OPERATING AND SERVICE MANUAL

MODEL 1349A/D
DIGITAL DISPLAY

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed **2437A.**

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section I.

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Microfiche Part Number 01349-80901

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HP MANUAL SCANS

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Thanks

Dave & Lynn Henderson

Dave & Lynn Henderson
Artek Media

SAFETY

This product has been designed and tested according to International Safety Requirements. To ensure safe operation and to keep the product safe, the information, cautions, and warnings in this manual must be heeded. Refer to Section I and the Safety Summary for general safety considerations applicable to this product.

CERTIFICATION

Hewlett-Packard Company certifies that this product met its published specifications at the time of shipment from the factory. Hewlett-Packard further certifies that its calibration measurements are traceable to the United States National Bureau of Standards, to the extent allowed by the Bureau's calibration facility, and to the calibration facilities of other International Standards Organization members.

WARRANTY

This Hewlett-Packard product is warranted against defects in material and workmanship for a period of one year from date of shipment. During the warranty period, Hewlett-Packard Company will, at its option, either repair or replace products which prove to be defective.

The cathode-ray tube (CRT) in the instrument and any replacement CRT purchased from HP are also warranted against electrical failure for a period of one year from the date of shipment from Colorado Springs. BROKEN TUBES AND TUBES WITH PHOSPHOR OR MESH BURNS, HOWEVER, ARE NOT INCLUDED UNDER THIS WARRANTY.

For warranty service or repair, this product must be returned to a service facility designated by HP. However, warranty service for products installed by HP and certain other products designated by HP will be performed at Buyer's facility at no charge within the HP service travel area. Outside HP service travel areas, warranty service will be performed at Buyer's facility only upon HP's prior agreement and Buyer shall pay HP's round trip travel expenses.

For products returned to HP for warranty service, Buyer shall prepay shipping charges to HP and HP shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to HP from another country.

LIMITATION OF WARRANTY

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied software or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. HP SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

EXCLUSIVE REMEDIES

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. HP SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

ASSISTANCE

Product maintenance agreements and other customer assistance agreements are available for Hewlett-Packard products.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

S C W & A 9/78 (CRT)

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

GROUND THE INSTRUMENT.

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS.

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE.

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

USE CAUTION WHEN EXPOSING OR HANDLING THE CRT.

Breakage of the Cathode-ray Tube (CRT) causes a high-velocity scattering of glass fragments (implosion). To prevent CRT implosion, avoid rough handling or jarring of the instrument. Handling of the CRT shall be done only by qualified maintenance personnel using approved safety mask and gloves.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification of the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

DANGEROUS PROCEDURE WARNINGS.

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING

Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.

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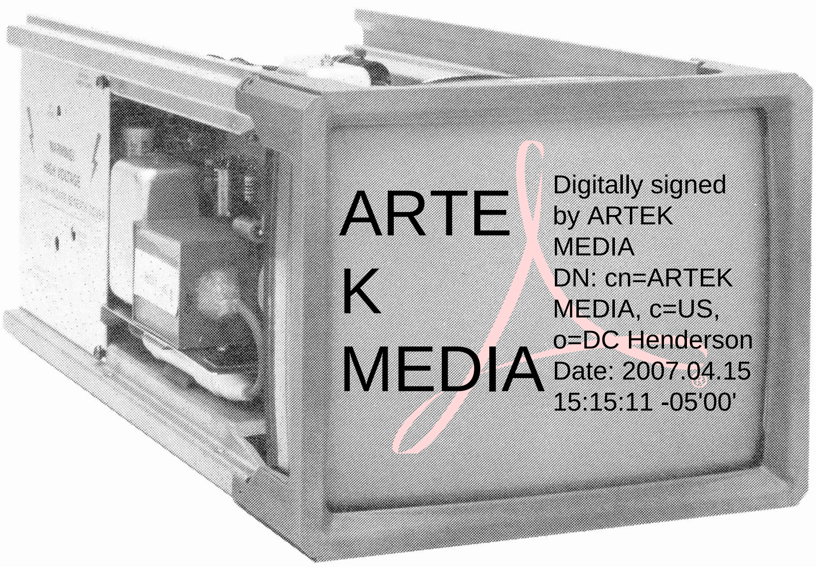


Figure 1-1. 1349A/D Digital Display

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This Operating and Service Manual contains information required to install, operate, test, adjust, and service the HP Model 1349A/D Digital Display.

1-3. Listed on the title page of this manual is a microfiche part number. This number can be used to order 4×6-inch microfilm transparencies of the manual. Each microfiche contains up to 96 photo-duplicates of the manual pages. The microfiche package also includes the latest Manual Changes supplement.

1-4. SPECIFICATIONS.

1-5. Instrument specifications are listed in table 1-1. These specifications are the performance standards or limits against which the instrument is tested. Table 1-2 lists 1349A/D functions. Supplemental characteristics are listed in table 1-3 and are not specifications but are typical characteristics included as additional information for the user.

1-6. SAFETY CONSIDERATIONS.

WARNING

To prevent personal injury, observe all safety precautions and warnings stated on the instrument and in this manual.

1-7. This product is a Safety Class 1 instrument. Review the instrument and manual for safety markings and instructions before operation. Specific warnings, cautions and instructions are placed wherever applicable. Refer to the Safety Summary in the front of this manual and to Sections II, V, and VIII for further safety precautions. These precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standard of design, manufacture, and intended use of this instrument. Hewlett-Packard assumes no liability for the customer's failure to comply with these requirements.

1-8. INSTRUMENTS COVERED BY MANUAL.

1-9. Attached to the instrument is a serial number tag. The serial number is in the form: 0000A00000. It is in two parts; the first four digits and the letter are the serial prefix, and the last five digits are the suffix. The prefix is the same for all identical instruments. The suffix, however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments with the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-10. An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates that the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a Manual Changes supplement. This supplement contains "change information" that explains how to adapt the manual to the newer instrument.

1-11. In addition to change information, the supplement may contain information for correcting errors in the manual. The supplement for this manual is identified with the manual print date and part number, both of which appear on the manual title page.

1-12. For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

Table 1-1. Specifications: 1349A (no memory); 1349D (with internal memory)

INTERFACE

General: 16 Bit Binary.

Signal lines:

Pin Name	Description	1349A	1349D
D0-D15	16-Bit TTL Data Bus Pos Logic	X	X
LWR	Low Memory Write	N/A	X
LDAV	Low Data Available	X	N/A
LRD	Low Memory Read	N/A	X
LRFD	Low Ready for Data	X	N/A
LDS	Low Device Select	N/A	X
SYNC	Ext Refresh Synchronization	N/A	X
LXACK	Low Transfer Acknowledge	N/A	X
GND	Logic Ground	X	X
DISCON	Disconnect Sense. Signal connector off activates self test when allowed to float.		

Logic Level: Standard TTL.

1349A		1349D	
Line	Loading	Line	Loading
D0-D4	1-MOS, 1-LSTTL, 1-STTL	D0-D13	1-MOS, 1-LSTTL
D5-D7	1-MOS, 2-LSTTL, 1-STTL	D14,D15	1-MOS, 2-LSTTL
D8-D15	1-MOS, 1-LSTTL, 1-STTL	LRD	1-MOS, 1-LSTTL
LDAV	1-MOS, 1-LSTTL, 1-STTL	LWR	1-MOS, 1-LSTTL
		LDS	1-MOS, 1-LSTTL
		SYNC	1-MOS, 1-LSTTL

Mating connector: 26-pin female transition connector; mating part Ansley 609-2630 (polarized).

CATHODE RAY TUBE

Type: Electrostatic focus and deflection, post accelerated. Aluminized P31 Phosphor.

Screen Size: 204 Square cm (31.6 square in.); approx. 20.8 cm (8.2 in.) diagonal; 12 cm (4.7 in.) vertical by 17 cm (6.7 in.) horizontally.

Resolution: Display is to be adjusted so that all lines of the secondary test pattern are distinguishable.

Display Memory (1349D only): 8K word by 16 bits.

INPUT POWER

+15VDC +-5% Regulated; <=1.3A @<=10 mV p-p ripple (measured at A3TP1).

-15VDC +-5% Regulated; <=0.35A @<=10 mV p-p ripple (measured at A3TP2).

+5VDC +5 -0% Regulated; <2.0A @<=50 mV p-p ripple (measured at A3TP3 1349A only).

Mating Connector: Molex No. 09-50-3061.

SAFETY

X-Ray Emission: CRT emission <=9,5 mR/hr (not measurable above background noise with Vicroreen Model 440RF/C when in normal operating modes).

OPERATING ENVIRONMENT

Temperature: (operating) 0° C to +65° C (+32° F to +149° F).

NOTE

The 65° C (149° F) temperature specification reflects the maximum allowable operating temperature with the 1349A/D enclosed, not the ambient temperature of the system housing. It is recommended that a minimum of 0.84 m^3/min (30 ft^3/min) of air flow is forced around and through the instrument to ensure that the maximum operating temperature of 65° C (149° F) is not exceeded. Refer to Section II, Paragraph 2-13 of this manual for temperature measurement instructions.

Temperature: (non-operating) -40° C to +70°C (-40° F to +167° F).

Table 1-1. Specifications (Cont'd)

Humidity: to 95% relative humidity up to +50° C.
Altitude: (operating) to 4600 m, (15,000 ft); (non-operating) to 15,300 m, (50,000 ft).
Shock:
Shock Intensity 60g.
Shock Pulse Duration 11 ms.
Shock tests are performed with the equipment non-operating and any auxiliary circuits not powered.
Vibration:
Vibration Frequency: 5-55-5 Hz.
Vibration Sweep: Cover the vibration frequency in 15 minutes.
Vibration Pulse Shape: Full sine wave.
Vibration peak-to-peak amplitude:
5-10 Hz, 6.34 mm (0.250 in.)
10-25 Hz, 3.05 mm (0.120 in.)
25-55 Hz, 0.76 mm (0.030 in.)
Dwell for 10 minutes at the four highest resonances found on each axis. If no major resonance can be detected, dwell at 55 Hz for 10 minute duration at 0.76 mm (0.030 in.).

CAUTION

The 1349A/D Displays have been tested at shock and vibration levels listed above. These are absolute maximum levels and apply to the 1349A/D only not to the host structure in which they are installed.

In general, the host structure will act to amplify shock and vibration applied to it when transmitting that energy to the 1349A/D.

Care must be taken that specified levels of shock and vibration are not applied to the 1349A/D.

Size: See outline drawing figure 1-2.
Weight: Net 6.0 kg (13.2 lbs).
Shipping Weight: 8.64 kg (19.0 lbs).

Table 1-2. 1349A/D Functions

GRAPHIC FUNCTIONS

Character Generator:
Stroke Characters: 32 by 20 point resolution; modified full ASCII set. Character Strokes are stored in ROM. Average character writing time is 16 μs.
4 Programmable Character Sizes:
1.0× = 68 Characters per line, 31 horizontal lines possible.
1.5× = 45 Characters per line, 21 horizontal lines possible.
2.0× = 34 Characters per line, 15 horizontal lines possible.
2.5× = 27 Characters per line, 12 horizontal lines possible.

NOTE

1× Character approximately 2mm high.

4 Programmable Character Orientations: 0, 90, 180, 270° (CCW) relative to horizontal.

VECTORS

Random Vector Plotting: Addressable resolution 2048 by 2048 points.
Line Types: Solid Line
Solid line with intensified end points
Short dashed line
Long dashed line
Dots

Velocity:
4 Programmable Writing Speeds: approximately 1.9, 3.4, 5.2 and 6.9 mm per μs.
Vector Drawing time: μs per vector + (length of vector/writing speed).
3 Programmable Intensities: Dim, medium brightness, full brightness (plus Blank or off).

PLOTTING
Plotting Modes: Plot absolute and Graph.
Beam Control: The beam may be turned on or off while plotting.

GRAPH GENERATION
Tick Marks: X- and Y-axis tick marks of four selectable lengths.
Graph Mode: Allows generation of graphs which have a constant X-incrememt between points by storing the X-increment once, requiring only new values for succeeding points.

SELF TEST

Self Test is invoked by disconnecting the I/O connector with power applied. The Test Pattern verifies that the 1349A/D is operational and provides necessary stimulus for routine calibration. An internal connector is provided for activation of an alternate test pattern. When the connector is shorted, the alternate pattern may be used to verify CRT resolution and allow calibration of focus and astigmatism adjustments. When memory is installed (1349D), the self test feature also performs a memory test.

Table 1-3. Supplemental Characteristics

ANALOG OUTPUTS

General: The 1349A/D Displays have internal connectors for output of X, Y, and Z analog signals to drive a slave CRT display.

Amplitudes: Approximate amplitude range is 0V to 1V.

Output Impedance: X, Y — 340 ohms nominal. Z — 250 ohms nominal.

Polarity: X — Positive-going voltage corresponds to right beam movement.
Y — Positive-going voltage corresponds to upward beam movement.
Z — Positive-going voltage corresponds to increasing luminance.

Recommended Bandwidth of slave display: X, Y — Axis: >=3 MHz
Z — Axis: >=10 MHz

Recommended Mating Connectors: Molex 22-01-1023. (3 required, 1 each for X, Y and Z Axis).

CATHODE RAY TUBE

Brightness: Shipped from the factory at approximately 140 Cd/sq. m at 1.9 mm/μs writing speed, full brightness at 60 Hz refresh rate, 7 by 7 cm, 50 line raster, 50% duty cycle.

1-13. DESCRIPTION.

1-14. The Hewlett-Packard Models 1349A and 1349D are 20.8 cm (approx. 9 in.) Display Components. Both produce vector graphics on their display screens in response to digital commands from a user processor. The 1349D contains an 8K word refresh memory which enables the display to refresh the picture without support from the user processor. The 1349A must be refreshed by the user.

The 1349A/D have an addressable resolution of 2048 by 2048 points which allows display of very high quality images, composed of straight or curved lines. Curved lines are formed by a series of short straight vectors joined end to end. The unit has programmable writing speeds and programmable intensities. Vectors, regardless of length can be drawn at constant speed so that the intensity does not vary from vector to vector.

For on screen labeling and identification, the 1349A/D have a built-in set of ASCII characters. The 1349A/D receive just one word from the user processor and all the vectors necessary to form one character are automatically produced from ROM.

1-15. ACCESSORIES SUPPLIED.

1-16. The following accessories are supplied with the 1349A/D:
One Operating and Service Manual.

1-17. RECOMMENDED TEST EQUIPMENT.

1-18. Equipment required to test and maintain the 1349A/D Displays is listed in table 1-4. Other equipment may be substituted if it meets or exceeds the critical specifications listed in the table.

Table 1-4. Recommended Test Equipment

Instrument Type	Recommended Model	Required Characteristics	Required For
Monitor Oscilloscope	HP Model 1740A	**Bandwidth:** 100 MHz **Input Z:** 50 ohms AND 1 Mohm shunted by approx. 20 pf.	A
Digital Voltmeter	HP Model 3466A	**Voltage Rating:** -15V to 250V **Accuracy:** 0.1 % **Input Resistance:** 10 Mohm	A
1000:1 Divider	HP Model 34111A	**Voltage Rating:** 12 kV	A
10:1 Divider Probe (Qty 2)	HP Model 10041A (supplied with model 1740A)	**Input Resistance:** 1 Mohm shunted by approx. 12 pf.	A
Power Supply	HP Model 63315E	**Output Voltage:** 5V at 2.0A **Output Voltage:** +15V at 0.5A -15V at 1.1A	P,A P,A
Signature Analyzer	HP Model 5005A		T

P = Performance test A = Adjustment T = Troubleshooting

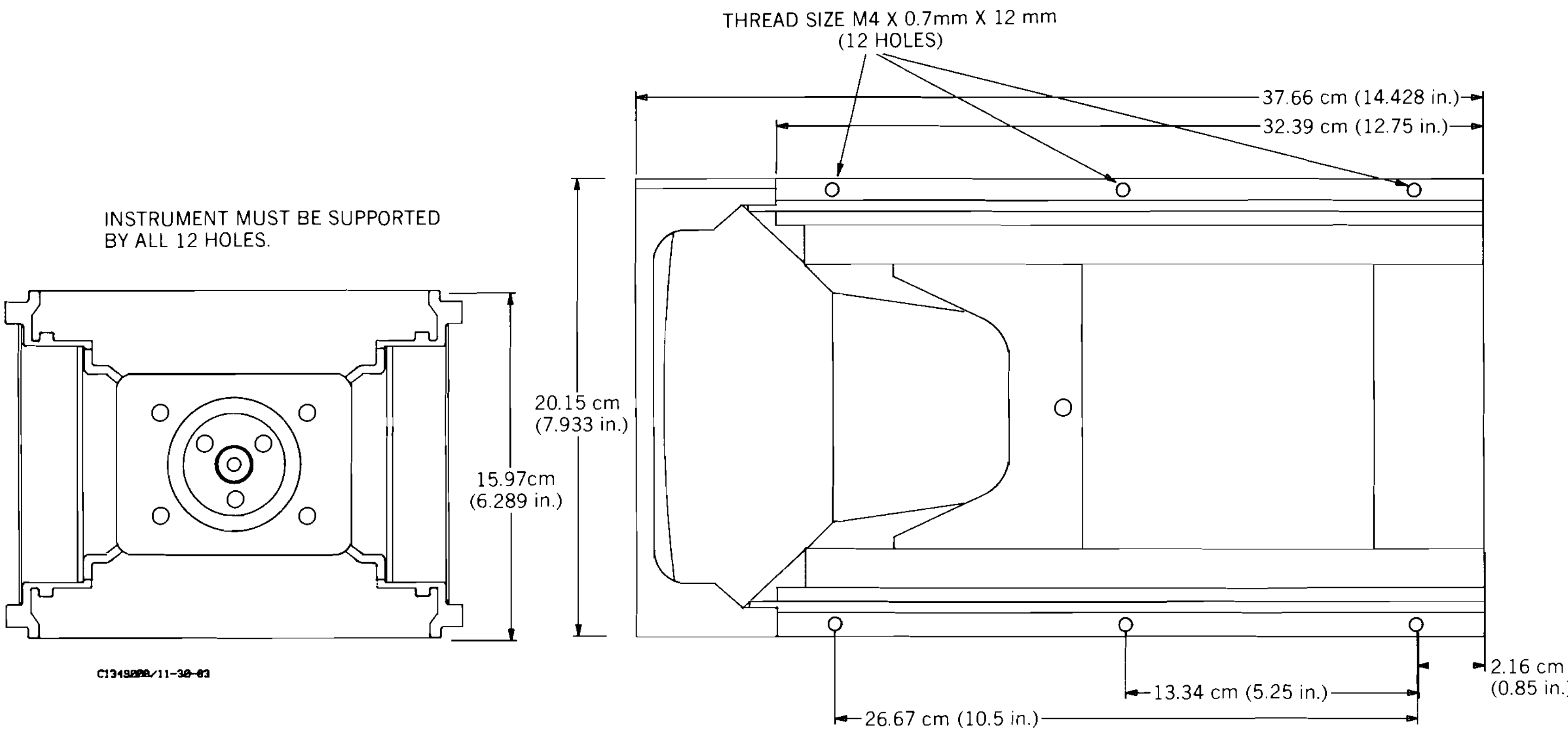


Figure 1-2. Dimensional Detail, 1349A.

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section provides installation instructions for the Model 1349A/D Digital Displays. This section also includes information about initial inspection, damage claims, preparation for use, and storage and shipment.

2-3. INITIAL INSPECTION.

2-4. Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as listed in the "Accessories Supplied" paragraph in Section I. Procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the Performance Tests, notify the nearest Hewlett-Packard office. If the shipping container is damaged, or the cushioning material shows signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping material for carrier's inspection. The HP office will arrange for repair or replacement at HP option without waiting for claim settlement.

2-5. PREPARATION FOR USE.

WARNING

Read the Safety Summary in the front of this manual and the "Safety Considerations" paragraph in Section I before installing or operating this instrument. Before any connections are made to the instrument, the chassis must be connected to a safety ground.

2-6. POWER REQUIREMENTS.

2-7. The 1349A/D requires the following power supplies for proper operation:

Table 2-1. 1349A/D Power Requirements

Operating Voltages		Max P-P Ripple	Max Current	
Voltage	Tolerance		1349D	1349A
+15 VDC	+-5%	10 mV	1.3A	1.3A
-15 VDC	+-5%	10 mV	350 mA	350 mA
+5 VDC	+5-0%	50 mV	2.0A	750 mA

2-8. POWER CONNECTOR.

2-9. A 6-pin connector (Molex 09-50-3061 or equivalent) is required to mate with the rear panel power connector (see figure 2-1).

2-10. I/O CONNECTOR.

A 26-pin connector (ANSLEY 609-2601M or equivalent) is required to mate with the rear panel connector. The connector is wired according to figure 2-2. It is recommended that the I/O cable length not exceed 45.7 cm (18 in.).

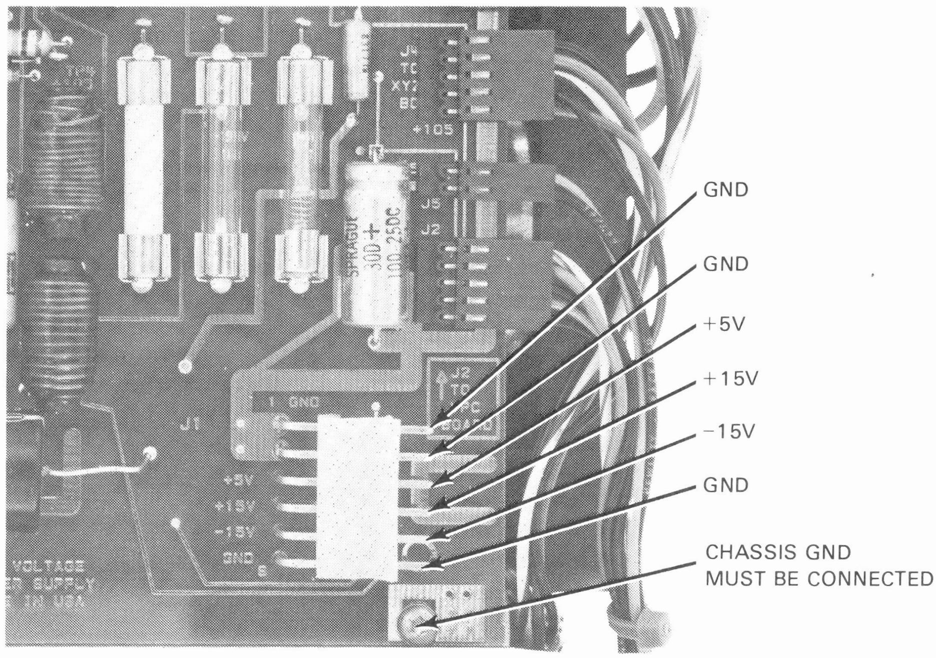


Figure 2-1. Power Connection for 1349A/D

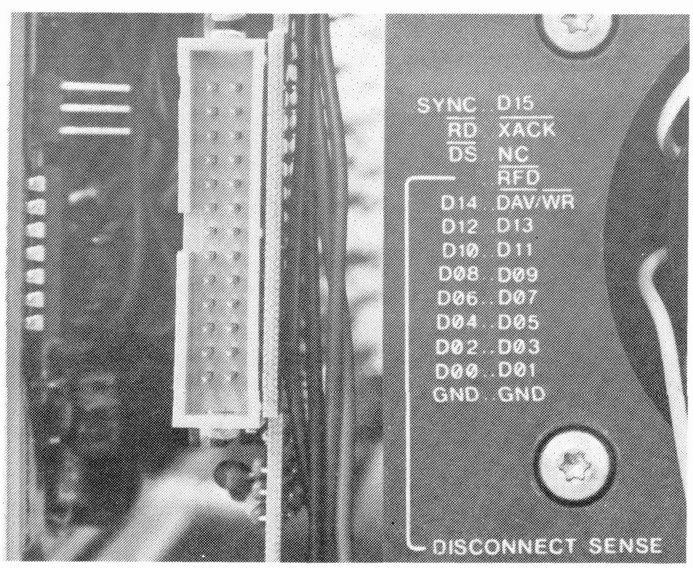


Figure 2-2. 1349A/D I/O Connector

2-11. ANALOG OUTPUTS (X-Y-Z).

The purpose of the Analog Output jacks on the X-Y-Z/Stroke Generator (A1) board is to connect an external X-Y-Z display. The output signals can drive 1V p-p into 600 ohm loads. The bandwidth of the external X-Y-Z display should have the following bandwidths:

X-Y Axis: >=3 MHz
Z Axis: >=10 MHz

The interface cables should not exceed 1.83m (6 ft) in length. Use the following table for interfacing:

A1J3 ....Z AXIS OUTPUT
A1J4 .... Y AXIS OUTPUT
A1J5 .... X AXIS OUTPUT

2-12. OPERATING ENVIRONMENT.

2-13. Temperature. The instrument may be operated in temperatures from 0° C to +65° C (+32° F to 149° F).

CAUTION

The airflow recommendations stated above must be adhered to in order to prevent damage to the instrument.

NOTE

The 65° C (+149° F) temperature specification reflects the maximum allowable operating temperature with the 1349A/D enclosed, not the ambient temperature of the system housing. It is recommended that a minimum of .84 m^3/min (30 ft^3/min) of air flow is forced around and through the instrument to ensure that the maximum operating temperature of 65° C (+149° F) is not exeeded.

Ambient temperature measurements should be taken at several points in the instrument. Use the following information as a guide for making these measurements:

Measure temperature at:

a. Between the High Voltage cover and Focus Gain Adjustment.

b. 0.64 cm (0.25 in.) above A4R31.

c. Between Vector Processor Board (A2) and the Memory Board (A5) near A2U16.

d. 0.64 cm (0.25 in.) above A1U23.

The surface temperature near A1U26 and A1U33 typically may be +50° C (+122° F) or more above the ambient temperature. It is therefore recommended that heat-sensitive devices or circuits not be placed in close proximity to these points.

2-14. Humidity. The instrument may be operated in environments with humidity up to 95%. However, the instrument should also be protected from temperature extremes which cause condensation within the instrument.

2-15. Altitude. The instrument may be operated at altitudes up to 4 600m (15 000 ft).

2-16. STORAGE AND SHIPMENT.

2-17. Environment. The instrument may be stored or shipped in environments within the following limits:

Temperature	-40° C to +70° C (-40° F to +158° F)
Humidity	up to 95% relative humidity at +50° C (+122° F)
Altitude	15 300m (50 000 ft)

The instrument should also be protected from temperature extremes which causes condensation within the instrument.

2-18. PACKAGING.

2-19. Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also mark the container FRAGILE to ensure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

2-20. Other Packaging. The following general instructions should be used for repacking with commercially available materials.

a. Wrap instrument in antistatic plastic. (If shipping to Hewlett-Packard office or service center, attach a tag indicating type of service required, return address, model number, and full serial number).

b. Use a strong shipping container. A double-wall carton made of 350-pound test material is adequate.

c. Use a layer of shock-absorbing material 70 to 100 mm (3 to 4 inches) thick around all sides of the instrument to provide firm cushioning and prevent movement inside the container. Protect control panel with cardboard.

d. Seal shipping container securely.

e. Mark shipping container FRAGILE to ensure careful handling.

f. In any correspondence, refer to instrument by model number and full serial number.

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. The purpose of this section is to give detailed information concerning the operation and programming of the 1349A/D. It includes a list of the programming instructions and a section containing a brief explanation of "bit programming". The end of this section contains several programming examples.

WARNING

SHOCK HAZARD

Before operating the instrument, connect the chassis of the display to a safety ground in the system.

3-3. SIGNAL LINE DEFINITIONS.

D0-D15
D0 through D14 are the vector data lines (TTL positive logic). D15 is used as a Vector Memory instruction. When D15 is a "1" then the input data is recognized as a memory command. When D15 is a "0" then all the input data forms the picture.

DISCONNECT SENSE
This line must be grounded to the display chassis when the data lines are active. The internal Performance Verification pattern will be displayed if the 26-pin connector is disconnected.

SYNC
External display refresh synchronization signal line. The line provides an external refresh clock when external sync mode has been selected via a jumper wire on the Vector Memory board.

LXACK
Acknowledge signal line. When low, this line indicates that the Vector Memory has completed the Read or Write operation requested by the user processor.

LDS
Device Select signal line. When low this line enables the Vector Memory to communicate with the user processor (write/read).

LWR
Memory Write signal line. When low, this line indicates that the 16-bit Data Bus contents are to be written into either the current Vector Memory location (D15=0) or into the User Address Pointer (D15=1).

LRD
Memory Read signal line. When low, this line indicates that the contents of the current Vector Memory location (as specified by the User Address Pointer) are to be placed on the 16-bit Data Bus for transmission back to the user processor.

NOTE

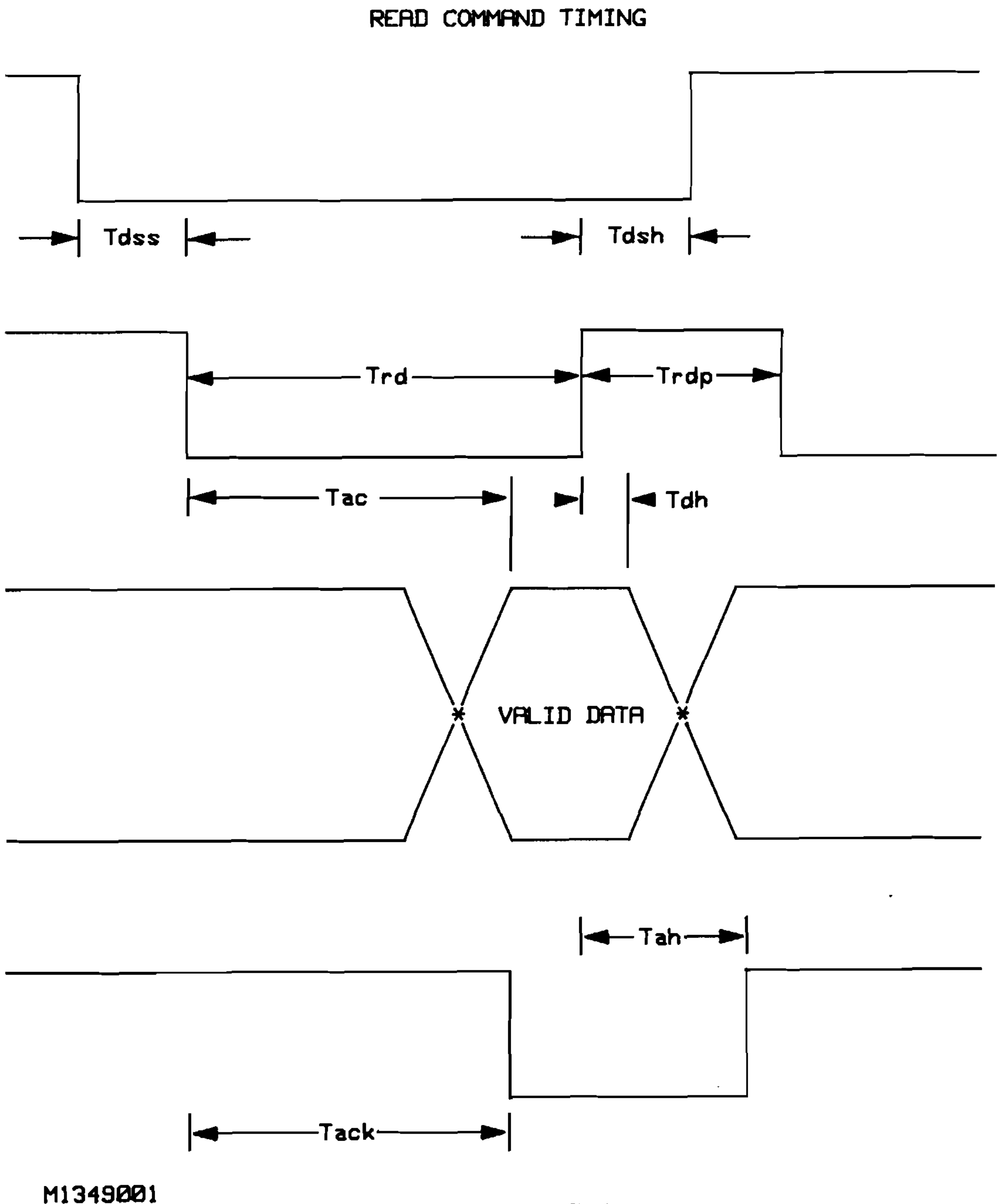
Whenever a Vector Memory location has been either written into or read from by the user processor, the User Address Pointer auto-increments to the next Vector Memory location (address).

3-4. HANDSHAKE TIMING FOR 1349D.

The TTL digital interface to the Vector Memory (1349D) is compatible with most microprocessor peripheral interface adaptor chips (the Motorola ® 6821).

Vector Memory digital interface consists of:

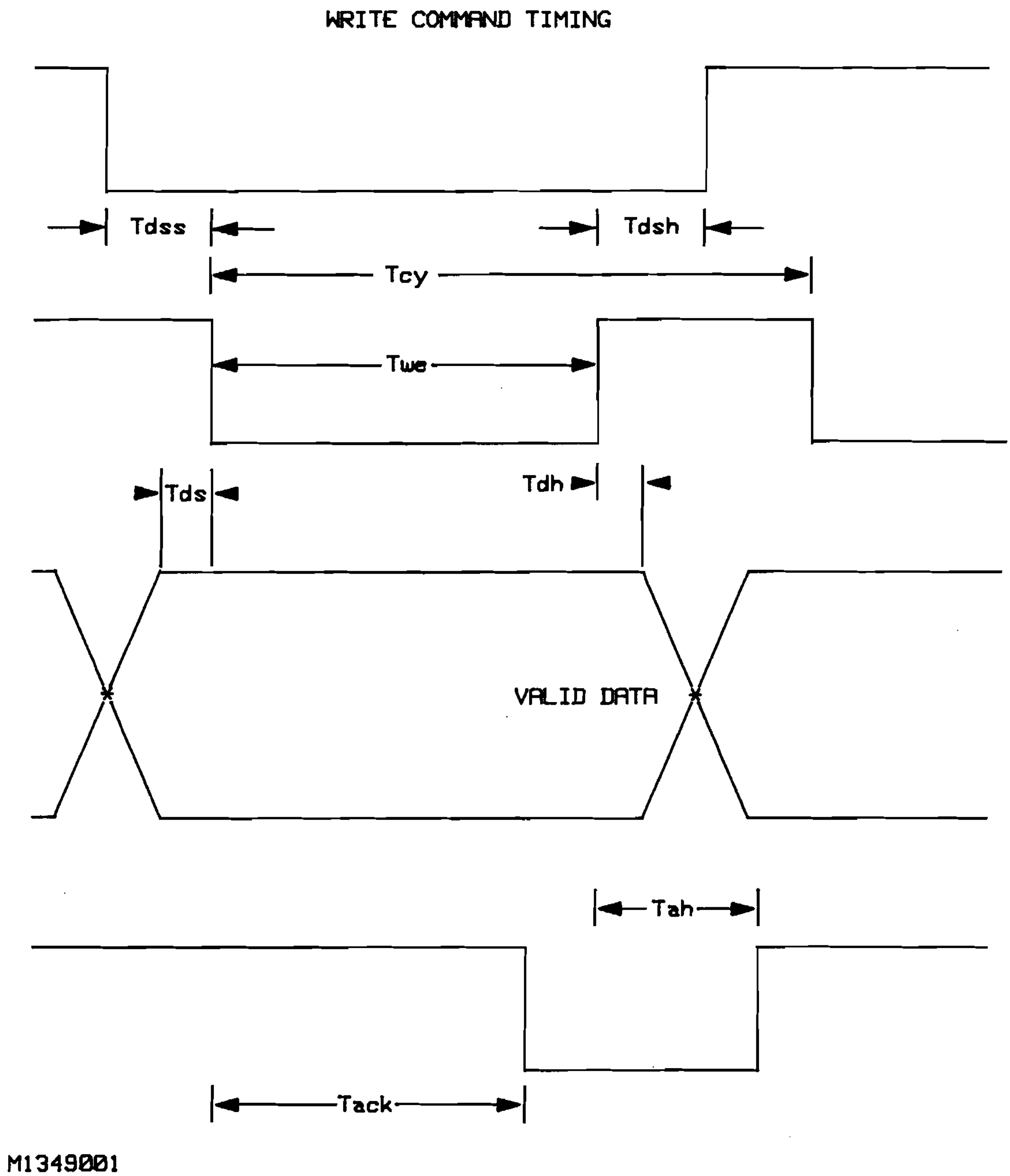
1. A 16-bit bidirectional Data Bus.
2. A Read Signal line LRD (input).
3. A Write signal line LWR (input).
4. A Device Select signal line LDS (input).
5. An Acknowledge signal line LXACK (output).
6. An External display Synchronization signal line SYNC (input use is optional).



Read Command Timing

Tdss — Device Select Setup Time	0 nsec min
Tdsh — Device Select Hold Time	0 nsec min
Trd — Read Pulse Time (ACK not used)	495 nsec min
(ACK used)	760 nsec min
Trdp — Read Precharge Time	25 nsec min
Tac — Read Access Time	760 nsec max
Tdh — Read Data Hold Time	30 nsec min
Tah — Acknowledge Hold Time	40 nsec min
	130 nsec max
Tack — Acknowledge Delay Time	455 nsec min
	855 nsec max

Figure 3-1. Read Command Timing



Write Command Timing

Tdss — Device Select Setup Time .... 0 nsec min
Tdsh — Device Select Hold Time .... 0 nsec min
Tcy — Write Cycle Time .... 820 nsec min
Twe — Write Command Active Time .. 795 nsec min
Tds — Data In Setup Time .... 0 nsec max
Tdh — Data In Hold Time .... 0 nsec min
Tack — acknowledge Delay Time ..... 455 nsec min
855 nsec max
Tah — Acknowledge Hold Time......... 40 nsec min
130 nsec max

Figure 3-2. Write Command Timing

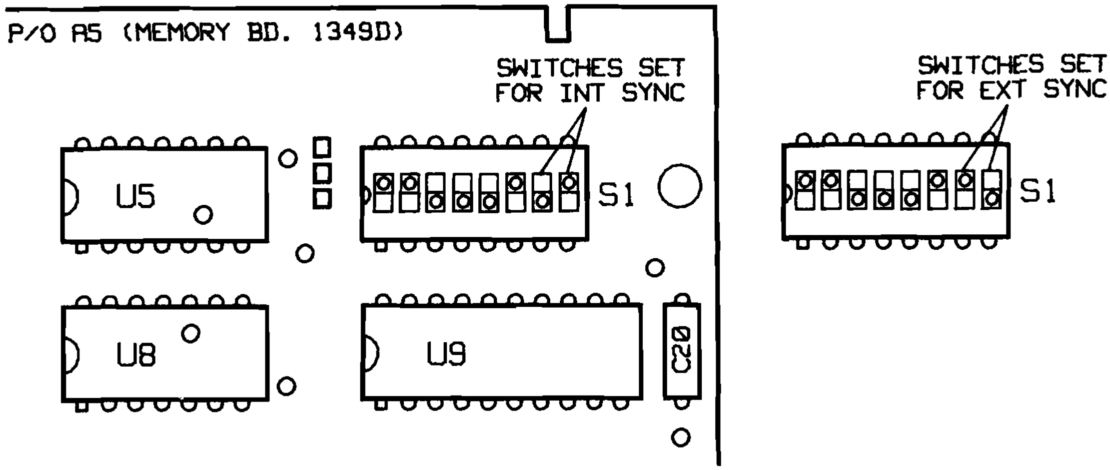


Figure 3-3. Refresh Mode Selection

3-5. PICTURE REFRESH REQUIREMENTS FOR 1349D.

Each time that the picture is redrawn by the 1349D, the display is refreshed. This prevents the phosphor light output from expiring. The refresh sync signal may be provided by either the internal refresh circuit, or an external source. To select the required mode of operation for refresh mode, set the Int/Ext switch (A5S1) on the Memory Board (A5) as shown in figure 3-3.

INTERNAL SYNC. When the jumper is in the Internal position, an on-board oscillator (A5U1) provides sync pulses at approximately a 60 Hz rate. The user processor can send all picture producing data to the Vector Memory at one time. The Vector Memory will then continuously refresh the display screen by redrawing the picture at regular intervals. This reduces overhead time for the user processor.

EXTERNAL SYNC. Sync pulses (TTL) must be supplied from an external source in the user system via the SYNC input signal line. This signal is useful when the display is used in electromagnetic fields which can cause the picture to "swim". Synchronizing the display with the interfering signal can stabilize the picture.

3-6. REFRESH MODES FOR 1349D.

The Vector Memory sends its data to the Vector Processor (VPC) each time the picture is to be drawn on screen. Data is send to the VPC either via synchronous mode or free running mode.

SYNCHRONOUS MODE. In synchronous mode, the Vector Memory waits until a synchronizing pulse occurs before it will begin its next data output cycle to the 1349A/D. Synchronous refresh mode is entered when the Refresh Pointer equals 8191. After sending the contents of address 8191 to the VPC, the Vector Memory waits for the next sync pulse before starting a new refresh cycle at address 0000.

Pictures A and B will be displayed at an even brightness (sync rate = refresh rate) even though picture A requires less drawing time (See Figure 3-4).

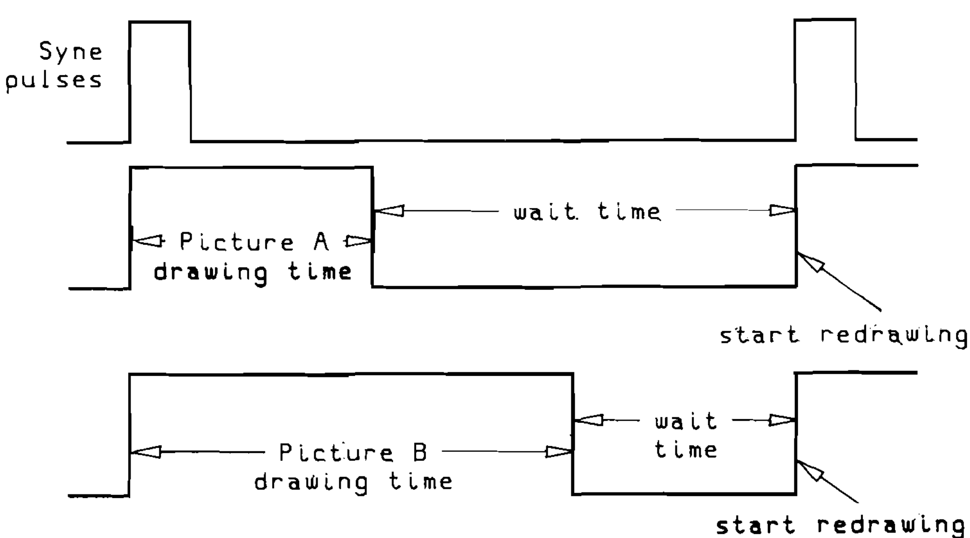


Figure 3-4. Synchronous Refresh Example

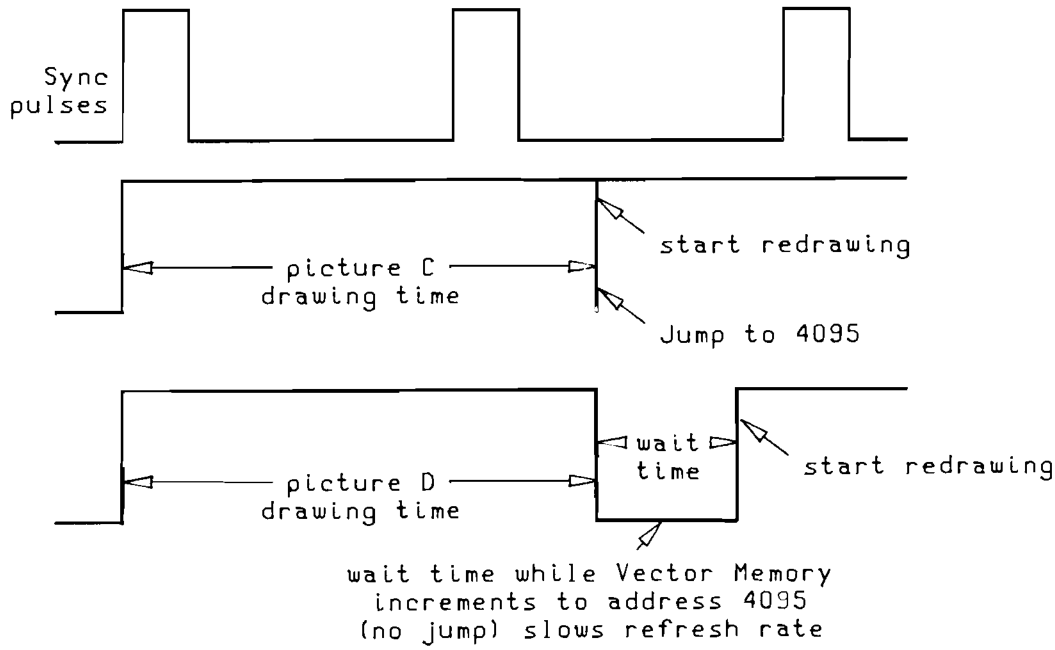


Figure 3-5. Asynchronous Refresh Example

FREE RUNNING MODE. Free Running mode is when the picture cannot be drawn in the time interval between sync pulses. The memory circuit automatically enters this mode whenever a sync edge arrives before the refresh counter reaches its highest address (8191). In this mode, the memory will not wait for a sync edge when it finishes the picture, but will immediately start drawing the picture again.

This sync override feature allows all simple pictures to be displayed at an even brightness (say 60 Hertz refresh rate), and complex pictures to be displayed at a level of brightness that depends only on the time it takes to draw the picture on the display.

3-7. MEMORY INITIALIZATION.

When the Vector Memory is powered up, its contents are in an unknown random state. There are several methods of memory initialization.

One method is to fill the entire memory with "jump to 8191" instructions. The benefit of using this method of initialization is that as the user fills the Vector Memory with picture information, the Vector Memory will always "jump to 8191" after drawing the picture, no matter how many words are used to form the picture. This ensures that the picture will be displayed at the optimum refresh rate.

Another way of initializing the Vector Memory is to write all zeros to all words. This data will be sent to the 1349D, but will draw nothing on screen (effectively a no-op). Each "no-op" will take about one microsecond, thus 8000 "no-ops" (8000 words in Vector Memory) will use up to 8 milliseconds of display time, producing a dimmer picture if in the free running mode.

The Vector Memory can be tested by the user processor as part of power-on self test routine. For example, first write all zeros to all words. Then "chase a one" through memory to check each cell. Also, the User Address Pointer can be checked by writing data sequentially through the memory and then using the Pointer Instruction to move the pointer, and reading the contents of the word selected by the pointer. BE CAREFUL - 11XXXXXXXXXXXXXX (set address pointer) will not be written into the memory and 011XXXXXX1XXXXXX (set condition) is illegal.

3-8. 1349A/D COMMAND SET.

The 1349A/D creates pictures by a technique called random vector plotting. A line is defined by its endpoints in 2048 by 2048 cartesian coordinate system. The origin (0,0) is in the lower lefthand corner. All points are positive reference. The 1349A/D references each vector by starting point, ending point, intensity level, line type, and writing speed. The 1349A/D has the following programming command set.

The 1349A/D recognizes D0-D14 on its input Data Bus as being one of four commands:

Command	Bit 14	Bit 13
1. Set Condition	1	1
2. Plot	0	0
3. Graph	0	1
4. Text	1	0

SET CONDITION.

The Set Condition command controls the intensity level, the line type, and the writing speed of vectors drawn on the CRT.

B14 = 1, B13 = 1: SET CONDITION COMMAND.

With both MSBs (Most Significant Bits) set to one, the 1349A/D is commanded to draw all following vectors according to the configuration commanded until changed by subsequent condition command.

NOTE

A one (1) = TTL high; a zero (0) = TTL low.

B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
1	1	I1	I0	X	L2	L1	L0	0	X	W1	W0	X	X	X

X = DON'T CARE

B6 MUST be zero.

B14=1, B13=1 : Set display configuration according to choices specified for intensity, line type, and writing speed.

I1	I0	Intensity
0	0	Blank
0	1	Dim
1	0	Half Brightness
1	1	Full Brightness

L2	L1	L0	Line Type
0	0	0	Solid Line
0	0	1	Intensify Endpoints (solid line)
0	1	0	Long Dashes
0	1	1	Short Dashes
1	0	1	Dots on endpoints

W1	W0	Writing Speed
1	1	0.19 cm per microsecond
1	0	0.34 cm per microsecond
0	1	0.52 cm per microsecond
0	0	0.69 cm per microsecond

When the line type "solid line with intensified endpoints" is selected, the intensity of the endpoints may vary due to optical illusion. As lines are linked together the intensity of the point where one line ends and the next line starts is a function of the angle separating the lines. The closer the angle is to 180 degrees, the brighter the point. The closer the angle is to zero degrees (absolute), the dimmer the point.

PLOT COMMAND (B14 = 0. B13 = 0).

With both MSBs set to zero, the 1349A/D is commanded to move the display beam to a specific X-Y location each time that a Y coordinate is received. The beam position may be moved with the beam either turned off or turned on. The Plot command will draw all vectors according to the display configuration established by the last Set Condition command received by the 1349A/D. Each time that a Y coordinate is received, the pen status (beam on or off) for the beam movement is established. Also, the X-Y location to be moved to is formed from the last X coordinate received and the current Y coordinate. For example, to draw a vertical line send the 1349A/D: (1) Plot Command - X value; (2) Plot Command - Y1 value (with beam off); (3) Plot Command - Y2 value (with beam on).

B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
0	0	XY	PC	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

DATA
MSB ———————— LSB

B14=0, B13=0 : Plot Command.

XY
0 = X coordinate (0-2047) as specified by D0 - D10.
1 = Y coordinate (0-2047) as specified by D0 - D10.

PC (Pen Control Bit B11)
0 = Move (draw vector with pen up).
1 = Draw (draw vector with pen down).

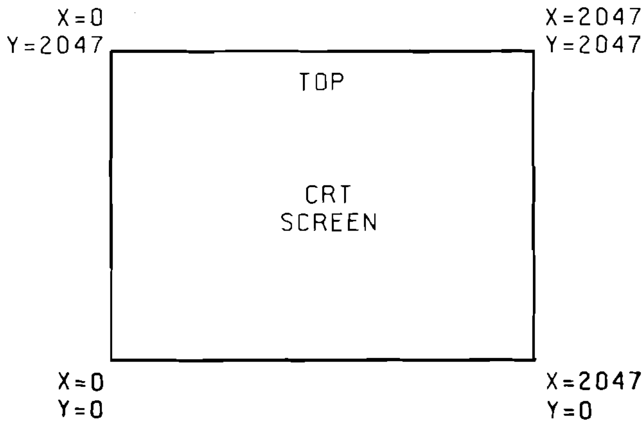


Figure 3-6. Vector Drawing Area

GRAPH COMMAND (B14=0, B13=1).

With the two MSBs set to zero and one respectively, the 1349A/D is commanded to either: (a) set the DELTA-X increment; or (b) move the beam to a specific X-Y location determined by the X increment and the Y coordinate.

The beam position may be moved with the beam either turned off or turned on. Beam status for the beam movement is established each time a Y coordinate graph command is received.

The Graph command will draw all vectors according to the display configuration established by the last Set Condition command received by the 1349A/D.

B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
0	1	XY	PC	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0

DATA
MSB ———————— LSB

B14=0, B13=1 : Graph Command.

XY
- 0 = set automatic DELTA-X increment (as specified by D0-D10) for all subsequent Y coordinate Graph commands received.
- 1 = Y coordinate (as specified by D0 - D10) to which the beam is to be moved in conjunction with the DELTA-X increment.

PC (Pen Control Bit B11).
- 0 = Move (draw the vector with beam off).
- 1 = Draw (draw the vector with beam on).

Example:
To graph, first move the beam to a starting position P1 (Plot Commands: X value; Y value with beam of). Then send the 1349A/D:

1) DELTA-X Graph command.
2) Y1 Graph command with the beam on. This moves the beam to point G1. Note that there is no DELTA-X increment with the first Y Graph command.
3) Y2 Graph command with the beam on. This moves the beam to point G2.
4) Y3 Graph command with the beam on. This moves the beam to point G3.
5) Y4 Graph command with the beam on. This moves the beam to point G4.

