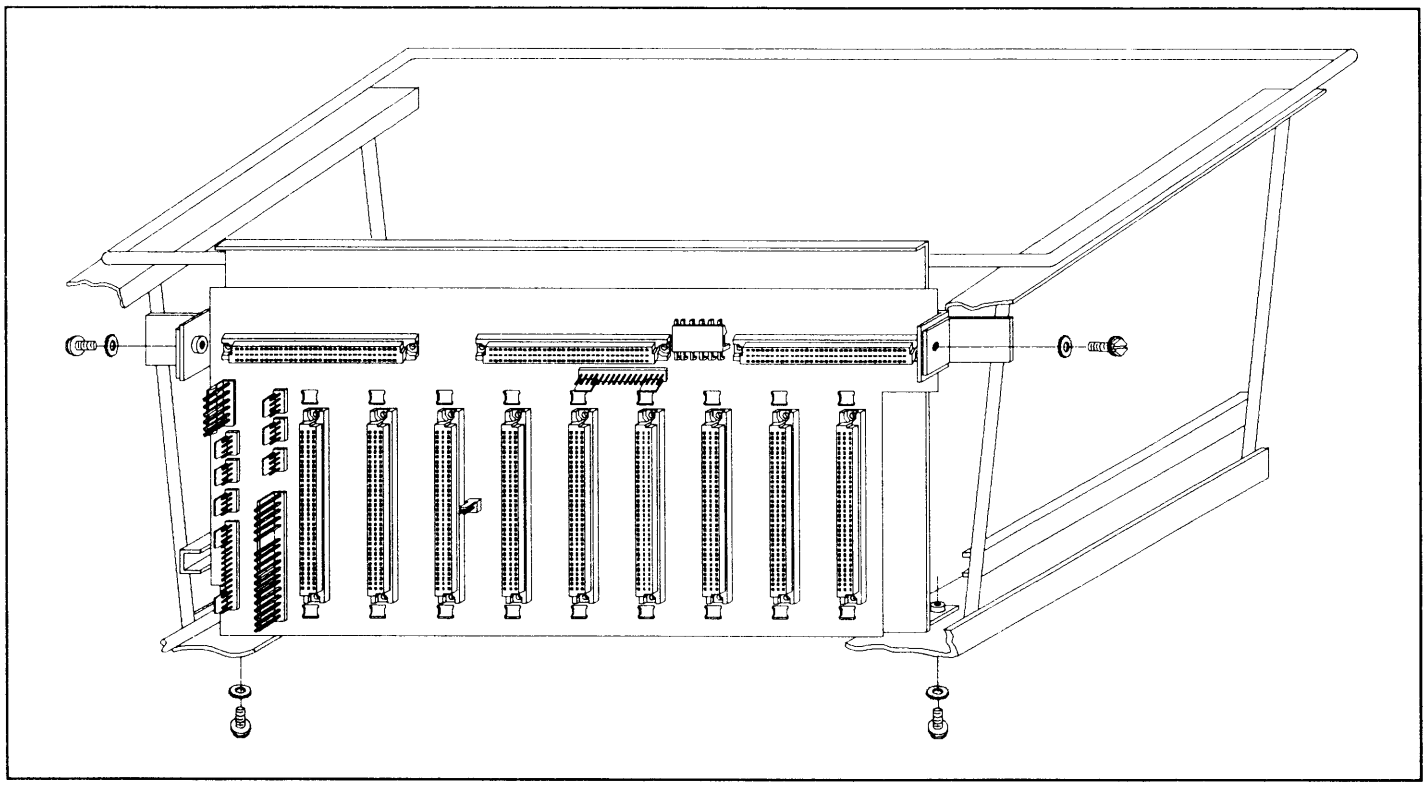

FIGURE 23-1. *Mother Board Assembly Removal*

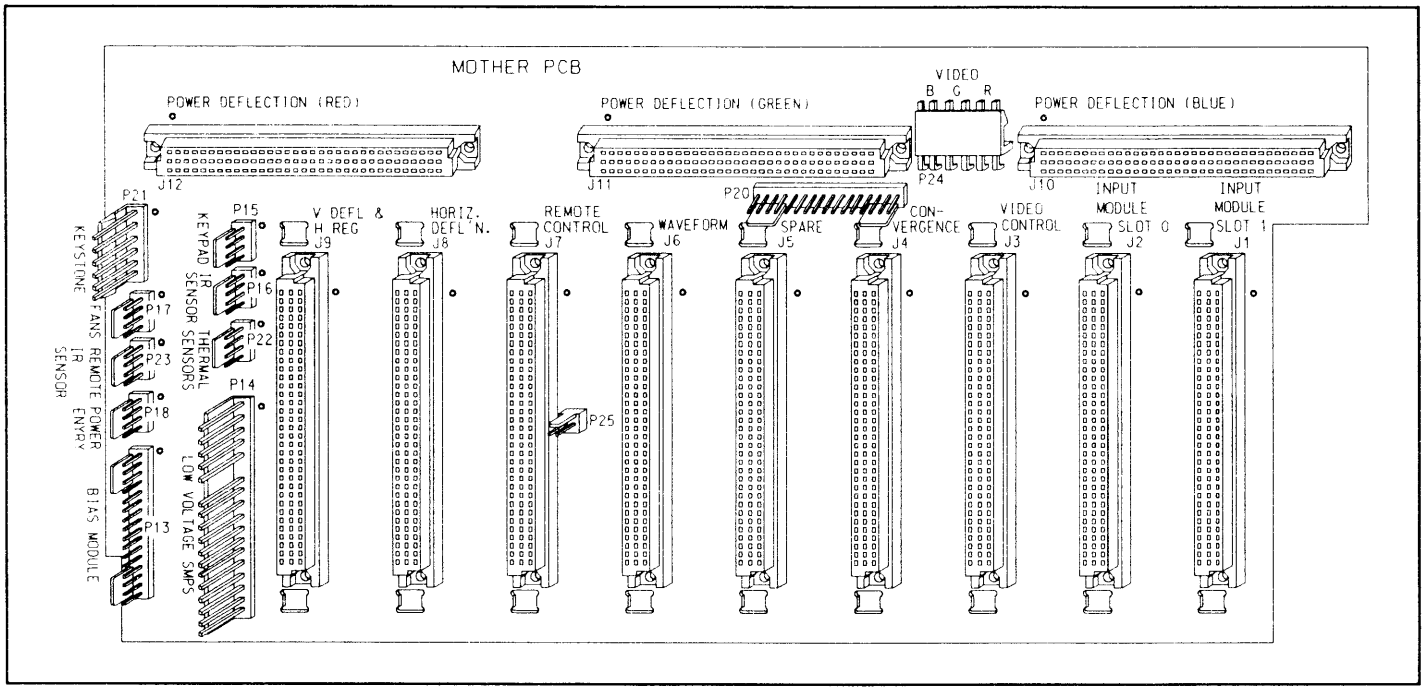

FIGURE 23-2. *Mother Board Terminal Layout*

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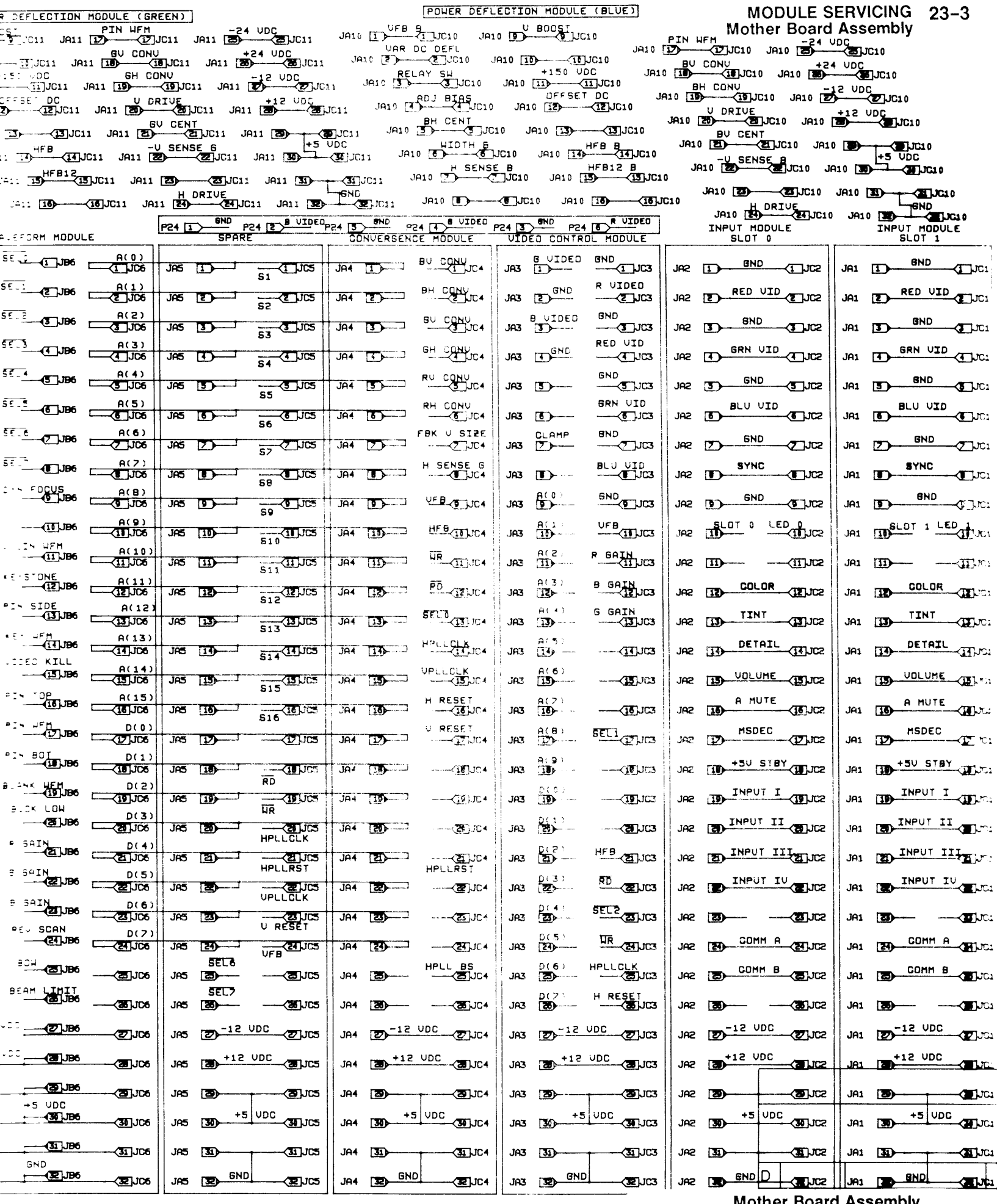
FIGURE 23-3.
Mother Board Schematic



24.4 PARTS LIST

Item Ref.	Part No.	Description
Connectors		
J1-J5,J8-J12	34-001056-02P	64 pin female
J6,J7	34-001056-03P	96 pin female
Headers		
P24	34-000557-06P	6 pin locking type
P15-P18,P22,P23	34-000813-04P	4 pin locking type
P13,P20	34-000813-16P	16 pin locking type
P21	34-000820-06P	6 pin 0.156" square pin
P14	34-000820-18P	0.156" square pin

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NOTES

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SECTION 24

ACON (Automatic Convergence Option)

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LIST OF ILLUSTRATIONS

LIST OF TABLES

No tables are included in this section.

24.1 TECHNICAL DESCRIPTION

24.1.1 General Description

ACON is an optional automatic convergence feature for Electrohome ECP 3100 series, 4100 series and future model projectors. The system consists of a Locator Assembly, Control Board and Locator Cable. The Locator Assembly, situated on the front of the projector, is the "eye" of the system. It mechanically scans the projected display in each convergence zone while sensing relative positions of each projected color. Sensory information is directed via wire harness to the Control board in the projector card rack. The Control board analyses this data to determine image positioning, then adjusts the vertical and horizontal positions of the red and blue colors until optimum convergence with the green image is achieved.

The ACON hardware is under the control of software stored in PROM on the Remote Control Board and is run by that board's 80C154 microcontroller. Automatic convergence is performed by the repetition of four fundamental operations: 1) a 'target' is generated at the location in the projected image that is to be converged; 2) the photosensor on the Locator Assembly is pointed at the target using the stepper motors; 3) registration between the color components of the target image is sensed by reading the photosensor; and 4) the color components at the current screen position are moved using the projector's convergence circuitry to register the colors. For off-center points, the Digital Convergence Board provides the correction. For the center, the Remote Control Board generates control voltages that specify the positions of each color raster as a whole. Convergence of the colors must be ensured at the center before converging any other area.

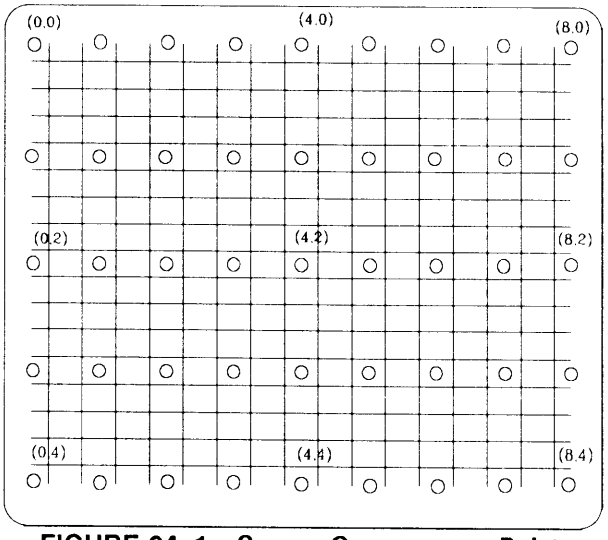

FIGURE 24-1. *Screen Convergence Points*

There are 45 convergence points arranged in a 9 X 5 rectangular matrix on the projected raster. Figure 24-1 illustrates the position of each convergence point in relationship to the internal crosshatch video pattern. The position of the red, green and blue component images are independently specified at each of these control points. Positioning between control points is calculated by linear interpolation: horizontally by software and vertically by the Digital Convergence board hardware (in real time).

24.1.2 Hardware Description

24.1.2.1 Locator Assembly

The Locator Assembly consists of a rigid metal casting supporting two stepper motors in an orthogonal-rotation configuration onto which is mounted a lens/sensor component containing an objective (imaging) lens at one end, and a photosensor device at the other end. The motors allow the optical system to be aimed at any arbitrary point on a projection screen in front of the system.

The photosensor is a custom designed quadrant photodiode array. The function of the sensor is to detect (through the objective lens) the position of a target imaged produced by the projector. The sensor size and lens focal length combine to give the assembly a telephoto view of the projected light on the screen. This allows the sensor to accurately determine the position of the image.

24.1.3 Circuit Description

The ACON electronics is divided between two circuit boards: the ACON Sensor Board (in the Locator Assembly) and the Control Board (in the projector card rack). The circuits are interconnected by the shielded multi-conductor Locator Cable.

24.1.3.1 ACON Sensor Board

The ACON Sensor Board is mounted at the back end of the lens/sensor component in the Locator Assembly. The photodiode array is mounted at the center of the board on the optical axis of the imaging lens. It is surrounded by surface-mounted amplifier circuitry; one amplifier channel for each quadrant of the sensor.

The board operates on +12V and -12V. It outputs four analog voltages proportional to the amount of light on each of the inner quadrant photodiodes. These signals are sent via the Locator Cable to the Control Board in the projector card rack.

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24.1.3.2 ACON Control Board

The ACON Control board (in the projector card rack) contains motor control, data acquisition and software recognition circuitry.

Motor Control Circuitry

The two stepper motors in the Locator Assembly are controlled by identical circuits, each consisting of a micro-step controller IC (U10 and U12) and a motor driver IC (U11 and U13). The micro-step controller IC specifies the levels of current in each of the two motor windings, as set by internal DACs that are loaded by the system microcontroller. The motor driver IC provides the specified current at 14VDC to both motor phases.

The +14V supply is obtained from the projector's +5V supply by means of an on-board boost converter.

Data Acquisition Circuitry

Each of the four photodiode quadrant signals are fed to analog peak-hold circuits (U1, U2, U3 and U4) which hold the highest voltage levels received until selectively discharged. The resultant "peak" signals are fed to a 4 channel 12-bit analog-to-digital converter (U9). Input range of the analog inputs is 0 - 5V. Channel selection and initiation of data conversion is made via data bus (D0 to D7), address bus (A0 to A15), and address-decoded 'select' lines (SEL6 and SEL7) under the control of the 80C154 microcontroller resident on the Remote Control Board.

Software Recognition Circuitry

The software recognition circuitry allows the projector's system software to recognize the existence of the ACON Control Board in the projector. It is comprised of a read-only register (U5) with a hard-wired identification code (55H), readable at a specific bus address by the projector's microcontroller.