This will give a picture as shown below.

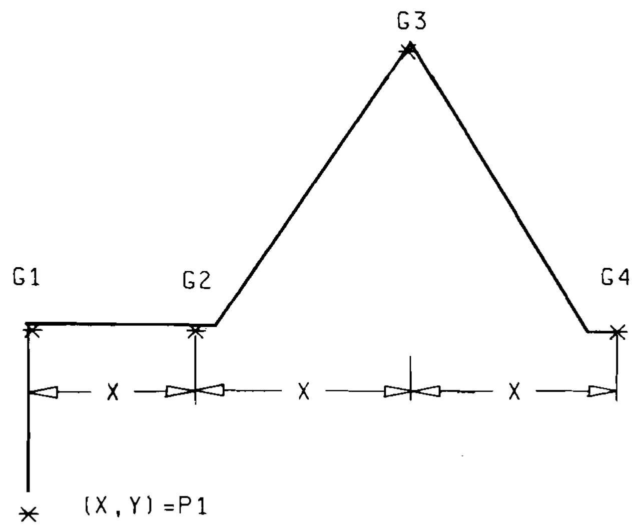


Figure 3-7. Graphing Example

TEXT COMMAND (B14 = 1, B13 = 0):

With the two MSBs set to one and zero respectively, the 1349A/D is commanded to draw all the vectors necessary to produce the character specified.

The 1349A/D automatically provides space to the right of each character for character spacing.

The Text command will draw the characters at the intensity level established by the last Set Condition Command, at the slowest writing speed and in the last line type specified (except dots).

Instead of specifying a character to be drawn, the Text command character code can be replaced by a beam movement control code. These codes that move the beam (with the beam off) are Carriage Return (CR), Line Feed (LF), Inverse Line Feed, Backspace (BS), 1/2 shift up, and 1/2 shift down. The amount and direction of beam movement depends on the character size and orientation specified. Line Feed and Inverse Line Feed provide automatic spacing between lines of text (spacing = height of one character between lines).

The starting point for non-rotated characters is the lower left-hand corner of the character area. For rotated characters the entire character area is rotated the specified number of degrees (90, 180, or 270) in a counterclockwise direction around the starting point.

When the 1349A/D has finished drawing a character it automatically advances the beam to the starting point for the next character. In this way the 1349A/D functions much like a typewriter when presenting text. The modified ASCII character set for the 1349A/D is shown in table 3-1.

B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
1	0	S1	S0	R1	R0	ES	D7	D6	D5	D4	D3	D2	D1	D0

CHARACTER
MSB ——————————— LSB

B14=1, B13=0 : commands that the 1349A display a text character (specified by D0 - D7)

ES (Establish size of character Bit B8).
  0 = use previous size and rotation.
  1 = establish new size and rotation according to S1-S0 and R1-R0.

R1	R0	Character Rotation (CCW)
0	0	0 degrees
0	1	90 degrees
1	0	180 degrees
1	1	270 degrees

S1	S0	Size	Width X Height (in addressable points)
0	0	1X	30 X 32
0	1	1.5X	45 X 48
1	0	2X	60 X 64
1	1	2.5X	75 X 80

Example:
1 X character spacing (in addressable points)

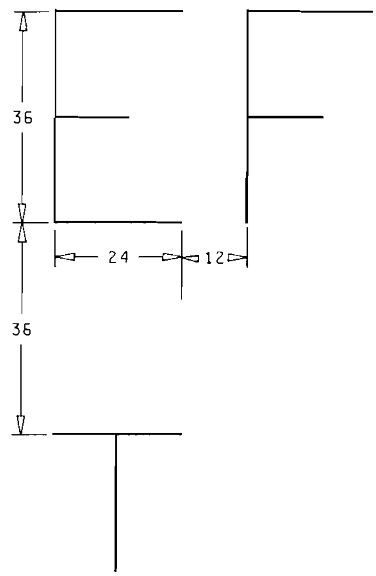


Figure 3-8. Example of Character Spacing

CALCULATING THE STARTING POINT FOR TEXT.

If we wish to display the characters "1349A" in the center of the display, proceed as follows.

Let's choose the 2.5 X (largest) character size. Each character will be 75 X 80 addressable points.

Calculation:

center screen = 1024,1024 (X,Y)

X = 1024 - (2.5 chars. X 75 points/char.)
 = 1024 - 188
 = 836
Y = 1024 - (0.5 char. X 80 points/char.)
 = 1024 - 40
 = 984

Send the 1349A/D a Plot X command with X=836. The Octal code to do this is 01504.

Send the 1349A/D a Plot Y command with the beam off and Y=984. The Octal code to do this is 11730.

Then send the Text commands to produce each of the characters.

Table 3-1. 1349A/D Character Set

0		32	Space	64	@	96	‘ NOTE 2
1	HP logo	33	!	65	A	97	a
2	beta	34	”	66	B	98	b
3		35	#	67	C	99	c
4	upper-half tic	36	$	68	D	100	d
5	lower-half tic	37	%	69	E	101	e
6	left-half tic	38	&	70	F	102	f
7	right-half tic	39	’	71	G	103	g
8	back space	40	(	72	H	104	h
9	1/2 shift down	41	)	73	I	105	i
10	line feed	42	*	74	J	106	j
11	inv. line feed	43	+	75	K	107	k
12	1/2 shift up	44	,	76	L	108	l
13	carriage return	45	-	77	M	109	m
14	horizontal tic	46	.	78	N	110	n
15	vertical tic	47	/	79	O	111	o
16	centered *	48	0	80	P	112	p
17	centered o	49	1	81	Q	113	q
18	up arrow	50	2	82	R	114	r
19	left arrow	51	3	83	S	115	s
20	down arrow	52	4	84	T	116	t
21	right arrow	53	5	85	U	117	u
22	square root	54	6	86	V	118	v
23	pi	55	7	87	W	119	w
24	delta	56	8	88	X	120	x
25	mu	57	9	89	Y	121	y
26	° (degree)	58	:	90	Z	122	z
27	ohm	59	;	91	[	123	{
28	rho	60	<	92	\	124	|
29	gamma	61	=	93	]	125	}
30	theta	62	>	94	^	126	box
31	lamda	63	?	95	— NOTE 1	127	shaded triangle

NOTES: 1. 95= Underline character with Auto Back Space
2. 96= Slanted in opposite direction of character 39.

The characters listed below cause wraparound if positioned too close to the edge of the Vector Drawing area. Wraparound appears as vectors drawn completely across the display. This condition can also be caused by vectors drawn outside the screen area.

Character Number	Character	Character Number	Character
1	HP Logo	41	)
2	beta	44	, (comma)
4	upper-half tic	59	; (semicolon)
5	lower-half tic	91	[
6	left-half tic	93	]
7	right-half tic	95	_ (underline)
14	horizontal tic	103	g
15	vertical tic	106	j
16	centered *	112	p
17	centered o	113	q
25	mu	121	y
26	° (degree)	123	{
28	rho	125	}
40	(		

3-9. VECTOR DRAWING EXAMPLES.

Example 1.

To draw a square on the display, use the following procedure.

a. Send the 1349A/D a Set Condition command to configure display brightness, line type, and writing rate.

b. Send the 1349A/D a Plot X1 command.

c. Send the 1349A/D a Plot Y1 command with the beam off. This moves the beam to the starting point of the square.

d. Send the 1349A/D a Plot Y2 command with the beam on. This moves the beam to the X1,Y2 point shown in the diagram below (draws vector "1").

e. Send the 1349A/D a Plot X2 command, then a Plot Y2 (beam on) command. This moves the beam to X2,Y2 (draws vector "2").

f. Send the 1349A/D a Plot Y1 command with the beam on. This moves the beam to X2,Y1 (draws vector "3").

g. Send the 1349A/D a Plot X1 command, then a Plot Y1 (beam on) command. This moves the beam back to the starting point (draws vector "4").

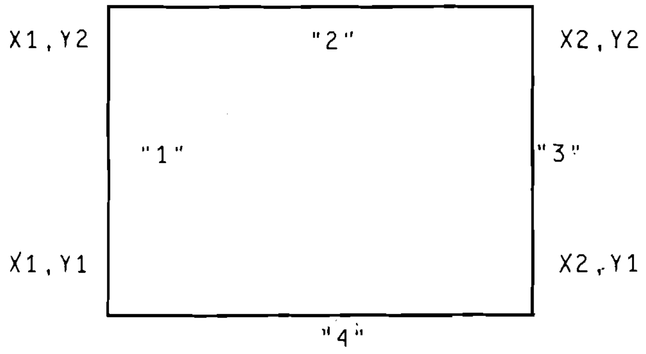


Figure 3-9. Drawing a Square on the Display

Example 2.

To draw two horizontal lines on the display, modify steps "d" and "f" in example 1 so that the 1349A/D receives the Plot Y command with beam off instead of beam on.

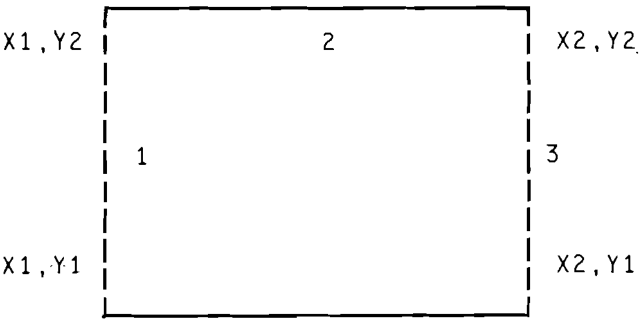


Figure 3-10. Drawing two horizontal lines on the Display

3-10. PROGRAMMING THE 1349D.

In the case of the 1349D, all commands from the user processor go to the Vector Memory as either a write operation or a read operation.

3-11. WRITE OPERATION.

The Write Operation allows the 16 bits on the data bus to be written into either the Vector Memory or the Address Pointer. A Vector Memory word can be either a Picture Data Word or an Internal Jump Word.

PICTURE DATA WORD. When bit M15 is set low, the other 15 data bits (M14-M0) must conform to the 1349A/D commands covered earlier in this section under Data Bit Definitions for 1349A/D commands.

M15	M14	M13	M12	M11	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0
0	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0

(See 1349A/D Commands).

When the display is refreshed, this data is sent from the Memory Board to the VPC for vector/character generation. If internal sync mode is selected, display refresh is accomplished without attention from the user processor once the picture has been loaded into Vector Memory. The write operation is controlled by the handshake sequence as presented in figure 3-2.

INTERNAL JUMPWORD. When M15 is high and M14 is low, then data bits M12 through M0 designate the address of the next word in Vector Memory that will be sent to the VPC. This allows the Memory to skip blocks of picture data on each pass through its address range when it is refreshing the display. Certain data in Memory is effectively suppressed until the user processor wants that data to be displayed. Refer to paragraph 3-14 for an example of using the Jump Instruction. When needed, a suppressed block of data can be added to the picture by changing only the Vector Memory Word that contains the internal jump code. An internal jump does not affect the User Pointer Address.

M15	M14	M13	M12	M11	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0
1	0	X	X	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0

X= DON'T CARE

M15=1, M14=0: Internal Jump to vector address specified by A11 through A0 during refresh.

POINTER INSTRUCTION. When bits M15 and M14 are both high, then data bits M12 through M0 designate the address to which the User Address Pointer will move. The value in the pointer register specifies the next address in Vector Memory that will be written into (or read from) by the user processor. The pointer increments to the next Vector Memory address after each read or write operation commanded by the user processor.

M15	M14	M13	M12	M11	M10	M9	M8	M7	M6	M5	M4	M3	M2	M1	M0
1	1	X	X	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0

X= DON'T CARE

Set pointer register to the Vector Memory address value specified by A11 through A0.

NOTE

The address is placed in the User Address Pointer, not the Vector Memory.

3-12. READ OPERATION.

The Address Pointer value specifies the word to be read from Vector Memory. The pointer increments with each Write or Read operation to the Vector Memory. Positioning of the Address Pointer to a specific location can also be accomplished via a write operation and the pointer instruction. This allows a selected word to be read from Vector Memory. The read operation is controlled by the handshake sequence as presented in figure 3-1.

3-13. PROGRAMMING SUMMARY.

A programming summary for the 1349A/D instruction set and commands is given in table 3-2.

Table 3-2. Truth Table for 1349A/D Instructions and Commands

BIT NUMBER M15	M14	M13	1349A/D INSTRUCTION OR COMMAND
0	0	0	PLOT
0	0	1	GRAPH
0	1	0	TEXT
0	1	1	SET CONDITION
1	0	0	INTERNAL JUMP
1	0	1	INTERNAL JUMP
1	1	0	SET POINTER
1	1	1	SET POINTER

3-14. USING THE JUMP INSTRUCTION.

The Internal Jump instruction resides in the Vector Memory. When it is encountered in the course of refreshing the 1349A/D it is not sent to the VPC. Instead, it causes the Vector Memory to do an absolute jump to a new location. The Vector Memory then resumes sending data to the VPC. This allows the user to store pictures in the Vector Memory but not display them until ready (by jumping past them). See the example below.

VECTOR MEMORY

Address	Contents
0000	Jump to 1002
0001 to 1000	Picture A
1001	Jump to 1002
1002 to 2002	Picture B
2003	Jump to 2062
2004 to 2060	Graticule A
2061	Jump to 2062
2062 to 2147	Graticule B
2148	Jump to 8191
2149 to 2255	Set of labels
2256	Jump to 8191
2257 to 8190	Unused Memory
8191	No-Op

By putting jump instructions around each block of data, it allows the user to turn parts of the complete picture on or off by writing only one or two words to the Vector Memory. Picture A might be used as a standard to compare against picture B which is being updated in real time. For this application, picture A can be turned on whenever it is needed by changing the contents of address 0000 to be "Jump to 0001".

NOTE

Vector Memory location 0000 is the first location sent to the 1349A/D in each refresh cycle. The Vector Memory then auto-increments to location 0001, 0002, etc.

3-15. OPTIMIZING PICTURE QUALITY

Due to differing conditions of ambient light when the 1349A/D is displaying pictures, the programmer may have to experiment with the Intensity and Writing Speed parameters of the Set Condition command.

For example, in an environment of high ambient light, the 1349A/D should be set to the highest brightness level and slowest writing speed.

3-16. OCTAL AND HEXADECIMAL RANGES FOR 1349A/D COMMANDS.

1349A/D Command	Octal Range	Hexadecimal Range
Plot		
X	00000 - 07777	0000 - 0FFF
Y (beam off)	10000 - 13777	1000 - 17FF
Y (beam on)	14000 - 17777	1800 - 1FFF
Graph		
Set DELTA-X	20000 - 27777	2000 - 2FFF
Y (beam off)	30000 - 33777	3000 - 37FF
Y (beam on)	34000 - 37777	3800 - 3FFF
Text	40000 - 57777	4000 - 5FFF
Set Condition	60000 - 77777	6000 - 7FFF
Internal Jump	100000 - 120000	8000 - A000
Set Pointer	140000 - 160000	C000 - E000

3-17. OPERATING CONSIDERATIONS FOR THE 1349A.

Model 1349A is not equipped with the Vector Memory Board.

3-18. SIGNAL LINE DEFINITIONS.

D0-D15.
D0 through D15 are the vector data lines (TTL positive logic). Bit D15 is used only with the Memory Board.

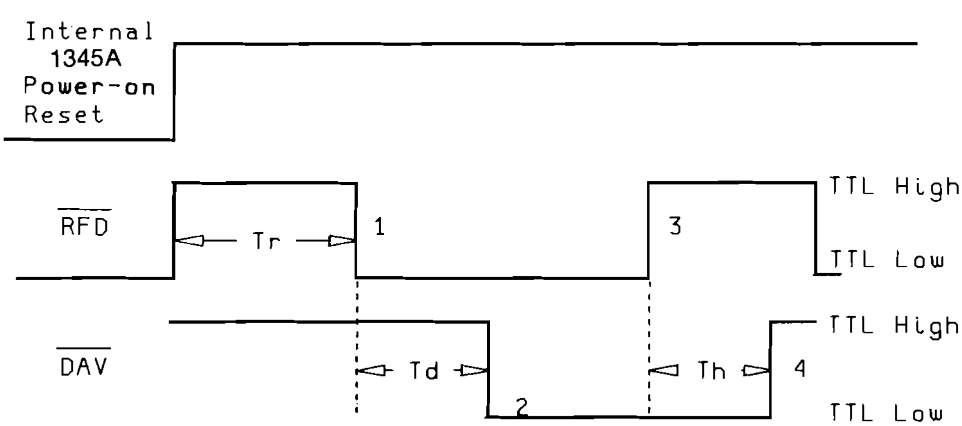
LDAV
Data Valid Signal Line (active low). Signal from user processor to 1349A. New output data is available on data bus.

LRFD
Ready for data signal line (active low). Signal to user processor. 1349A is ready for next data transfer.

DISCONNECT SENSE.
This line must be grounded when above signal lines are active. The internal performance verification pattern will be displayed if this line in not grounded.

3-19. HANDSHAKE TIMING FOR 1349A.

$\overline{\text{RFD}}$ and $\overline{\text{DAV}}$ (Ready For Data, Data Valid) Handshake.



Tr - Ready Time (1349A Power-on delay) .... 400 nsec min
100 usec max
(assume $\overline{\text{DAV}}$ is high at Power-on)

Td - Data Valid Delay Time (after $\overline{\text{RFD}}$ goes low) .... 0 nsec min
Th - Data Valid Hold Time (after $\overline{\text{RFD}}$ goes high) .... 0 nsec min

3-20. TRANSFER SEQUENCE.

1. 1349A sets RFD low to indicate that it is ready for a word from the 16-bit Data Bus.
2. User processor sets DAV low to indicate that the contents of the 16-bit Data Bus are valid.
3. 1349A returns RFD high to indicate that it has accepted the word from the 16-bit Data Bus.
4. User processor returns DAV high so that the 1349A can initiate the next transfer.
5. 1349A sets RFD low to indicate that it is ready for a word from the 16-bit Data Bus.

3-21. RESTRICTIONS.

1. User processor can set DAV low at the same time or after 1349A sets RFD low, but NOT BEFORE.
2. User processor can return DAV high at the same time or after 1349A returns RFD high, but NOT BEFORE.

NOTE

While DAV remains low, the 1349A will not act on the command from the Data Bus, even though it has signalled that it has accepted the word from the Data Bus. It is recommended that the host system keep Th to a minimum.

3. 1349A will not set RFD low unless DAV is high.
4. Data on the 16-bit Data Bus must remain valid as long as DAV is low.

NOTE

For maximum speed and performance, it is advisable that the host system use EDGE TRIGGERED logic.

SECTION IV

PERFORMANCE VERIFICATION

4-1. INTRODUCTION.

4-2. The Performance Verification Procedures in this section test the instrument's electrical performance. The procedures provide approximately 90% assurance of proper 1349A/D operation.

4-3. EQUIPMENT REQUIRED.

4-4. Equipment required for the performance tests is listed in Section I, table 1-4. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended models.

4-5. CALIBRATION CYCLE.

4-6. Periodic performance verification is not normally required for this instrument. Performance tests should be performed after service work has been performed or if improper operation is suspected.

4-7. Further checks that require access to the interior of the instrument are included in the adjustment section, but are not required for the performance verification.

WARNING

ELECTRICAL SHOCK HAZARD

This instrument is designed and manufactured for OEM systems. Protective covers are not provided and internal hazardous voltages are exposed when power is applied. Component replacement, including fuses, and internal adjustments must be made by qualified maintenance personnel.

4-8. PERFORMANCE TEST PROCEDURES.

PERFORMANCE TESTS

4-9. PERFORMANCE VERIFICATION.

DESCRIPTION:

The following procedure is directed at obtaining the correct performance verification pattern on the 1349A/D screen.

EQUIPMENT REQUIRED:

Power Supply
Power Connector

PROCEDURE:

a. Adjust power supply outputs to values shown in table 4-1.

Table 4-1. Power Supply Output

Operating Voltages		Max P-P Ripple	Max Current	
Voltage	Tolerance		1349D	1349A
+15 VDC	+-5%	10 mV	1.3A	1.3A
-15 VDC	+-5%	10 mV	350 mA	350 mA
+5 VDC	+-5%	50 mV	2.0A	750 mA

b. Connect power supply to the 1349A/D and turn on power. (See figure 4-1 for power connections.)

PERFORMANCE TESTS

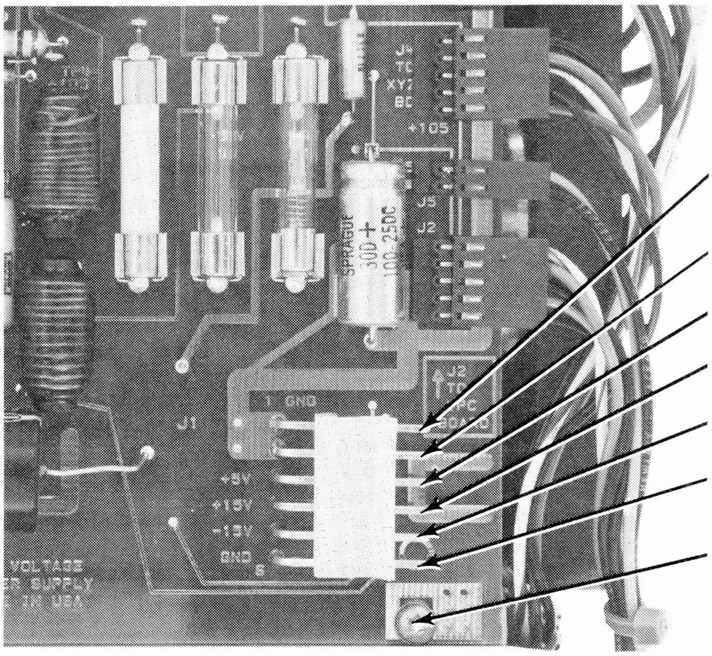


Figure 4-1. 1349A/D Power Connections

c. Check for a display as shown in figure 4-2.

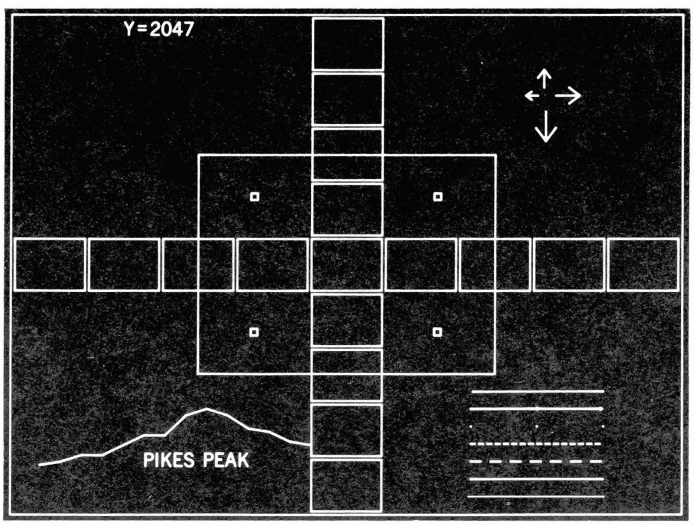


Figure 4-2. 1349A/D Primary Test Pattern

The 1349A/D cycles through the four Commands: Set Condition, Plot, Graph and Text Command. The relationship of the test pattern and the 1349A/D Commands is shown in figure 4-3. If any portion of the test pattern is not displayed, refer to Section VIII, Service and Troubleshooting.

PERFORMANCE TESTS

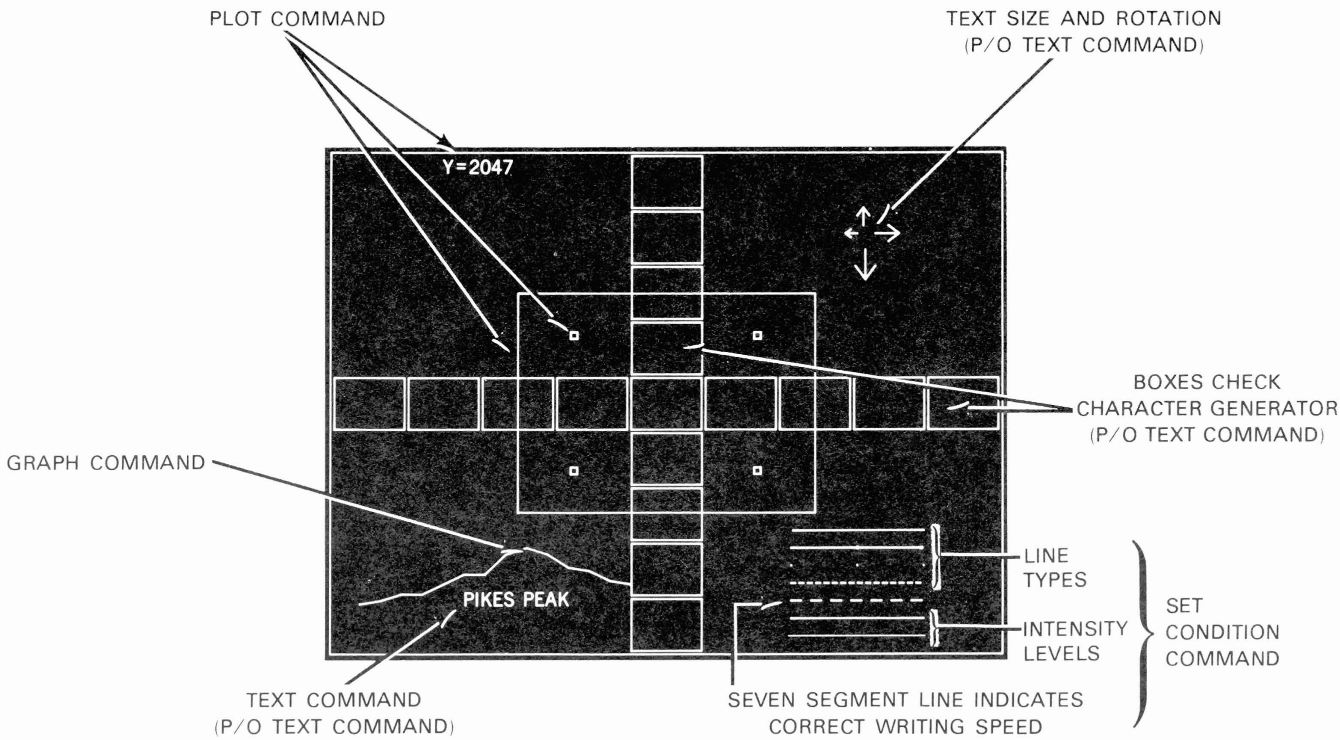


Figure 4-3. 1349A/D Command Check-out

d. If a test pattern as shown in figure 4-4 is displayed, then the memory circuit is defective. Refer to Section VIII, Service and Troubleshooting.

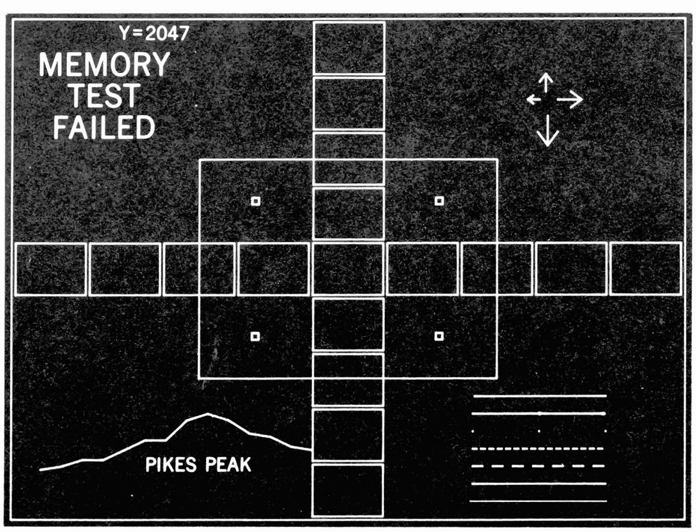


Figure 4-4. Memory Fail Test Pattern (1349D only)

PERFORMANCE TESTS

4-10. RESOLUTION VERIFICATION.

DESCRIPTION:

An internal test pattern is used to check resolution.

EQUIPMENT REQUIRED:

Power Supply
Power Connector

PROCEDURE:

a. Disconnect the 1349A/D I/O Port (A2J4) and apply power.

b. Short A2J6-1 to A2J6-2 and display the focus and resolution test pattern (see figure 4-5).

c. To check resolution:

The 1349A/D passes the resolution test if every one of the lines in the 13 boxes can be resolved. Should the test fail, perform the Focus and Astigmatism Adjustments described in Section V of this manual.

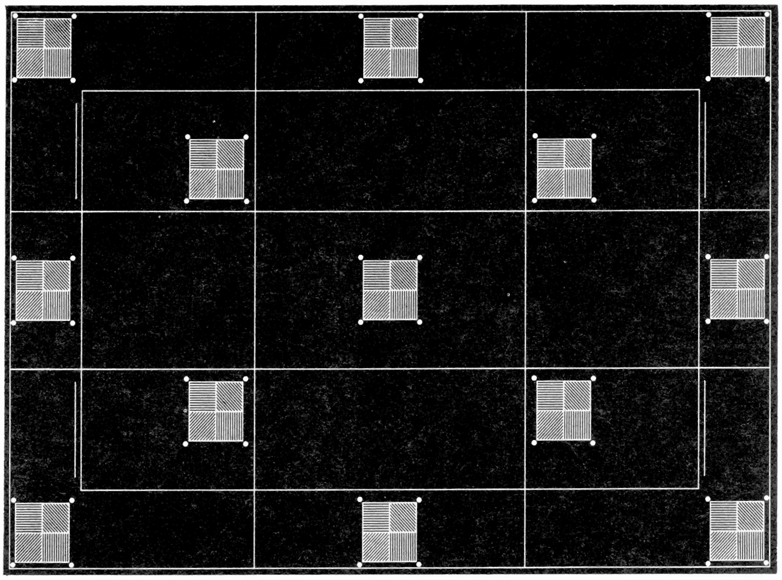


Figure 4-5. 1349A/D Focus and Resolution Test Pattern

SECTION V

ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section describes adjustments and checks required to return the 1349A/D to peak operating capabilities when repairs have been made. Included in this section are equipment setups and adjustment procedures.

5-3. SAFETY REQUIREMENTS.

5-4. Although this instrument has been designed in accordance with international safety standards, general safety precautions must be observed during all phases of operation, service and repair of the instrument. Failure to comply with the precautions listed in the Safety Summary at the front of this manual or with specific warnings given throughout this manual could result in serious injury or death. Service and adjustments should be performed only by qualified service personnel.

5-5 EQUIPMENT REQUIRED.

5-6. A complete list of required test equipment is given in Section 1, table 1-4. Test equipment equivalent to that recommended may be substituted, provided it meets the required characteristics. For best results, use recently calibrated test equipment.

5-7. ADJUSTMENTS.

5-8. The adjustment procedures are arranged in a recommended sequence of adjustments. While most adjustments may be made independent of other adjustments, it is recommended that adjustments be made sequentially as a number of adjustments are directly related to preceeding or following adjustments. For best results, allow the instrument to warm up for 15 minutes before making adjustments. See table 5-1 for sequence of adjustments.

5-9. ADJUSTMENT PROCEDURES.

WARNING

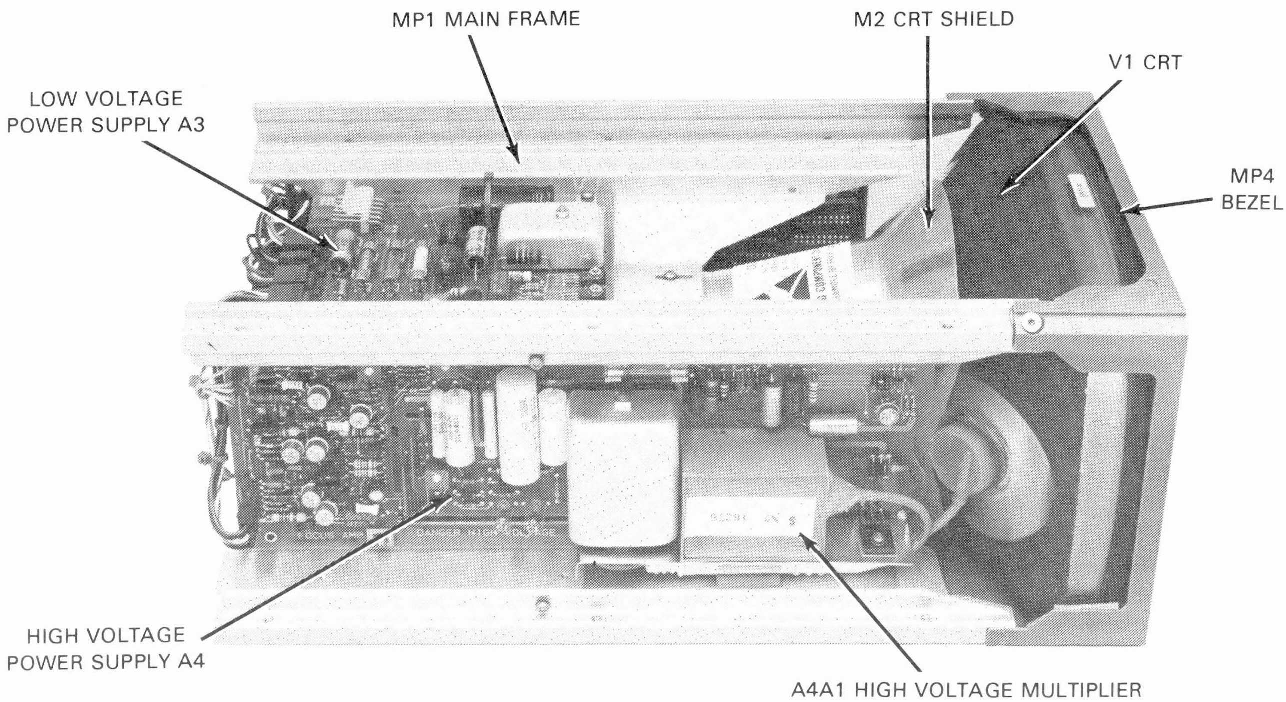
SHOCK HAZARD

This instrument is designed and manufactured for OEM systems. Protective covers are not provided and internal hazardous voltages are exposed when power is applied. Voltages up to 20 kV are present around the CRT and HVPS areas and are capable of causing serious injury or death. Before any connections are made to the instrument, the chassis must be connected to a safety ground. Component replacement, including fuses, and internal adjustments must be made by qualified maintenance personnel.

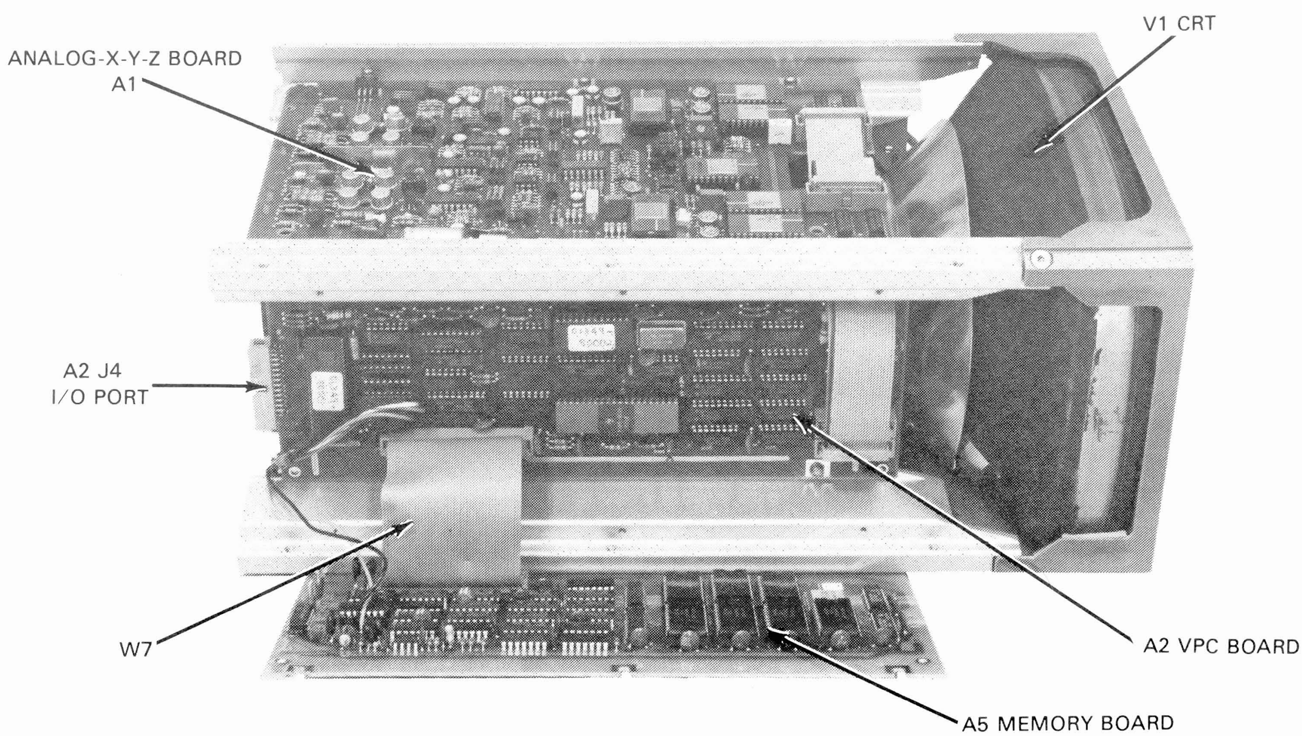
Table 5-1. Sequence of Adjustments

Adjustment	Order of Adjustment	Paragraph No.
Low Voltage Power Supply	1	5-10
High Voltage Power Supply	2	5-11
Z-Axis Drive and Test Pattern Set-up	3	5-12
Preliminary Focus and Astigmatism	4	5-13
Intensity Cut-Off Level	5	5-14
Trace Alignment and Writing Speed	6	5-15
Stroke Generator	7	5-16
Stroke Intensity	8	5-17
Image Size and Position	9	5-18
Vector Closure	10	5-19
Fine Focus and Astigmatism	11	5-20
Resolution Check	12	5-20
Auxiliary X-Y-Z Amplifier Output Check	13	5-21

ADJUSTMENTS



1349A TOP VIEW



1349A BOTTOM VIEW

Figure 5-1. 1349A/D Assembly Location Identification

ADJUSTMENTS

5-10. LOW VOLTAGE POWER SUPPLY ADJUSTMENT.

REFERENCE:
Service Sheet 4

DESCRIPTION:
In this procedure the input power supplies are verified and the +105V power supply is adjusted to +105V ± 250 mV.

EQUIPMENT:
Digital Voltmeter
Power Supply

PROCEDURE:

a. Preset the Intensity (A1R128) and Intensity Cut-off A1R131 fully ccw. This step is done to protect the CRT when power is applied to the instrument.

b. Apply power to the power connector on the Low Voltage Power Supply Board (A3J1) and check input power supplies as indicated below:

Monitor	Supply	Test Limits
A3TP1	+15 V	±750 mV
A3TP3	+ 5 V	0 mV±250 mV
A3TP2	-15 V	±750 mV

c. Monitor A3TP4 with the digital voltmeter and adjust the +105V supply for 105V ±250 mV.

Table 5-2. +105V Adjustment.

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A3R10	+105V Adjust	5-10, c	4	Adjust for +105V ±250 mV

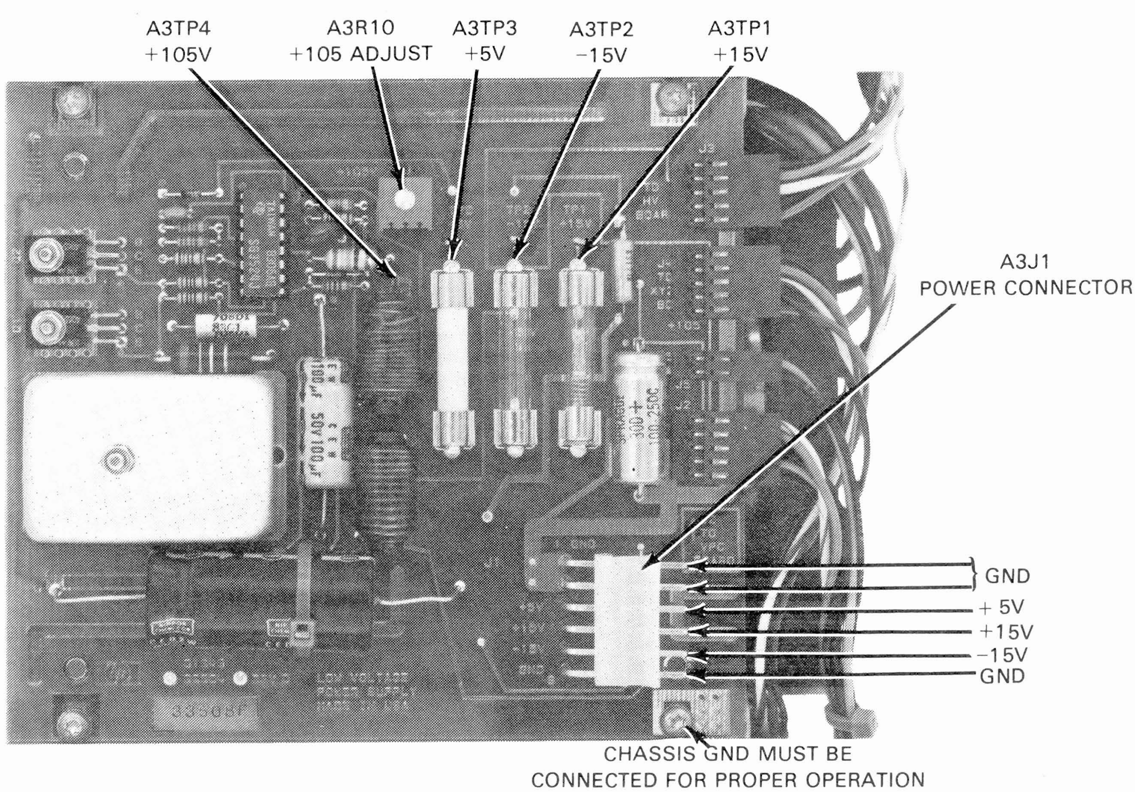


Figure 5-2. Low Voltage Power Supply Adjustment Locations

ADJUSTMENTS

5-11. HIGH VOLTAGE POWER SUPPLY ADJUSTMENT.

REFERENCE:
Service Sheet 5.

DESCRIPTION:
This procedure describes the Cathode Voltage adjustment. The Cathode Voltage is set to -2450V, ±25V.

EQUIPMENT REQUIRED:
Digital Voltmeter
1000:1 Divider Probe
Power Supply

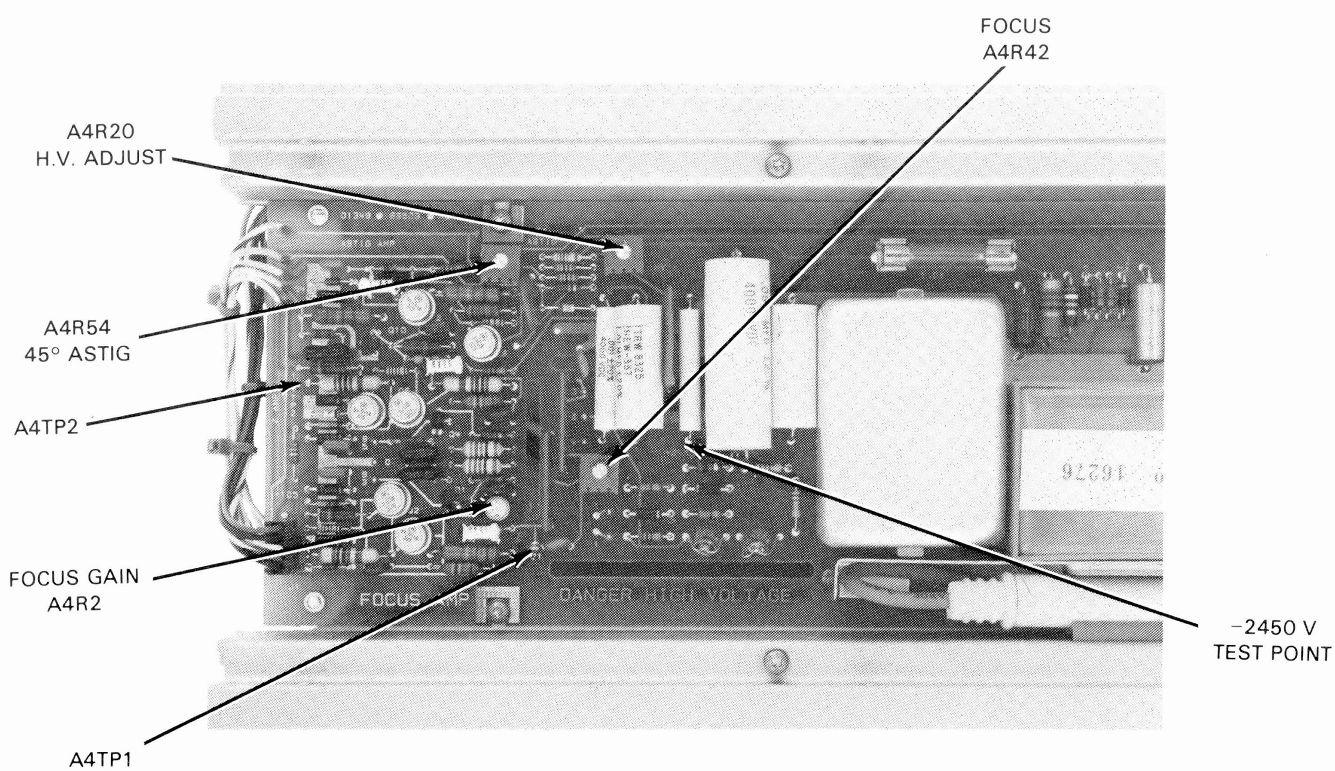
PROCEDURE:

a. Adjust Intensity Cut Off Level (A1R131) and Intensity control (A1R129) to the ccw stop. This step is done to protect the CRT when power is applied (adjustments are on the Analog X-Y-Z Stroke Generator board, A1).

b. Calibrate the 1000:1 divider probe against the +105V supply. Monitor the cathode voltage at A4TP3 on the H.V.P.S board using the 1000:1 divider probe and adjust High Voltage Adjust (A4R20) -2450V.

Table 5-3. High Voltage Power Supply Adjustment

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A4R20	High Voltage Adj	5-11, c	5	Adjust for -2450V



Note: High Voltage cover is removed.

Figure 5-3. High Voltage Power Supply Adjustment Locators

ADJUSTMENTS

5-12. Z-AXIS DRIVE ADJUSTMENT AND TEST PATTERN SET-UP.

REFERENCE:
Service Sheets 5, 3C

DESCRIPTION:
The purpose of these adjustments are to set Z-Axis drive and to initially set image size and positioning.

EQUIPMENT REQUIRED:
Power Supply
Oscilloscope

PROCEDURE:

a. Apply power to the instrument. Most of the 1349A/D primary test pattern should be on screen.

b. Monitor A4TP2 with the oscilloscope. Set the oscilloscope sweep speed for 0.5 mSec/Div and 1 V/Div, using a 10:1 divider probe. DC couple the vertical attenuator.

c. Adjust Intensity Cut-off level (A1R131) so that the bottom level of the waveform is set to +20 VDC with respect to ground, or until rest dot is extinguished (dot above and to the right of Y=2047).

d. Adjust Intensity control (A1R129) so that the peak-to-peak value of the waveform is equal to the value marked on top of the CRT plus 1V. Use the sticker with the largest voltage value.

EXAMPLE: If CRT label reads 35V/140, then set p-p value to 36V.

e. Adjust Med Intensity control (A1R181) so that the peak-to-peak value of the first narrow level towards the end of the waveform is equal to the value marked on top of the CRT plus 1V. Use the sticker with the medium voltage value.

f. Adjust Dim Intensity control (A1R180) so that the peak-to-peak value of the second narrow level towards the end of the waveform is equal to the value marked on top of the CRT plus 1V. Use the sticker with the smallest voltage value.

g. Adjust Y-Gain (A1R110) for a 12 cm (4.72 in.) high and X-Gain (A1R87) for a 17 cm (6.7 in.) wide display. It may be necessary to to adjust Y-Pos (A1R105) and X-Pos (A1R82) to bring the display on screen. The primary test pattern is shown in figure 5-4.

h. Mechanically center X-Current Off-set (A1R56) and Y-Current Off-set (A1R65).

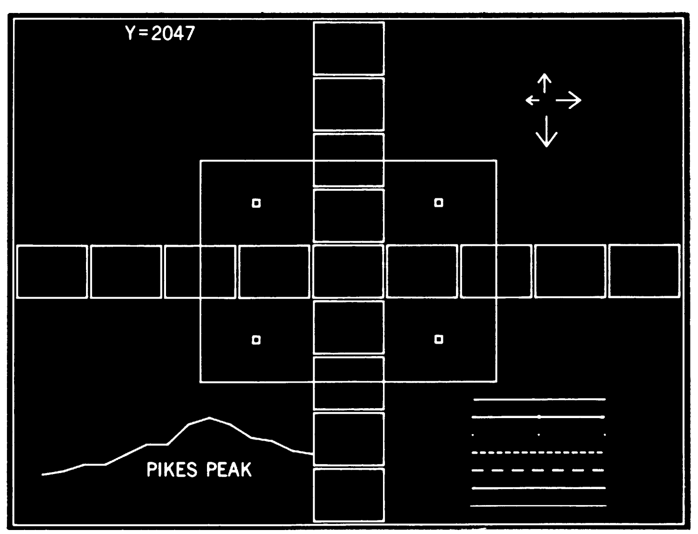
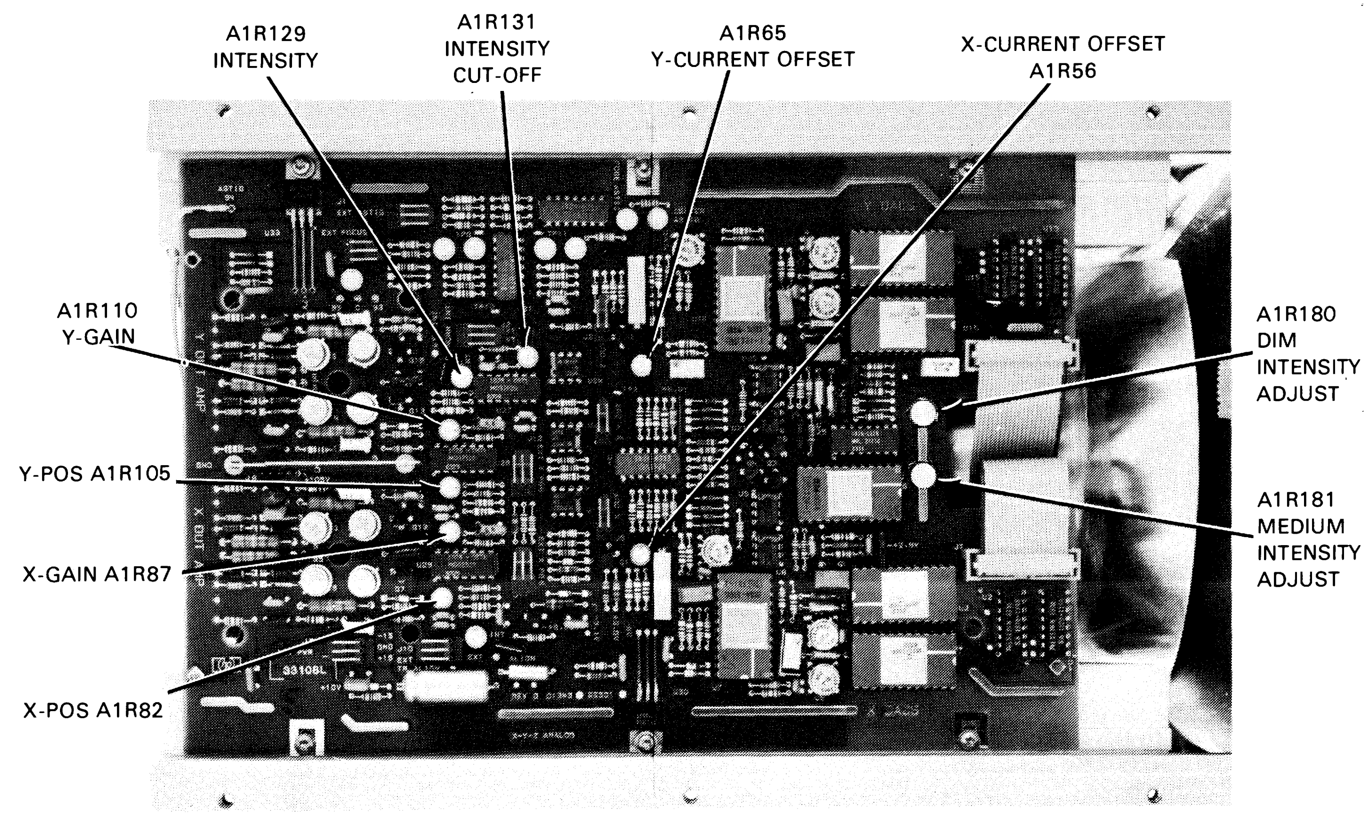


Figure 5-4. 1349A/D Primary Test Pattern

ADJUSTMENTS

Table 5-4. Z-Axis Drive Adjustment and Test Pattern Set-up

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R131	Intensity Cut-Off	5-12, c	3C	Adjust so that monitored signal is +20 VDC above ground
A1R128	Intensity	5-12, d	3C	Adjust p-p value as marked on the CRT +1V (largest sticker value)
A1R181	Medium Intensity	5-12, e	3B	Adjust p-p level of first narrow level as marked on CRT +1V (medium sticker value)
A1R180	Dim Intensity	5-12, f	3B	Adjust p-p value of second narrow level as marked on CRT +1V (smallest sticker value)
A1R110	Y-Gain	5-12, g	3C	Adjust for a 12 cm high display
A1R87	X-Gain	5-12, g	3C	Adjust for a 17 cm wide display
A1R105	Y-Pos	5-12, g	3C	Adjust as required
A1R82	X-Pos	5-12, g	3C	Adjust as required
A1R56	X-Current Off-set	5-12, h	3B	Mechanical center
A1R65	Y-Current Off-set	5-12, h	3B	Mechanical center



P/O Figure 5-5. Z-Axis Drive and Preliminary Focus Adjustment Locations

ADJUSTMENTS

5-13. PRELIMINARY FOCUS AND ASTIGMATISM ADJUSTMENT.

REFERENCE:
Service Sheets 3C, 5.

DESCRIPTION:
These procedures provide the necessary adjustments for preliminary focus and astigmatism set-up. The only signal source required is the primary test pattern.

EQUIPMENT REQUIRED:
Power Supply
Oscilloscope

PROCEDURE:

a. Preset X-Focus Gain (A1R142) fully cw, Y-Focus Gain (A1R145) fully ccw, and Focus Gain on the High Voltage Board (A4R2) fully cw.

b. Apply power to the instrument. The primary test pattern should be displayed on screen.

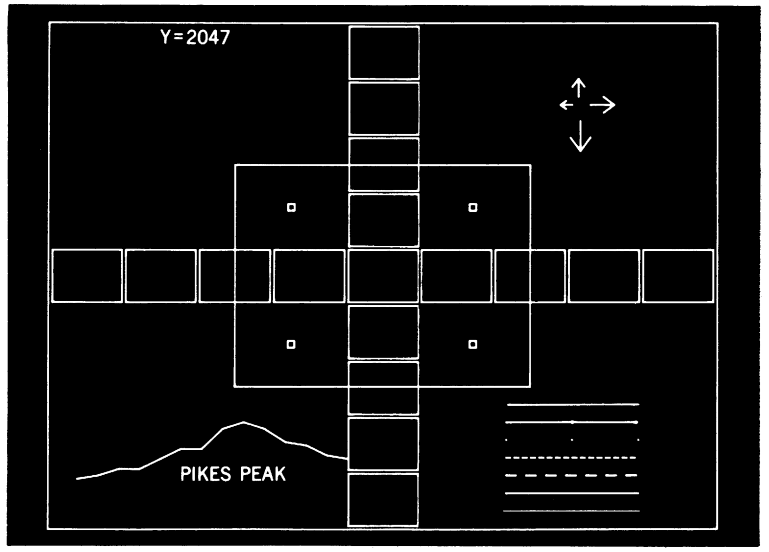


Figure 5-6. 1349A/D Primary Test Pattern

c. Set monitor oscilloscope sweep speed to 2 mSec/Div, and vertical attenuator to 0.2 V/Div. Use a 10:1 divider probe and DC couple the attenuator. Monitor A1TP10 and position the trace on the center graticule line with the vertical position control.

d. Monitor A1TP9 and adjust Y-Focus Off-set (A1R138) so that the bottom of the signal is on the center graticule line.

e. Move the scope probe to A1TP11 and adjust X-Focus Off-set (A1R135) so that the bottom of the signal is on center graticule line. Readjust scope trigger level if necessary.

f. Set monitor scope sweep speed to 0.2 mSec/Div and the vertical attenuator to 0.5 V/Div. DC couple the vertical attenuator and monitor A4TP1 (on High Voltage Board) with a 10:1 divider probe.

g. Set A1R149 fully cw. Adjust A1R149 slowly in the ccw direction and note the signal level where clipping ends. Adjust A1R149 so that the bottom of the waveform is 5 VDC above the clipping level.

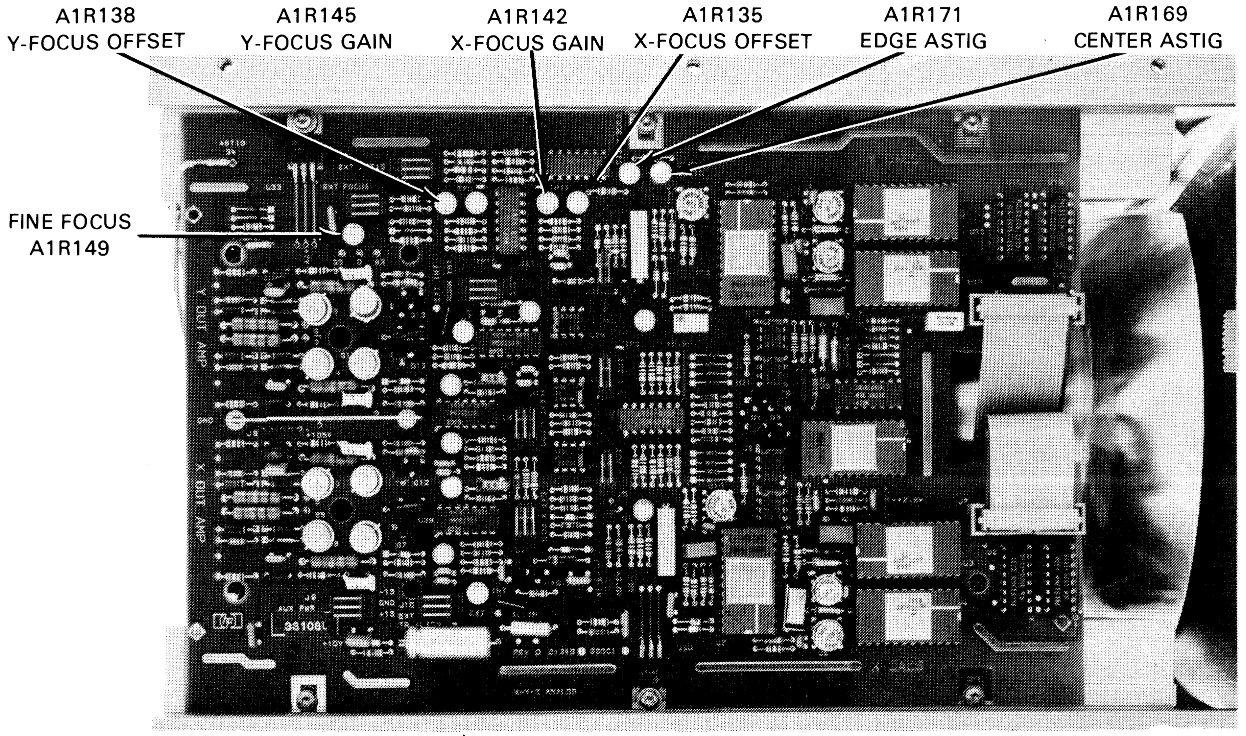
h. Center adjustments Edge Astig (A1R171) and Center Astig (A1R169).

i. Adjust Focus (A4R42), 45° Astig (A4R54), and Center Astig (A1R169) for best display.

ADJUSTMENTS

Table 5-5. Preliminary Focus and Astigmatism Adjustment

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R142	X-Focus Gain	5-13, a	3C	Preset to fully cw
A1R145	Y-Focus Gain	5-13, a	3C	Preset to fully ccw
A4R2	Focus Gain	5-13, a	5	Preset to fully cw
A1R138	Y-Focus Off-set	5-13, d	3C	Bottom of signal to A1TP10 DC level
A1R135	X-Focus Off-set	5-13, e	3C	Bottom of signal to A1TP10 DC level
A1R149	Fine Focus	5-13, g	3C	5 VDC above signal clipping level
A1R171,A1R169	Edge Astig Center Astig	5-13, h	3C	Center both adjustments
A4R42 A4R54 A1R169	Focus 45° Astig Center Astig	5-13, i	3C, 5	For best overall display



Note: Adjustment Locations for A4R2, A4R42, and A4R54 are shown on figure 5-3.

Figure 5-7. Z-Axis Drive and Preliminary Focus Adjustment Locations

ADJUSTMENTS

5-14. INTENSITY CUT-OFF LEVEL

REFERENCE:
Service Sheets 3C, 5

DESCRIPTION:
The primary test pattern is used as the signal source to adjust the intensity cut-off level.

EQUIPMENT REQUIRED:
Power Supply
Oscilloscope

PROCEDURE:

a. Apply power to the instrument and display the primary test pattern.

b. Set monitor scope sweep speed to 2 mSec/Div and set the vertical attenuator to 0.5 V/Div. DC couple the attenuator and use a 10:1 divider probe to monitor A4TP2 on High Voltage board.

c. Set Intensity Cut-off (A1R131) cw until a dot just appears above and to the right of the note "Y=2047" in the primary test pattern.

d. Readjust Intensity Cut-off (A1R131) until dot is just extinguished. Note the signal level on the monitor scope.

e. Adjust Intensity Cut-off level so that the signal level displayed on the scope is 1V below the level of visual cut-off.

f. Readjust Focus (A4R42) for best display.

Table 5-6. Intensity Cut-off Level Adjustments

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R131	Intensity Cut-off	5-14, c	3C	Set cw until dot appears
A1R131	Intensity Cut-off	5-14, d	3C	Adjust until dot in test pattern is extinguished
A1R131	Intensity Cut-off	5-14, e	3C	Adjust monitored signal to 1V below visual cut-off
A4R42	Focus	5-14, f	5	Adjust for best display

ADJUSTMENTS

5-15. TRACE ALIGNMENT AND WRITING SPEED ADJUSTMENT.

REFERENCE:
Service Sheets 3B, 5

DESCRIPTION:
The 1349A/D primary test pattern is used for trace alignment and writing speed adjustment. The seven segment line of the test pattern is used to adjust writing speed.

EQUIPMENT REQUIRED:
Power Supply.

PROCEDURE:

a. Apply power to the instrument and display the primary test pattern.

b. Adjust Trace Align (A1R160) to align test pattern horizontally.

c. Adjust Writing Speed (A1R70) for the seven segment line as shown in figure 5-8.

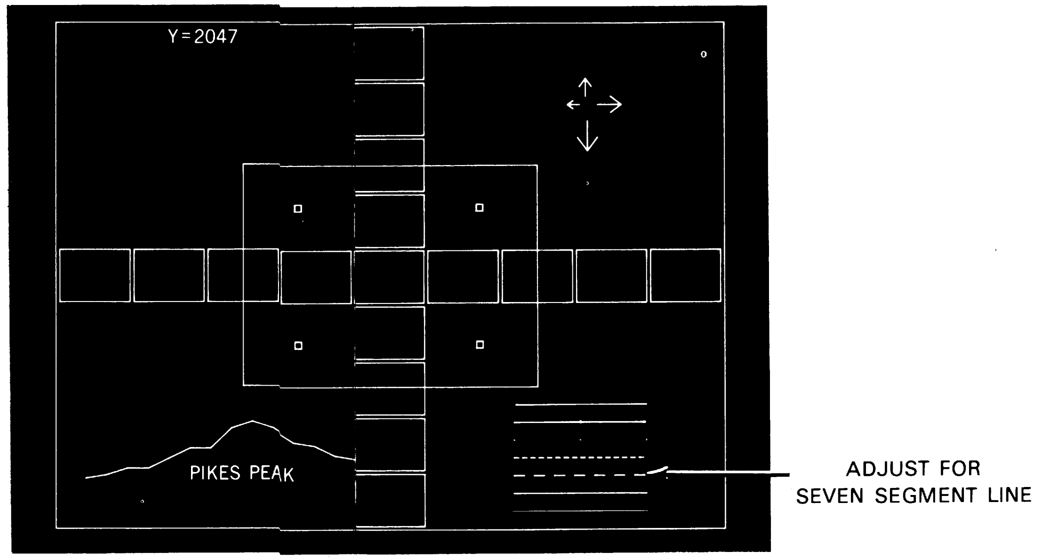
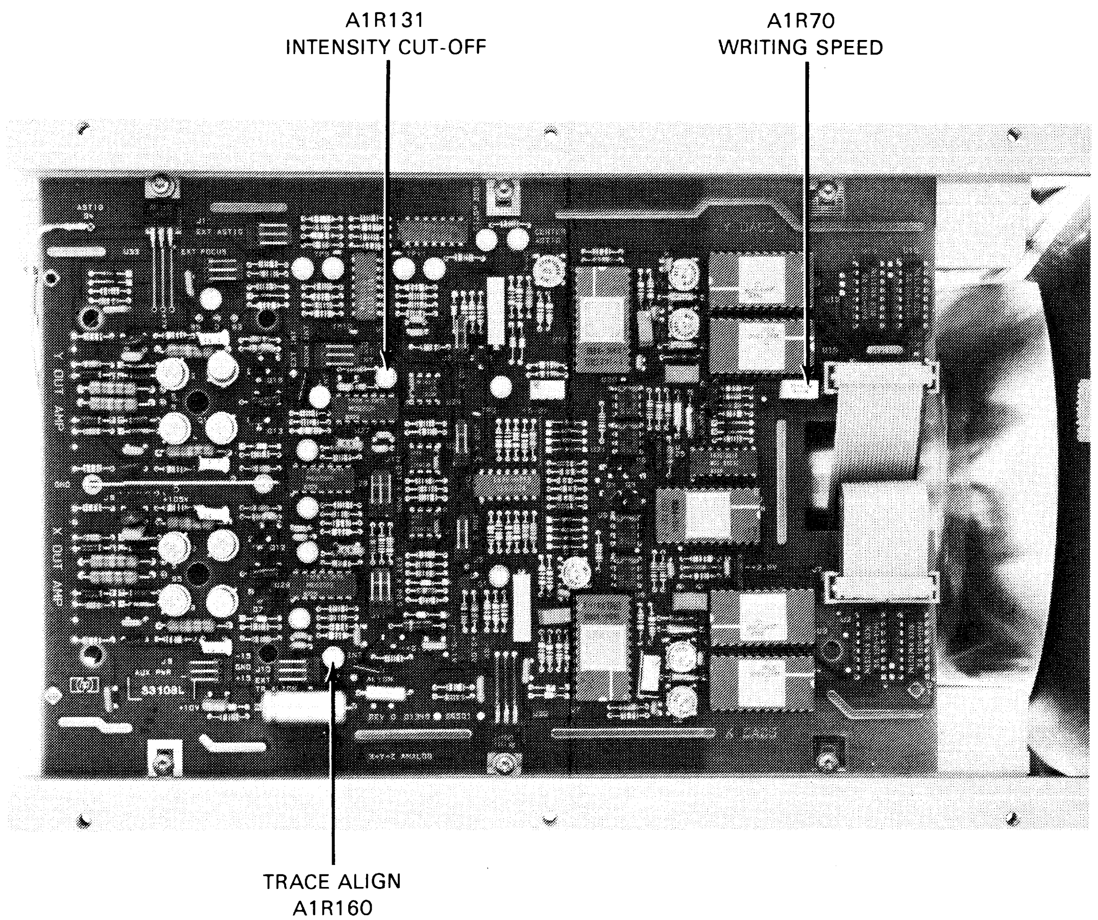


Figure 5-8. Writing Speed Adjustment

ADJUSTMENTS

Table 5-7. Trace Align and Writing Speed Adjustment

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R160	Trace Align	5-15, b	5	Align test pattern horizontally
A1R70	Writing Speed	5-15, c	3B	Adjust for the seven segment line in primary test pattern



Note: Adjustment Locations for A4R42 is shown on figure 5-3.

Figure 5-9. Intensity Cut-off Level, Trace Alignment and Writing Speed Adjustment Locations

ADJUSTMENTS

5-16. STROKE GENERATOR ADJUSTMENTS.

REFERENCE:
Service Sheets 3A, 3B.

DESCRIPTION:
This procedure describes the adjustments necessaryto ensure proper vector stroke generation.

EQUIPMENT REQUIRED:
Power Supply

PROCEDURE:

NOTE

The following procedures are referenced to figure 5-10. Perform the following adjustment steps in the same sequence as outlined below:

a. Apply power to the instrument and display the primary test pattern.

b. Adjust A1R36 for parallel adjacent lines of the bottom two boxes in the test pattern.

c. Adjust A1R30 for parallel adjacent lines of the top two boxes in the test pattern.

d. Adjust A1R8 for parallel adjacent lines of the left two boxes in the test pattern.

e. Adjust A1R1 for parallel adjacent lines of the right two boxes in the test pattern.

f. All adjacent sides of the boxes in the test pattern should now be parallel. If not, repeat steps b through f.

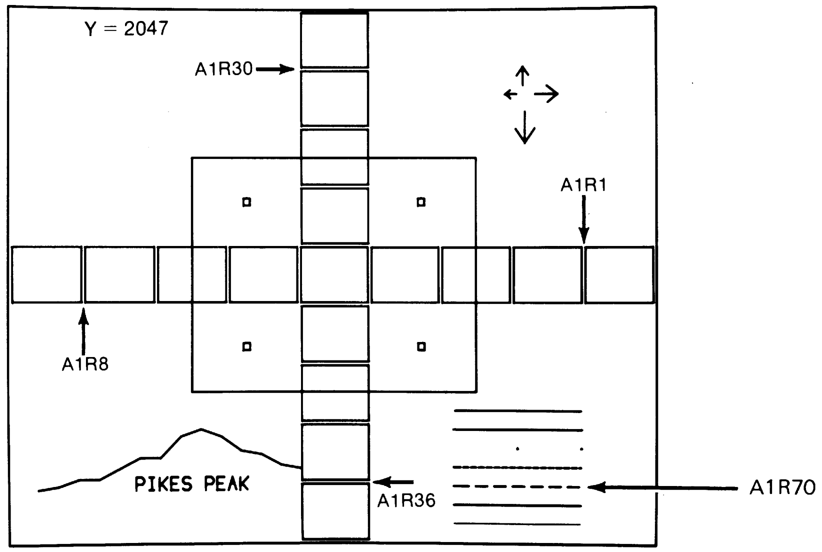


Figure 5-10. Stroke Generator Adjustments

NOTE

The following procedures are referenced to figure 5-11. Perform the following adjustment steps in the sequence outlined below.

g. Adjust A1R39 so that the left vertical line of the pattern starts exactly the bottom horizontal line in the test pattern.

ADJUSTMENTS

h. Adjust A1R48 so that the left vertical line ends at exactly the top horizontal line in the test pattern.

i. Adjust A1R11 so that the top horizontal line originates at exactly the left vertical line in the test pattern.

j. Adjust A1R20 so that the top horizontal line ends at exactly the right vertical line in the test pattern.

k. The outside box of the pattern should now be closed properly. If not, recheck steps h through k.

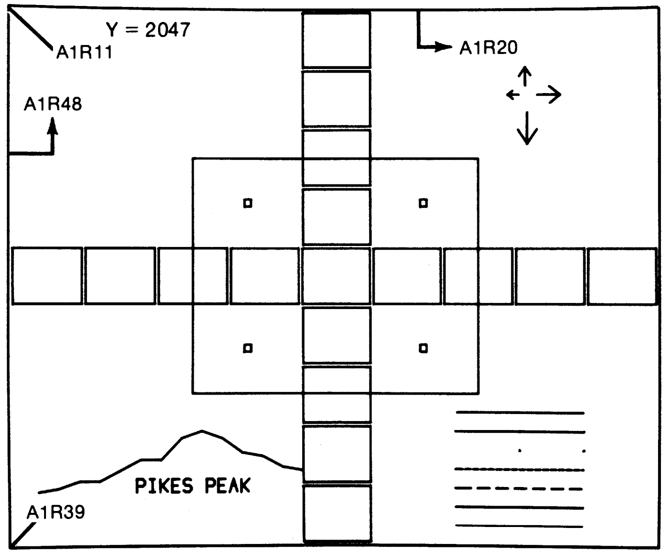


Figure 5-11. Stroke Length Adjustment

Table 5-8. Stroke Generator and Stroke Length Adjustments

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R36	Y-Stroke	5-16, c Offset	3A	Parallel lines of bottom boxes in the test pattern (figure 5-10)
A1R30	Y-Dac Gain	5-16, d	3A	Parallel line of top boxes in the test pattern (figure 5-10)
A1R8	X-Stroke Offset	5-16, e	3A	Parallel lines of left boxes in the test pattern (figure 5-10)
A1R1	X-Dac Gain	5-16, f	3A	Parallel lines of right boxes in the test pattern (figure 5-10)
A1R39	Y-Ramp Offset	5-16, h	3A	Left vertical line starts at bottom horizontal line in the test pattern (figure 5-11)

ADJUSTMENTS

Table 5-8. Stroke Generator and Stroke Length Adjustments (Con't)

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R48	Y-Stroke Length	5-16, i	3A	Left Vertical Line ends at top horizontal line in the test pattern (figure 5-11)
A1R11	X-Ramp Offset	5-16, h	3A	Top horizontal line starts at left Vertical line in the test pattern (figure 5-11)
A1R20	X-Stroke Length	5-16, k	3A	Top horizontal line ends at right vertical line in the test pattern (figure 5-11)

5-17. STROKE INTENSITY ADJUSTMENT.

REFERENCE:
Service sheet 3B.

DESCRIPTION:
This procedure describes the adjustments necessary to ensure equal intensity of all vectors.

EQUIPMENT REQUIRED:
Power supply

PROCEDURE:

NOTE

The following procedures are referenced to figure 5-11. Perform the following adjustments in the same sequence as outlined below:

a. Apply power to the instrument and obtain the primary test pattern on screen.

b. Adjust A1R56 so that the horizontal lines of the four small boxes in the test pattern are of equal intensity.

c. Adjust A1R65 so that the vertical lines of the four small boxes in the test pattern are of equal intensity.

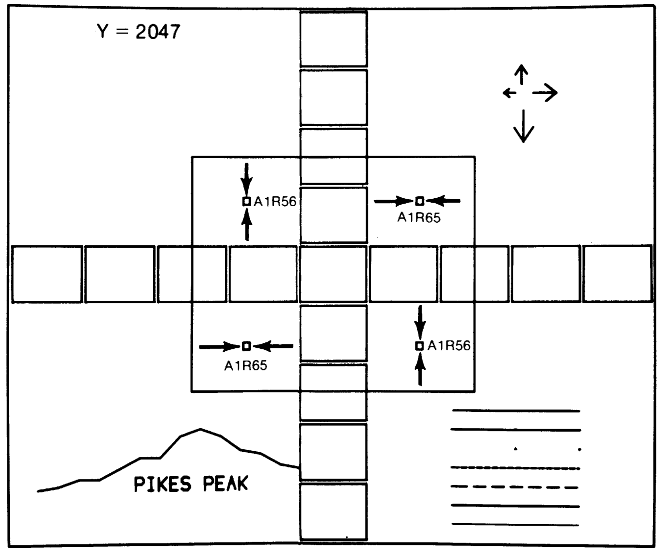


Figure 5-12. Stroke Intensity Adjustments

ADJUSTMENTS

Table 5-9. Stroke Intensity Adjustments.

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R56	X-Current Offset	5-17, b	3B	Equal intensity of horizontal lines of four small boxes in the test pattern (figure 5-12)
A1R65	Y-Current Off-set	5-17, c	3B	Equal intensity of vertical lines of four small boxes in the test pattern (figure 5-12)

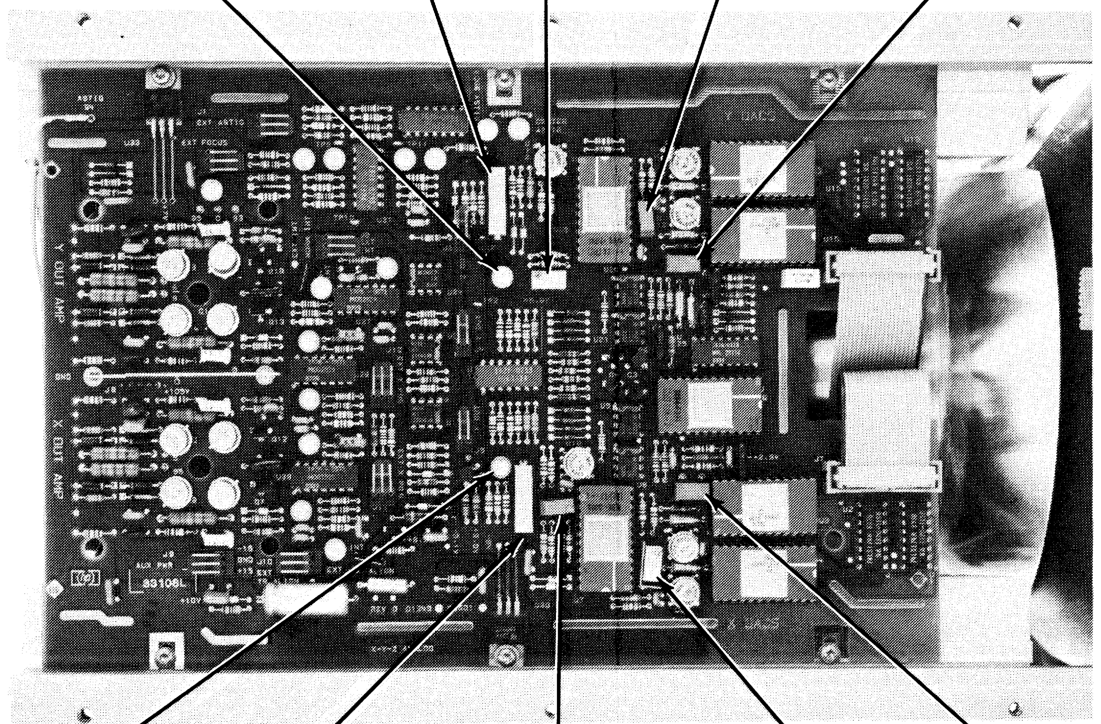


Figure 5-13. Stroke Generator, Stroke Length and Stroke Intensity Adjustment Locations

ADJUSTMENTS

5-18. IMAGE SIZE AND POSITION ADJUSTMENTS.

REFERENCE:
Service Sheet 3C

DESCRIPTION:
Using the 1349A/D secondary test pattern, the X Gain is set to 17 cm (6.69 in.) and the Y Gain is set to 12 cm (4.72 in.). The test pattern is also centered vertically and horizontally.

EQUIPMENT REQUIRED:
Power Supply

PROCEDURE:

a. Short A2J6-1 to A2J6-2 and apply power to the instrument. The secondary test pattern should be displayed.

b. Adjust Y-Pos (A1R105) until the test pattern is vertically centered.

c. Adjust Y-Gain (A1R110) so that the outside box of the pattern is exactly 12 cm (4.72 in.) high. A plastic see-through ruler cut to length and held against the CRT may be used for this measurement.

d. Adjust X-Pos (A1R82) to center the pattern horizontally.

e. Adjust X-Gain (A1R87) so that the outside box of the test pattern is exactly 17 cm (6.69 in.) wide. Use the same method of measurement as in step c.

f. Recenter the test pattern as necessary using X-Pos (A1R82) and Y-Pos (A1R105).

NOTE: Adjustment Locations for Image Size and Positioning are shown in figure 5-5.

Table 5-10. Image Size and Position Adjustments

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R105	Y-Pos	5-18, b	3C	Center test pattern vertically
A1R110	Y-Gain	5-18, c	3C	Adjust for a 12 cm (4.72 in.) high display
A1R82	X-Pos	5-18, d	3C	Center test pattern horizontally
A1R87	X-Gain	5-18, e	3C	Adjust for a 17 cm (6.69 in.) wide display

ADJUSTMENTS

h. Adjust A1R48 so that the left vertical line ends at exactly the top horizontal line in the test pattern.

i. Adjust A1R11 so that the top horizontal line originates at exactly the left vertical line in the test pattern.

j. Adjust A1R20 so that the top horizontal line ends at exactly the right vertical line in the test pattern.

k. The outside box of the pattern should now be closed properly. If not, recheck steps h through k.

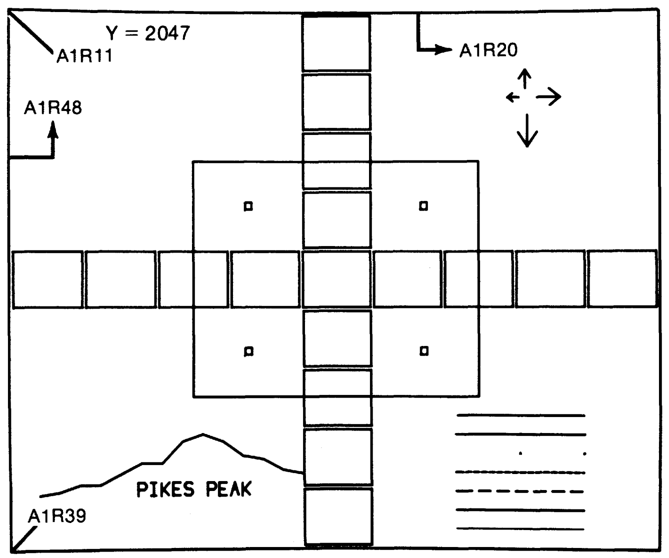


Figure 5-11. Stroke Length Adjustment

Table 5-8. Stroke Generator and Stroke Length Adjustments

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R36	Y-Stroke	5-16, c Offset	3A	Parallel lines of bottom boxes in the test pattern (figure 5-10)
A1R30	Y-Dac Gain	5-16, d	3A	Parallel line of top boxes in the test pattern (figure 5-10)
A1R8	X-Stroke Offset	5-16, e	3A	Parallel lines of left boxes in the test pattern (figure 5-10)
A1R1	X-Dac Gain	5-16, f	3A	Parallel lines of right boxes in the test pattern (figure 5-10)
A1R39	Y-Ramp Offset	5-16, h	3A	Left vertical line starts at bottom horizontal line in the test pattern (figure 5-11)

ADJUSTMENTS

Table 5-8. Stroke Generator and Stroke Length Adjustments (Con't)

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R48	Y-Stroke Length	5-16, i	3A	Left Vertical Line ends at top horizontal line in the test pattern (figure 5-11)
A1R11	X-Ramp Offset	5-16, h	3A	Top horizontal line starts at left Vertical line in the test pattern (figure 5-11)
A1R20	X-Stroke Length	5-16, k	3A	Top horizontal line ends at right vertical line in the test pattern (figure 5-11)

5-17. STROKE INTENSITY ADJUSTMENT.

REFERENCE:
Service sheet 3B.

DESCRIPTION:
This procedure describes the adjustments necessary to ensure equal intensity of all vectors.

EQUIPMENT REQUIRED:
Power supply

PROCEDURE:

NOTE

The following procedures are referenced to figure 5-11. Perform the following adjustments in the same sequence as outlined below:

a. Apply power to the instrument and obtain the primary test pattern on screen.

b. Adjust A1R56 so that the horizontal lines of the four small boxes in the test pattern are of equal intensity.

c. Adjust A1R65 so that the vertical lines of the four small boxes in the test pattern are of equal intensity.

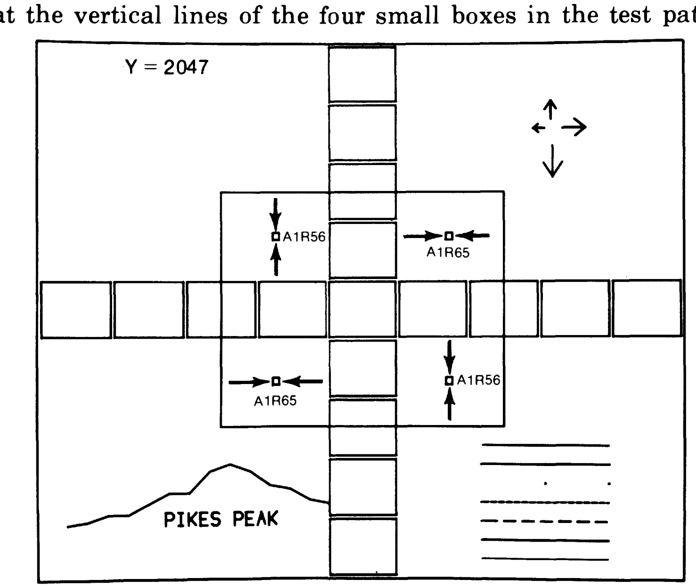


Figure 5-12. Stroke Intensity Adjustments

ADJUSTMENTS

Table 5-9. Stroke Intensity Adjustments.

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R56	X-Current Offset	5-17, b	3B	Equal intensity of horizontal lines of four small boxes in the test pattern (figure 5-12)
A1R65	Y-Current Off-set	5-17, c	3B	Equal intensity of vertical lines of four small boxes in the test pattern (figure 5-12)

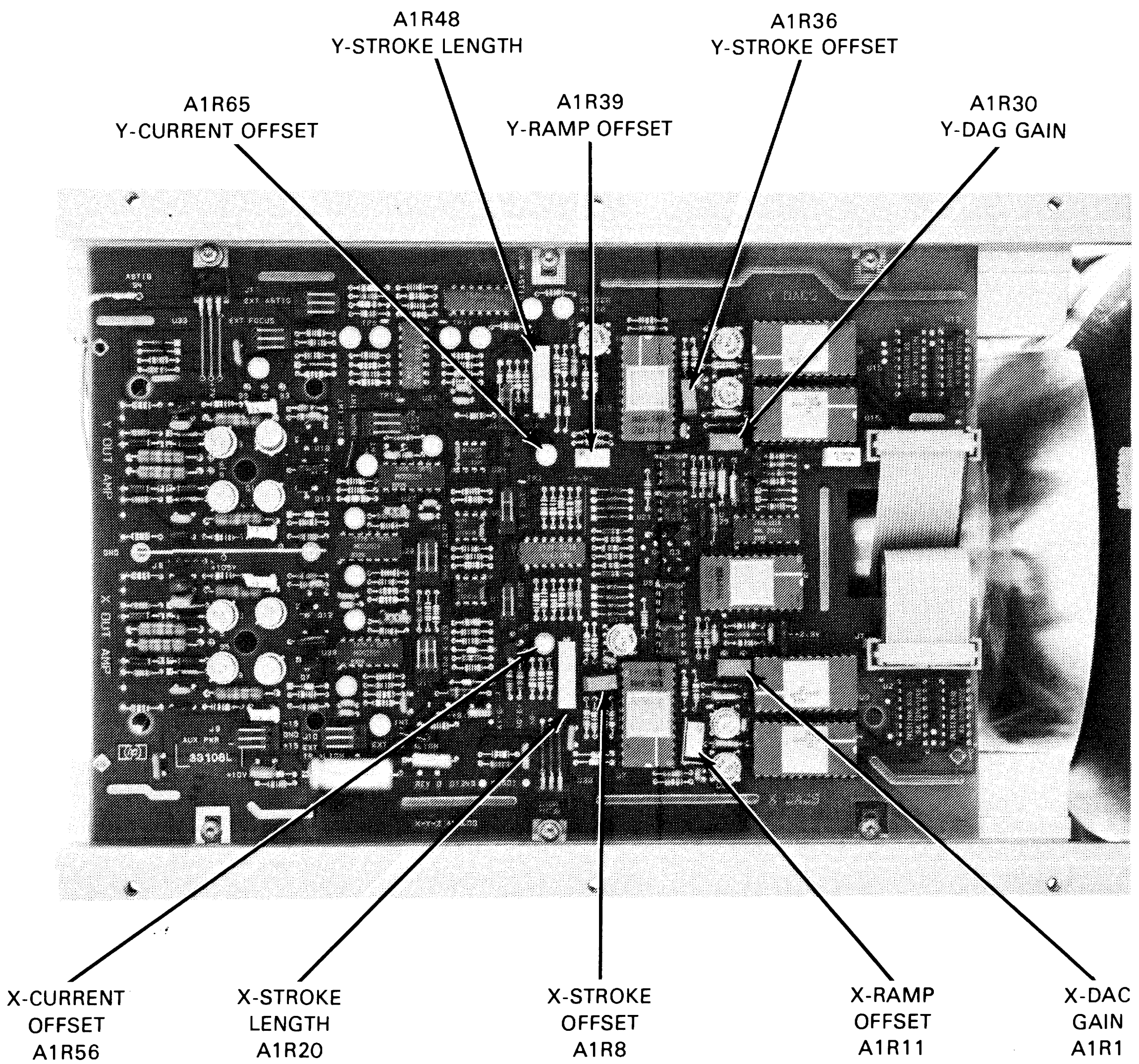


Figure 5-13. Stroke Generator, Stroke Length and Stroke Intensity Adjustment Locations

ADJUSTMENTS

5-18. IMAGE SIZE AND POSITION ADJUSTMENTS.

REFERENCE:
Service Sheet 3C

DESCRIPTION:
Using the 1349A/D secondary test pattern, the X Gain is set to 17 cm (6.69 in.) and the Y Gain is set to 12 cm (4.72 in.). The test pattern is also centered vertically and horizontally.

EQUIPMENT REQUIRED:
Power Supply

PROCEDURE:

a. Short A2J6-1 to A2J6-2 and apply power to the instrument. The secondary test pattern should be displayed.

b. Adjust Y-Pos (A1R105) until the test pattern is vertically centered.

c. Adjust Y-Gain (A1R110) so that the outside box of the pattern is exactly 12 cm (4.72 in.) high. A plastic see-through ruler cut to length and held against the CRT may be used for this measurement.

d. Adjust X-Pos (A1R82) to center the pattern horizontally.

e. Adjust X-Gain (A1R87) so that the outside box of the test pattern is exactly 17 cm (6.69 in.) wide. Use the same method of measurement as in step c.

f. Recenter the test pattern as necessary using X-Pos (A1R82) and Y-Pos (A1R105).

NOTE: Adjustment Locations for Image Size and Positioning are shown in figure 5-5.

Table 5-10. Image Size and Position Adjustments

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R105	Y-Pos	5-18, b	3C	Center test pattern vertically
A1R110	Y-Gain	5-18, c	3C	Adjust for a 12 cm (4.72 in.) high display
A1R82	X-Pos	5-18, d	3C	Center test pattern horizontally
A1R87	X-Gain	5-18, e	3C	Adjust for a 17 cm (6.69 in.) wide display

ADJUSTMENTS

5-19. VECTOR CLOSURE.

REFERENCE:
Service Sheet 3A

DESCRIPTION:
The procedures outlined below describe the adjustments necessary for best overall vector closure between the low speed vectors and high speed vectors. The secondary test pattern is used for this procedure.

EQUIPMENT REQUIRED:
Power Supply

PROCEDURE:

a. Short A2J6-1 to A2J6-2 and apply power to the instrument to obtain the secondary test pattern.

b. Adjust Y-Ramp Offset (A1R39) and Y-Stroke Length (A1R48) for best overall vector closure between low speed vector and high speed vectors. Try to keep the low speed box corners closed while adjusting the high speed as close as possible. Refer to figure 5-14.

c. Adjust X-Ramp Offset (A1R11) and X-Stroke Length (A1R20) for best overall closure between the low speed vectors and the high speed vectors. Try to keep the low speed corners closed while bringing the high speed as close as possible. Refer to figure 5-14.

Table 5-11. Vector Closure Adjustments

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R39	Y-Ramp Offset	5-19, b	3A	Best overall vector closure (Y-Axis)
A1R48	Y-Stroke Length	5-19, b	3A	Best overall vector closure (Y-Axis)
A1R11	X-Ramp Offset	5-19, c	3A	Best overall vector closure (X-Axis)
A1R20	X-Stroke Length	5-19, c	3A	Best overall vector closure (X-Axis)

ADJUSTMENTS

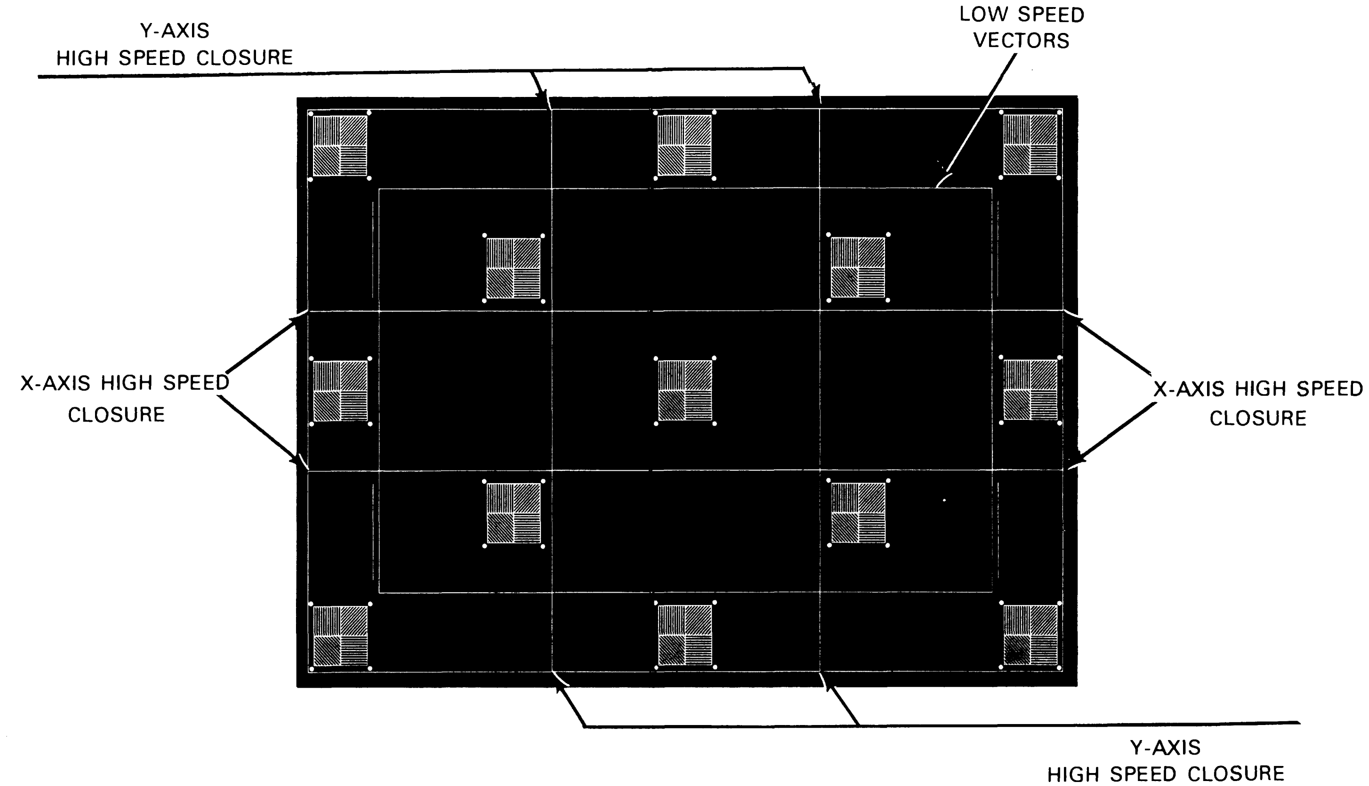


Figure 5-14. X-Y Vector Closure

ADJUSTMENTS

5-20. FINE FOCUS AND ASTIGMATISM ADJUSTMENT AND RESOLUTION CHECK.

REFERENCE:
Service Sheet 3C, 5

DESCRIPTION:
These procedures provide the necessary adjustments for optimum focus of the display. The secondary test pattern is used as the signal source. A resolution check at the end of this procedure is also included.

EQUIPMENT REQUIRED:
Power Supply

PROCEDURE:

NOTE

The fine focus and astigmatism adjustment is based on the correct set-up of all previous adjustment procedures.

The following procedures reference figure 5-15. Perform the following adjustments in the same sequence as outlined below:

a. Short A2J6-1 to A2J6-2 and apply power to the instrument to obtain the secondary test pattern.

b. Adjust Focus (A4R42) on High Voltage board and Center Astig (A1R169) on Analog X-Y-Z board to convert dots on secondary test pattern to short vertical lines.

c. Adjust 45° Astig (A4R54) on High Voltage board so that all converted dots are close to vertical. When optimally set the converted dots may lean to left and right of vertical in different parts of CRT. In this case set to least overall departure from vertical.

d. Adjust Center Astig (A1R169) so that dots around the three centermost patters stay round when Focus (A4R42) is adjusted slightly either side of smallest dots. This may require some compromise between Center Astig and Focus adjustments.

e. Adjust Edge Astig (A1R171) for best display at the centermost edge patterns.

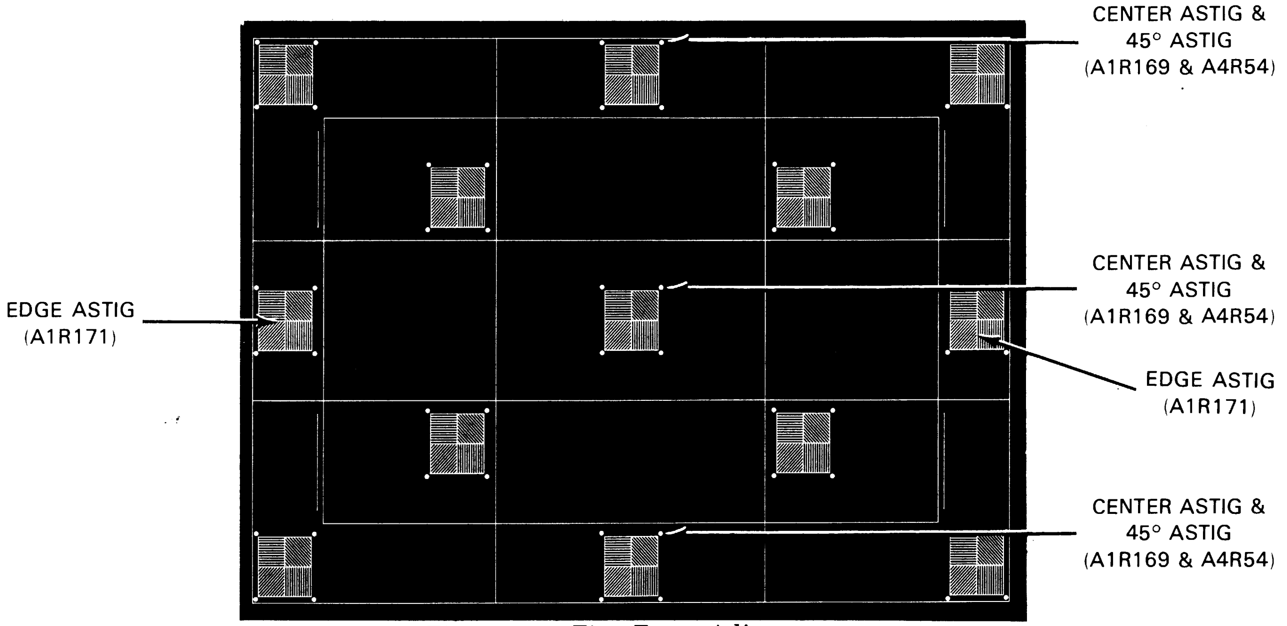


Figure 5-15. Fine Focus Adjustment

ADJUSTMENTS

NOTE

Refer to figure 5-16 for the following procedures.

f. Adjust X-Focus Gain (A1R142) for best display at the X-Axis edges.

g. Adjust Y-Focus Gain (A1R145) for best display at the Y-Axis edges.

h. Adjust Focus (A4R42 on High Voltage Board) for best picture. Concentrate on the four vertical medium intensity segments of the pattern while keeping best overall focus on the rest of the display.

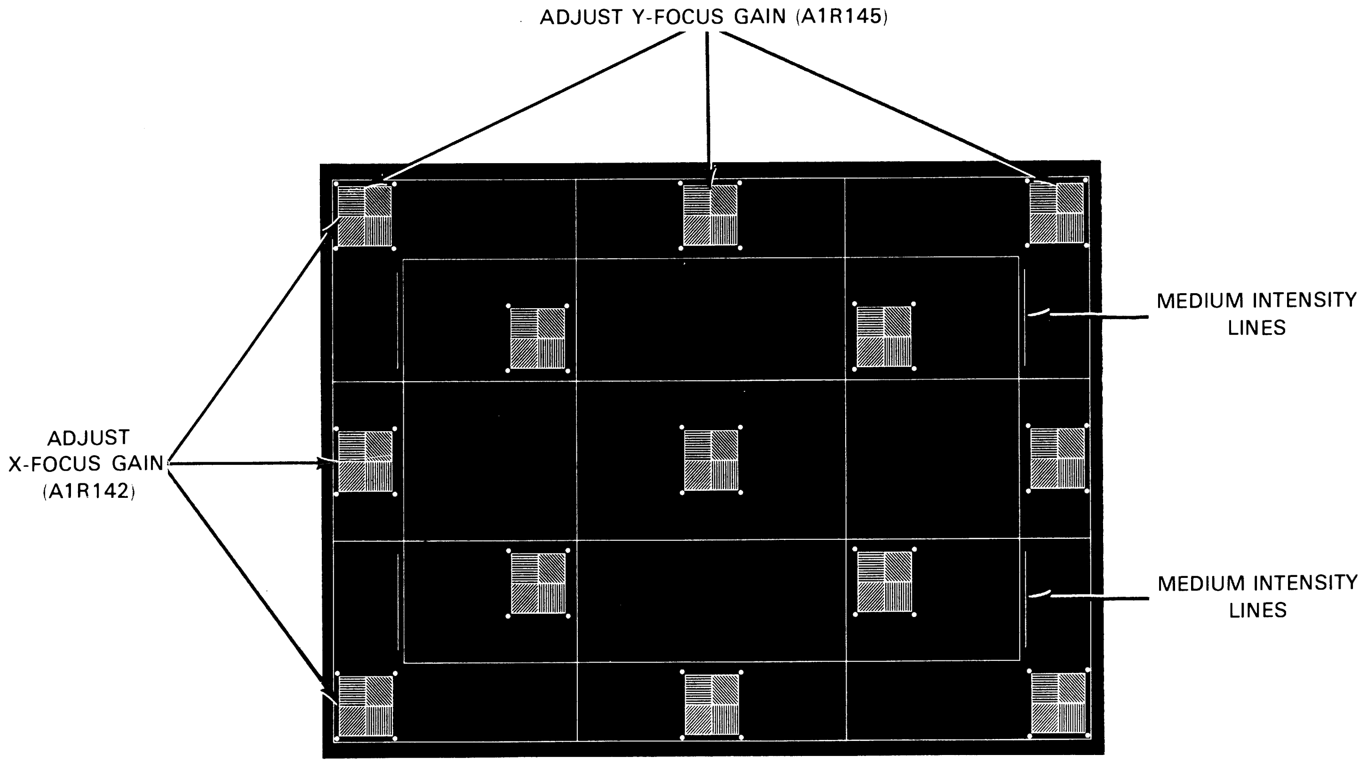
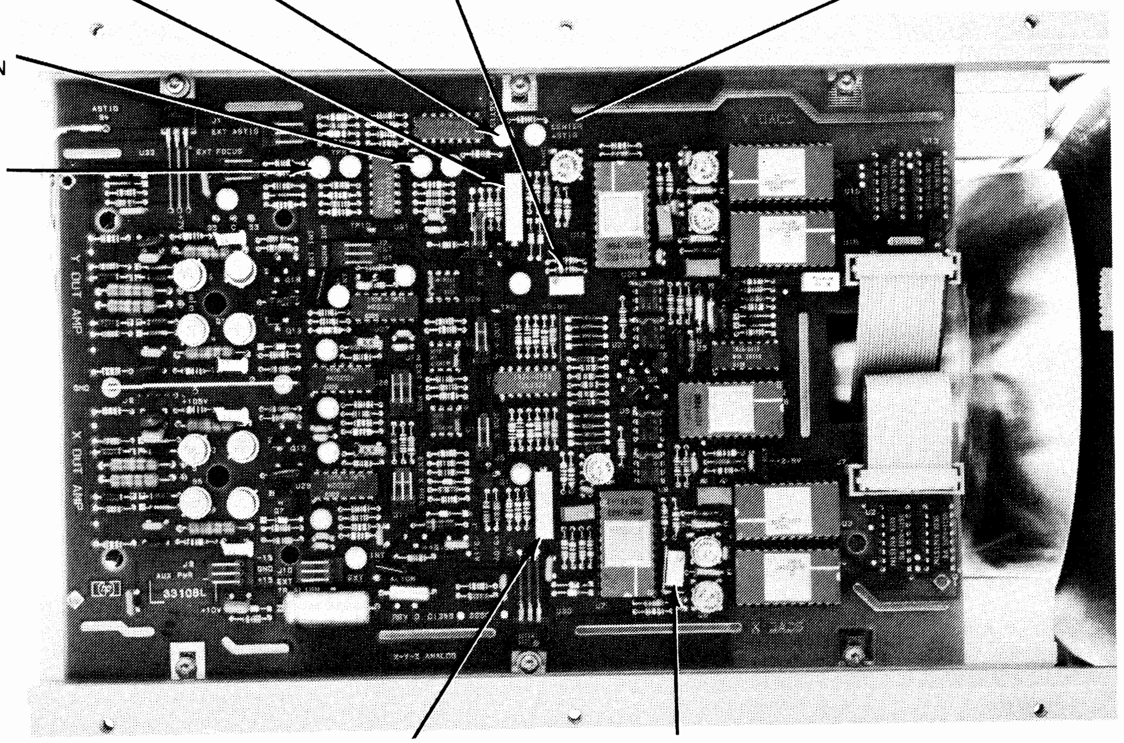


Figure 5-16. Fine Focus Adjustment

ADJUSTMENTS



Note: High Voltage cover is removed.