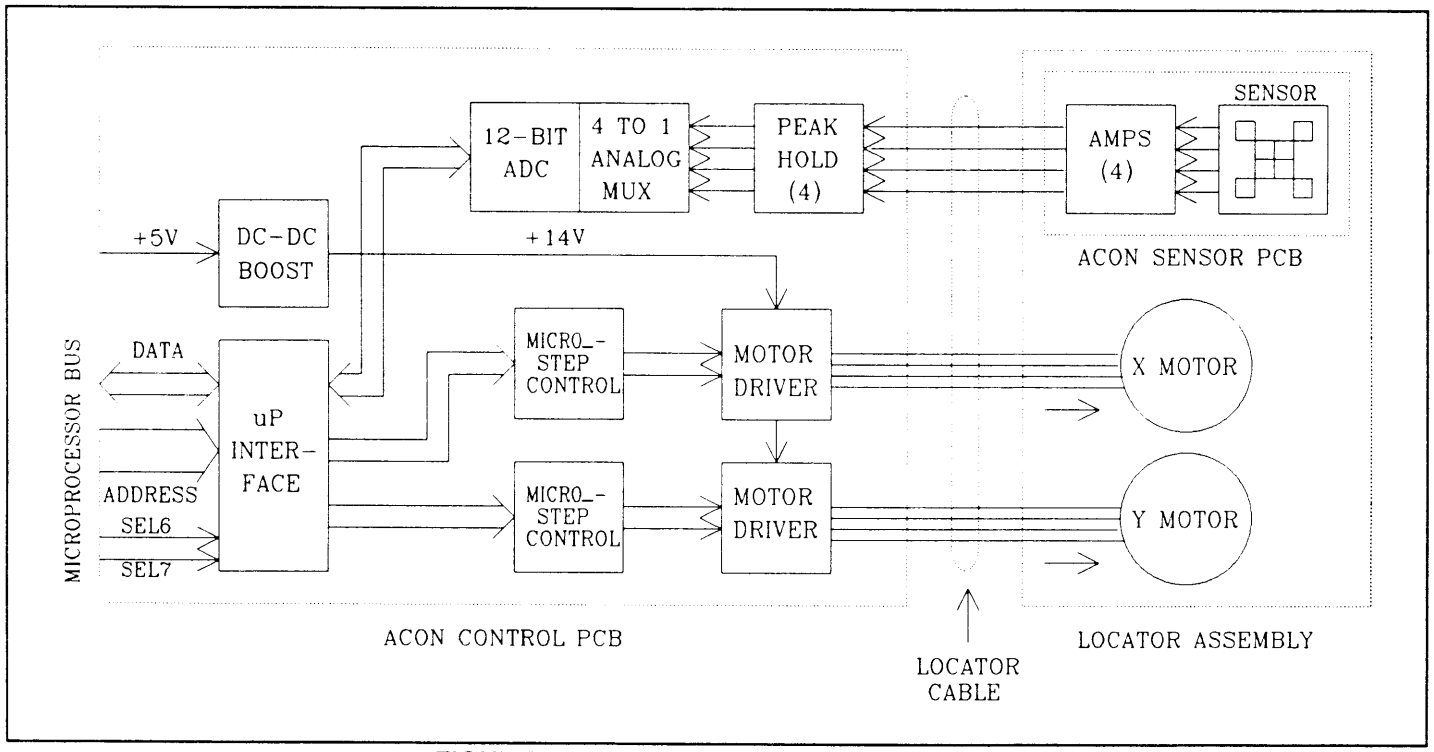

FIGURE 24-2. ***ACON Function Block Diagram***

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24.2 SERVICING AND ALIGNMENT

24.2.1 Disassembly and Access

WARNING

STATIC SENSITIVE COMPONENTS
STATIC CONTROLLED WORK STATION REQUIRED

Module Location:
- card rack (Control Board)
- front panel (Locator Assembly)

Tools & Equipment Required:
- Phillips screw driver
- circuit board extractor

24.2.1.1 Control Board Removal

a) Remove the back panel as described in Section 5.

b) Locate the ACON Control Board in the rear panel card rack. The ACON Control Board is located in the "SPARE" slot of the Card Rack (refer to Figure 5-8). Using the printed circuit board extractor from the tool pouch, pull the module from the card rack as described in Section 5.2.

24.2.1.2 Locator Assembly Removal

a) Remove the three mounting screws securing the Locator Assembly to the front panel.

b) Gently Slide the Locator Assembly down (away from lens') about 2 inches. Disconnect the Locator Cable from the assembly by removing the two connector screws.

24.2.1.3 Locator Cable Removal

The Locator Cable connects between the P20 connector on the Mother Board and the Locator Assembly. The Locator Cable path is illustrated in Figure E-1 in Appendix E.

a) Remove the ACON Control Board per step 24.2.1.1 above. In the same way, remove the Convergence module.

b) Remove the upper and lower snap-in type card slides and module shields for the two removed boards.

c) Unplug the Locator Cable at the P20 connector on the Mother Board.

d) Remove the Locator Assembly per step 24.2.1.2 above.

e) Remove the front top cover per Section 5.2.1.

f) From the lens area, pull out both ends of the Locator Cable and remove.

24.2.2 Diagnostics

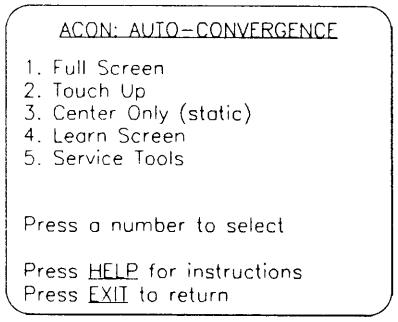
ACON's software includes a servicing mode to assist when trying to identify or pinpoint the source of an automatic convergence problem. While in service mode, the service technician can:

1) Auto-converge at any specified convergence point,
2) Record and analyse sensory data for any specified convergence point.

To enter service mode:

a) Call up the CONVERGENCE menu by pressing the **CONV** button on the projector keypad. Select item 4, *ACON: Auto-Convergence*.

b) With the ACON Automatic Convergence menu displayed, press the "*" key. Item 5, *Service Tools* will appear as shown.



c) Select item 5. The screen will display all 45 convergence points. ACON is now in service mode. Leave service mode at any time by pressing the **EXIT** key on the keypad. Pressing the **HELP** key will display a summary of available functions.

To automatically converge or view sensory data of a convergence point, press the **MOV** key on the keypad. The screen will prompt you for the *x* and *y* coordinates of the convergence point. Input each coordinate from the keypad (refer to Figure 24-1). Upon completion, a green "target" will be displayed for the convergence point. The sensor motors will position the sensor to the center of the target, based on data stored in the automatic convergence database. Sensory data currently recorded by the sensors is displayed on the screen.

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To converge the selected point:

Press the **CONV** key on the keypad.

Selection of the individual red, green or blue colors for viewing and analysis may be made by pressing the **COLOR** button on the keypad. Repeated presses of the **COLOR** button cycle the colors in the following order:

1. white (all colors)
2. green
3. red
4. blue
5. background (no target)

How to analyse the positional data

ACON measures the reflected light from a target in each of the four sensor quadrants as illustrated below.

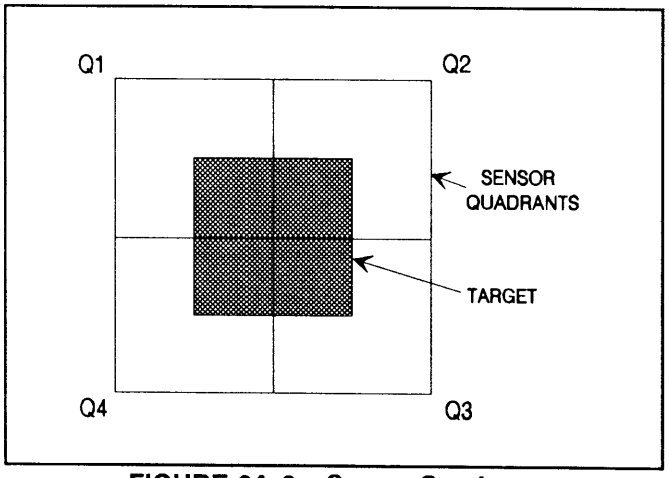

FIGURE 24-3. ***Sensor Quadrants***

Analog values are converted by the analog-to-digital convertor on the ACON Control Board and displayed in hexadecimal format on the display screen. Calculated positional data based on the above measurements is also displayed. Each data value displayed is described below.

Q1 A hexadecimal value between 000 and FFF representing the amount of reflected light measured in quadrant Q1.

Q2 A hexadecimal value between 000 and FFF representing the amount of reflected light measured in quadrant Q2.

Q3 A hexadecimal value between 000 and FFF representing the amount of reflected light measured in quadrant Q3.

Q4 A hexadecimal value between 000 and FFF representing the amount of reflected light measured in quadrant Q4.

CX A hexadecimal value between -400 and +400 representing the horizontal displacement of the target's centroid relative to the center of the sensor.

CY A hexadecimal value between -400 and +400 representing the vertical placement of the target's centroid relative to the center of the sensor.

MX A hexadecimal value between 000 and C80 representing the displacement of the horizontal motor relative to the home position.

MY A hexadecimal value between 000 and FFF representing the displacement of the vertical motor relative to the home position.

Based on the screen information, it may be possible to pinpoint automatic convergence problems.

Ideally, but impractically, the amount of light measured in each quadrant when the sensor points at a converged target should be identical and constant. As it is not reasonable to expect exact matching, the fact that the displayed values are reasonably close is a good sign. In addition, the values constantly change due to factors such as electrical field noise, magnetic fluctuations, thermal noise and vibration. Changes up to 10 (HEX) are considered normal.

The values CX and CY represent the horizontal and vertical distances, respectively, of an imaged target in a given color from the center of the sensor. For the green color, both CX and CY will normally be less than 80 (Hex). On a converged point, the CX and CY values of the red and blue colors should closely match the corresponding values for the green color.

If the displayed values are not as described above, auto-converge the selected point. If a problem still exists, check other convergence points. If the problem is consistent among other convergence points, reduce the amount of room lighting and try again. If the problem persists, the Locator Assembly or the Control Board may require replacement. Inconsistency amongst different convergence points (or the same point tested at different times) may indicate that the eccentric motor stops are not properly positioned. If this is the case, refer to section 24.2.3, *Alignment and Adjustments*.

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Problems at edge points may result from a reflective screen frame. If this is indicated, cover the screen frame surface facing ACON with a matte black material such as black felt.

If all light measurements are close to 000 or FFF when any of the red, green or blue colors are displayed, the motors may not be placing the sensor at the projected target. This can occur if the setup configuration (Learn Screen) does not match the actual system configuration or the motor drive circuitry is not operating properly. Use the Learn Screen feature as described in the ACON User's manual and re-converge. If the problem still exists, check the physical position of the lens/sensor component. If it does not appear to be positioned toward the specified convergence point on the display, the motor drive circuitry on the Control Board may be at fault.

24.2.3 Alignment and Adjustments

Adjustment of the eccentric motor end stops is the only service adjustment which may be performed to the ACON system. This adjustment may be required if ACON does not accurately or consistently auto-converge at each convergence point. There are two end stops, one at each end of the "stop bar" on the Locator Assembly. Each end stop consists of a rubber grommet with an eccentrically placed center hole. When the motors move to their "home" position, the lens/sensor component butts up against each stop. Rotating the stop changes the physical location of the home position.

The final end adjustment of each end stop can be critical to assure repeatable and reliable positioning of the Locator Assembly stepper motors. To adjust the eccentric end stops, follow the procedure below.

a) Enter servicing mode.

b) Press the **RESET** key on the projector keypad. This sets the motors to their home position.

c) Select one of the convergence points using the **MOV** command.

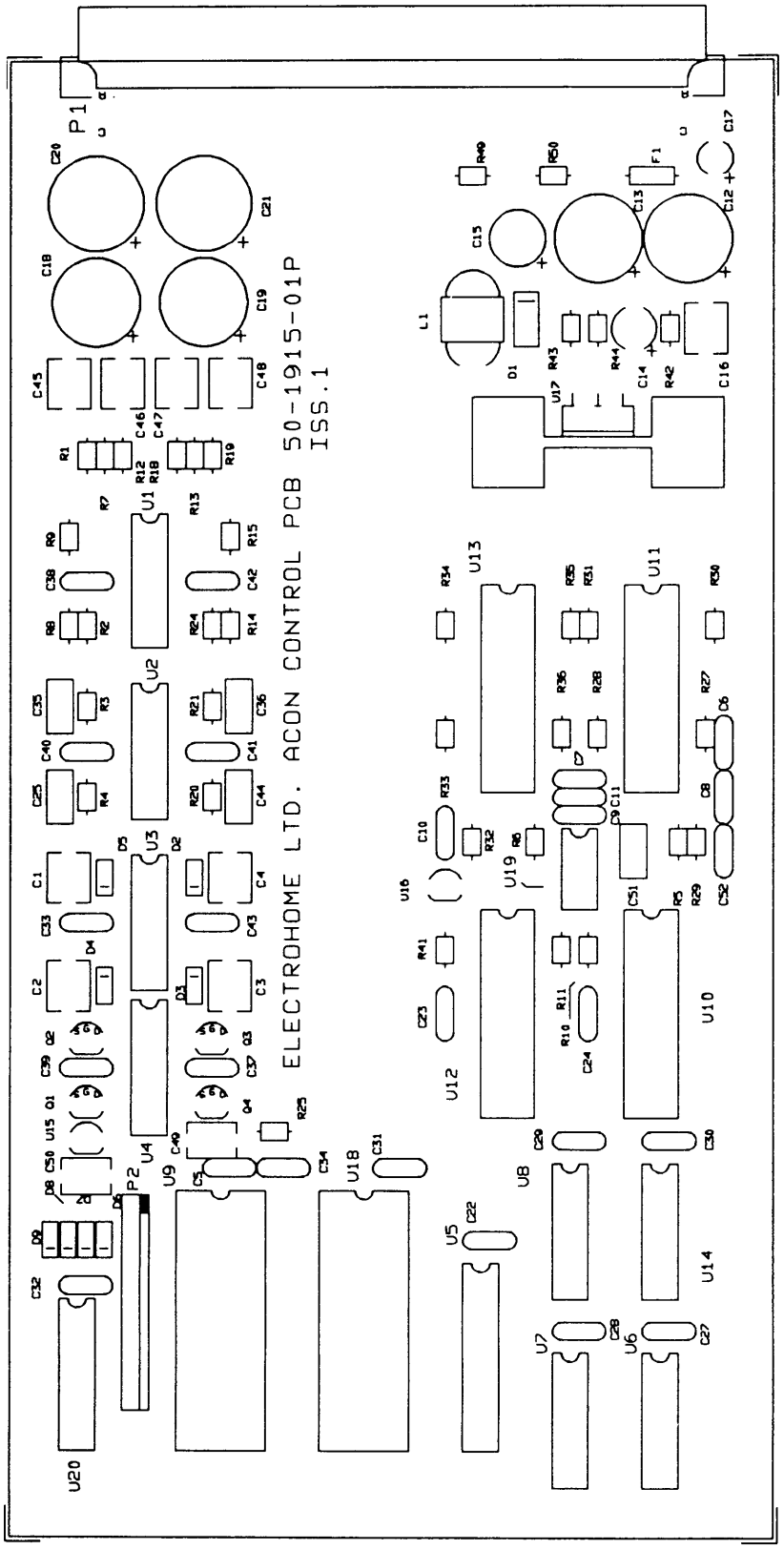
d) Record the CX and CY coordinate values.

e) Repeat b) to d) above (selecting the same convergence point). If either the CX or CY coordinate values are significantly different than the first readings, slightly rotate the appropriate end stop grommet. Repeat b) to e) until the readings are reasonably close between measurements.

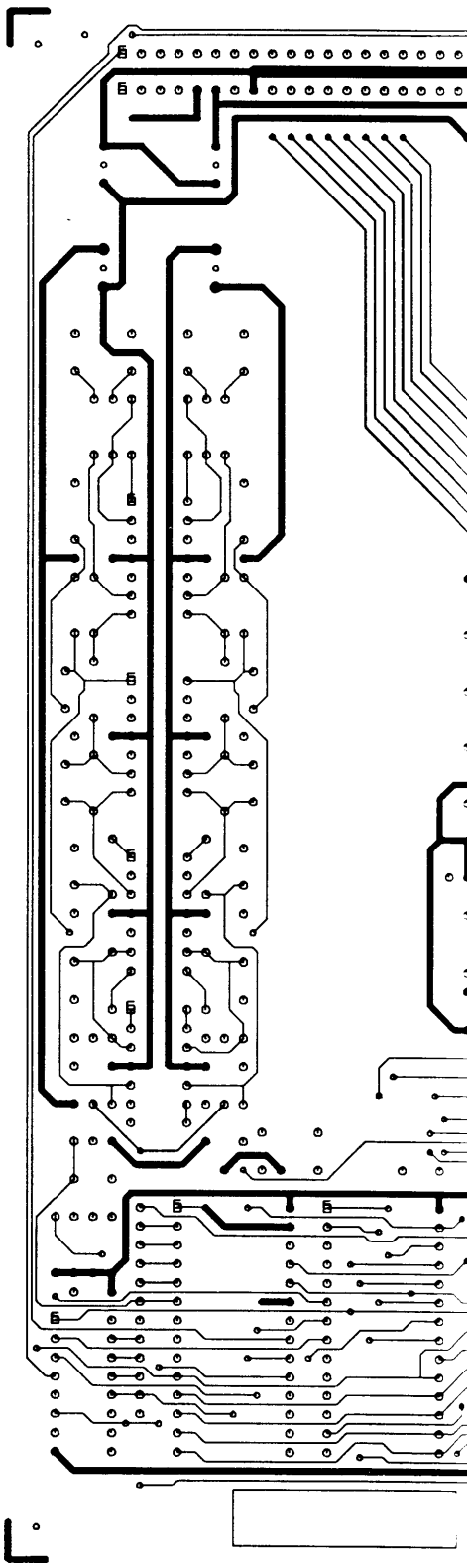
Note: The upper grommet affects the vertical positioning and the lower grommet affects the horizontal positioning.