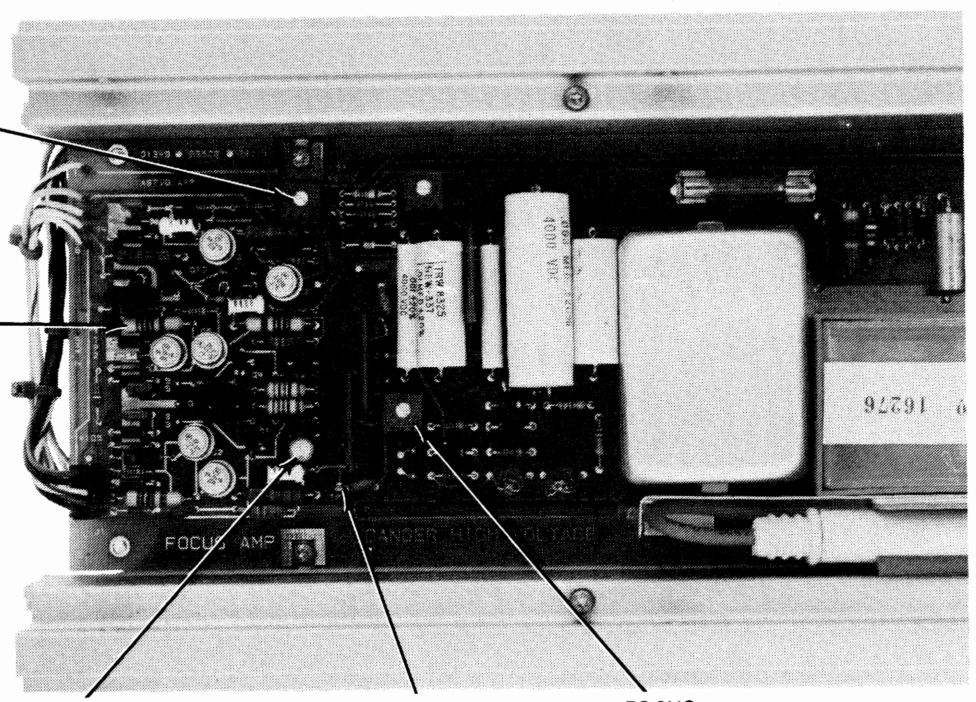


Figure 5-17. Vector Closure, Focus and Astig Adjustment Locations

ADJUSTMENTS

RESOLUTION CHECK.

A 1349A/D passes the resolutuion test if all of the lines in the 13 boxes of the test pattern can be resolved. If the resolution tests fails, it may be necessary to adjust Focus and Astig adjustments slightly to improve overall definition of the secondary test pattern.

Table 5-12. Fine Focus and Astigmatism Adjustment

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A4R54	45 degree Astig	5-20, b, c	5	Adjust for most vertical converted dots
A1R169	Center Astig	5-20, d	3C	Adjust for round dots on both sides of Focus of three centermost patterns
A1R171	Edge Astig	5-20, e	3C	Adjust for best display of center-most edge patterns
A1R142	X-Focus Gain	5-20, f	3C	Adjust for best display at X-Axis
A1R145	Y-Focus Gain	5-20, g	3C	Adjust for best display at Y-Axis
A4R42	Focus	5-20, h	5	Adjust for best overall display

ADJUSTMENTS

5-21. AUXILIARY X-Y-Z OUTPUT CHECK

REFERENCE:
Service Sheets 3A, 3B.

DESCRIPTION:
This check verifies the auxiliary X-Y-Z Outputs

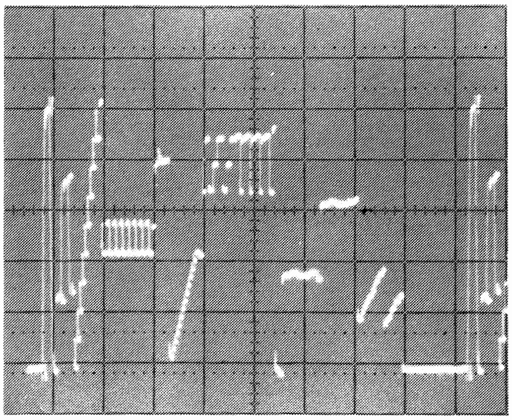
EQUIPMENT REQUIRED:
Power Supply
Oscilloscope
10:1 Divider Probe

PROCEDURE:

a. Apply power to the instrument and obtain the primary test pattern on screen.

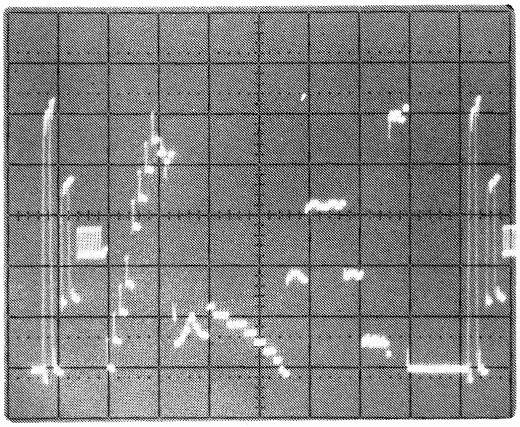
b. Connect oscilloscope to A1J5 pin 2 and check for a display as shown in figure 5-18.

c. Monitor A1J4 Pin 2 and check the oscilloscope for a display as shown in figure 5-19.



VERTICAL ATTENUATOR = 20 mV/div.
SWEEP = 1 mS/div.

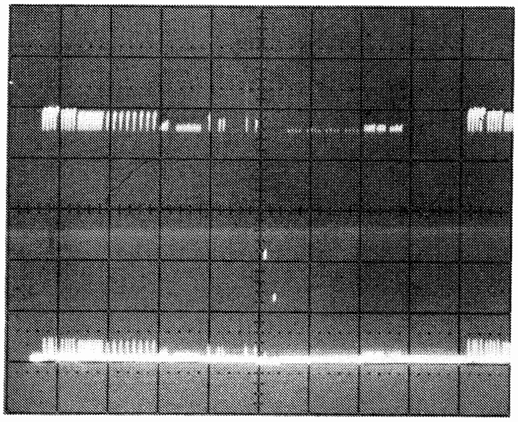
Figure 5-18. X-Amplifier Auxiliary Output



VERTICAL ATTENUATOR = 20 mV/div.
SWEEP = 1 ms/div.

Figure 5-19. Y-Amplifier Auxiliary Output

d. Monitor A1J3 Pin 2 and check for a display on the oscilloscope as shown in figure 5-20.



VERTICAL ATTENUATOR = 20 mV/div.
SWEEP = 500 mS/div.

Figure 5-20. Z-Amplifier Auxiliary Output

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering parts. Table 6-1 lists abbreviations used in the parts list, table 6-2 lists all replaceable parts in reference designator order.

6-3. ABBREVIATIONS.

6-4. Table 6-1 lists abbreviations used in the parts list, the schematics, and throughout the manual. In some cases, two forms of the abbreviations are used, one all in capital letters, and one partial or no capitals. This occurs because the abbreviations in the parts list are always all capitals. However, in other parts of the manual other abbreviation forms are used with both lower and uppercase letters.

6-5. REPLACEABLE PARTS LIST.

6-6. Table 6-2 is the list of replaceable parts and is organized as follows:

a. Electrical assemblies in alphanumerical order by reference designation.

b. Chassis-mounted parts in alphanumerical order by reference designation.

c. Electrical assemblies and their components in alphanumerical order by reference designation.

The information given for each part consists of the following:

a. Complete reference designation.

b. Hewlett-Packard part number.

c. Total quantity (Qty) in instrument.

d. Description of part.

e. Check digit.

The total quantity for each part is only given once, at the first appearance of the part number in the list.

6-7. ORDERING INFORMATION.

6-8. To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number, check digit, indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

6-9. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and number of parts required. Address the order to the nearest Hewlett-Packard office.

6-10. DIRECT MAIL ORDER SYSTEM.

6-11. Within the USA, Hewlett-Packard can supply parts through a direct mail order system. Advantages of using the system are as follows:

a. Direct ordering and shipment from HP Parts Center in Mountain View, California.

b. No maximum or minimum on any mail order (there is a minimum order amount for parts ordered through local HP offices when orders require billing and invoicing).

c. Prepaid transportation (there is a small handling charge for each order).

d. No invoices - to provide these advantages, check or money order must accompany each order.

6-12. Mail order forms and specific ordering information are available through your local HP offices.

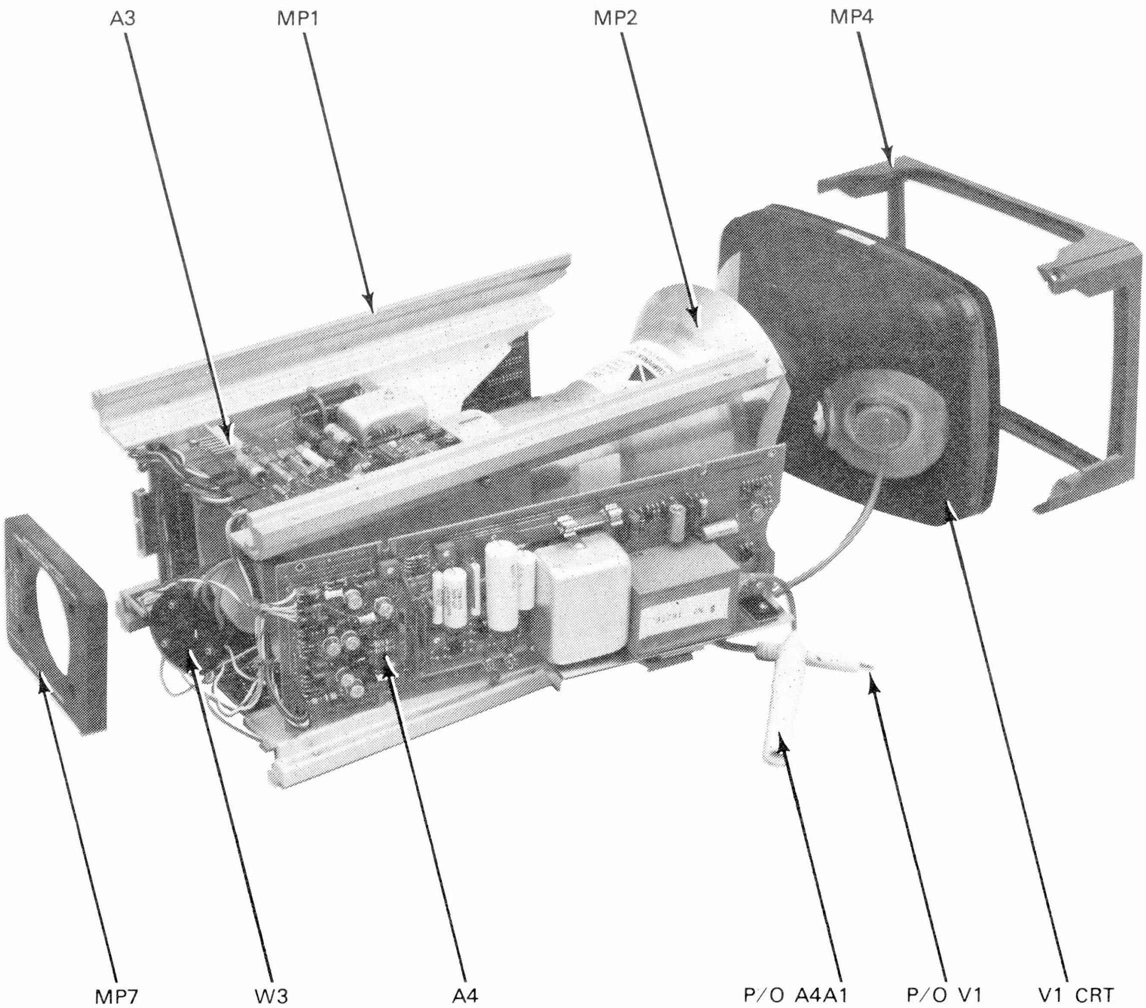
Table 6-1. Reference Designators and Abbreviations

REFERENCE DESIGNATORS

A	= assembly	**F**	= fuse	**MP**	= mechanical part	**U**	= integrated circuit
B	= motor	**FL**	= filter	**P**	= plug	**V**	= vacuum, tube, neon bulb, photocell, etc
BT	= battery	**IC**	= integrated circuit	**Q**	= transistor		
C	= capacitor	**J**	= jack	**R**	= resistor	**VR**	= voltage regulator
CP	= coupler	**K**	= relay	**RT**	= thermistor	**W**	= cable
CR	= diode	**L**	= inductor	**S**	= switch	**X**	= socket
DL	= delay line	**LS**	= loud speaker	**T**	= transformer	**Y**	= crystal
DS	= device signaling (lamp)	**M**	= meter	**TB**	= terminal board	**Z**	= tuned cavity network
E	= misc electronic part	**MK**	= microphone	**TP**	= test point		

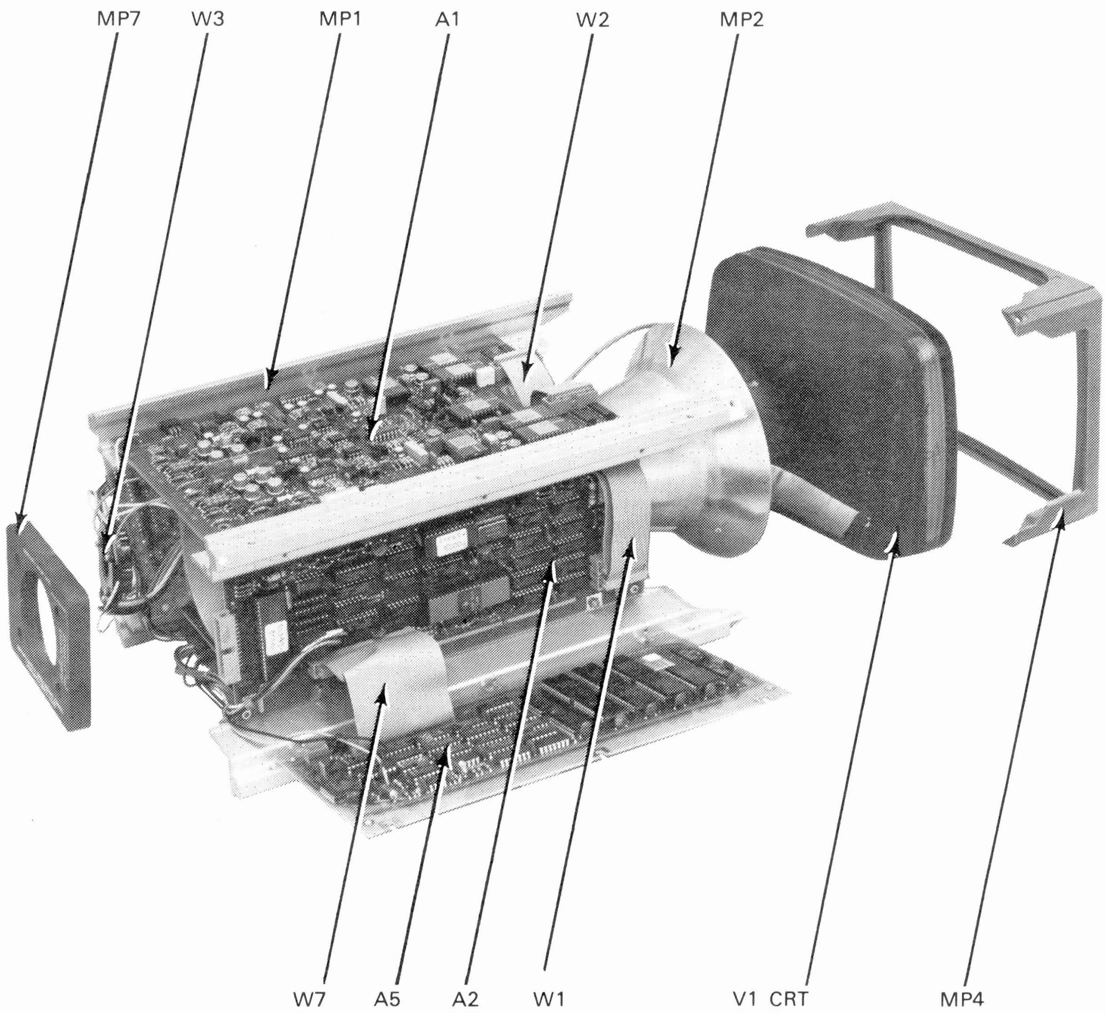
ABBREVIATIONS

A	= amperes	**H**	= henries	**N/O**	= normally open	**RMO**	= rack mount only
AFC	= automatic frequency control	**HDW**	= hardware	**NOM**	= nominal	**RMS**	= root-mean square
AMPL	= amplifier	**HEX**	= hexagonal	**NPO**	= negative positive zero (zero temperature coefficient)	**RWV**	= reverse working voltage
		HG	= mercury				
BFO	= beat frequency oscillator	**HR**	= hour(s)				
BE CU	= beryllium copper	**HZ**	= hertz	**NPN**	= negative-positive-negative	**S-B**	= slow-blow
BH	= binder head					**SCR**	= screw
BP	= bandpass			**NRFR**	= not recommended for field replacement	**SE**	= selenium
BRS	= brass	**IF**	= intermediate freq			**SECT**	= section(s)
BWO	= backward wave oscillator	**IMPG**	= impregnated	**NSR**	= not separately replaceable	**SEMICON**	= semiconductor
		INCD	= incandescent			**SI**	= silicon
CCW	= counter-clockwise	**INCL**	= include(s)			**SIL**	= silver
CER	= ceramic	**INS**	= insulation(ed)	**OBD**	= order by description	**SL**	= slide
CMO	= cabinet mount only	**INT**	= internal	**OH**	= oval head	**SPG**	= spring
COEF	= coeficient			**OX**	= oxide	**SPL**	= special
COM	= common	**K**	= kilo=1000			**SST**	= stainless steel
COMP	= composition					**SR**	= split ring
COMPL	= complete	**LH**	= left hand	**P**	= peak	**STL**	= steel
CONN	= connector	**LIN**	= linear taper	**PC**	= printed circuit		
CP	= cadmium plate	**LK WASH**	= lock washer	**PF**	= picofarads= 10^{-12} farads	**TA**	= tantalum
CRT	= cathode-ray tube	**LOG**	= logarithmic taper			**TD**	= time delay
CW	= clockwise	**LPF**	= low pass filter	**PH BRZ**	= phosphor bronze	**TGL**	= toggle
				PHL	= phillips	**THD**	= thread
DEPC	= deposited carbon	**M**	= milli=10^{-3}	**PIV**	= peak inverse voltage	**TI**	= titanium
DR	= drive	**MEG**	= meg=10^{6}	**PNP**	= positive-negative-positive	**TOL**	= tolerance
		MET FLM	= metal film			**TRIM**	= trimmer
ELECT	= electrolytic	**MET OX**	= metallic oxide	**P/O**	= part of	**TWT**	= traveling wave tube
ENCAP	= encapsulated	**MFR**	= manufacturer	**POLY**	= polystyrene		
EXT	= external	**MHZ**	= mega hertz	**PORC**	= porcelain	**U**	= micro=10^{-6}
		MINAT	= miniature	**POS**	= position(s)		
F	= farads	**MOM**	= momentary	**POT**	= potentiometer	**VAR**	= variable
FH	= flat head	**MOS**	= metal oxide substrate	**PP**	= peak-to-peak	**VDCW**	= dc working volts
FIL H	= fillister head	**MTG**	= mounting	**PT**	= point		
FXD	= fixed	**MY**	= "mylar"	**PWV**	= peak working voltage	**W/**	= with
						W	= watts
G	= giga (10^{9})	**N**	= nano (10^{-9})	**RECT**	= rectifier	**WIV**	= working inverse voltage
GE	= germanium	**N/C**	= normally closed	**RF**	= radio frequency		
GL	= glass	**NE**	= neon	**RH**	= round head or right hand	**WW**	= wirewound
GRD	= ground(ed)	**NI PL**	= nickel plate			**W/O**	= without



HARDWARE FOR:	USE HARDWARE	QTY	USE TORX SCREW DRIVER NO.
PC BOARDS	0515-0432 (H1)	25	T10
PRELOAD RING (MP7)	0515-0636 (H4)	4	T15
CRT BEZEL (MP4)	0515-0788 (H2)	4	T10

P/O Figure 6-1. Chasis Parts and Board Assembly Identification



HARDWARE FOR:	USE HARDWARE	QTY	USE TORX SCREW DRIVER NO.
PC BOARDS	0515-0432 (H1)	25	T10
PRELOAD RING (MP7)	0515-0636 (H4)	4	T15
CRT BEZEL (MP4)	0515-0788 (H2)	4	T10

P/O Figure 6-1. Chasis Parts and Board Assembly Identification

Table 6-2. Replaceable Parts

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	01349-66509	2	1	BOARD ASSEMBLY-ANALOG-XYZ	28480	01349-66509
A2	01349-66507	3	1	BOARD ASSEMBLY-VPC DOT	28480	01349-66507
A3	01349-66504	5	1	BOARD ASEMBLY-LOW VOLTAGE	28480	01349-66504
A4	01349-66508	4	1	BOARD ASSEMBLY-HIGH VOLTAGE	28480	01349-66508
A5	01349-66506	6	1	BOARD ASSEMBLY-MEMORY (1349D ONLY)	28480	01349-66506
H1	0515-0432	5	25	SCREW-METRIC M3X.05 6MM LG PAN-HD TAPTITE	00000	ORDER BY DESCRIPTION
H2	0515-0788		4	SCREW-METRIC M4.0X0.7X10MM LONG TAPTITE	00000	ORDER BY DESCRIPTION
H3	0515-1026	5	2	SCREW-METRIC M3X.05 10MM LG TO-10 TAPTITE	00000	ORDER BY DESCRIPTION
H4	0515-0636	1	4	SCREW-MACHINE M4X.07 25MM-LG PAN-HD	00000	ORDER BY DESCRIPTION
H5	3050-0105	6	2	WASHER FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
H6	2190-0584	0	2	WASHER-LK HLCL 3.0MM 3.1MM-ID	28480	2190-0584
MP1	01349-00501	4	1	MAIN FRAME	28480	01349-00501
MP2	01349-60601	1	1	SHIELD-CRT	28480	01349-60601
MP3	01349-66001	7	1	ALIGNMENT COIL ASSEMBLY	28480	01349-66001
MP4	01349-40001		1	BEZEL	28480	01349-40001
MP5	1520-0661	4	4	FOAM VIBRATION MOUNT-BEZEL	28480	1520-0661
MP6	0330-0379	7	1	SHOCK RING-CRT	28480	0330-0379
MP7	01349-40003	8	1	RING-PRELOAD	28480	01349-40003
MP8	0400-0009	9	1	GROMMET-RND .125-IN-ID .25-IN-GRV-OD	28480	0400-0009
MP9	0340-0564	3	2	INSULATOR-XSTOR THERM CNDT	28480	0340-0564
MP10	0340-0977	2	2	INSULATOR-FLG-BSHG NYLON	28480	0340-0977
MP11	1400-1251	6	1	CLAMP-CABLE	28480	1400-1251
MP12	01349-00601	5	1	SHIELD-OUTER HIGH VOLTAGE	28480	01349-00601
MP13	1400-0249	0	3	CABLE TIE .062-.625 DIA .091-WD NYL	06383	PLT1M-8
V1	5083-6350	6	1	ELECTRON TUBE: PHOSPHOR CRT P31 AL NG	28480	5083-6350
W1	01349-61601	3	1	CABLE VPC TO ANALOG	28480	01349-61601
W2	01349-61602	4	1	CABLE VPC TO ANALOG	28480	01349-61602
W3	01349-61607	9	1	CABLE CRT HARNESS	28480	01349-61607
W4	01349-61605	7	1	CABLE ASSEMBLY-LOW VOLTAGE TO HIGH VOLTAGE	28480	01349-61605
W5	01349-61608	0	1	CABLE ASSEMBLY-LOW VOLTAGE TO VPC	28480	01349-61608
W6	01349-61604	6	1	CABLE ASSEMBLY-LOW VOLTAGE TO VPC	28480	01349-61604
W7	01349-61603	2	1	CABLE VECTOR MEMORY TO VPC	28480	01349-61603
				MISCELLANEOUS		
	8150-0005		1	JUMPER-BLACK (0) ANALOG BD TO HIGH VOLTAGE BD	28480	8150-0005
	8150-0013		1	JUMPER-GREEN/WHITE (95) ANALOG BD TO HIGH VOLTAGE BD	28480	8150-0013
	8150-0018		1	JUMPER-ORANGE/WHITE (93) ANALOG BD TO HIGH VOLTAGE BD	28480	8150-0018
	8150-0040		1	JUMPER-YELLOW/WHITE (94) ANALOG BD TO HIGH VOLTAGE BD	28480	8150-0040
			1	INSTALLATION GUIDE	28480	
	9282-0100		1	BINDER-3 RING	28480	9282-0100
	01349-90901		1	OPERATING AND SERVICE MANUAL	28480	01349-90901

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	01349-66509	2	1	BOARD-ASSY-ANA XYZ	28480	01349-66509
A1C1	0160-3569	2	4	CAPACITOR-FXD 27PF ±5% 100VDC CER 0±30	28480	0160-3569
A1C2	0160-3569	2		CAPACITOR-FXD 27PF ±5% 100VDC CER 0±30	28480	0160-3569
A1C3	0160-3569	2		CAPACITOR-FXD 27PF ±5% 100VDC CER 0±30	28480	0160-3569
A1C4	0160-3569	2		CAPACITOR-FXD 27PF ±5% 100VDC CER 0±30	28480	0160-3569
A1C5	0180-0374	3	1	CAPACITOR-FXD 10UF ±10% 20VDC TA	56289	150D106X9020B2
A1C6	0160-2204	0	3	CAPACITOR-FXD 100PF ±5% 300VDC MICA	28480	0160-2204
A1C7	0160-3443	1	14	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1C8	0160-2204	0		CAPACITOR-FXD 100PF ±5% 300VDC MICA	28480	0160-2204
A1C9	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1C10	0140-0196	3	1	CAPACITOR-FXD 150PF ±5% 300VDC MICA	72136	DM15F151J0300WV1CR
A1C11	0160-2204	0		CAPACITOR-FXD 100PF ±5% 300VDC MICA	28480	0160-2204
A1C12	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1C13	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1C14	0160-2253	9	2	CAPACITOR-FXD 6.8PF ±.25PF 500VDC CER	28480	0160-2253
A1C15				NOT ASSIGNED		
A1C16	0160-2237	9	4	CAPACITOR-FXD 1.2PF 500VDC CER	28480	0160-2237
A1C17	0160-2055	9	4	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C18	0160-3670	6	4	CAPACITOR-FXD .1UF ±20% 200VDC CER	28480	0160-3670
A1C19	0160-3670	6		CAPACITOR-FXD .1UF ±20% 200VDC CER	28480	0160-3670
A1C20	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C21	0160-2237	9		CAPACITOR-FXD 1.2PF 500VDC CER	28480	0160-2237
A1C22	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1C23	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1C24	0160-2253	9		CAPACITOR-FXD 6.8PF ±.25PF 500VDC CER	28480	0160-2253
A1C25				NOT ASSIGNED		
A1C26	0160-2237	9		CAPACITOR-FXD 1.2PF 500VDC CER	28480	0160-2237
A1C27	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C28	0160-3670	6		CAPACITOR-FXD .1UF ±20% 200VDC CER	28480	0160-3670
A1C29	0160-3670	6		CAPACITOR-FXD .1UF ±20% 200VDC CER	28480	0160-3670
A1C30	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A1C31	0160-2237	9		CAPACITOR-FXD 1.2PF 500VDC CER	28480	0160-2237
A1C32	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1C33	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1C34	0160-3470	4	2	CAPACITOR-FXD .01UF +80-20% 50VDC CER	28480	0160-3470
A1C35	0160-3470	4		CAPACITOR-FXD .01UF +80-20% 50VDC CER	28480	0160-3470
A1C36	0160-3508	9	7	CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A1C37	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A1C38	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A1C39	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A1C40	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A1C41	0180-0094	1	2	CAPACITOR-FXD 100UF +75-10% 25VDC AL	56289	30D107G025DD2
A1C42	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A1C43	0160-3508	9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A1C44	0160-0197	6	6	CAPACITOR-FXD 2.2UF ±10% 20VDC TA	28480	150D225X9020A2
A1C45	0160-0197			CAPACITOR-FXD 2.2UF ±10% 20VDC TA	28480	150D225X9020A2
A1C46	0180-0197	8		CAPACITOR-FXD 2.2UF ±10% 20VDC TA	56289	150D225X9020A2
A1C47	0180-0197	8		CAPACITOR-FXD 2.2UF ±10% 20VDC TA	56289	150D225X9020A2
A1C48	0180-0197	8		CAPACITOR-FXD 2.2UF ±10% 20VDC TA	56289	150D225X9020A2
A1C49	0180-0197	8		CAPACITOR-FXD 2.2UF ±10% 20VDC TA	56289	150D225X9020A2
A1C50	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1C51	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1C52	0160-3443	1		CAPACITOR-FXD 0.1UF +80-20% 50VDC CER	28480	0160-3443
A1C53	0160-3443	1		CAPACITOR-FXD 0.1UF +80-20% 50VDC CER	28480	0160-3443
A1C54	0160-3443	1		CAPACITOR-FXD 0.1UF +80-20% 50VDC CER	28480	0160-3443
A1C55	0160-3443	1		CAPACITOR-FXD 0.1UF +80-20% 50VDC CER	28480	0160-3443
A1CR1	1901-1068	5	8	DIODE-SM SIG SCHOTTKY	28480	1901-1068
A1CR2	1901-1068	5		DIODE-SM SIG SCHOTTKY	28480	1901-1068
A1CR3	1901-1068	5		DIODE-SM SIG SCHOTTKY	28480	1901-1068
A1CR4	1901-1068	5		DIODE-SM SIG SCHOTTKY	28480	1901-1068
A1CR5	1901-1068	5		DIODE-SM SIG SCHOTTKY	28480	1901-1068
A1CR6	1901-1068	5		DIODE-SM SIG SCHOTTKY	28480	1901-1068
A1CR7	1901-1068	5		DIODE-SM SIG SCHOTTKY	28480	1901-1068
A1CR8	1901-1068	5		DIODE-SM SIG SCHOTTKY	28480	1901-1068
A1CR9	1901-0040	1	5	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR11	1901-0028	5	8	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A1CR12	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A1CR13	1901-0096	7	4	DIODE-SWITCHING 120V 50MA 100NS	28480	1901-0096
A1CR14	1901-0096	7		DIODE-SWITCHING 120V 50MA 100NS	28480	1901-0096

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1CR15	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A1CR16	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A1CR17	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A1CR18	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A1CR19	1901-0096	7		DIODE-SWITCHING 120V 50MA 100NS	28480	1901-0096
A1CR20	1901-0096	7		DIODE-SWITCHING 120V 50MA 100NS	28480	1901-0096
A1CR21	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A1CR22	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A1CR23	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR24	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1CR25	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A1E1	0360-1653	5	9	CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1653
A1E2	0360-1653	5		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1653
A1E3	0360-1653	5		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1653
A1E4	0360-1653	5		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1653
A1E5	0360-1653	5		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1653
A1E6	0360-1653	5		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1653
A1E7	0360-1653	5		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1653
A1E8	0360-1653	5		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1653
A1E9	0360-1653	5		CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1653
A1E10	1258-0124	7	2	PIN-PROGRAMING DUMPER .30 CONTACT	91506	8136-475G1
A1E11	1258-0124	7		PIN-PROGRAMING DUMPER .30 CONTACT	91506	8136-475G1
A1J1	1251-5971	8	7	CONNECTOR 3-PIN M METRIC POST TYPE	28480	1251-5971
A1J2	1251-5971	8		CONNECTOR 3-PIN M METRIC POST TYPE	28480	1251-5971
A1J3	1251-4836	2	3	CONNECTOR 2-PIN M METRIC POST TYPE	28480	1251-4836
A1J4	1251-4836	2		CONNECTOR 2-PIN M METRIC POST TYPE	28480	1251-4836
A1J5	1251-4836	2		CONNECTOR 2-PIN M METRIC POST TYPE	28480	1251-4836
A1J6	1251-6823	1	2	CONNECTOR 20-PIN M POST TYPE	28480	1251-6823
A1J7	1251-6823	1		CONNECTOR 20-PIN M POST TYPE	28480	1251-6823
A1J8	1251-6000	6	1	CONNECTOR 5-PIN M METRIC POST TYPE	28480	1251-6000
A1J9	1251-5971	8		CONNECTOR 3-PIN M METRIC POST TYPE	28480	1251-5971
A1J10	1251-5971	8		CONNECTOR 3-PIN M METRIC POST TYPE	28480	1251-5971
A1J11	1251-5971	8		CONNECTOR 3-PIN M METRIC POST TYPE	28480	1251-5971
A1J12	1251-5971	8		CONNECTOR 3-PIN M METRIC POST TYPE	28480	1251-5971
A1J13	1251-5971	8		CONNECTOR 3-PIN M METRIC POST TYPE	28480	1251-5971
A1MP1	1600-1038	1	1	SHIELD-AMPLIFIER	28480	1600-1038
A1MP2	1600-1148	4	1	SHIELD CONTROL	28480	1600-1148
A1Q1	1855-0052	6	2	TRANSISTOR J-FET P-CHAN D-MODE TO-92 SI	07263	2N4360
A1Q2	1855-0052	6		TRANSISTOR J-FET P-CHAN D-MODE TO-92 SI	07263	2N4360
A1Q3	1853-0354	7	4	TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A1Q4	1853-0354	7		TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A1Q5	1853-0354	7		TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A1Q6	1853-0354	7		TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A1Q7	1853-0036	2	4	TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1Q8	1853-0038	4	4	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A1Q9	1854-0419	7	4	TRANSISTOR NPN SI TO-39 PD=1W FT=200MHZ	28480	1854-0419
A1Q10	1853-0038	4		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A1Q11	1854-0419	7		TRANSISTOR NPN SI TO-39 PD=1W FT=200MHZ	28480	1854-0419
A1Q12	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1Q13	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1Q14	1853-0038	4		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A1Q15	1854-0419	7		TRANSISTOR NPN SI TO-39 PD=1W FT=200MHZ	28480	1854-0419
A1Q16	1853-0038	4		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A1Q17	1854-0419	7		TRANSISTOR NPN SI TO-39 PD=1W FT=200MHZ	28480	1854-0419
A1Q18	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1R1	2100-3349	2	2	RESISTOR-TMR 100 10% C SIDE ADJ 1-TRN	28480	2100-3349
A1R2	0757-0394	0	4	RESISTOR 51.1 1% .125W F TC=0±100	24546	C4-1/8-T0-51R1-F
A1R3	0757-0418	9	2	RESISTOR 619 1% .125W F TC=0±100	24546	C4-1/8-T0-619R-F
A1R4	0757-1094	9	2	RESISTOR 1.47K 1% .125W F TC=0±100	24546	C4-1/8-T0-1471-F
A1R5	0757-0433	8	17	RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-F
A1R6	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-F
A1R7	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-F
A1R8	2100-3288	8	4	RESISTOR-TRMR 50 20% C TOP-ADJ 17-TRN	28480	2100-3288
A1R9	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-F
A1R10	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-F
A1R11	2100-3288	8		RESISTOR-TRMR 50 20% C TOP-ADJ 17-TRN	28480	2100-3288
A1R12	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-F
A1R13	0757-0439	4	3	RESISTOR 6.81K 1% .125W F TC=0±100	24546	C4-1/8-T0-6811-F
A1R14	0698-3154	0	12	RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-T0-4221-F
A1R15	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-T0-4221-F

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Table 6-2. Replaceable Parts (Cont'd)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R16	0757-0428	1	6	RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-TO-1621-F
A1R17	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-TO-3321-F
A1R18	0698-3154	8	12	RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-TO-4221-F
A1R19	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-TO-3321-F
A1R20	2100-3161	6	2	RESISTOR-TRMR 20K 10% C SIDE-ADJ 17-TRN	28480	2100-3161
A1R21	0757-0280	3	8	RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-TO-1001-F
A1R22	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-TO-1001-F
A1R23	0757-0411	2	3	RESISTOR 332 1% .125W F TC=0±100	24546	C4-1/8-TO-332R-F
A1R24	0757-0416	7	8	RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-TO-5112-F
A1R25	0757-0402	1	1	RESISTOR 110 1% .125W F TC=0±100	24546	C4-1/8-TO-111-F
A1R26	0757-0409	8	2	RESISTOR 274 1% .125W F TC=0±100	24546	C4-1/8-TO-274R-F
A1R27	0698-3427	0	1	RESISTOR 13.3 1% .125W F TC=0±100	03888	PME55-1/8-TO-13R3-F
A1R28	0698-3443	0	5	RESISTOR 287 1% .125W F TC=0±100	24546	C4-1/8-TO-287R-F
A1R29	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0±100	24546	C4-1/8-TO-51R1-F
A1R30	2100-3349	2		RESISTOR-TMR 100 10% C SIDE ADJ 1-TRN	28480	2100-3349
A1R31	0757-0418	9		RESISTOR 619 1% .125W F TC=0±100	24546	C4-1/8-TO-619R-F
A1R32	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0±100	24546	C4-1/8-TO-1471-F
A1R33	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-TO-3321-F
A1R34	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-TO-3321-F
A1R35	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-TO-3321-F
A1R36	2100-3288	8		RESISTOR-TRMR 50 20% C TOP-ADJ 17-TRN	28480	2100-3288
A1R37	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-TO-3321-F
A1R38	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-TO-3321-F
A1R39	2100-3288	8		RESISTOR-TRMR 50 20% C TOP-ADJ 17-TRN	28480	2100-3288
A1R40	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-TO-3321-F
A1R41	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0±100	24546	C4-1/8-TO-6811-F
A1R42	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-TO-4221-F
A1R43	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-TO-4221-F
A1R44	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-TO-1621-F
A1R45	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-TO-3321-F
A1R46	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-TO-1001-F
A1R47	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-TO-3321-F
A1R48	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-TO-3321-F
A1R49	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-TO-1001-F
A1R50	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-TO-1001-F
A1R51	0757-0411	2		RESISTOR 332 1% .125W F TC=0±100	24546	C4-1/8-TO-332R-F
A1R52	0757-0453	2	4	RESISTOR 30.1K 1% .125W F TC=0±100	24546	C4-1/8-TO-3012-F
A1R53	0757-0431	6	1	RESISTOR 2.43K 1% .125W F TC=0±100	24546	C4-1/8-TO-2431-F
A1R54	0683-1265	9	2	RESISTOR 12M 5% .25W FC TC=-900/+1200	01121	CB1265
A1R55	0757-0453	2		RESISTOR 30.1K 1% .125W F TC=0±100	24546	C4-1/8-TO-3012-F
A1R56	2100-2497	9	5	RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	73138	82PR2K
A1R57	0757-0465	6	8	RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-TO-1003-F
A1R58	0698-3443	0		RESISTOR 287 1% .125W F TC=0±100	24546	C4-1/8-TO-287-F
A1R59	0698-3443	0		RESISTOR 287 1% .125W F TC=0±100	24546	C4-1/8-TO-287-F
A1R60	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-TO-1003-F
A1R61	0757-0453	2		RESISTOR 30.1K 1% .125W F TC=0±100	24546	C4-1/8-TO-3012-F
A1R62	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0±100	24546	C4-1/8-TO-2871-F
A1R63	0683-1265	9		RESISTOR 12M 5% .25W FC TC=-900/+1200	01121	CB1265
A1R64	0757-0453	2		RESISTOR 30.1K 1% .125W F TC=0±100	24546	C4-1/8-TO-3012-F
A1R65	2100-2497	9		RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	73138	82PR2K
A1R66	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-TO-1003-F
A1R67	0698-3443	0		RESISTOR 287 1% .125W F TC=0±100	24546	C4-1/8-TO-287-F
A1R68	0698-3443	0		RESISTOR 287 1% .125W F TC=0±100	24546	C4-1/8-TO-287-F
A1R69	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-TO-1003-F
A1R70	2100-3274	2	1	RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A1R71	0757-0462	3	1	RESISTOR 75K 1% .125W F TC=0±100	24546	C4-1/8-TO-7502-F
A1R72	0757-0409	8		RESISTOR 274 1% .125W F TC=0±100	24546	C4-1/8-TO-274R-F
A1R73	0757-0459	8	1	RESISTOR 56.2K 1% .125W F TC=0±100	24546	C4-1/8-TO-5622-F
A1R74	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0±100	24546	C4-1/8-TO-2871-F
A1R75	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0±100	24546	C4-1/8-TO-6811-F
A1R76	0757-0406	5	1	RESISTOR 182 1% .125W F TC=0±100	24546	C4-1/8-TO-182R-F
A1R77	0698-3156	2	1	RESISTOR 14.7K 1% .125W F TC=0±100	24546	C4-1/8-TO-1472-F
A1R78	0757-0442	9	8	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-TO-1002-F
A1R79	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-TO-1002-F
A1R80	0757-0408	7	1	RESISTOR 243 1% .125W F TC=0±100	24546	C4-1/8-TO-243R-F
A1R81	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-TO-4221-F
A1R82	2100-1788	9	3	RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	73138	82PR500
A1R83	0757-0290	5	6	RESISTOR 6.19K 1% .125W F TC=0±100	19701	MF4C1/8-TO-6191-F
A1R84	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-TO-1001-F
A1R85	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-TO-1621-F

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R86	0757-0416	7	7	RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A1R87	2100-1986	9	4	RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	73138	82PR1K
A1R88	0757-0472	5	2	RESISTOR 200K 1% .125W F TC=0±100	24546	C4-1/8-T0-2003-F
A1R89				NOT ASSIGNED		
A1R90	0757-0448	5	4	RESISTOR 18.2K 1% .125W F TC=0±100	24546	C4-1/8-T0-1822-F
A1R91	0757-0419	0	6	RESISTOR 681 1% .125W F TC=0±100	24546	C4-1/8-T0-681R-F
A1R92	0757-0847	8	8	RESISTOR 27.4K 1% .5W F TC=0±100	28480	0757-0847
A1R93	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0±100	19701	MF4C1/8-T0-6191-F
A1R94	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A1R95	0757-0317	7	4	RESISTOR 1.33K 1% .125W F TC=0±100	24546	C4-1/8-T0-1331-F
A1R96	0757-0847	8		RESISTOR 27.4K 1% .5W F TC=0±100	28480	0757-0847
A1R97	0757-0847	8		RESISTOR 27.4K 1% .5W F TC=0±100	28480	0757-0847
A1R98	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0±100	24546	C4-1/8-T0-1331-F
A1R99	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A1R100	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0±100	19701	MF4C1/8-T0-6191-F
A1R101	0757-0847	8		RESISTOR 27.4K 1% .5W F TC=0±100	28480	0757-0847
A1R102	0757-0419	0		RESISTOR 681 1% .125W F TC=0±100	24546	C4-1/8-T0-681R-F
A1R103	0757-0448	5		RESISTOR 18.2K 1% .125W F TC=0±100	24546	C4-1/8-T0-1822-F
A1R104	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-T0-4221-F
A1R105	2100-1788	9		RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	73138	82PR500
A1R106	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0±100	19701	MF4C1/8-T0-6191-F
A1R107	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A1R108	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-T0-1621-F
A1R109	0757-0416	7		RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A1R110	2100-1986	9		RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	73138	82PR1K
A1R111	0757-0472	5		RESISTOR 200K 1% .125W F TC=0±100	24546	C4-1/8-T0-2003-F
A1R112				NOT ASSIGNED		
A1R113	0757-0448	5		RESISTOR 18.2K 1% .125W F TC=0±100	24546	C4-1/8-T0-1822-F
A1R114	0757-0419	0		RESISTOR 681 1% .125W F TC=0±100	24546	C4-1/8-T0-681R-F
A1R115	0757-0847	8		RESISTOR 27.4K 1% .5W F TC=0±100	28480	0757-0847
A1R116	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0±100	19701	MF4C1/8-T0-6191-F
A1R117	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A1R118	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0±100	24546	C4-1/8-T0-1331-F
A1R119	0757-0847	8		RESISTOR 27.4K 1% .5W F TC=0±100	28480	0757-0847
A1R120	0757-0847	8		RESISTOR 27.4K 1% .5W F TC=0±100	28480	0757-0847
A1R121	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0±100	24546	C4-1/8-T0-1331-F
A1R122	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A1R123	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0±100	19701	MF4C1/8-T0-6191-F
A1R124	0757-0847	8		RESISTOR 27.4K 1% .5W F TC=0±100	28480	0757-0847
A1R125	0757-0419	0		RESISTOR 681 1% .125W F TC=0±100	24546	C4-1/8-T0-681R-F
A1R126	0757-0448	5		RESISTOR 18.2K 1% .125W F TC=0±100	24546	C4-1/8-T0-1822-F
A1R127	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A1R128	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A1R129	2100-1986	9		RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	73138	82PR1K
A1R130	0698-0084	9	1	RESISTOR 2.15K 1% .125W F TC=0±100	24546	C4-1/8-T0-2151-F
A1R131	2100-2497	9		RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	73138	82PR2K
A1R132	0757-0426	9	1	RESISTOR 1.3K 1% .125W F TC=0±100	24546	C4-1/8-T0-1301-F
A1R133	0757-0419	0		RESISTOR 681 1% .125W F TC=0±100	24546	C4-1/8-T0-681R-F
A1R134	0757-0416	7		RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A1R135	2100-2216	0	7	RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	73138	82PR5K
A1R136	0757-0273	4	2	RESISTOR 3.01K 1% .125W F TC=0±100	24546	C4-1/8-T0-3011-F
A1R137	0757-0416	7		RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A1R138	2100-2216	0		RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	73138	82PR5K
A1R139	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0±100	24546	C4-1/8-T0-3011-F
A1R140	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-T0-4221-F
A1R141	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-T0-4221-F
A1R142	2100-2216	0		RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	73138	82PR5K
A1R143	0757-0416	7		RESISTOR 5111% .125W F TC=0±100	24546	C4-1/8-T0-5112
A1R144	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A1R145	2100-2216	0		RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	73138	82PR5K
A1R146	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-T0-4221-F
A1R147	2100-2216	0		RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	73138	82PR5K
A1R148	0757-3154	6		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-T0-2001-F
A1R149	0757-0283	6		RESISTOR 2K 1% .125W F TC=0±100	24546	C4-1/8-T0-2001-F
A1R150	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A1R151	0757-0407	6	4	RESISTOR 200 1% .125W F TC=0±100	24546	C4-1/8-T0-4221-F
A1R152	0757-0407	6		RESISTOR 200 1% .125W F TC=0±100	24546	C4-1/8-T0-201-F
A1R153	0757-0407	6		RESISTOR 200 1% .125W F TC=0±100	24546	C4-1/8-T0-201-F
A1R154	0757-0407	6		RESISTOR 200 1% .125W F TC=0±100	24546	C4-1/8-T0-201-F
A1R155	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-T0-1621-F

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1R156	0757-0411	2		RESISTOR 332 1% .125W F TC=0±100	24546	C4-1/8-TO-332R-F
A1R157	0698-3445	2	1	RESISTOR 348 1% .125W F TC=0±100	24546	C4-1/8-TO-348R-F
A1R158	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-TO-1621-F
A1R159	0757-0714	8	1	RESISTOR 130 1% .25W F TC=0±100	24546	C5-1/4-TO-131-F
A1R160	2100-2216	0		RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	73138	82PR5K
A1R161	0698-3438	3		RESISTOR 147 1% .125W F TC=0±100	28480	0698-3438
A1R162	0757-0421	4		RESISTOR 825 1% .125W F TC=0±100	28480	0757-0421
A1R163	0757-0416	7		RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-TO-5112-F
A1R164	0757-0416	7		RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-TO-5112-F
A1R165	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-TO-1002-F
A1R166	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-TO-1002-F
A1R167	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0±100	24546	C4-1/8-TO-51R1-F
A1R168	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0±100	24546	C4-1/8-TO-51R1-F
A1R169	2100-1738	9		RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	73138	82PR10K
A1R170	0698-3136	8		RESISTOR 17.8K 1% .125W F TC=0±100	24546	C4-1/8-TO-1782-F
A1R171	2100-2216	0		RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	73138	82PR5K
A1R172	0757-0419	0		RESISTOR 681 1% .125W F TC=0±100	24546	C4-1/8-TO-681R-F
A1R173	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0±100	19701	MF4C1/8-TO-6191-F
A1R174	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-TO-1002-F
A1R175	0698-3762	0		RESISTOR 46.4K 1% .125W F TC=0±100	24546	C4-1/8-TO-4642-F
A1R176	0757-0435	0		RESISTOR 3.92K 1% .125W F TC=0±100	24546	C4-1/8-TO-3921-F
A1R177	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-TO-1002-F
A1R178	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-TO-3321-F
A1R179	0757-0281	4		RESISTOR 2.74K 1% .125W F TC=0±100	24546	C4-1/8-TO-2741-F
A1R180	2100-1788	9		RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	73138	82PR500
A1R181	2100-1986	9		RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	73138	82PR1K
A1TP1				NOT ASSIGNED		
A1TP2	0360-0535	0	4	TERMINAL TEST POINT PCB	28480	0360-0535
A1TP3				NOT ASSIGNED		
A1TP4				NOT ASSIGNED		
A1TP5				NOT ASSIGNED		
A1TP6				NOT ASSIGNED		
A1TP7				NOT ASSIGNED		
A1TP8				NOT ASSIGNED		
A1TP9	0360-0535	0		TERMINAL TEST POINT PCB	28480	0360-0535
A1TP10	0360-0535	0		TERMINAL TEST POINT PCB	24840	0360-0535
A1TP11	0360-0535	0		TERMINAL TEST POINT PCB	24840	0360-0535
A1U1	1820-1196	8	4	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A1U2	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A1U3	1826-0860	3	4	IC CONV 12-B-D/A 24-DIP-C PKG	34371	HI1-562A-5
A1U4	1826-0860	3		IC CONV 12-B-D/A 24-DIP-C PKG	34371	HI1-562A-5
A1U5	1826-0930	8	6	IC OP AMP LOW BIAS-H-IMPD TO99 PKG	3L585	CA3140AS
A1U6	1826-0930	8		IC OP AMP LOW-BIAS-H-IMPD TO99 PKG	3L585	CA3140AS
A1U7	1NB4-5003	4	2	ANALOG MULTI. PACK	28480	1NB4-5003
A1U8	1826-0207	2	4	IC OP AMP WB 8-DIP-P PKG	01295	LM318P
A1U9	1826-0207	2		IC OP AMP WB 8-DIP-P PKG	01295	LM318P
A1U10	1826-0930	8		IC OP AMP LOW-BIAS-H-IMPD TO99 PKG	3L585	CA3140AS
A1U11	1826-0208	3	3	IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A1U12	1826-0753		3	IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-D	27014	LF3478N
A1U13	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A1U14	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A1U15	1826-0860	3		IC CONV 12-B-D/A 24-DIP-C PKG	34371	HI1-562A-5
A1U16	1826-0860	3		IC CONV 12-B-D/A 24-DIP-C PKG	34371	HI1-562A-5
A1U17	1826-0930	8		IC OP AMP LOW-BIAS-H-IMPD TO99 PKG	3L585	CA3140AS
A1U18	1826-0930	8		IC OP AMP LOW-BIAS-H-IMPD TO99 PKG	3L585	CA3140AS
A1U19	1NB4-5003	4		ANALOG MULTI. PACK	28480	1NB4-5003
A1U20	1826-0207	2		IC OP AMP WB 8-DIP-P PKG	01295	LM318P
A1U21	1826-0207	2		IC OP AMP WB 8-DIP-P PKG	01295	LM318P
A1U22	1826-0930	8		IC OP AMP LOW-BIAS-H-IMPD TO99 PKG	3L585	CA3140AS
A1U23	1826-0208	3		IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A1U24	1826-0208	3		IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A1U25	1826-1224	1	1	IC 20-DIP-C PKG	28480	1826-1224
A1U26	1NB4-5004	5	1	RAMP GENERATOR	28480	1NB4-5004
A1U27	1826-0871	6	3	IC LINEAR	28480	1826-0871
A1U28	1826-0871	6		IC LINEAR	28480	1826-0871
A1U29	1826-0871	6		IC LINEAR	28480	1826-0871
A1U30	1826-0527	9	1	IC V RGLTR TO-220	04713	MC34004BL
A1U31	1826-0753	3		IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-C	04713	MC34004BL
A1U32	1826-0753	3		IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-C	04713	MC34004BL
A1U33	1826-0393	7	1	IC V RGLTR TO-220	27014	LM317T
A1VR1	1826-0825	0	1	IC-VOLTAGE REGULATOR	28480	1826-0825
A1VR2	1902-0025	4	3	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1VR3	1902-0025	4		DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
A1VR4	1902-0025	4		DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
A1VR5	1902-3036	3	1	DIODE-ZNR 3.16V 5% DO-7 PD=.4W TC=-.064%	28480	1902-3036
A1VR6	1902-0048	1	2	DIODE-ZNR 6.81V 5% DO-35 PD=.4W	28480	1902-0048
A1VR7	1902-0048	1		DIODE-ZNR 6.81V 5% DO-35 PD=.4W	28480	1902-0048
A1VR8	1902-3070	5	4	DIODE-ZNR 4.22V 5% DO-35 PD=.4W	28480	1902-3070
A1VR9	1902-3070	5		DIODE-ZNR 4.22V 5% DO-35 PD=.4W	28480	1902-3070
A1VR10	1902-3070	5		DIODE-ZNR 4.22V 5% DO-35 PD=.4W	28480	1902-3070
A1VR11	1902-3070	5		DIODE-ZNR 4.22V 5% DO-35 PD=.4W	28480	1902-3070
A1XU3	1200-0541	1	7	SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A1XU4	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A1XU7	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A1XU15	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A1XU16	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A1XU19	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A1XU26	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2	01349-66502	9	2	BOARD-VECT PROD	28480	01349-26502
A2C1	0160-2264	2	2	CAPACITOR-FXD 20PF ±5% 500VDC CER 0±30	28480	0160-2264
A2C2	0160-2264	2		CAPACITOR-FXD 20PF ±5% 500VDC CER 0±30	28480	0160-2264
A2C3	0180-0374	3	1	CAPACITOR-FXD 10UF ±10% 20VDC TA	56289	150D106X9020B2
A2C4	0160-3451	1	4	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3451
A2C5	0160-3451	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3451
A2C6	0160-5298	1	16	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-5298
A2C7	0160-3451	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3451
A2C8	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C9	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C10	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C11	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C12	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C13	0160-2264	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2264
A2C14	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C15	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C16	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C17	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 5VDC CER	28480	0160-3443
A2C18	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2CR1	1901-0040	1	1	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR2	1901-1065	2	1	DIODE-PWR RECT 400V 1A	28480	1901-1065
A2E1	1258-0124	7	1	PIN-PROGRAMMING DUMPER .30 CONTACT	91506	8136-457G1
A2H1	3050-0367	2	2	WASHER-FL MTLC NO. 3 .10-IN-ID	28480	3050-0376
A2H2	0515-0403	0	2	SCREW-MACH 2.5X.48X8MM	00000	ORDER BY DESCRIPTION
A2H3	0535-0008	3	2	NUT-HEX-DBL-CHAM M 2.5X0.45X2MM	28480	0535-0008
A2J1	1251-8262	0	1	CONNECTOR 44-PIN M POST TYPE	28480	1251-8262
A2J2	1251-6823	1	2	CONNECTOR 20-PIN M POST TYPE	28480	1251-6823
A2J3	1251-6823	1		CONNECTOR 20-PIN M POST TYPE	28480	1251-6823
A2J4	1251-7229	3	1	CONNECTOR 26-PIN M RIGHT ANGLE	28480	1251-7229
A2J5	1251-6000	6	1	CONNECTOR 5-PIN M METRIC POST TYPE	28480	1251-6000
A2J6	1251-4836		1	CONNECTOR-WAFER 2P	28480	1251-4836
A2L1	9100-1629	4	1	INDUCTOR RF-CH-MLD 47UH 5% .166DX.385LG	28480	9100-1629
A2Q1	1854-0300	5	1	TRANSISTOR NPN SI PD=21W FT=10MHZ	28480	1854-0300
A2Q2	1854-0215	1	1	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A2R1	0683-1035	9	2	RESISTOR 10K 5% .25W FC TC=-400/+600	01121	CB1025
A2R2	0757-0280	3	2	RESISTOR 1K 1% .125W F TC=0 +/-100	24546	C4-1/8-TO-1001-F
A2R3	0683-0275	9	1	RESISTOR 2.7 5% .250W FC TC=-400/+500	28480	0683-0275
A2R4	0683-1035	9		RESISTOR 10K 5% .25W FC TC=-400/+600	01121	CB1025
A2R5	0757-0273	4	1	RESISTOR 3.01K 1% .125W TC=0+/-100	24546	C4-1/8-TO-3011-F
A2R6	0757-0416	7	2	RESISTOR 511 1% .125W F TC=0+/-100	24546	C4-1/8-TO-511R-F
A2R7	0757-0449	6	1	RESISTOR 20K 1% .125W F TC=0+/-100	24546	C4-1/8-T0-2002-F
A2R8	0757-0159	5	1	RESISTOR 1K 1% .5W F TC=0+/-100	28480	0757-0159
A2R9	0698-3394	0	1	RESISTOR 31.6 1% .5W F TC=0+/-100	28480	0698-3394
A2R10	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+/-100	24546	C4-1/8-TO-1001-F
A2R11	0698-3154	0	1	RESISTOR 4.22K 1% .125W F TC=0+/-100	24546	C4-1/8-to-4221-F
A2R12	0757-0416	7		RESISTOR 511 1% .125W TC=0+/-100	24546	C4-1/8-TO-511R-F
A2R13	0761-0035	5	1	RESISTOR 150 5% 1W MO TC=0+/-200	28480	0761-0035
A2RP1	1810-0206		1	RESISTOR NETWORK 7×10K	28480	1810-0206
A2RP2	1810-0204		1	RESISTOR NETWORK 7×1K	28480	1810-0204
A2U1	01349-80003	1	1	IC-SELF-TEST PROCESSOR	28480	01349-80003
A2U2	1820-1297	0	1	IC GATE TTL LS EXCL-NOR QUAD 2-INP	01295	SN74LS266N
A2U3	1810-0307	0	2	NETWORK-CNDCT MODULE DIP 16 PINS; 0.100	28480	1810-0307
A2U4	1810-0307	0		NETWORK-CNDCT MODULE DIP 16 PINS; 0.100	28480	1810-0307
A2U5	1816-1500	9	1	IC TTL S 4096 (4K) PROM85-NS 3-S	01295	TBP18S42N
A2U6	1820-2024	3	4	IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A2U7	1820-1198	0	1	IC GATE TTL LS NAND WUAD 2-INP	28480	1820-1198
A2U8	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A2U9	1820-1432	5	4	IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS163AN
A2U10	1820-1432	5		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS163AN

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A2U11	1820-1432	5		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS163AN
A2U12	01349-80002	8	1	IC CHAR ROM 2732A	28480	01349-80002
A2U13	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A2U14	1813-0149	4	1	IC OSC HYBRID	34344	K1148A-19.6608MHZ
A2U15	1820-1322	2	1	IC GATE TTL S NOR QUAD 2-INP	01295	SN74S02N
A2U16	1820-2617	0	1	IC SCNR HTL	28480	1SB5-0025
A2U17	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A2U18	1820-1997	7	2	IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	01295	SN74LS374N
A2U19	1820-1997	7		IC FF TTL LS D-TYPE POS-EDGE-TRIG PRL-IN	01295	SN74LS374N
A2U20	1820-1444	9	1	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS298N
A2U21	1820-1422	3	1	IC MV TTL LS MONOSTBL RETRIG	01295	SN74LS122N
A2U22	1820-1196	8	4	IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A2U23	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A2U24	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A2U25	1820-1196	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG COM	01295	SN74LS174N
A2U26	1820-1432	5		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS163AN
A2U27	1820-1217	4	1	IC MUXR/DATA-SEL TTL LS 8-TO-1 LINE	01295	SN74LS151N
A2U28	1820-2024	3		IC DVR TTL LS LINE DRVR OCTL	01295	SN746S244N
A2VR1	1902-3126	2	1	DIODE-ZNR 7.15V 2% DO-35 PD=.4W	28480	1902-3126
A2XU1	1200-0654	7	2	SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
A2XU3	1200-0607	0	2	SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A2XU4	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A2XU5	1200-0639	8	1	SOCKET-IC 20-CONT DIP DIP-SLDR	28480	1200-0639
A2XU12	1200-0541	1	1	SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A2XU16	1200-0654	7		SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654
				MISCELLANEOUS		
	0360-0535	0		TERMINAL-TEST POINT PCB	28480	0360-0535
	0360-0535	0		TERMINAL-TEST POINT PCB	28480	0360-0535
	0360-0535	0		TERMINAL-TEST POINT PCB	28480	0360-0535
	0360-0535	0		TERMINAL-TEST POINT PCB	28480	0360-0535

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3	01349-66504	1	1	BOARD ASSEMBLY-LV	28480	01349-26504
A3C1	0180-0094	4	1	CAPACITOR-FXD 100UF +75-10% 25VDC AL	56289	30D107G025DD2
A3C2	0160-3443	1	1	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A3C3	0180-0106	9	1	CAPACITOR-FXD 60UF ±20% 6VDC TA	56289	150D606X0006B2
A3C4	0160-3448	6	1	CAPACITOR-FXD 1000PF ±10% 1KVDC CER	28480	0160-3448
A3C5	0160-0207	9	1	CAPACITOR-FXD .01UF ±5% 200VDC POLYE	28480	0160-0207
A3C6	0180-1819	3	1	CAPACITOR-FXD 100UF +75-10% 50VDC AL	56289	30D107G050DH2
A3C7	0180-2089	1	1	CAPACITOR-FXD 100UF +50-10% 150VDC AL	56289	39D107F150FP4
A3CR1	1901-0040	1	2	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR3	1901-0669	0	2	DIODE-PWR RECT 400V 1A 150NS	14099	S4F
A3CR4	1901-0669	0		DIODE-PWR RECT 400V 1A 150NS	14099	S4F
A3F1	2110-0303	3	1	FUSE 2.0A 250V TD 1.25X.25 UL	28480	2110-0303
A3F2	2110-0367	9	1	FUSE 5.0A 250V TD 1.25X.25 UL	28480	2110-0367
A3F3	2110-0001	8	1	FUSE 1.0A 250V NTD 1.25X.25 UL	28480	2110-0001
A3H1	0340-0114	9	1	INSULATOR-FLG-BSHG NYLON	28480	0340-0114
A3H2	2110-0269	0	6	FUSEHOLDER-CLIP TYPE.25D-FUSE	28480	2110-0269
A3H3	2190-0584	0	1	WASHER-LK HLCL 3.0MM 3.1-MM-ID	28480	2190-0584
A3H4	0515-0403	0		SCREW-MACH M2.5X0.45 8MM-LG	00000	ORDER BY DESCRIPTION
A3H5	0515-0065	0	2	SCREW-MACH M3X0.5 25MM-LG PAN-HD	28480	2200-0065
A3H6	3050-0367	2	2	WASHER-FL MTLC NO. 3 .105-IN-ID	28480	3050-0367
A3H7	0535-0008	3	1	NUT-HEX DBL-CHAM M2.5X0.45 2MM-THK	00000	ORDER BY DESCRIPTION
A3J1	1251-8028		1	CONNECTOR 6-PIN M UTILITY	28480	1251-8028
A3J2	1251-6000	6	3	CONNECTOR 5-PIN M METRIC POST TYPE	28480	1251-6000
A3J3	1251-6000	6		CONNECTOR 5-PIN M METRIC POST TYPE	28480	1251-6000
A3J4	1251-6000	6		CONNECTOR 5-PIN M METRIC POST TYPE	28480	1251-6000
A3J5	1251-4836	2	1	CONNECTOR 2-PIN M METRIC POST TYPE	28480	1251-4836
A3L1	9100-3139	5	2	INDUCTOR 75UH 15% .5DX.875LG	28480	9100-3139
A3L2	9140-0137	1	1	INDUCTOR RF-CH-MLD 1MH 5% .2DX.45LG Q=60	28480	9140-0137
A3L3	9100-3139	5		INDUCTOR 75UH 15% .5DX.875LG	28480	9100-3139
A3MP1	01345-04101	4	1	COVER LV	28480	01345-04101
A3MP2	1400-0249	0	1	CABLE TIE .062-.625 DIA .091-WD NYL	06383	PLT1M-8
A3Q1	1854-0659	7	2	TRANSISTOR NPN SI PD=12.5W FT=50MHZ	04713	MJE180
A3Q2	1854-0659	7		TRANSISTOR NPN SI PD=12.5W FT=50MHZ	04713	MJE180
A3R1	0757-0438	3	2	RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A3R2	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A3R3	0757-0449	6	1	RESISTOR 20K 1% .125W F TC=0±100	24546	C4-1/8-T0-2002-F
A3R4	0698-0085	0	1	RESISTOR 2.61K 1% .125W F TC=0±100	24546	C4-1/8-T0-2611-F
A3R5	0757-0720	6	1	RESISTOR 243 1% .25W F TC=0±100	24546	C5-1/4-T0-243R-F
A3R6	0757-0401	0	2	RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A3R7	0757-0401	0		RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A3R8	0811-3293	0	1	RESISTOR .18 5% 2W PW TC=0±800	28480	0811-3293
A3R9	0757-0466	7	1	RESISTOR 110K 1% .125W F TC=0±100	24546	C4-1/8-T0-1103-F
A3R10	2100-0554	5	1	RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	28480	2100-0554
A3R11	0757-0431	6		RESISTOR 2.43K 1% .125W F TC=0±100	24546	C4-1/8-T0-2431-F
A3T1	01345-61102	5	1	TRANS ASSEMBLY	28480	01345-61102
A3TP1	0360-0535	0	4	TERMINAL TEST POINT PCB	28480	0360-0535
A3TP2	0360-0535	0		TERMINAL TEST POINT PCB	28480	0360-0535
A3TP3	0360-0535	0		TERMINAL TEST POINT PCB	28480	0360-0535
A3TP4	0360-0535	0		TERMINAL TEST POINT PCB	28480	0360-0535
A3U1	1826-0428	9	1	IC 3524 MODULATOR 16-DIP-C	01295	SG3524J
A3XU1	1200-0607	0		SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607

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Table 6-2. Replaceable Parts (Cont'd)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4	01349-66508	4	1	BOARD ASSEMBLY-HV	28480	01349-66508
A4A1	0960-0678	4	1	MULTIPLIER-H.V. X8 HI	28480	0960-0678
A4C1	0160-2205	1	2	CAPACITOR-FXD 120PF ±5% 300VDC MICA	28480	0160-2205
A4C2				NOT ASSIGNED		
A4C3	0160-5473		3	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-5473
A4C4	0160-5211	6	2	CAPACITOR-FXD .1UF +80-20% 200VDC CER	28480	0160-5211
A4C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4C6	0160-5473	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-5473
A4C7	0160-5211	6		CAPACITOR-FXD .1UF +80-20% 200VDC CER	28480	0160-5211
A4C8	0180-0098	8	2	CAPACITOR-FXD 100UF ±20% 20VDC TA	56289	150D107X0020S2
A4C9	0180-0098	8		CAPACITOR-FXD 100UF ±20% 20VDC TA	56289	150D107X0020S2
A4C10	0160-0165	8	1	CAPACITOR-FXD .056UF ±10% 200VDC POLYE	28480	0160-0165
A4C11	0160-3443	1	1	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A4C12	0160-4051	9	2	CAPACITOR-FXD .01UF ±20% 4KVDC	28480	0160-4051
A4C13	0160-0584	5		CAPACITOR-FXD .068UF ±20% 4KVDCMY	56289	430P683040
A4C14	0160-2264	2	1	CAPACITOR-FXD 20PF ±5% 500VDC CER 0±30	28480	0160-2264
A4C15	0160-0684	6	2	CAPACITOR-FXD 1000PF ±20% 4KVDC	28480	0160-0684
A4C16	0160-0684	6		CAPACITOR-FXD 1000PF ±20% 4KVDC	28480	0160-0684
A4C17	0160-4051	9		CAPACITOR-FXD .01UF ±20% 4KVDC	28480	0160-4051
A4C18	0160-2205	1	1	CAPACITOR-FXD 120PF ±5% 300VDC MICA	28480	0160-2205
A4C19	0160-3665	9	1	CAPACITOR-FXD .01UF +80-20% 500VDC CER	28480	0160-3665
A4C20	0160-5337	6	1	CAPACITOR-FXD 30PF ±20% 3KVDC CER	28480	0160-5337
A4C21	0160-5336	5	1	CAPACITOR-FXD 20PF ±20% 3KVDC CER	28480	0160-5336
A4C22	0160-0162	5	1	CAPACITOR-FXD .022UF ±10% 200VDC POLYE	28480	0160-0162
A4C23	0160-0134	1		CAPACITOR 220PF ±5% 300VDC MICA	28480	0160-0134
A4C24	0160-2240	4		CAPACITOR 2.0PF ±.25PF 500VDC CER	28480	0160-2240
A4C25	0160-5473	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-5473
A4C26	0160-5211	6		CAPACITOR-FXD .1UF ±20% 200VDC CER	28480	0160-5211
A4C27	0160-2234	6	1	CAPACITOR-FXD .51PF ±.25PF 500VDC CER	28480	0160-2234
A4C28	0160-5211			CAPACITOR-FXD .1 +80 -20% 200VDC CER	28480	0160-5211
A4C29	0160-5211			CAPACITOR-FXD .1 +80 -20% 200VDC CER	28480	0160-5211
A4CR1	1901-0028	5	12	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A4CR2	1901-0096	7		DIODE-SWITCHING 120V 50MA 100NS	28480	1901-0096
A4CR3	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A4CR4	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A4CR5	1901-0096	7		DIODE-SWITCHING 120V 50MA 100NS	28480	1901-0096
A4CR6	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A4CR7	1901-0040	1	2	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A4CR9	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A4CR10	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A4CR11	1901-0683	8	1	DIODE-HV RECT 10KV 5MA 250NS	28480	1901-0683
A4CR12	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A4CR13	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A4CR14	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A4CR15	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A4CR16	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A4CR17	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A4CR18	1901-0096	7		DIODE-SWITCHING 120V 50MA 100NS	28480	1901-0096
A4F1	2110-0001	8	1	FUSE 1.0A 250V NTD 1.25X.25UL	28480	2110-0001
A4H1	2110-0269	0	2	FUSE HOLDER-CLIP TYPE .25D-FUSE	28480	2110-0269
A4H2	0515-0372	2	3	SCREW-MACHINE ASSEMBLY M3X0.5 8MM-LG	00000	ORDER BY DESCRIPTION
A4H3	0360-1653		13	TERMINAL PN STRAIGHT	28480	0360-1653
A4H4	0515-0372		3	PHMS M3X0.5 8 LG	28480	0515-0372
A4H5	0340-0564		1	INSULATOR XSTR	28480	0340-0564
A4J1	1251-5863	7		CONNECTOR 5-PIN M METRIC POST TYPE	28480	1251-5863
A4L1	9140-0115	5	1	INDUCTOR RF-CH-MLD 22UH 10% .23DX.57LG	28480	9140-0115
A4L2	9140-0129	1	1	INDUCTOR RF-CH-MLD 220UH 5% .166DX.385LG	28480	9140-0129
A4MP1	01345-04103	6	1	COVER HV INNER	28480	01345-04103
A4MP2	01349-60602	2	1	PA CONN SHIELD	28480	01349-60602
A4Q1	1854-0215	1	2	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A4Q2	1853-0038	4	3	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A4Q3	1854-0419	7	3	TRANSISTOR NPN SI TO-39 PD=1W FT=200MHZ	28480	1854-0419
A4Q4	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A4Q5	1853-0038	4		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A4Q6	1854-0419	7		TRANSISTOR NPN SI TO-39 PD=1W FT=200MHZ	28480	1854-0419
A4Q7	1854-0433	5	1	TRANSISTOR NPN SI PD=90W FT=2MHZ	28480	1854-0433
A4Q8	1853-0038	4		TRANSISTOR PNP S1 TO-39 PD=1W FT=100MHZ	28480	1853-0038
A4Q9	1853-0419	7		TRANSISTOR NPN S1 TO-39 PD=1W FT=200MHZ	28480	1853-0419
A4Q10	1853-0036	2		TRANSISTOR PNP S1 PD=31MW FT=250MHZ	28480	1853-0036

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A4R1	0684-6811	3	6	RESISTOR 680 10% .25W FC TC=-400/+600	01121	CB6811
A4R2	2100-1738	9	1	RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	73138	82PR10K
A4R3	0698-3421	4	1	RESISTOR 38.3K 1% .5W F TC=0±100	28480	0698-3421
A4R4	0684-1011	5	6	RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A4R5	0757-0442	9	2	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A4R6	0757-0775	1	2	RESISTOR 90.9K 1% .25W F TC=0±100	24546	C5-1/4-TO-9092-F
A4R7	0757-0726	2	2	RESISTOR 511 1% .25W F TC=0±100	24546	C5-1/4-TO-511R-F
A4R8	0757-0735	3	2	RESISTOR 1.3K 1% .25W F TC=0±100	24546	C5-1/4-TO-1301-F
A4R9	0757-0190	4	3	RESISTOR 20K 1% .5W F TC=0±100	28480	0757-0190
A4R10	0684-1011	5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A4R11	0757-0190	4		RESISTOR 20K 1% .5W F TC=0±100	28480	0757-0190
A4R12	0683-2715	6	1	RESISTOR 270 5% .25W FC TC-400/+600	28480	0683-2715
A4R13	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A4R14	0757-0775	1		RESISTOR 90.9K 1% .25W F TC=0±100	24546	C5-1/4-TO-9092-F
A4R15	0757-0726	2		RESISTOR 511 1% .25W F TC=0±100	24546	C5-1/4-TO-511R-F
A4R16	0757-0735	3		RESISTOR 1.3K 1% .25W F TC=0±100	24546	C5-1/4-TO-1301-F
A4R17	0757-0190	4		RESISTOR 20K 1% .5W F TC=0±100	28480	0757-0190
A4R18	0684-1011	5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A4R19	0757-0486	1	1	RESISTOR 750K 1% .125W F TC=0±100	28480	0757-0486
A4R20	2100-0580	7	1	RESISTOR-TRMR 500K 10% C TOP-ADJ 1-TRN	28480	2100-0580
A4R21	0757-0465	6	2	RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A4R22	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A4R23	0683-2265	1	1	RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A4R24	0684-4731	2	1	RESISTOR 47K 10% .25W FC TC=-400/+800	01121	CB4731
A4R25	0684-1011	5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A4R26	0683-3915	0	1	RESISTOR 390 5% .25W FC TC=-400/+600	01121	CB3915
A4R27	0684-2221	1	1	RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A4R28	0684-1021	7	1	RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A4R29	0687-3941	0	1	RESISTOR 390K 10% .5W CC TC=0+882	01121	EB3941
A4R30	0684-6811	3		RESISTOR 680 10% .25W FC TC=-400/+600	01121	CB6811
A4R31	0684-6811	3		RESISTOR 680 10% .25W FC TC=-400/+600	01121	CB6811
A4R32	0684-5621	1	1	RESISTOR 5.6K 10% .25W FC TC=-400/+700	01121	CB5621
A4R33	0699-0167	1	1	RESISTOR 20M 5% 1W C TC=0±250	28480	0699-0167
A4R34	0684-6811	3		RESISTOR 680 10% .25W FC TC=-400/+600	01121	CB6811
A4R35	0684-6811	3		RESISTOR 680 10% .25W FC TC=-400/+600	01121	CB6811
A4R36	0684-1061	5	1	RESISTOR 10M 10% .25W FC TC=-900/+1100	01121	CB1061
A4R37	0684-1011	5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A4R38	0683-2235	5		RESISTOR 22K 5% .25W FC TC=-400/+800	01121	CB2235
A4R39	0683-3945	6	1	RESISTOR 390K 5% .25W FC TC=-800/+900	01121	CB3945
A4R40	0699-0187	5	1	RESISTOR 1.8 5% .25W FC TC=-400/+450	01121	CB18G5
A4R41	0699-0171	7	1	RESISTOR 6.5 MEG 5% 1W C TC=0±250	28480	0699-0171
A4R42	2100-0569	2	1	RESISTOR-TRMR 1M 20% C TOP-ADJ 1-TRN	28480	2100-0569
A4R43	0699-0172	8	1	RESISTOR 3M 5% 1W C TC=0±250	28480	0699-0172
A4R44	0684-6811	3		RESISTOR 680 10% .25W FC TC=-400/+600	01121	CB6811
A4R45	0757-0398	4	1	RESISTOR 75 1% .125W F TC=0±100	24546	C4-1/8-TO-75R0-F
A4R46	0683-4725	2	1	RESISTOR 4.7K 5% .25W FC TC=-400/+700	01121	CB4725
A4R47	0757-0847	8	2	RESISTOR 27.4K 1% .5W F TC=0±100	28480	0757-0847
A4R48	0757-0290	5	1	RESISTOR 6.19K 1% .125W F TC=0±100	19701	MF4C1/8-TO-6191-F
A4R49	0757-0777	3	1	RESISTOR 121K 1% .25W F TC=0±100	28480	0757-0777
A4R50	0757-0734	2	1	RESISTOR 1.2K 1% .25W F TC=0±100	28480	0757-0734
A4R51	0757-0847	8		RESISTOR 27.4K 1% .5W F TC=0±100	28480	0757-0847
A4R52	0684-1011	5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A4R53	0757-0443	0	2	RESISTOR 11K 1% .125W F TC=0±100	45546	C4-1/8-TO-1102-F
A4R54	2100-0558	9	1	RESISTOR-TRMR 20K 10% C TOP-ADJ 1-TRN	28480	2100-0558
A4R55	0757-0443	0		RESISTOR 11K 1% .125W F TC=0±100	45546	C4-1/8-TO-1102-F
A4R56	0757-0407	6	3	RESISTOR 200 1% .125W F TC=0+/-100	24546	C4-1/8-TO-200R-F
A4R57	0757-0407	6	3	RESISTOR 200 1% .125W F TC=0+/-100	24546	C4-1/8-TO-200R-F
A4R58	0757-0407	6	3	RESISTOR 200 1% .125W F TC=0+/-100	24546	C4-1/8-TO-200R-F
A4T1	01345-61101	4	1	HV TRANSFORMER	28480	01345-61101
A4TP1	0360-0535	0	3	TERMINAL TEST PT PCB	28480	0360-0535
A4TP2	0360-0535	0		TERMINAL TEST PT PCB	28480	0360-0535
A4TP3	0360-0535	0		TERMINAL TEST PT PCB	28480	0360-0535
A4U1	1826-0167	3	1	IC OP AMP PRGMBL TO-99 PKG	0192B	CA3094AT
A4V1	2140-0018	0	2	LAMP-GLOW A9A-CT 90VDC 700UA T-2-BULB	0046G	A9A-CT
A4V2	2140-0018	0		LAMP-GLOW A9A-CT 90VDC 700UA T-2-BULB	0046G	A9A-CT
A4VR1	1902-0049	2	2	DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A4VR2	1902-3104	6		DIODE-ZNR 5.62V 5% DO-35 PD=.4W	28480	1902-3104
A4VR3	1902-0049	2	1	DIODE-ZNR 6.19V 5% DO-35 PD=.4W	28480	1902-0049
A4VR4	1902-3354	8	1	DIODE-ZNR 54.9V 5% DO-7 PD=.4W TC=+.081%	28480	1902-3354
				MISCELLANEOUS		
	0360-1653	5	13	CONNECTOR-SGL CONT PIN .045-IN-BSC-SZ SQ	28480	0360-1653

See introduction to this section for ordering information

Table 6-2. Replaceable Parts (Cont'd)

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5 (1349D ONLY)	01349-66506	7	1	BOARD ASSEMBLY-MEMORY (1349D ONLY)	28480	01349-66506
A5C1	0160-5471	9	1	CAPACITOR-FXD 0.1UF +/-5% 50VDC MET-POLYE	28480	0160-5471
A5C2	0160-5921	4	19	CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C3	0180-0374	3	1	CAPACITOR-FXD 10UF +/-10% 20VDC TA	28480	0180-0374
A5C4	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C5	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C6	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C7	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C8	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C9	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C10	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C11	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C12	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C13	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C14	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C15	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C16	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C17	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C18	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C19	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C20	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5C21	0160-5921	4		CAPACITOR-FXD 0.01UF +/-20% 50VDC	28480	0160-5921
A5R1	0757-0442	9		RESISTOR-FXD 10K 1% .125W F TC=0+/-100	24546	CT4-1/8-TO-1002-F
A5R2	0757-0467	8		RESISTOR-FXD 121K 1% .125W F TC=0+/-100	24546	CT4-1/8-TO-1213-F
A5R3	0757-0442	9		RESISTOR-FXD 10K 1% .125W F TC=0+/-100	24546	CT4-1/8-TO-1002-F
A5R4	0757-0442	9		RESISTOR-FXD 10K 1% .125W F TC=0+/-100	24546	CT4-1/8-TO-1002-F
A5U1	1826-0180	0	1	IC TIMER TTL MONO/ASTBL	01295	NE555P
A5U2	1818-3330	1	2	IC CMOS STAT RAM 64K 120NS 3-S	54013	HM6264P-12
A5U3	1820-1432	5	8	IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS163AN
A5U4	1820-1432	5		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS163AN
A5U5	1820-1416	5	1	IC SCHMITT-TRIG TTL LS INV HEX 1-INP	01295	SN74LS14N
A5U6	1820-1432	5		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS163AN
A5U7	1820-1432	5		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS163AN
A5U8	1820-1197	9	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A5U9	1820-1997	7	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS374N
A5U10	1820-2102	8	2	IC LCH TTL LS D-TYPE OCTL	01295	SN74LS373N
A5U11	1820-2102	8		IC LCH TTL LS D-TYPE OCTL	01295	SN74LS373N
A5U12	1820-1997	9	3	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS374N
A5U13	1820-1997	9		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS374N
A5U14				NOT ASSIGNED		
A5U15	1820-1470	1	4	IC MUXR/DATA-SEL TTL LS 2-TO-1 LINE QUAD	01295	SN74LS157N
A5U16	1820-1470	1		IC MUXR/DATA-SEL TTL LS 2-TO-1 LINE QUAD	01295	SN74LS157N
A5U17	1820-1440	1	1	IC LCH TTL LS QUAD	01295	SN74LS279N
A5U18	1816-1516	7	2	IC TTL S 8192 (8K) PROM 55NS 3-5	28480	1816-1516
A5U19				NOT ASSIGNED		
A5U20	1820-1432	5		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS163AN
A5U21	1820-1432	5		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS163AN
A5U22	1820-1202	7	1	IC GATE TTL LS NAND TPL 3-INP	01295	SN74LS10N
A5U23	1816-1516	7		IC TTL S 8192 (8K) PROM 55NS 3-5	28480	1816-1516
A5U24	1820-2024	3	2	IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A5U25	1820-2024	3		IC DRVR TTL LS LINE DRVR OCTL	01295	SN74LS244N
A5U26				NOT ASSIGNED		
A5U27				NOT ASSIGNED		
A5U28	1818-3330	1		IC CMOS STAT RAM 64K 120NS 3-S	54013	HM6264P-12
A5U29	1820-1432	5		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS163AN
A5U30	1820-1432	5		IC CNTR TTL LS BIN SYNCHRO POS-EDGE-TRIG	01295	SN74LS163AN
A5U31	1820-1208	3	1	IC GATE TTL LS OR QUAD 2-INPUT	01295	SN74LS32N
A5U32	1820-1112	8	2	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A5U33	1820-1470	1		IC MUXR/DATA-SEL TTL LS 2-TO-1 LINE QUAD	01295	SN74LS157N
A5U34	1820-1470	1		IC MUXR/DATA-SEL TTL LS 2-TO-1 LINE QUAD	01295	SN74LS157N
A5U35	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A5U36	1820-1645	2	1	IC BFR TTL LS BUS QUAD	01295	SN74LS126AN
A5U37	1813-0139	2	1	XTAL-CLOCK-OSCILLATOR 10MHZ 0.01% TTL	03795	K1100A-10.0MHZ
A5W1	01349-61606	0	1	MEMORY POWER CABLE		
A5W2	01349-61609	1	1	DATA CABLE TO VPC		
A5XU2	1200-0567	1	2	SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567
A5XU28	1200-0567	1		SOCKET-IC 28-CONT DIP DIP-SLDR	28480	1200-0567

See introduction to this section for ordering information

Table 6-3. List of Manufacturers' Codes

Mfr No.	Manufacturer Name	Address		Zip Code
00000	ANY SATISFACTORY SUPPLIER			
01121	ALLEN-BRADLEY CO	MILWAUKEE	WI	53204
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS	TX	75222
0192B	RCA CORP SOLID STATE DIV	SOMERVILLE	NJ	08876
02111	SPECTROL ELECTRONICS	CITY OF IND	CA	91745
03508	GE CO SEMICONDUCTOR PROD DEPT	SYRACUSE	NY	13201
03888	KDI PYROFILM CORP	WHIPPANY	NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX	AZ	85062
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW	CA	94042
11502	TRW INC	BOONE DIV	NC	28607
19701	MEPCO/ELECTRA CORP	MINERALS WELLS	TX	76067
24046	TRANSITRON ELECTRONIC CORP	WAKEFIELD	MA	01880
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
27014	NATIONAL SEMICONDUCTOR CORP	PALO ALTO	CA	94304
27167	CORNING GLASS WORKS (WILMINGTON)	WILMINGTON	NC	28401
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
30983	MEPCO/ELECTRA CORP	SAN DIEGO	CA	92121
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE	CA	92507
34371	HARRIS SEMICON DIV	MELBOURNE	FL	32901
50088	MOSTEK CORP	CARROLLTON	TX	75006
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS	MA	01247
72136	ELECTRO MOTIVE CORP SUB IEC	WILLIMANTIC	CT	06226
72982	ERIE TECHNOLOGICAL PRODUCTS INC	ERIE	PA	16512
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON	CA	92634
74100	BUSSMAN MFG DIV OF MCGRAW-EDISON CO	ST LOUIS	MO	63107
75915	LITTLEFUSE INC	DES PLAINES	IL	60016
84411	TRW CAPACITOR DIV	OGALLALA	NE	69153
91506	AUGAT INC	ATTLEBORO	MA	02703

SECTION VII

MANUAL CHANGES

7-1. INTRODUCTION.

7-2. This section normally contains information for adapting this manual to instruments for which the content does not apply directly. Since this manual does apply directly to all instruments up to the serial number listed on the title page, no change information is given here. Refer to INSTRUMENTS COVERED BY THIS MANUAL in Section I for additional important information about serial number coverage.

SECTION VIII

SERVICE

8-1. INTRODUCTION.

8-2. This section provides instructions for troubleshooting and repairing the Model 1349A/D Digital Display.

8-3. Detailed theory of operation and troubleshooting information are located opposite the schematics on foldout Service Sheets. The remainder of this section has general service information that should help you quickly service and repair the Display.

8-4. THEORY OF OPERATION.

8-5. Overall theory of operation appears on pages opposite the Block Diagram (Service Sheet 1). Each section of the diagram refers to service sheets where detailed theory, schematics and troubleshooting information are presented. Figure 8-2 explains any unusual symbols that appear on the schematics.

8-6. LOGIC CONVENTIONS. Positive logic convention is used in this manual, unless otherwise noted on the schematics. Positive logic convention defines "1" as the more positive voltage (high) and a logic "0" as the more negative voltage (low).

8-7. LOGIC SYMBOLOGY. The new ANSI logic symbology is used in this manual. The purpose of these symbols is to graphically represent device function so that the operation can be understood without having to "look up" how a device works. Basic logic symbols and examples of symbols are shown in Figure 8-3. Table 8-2 provides an explanation of function lables used in the schematics.

8-8. RECOMMENDED TEST EQUIPMENT.

8-9. Test equipment required for maintaining the 1349A/D is listed in Section I Table 1-4. Equipment other than that listed may be substituted if it meets the listed specifications.

8-10. REPAIR.

8-11. ASSEMBLY REMOVAL. Major assembly removal is shown in Figure 6-1. Refer to Table 8-1 for the list of assemblies indexed to Service Sheets.

Table 8-1. Service Sheet Quick Reference.

Assembly	Name	Service Sheet(s)
A1	X-Y Stroke Generator	3A, 3B, 3C
A2	Vector Processor	2A, 2B
A3	Low Voltage Power Supply	4
A4	High Voltage Power Supply	5
A5	Memory Circuit (1349D only)	6A, 6B

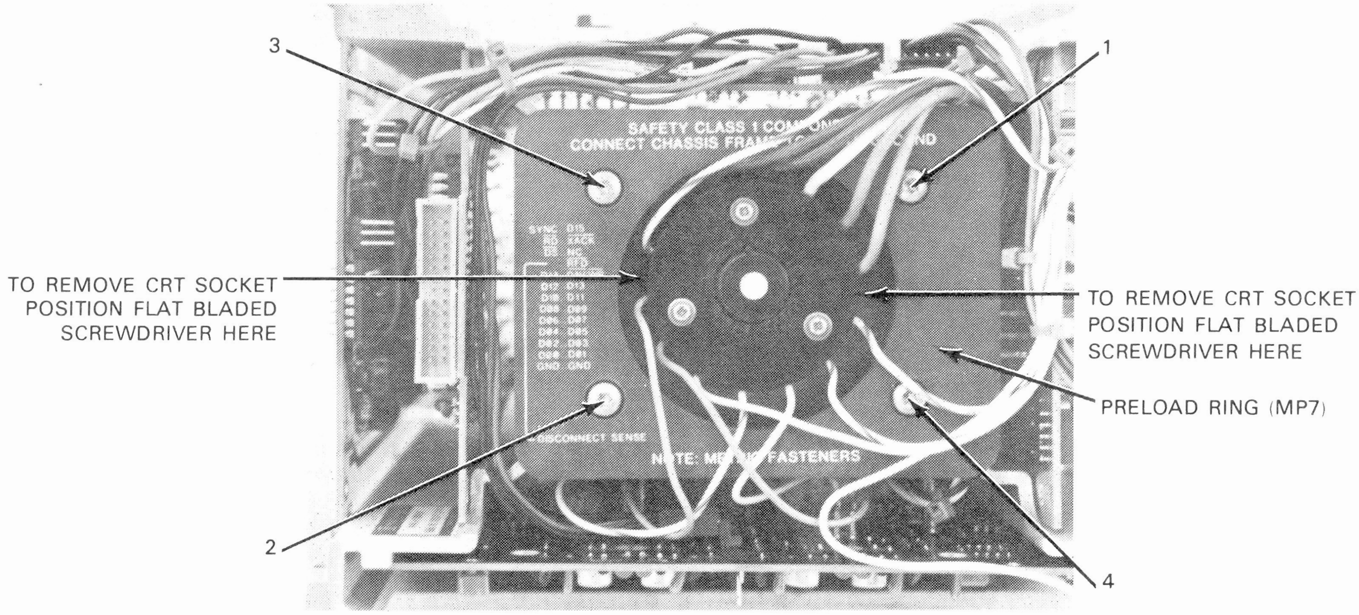
8-12. CRT REMOVAL PROCEDURE.

a. Remove power from the instrument.

b. Remove CRT socket. Use two thin bladed screwdrivers to pry the socket away from the CRT (see Figure 8-3). Disconnect the PA lead.

c. Loosen screw on the CRT Shield (MP2) on top of the instrument (next to the Low Voltage Power Supply).

d. Loosen Preload Ring (MP7). Use a No. T15 Torx screwdriver. Gradually release the pressure of the Preload Ring by loosening the screws in the 1, 2, 3, 4 sequence as shown in Figure 8-1.



LOOSEN PRELOAD RING (MP7) IN THE 1, 2, 3, 4 SEQUENCE

Figure 8-1. CRT Removal.

e. Remove CRT Bezel (MP4) using a No. T10 Torx screwdriver. Remove the CRT from the CRT Shield (MP2).

f. When reinstalling a CRT, relubricate the Yoke assembly with silicone grease. Ensure a layer of grease where ever the CRT contacts the Yoke assembly.

g. Lubricate the PA lead from the CRT. Wipe the electrical connector part of the PA lead clean.

h. To reassemble the instrument reverse the above procedure (steps e through b).

8-13. TROUBLESHOOTING.

WARNING

Read the safety summary at the front of this manual before troubleshooting the instrument.

8-14. DC VOLTAGES AND WAVEFORMS. DC voltages, waveforms and conditions for making these measurements are given on, or are adjacent to schematics on the Service Sheets. Since conditions for making measurements may differ from one circuit to another, always check the specific conditions listed for each schematic.

8-15. INITIAL TROUBLESHOOTING PROCEDURE. Before attempting to troubleshoot the 1349A/D, visually inspect the interior of the instrument for any signs of abnormal internally generated heat, such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing. Determine and remedy the cause of such conditions. If no abnormal conditions are found, try to perform the adjustment procedure in Section V of this manual. Some apparent malfunctions may be corrected by these adjustments, or failure to obtain a correct adjustment will often reveal the source of trouble.

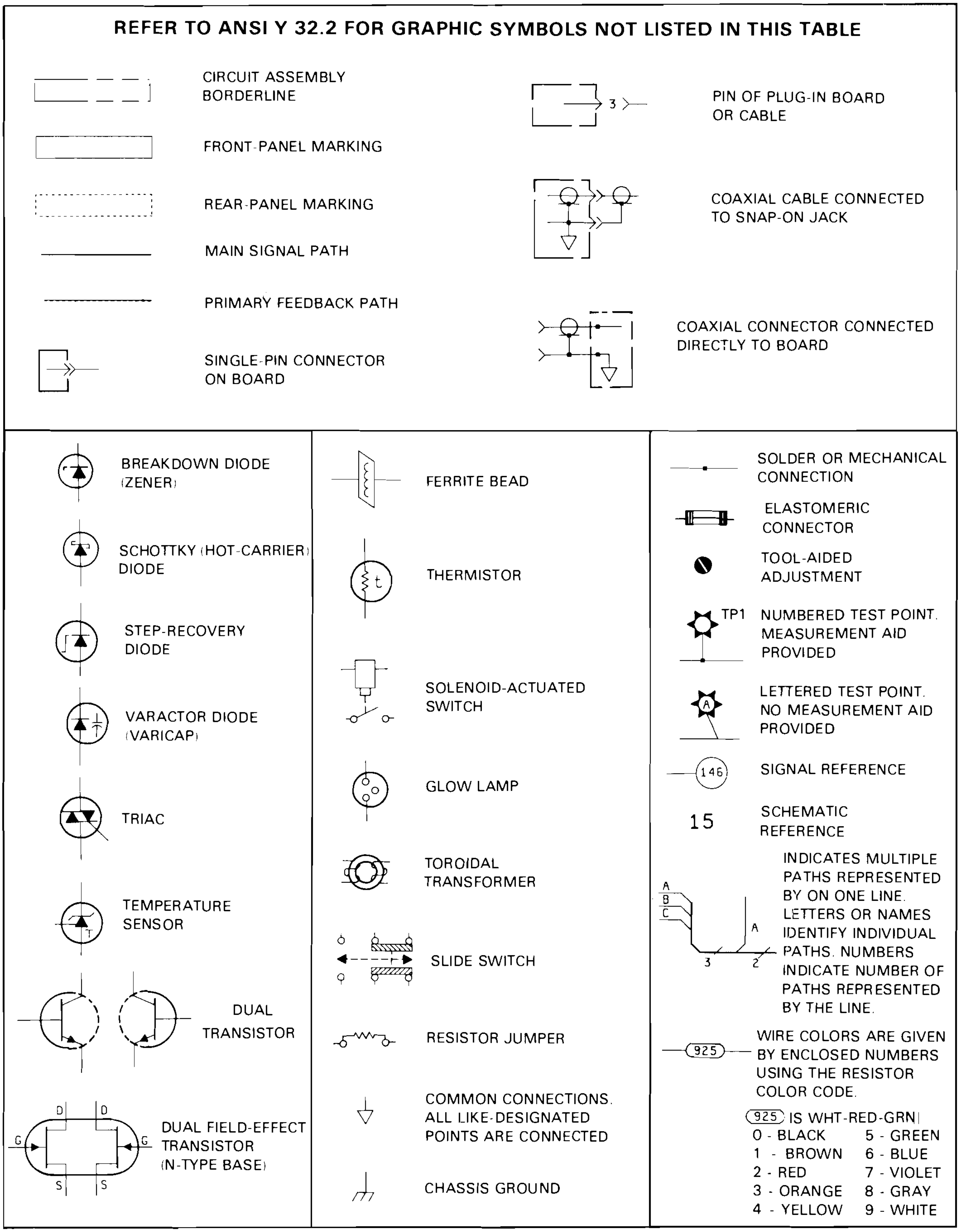


Figure 8-2. Schematic Diagram Symbols.

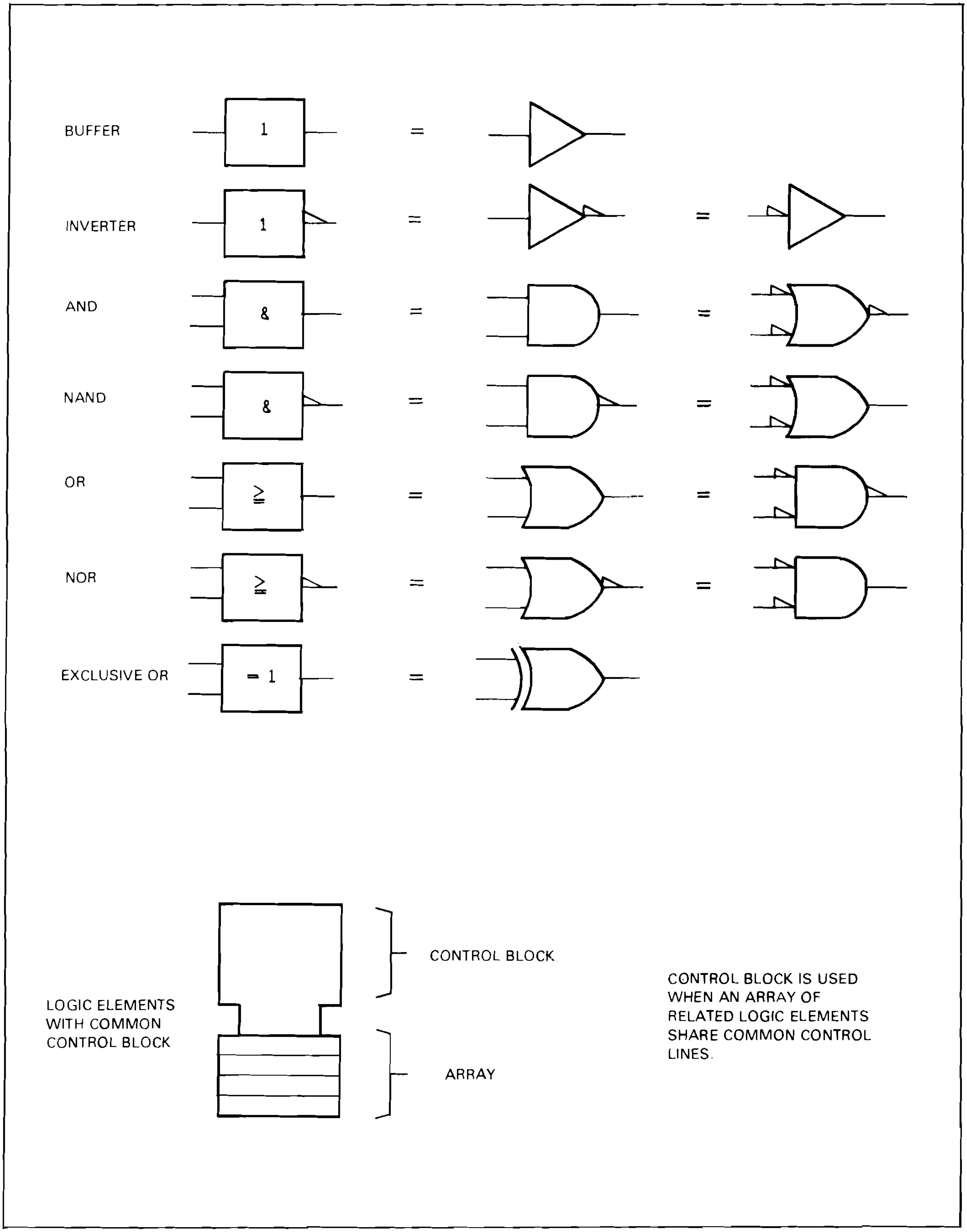


Figure 8-3. Basic Logic Symbols (Sheet 1).