24.3 COMPONENT LAYOUT AND SCHEMATICS

Refer to the following pages for component layouts and schematics of the ACON Control Board.

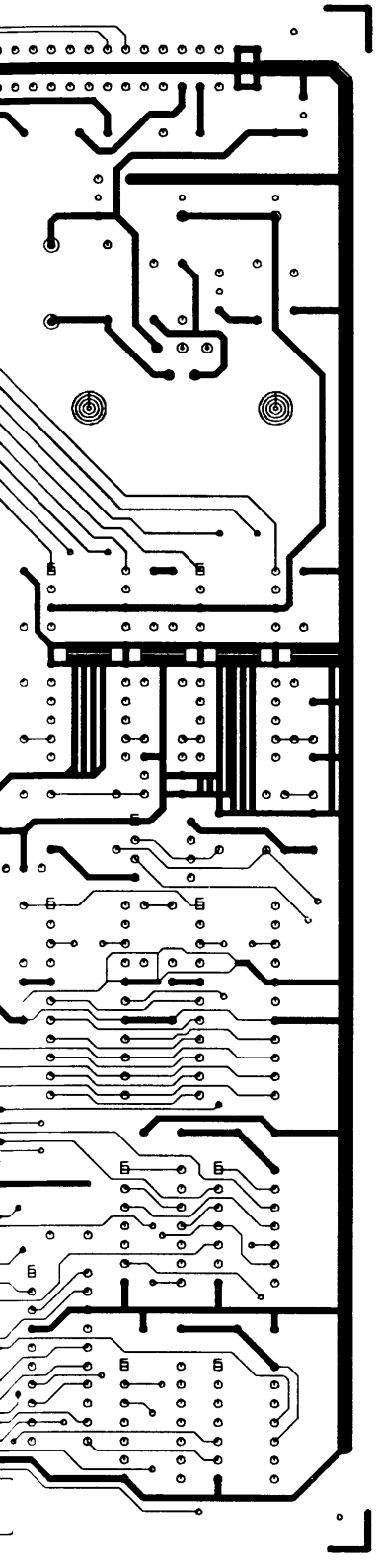


Component Layout

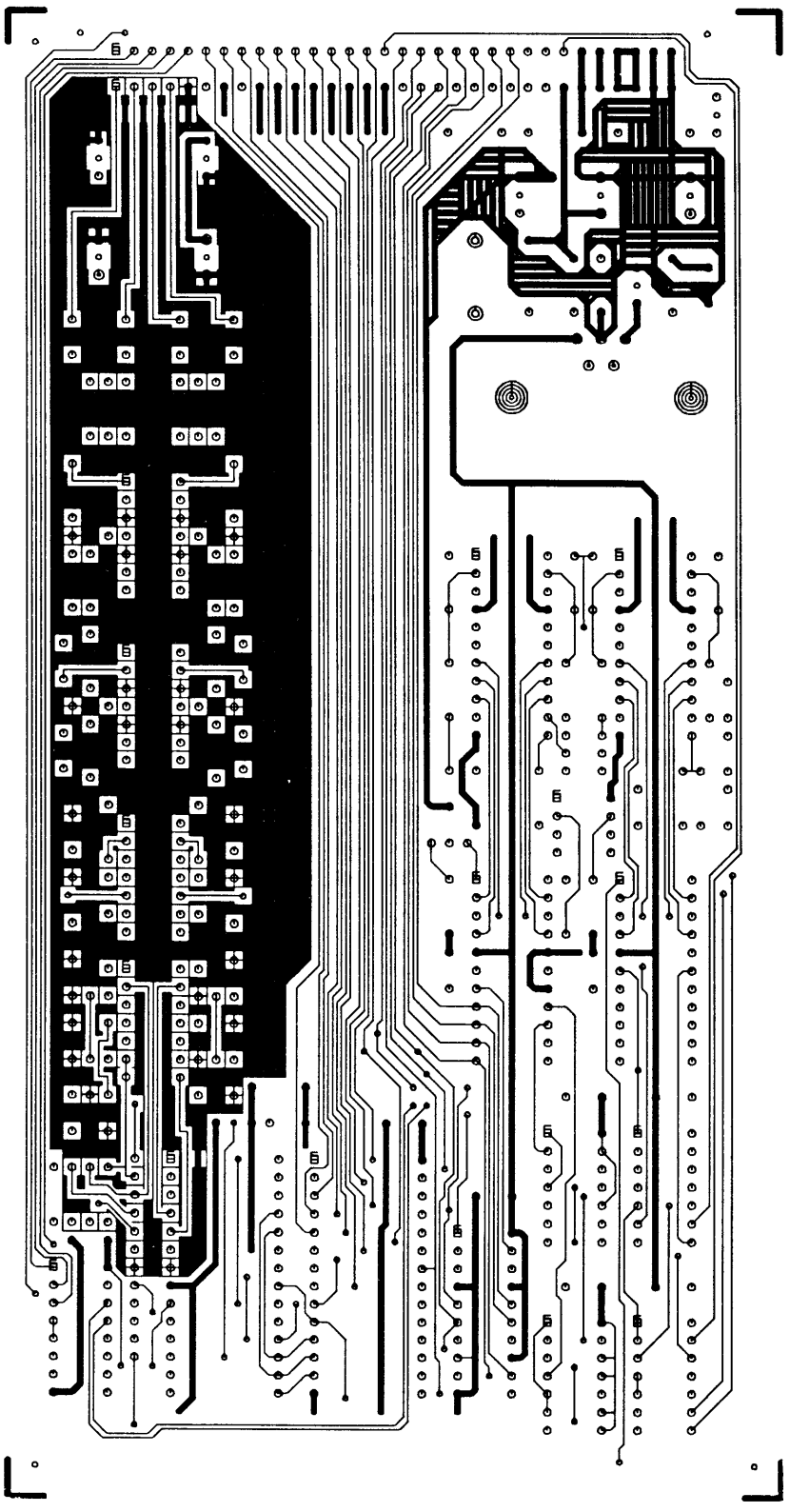


Solder Side
(Viewed from Compo

54-7904-02P/54-7904-03P (06/90)

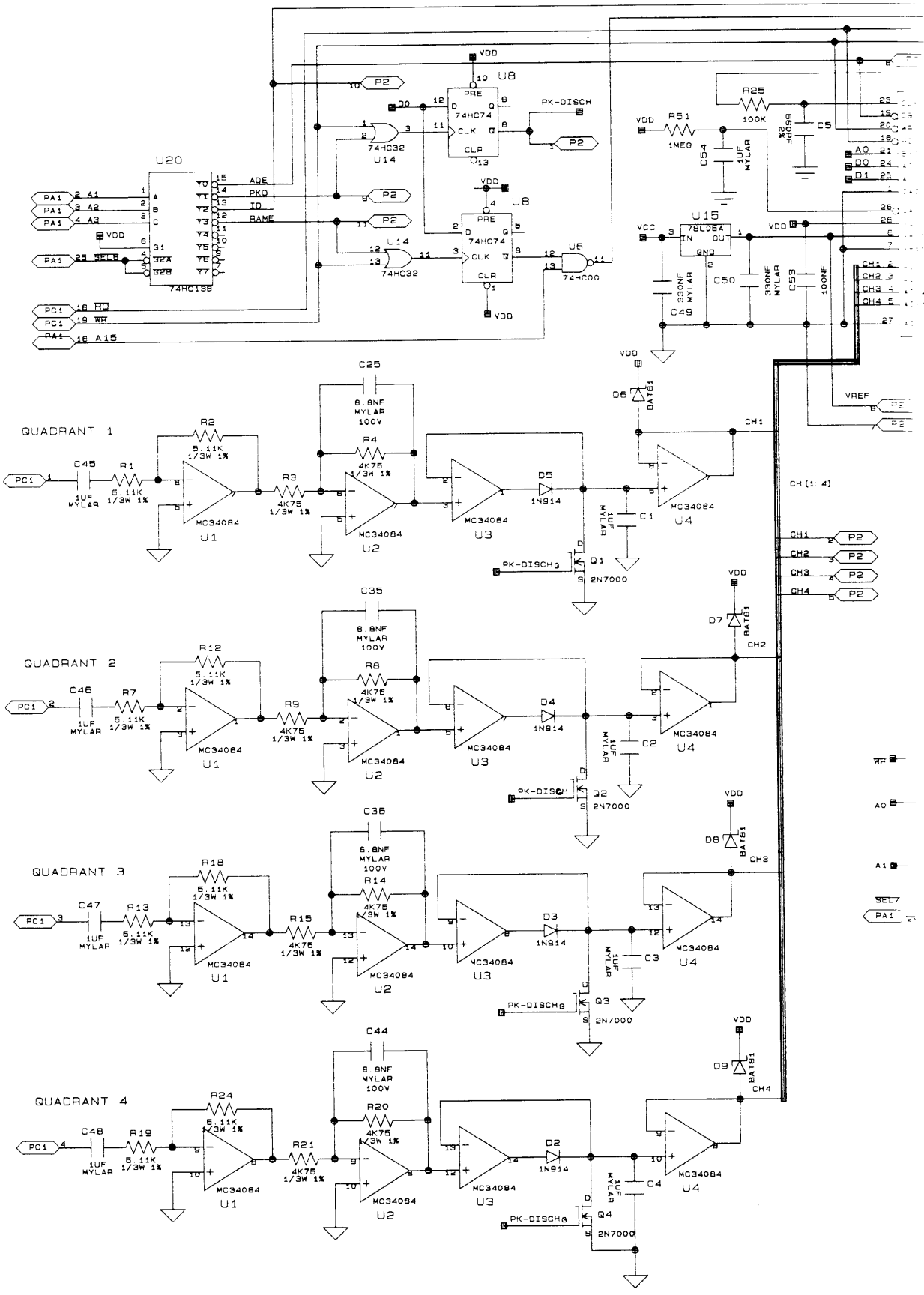


de
onent Side)



Component Side

FIGURE 24–4.
ACON Control Board Component Layout


QUADRANT 1
QUADRANT 2
QUADRANT 3
QUADRANT 4
U20
74HC138
U8
74HC74
U14
74HC32
U5
74HC00
U15
78L05A
U1
MC34084
U2
MC34084
U3
MC34084
U4
MC34084
VDD
P2
PK-DISCH
PA1
PC1
ADE
PKD
ID
RAME
RD
WR
A15
SELE
R1
R2
R3
R4
R7
R8
R9
R12
R13
R14
R15
R18
R19
R20
R21
R24
R25
R51
C1
C2
C3
C4
C5
C45
C46
C47
C48
C49
C50
C53
C54
C25
C35
C36
C44
6.8NF MYLAR 100V
1UF MYLAR
330NF MYLAR
100NF
5.11K 1/3W 1%
4K75 1/3W 1%
100K
1MEG
1N914
2N7000
BAT81
Q1
Q2
Q3
Q4
D5
D7
D8
D9
D4
D3
D2
CH1
CH2
CH3
CH4
CH [1: 4]
VREF
A0
A1
SEL7
WR

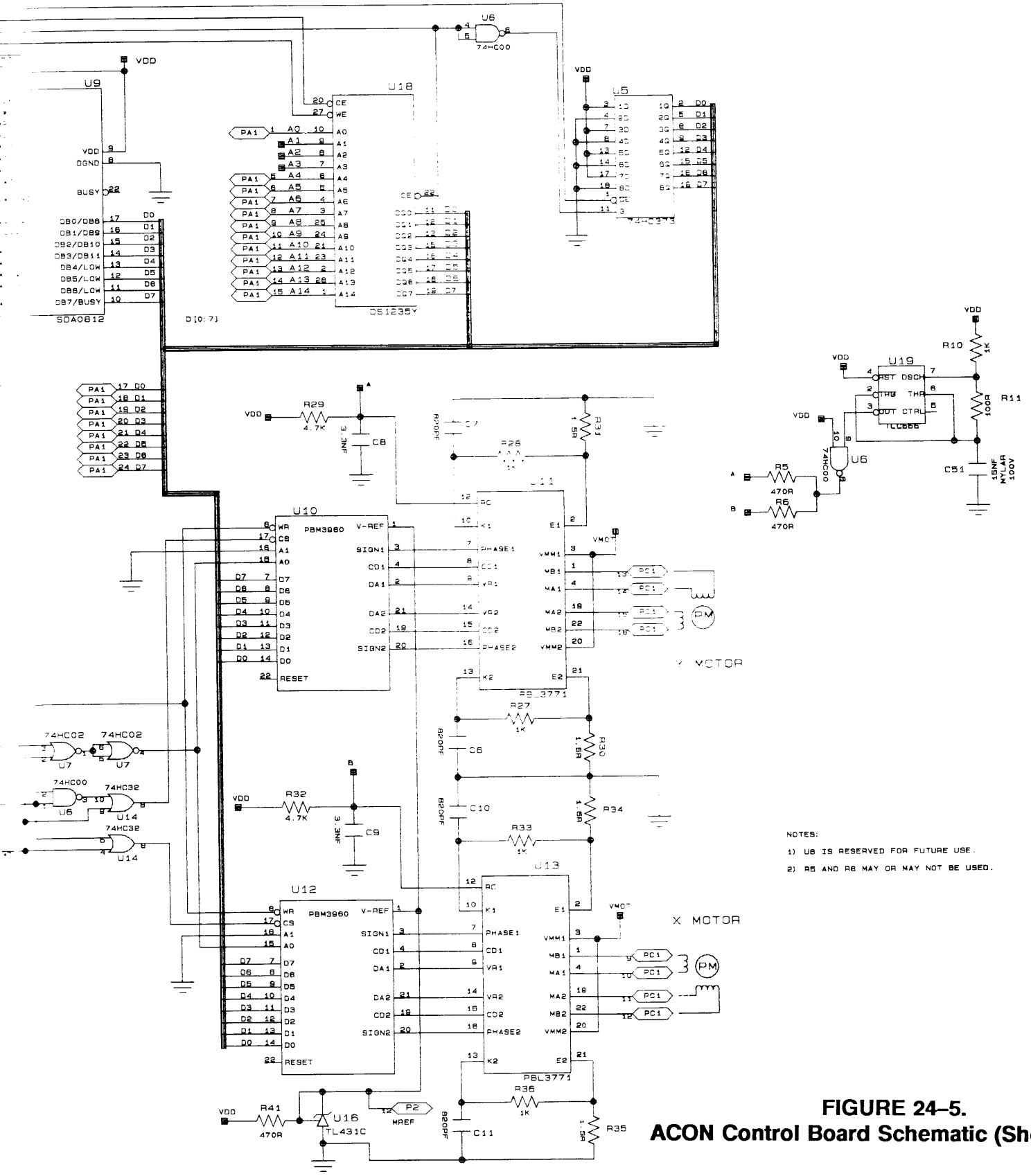
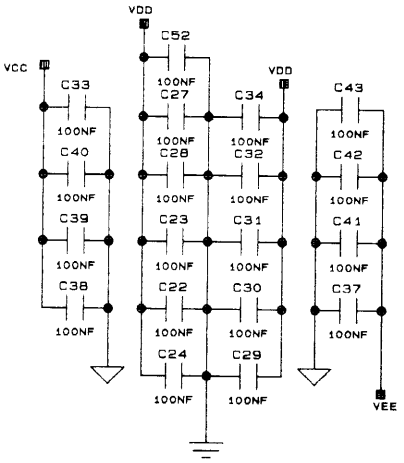
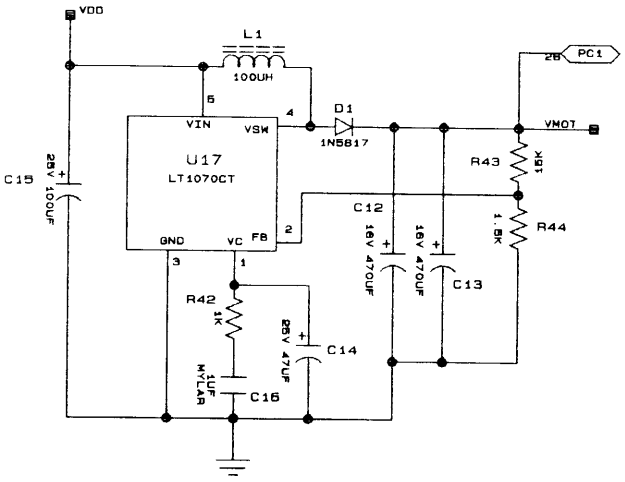
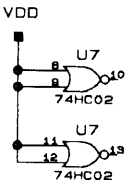


FIGURE 24–5.
ACON Control Board Schematic (Sheet 1 of 2)







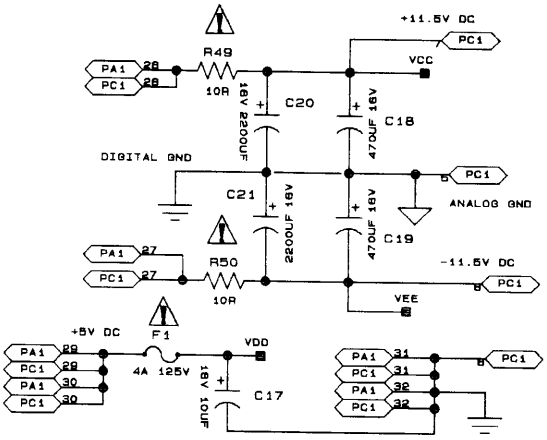


FIGURE 24–6.
ACON Control Board Schematic (Sheet 2 of 2)

24.4 PARTS LIST

24.4.1 ACON Control Board

Item Ref.	Part No.	Description
Integrated Circuits		
U1-U4	14-002164-01P	MC34084, op amp
U5	14-A04010-01P	74HC373, H-CMOS transparent octal latch
U6	14-A04001-01P	74HC00, quad 2-input NAND gate
U7	14-A04090-01P	74HC02, quad 2-input NOR gate
U9	14-A03042-01P	SDA0812, 12-bit A/D converter
U10,U12	14-A03043-01P	PBM3960, dual D/A converter
U11,U13	14-A03044-01P	PBL3771, precision stepper motor driver
U14	14-A04005-01P	74HC32, quad 2-input OR gate
U15	14-002814-02P	LM78L05ACZ, +5V regulator
U16	14-002833-01P	TL431C, precision shunt regulator
U17	14-002847-01P	LT1070CT, switch mode regulator
U19	14-A04069-01P	TLC555C, CMOS digital timer
U20	14-A04045-01P	74HC138, 3 to 8 decoder
Transistors and Diodes		
Q1-Q4	14-A00705-01P	2N7000, TMOS, 60V, 0.2A, 4W
D1	14-000533-02P	1N5817, Schottky barrier diode
D2-D5	14-000513-01P	1N914, 0.075A, 75V
D6-D9	14-000533-01P	BAT81, Schottky barrier diode
Capacitors		
C1-C4,C16, C45-C48,C54	88-171053-02P	1 μF, 50V, mylar
C5	86-656151-02P	560 pF, 100V, Y5P
C6,C7,C10, C11	86-682151-02P	820 pF, 100V, Y5P
C8,C9	86-633252-02P	3300 pF, 100V, Y5P
C12,C13	49-000020-01P	470 μF, 16V, low ESR electrolytic
C14	84-447004-02P	47 μF, 25V
C15	84-410104-03P	100 μF, 25V
C17	84-410004-01P	10 μF, 25V
C18,C19	44-447103-06P	470 μF, 16V
C20,C21	44-422203-08P	2200 μF, 16V
C22-C24,C27-C34, C37-C43,C52,C53	89-000032-03P	100nF, 50V
C25,C35,C36, C44	88-176821-03P	6800 pF, 100v, ±5%
C49,C50	88-173340-02P	330 nF, 63V, 10%, mylar
C51	88-171531-01P	15 nF, 100V, mylar

24.4 PARTS LIST (cont.)

24.4.1 ACON Control Board (cont.)

	Item Ref.	Part No.	Description
	Resistors		
	R1,R2,R7,R12,R13, R18,R19,R24	82-351111-29P	5.11K, 1/3W, 1%, metal film
	R2,R12,R18, R24	82-324311-29P	2.43K, 1/3W, 1%, metal film
	R3,R4,R8,R9,R14, R15,R20,R21	82-347511-29P	4.75K, 1/3W, 1%, metal film
	R10,R27,R28,R33, R36,R42	80-110015-11P	1k , 1/2W, 5%, metal film
	R11	80-110005-11P	100R, 1/2W, 5%, metal film
	R25	80-110035-11P	100K , 1/2W, 5%, metal film
	R51	80-110045-11P	1M, 1/2W, 5%, metal film
	R29,R32	80-147015-11P	4.7K, 1/2W, 5%, metal film
	R30,R31,R34, R35	80-115085-11P	1.5R, 1/2W, 5%, metal film
	R41	80-147005-11P	470R, 1/2W, 5%, metal film
	R43	80-115025-11P	15K , 1/2W, 5%, metal film
	R44	80-115015-11P	1.5K, 1/2W, 5%, metal film
⚠	**R49,R50**	**80-110095-11P**	**10R, 1/2W, 5%, metal film**
	Coils and Transformers		
	L1	21-001459-01P	100 μH, choke
	Miscellaneous		
⚠	**F1**	**27-000034-06P**	**4A, 125V, subminiature fuse**

NOTE: The ACON Sensor module is Electrohome part# 02-270016-01P.

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24.5 SYSTEM SPECIFICATIONS

24.5.1 Functional

Projector Models 3100/4100
Screen Sizes . . . . . 5' to 25'
Screen Types . . . . . flat, curved and rear
Convergence Zones . . . . . 9 horizontal by 5 vertical
Convergence Accuracy . . . . . .05% of screen width
Ambient Light Rejection . . . . . up to 5 foot-lamberts at screen surface
Convergence Time (typical) . . . . . <3 minutes

Operating Power (from projector)
+5V . . . . . +5 VDC @ 1.5A
+12V . . . . . +12 VDC @ 150mA
-12V . . . . . -12 VDC @ 100mA

Operating Environment
Temperature . . . . . 32 to 95° F (0 to 35° C)
Humidity . . . . . 0 to 90% NC
Altitude . . . . . 0 to 10,000 ft (0 to 3000m)

Storage Environment
Temperature . . . . . -22 to 149° F (-30 to 65° C)
Humidity . . . . . 0 to 90% NC

24.5.2 Mechanical/Electrical

Control Board

Data Acquisition Circuits
Number of channels 4
A/D Conversion Accuracy . . . . . 12 bits
Input Voltage Range . . . . . 0 to +5V
Gain Matching between Channels . . . . . ±5%

Motor Control Circuitry
Number of Driver Circuits 2
Control Method . . . . . micro-stepping
Output Current/Phase . . . . . 650mA maximum
Drive method . . . . . switch-mode constant current

Locator Assembly

Imaging System
Lens type . . . . . single acrylic plano-convex
Sensor type . . . . . photodiode array
Lens Aperture . . . . . 47mm (1.85")
Focal Length . . . . . 53mm (2.1")
Focus . . . . . fixed
Quadrant Sensor Field of View . . . . . 3° x3°

Lens/Sensor Component
Degrees of Freedom . . . . . 2, rotational, orthogonal
Motive Force . . . . . stepper motors, direct drive
Configuration
Motor A . . . . . azimuth, driving optical system
Motor B . . . . . altitude, driving motor A assembly
Sweep Angles
Motor A . . . . . 80° minimum
Motor B . . . . . 120° minimum

Motor Specifications
Type . . . . . hybrid stepper
Step Angle . . . . . 0.9° (400s/r)
Drive . . . . . 2 phase, bipolar
Phase Voltage (typical) 14VDC
Current/Phase . . . . . 300mA maximum
Resistance/Phase . . . . . 20 ohms
Inductance/Phase 5mH

Size . . . . . 13x15x10cm (5x6x4")

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APPENDIX A

COMPUTER COMMUNICATION

Computer generated control signals, transmitted by an IR Remote keypad (remote control infrared transmitter), can be used to remotely control the projector. The control signals must meet the following specifications:

- No-signal voltage level = 5 to 12V DC.
- Signal voltage level = 0V.
- A signal must start with two "Start Instruction Codes" (hex 1F). The start instruction codes must be followed by one or more "Key Instruction Codes", e.g., **CONT** (hex 19). See Table A-1.
- Control signals must be terminated with two "End Instruction Codes" (hex 1F). Reference Figure A-1.
- Projectors can be programmed via the built-in or a wired keypad to respond to Protocol 1 or Protocol 2. See Table A-2.
- A control signal must be transmitted at least 4 times.
- The control line must be connected to the REMOTE SENSOR jack on the projector.

All signals are encoded by a bi-phase encoder. See Figure A-2.

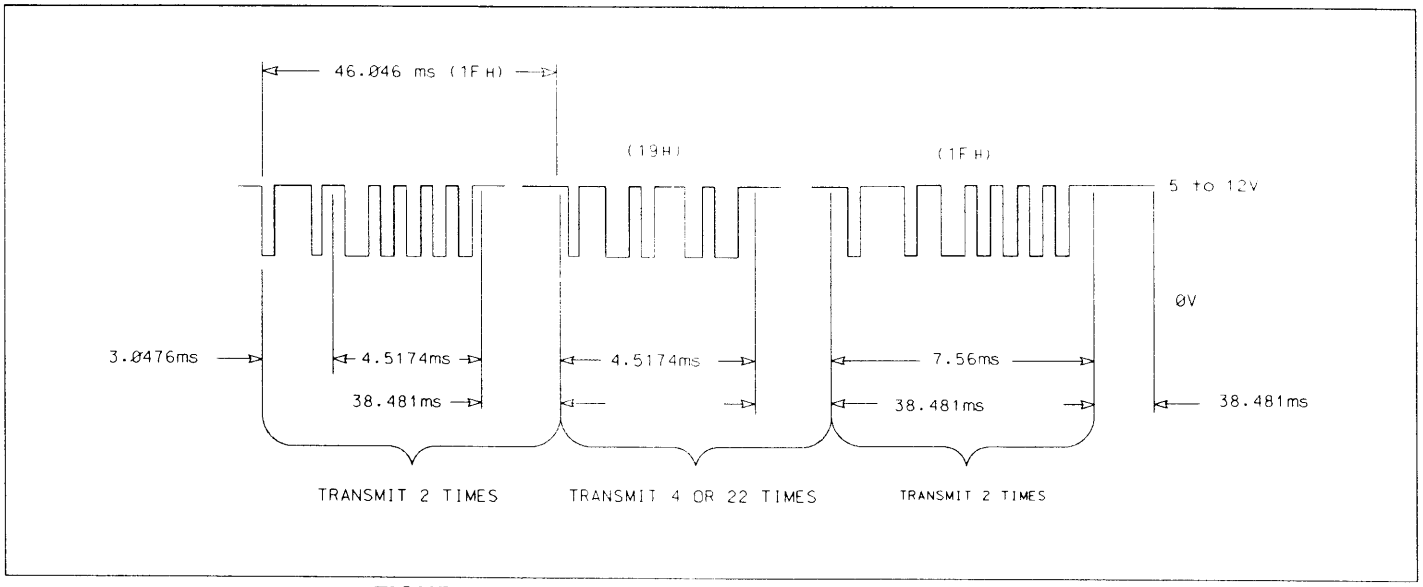

FIGURE A-1. *Start and End Codes for Protocol 1 and 2*

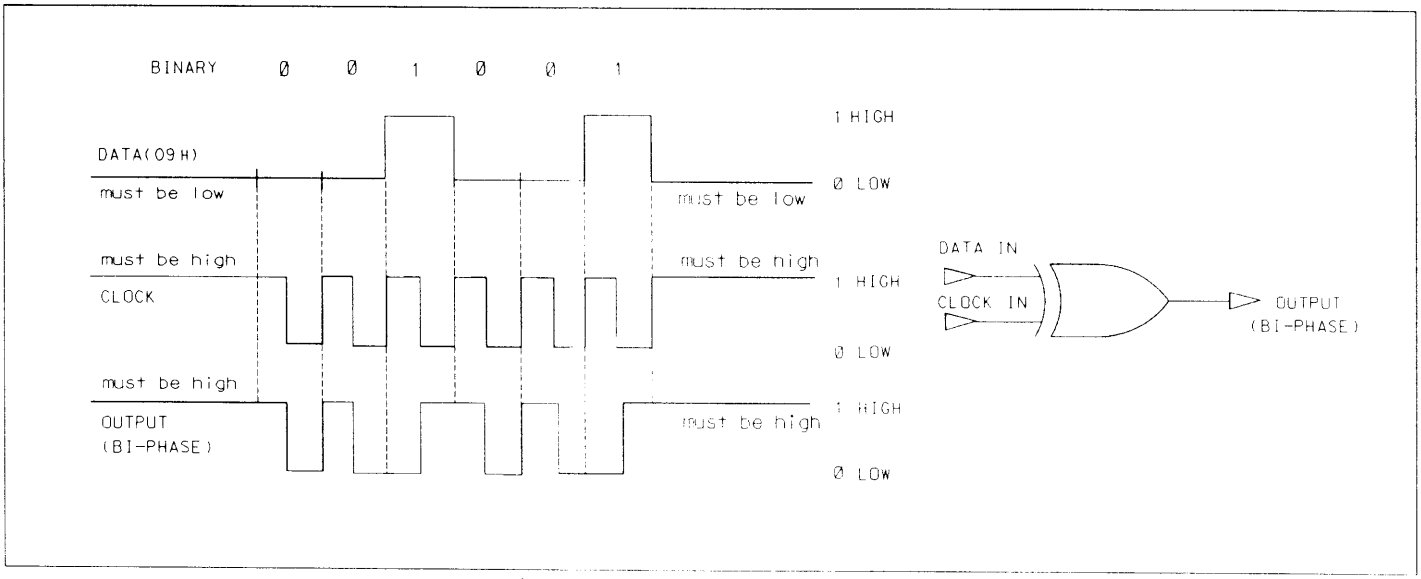

FIGURE A-2. *The Bi-phase Encoder*

TABLE A-1. *IR (Infrared) Key Instruction Codes*

Keypad Function	Hex Code	Binary Code	Minimum Number of Times Transmitted
#	00	000000	4 times
EXIT	02	000010	4 times
HELP	03	000011	4 times
SIZE	04	000100	4 times
4	05	000101	4 times
POWER	07	000111	22 times
FAST/SLOW SYNC	08	001000	4 times
SOURCE	09	001001	4 times
KEY	0C	001100	4 times
7	0D	001101	4 times
TINT	10	010000	4 times
2	13	010011	4 times
H HOLD	14	010100	4 times
6	15	010101	4 times
VOL	17	010111	4 times
*	18	011000	4 times
CONT	19	011001	4 times
U	1A	011010	2 times
FOCUS	1C	011100	4 times
9	1D	011101	4 times
D	1E	011110	2 times
START/STOP	1F	011111	4 times
DETAIL	20	100000	4 times
3	23	100011	4 times
V HOLD	24	100100	4 times
5	25	100101	4 times
R	26	100110	2 times
MUTE	27	100111	22 times
PIN	28	101000	4 times
BRITE	29	101001	4 times
VBLANK	2C	101100	4 times
8	2D	101101	4 times
0	30	110000	4 times
CONVERGE	32	110010	4 times
1	33	110011	4 times
BOW	34	110100	4 times
STANDBY	35	110101	22 times
L	36	110110	2 times
RESET	37	110111	22 times
PROJ	38	111000	4 times
COLOR	39	111001	4 times
MOVE	3C	111100	4 times
RECALL	3D	111101	4 times

TABLE A-2. *Wired Keypad Instruction Codes*

Keypad Function	Hex Code	Binary Code	Minimum Number of Times Transmitted
#	00	000000	4 times
EXIT	02	000010	4 times
HELP	03	000011	4 times
SIZE	04	000100	4 times
8	05	000101	4 times
POWER	07	000111	22 times
FAST/SLOW SYNC	08	001000	4 times
SOURCE	09	001001	4 times
KEY	0C	001100	4 times
9	0D	001101	4 times
TINT	10	010000	4 times
4	13	010011	4 times
H HOLD	14	010100	4 times
2	15	010101	4 times
VOL	17	010111	4 times
*	18	011000	4 times
CONT	19	011001	4 times
L	1A	011010	2 times
FOCUS	1C	011100	4 times
3	1D	011101	4 times
R	1E	011110	2 times
DETAIL	20	100000	4 times
start	21	100001	4 times
stop	22	100010	4 times
1	23	100011	4 times
V HOLD	24	100100	4 times
5	25	100101	4 times
U	26	100110	2 times
MUTE	27	100111	22 times
PIN	28	101000	4 times
BRITE	29	101001	4 times
mute ON	2A	101010	22 times
mute OFF	2B	101011	22 times
VBLANK	2C	101100	4 times
6	2D	101101	4 times
standby ON	2E	101110	22 times
standby OFF	2F	101111	22 times
0	30	110000	4 times
CONVERGE	32	110010	4 times
7	33	110011	4 times
BOW	34	110100	4 times
STANDBY	35	110101	22 times
D	36	110110	2 times
RESET	37	110111	22 times
PROJ	38	111000	4 times
COLOR	39	111001	4 times
MOVE	3C	111100	4 times
RECALL	3D	111101	4 times

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APPENDIX B

REVERSE SCAN INSTALLATION

This appendix provides instructions for installing the projector from normal to reverse scan installation.

WARNING

The reverse scan procedure MUST be performed by a qualified service technician.

Tools & Equipment Required:
- Phillips screwdriver
- 1/4" hex socket driver

STEP 1 - DISCONNECT YOKE PLUGS

a) Remove Top Covers of Projector. Remove the projector's top covers to access the deflection yoke plugs. Reference Section 5.

b) Remove Lower Case. See Section 5.

c) Locate the Yoke Plugs. The horizontal and vertical yoke plugs are located at the top rear of the projector, slightly below the CRT necks. See Figure B-1 below.