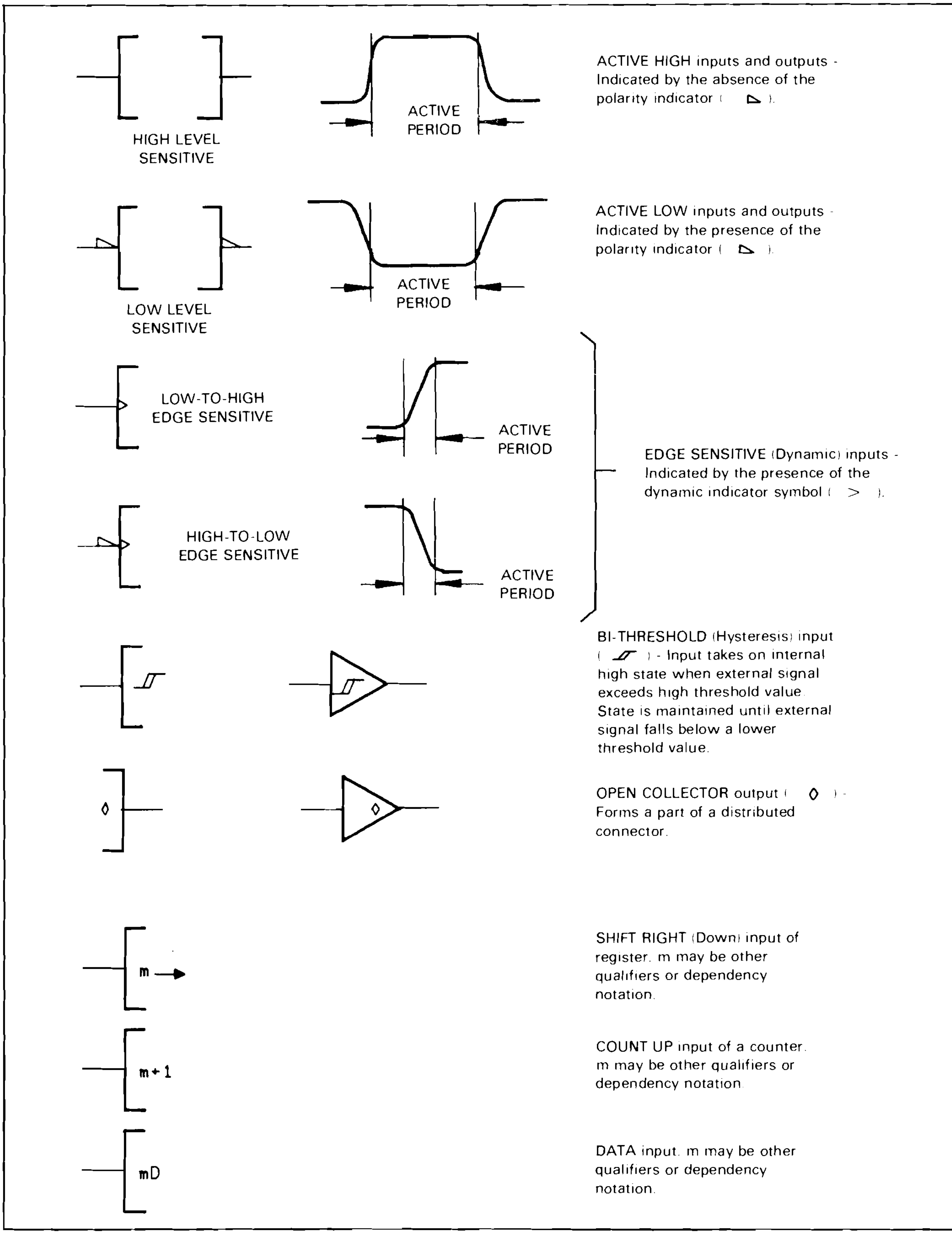


Figure 8-3. Qualifying Symbols (Sheet 2).

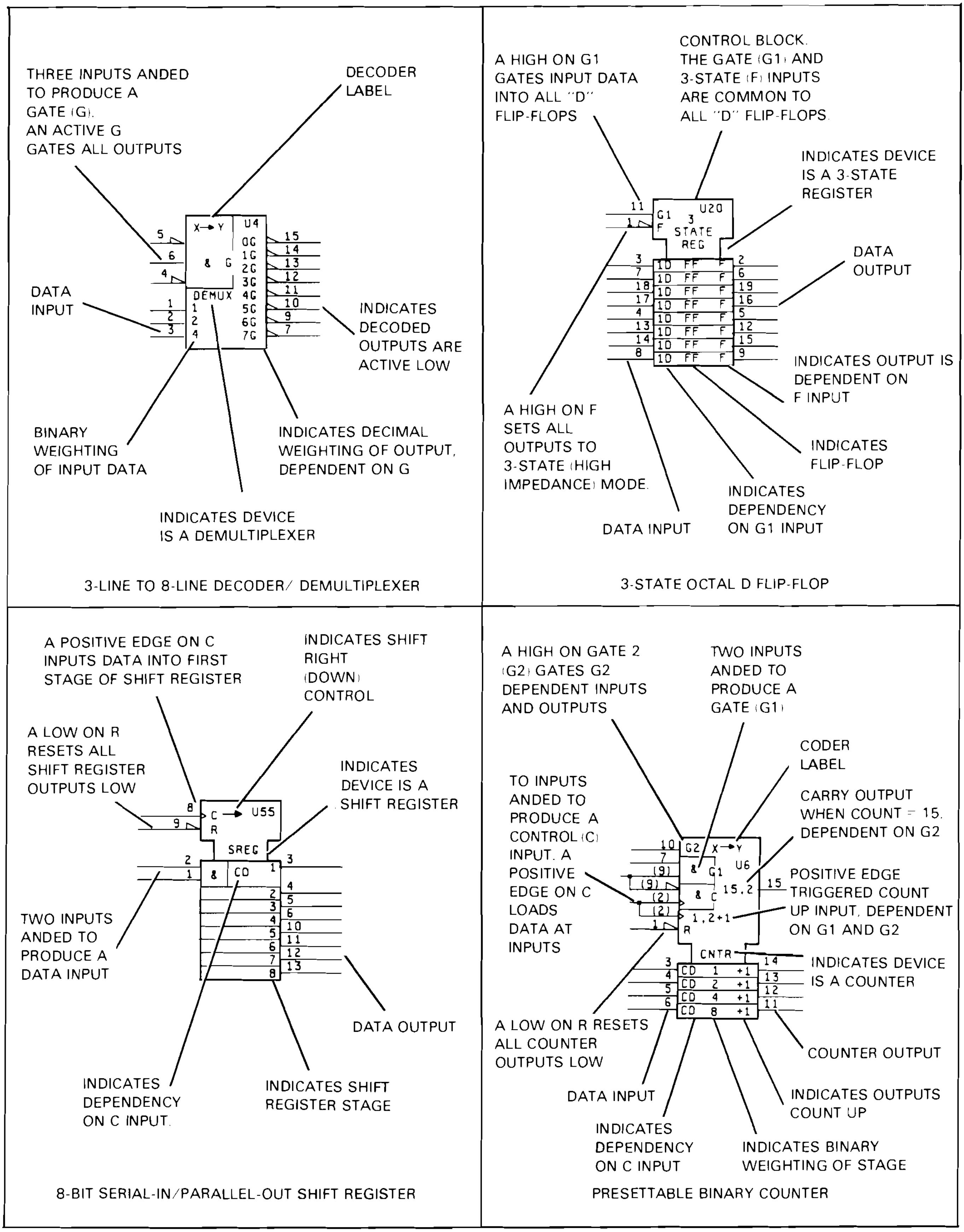


Figure 8-3. Example Complex Logic Symbols (Sheet 3).

Table 8-2. Function Labels.

▷	AMPLIFIER/BUFFER
1 ⎍	MONOSTABLE MULTIVIBRATOR (ONE-SHOT)
&	AND GATE
≧ 1	OR GATE
= 1	EXCLUSIVE OR GATE
X→Y	ENCODER, DECODER
XMAX→Y	PRIORITY ENCODER
CNTR	COUNTER
DEMUX	DEMULTIPLEXER
FF	FLIP-FLOP
RAM	RANDOM-ACCESS MEMORY
REG	REGISTER
ROM	READ-ONLY MEMORY
SAR	SUCCESSIVE APPROXIMATION REGISTER
SEL	SELECTOR
SREG	SHIFT REGISTER
TX/RX	TRANSMITTER/RECEIVER

8-16. SERVICE SHEET 1, THEORY OF OPERATION.

8-17. INTRODUCTION. The following paragraphs contain functional descriptions keyed to the simplified block diagram on the opposite page. The block diagram is drawn for function and does not show circuit details. Circuit details and circuit descriptions are located on the schematics following the block diagram. Refer to Table 8-1 for schematic identification.

8-18. VECTOR PROCESSOR (Assembly A2, Service Sheets 2, 2A).

The purpose of the Vector Processor Control is to convert the digital 16 bit input data from the user processor to absolute coordinate vector data for the Stroke Generator (A1). The self test processor A2U1 is used to display the primary and secondary test patterns. The patterns are used for the Performance Checks (Section IV) and the Adjustment Procedures (Section V). The Vector Processor Control Board contains the following primary circuits:

1. Input Data Latches (A2U6, A2U8, A2U13).
2. Output Data Latches (A2U22-A2U25).
3. Character Generator (A2U5, A2U9 - A2U12).
4. Timing Circuits (A2U14, A2U26).
5. Vector Processor (A2U16).

8-19. X-Y STROKE GENERATOR (Assembly A1, Service Sheets 3A, 3B, 3C).

The Stroke Generator converts binary data from the Vector Processor to analog deflection information. The Stroke Generator consists of the following primary circuits:

1. Digital to Analog Converters (A1U1-A1U6, A1U13-A1U18).
2. Analog Multiplier (A1U7, A1U19).
3. Ramp Generator (A1U26).
4. Intensity Controller (A1U25).
5. X and Y Output Amplifiers.

8-20. LOW VOLTAGE AND HIGH VOLTAGE POWER SUPPLIES (Assemblies A3, A4 Service Sheets 4, 5).

The Low Voltage Power Supply (A3) conditions the operating potentials for the 1349A/D. Additionally, the assembly provides a +105V supply for the High Voltage Power Supply, the X-Y Deflection Amplifiers, Intensity Amplifier and Astigmatism Amplifiers. The High Voltage Power Supply (A4) provides the operating potentials for the CRT. The supply consists of the following circuits:

1. Oscillator Circuit (A4Q7).
2. Cathode Rectifier and Filter (A4CR11, A4C12, A4C13).
3. High Voltage Regulator (A4U1).
4. Level Translator Circuit (A4CR14, A4CR15, A4C16).

8-21. MEMORY CIRCUIT (Assembly A5, Service Sheet 6).

The Vector Memory circuit can store all the 1349A/D commands to draw a picture on the screen. The user processor can access any address in Vector Memory via the Address Pointer. This allows selected portions of a picture to be changed or sent back to the processor for checking or processing.

The Memory Circuit also has a feature whereby the user processor can supress portions of the picture (such as graticules or labels). Suppressed information is not erased from the Vector Memory. This is done by having the Memory do an Internal Jump past the data that is not to be displayed. Suppressed data can be made part of the picture by using only a few user processor commands, thus reducing overhead time.

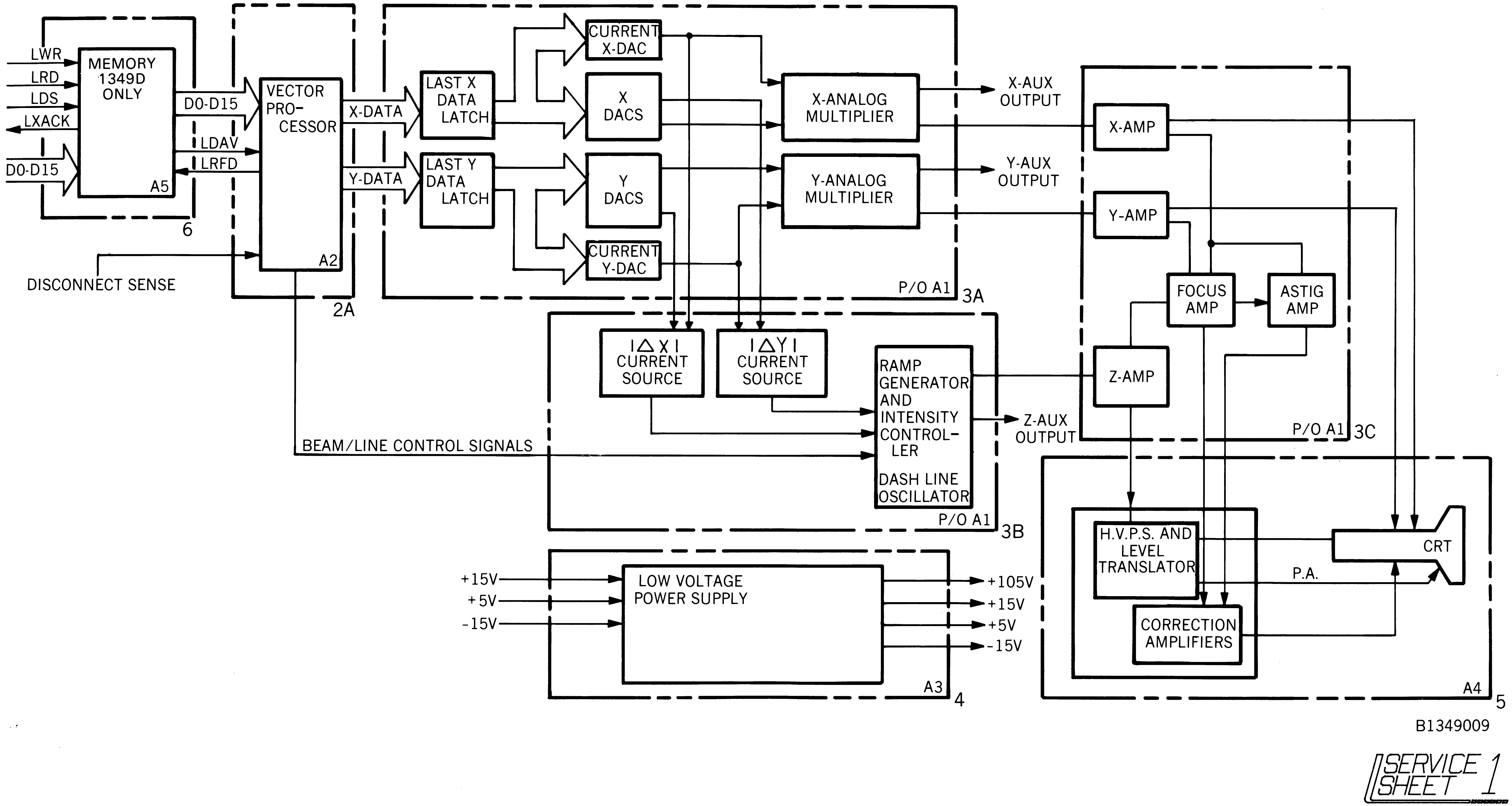


Figure 8-4.
1349A/D *Block Diagram.*

8-22. SERVICE SHEETS 2, 2B, THEORY OF OPERATION.

The 16 bit data from a user processor is converted to absolute coordinate vector data for the X-Y Stroke Generator (A1). This is accomplished by interfacing a host processor or refresh system with the circuit board. The self test processor is used for storing the primary and secondary test patterns. The Vector Processor consists of the following circuits which are described below:

1. Input Data Latches (A2U6, A2U8).
2. Output Data Latches (A2U22-A2U25).
3. Character Generator (A2U5, A2U9-A2U13).
4. Timing Circuit (A2U14, A2U26).
5. Vector Processor (A2U16).
6. Condition Latches (A2U18-20).

INPUT DATA BUFFERS. The Input Data Buffers provide buffering for the Vector Processor (A2U16). The input data is gated to the when the VPC is ready for new vector data. Character data is handled by A2U13, while vector data is handled by A2U6 and A2U8. The VPC controls the gating of the data by using the signal lines VECTOR and CHARACTER.

OUTPUT DATA AND CONDITION LATCHES. The absolute X and Y vector values generated by the VPC (A2U16), are held in output latches A2U22-A2U25 for use by the Stroke Generator. The vector data is transfered by the Data Latch signal into the Output Latches. Condition Latches (A2U18-A2U20) contain the last Set Condition commands.

CHARACTER GENERATOR. The Character Generator translates character data into vector data for the VPC (A2U16). ROM A2U12 contains the stroke information for the modified ASCII character set. The character size and rotation is processed by the VPC for proper vector generation.

To generate a character:

1. LRFD is set low by the VPC.
2. LDAV is set low by the user processor (or by A2U1 if in self test).
3. VPC sets LVECTOR low to read Data Bus Command from Data Buffers A2U6 and A2U8.
4. At the same time LVECTOR goes low, A2U9-U11 are loaded with the address of the character from Character look-up ROM A2U5.
5. VPC set LRFD high.
6. VPC sets LCHARACTER low to read byte from Character ROM A2U12 via Character Buffer A1U13.
7. VPC sets LCHARACTER high to clock A2U9-A2U11 via A2U15B (COUNT INC goes positive) for next character byte.
8. Steps 6 and 7 repeat until last stroke of the character has been transferred to the Analog Board.
9. VPC sets LRFD low for next Data Bus command.

TIMING CIRCUIT. The clock circuit (A2U14,A2U26) provides the clock for the VPC. A2U14 generates a 19.66 MHz pulse and A2U26 divides that pulse by 5 to 3.93 MHz for the VPC.

VECTOR PROCESSOR (VPC). The VPC is the controlling device for vector generation, using four programmable modes of operation.

1. Set Condition
2. Plot Absolute
3. Graph Absolute
4. Text

SET CONDITION. When bits B14, and B13 of an input word are set to "1", the VPC recognizes the Set Condition Command. The Set Condition Command controls the intensity level, the line type, and the writing speed of the vector drawn. Once a Set Condition has been defined, the data remains stored in buffers A2U18-A2U20 until a new Set Condition Command is received.

PLOT COMMAND. When bits B14 and B13 are set to "0", the VPC is ready to process vector data. Data bits B0-B10 define X or Y coordinates. When bit B12 is set to "0" the incomming data is an X coordinate, when bit B12 is set to "1" the incoming data is a Y coordinate. The beam can be turned on or off depending on the status of bit B11. The present X-Y coordinates are latched into A2U22-A2U25.

GRAPH COMMAND. The Graph Command allows automatic X incrementing with each new Y coordinate input. To invoke the Graph Command, data bits B14 must be set to "0" and B13 must be set to "1". When bit B12 is set to "0", B0-B10 define the X increment. The VPC is now programmed to increment the X coordinate each time a new Y coordinate is received. Bits B0-B10 contain Y coordinate information when B12 is set to "1".

TEXT COMMAND. When bit B14 is set to "1" and B13 is set to "0", the VPC is instructed to go to the Text Mode. Bits B0-B7 define the character to be drawn. B11-B12 define the size of character to be drawn, B9-B10 determine rotation of the character. When bit B8 is set to "0" the VPC defaults to the previous size and rotation data. When set to "1" size and rotation information is determined via data bits B9-B12.

VPC/Analog Handshake Sequence.

1. Analog Board sets VECTOR DONE high (forced by Stroker Restart A2U21 on VPC Board at power-on. This line is normally controlled by Ramp Generator A2U26 on the Analog Board.
2. VPC sets Data Latch high.
3. VPC sets Start Vector 1 high, then waits for a high on VECTOR DONE (step 1).

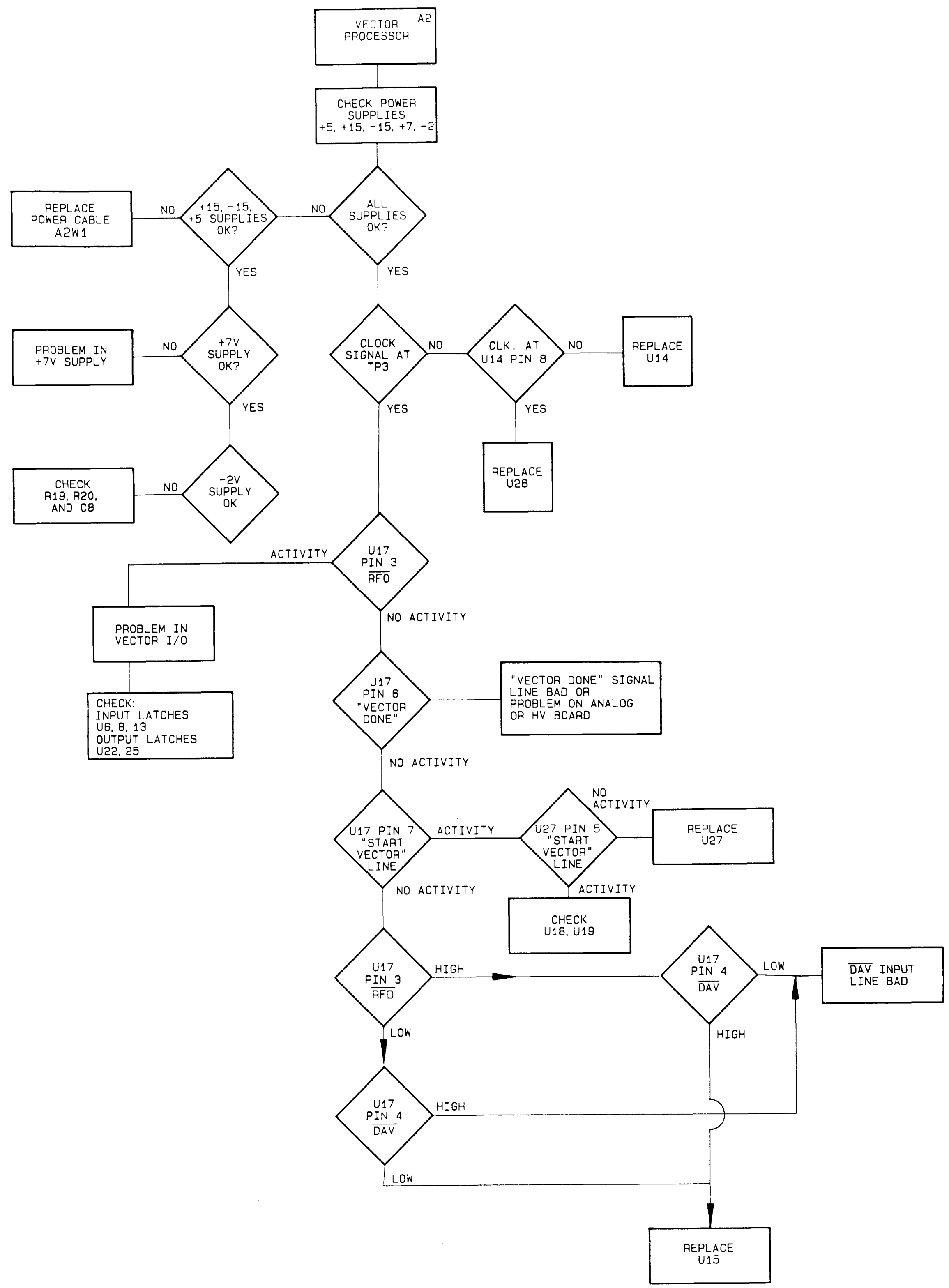


Figure 8-5. Vector Processor Troubleshooting Flow Chart.

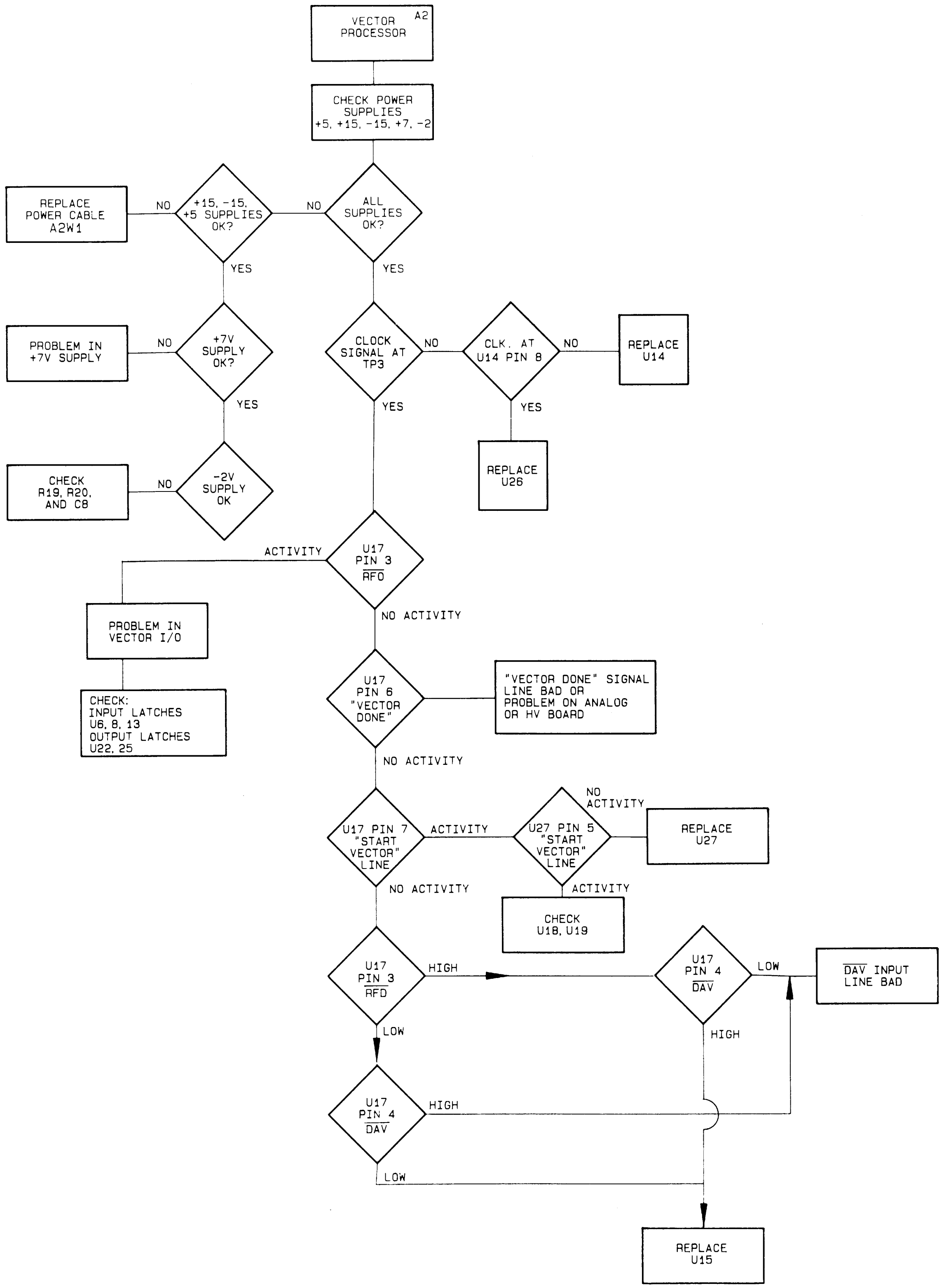
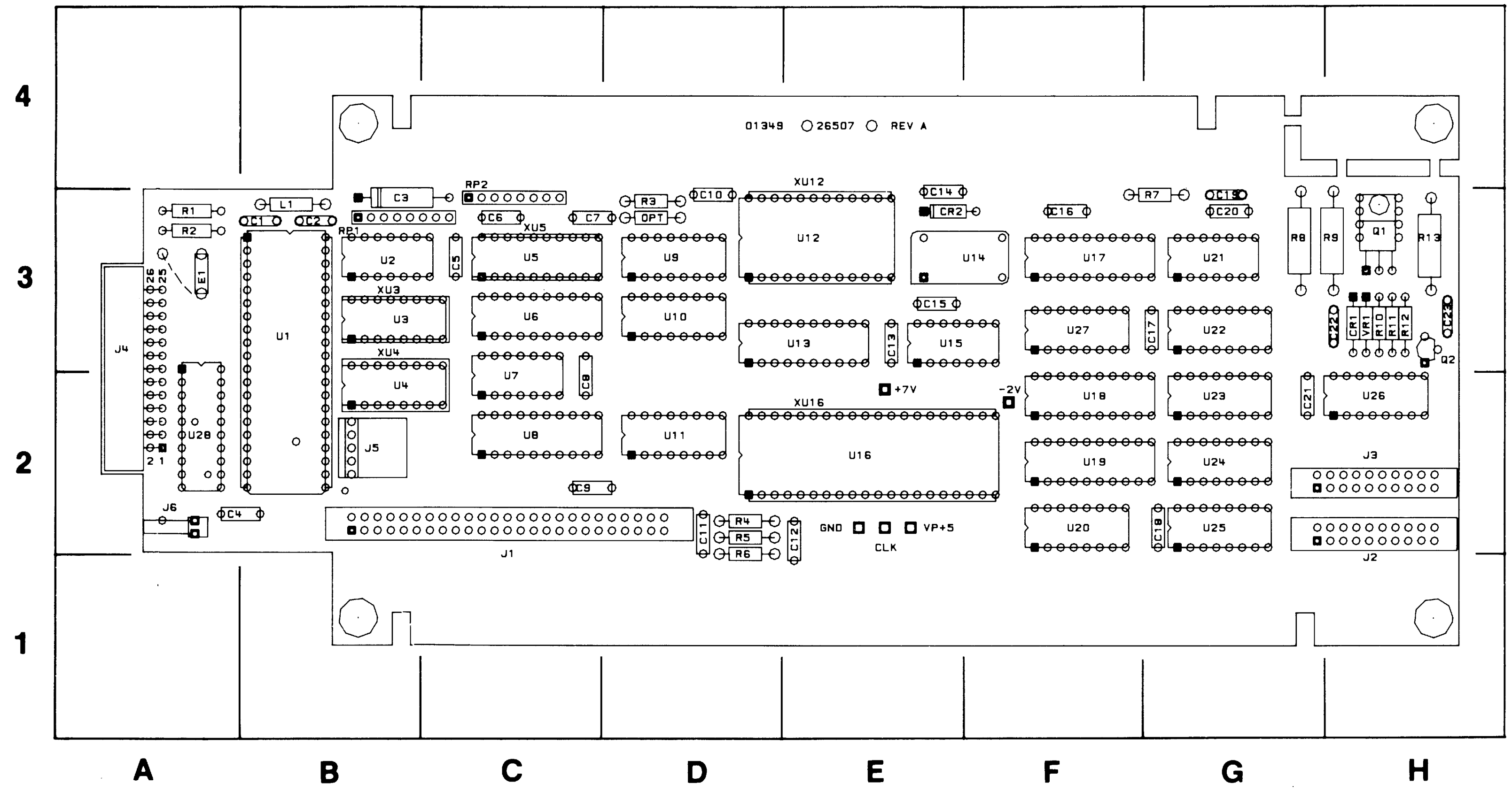
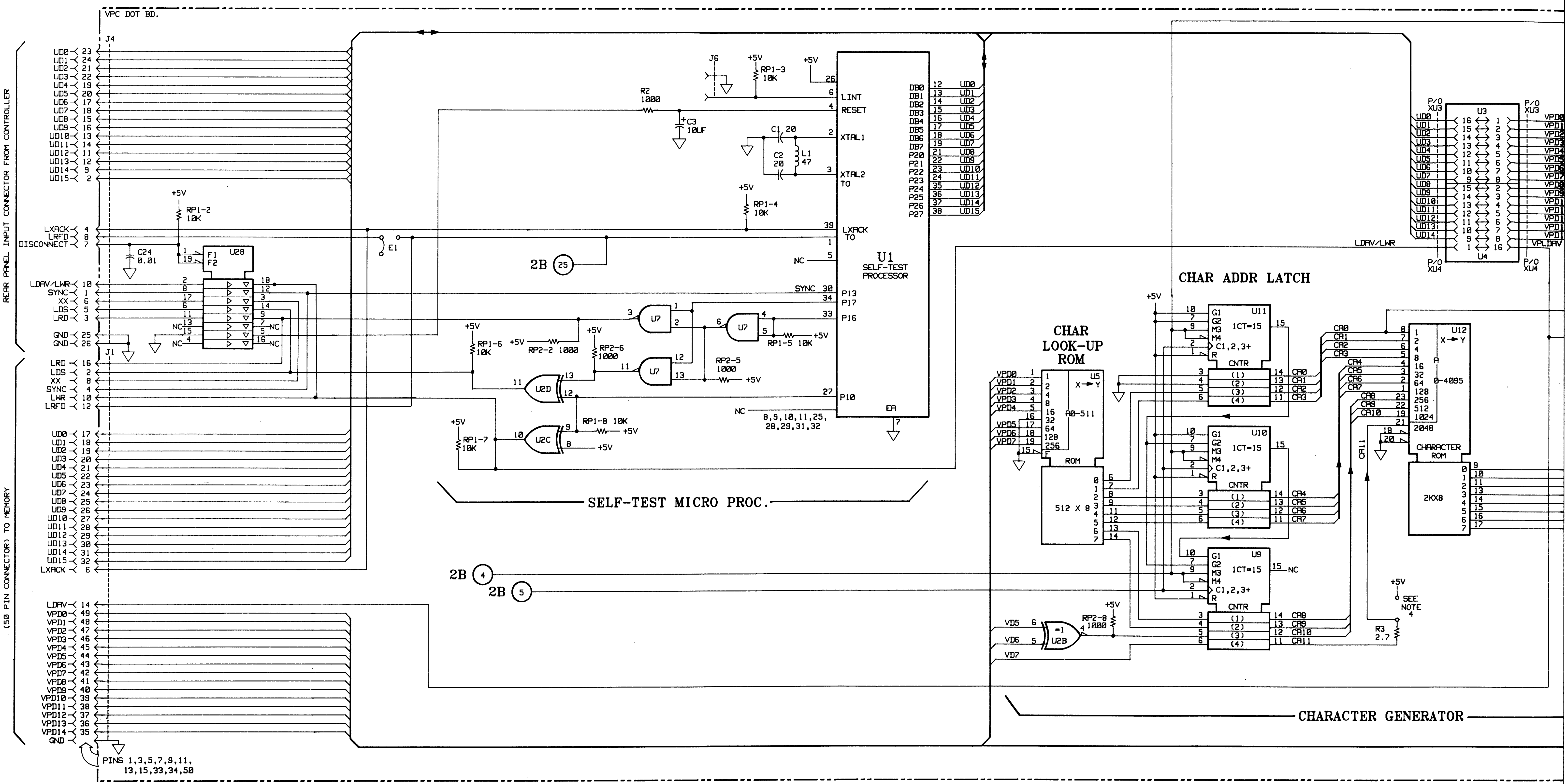


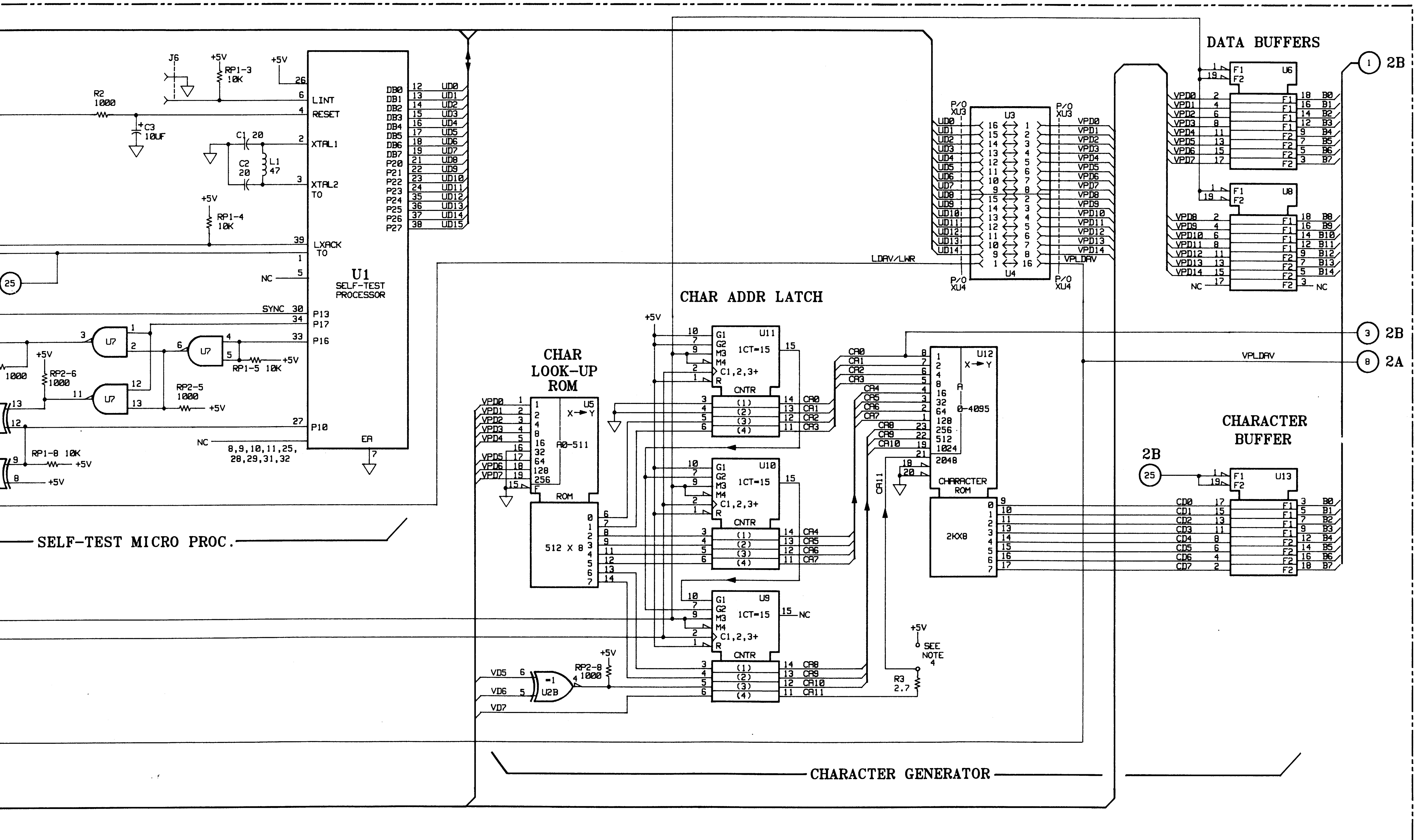
Figure 8-5. Vector Processor Troubleshooting Flow Chart.



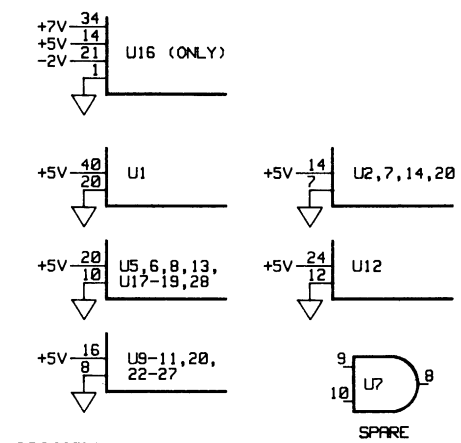
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-3	C22	H-3	R7	G-3	U12	E-3
C2	B-3	C23	H-3	R8	G-3	U13	E-3
C3	B-3	CR1	H-3	R9	H-3	U14	F-3
C4	A-2	CR2	E-3	R10	H-3	U15	E-3
C5	C-3	E1	A-3	R11	H-3	U16	E-2
C6	C-3	J1	C-1	R12	H-3	U17	F-3
C7	C-3	J2	H-1	R13	H-3	U18	F-2
C8	C-2	J3	H-2	RP1	B-3	U19	F-2
C9	C-2	J4	A-3	RP2	C-4	U20	F-2
C10	D-3	J5	B-2	U1	B-3	U21	G-3
C11	D-2	J6	A-2	U2	B-3	U22	G-3
C12	E-2	L1	B-3	U3	B-3	U23	G-2
C13	E-3	Q1	H-3	U4	B-2	U24	G-2
C14	E-3	Q2	H-3	U5	C-3	U25	G-2
C15	E-3	R1	A-3	U6	C-3	U26	H-2
C16	F-3	R2	A-3	U7	C-2	U27	F-3
C17	G-3	R3	D-3	U8	C-2	U28	A-2
C18	G-2	R4	D-2	U9	D-3	VR1	H-3
C19	G-3	R5	D-2	U10	D-3	XU4	B-3
C20	G-3	R6	D-1	U11	D-2	XU5	C-3
C21	G-2					XU16	E-2

Figure 8-6. Vector Processor Component Locator.


VPC DOT BD.
REAR PANEL INPUT CONNECTOR FROM CONTROLLER
(50 PIN CONNECTOR) TO MEMORY
U1
SELF-TEST PROCESSOR
SELF-TEST MICRO PROC.
CHAR LOOK-UP ROM
CHAR ADDR LATCH
CHARACTER ROM
CHARACTER GENERATOR
PINS 1,3,5,7,9,11, 13,15,33,34,50



IC DEVICE POWER CONNECTIONS



NOTES:

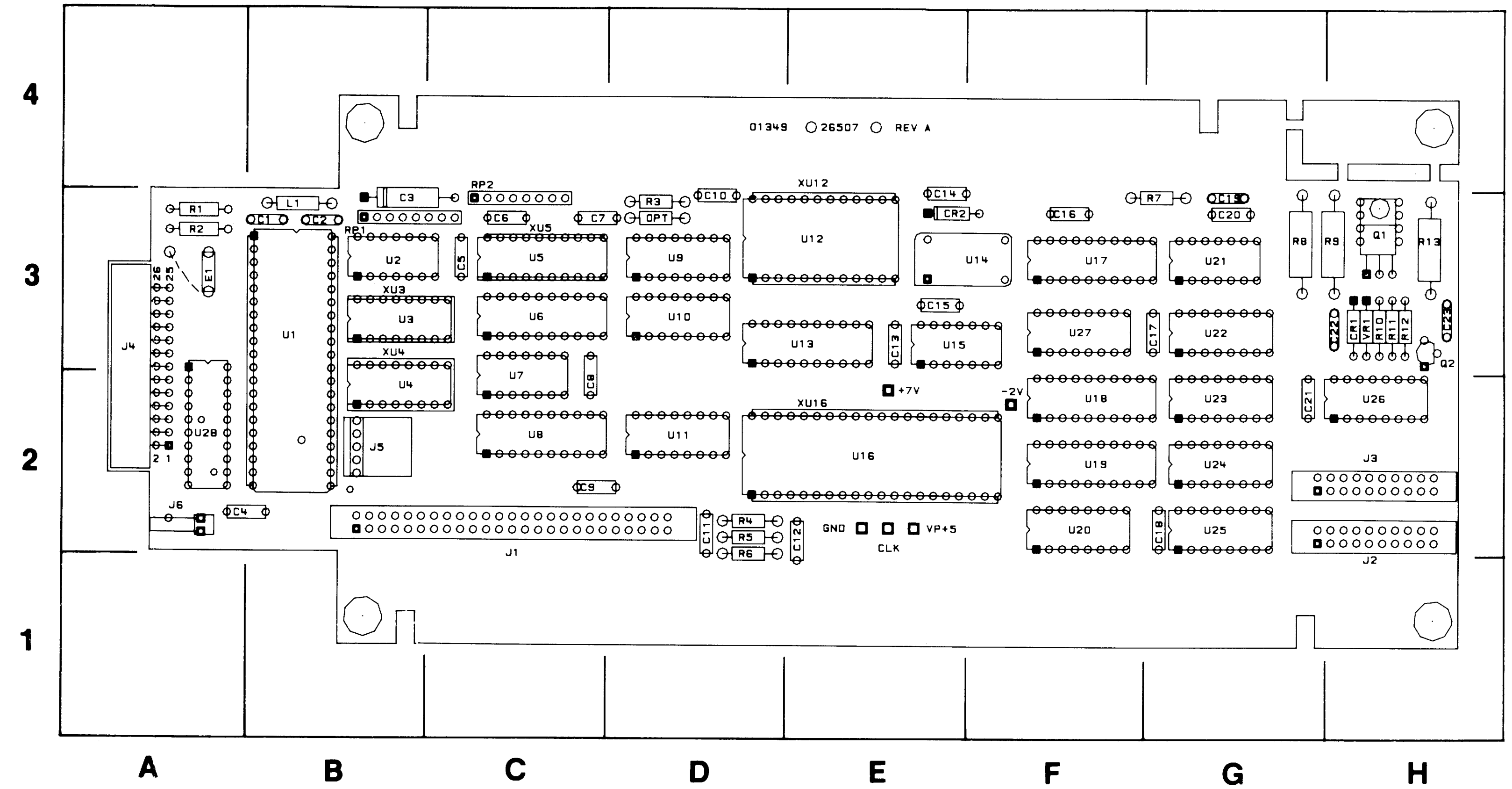
1. GATES ARE SYMBOLIZED ACCORDING TO CIRCUIT FUNCTION.
2. UNLESS OTHERWISE NOTED:
   RESISTANCE IN OHMS
   CAPACITANCE IN PICOFARADS
   INDUCTANCE IN MICROHENRIES
3. UNLESS OTHERWISE NOTED:
   LOGIC LEVELS ARE TTL:
   +2.0V TO +5.0V=LOGIC"1"=H
   0V TO +0.8V=LOGIC"0"=L
4. R3 SHOWN IN POSITION FOR 32K ROM. USE ALTERNATE POSITION FOR 16K ROM.
5. WHEN MEMORY IS INSTALLED, JUMPERS U3 & U4 MUST BE REMOVED.
6. JUMPER E1 SHOWN "MEMORY INSTALLED". ALTERNATE POSITION IS FOR NO MEMORY.

PARTS ON THIS SCHEMATIC
C1-3,24 E1 J1,4,6 R2,3 RP1,2 U1-8,10-13,28

C1349009/02JUL84

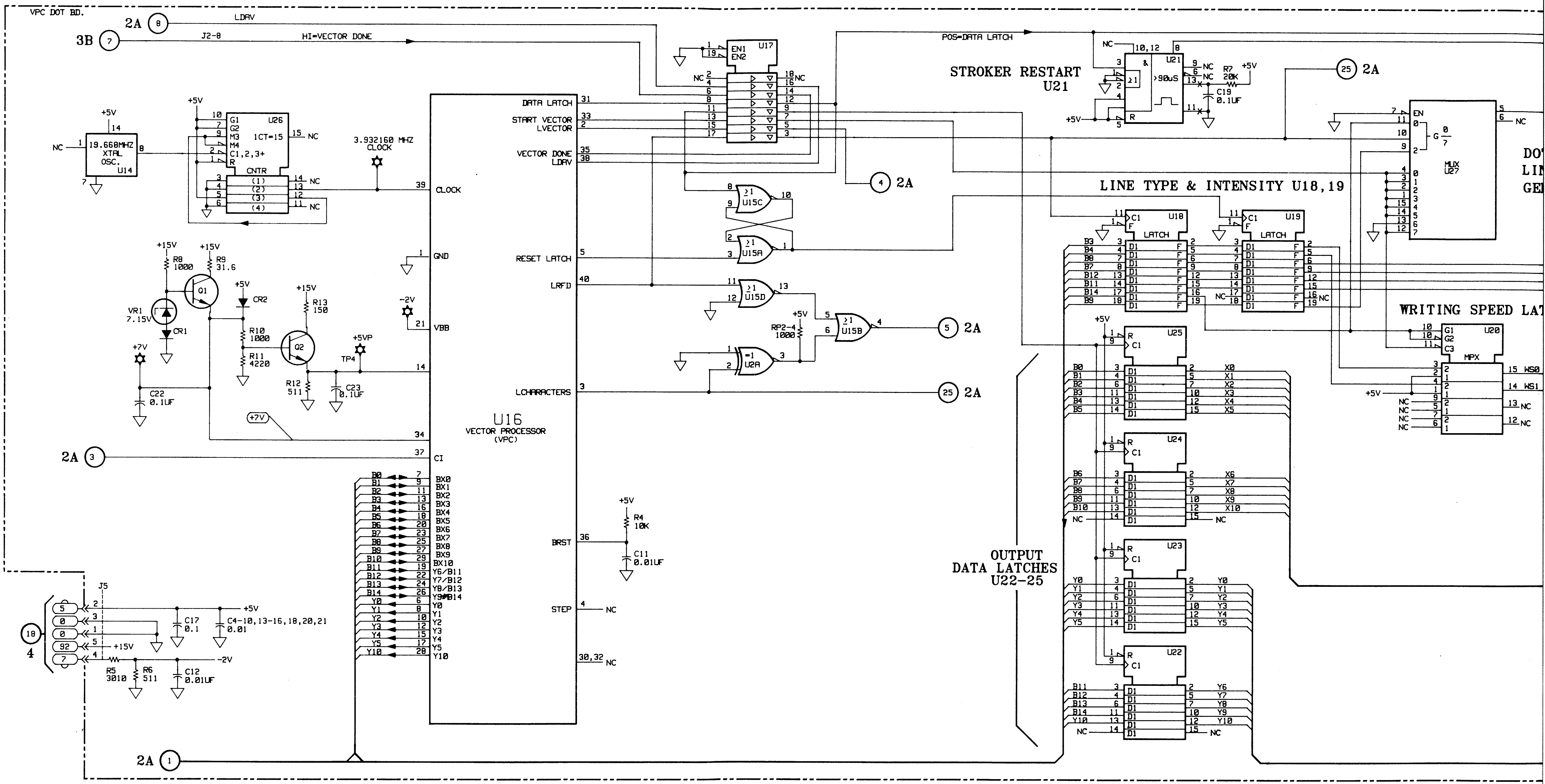
SERVICE SHEET 2A

Figure 8-7.
P/O Vector Processor

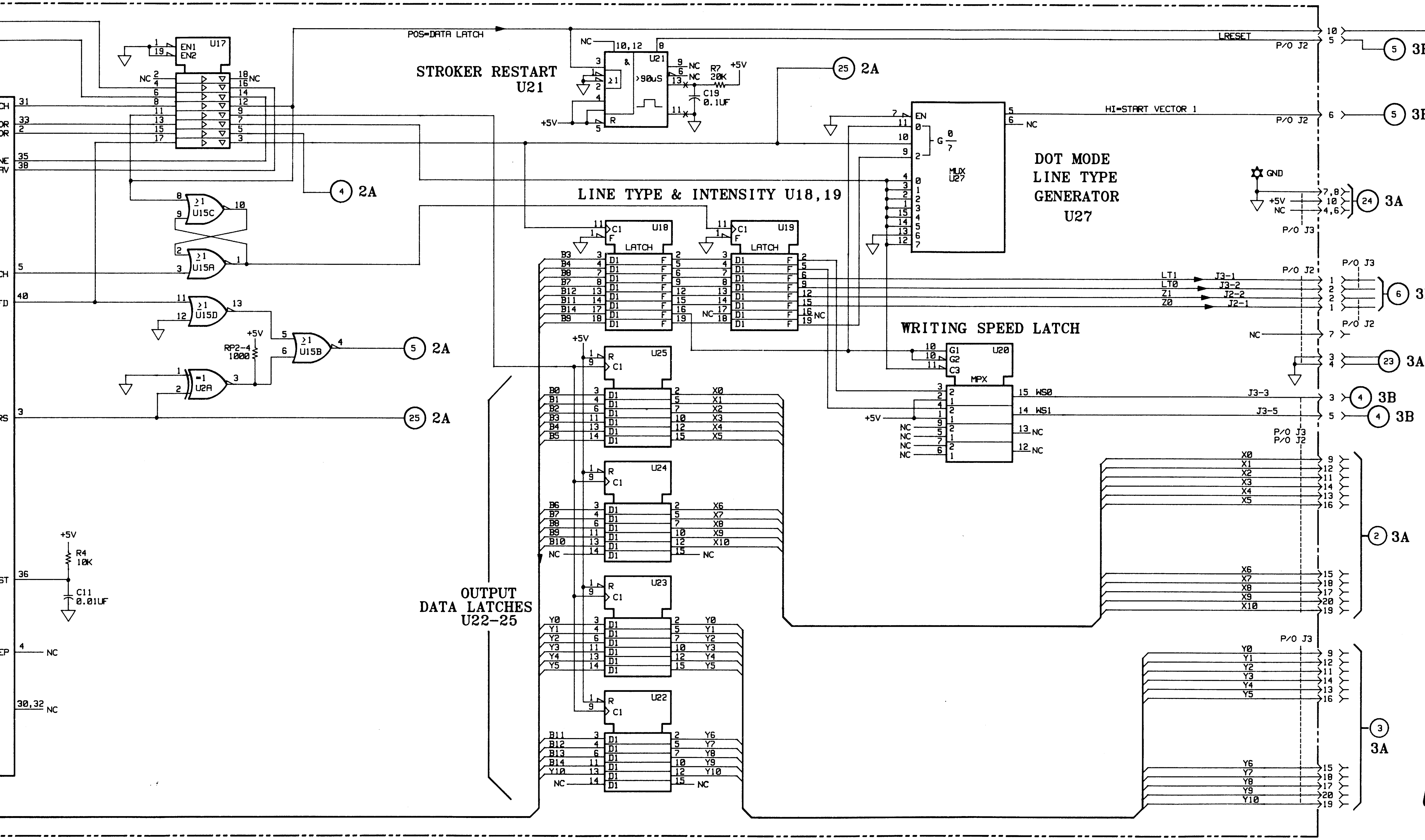


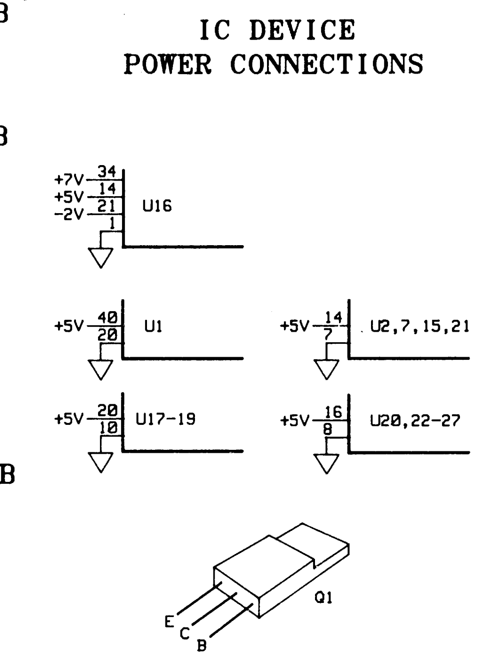
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-3	C22	H-3	R7	G-3	U12	E-3
C2	B-3	C23	H-3	R8	G-3	U13	E-3
C3	B-3	CR1	H-3	R9	H-3	U14	F-3
C4	A-2	CR2	E-3	R10	H-3	U15	E-3
C5	C-3	E1	A-3	R11	H-3	U16	E-2
C6	C-3	J1	C-1	R12	H-3	U17	F-3
C7	C-3	J2	H-1	R13	H-3	U18	F-2
C8	C-2	J3	H-2	RP1	B-3	U19	F-2
C9	C-2	J4	A-3	RP2	C-4	U20	F-2
C10	D-3	J5	B-2	U1	B-3	U21	G-3
C11	D-2	J6	A-2	U2	B-3	U22	G-3
C12	E-2	L1	B-3	U3	B-3	U23	G-2
C13	E-3	Q1	H-3	U4	B-2	U24	G-2
C14	E-3	Q2	H-3	U5	C-3	U25	G-2
C15	E-3	R1	A-3	U6	C-3	U26	H-2
C16	F-3	R2	A-3	U7	C-2	U27	F-3
C17	G-3	R3	D-3	U8	C-2	U28	A-2
C18	G-2	R4	D-2	U9	D-3	VR1	H-3
C19	G-3	R5	D-2	U10	D-3	XU4	B-3
C20	G-3	R6	D-1	U11	D-2	XU5	C-3
C21	G-2					XU16	E-2

Figure 8-8. Vector Processor Component Locator



VPC DOT BD.
LDAV
HI=VECTOR DONE
J2-8
POS=DATA LATCH
STROKER RESTART
U21
LINE TYPE & INTENSITY U18,19
WRITING SPEED LAT
U17
U26
1CT=15
CNTR
19.660MHZ XTAL OSC.
U14
3.932160 MHZ CLOCK
DATA LATCH
START VECTOR
LVECTOR
VECTOR DONE
LDAV
CLOCK
GND
RESET LATCH
LRFD
VBB
LCHARACTERS
CI
BRST
STEP
U16
VECTOR PROCESSOR
(VPC)
U15C
U15A
U15D
U15B
U2A
>90uS
U18
U19
LATCH
MUX
U27
U20
MPX
U25
U24
U23
U22
OUTPUT
DATA LATCHES
U22-25
Q1
Q2
VR1
7.15V
CR1
CR2
R8 1000
R9 31.6
R10 1000
R11 4220
R12 511
R13 150
R4 10K
R5 3010
R6 511
R7 20K
C11 0.01UF
C12 0.01UF
C17 0.1
C19 0.1UF
C22 0.1UF
C23 0.1UF
C4-10,13-16,18,20,21 0.01
RP2-4 1000
J5
TP4
+5VP
+7V
+15V
+5V
-2V
NC





NOTES:

1. GATES ARE SYMBOLIZED ACCORDING TO CIRCUIT FUNCTION.
2. UNLESS OTHERWISE NOTED:
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   CAPACITANCE IN PICOFARADS
   INDUCTANCE IN MICROHENRIES
3. UNLESS OTHERWISE NOTED:
   LOGIC LEVELS ARE TTL:
   +2.0V TO +5.0V=LOGIC"1"=H
   0V TO +0.8V=LOGIC"0"=L
4. R3 SHOWN IN POSITION FOR 32K ROM. USE ALTERNATE POSITION FOR 16K ROM.
5. WHEN MEMORY IS INSTALLED, JUMPERS U3 & U4 MUST BE REMOVED.
6. JUMPER E1 SHOWN "MEMORY INSTALLED". ALTERNATE POSITION IS FOR NO MEMORY.