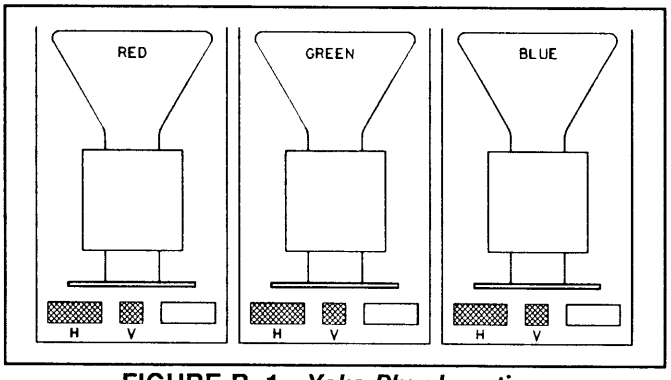

FIGURE B-1. *Yoke Plug Locations*

NOTE: When a deflection yoke plug is in the reverse position, the label "REVERSE SCAN", is visible on the plug. In the normal position, no marking is visible.

d) Plug Removal. Remove the horizontal (P6) and vertical (P8) deflection yoke plugs from each of the 3 deflection boards.

STEP 2 - CONNECT YOKE PLUGS ACCORDING TO INSTALLATION TYPE

There are four installation types:

1) front screen projection - floor mount (normal)
2) front screen projection - ceiling mount (inverted)
3) rear screen projection - floor mount
4) rear screen projection - ceiling mount (inverted)

The yoke plugs are connected differently for each installation type. Unless specified, the projector is shipped from the factory with the yoke plugs connected for a front screen projection - floor mount installation. To alter the yoke plug connections for other installation types, refer to Figures B-2 to B-4.

Rear Screen Projection - Floor Mount

Reverse the horizontal deflection plug, P6. Plug the vertical deflection yoke plug, P8, into its normal position. Plug orientation must be as shown below.

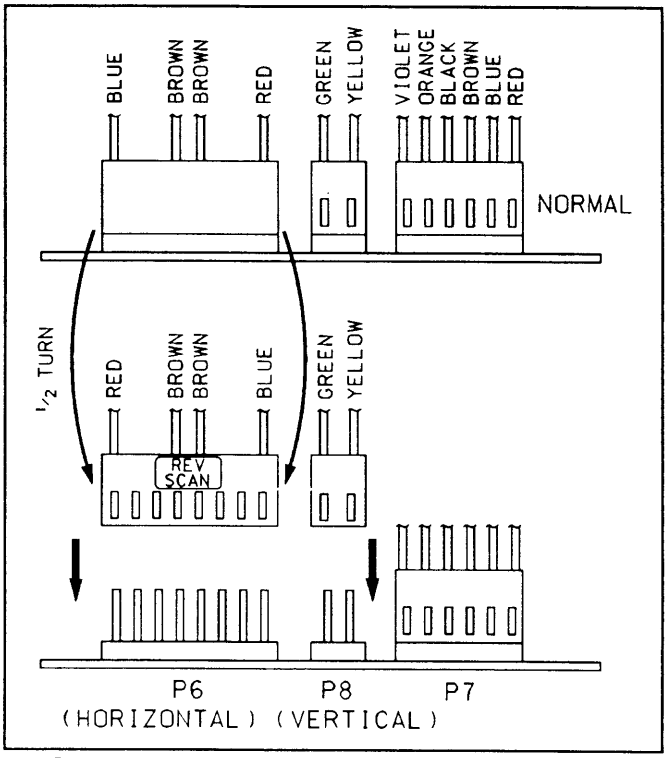

FIGURE B-2. *Rear Screen Projection- Floor Mount*

Front Screen Projection – Ceiling Mount

Reverse the horizontal plug, P6. Reverse the vertical deflection yoke plug, P8. Plug orientation must be as shown below.

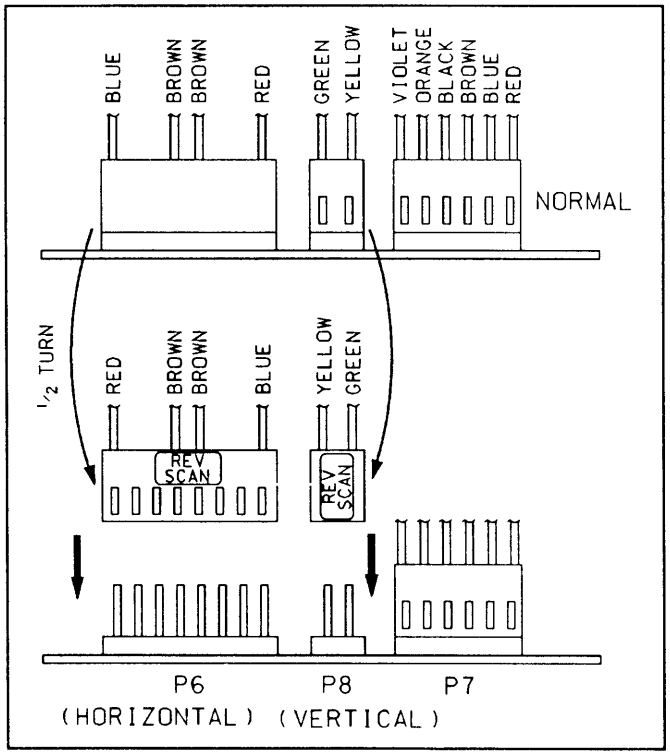

FIGURE B-3. *Front Screen Projection - Ceiling Mount*

Rear Screen Projection – Ceiling Mount

Plug the horizontal deflection yoke plug, P6, into its normal position. Reverse the vertical deflection yoke plug, P8. Plug orientation must be as shown below.

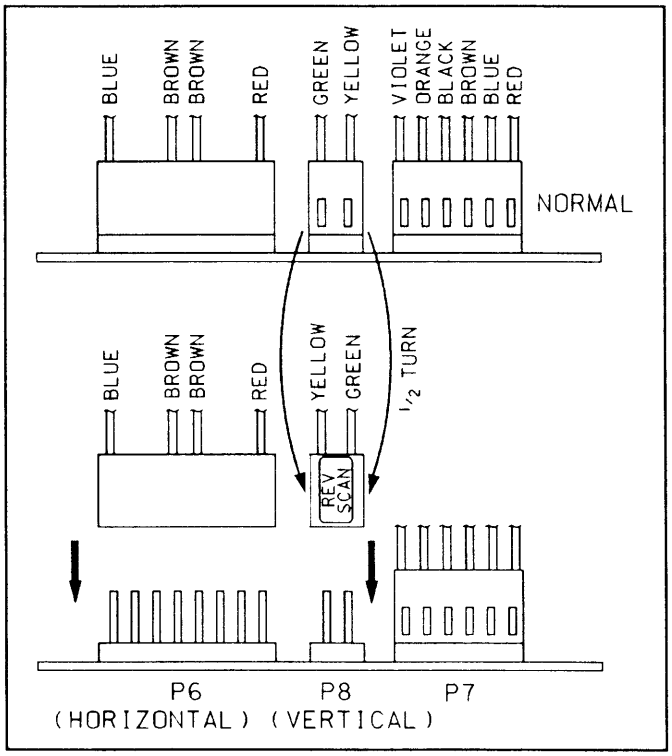

FIGURE B-4. *Rear Screen Projection - Ceiling Mount*

STEP 3 – INSTALL BUILT-IN KEYPAD

Install the built-in keypad following the STEP 1(b) in reverse order. NOTE: If the projector is to be ceiling mounted, install the built-in keypad such that the keypad sensor is next to the right side bracket (serviceman standing behind the projector and facing same direction as projector lenses). This will ensure the key labels are right side up once the projector is mounted.

STEP 4 – MOUNT THE PROJECTOR

Refer to the mounting procedure in the System Owner's Manual.

STEP 5 – ALIGN AND CONVERGE THE PROJECTOR

Set the internal mounting configuration settings using the HELP →UTILITIES →MOUNTING POSITIONS menu. Converge the system using the convergence procedure in the Owner's manual.

STEP 6 – INSTALL PROJECTOR TOP COVERS

Follow STEP 1(a) in reverse order.

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APPENDIX C

HARNESS/WIRING DIAGRAM

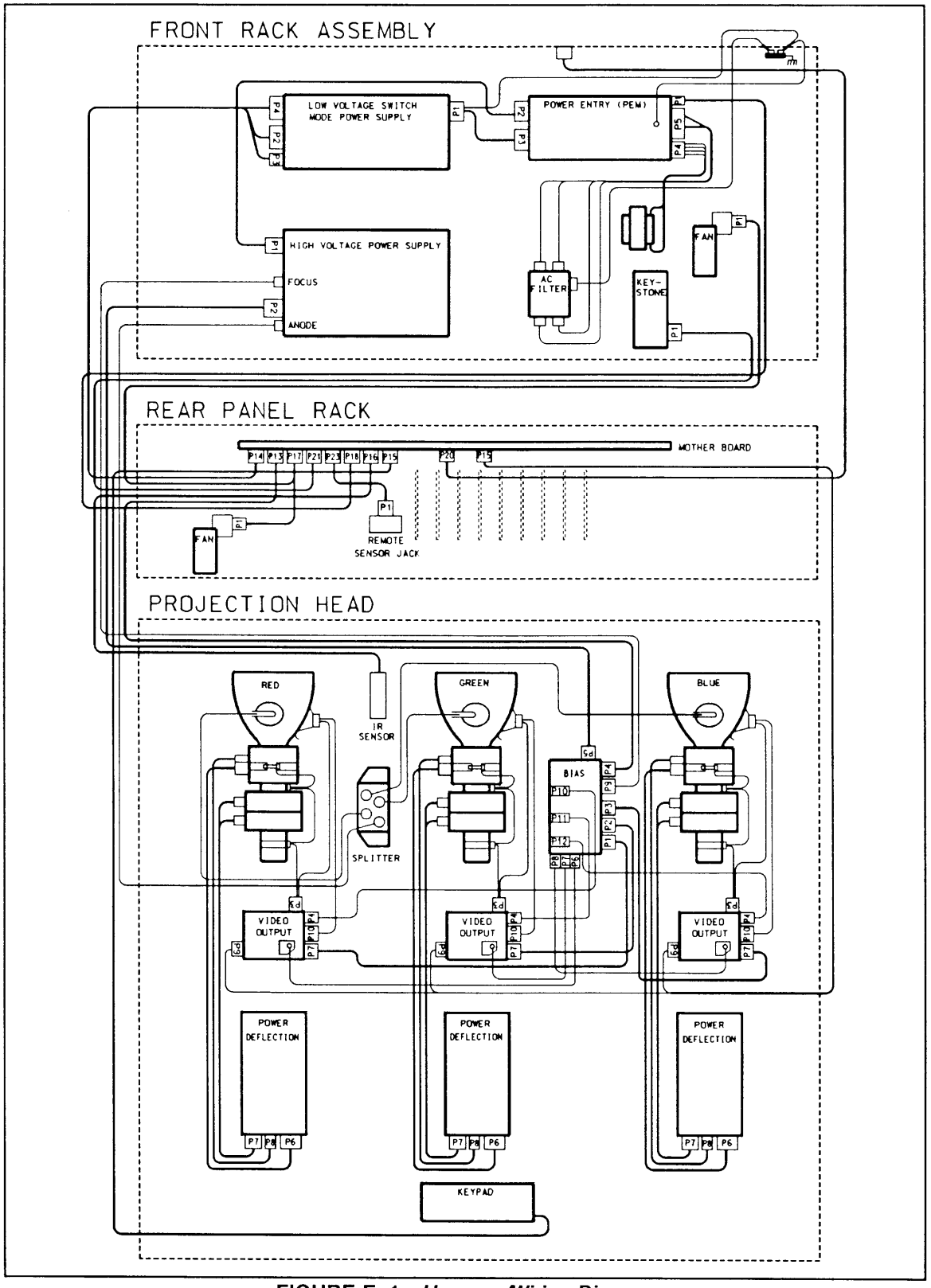

FIGURE E-1. *Harness/Wiring Diagram*

APPENDIX D

TERMS/CONCEPTS/ABBREVIATIONS

ALE	address line enable
A MUTEa	audio mute
B GAIN	blue gain
BH CENT	blue horizontal centering
BH CONV	blue horizontal convergence
BLK LEVEL	black level
BUCK LOW	a DC voltage proportional to BUCK OUT
BUCK OUT	a DC voltage output from the horizontal regulator
BV CENT	blue vertical centering
BV CONV	blue vertical convergence
CAB LIMIT	cabinet (temperature) limit switch
COMM A	communication line A
COMM B	communication line B
DAC	digital to analog converter
DACOUT1	digital to analog converter output #1
DACOUT2	digital to analog converter output #2
DYNFOCUS	dynamic focus
EHT	extra high tension (voltage)
ELEC FOCUS	electronic focus
FBK V SIZE	vertical size feedback
G GAIN	green gain
GH CENT	green horizontal centering
GH CONV	green horizontal convergence
GND	earth ground
GV CENT	green vertical centering
GV CONV	green vertical convergence
H A/M SW	horizontal auto/manual switch
H DELAY SW	horizontal delay switch
HDRIVE	horizontal drive pulse
HFB	horizontal flyback
H HOLD	horizontal hold
H PHASE	horizontal phase
HPLLCLK	horizontal phase locked loop clock
HRESET	horizontal reset
H SIZE	horizontal size
IR	infrared (or infrared sensor)
KEY WFM	keystone waveform
PEM	power entry module
PIN BOT	pincushion bottom control
PIN SIDE	pincushion side control
PIN TOP	pincushion top control
PIN WFM	pincushion waveform
PSEN	program store enable
PWR RELAY	power relay
$\overline{RD}$	read
RD	read (active low)
REVERSE SCAN	use of the projector in ceiling mounted or rear screen applications
REV SCAN	reverse scan
R GAIN	red gain
RGB	red, green, blue
RH CENT	red horizontal centering
RH CONV	red horizontal convergence
RV CENT	red vertical centering
RH CONV	red horizontal convergence
RXD	receive date
SDA	serial data address
SEL	select
SEL	select (active low)
SMPS	switch mode power supply
STBY	standby
TTL	transistor-transistor logic
TXD	transmit data
V A/M SW	vertical auto/manual switch
VAR DC DEFL	variable DC deflection
VCR SW	video cassette recorder switch
V DELAY SW	vertical delay switch
VERT 1	vertical 1, a positive going vertical sync pulse
VFB	vertical flyback
V HOLD	vertical hold
V PHASE	vertical phase
VPLLCLK	vertical phase locked loop clock
VRESET	vertical reset
V SIZE	vertical size
WFM	waveform
$\overline{WR}$	write
WR	write (active low)

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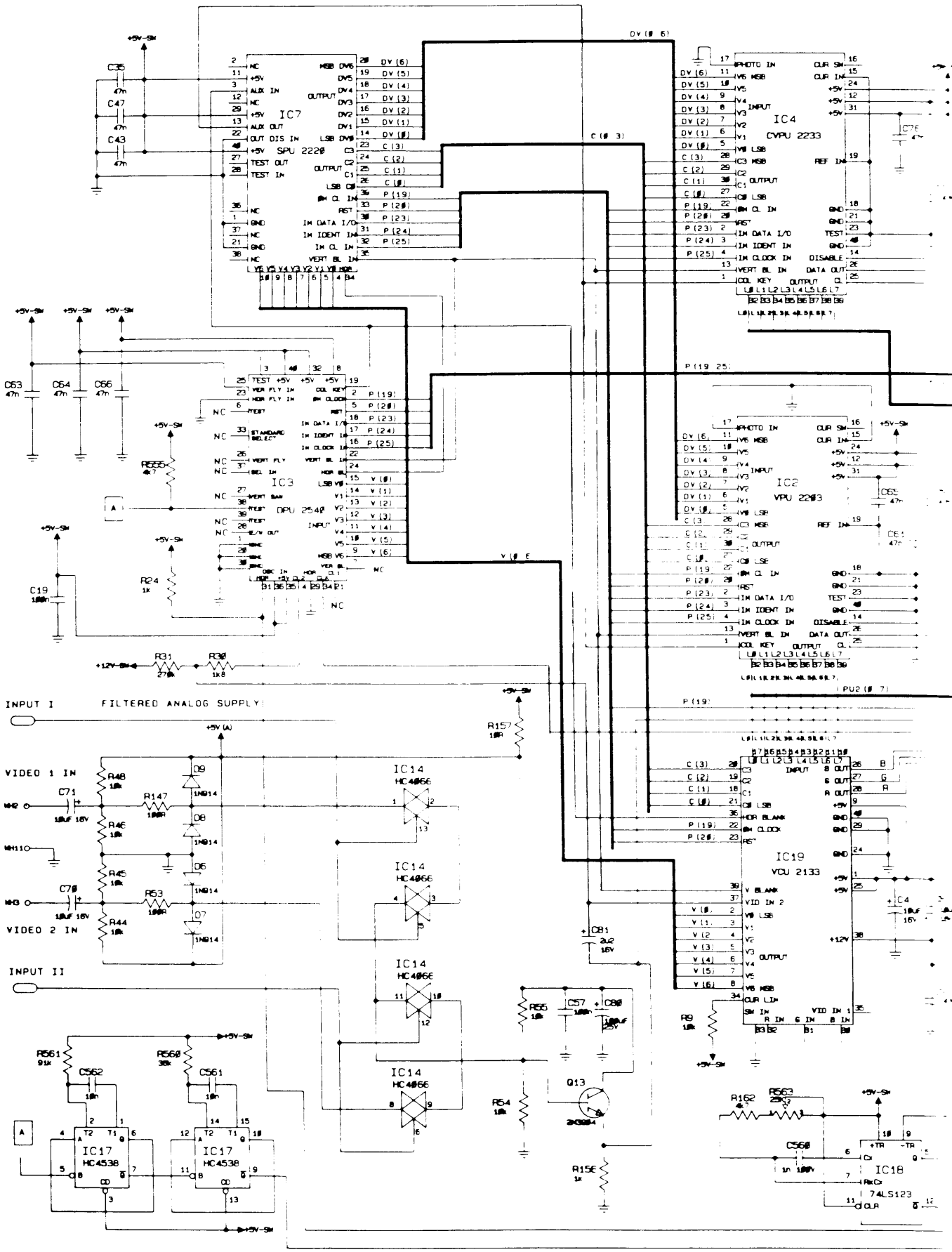
APPENDIX E

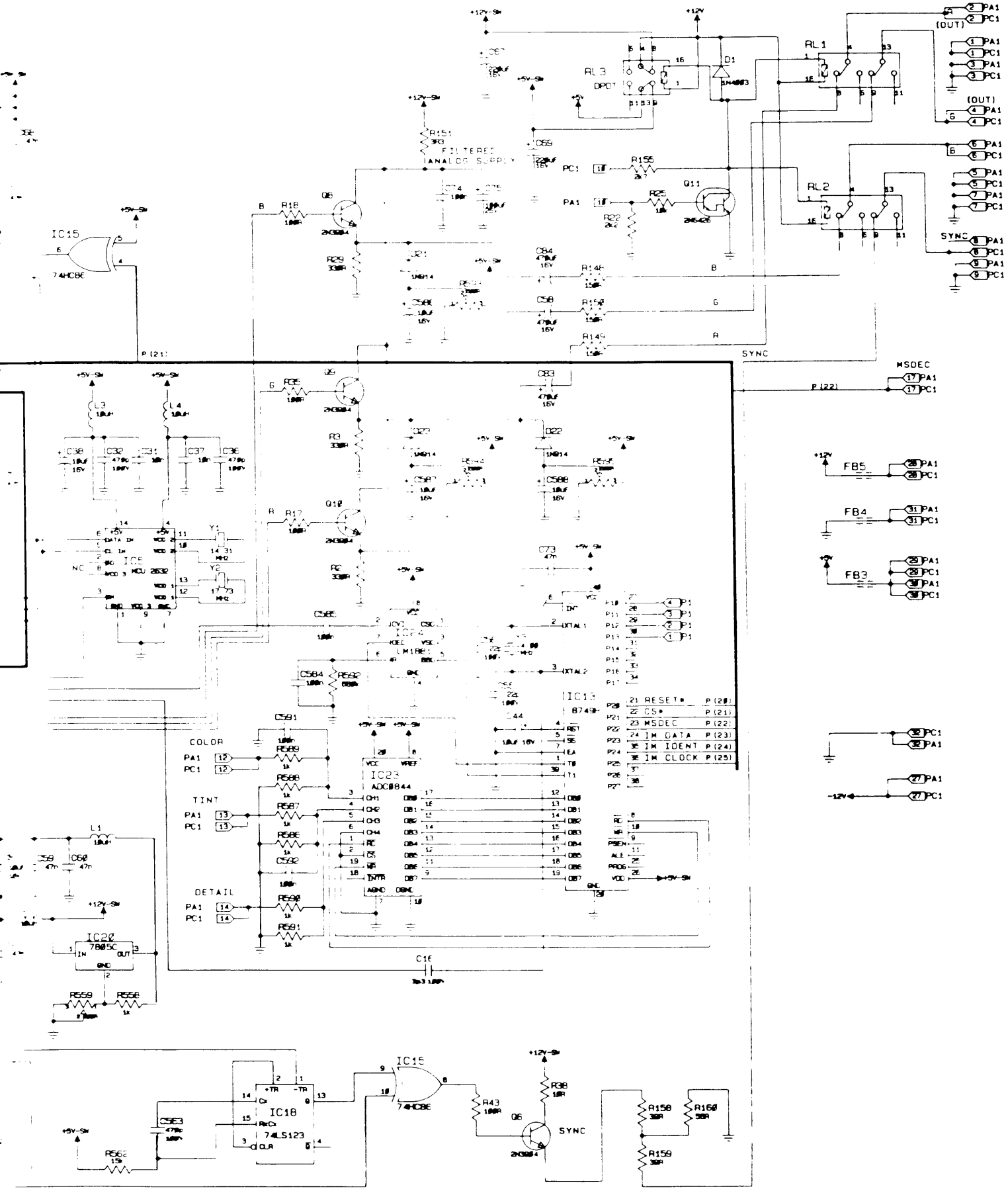
INTERFACE SCHEMATICS

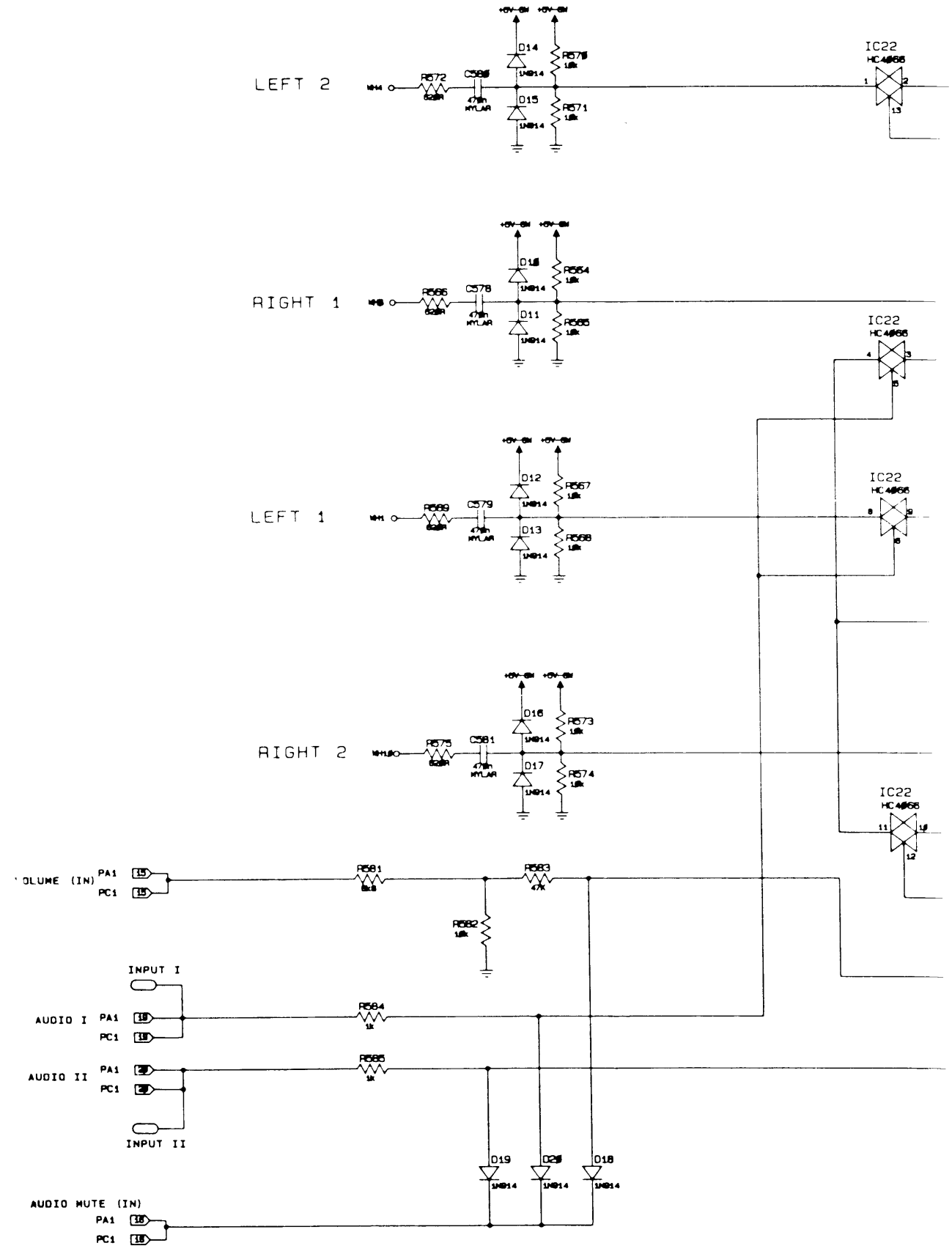
The following interface schematics are included within this appendix

- Multi-standard Decoder
- PS/2-GP Analog Interface
- PC Enhanced Interface
- GP TTL Interface

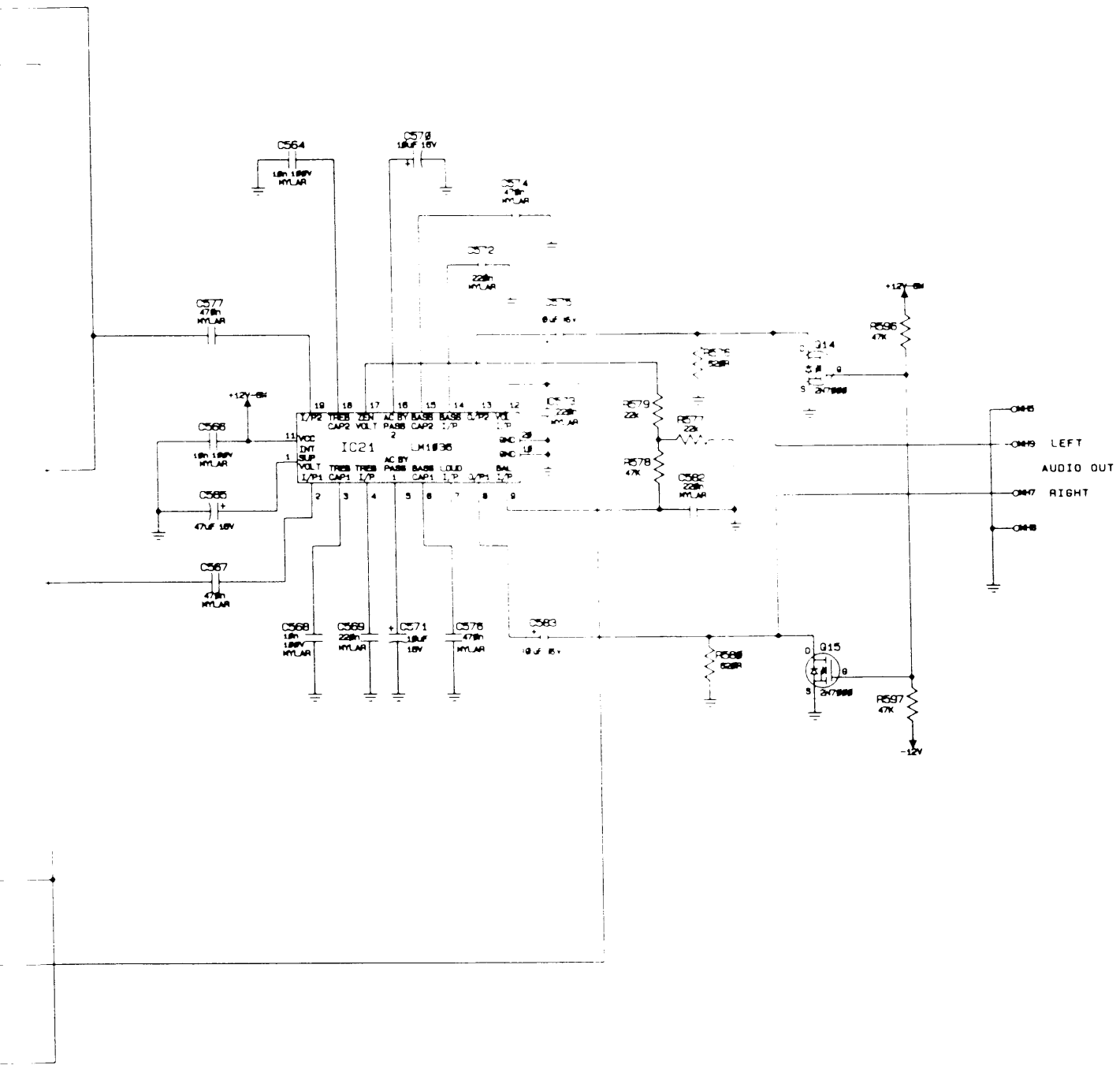


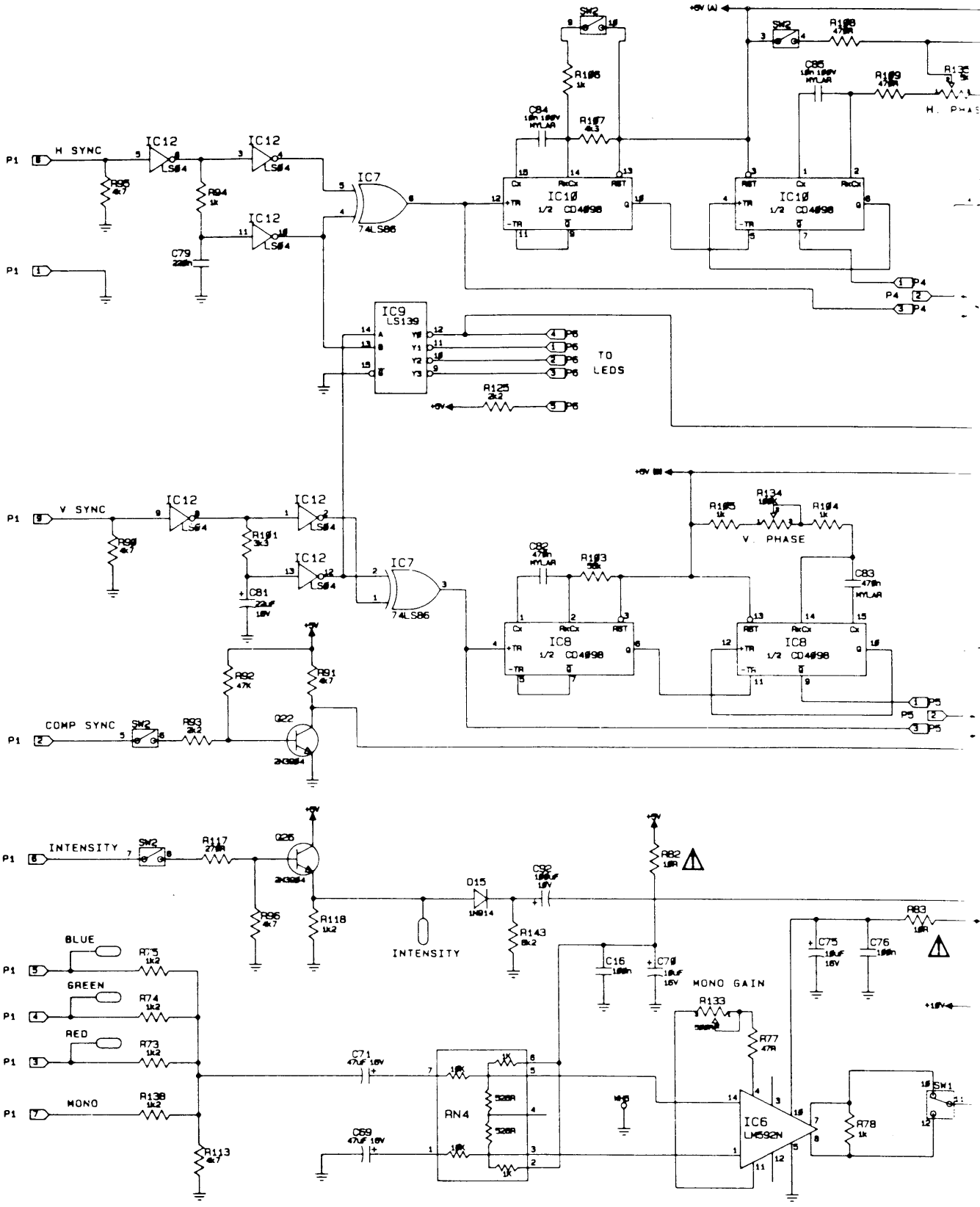
Multi-standard Decoder Schematic (Sheet 1 of 2)