PARTS ON THIS SCHEMATIC
C4-23
CR1,2
J2,3,5
Q1,2
R4-13
U14-27
VR1

C1349012/02JUL84

SERVICE SHEET 2B

Figure 8-9.
P/O Vector Processor

8-23. SERVICE SHEETS 3A, 3B, 3C THEORY OF OPERATION.

The Stroke Generator converts the binary data from the VPC to analog deflection information. Since the X-Y Stroke Generator and the X-Y Amplifiers are identical, only the X-Axis circuits will be described.

DIGITAL TO ANALOG CONVERTER. A1U1 and A1U2 latch the previous X coordinate for comparison with the present X coordinate data. A1U3 and A1U4 are 12 bit DACs that convert the binary coordinate data to a corresponding analog current. The output voltage of operational amplifiers A1U5 and A1U6 represents the present and previous X coordinates. The difference between these two voltages determines the next relative beam movement in the X direction.

ANALOG MULTIPLIER. The Analog Multiplier multiplies two signals: the ramp generated by A1U26, and the DAC outputs. The output of A1U10 is a ramp whose amplitude is a function of the desired relative X beam movement and whose offset is a function of screen location (see Figure 8-10).

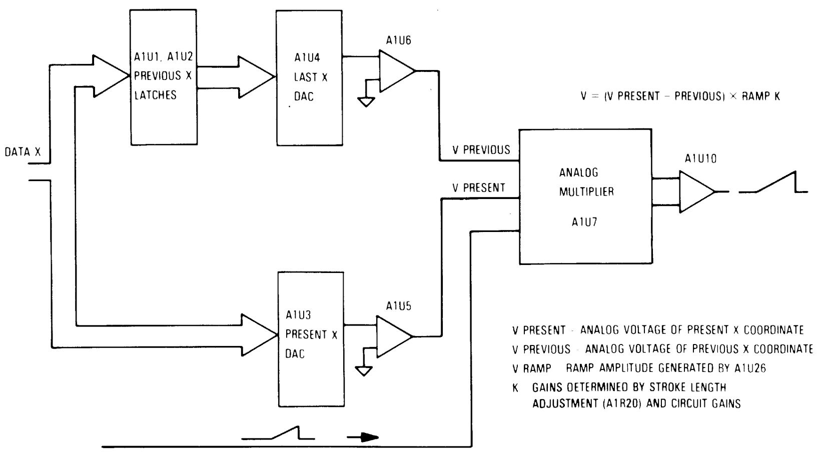


Figure 8-10. Simplified Block Diagram of Analog Multiplier.

RAMP GENERATOR. The Ramp Generator (A1U26) provides two signals: a ramp for X-Y beam movement, and the gate pulse for beam blanking. In order to maintain a constant intensity level for different vector length, the slope of the ramp (writing speed) must be held constant. The ramp slope is controlled by a combination of four inputs to A1U26. (See Figure 8-11 for the current definitions).

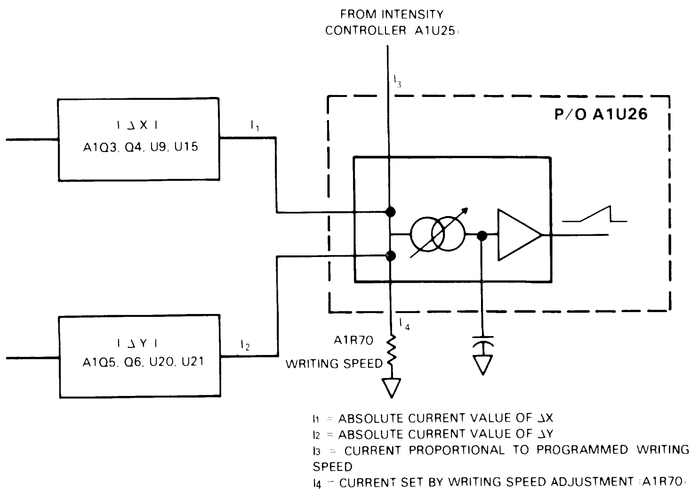


Figure 8-11. Current Definition For Ramp Generator

INTENSITY CONTROLLER. The Intensity Controller converts digital line writing and intensity information to analog voltages for use by the Intensity Amplifier. The only other input to the Intensity Controller is the gate pulse for beam blanking generated by A1U26. The current controlled oscillator in A1U25 generates two chopping frequencies: one for short dash line type and the other for long dash line type.

X-Y AMPLIFIERS. The X and Y amplifiers are identical. They amplify the X and Y analog coordinates from the Analog Multiplier (A1U7, A1U19) to drive the CRT horizontal and vertical deflection plates. Since both amplifiers are identical, only the X amplifier will be described. The X amplifier consits of a preamplifier (A1U29) and an output amplifier (A1Q7-A1Q12). The differential output from preamp A1U29 is applied to two identical amplifiers A1Q7-A1Q9 and A1Q10-A1Q12. The signal voltage is raised by these two amplifiers to the required level to drive the horizontal deflection plates. The gain of the output amplifier is stabilized by the negative feedback path through A1R92 and A1R101. The gain and balance of the X amplifier is set by A1R87 and A1R82 respectively.

Z-AXIS AMPLIFIER. The operating potential between the CRT grid and cathode is controlled by the Z-Axis amplifier output level. The amplifier consists of the Z-Axis preamp located on the Stroke Generator assembly (A1) and the Intensity Amplifier located on the High Voltage Power Supply assembly (A4). The output of the preamp A1U27 is applied to the Focus Correction Amplifier (A1U31) and the Intensity Amplifier A4Q4-A4Q6. The output of emitter follower A1Q4 is applied to amplifier A1Q5 and A1Q6 where the signal amplitude is raised to the required level to control the operating potential of the CRT control grid. Intensity Amplifier gain is stabilized by the negative feedback path through A1R11. A1CR5 and A1CR6 provide protection for the Intensity Amplifier output stage against arcs and transients.

FOCUS CORRECTION AMPLIFIER. The Focus Correction circuit provides an optimum focused display over the entire viewing area. The amplifier uses three inputs for proper focus correction voltage generation. A voltage proportional to the beam position is coupled from the X and Y preamps to A1U31D and A1U31A. The Z axis correction voltage is fed from the Z axis preamp to the output of A1U31B. The X Gain and Balance is adjusted by A1R142 and A1R135, the Y Gain and Balance is adjusted by A1R145 and A1R138. The focus correction signal is applied to Focus Output amplifier A4Q1-A4Q3. The Output amplifier operates identical to the Intensity Amplifier.

Component Locator for 3A is shown on Service Sheet 3B & 3C.

amplifiers are identical, only the X amplifier will be described. The X amplifier consits of a preamplifier (A1U29) and an output amplifier (A1Q7-A1Q12). The differential output from preamp A1U29 is applied to two identical amplifiers A1Q7-A1Q9 and A1Q10-A1Q12. The signal voltage is raised by these two amplifiers to the required level to drive the horizontal deflection plates. The gain of the output amplifier is stabilized by the negative feedback path through A1R92 and A1R101. The gain and balance of the X amplifier is set by A1R87 and A1R82 respectively.

Z-AXIS AMPLIFIER. The operating potential between the CRT grid and cathode is controlled by the Z-Axis amplifier output level. The amplifier consists of the Z-Axis preamp located on the Stroke Generator assembly (A1) and the Intensity Amplifier located on the High Voltage Power Supply assembly (A4). The output of the preamp A1U27 is applied to the Focus Correction Amplifier (A1U31) and the Intensity Amplifier A4Q4-A4Q6. The output of emitter follower A1Q4 is applied to amplifier A1Q5 and A1Q6 where the signal amplitude is raised to the required level to control the operating potential of the CRT control grid. Intensity Amplifier gain is stabilized by the negative feedback path through A1R11. A1CR5 and A1CR6 provide protection for the Intensity Amplifier output stage against arcs and transients.

FOCUS CORRECTION AMPLIFIER. The Focus Correction circuit provides an optimum focused display over the entire viewing area. The amplifier uses three inputs for proper focus correction voltage generation. A voltage proportional to the beam position is coupled from the X and Y preamps to A1U31D and A1U31A. The Z axis correction voltage is fed from the Z axis preamp to the output of A1U31B. The X Gain and Balance is adjusted by A1R142 and A1R135, the Y Gain and Balance is adjusted by A1R145 and A1R138. The focus correction signal is applied to Focus Output amplifier A4Q1-A4Q3. The Output amplifier operates identical to the Intensity Amplifier.

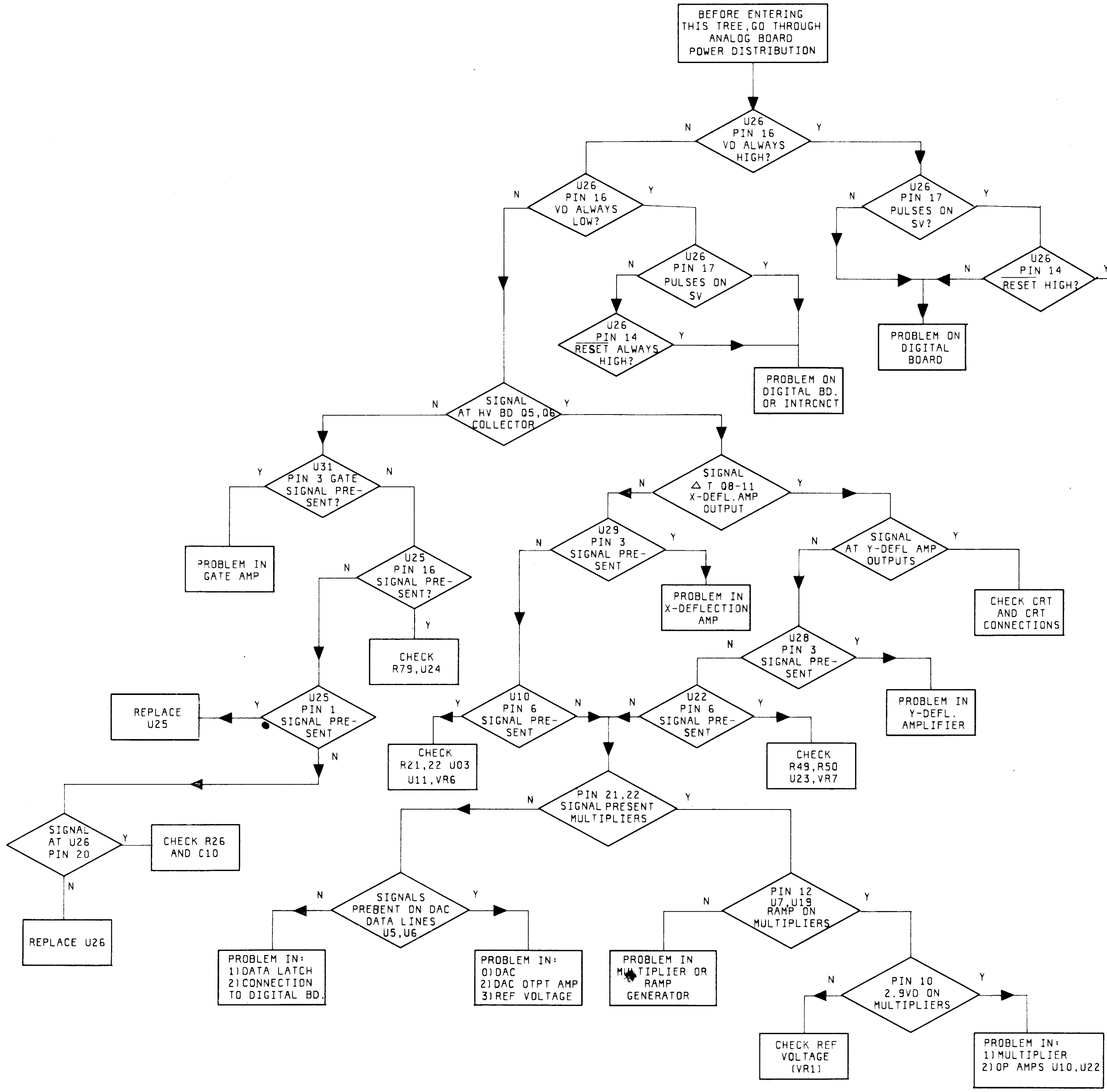
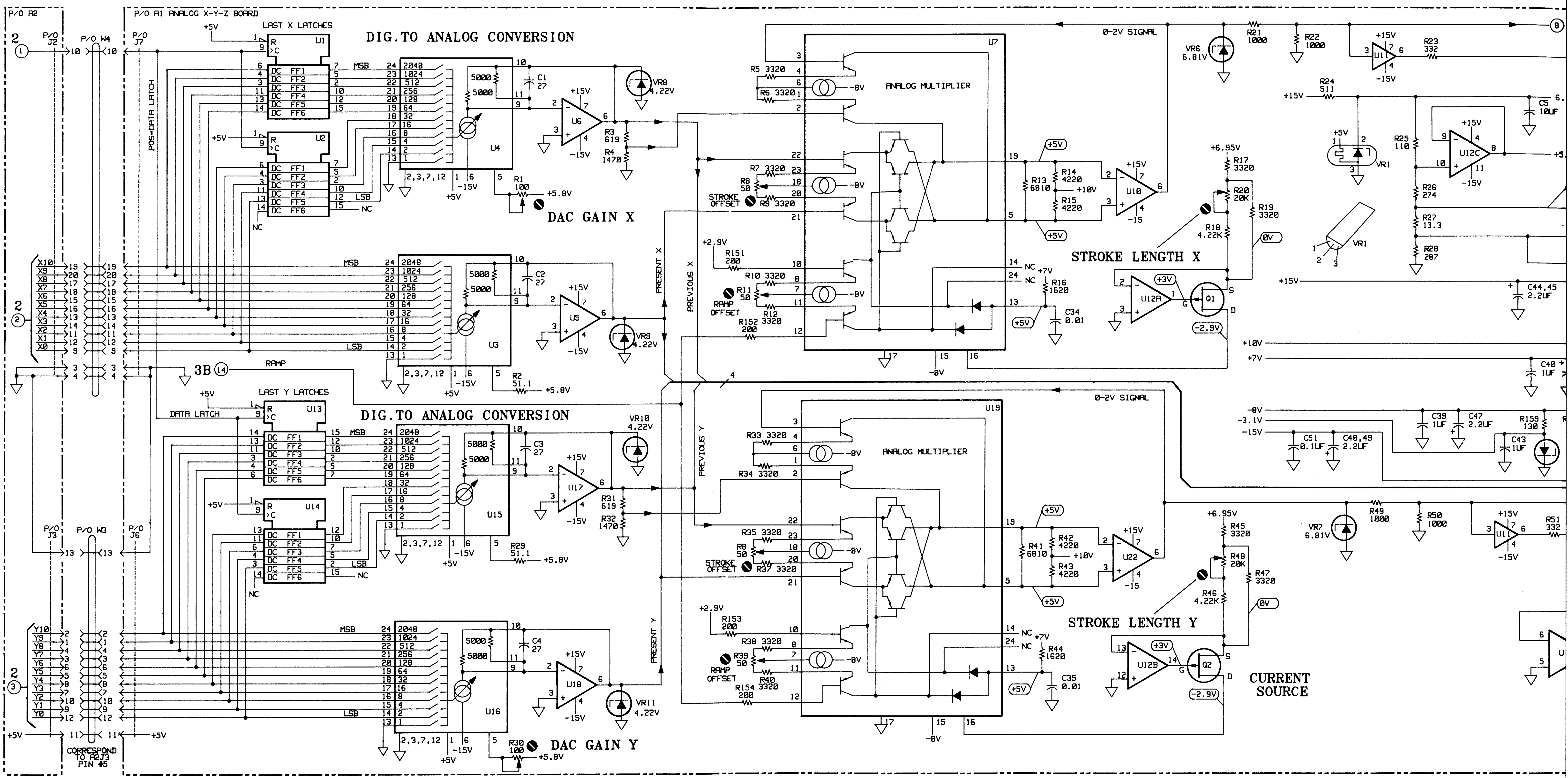
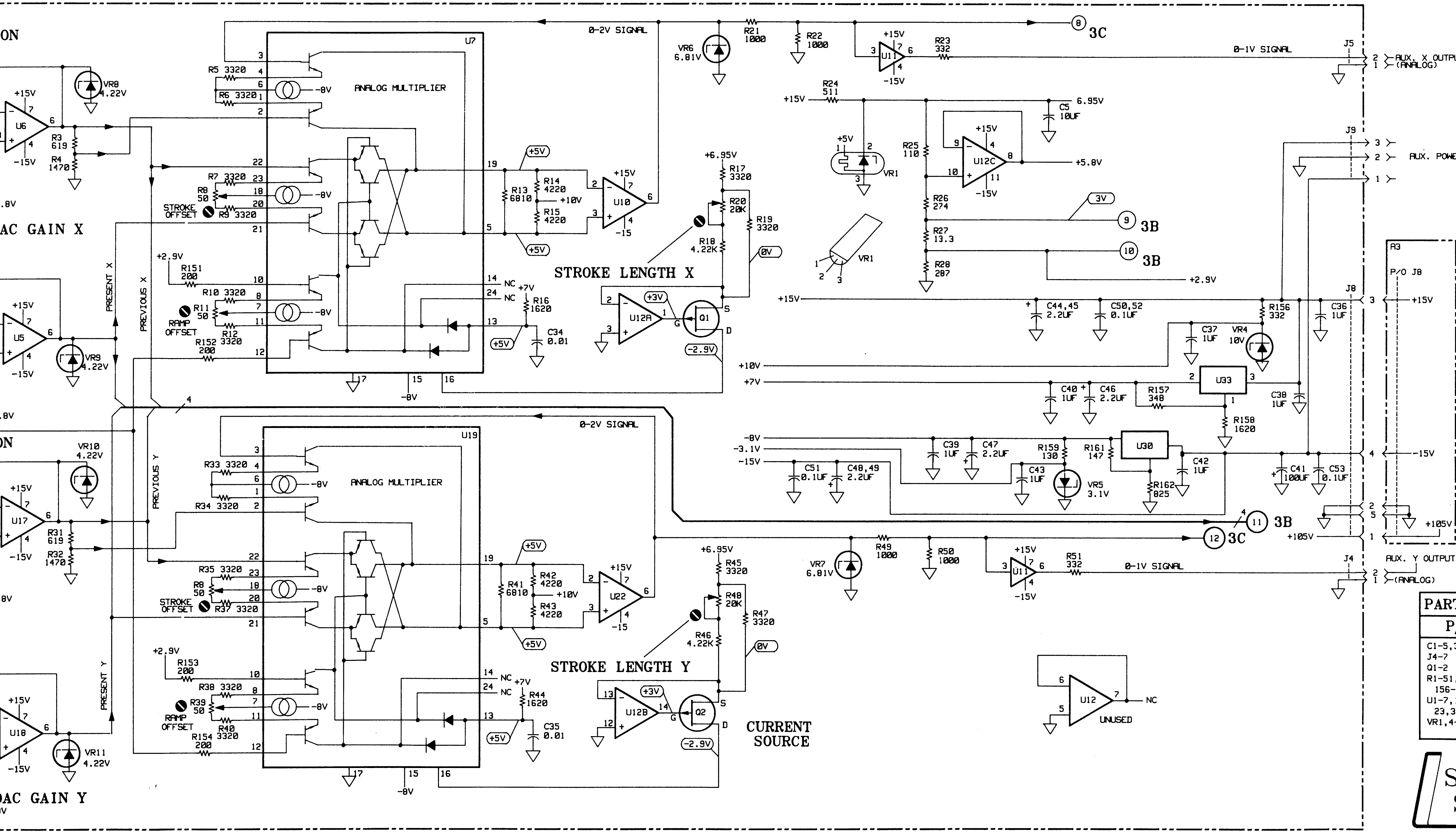


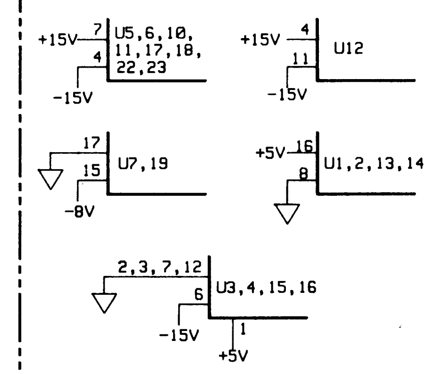
Figure 8-12. Analog X-Y-Z Troubleshooting Flow Chart.



P/O A1 ANALOG X-Y-Z BOARD
DIG. TO ANALOG CONVERSION
DAC GAIN X
ANALOG MULTIPLIER
STROKE LENGTH X
DIG. TO ANALOG CONVERSION
DAC GAIN Y
STROKE LENGTH Y
CURRENT SOURCE
LAST X LATCHES
LAST Y LATCHES
0-2V SIGNAL
STROKE OFFSET
RAMP OFFSET
PRESENT X
PREVIOUS X
PRESENT Y
PREVIOUS Y
CORRESPOND TO A2J3 PIN #5



IC DEVICE POWER CONNECTIONS



NOTES:

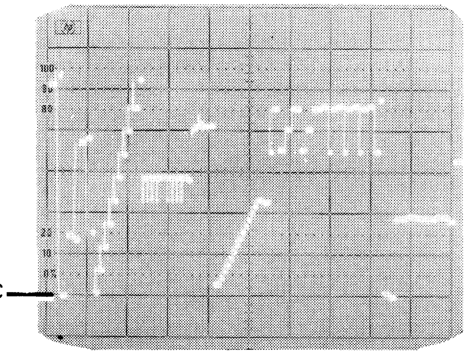
1. GATES ARE SYMBOLIZED ACCORDING TO CIRCUIT FUNCTION.
2. UNLESS OTHERWISE NOTED: RESISTANCE IN OHMS CAPACITANCE IN PICOFARADS INDUCTANCE IN MICROHENRIES
3. UNLESS OTHERWISE NOTED: LOGIC LEVELS ARE TTL: +2V TO +5V=LOGIC"1"=H 0V TO +0.8V=LOGIC"0"=L

PARTS ON THIS SCHEMATIC	
P/O A1	
C1-5,34,53 J4-7 Q1-2 R1-51,151-154, 156-159 U1-7,10,19-22, 23,30,33 VR1,4-11	

C1349004/21JUN84

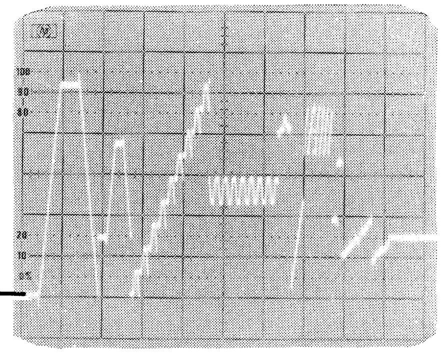
SERVICE SHEET 3A

Figure 8-13.
P/O X-Y-Z Amp/Stroke Generator



AUXILIARY X-OUTPUT (A1J5) 1349A

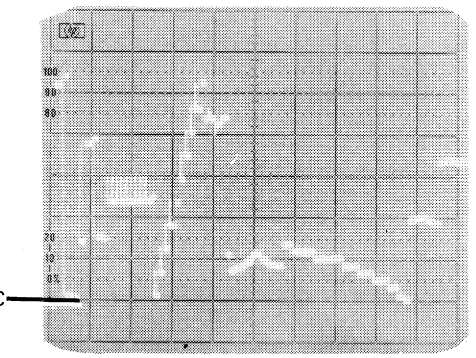
DEFLECTION FACTOR = 0.2V/DIV
SWEEP = 0.2ms/DIV



AUXILIARY X-OUTPUT (A1J5) 1349D

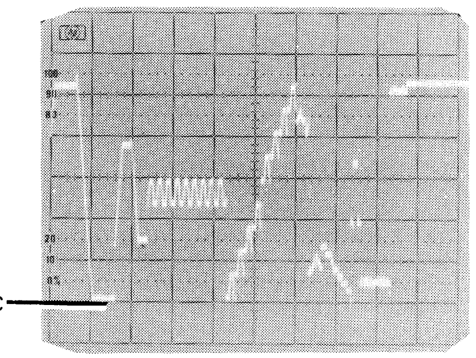
DEFLECTION FACTOR = 0.2V/DIV
SWEEP = 1ms/DIV

MEASUREMENT CONDITIONS:
OBTAIN 1349A/D PRIMARY
TEST PATTERN



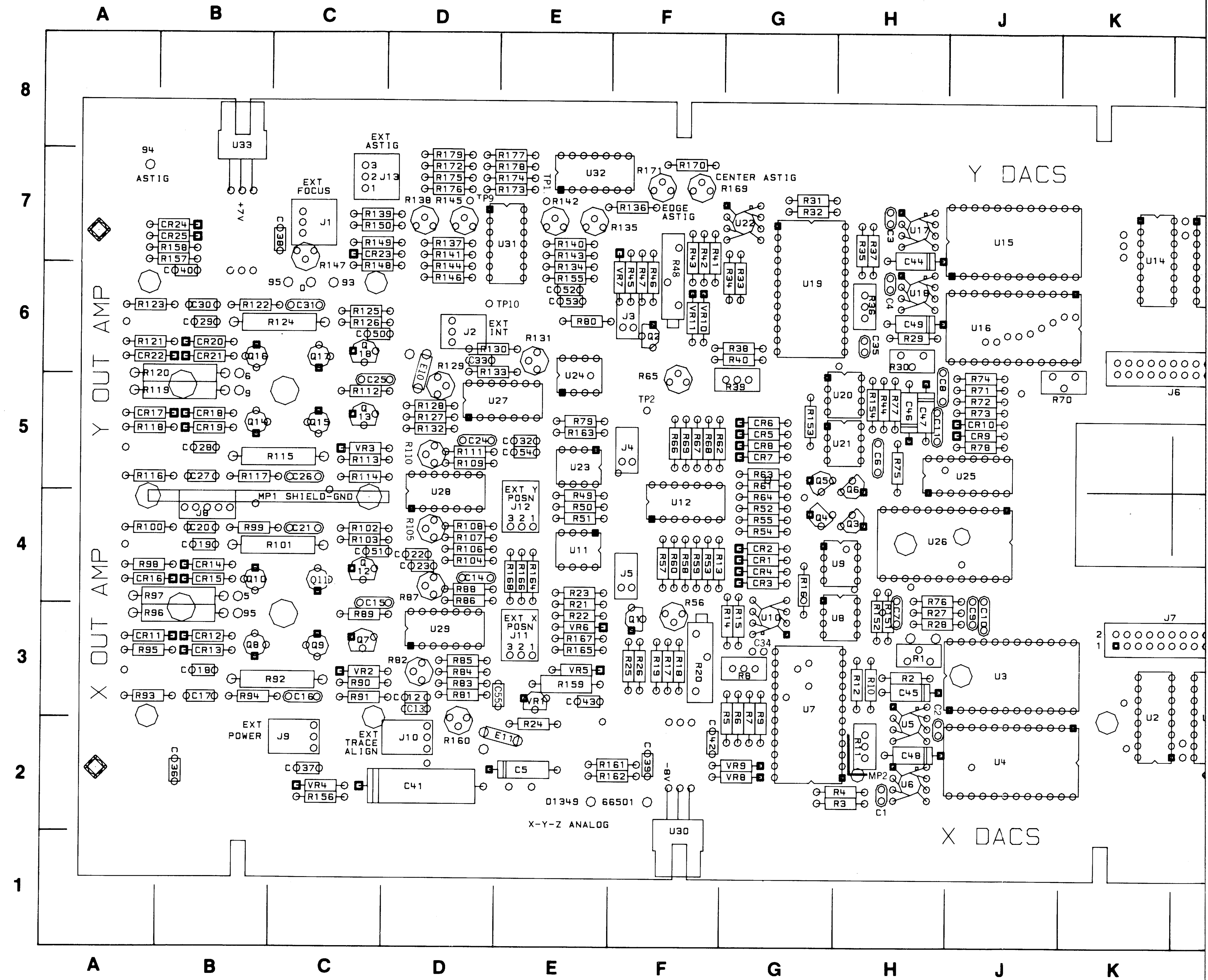
AUXILIARY Y-OUTPUT (A1J4) 1349A

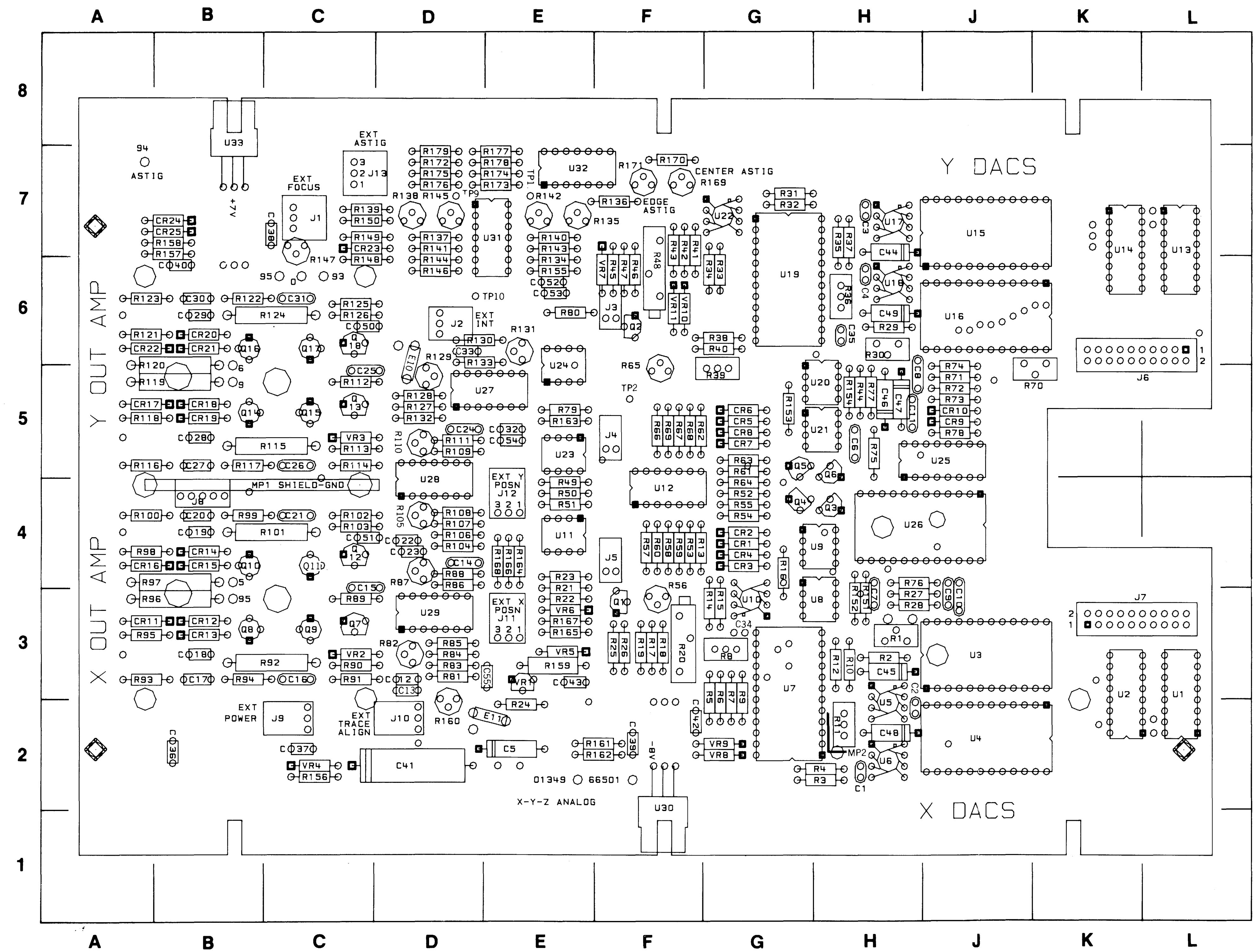
DEFLECTION FACTOR = 0.2V/DIV
SWEEP = 1 ms/DIV



AUXILIARY Y-OUTPUT (A1J4) 1349D

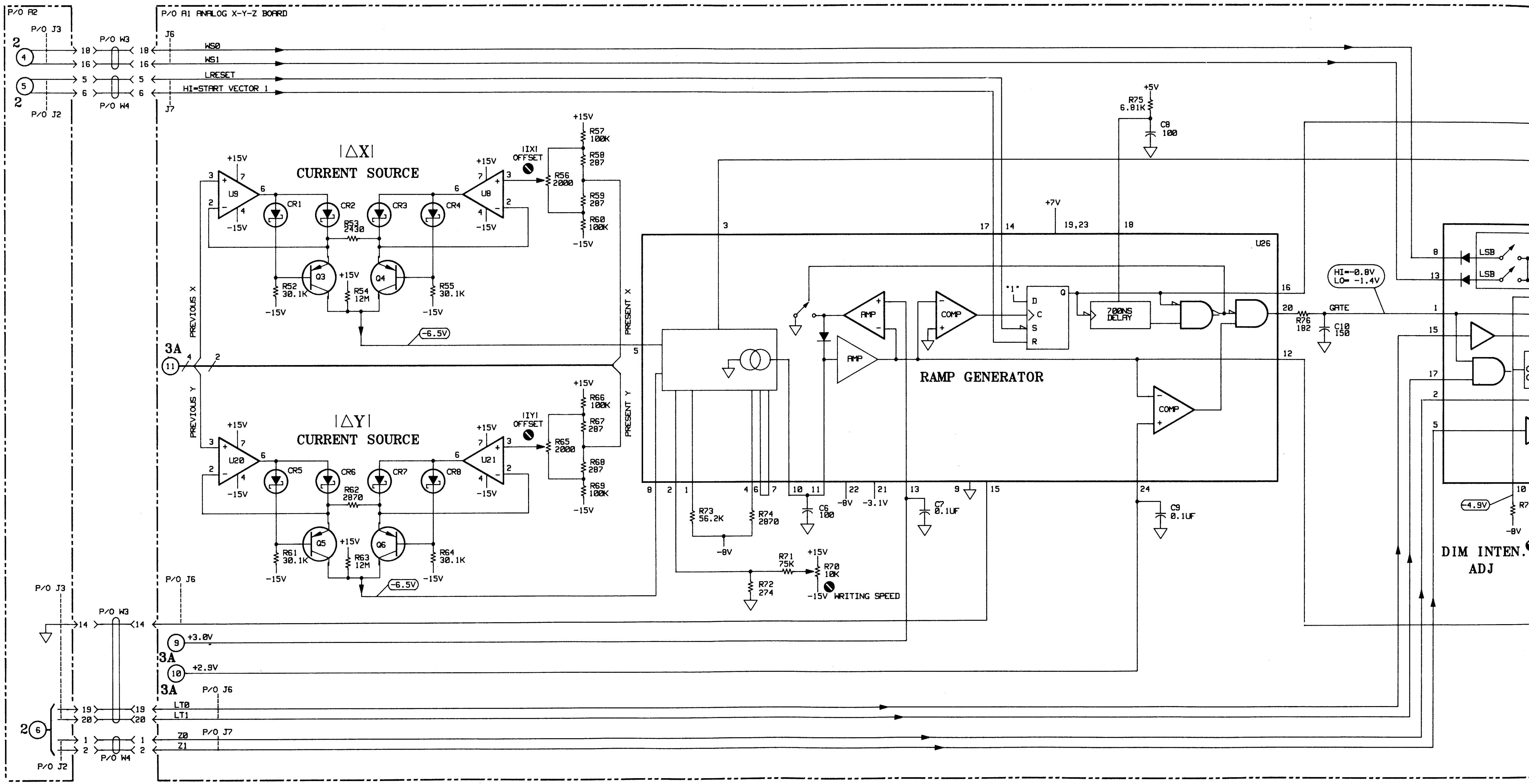
DEFLECTION FACTOR = 0.2V/DIV
SWEEP = 0.2ms/DIV

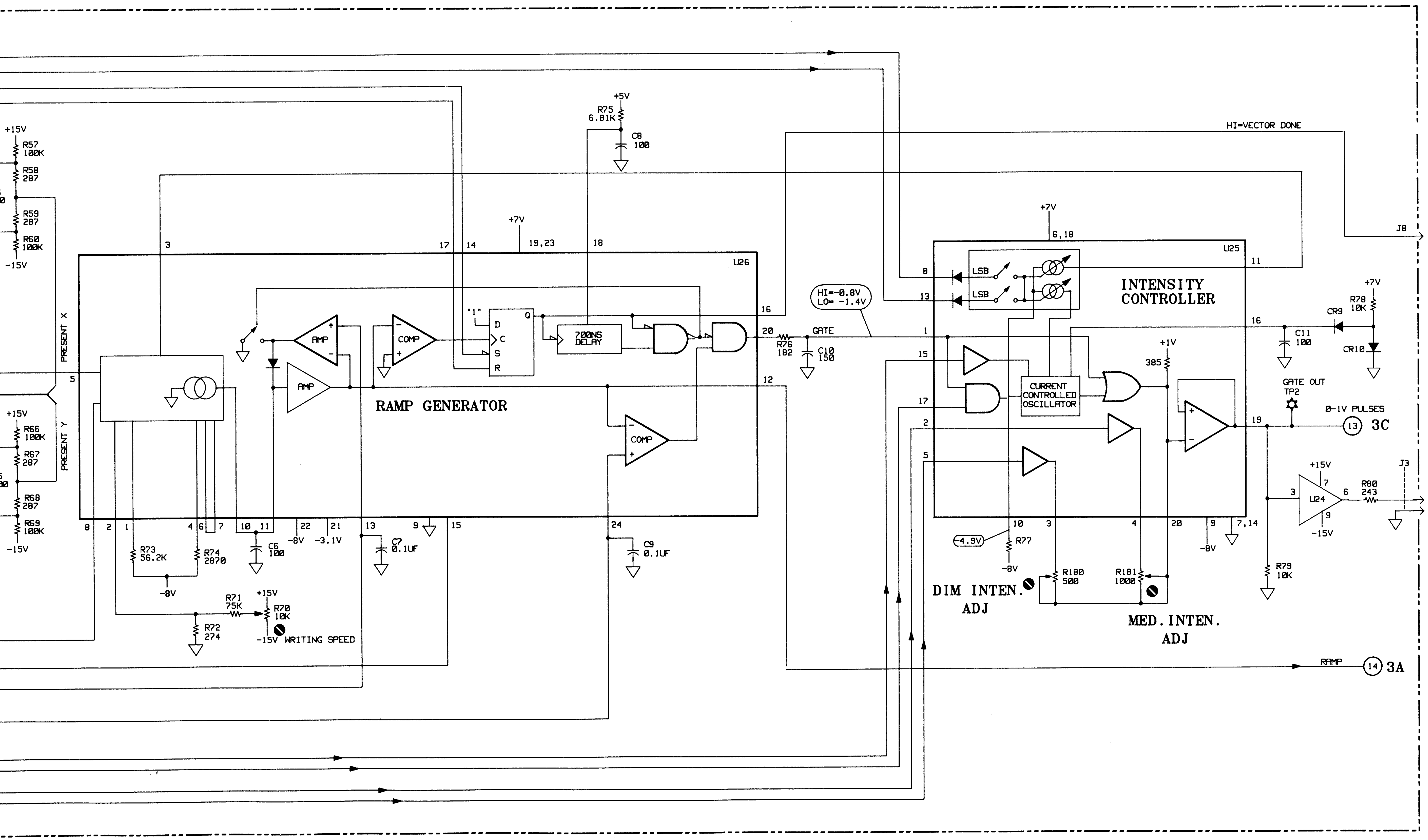


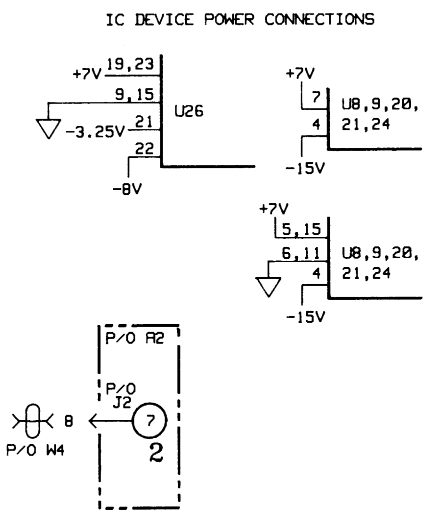


REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	H-2	CR15	B-4	R24	E-2	R93	A-3	R161	F-2
C2	H-2	CR16	A-4	R25	F-3	R94	B-3	R162	F-2
C3	H-7	CR17	A-5	R26	F-3	R95	A-3	R163	E-5
C4	H-6	CR18	B-5	R27	H-3	R96	B-3	R164	E-4
C5	E-2	CR19	B-5	R28	H-3	R97	B-4	R165	E-3
C6	H-5	CR20	B-6	R29	H-6	R98	A-4	R166	E-4
C7	H-3	CR21	B-6	R30	H-6	R99	B-4	R167	E-3
C8	H-5	CR22	A-6	R31	G-7	R100	A-4	R168	E-4
C9	J-3	CR23	C-7	R32	G-7	R101	C-4	R169	F-7
C10	J-3	CR24	B-7	R33	G-6	R102	C-4	R170	F-7
C11	H-5	CR25	B-7	R34	G-6	R103	C-4	R171	F-7
C12	D-3	E10	D-6	R35	H-7	R104	D-4	R172	D-7
C13	D-3	E11	E-2	R36	H-6	R105	D-4	R173	E-7
C14	D-4	J1	C-7	R37	H-7	R106	D-4	R174	E-7
C15	C-4	J2	D-6	R38	G-6	R107	D-4	R175	D-7
C16	C-3	J3	F-6	R39	G-5	R108	D-4	R176	D-7
C17	B-3	J4	F-5	R40	G-6	R109	D-5	R177	E-7
C18	B-3	J5	F-4	R41	F-7	R110	D-5	R178	E-7
C19	B-4	J6	K-6	R42	F-7	R111	D-5	R179	D-7
C20	B-4	J7	K-3	R43	F-7	R112	C-5	TP2	F-5
C21	C-4	J8	B-4	R44	H-5	R113	C-5	TP9	D-7
C22	D-4	J9	C-2	R45	F-6	R114	C-5	TP10	D-6
C23	D-4	J10	D-2	R46	F-6	R115	C-5	TP11	E-7
C24	D-5	J11	E-3	R47	F-6	R116	A-5	U1	L-3
C25	C-5	J12	E-4	R48	F-6	R117	B-5	U2	K-3
C26	C-5	J13	C-7	R49	E-4	R118	A-5	U3	J-3
C27	B-5	MP1	B-4	R50	E-4	R119	B-5	U4	J-2
C28	B-5	MP2	H-2	R51	E-4	R120	B-5	U5	H-2
C29	B-6	Q1	F-3	R52	G-4	R121	A-6	U6	H-2
C30	B-6	Q2	F-6	R53	F-4	R122	B-6	U7	G-3
C31	C-6	Q3	H-4	R54	G-4	R123	A-6	U8	H-3
C32	E-5	Q4	G-4	R55	G-4	R124	C-6	U9	H-4
C33	D-6	Q5	G-5	R56	F-3	R125	C-6	U10	G-3
C34	G-3	Q6	H-5	R57	F-4	R126	C-6	U11	E-4
C35	H-6	Q7	C-3	R58	F-4	R127	D-5	U12	F-4
C36	B-2	Q8	B-3	R59	F-4	R128	D-5	U13	L-6
C37	C-2	Q9	C-3	R60	F-4	R129	D-5	U14	K-7
C38	C-7	Q10	B-4	R61	G-5	R130	D-5	U15	J-7
C39	F-2	Q11	C-4	R62	F-5	R131	E-6	U16	J-6
C40	B-6	Q12	C-4	R63	G-5	R132	D-5	U17	H-7
C41	D-2	Q13	C-5	R64	G-4	R133	D-6	U18	H-6
C42	F-2	Q14	B-5	R65	F-5	R134	E-6	U19	G-6
C43	E-3	Q15	C-5	R66	F-5	R135	E-7	U20	H-5
C44	H-7	Q16	B-6	R67	F-5	R136	F-7	U21	H-5
C45	H-3	Q17	C-6	R68	F-5	R137	D-7	U22	G-7
C46	H-5	Q18	C-6	R69	F-5	R138	D-7	U23	E-5
C47	H-5	R1	H-3	R70	K-5	R139	C-7	U24	E-6
C48	H-2	R2	H-3	R71	J-5	R140	E-7	U25	J-5
C49	H-6	R3	H-2	R72	J-5	R141	D-7	U26	H-4
C50	C-6	R4	H-2	R73	J-5	R142	E-7	U27	E-5
C51	C-4	R5	G-3	R74	J-5	R143	E-7	U28	D-5
C52	E-6	R6	G-3	R75	H-5	R144	D-6	U29	D-3
C53	E-6	R7	G-3	R76	H-4	R145	D-7	U30	F-1
C54	E-5	R8	G-3	R77	H-5	R146	D-6	U31	E-7
C55	E-3	R9	G-3	R78	J-5	R147	C-7	U32	E-7
CR1	G-4	R10	H-3	R79	E-5	R148	C-6	U33	B-8
CR2	G-4	R11	H-2	R80	E-6	R149	C-7	VR1	E-1
CR3	G-4	R12	H-3	R81	D-3	R150	C-7	VR2	C-3
CR4	G-4	R13	F-4	R82	D-3	R151	H-3	VR3	C-5
CR5	G-5	R14	G-3	R83	D-3	R152	H-3	VR4	C-2
CR6	G-5	R15	G-3	R84	D-3	R153	G-5	VR5	E-3
CR7	G-5	R16	G-4	R85	D-3	R154	H-5	VR6	E-3
CR8	G-5	R17	F-3	R86	D-4	R155	E-6	VR7	F-6
CR9	J-5	R18	F-3	R87	D-4	R156	C-2	VR8	G-2
CR10	J-5	R19	F-3	R88	D-4	R157	B-7	VR9	G-2
CR11	A-3	R20	F-3	R89	C-3	R158	B-7	VR10	F-6
CR12	B-3	R21	E-3	R90	C-3	R159	E-3	VR11	F-6
CR13	B-3	R22	E-3	R91	C-3	R160	D-2		
CR14	B-4	R23	E-4	R92	C-3				

Figure 8-14. Analog X-Y-Z Component Locator.