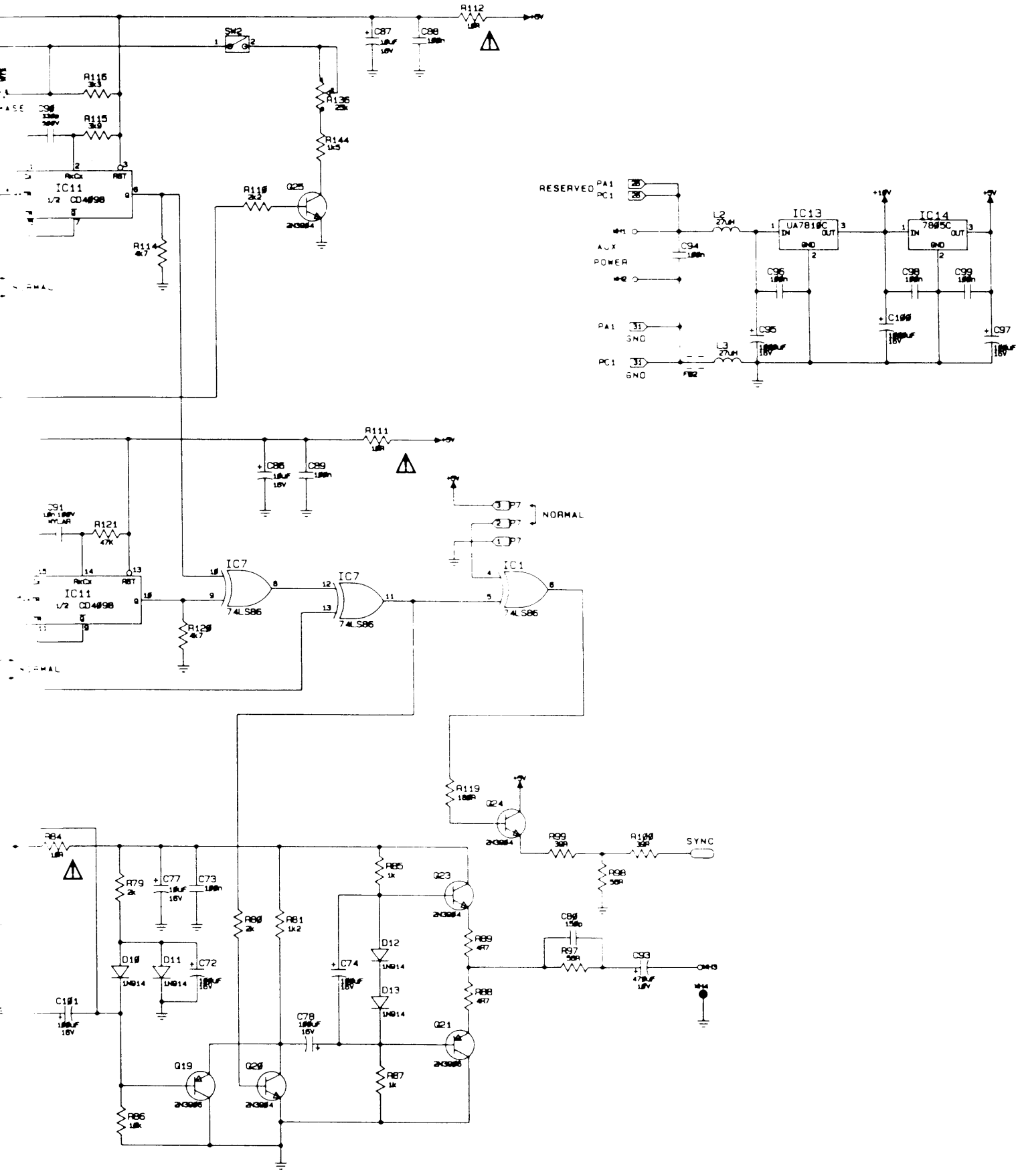


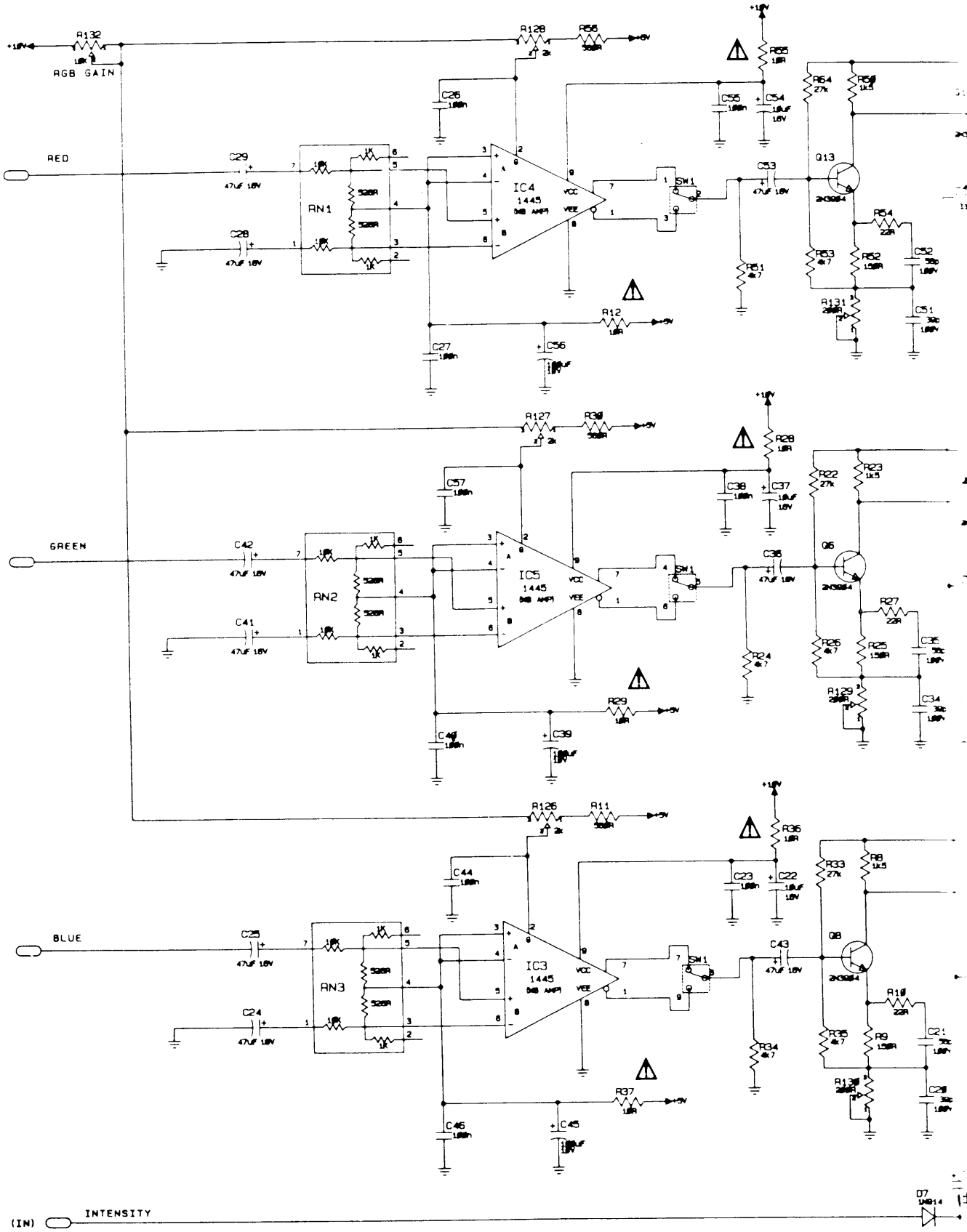
Multi-standard Decoder Schematic (Sheet 2 of 2)



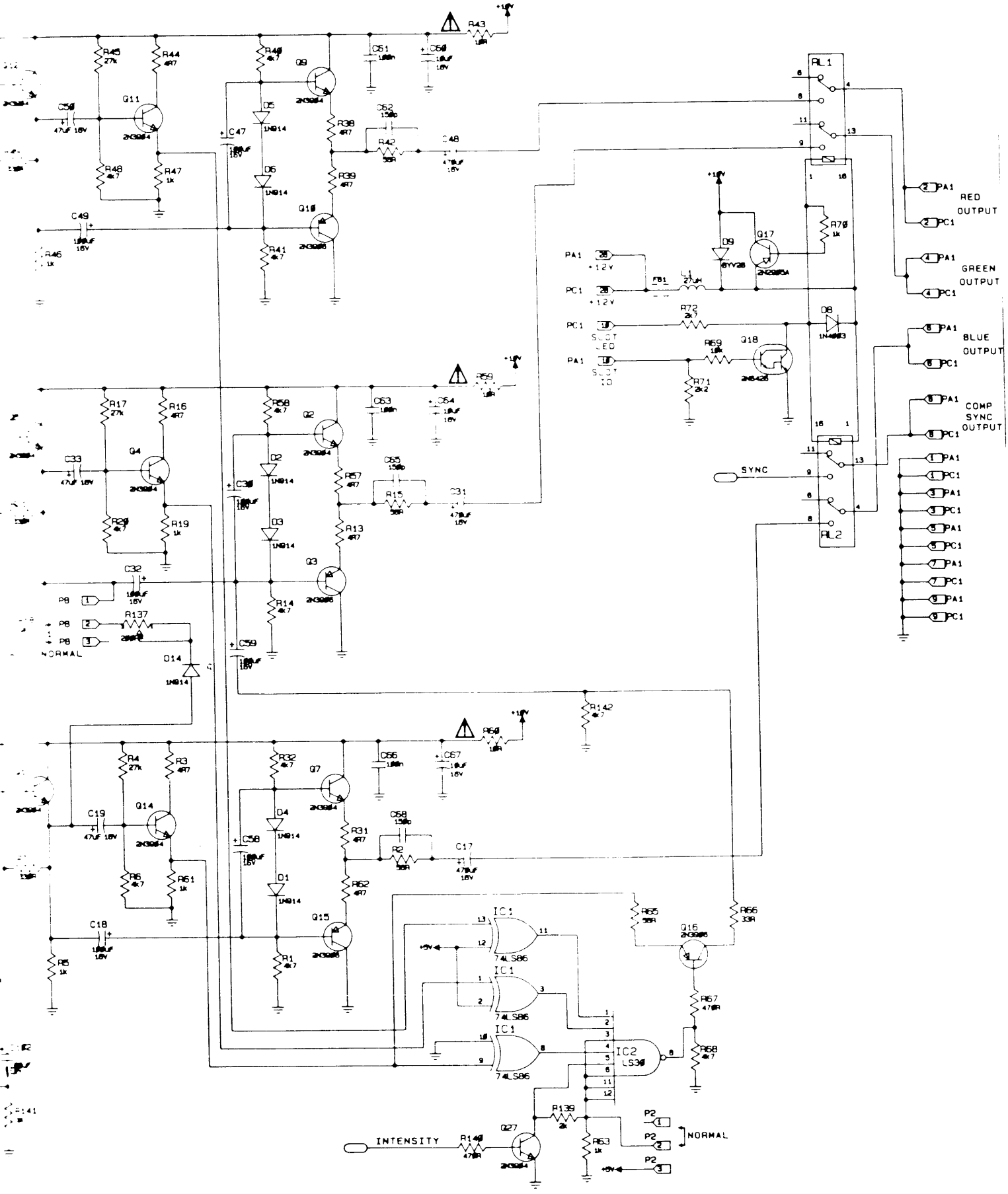


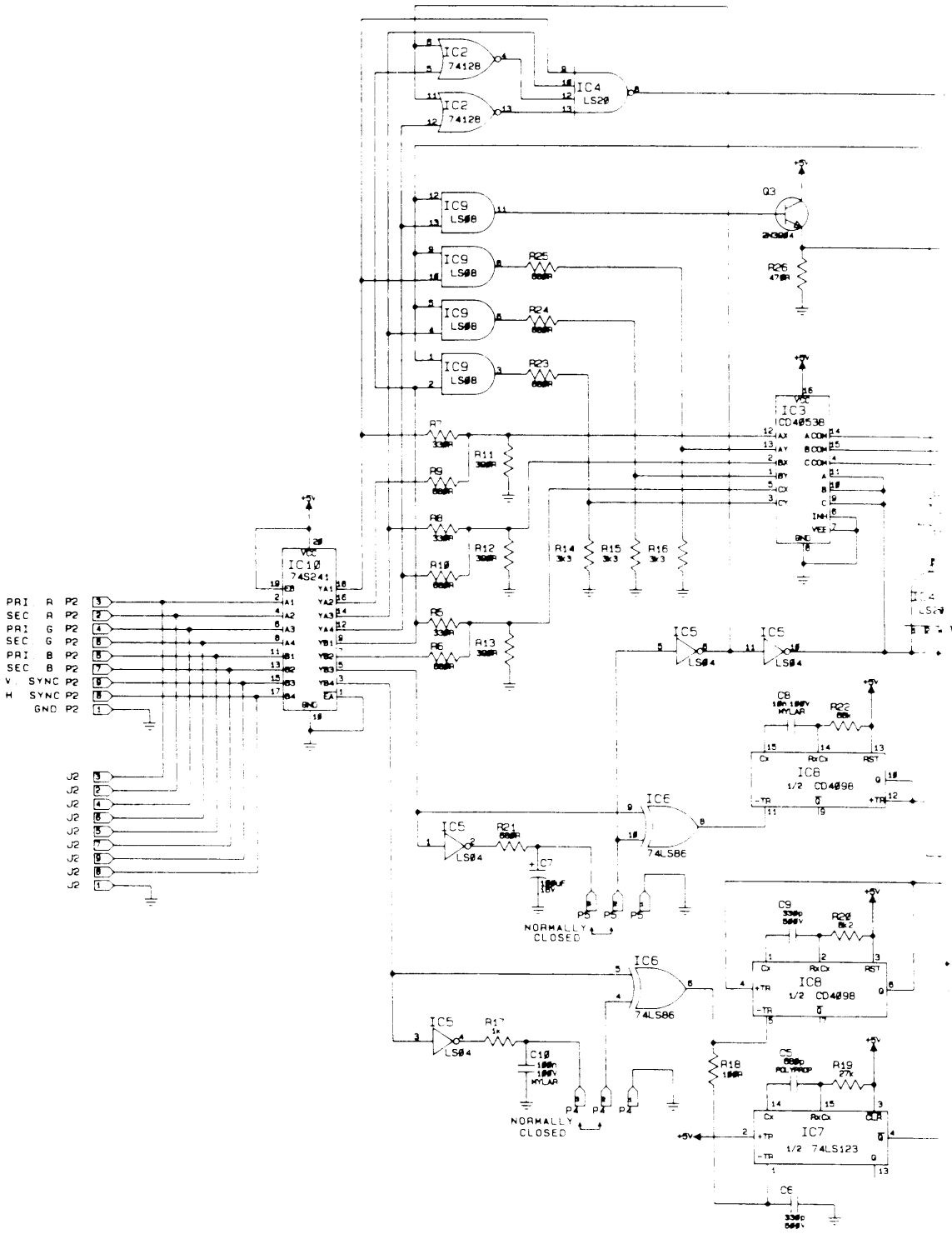
PS/2–GP Analog Interface Schematic (Sheet 1 of 2)



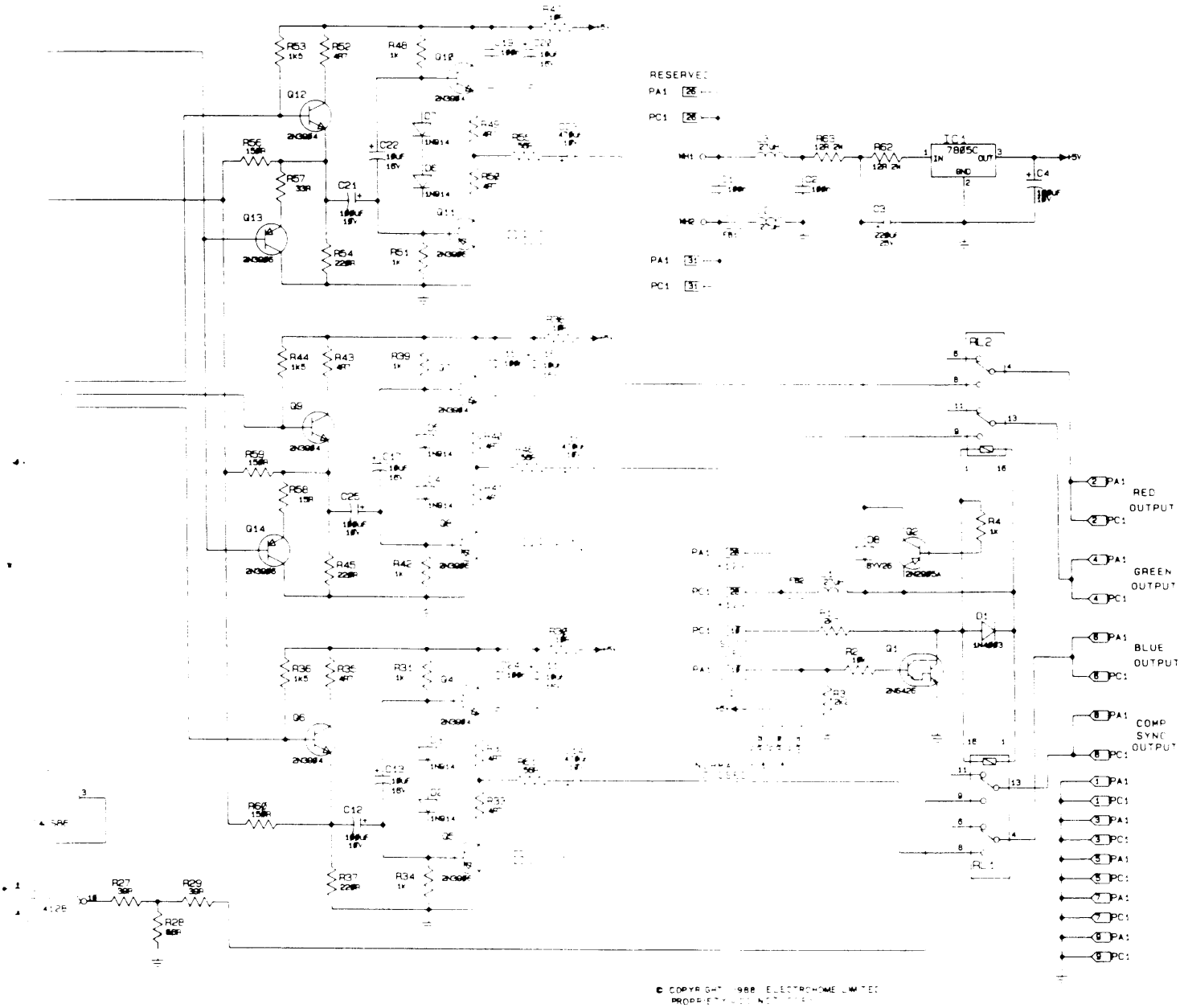


PS/2–GP Analog Interface Schematic (Sheet 2 of 2)





PC Enhanced Interface Schematic



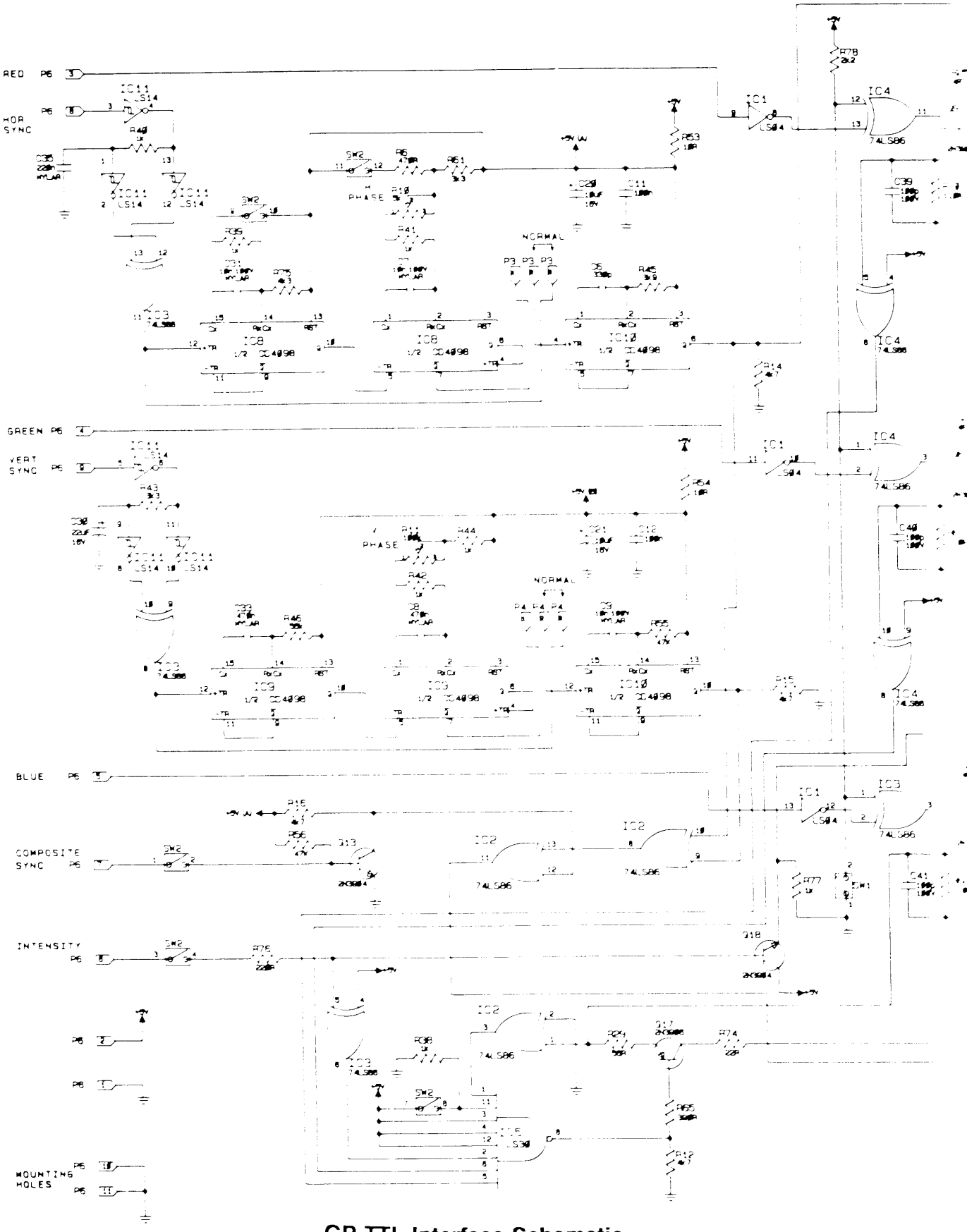
CAUTION

FOR CONTINUED SAFETY REPLACE COMPONENTS NOTED BY ⚠ WITH EXACT REPLACEMENT PARTS ONLY. CONSULT SERVICE MANUAL PARTS LIST SECTION "SAFETY COMPONENTS".

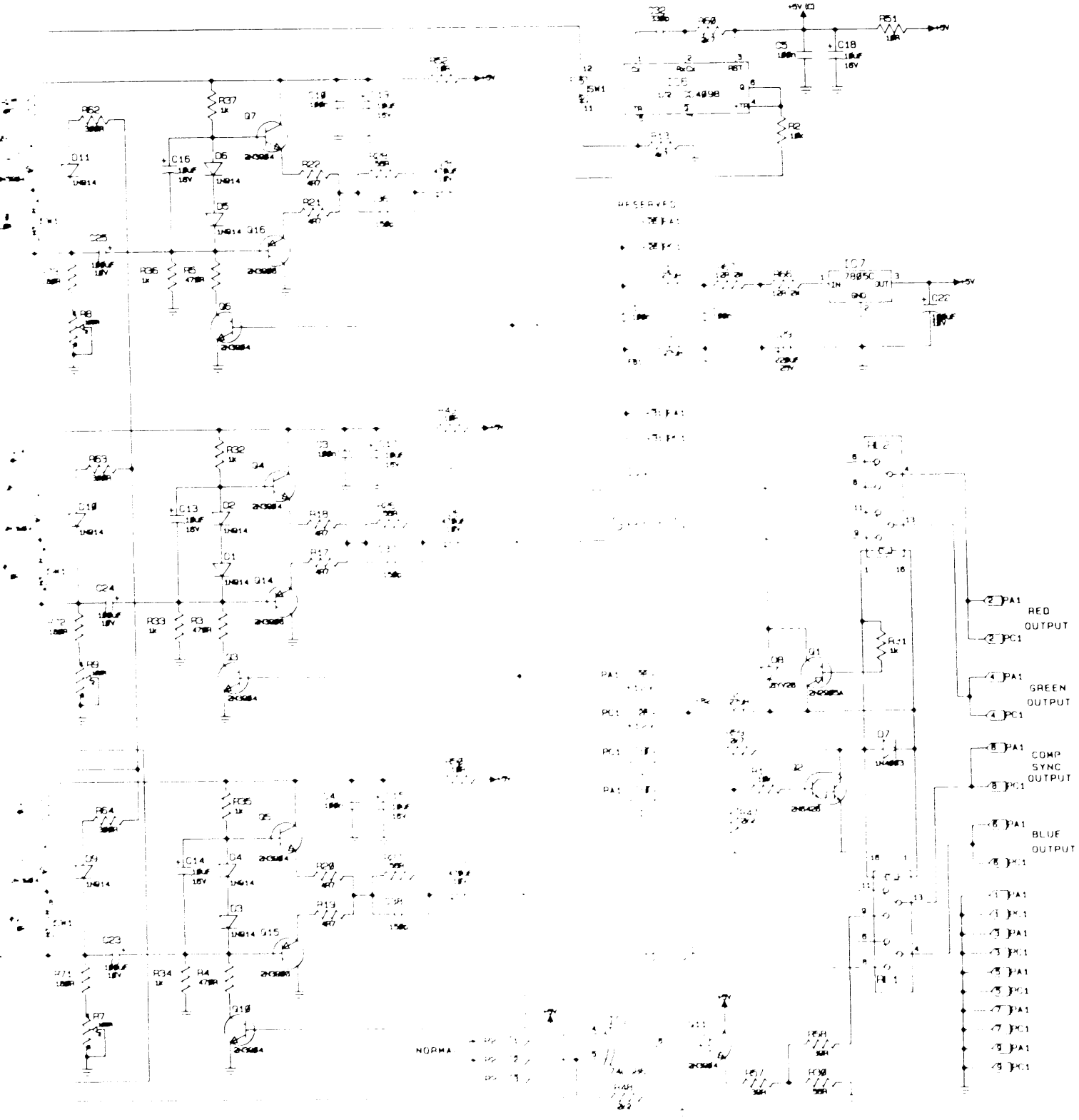
LEGEND

RESISTORS: RESISTANCE IS IN R (OHMS), k (KILOHMS), OR M (MEGAOHMS) 1/4 WATT, 5% TOLERANCE UNLESS OTHERWISE SPECIFIED

CAPACITORS: CAPACITY IN p (PICOFARADS), n (NANOFARADS), OR µ (MICROFARADS) D.C.W.V. & TOLERANCE NOTED WHERE CRITICAL.



GP TTL Interface Schematic



54-7904-02P/54-7904-03P (08/90)

APPENDIX F

SERVICE REPLACEMENT MODULES AND ASSEMBLIES

Refer to the following list for the service replacement modules and assemblies available for the ECP 4100 series projection system.

ITEM	PART #
Adjusting Tool (for tool kit)	39-001453-01P
Allen Wrench - 3/16" (for tool kit)	33-000723-04P
Ball Top Driver (for tool kit)	33-000812-02P
Bias Module	03-270008-01P
Bulkhead Assembly - BLUE	03-230001-03P
	03-230001-06P
Bulkhead Assembly - RED	03-230001-01P
	03-230001-04P
Bulkhead Assembly - GREEN	03-230001-02P
	03-230001-05P
Card Extractor (for tool kit)	35-005015-01P
Case - Front Top Cover (complete)	03-230366-02P
Case - Front Top Cover (without tape)	53-001971-02P
Tape - #2 charcoal (for top cover)	36-000126-03P
Case - Rear Top Cover (complete)	03-230367-01P
Rear Top Cover (without name plate or grill)	53-001972-02P
Name Plate	53-001976-01P
Grill Vent	53-100975-02P
Case - Lower (complete)	03-230368-02P
Lower Case (without tape or nameplate)	53-001973-03P
Tape #2 Charcoal	36-000126-03P
Name Plate	53-001847-04P
Converge/DC Centering Assembly (for CRT)	21-000163-05P
Convergence Module	03-270007-02P
Yoke, Deflection	21-000161-02P
Extender Card	03-230330-01P
Fan Filter Assembly	03-201044-02P
Foam Shield	39-001497-01P
Horizontal Deflection Module	03-270005-01P
Keypad - Fixed	03-201046-02P
Keypad - IR Hand Held Remote	03-000213-01P
Keypad - Protocol 2	38-800625-01

ITEM	PART #
Keypad - Wired Remote	38-800624-01
Keypad - Executive Remote	38-800630-01
Keystone Module	03-270013-01P
Lens Assembly	03-000215-01P
Line Cord	34-000604-26P
Mother Board	03-230299-02P
	03-260101-02P
Panel - right side (from back)	53-100996-03P
	53-100996-05P
Panel - left side (from back)	53-100996-04P
	53-100996-06P
Pouch (tool kit)	39-001524-01P
Power Supply - High Voltage (HV)	03-000222-01P
	03-000226-01P
Power Supply - Low Voltage Switch Mode (LVSM)	03-230328-01P
	03-000225-01P
Power Deflection Module	03-270003-01P
Power Entry Module	03-260102-01P
Remote Sensor Assembly	03-201043-01P
Remote Control Module	03-270010-02P
Remote Jack PCB	02-260104-01P
Vertical Deflection and Horizontal Regulation Module	03-270009-01P
Video Output Module	03-270012-01P
Video Control Module	03-270011-01P
Waveform Module	03-270001-02P
Wrench - 7/16" (for tool kit)	33-000919-01P
Yoke Clamp	33-000901-02P
ECP 4101 only:	
ACON Control Module	03-270006-01P
ACON Locator Kit	03-230211-01P

54-7904-03P (06/90)

PROJECTION SYSTEMS LIMITED WARRANTY POLICY

WARRANTY

Electrohome Projection Products are warranted to be free of defects in material and workmanship in normal use for the period listed below from the original date of purchase:

PRODUCT	PART	PICTURE TUBE	LABOUR
Monochrome Projection Monitor	1 Year	1 Year	1 Year
Color Projection Monitor	1 Year	1 Year	1 Year
Interface Devices	1 Year replacement warranty		
Wire Harness	90 Day replacement warranty		
Accessories (stands, Screens, etc.)	90 Day replacement warranty		

This warranty does not apply to units which have been subject to abuse, accident, improper installation or on which the serial number has been removed or damaged.

1. LIMITATIONS

1. The labour warranty is valid only if the malfunctioning is returned prepaid to an authorized service depot or selling dealer. It does not cover "on location" service.
2. The warranty does not cover:
   a) Problems caused by associated equipment such as antenna distribution systems, video tape recorders, cameras, etc.
   b) Damage caused by accident , misuse, improper power source, fire, flood, lighting, other acts of God, repair or alteration by other than Electrohome Limited authorized service organization.
   c) Transit damage.
   d) Phosphor degradation of the picture tube: example, visible burns or patterns on phosphor screen during normal use.
3. Proof of purchase is necessary for verification of warranty.
4. Unit must be properly packaged (in original packaging if possible) when returned under warranty.
5. Electrohome Interface devices are designed to be used with Electrohome projection systems. Use of other interface devices with Electrohome projection systems could void the warranty. Interfaces used with other than Electrohome projection systems are void of all warranty.
6. Wire harness assemblies sold by Electrohome contain installation instructions. These instructions are current at the time of printing and updating as necessary. Although Electrohome strives to maintain our technical information as current as possible, we cannot be responsible for changes made by the terminal manufacturer to their specs and equipment as it applies to the installation of the wiring harness or its operation. Wire harness should be installed by qualified technical personnel.

2. DEALER'S OBLIGATION

1. The dealer is expected to evaluate the merchandise to insure that it is in working order, and is responsible for making any minor setup adjustments at no cost to Electrohome or the customer.
2. The dealer must advise the customer that the warranty registration card is to filled out and mailed to Electrohome within 7 days of the date of purchase using the return envelope provided.
3. If assistance or guidance is required on technical problems, it is the dealer's responsibility to contact Electrohome Limited, or the nearest authorized service depot.
4. Where warranty service is required, it is the dealer's responsibility to insure that the unit is packed and shipped prepaid to an authorized Electrohome Limited service depot.
5. If a dealer elects to make warranty repairs through anyone other than an authorized Electrohome Service depot, the warranty becomes void, unless otherwise specified.
6. A current list of all authorized serviced organizations can be obtained from Electrohome Limited (see back cover).
7. When returning a unit for repair to an authorized service depot, documentation should be included with the following information.

   In Warranty
   A. Customer's name and address.
   B. Date of Purchase.
   C. Specific complaint/failure (Notations such as "defective" or "repair under warranty" are not acceptable).

   Out of Warranty
   A. Include terms A, B, C, of "In Warranty".
   B. A purchase Order to cover the cost of repairs.

   Damaged Merchandise
   See transit damage/loss below.

3. TRANSIT DAMAGE/LOSS

VISIBLE/HIDDEN DAMAGE

Electrohome Limited endeavour to use reliable and reputable carriers but occasionally damage or loss can occur. Resolving the problem of transit damage or loss depends on the co-operation of all parties. The following will outline the responsibilities of the various parties involved.

The consignee or buyer **must**:
- Inspect all shipments on arrival.
- If damage, suspected damage or loss is apparent upon delivery, an appropriate notation should be marked on all copies of the carrier's pro bill and the driver **must** sign all copies to acknowledge this notation.
- Ask the carrier to do a detailed inspection of the damages.
- File a claim with the carrier.
- Co-operated with the carrier to achieve damage repair where possible.
- Follow-up as necessary to secure final settlement.

The carrier should:
- Co-operate in every way with the buyer/claimant to achieve an amicable settlement.

Electrohome will:
- **Assist** our customers, through our Distribution Services Department, in freight claim matters.
- **Drop Shipments:** Electrohome does not promote the practice of drop shipments.
- Although Electrohome will provide every assistance, we cannot be responsible for the actual filing of claims on the carrier or accept liability for uncontrolled freight claims.

4. SERVICE DEALER

Dealers who maintain their own service facilities and would like to become an authorized depot may acquire application forms from Electrohome Limited (see back cover).

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PROJECTION SYSTEMS

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(U.S.A. only)

Electrohome USA (1989) Inc.
1155 S. Milliken Ave. Suite F
Ontario, California 91761
Telephone: (714) 983-5660
FAX: (714) 983-9987

Factory Service Depot only:
Electrohome USA (1989) Inc.
700 Ensminger Road, Suite 112
Tonawanda, N.Y. 14150
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FAX: (716) 874-4309

Electrohome Europe Limited
7 Civic Way
Ellesmere Port, South Wirral
Cheshire, England L65 OAX
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