P/O A2
P/O A1 ANALOG X-Y-Z BOARD
WS0
WS1
LRESET
HI=START VECTOR 1
|ΔX|
CURRENT SOURCE
|ΔY|
CURRENT SOURCE
|IX| OFFSET
|IY| OFFSET
PREVIOUS X
PRESENT X
PREVIOUS Y
PRESENT Y
U26
RAMP GENERATOR
700NS DELAY
COMP
AMP
GATE
HI=-0.8V LO=-1.4V
WRITING SPEED
DIM INTEN. ADJ
LSB
LT0
LT1
Z0
Z1
+3.0V
+2.9V





NOTES:

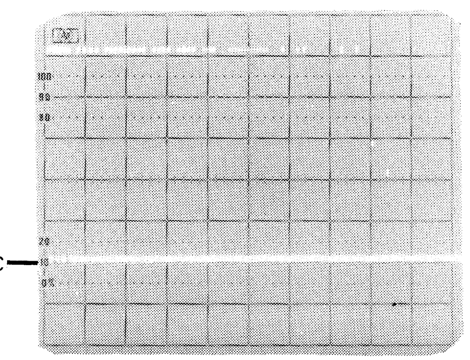
1. GATES ARE SYMBOLIZED ACCORDING TO CIRCUIT FUNCTION.
2. UNLESS OTHERWISE NOTED: RESISTANCE IN OHMS CAPACITANCE IN PICOFARADS INDUCTANCE IN MICROHENRIES
3. UNLESS OTHERWISE NOTED: LOGIC LEVELS ARE TTL: +2V TO +5V=LOGIC"1"=H 0V TO +0.8V=LOGIC"0"=L

PARTS ON THIS SCHEMATIC	
P/O A1	CHASSIS
C6-11 CR1-11 J3,6,7 Q3-6 R52-80 U8,9,20,21,24-26	P/O W3 P/O W4

C1349002/21JUN84

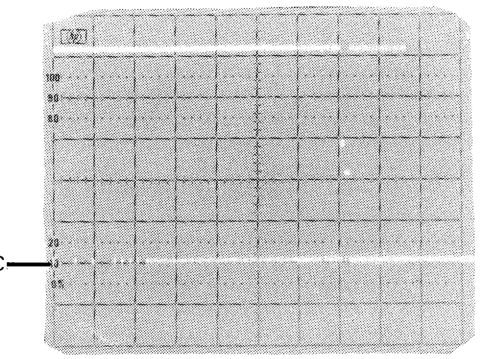
SERVICE SHEET 3B

Figure 8-15.
P/O X-Y-Z Stroke Generator



AUXILIARY Z-OUTPUT (A1J3) 1349A

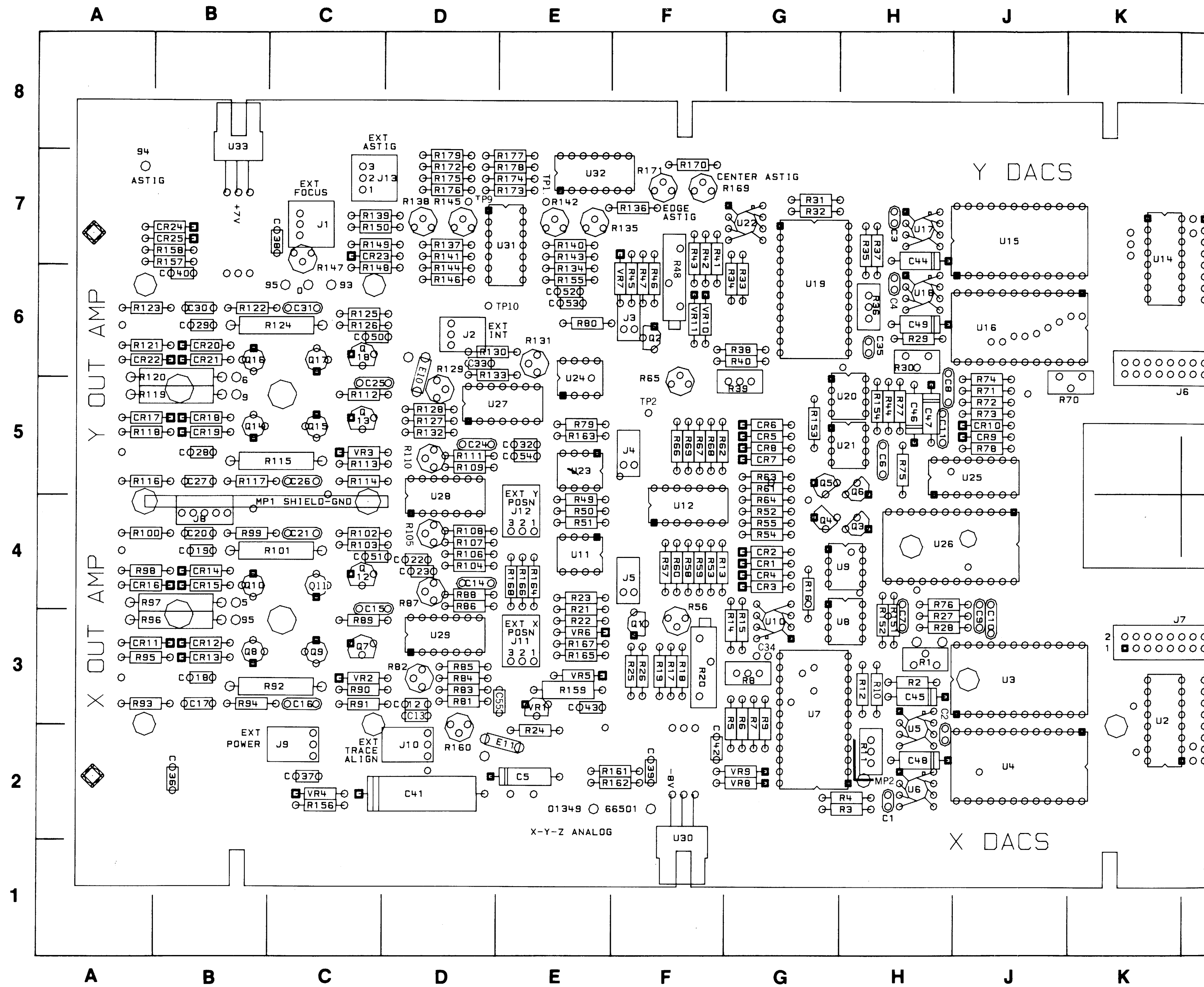
DEFLECTION FACTOR = 0.2V/DIV
SWEEP = 1ms/DIV

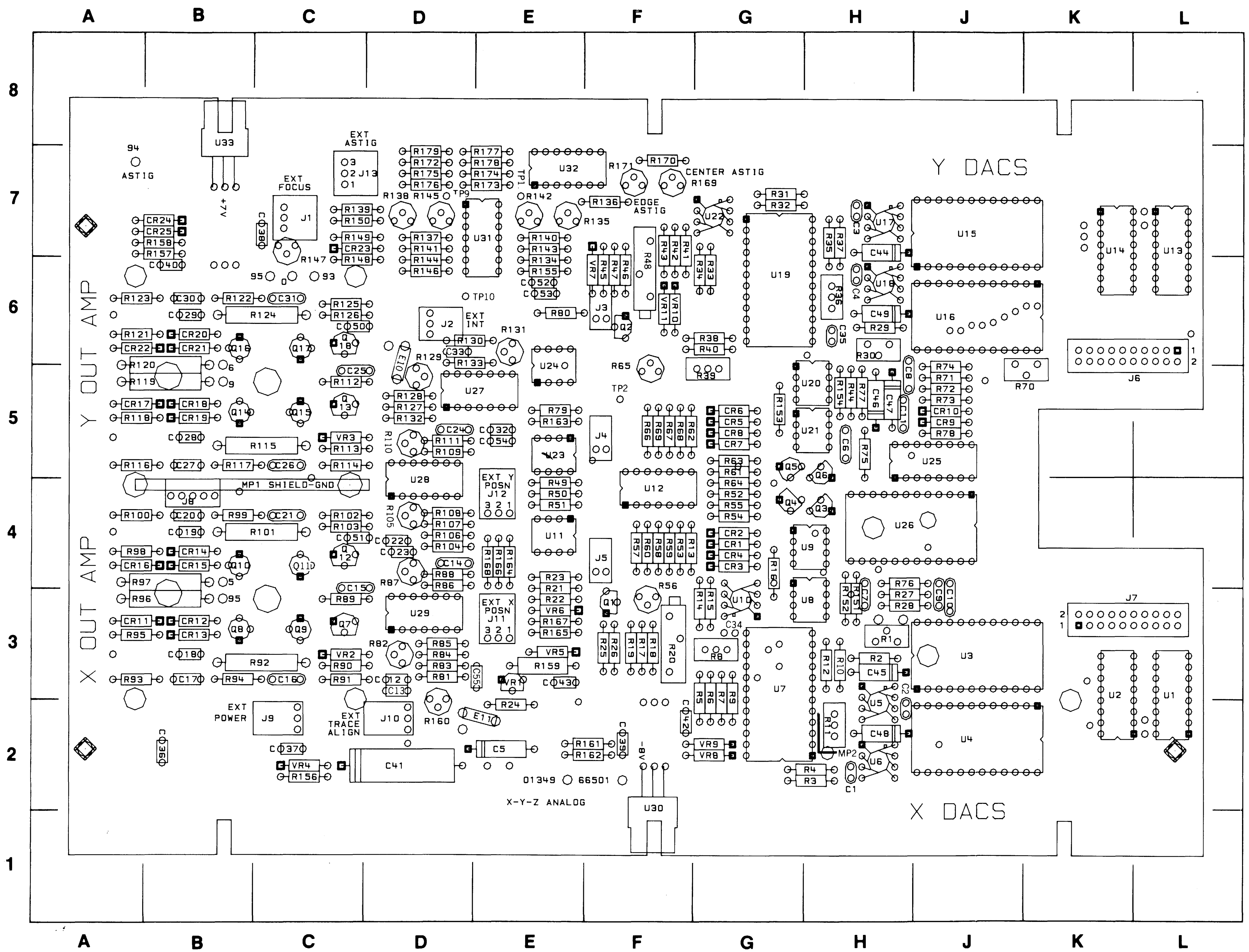


AUXILIARY Z-OUTPUT (A1J3) 1349D

DEFLECTION FACTOR = 0.2V/DIV
SWEEP = 0.2ms/DIV

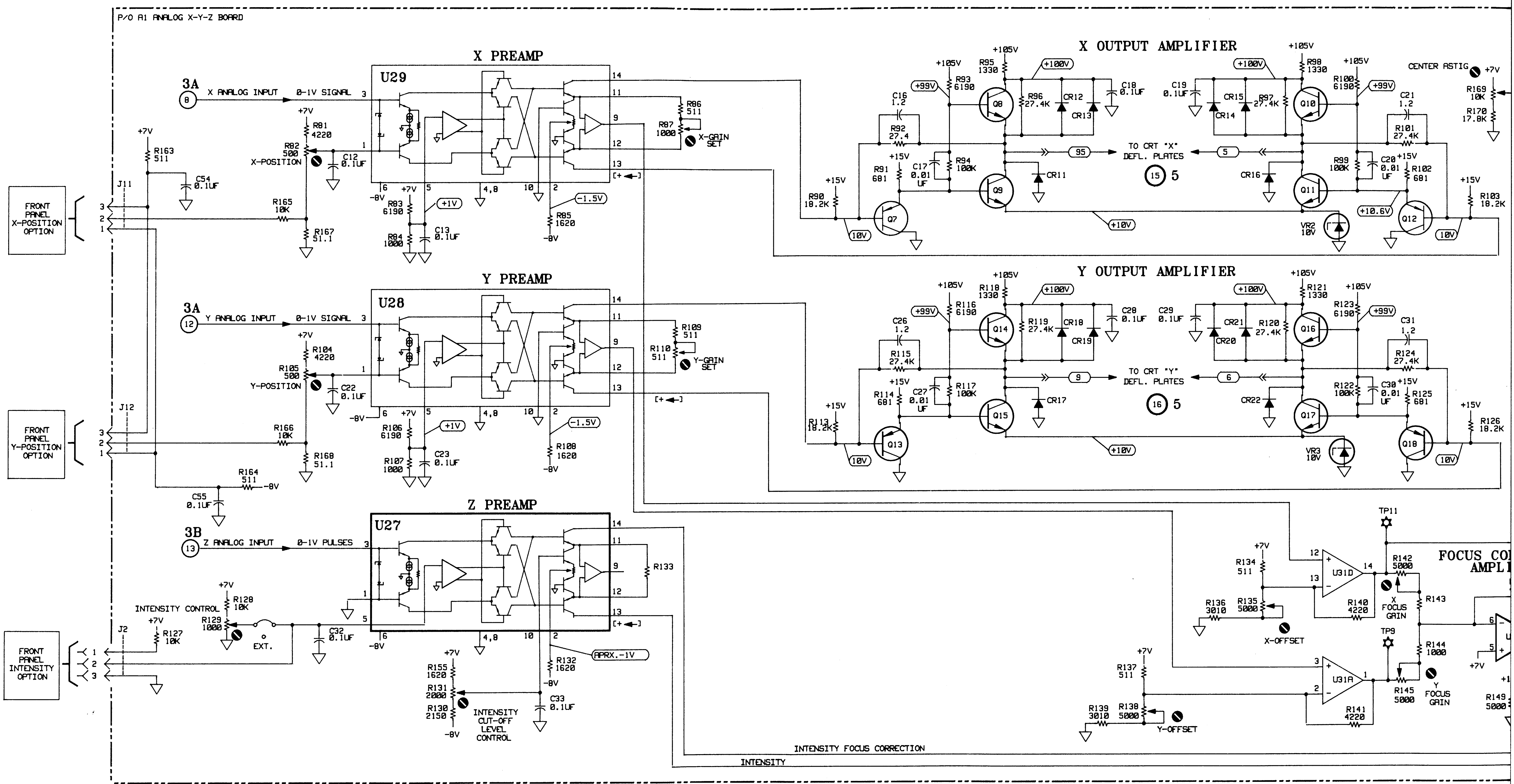
MEASUREMENT CONDITIONS:
OBTAIN 1349A/D PRIMARY
TEST PATTERN



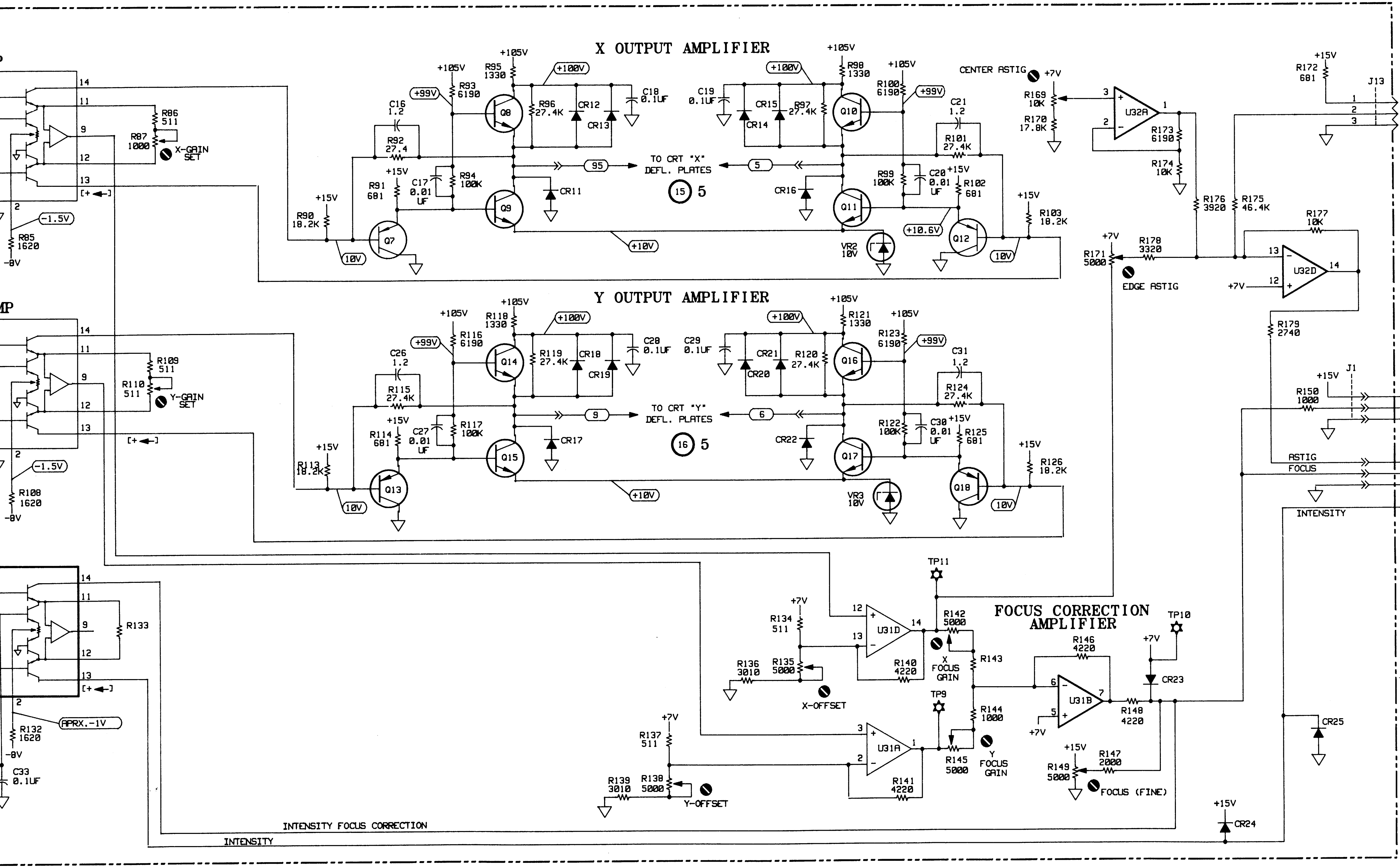


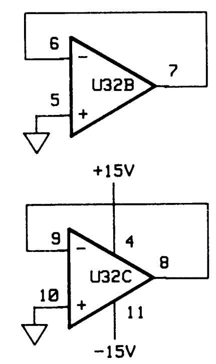
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	H-2	CR15	B-4	R24	E-2	R93	A-3	R161	F-2
C2	H-2	CR16	A-4	R25	F-3	R94	B-3	R162	F-2
C3	H-7	CR17	A-5	R26	F-3	R95	A-3	R163	E-5
C4	H-6	CR18	B-5	R27	H-3	R96	B-3	R164	E-4
C5	E-2	CR19	B-5	R28	H-3	R97	B-4	R165	E-3
C6	H-5	CR20	B-6	R29	H-6	R98	A-4	R166	E-4
C7	H-3	CR21	B-6	R30	H-6	R99	B-4	R167	E-3
C8	H-5	CR22	A-6	R31	G-7	R100	A-4	R168	E-4
C9	J-3	CR23	C-7	R32	G-7	R101	C-4	R169	F-7
C10	J-3	CR24	B-7	R33	G-6	R102	C-4	R170	F-7
C11	H-5	CR25	B-7	R34	G-6	R103	C-4	R171	F-7
C12	D-3	E10	D-6	R35	H-7	R104	D-4	R172	D-7
C13	D-3	E11	E-2	R36	H-6	R105	D-4	R173	E-7
C14	D-4	J1	C-7	R37	H-7	R106	D-4	R174	E-7
C15	C-4	J2	D-6	R38	G-6	R107	D-4	R175	D-7
C16	C-3	J3	F-6	R39	G-5	R108	D-4	R176	D-7
C17	B-3	J4	F-5	R40	G-6	R109	D-5	R177	E-7
C18	B-3	J5	F-4	R41	F-7	R110	D-5	R178	E-7
C19	B-4	J6	K-6	R42	F-7	R111	D-5	R179	D-7
C20	B-4	J7	K-3	R43	F-7	R112	C-5	TP2	F-5
C21	C-4	J8	B-4	R44	H-5	R113	C-5	TP9	D-7
C22	D-4	J9	C-2	R45	F-6	R114	C-5	TP10	D-6
C23	D-4	J10	D-2	R46	F-6	R115	C-5	TP11	E-7
C24	D-5	J11	E-3	R47	F-6	R116	A-5	U1	L-3
C25	C-5	J12	E-4	R48	F-6	R117	B-5	U2	K-3
C26	C-5	J13	C-7	R49	E-4	R118	A-5	U3	J-3
C27	B-5	MP1	B-4	R50	E-4	R119	B-5	U4	J-2
C28	B-5	MP2	H-2	R51	E-4	R120	B-5	U5	H-2
C29	B-6	Q1	F-3	R52	G-4	R121	A-6	U6	H-2
C30	B-6	Q2	F-6	R53	F-4	R122	B-6	U7	G-3
C31	C-6	Q3	H-4	R54	G-4	R123	A-6	U8	H-3
C32	E-5	Q4	G-4	R55	G-4	R124	C-6	U9	H-4
C33	D-6	Q5	G-5	R56	F-3	R125	C-6	U10	G-3
C34	G-3	Q6	H-5	R57	F-4	R126	C-6	U11	E-4
C35	H-6	Q7	C-3	R58	F-4	R127	D-5	U12	F-4
C36	B-2	Q8	B-3	R59	F-4	R128	D-5	U13	L-6
C37	C-2	Q9	C-3	R60	F-4	R129	D-5	U14	K-7
C38	C-7	Q10	B-4	R61	G-5	R130	D-5	U15	J-7
C39	F-2	Q11	C-4	R62	F-5	R131	E-6	U16	J-6
C40	B-6	Q12	C-4	R63	G-5	R132	D-5	U17	H-7
C41	D-2	Q13	C-5	R64	G-4	R133	D-6	U18	H-6
C42	F-2	Q14	B-5	R65	F-5	R134	E-6	U19	G-6
C43	E-3	Q15	C-5	R66	F-5	R135	E-7	U20	H-5
C44	H-7	Q16	B-6	R67	F-5	R136	F-7	U21	H-5
C45	H-3	Q17	C-6	R68	F-5	R137	D-7	U22	G-7
C46	H-5	Q18	C-6	R69	F-5	R138	D-7	U23	E-5
C47	H-5	R1	H-3	R70	K-5	R139	C-7	U24	E-6
C48	H-2	R2	H-3	R71	J-5	R140	E-7	U25	J-5
C49	H-6	R3	H-2	R72	J-5	R141	D-7	U26	H-4
C50	C-6	R4	H-2	R73	J-5	R142	E-7	U27	E-5
C51	C-4	R5	G-3	R74	J-5	R143	E-7	U28	D-5
C52	E-6	R6	G-3	R75	H-5	R144	D-6	U29	D-3
C53	E-6	R7	G-3	R76	H-4	R145	D-7	U30	F-1
C54	E-5	R8	G-3	R77	H-5	R146	D-6	U31	E-7
C55	E-3	R9	G-3	R78	J-5	R147	C-7	U32	E-7
CR1	G-4	R10	H-3	R79	E-5	R148	C-6	U33	B-8
CR2	G-4	R11	H-2	R80	E-6	R149	C-7	VR1	E-1
CR3	G-4	R12	H-3	R81	D-3	R150	C-7	VR2	C-3
CR4	G-4	R13	F-4	R82	D-3	R151	H-3	VR3	C-5
CR5	G-5	R14	G-3	R83	D-3	R152	H-3	VR4	C-2
CR6	G-5	R15	G-3	R84	D-3	R153	G-5	VR5	E-3
CR7	G-5	R16	G-4	R85	D-3	R154	H-5	VR6	E-3
CR8	G-5	R17	F-3	R86	D-4	R155	E-6	VR7	F-6
CR9	J-5	R18	F-3	R87	D-4	R156	C-2	VR8	G-2
CR10	J-5	R19	F-3	R88	D-4	R157	B-7	VR9	G-2
CR11	A-3	R20	F-3	R89	C-3	R158	B-7	VR10	F-6
CR12	B-3	R21	E-3	R90	C-3	R159	E-3	VR11	F-6
CR13	B-3	R22	E-3	R91	C-3	R160	D-2		
CR14	B-4	R23	E-4	R92	C-3				

Figure 8-16. Analog X-Y-Z Component Locator



P/O A1 ANALOG X-Y-Z BOARD
X PREAMP
U29
Y PREAMP
U28
Z PREAMP
U27
X OUTPUT AMPLIFIER
Y OUTPUT AMPLIFIER
FOCUS CO
AMPL
X ANALOG INPUT
0-1V SIGNAL
Y ANALOG INPUT
Z ANALOG INPUT
0-1V PULSES
X-POSITION
Y-POSITION
X-GAIN SET
Y-GAIN SET
FRONT PANEL X-POSITION OPTION
FRONT PANEL Y-POSITION OPTION
FRONT PANEL INTENSITY OPTION
INTENSITY CONTROL
EXT.
INTENSITY CUT-OFF LEVEL CONTROL
APRX.-1V
TO CRT "X" DEFL. PLATES
TO CRT "Y" DEFL. PLATES
CENTER ASTIG
X FOCUS GAIN
Y FOCUS GAIN
X-OFFSET
Y-OFFSET
INTENSITY FOCUS CORRECTION
INTENSITY





NOTES:

1. GATES ARE SYMBOLIZED ACCORDING TO CIRCUIT FUNCTION.
2. UNLESS OTHERWISE NOTED: RESISTANCE IN OHMS CAPACITANCE IN PICOFARADS INDUCTANCE IN MICROHENRIES
3. UNLESS OTHERWISE NOTED: LOGIC LEVELS ARE TTL: +2V TO +5V=LOGIC"1"=H 0V TO +0.8V=LOGIC"0"=L

PARTS ON THIS SCHEMATIC	
P/O A1	
C12-33 CR11-25 J1-13 Q7-18 R81-179 U27-29,31,32 VR2,3	

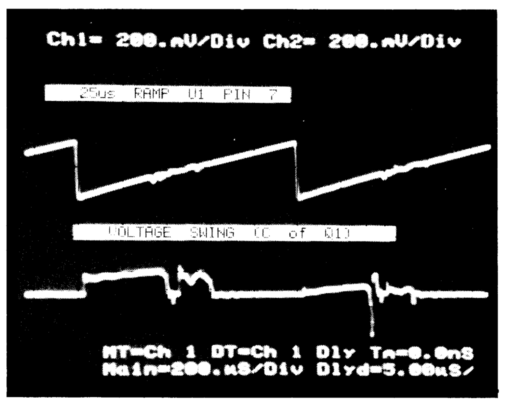
C1349003/21JUN84

SERVICE SHEET 3C

Figure 8-17.
P/O X-Y-Z Amp/Stroke Generator

8-24. SERVICE SHEET 4, THEORY OF OPERATION.

The purpose of the Low Voltage Power Supply is to provide the +105V for the X-Y Deflection Amplifiers, the Intensity Amplifier, and the High Voltage Power Supply. The supply consists of only one primary circuit, the +105V supply. All other required operating voltages must be provided by an external supply. The +105V power supply is a switching supply consisting of A3U1, A3Q1,A3Q2 and A3T1. A3U1 contains all the functions necessary for current limiting; regulating and switching the power transistors A3Q1 and A3Q2. A3C5 and A3R4 determine the switching frequency of the oscillator of A3U1. A3T1 steps up the switching voltage. A3CR3 and A3CR4 make up the rectifier. Filtering is accomplished by A3L2 and A3C7. A3R11 adjusts the +105V supply.



TOP: OSCILLATOR SIGNAL AT A3U1, PIN 7
BOTTOM: COLLECTOR OF A3Q1

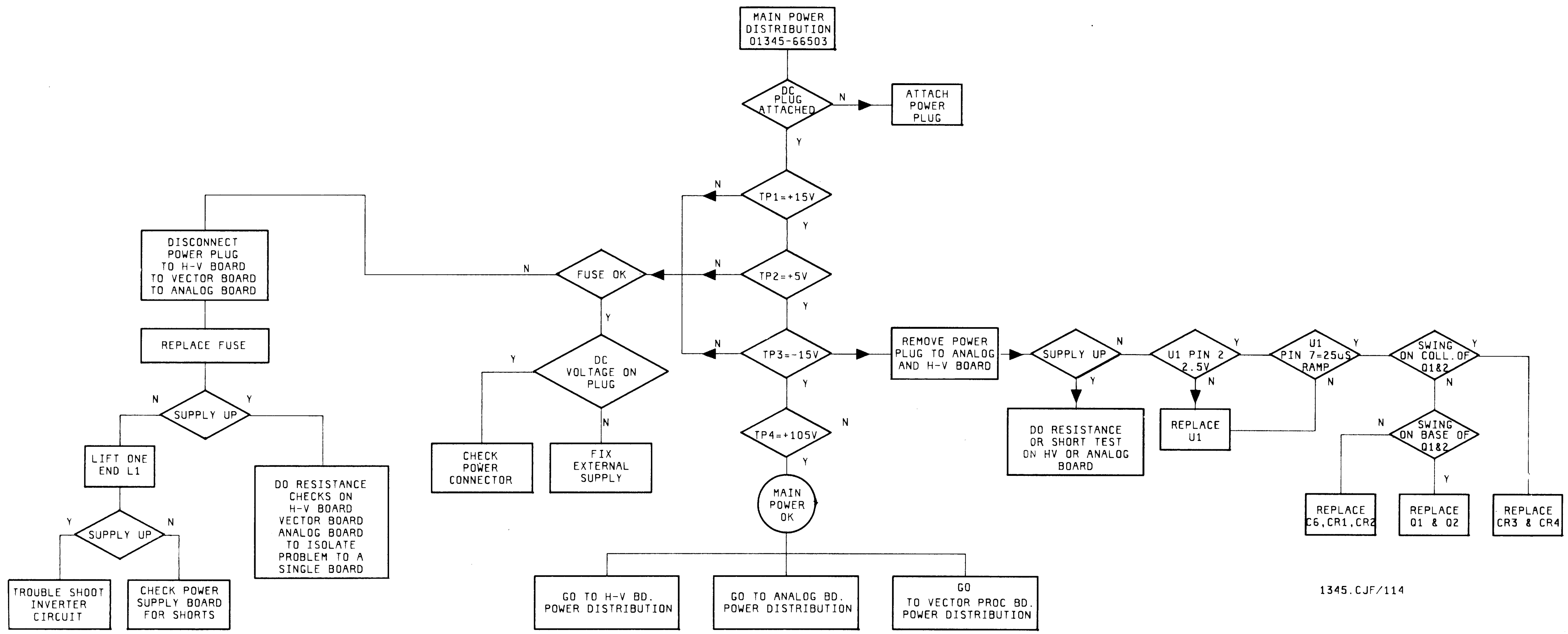


Figure 8-18. Low Voltage Power Supply Troubleshooting Flow Chart.

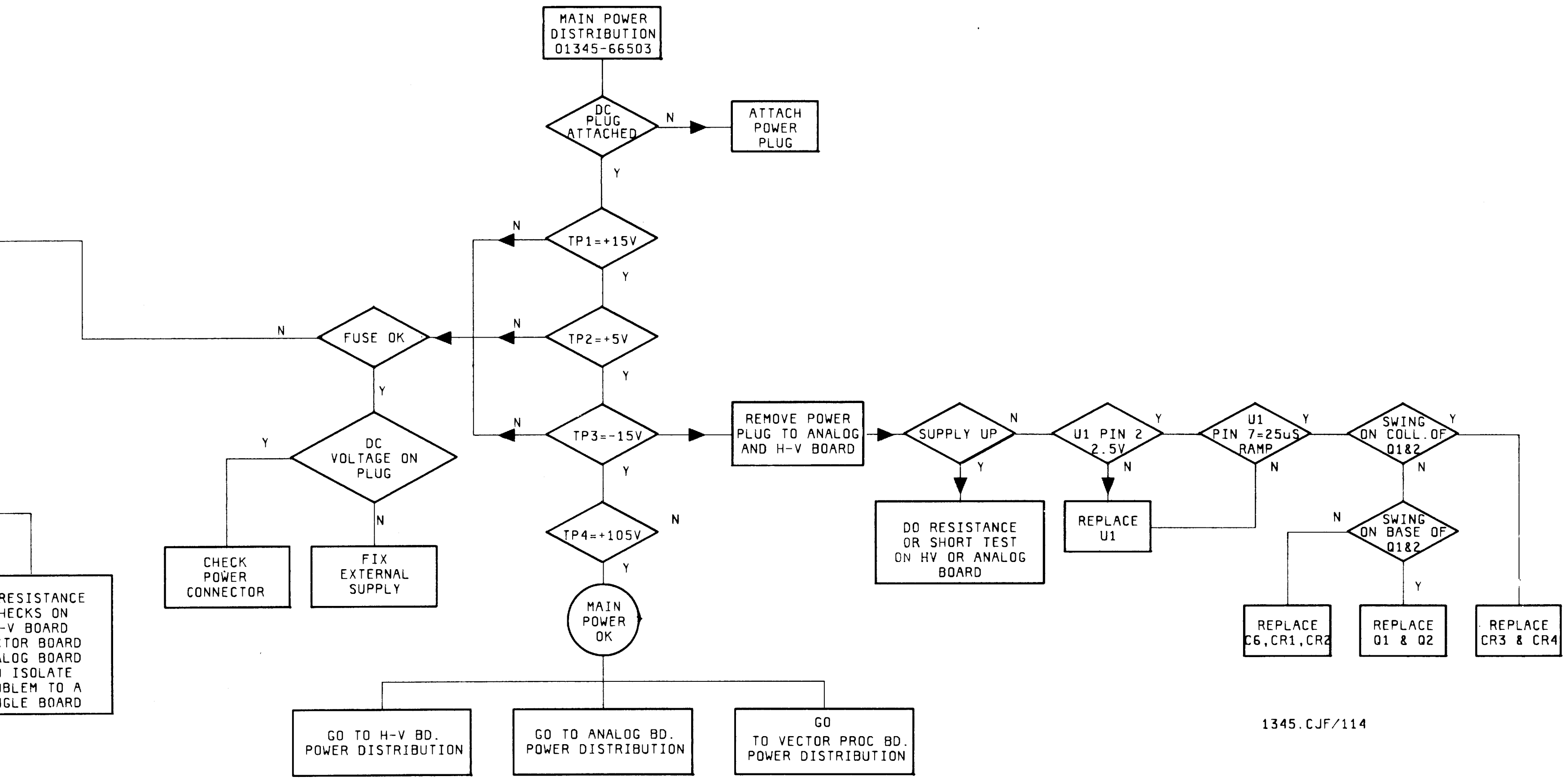
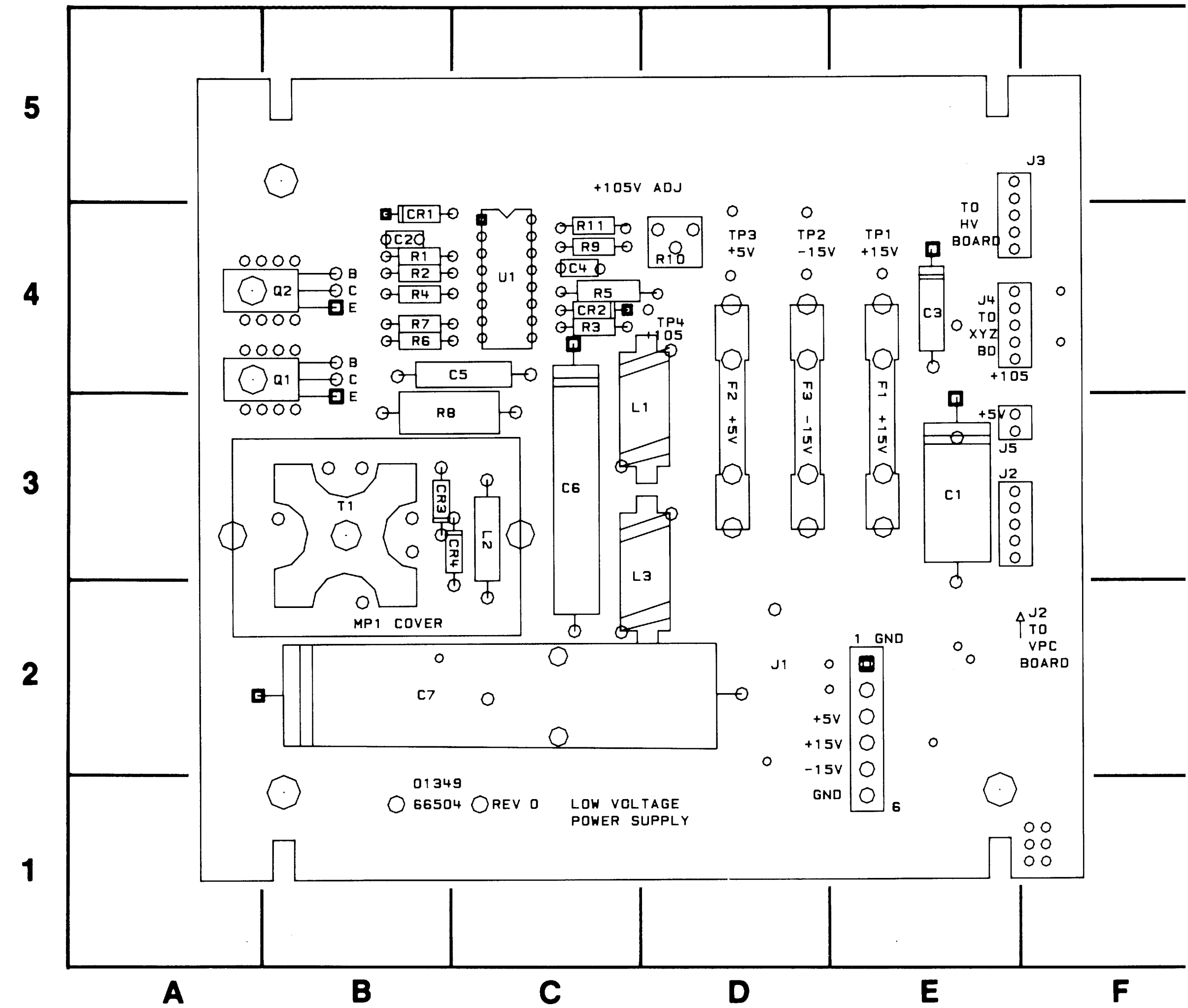
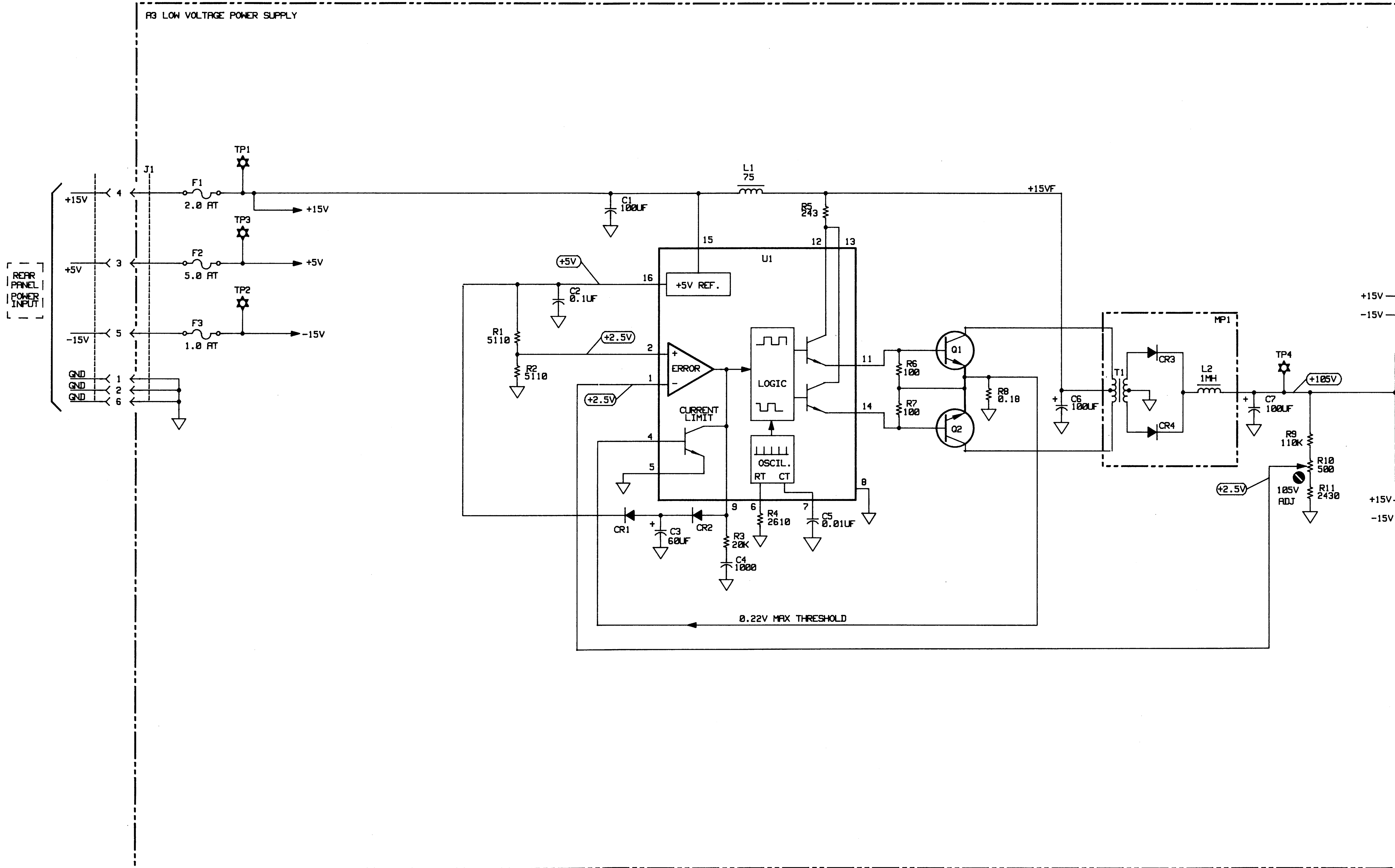


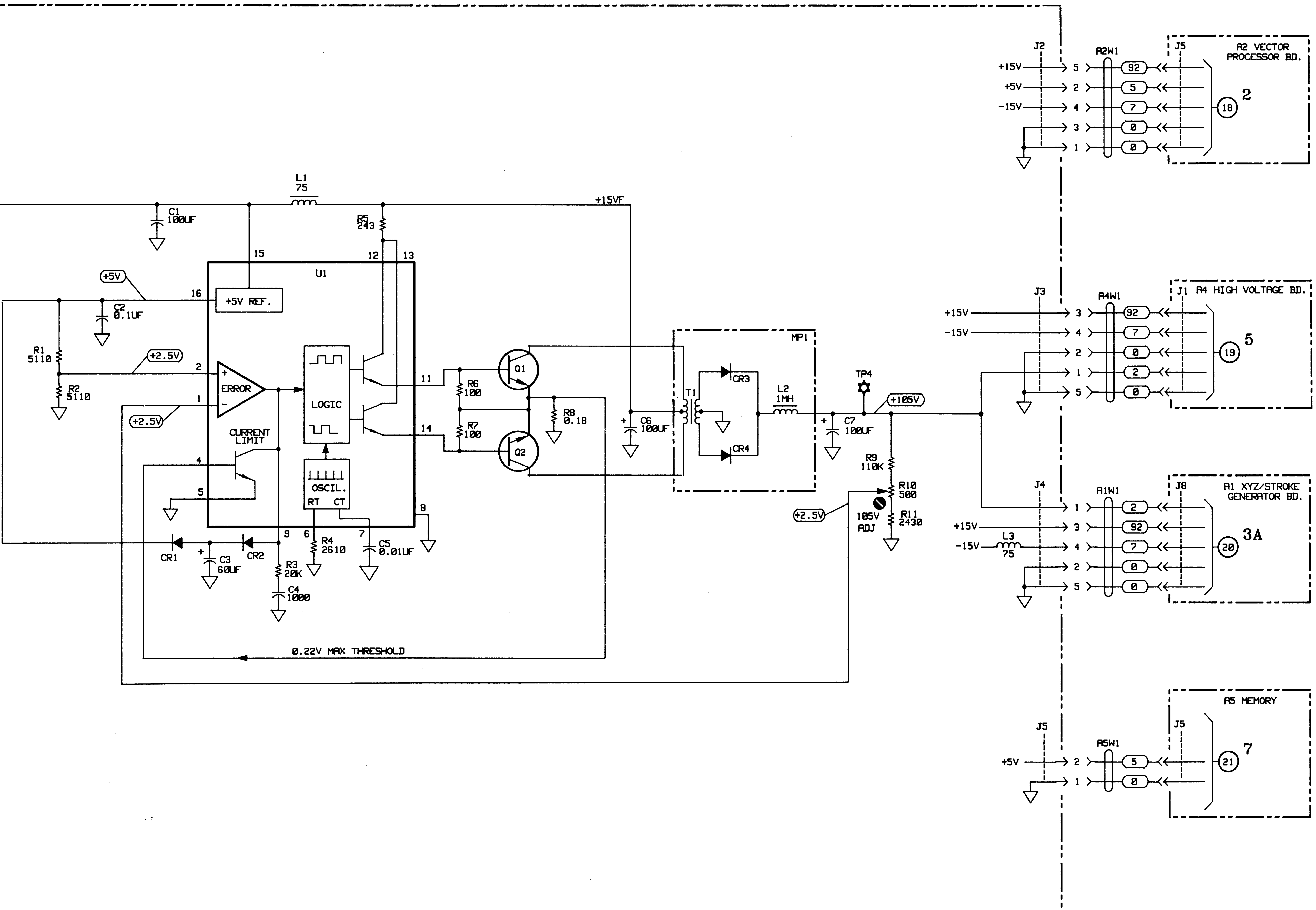
Figure 8-18. Low Voltage Power Supply Troubleshooting Flow Chart.



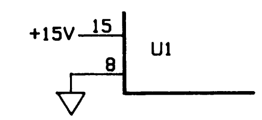
REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	E-3	L3	D-3
C2	B-4	MP1	B-3
C3	E-4	Q1	A-4
C4	C-4	Q2	A-4
C5	C-4	R1	B-4
C6	C-3	R2	B-4
C7	C-2	R3	C-4
CR1	B-4	R4	B-4
CR2	C-4	R5	C-4
CR3	B-3	R6	B-4
CR4	C-3	R7	B-4
F1	E-3	R8	B-3
F2	D-3	R9	C-4
F3	D-3	R10	D-4
H1	B-3	R11	C-4
J1	E-2	T1	B-3
J2	E-3	TP1	E-4
J3	E-4	TP2	D-4
J4	E-4	TP3	D-4
J5	E-3	TP4	D-4
L1	D-3	U1	C-4
L2	C-3		

Figure 8-19. Low Voltage Power Supply Component Locator.


A3 LOW VOLTAGE POWER SUPPLY
REAR PANEL POWER INPUT
J1
+15V
+5V
-15V
GND
TP1
TP2
TP3
TP4
F1 2.0 AT
F2 5.0 AT
F3 1.0 AT
L1 75
+15VF
C1 100UF
C2 0.1UF
C3 60UF
C4 1000
C5 0.01UF
C6 100UF
C7 100UF
R1 5110
R2 5110
R3 20K
R4 2610
R5 243
R6 100
R7 100
R8 0.18
R9 110K
R10 500
R11 2430
U1
+5V REF.
ERROR
LOGIC
CURRENT LIMIT
OSCIL.
RT
CT
Q1
Q2
CR1
CR2
CR3
CR4
T1
MP1
L2 1MH
+105V
105V ADJ
+2.5V
0.22V MAX THRESHOLD



IC DEVICE POWER CONNECTIONS



NOTES:

1. GATES ARE SYMBOLIZED ACCORDING TO CIRCUIT FUNCTION.
2. UNLESS OTHERWISE NOTED: RESISTANCE IN OHMS CAPACITANCE IN PICOFARADS INDUCTANCE IN MICROHENRIES
3. UNLESS OTHERWISE NOTED: LOGIC LEVELS ARE TTL: +2V TO +5V=LOGIC"1"=H 0V TO +0.8V=LOGIC"0"=L

PARTS ON THIS SCHEMATIC			
A3		P/O A1	P/O A2
C1-7 CR1-4 F1-3 J1-5 L1-3 Q1,2 R1-11 T1 TP1-4	U1	J8	J5
		P/O A4	P/O A5
		J1	J5

C1349805/21JUN84

SERVICE SHEET 4

Figure 8-20.
Low Voltage Power Supply

8-25. SERVICE SHEET 5, THEORY OF OPERATION.

The High Voltage Power Supply provides the high operating potentials for the CRT. The supply consists of the following primary circuits: an oscillator; the cathode rectifier and filter circuit; a regulator circuit and the level translator. The oscillator signal is stepped up by tranformer A4T1 and rectified by A4CR11. A4C12, A4C13 and A4R32 provide filtering for the cathode supply. A4R33 and A4U1 make up the regulator circuit. The feedback voltage from A4R33 is compared to the +105V reference voltage at the junction of A4R21 and A4R33. The resultant output voltage of A4U1 controls the amplitude of the High Voltage Oscillator A4Q7. The Level Translator, A4CR14 and A4CR15, establishes the operating potential between cathode and grid of the CRT.

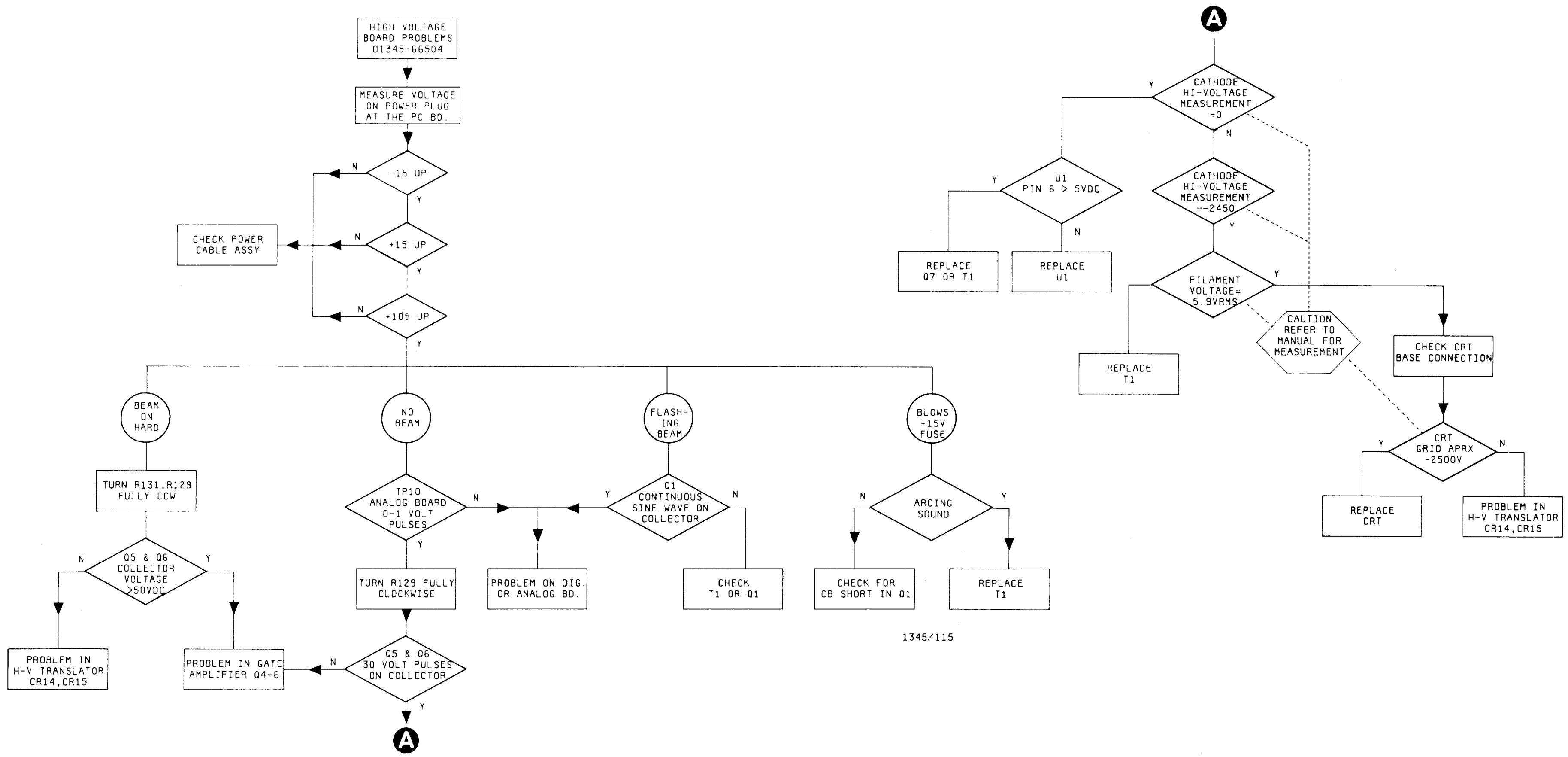
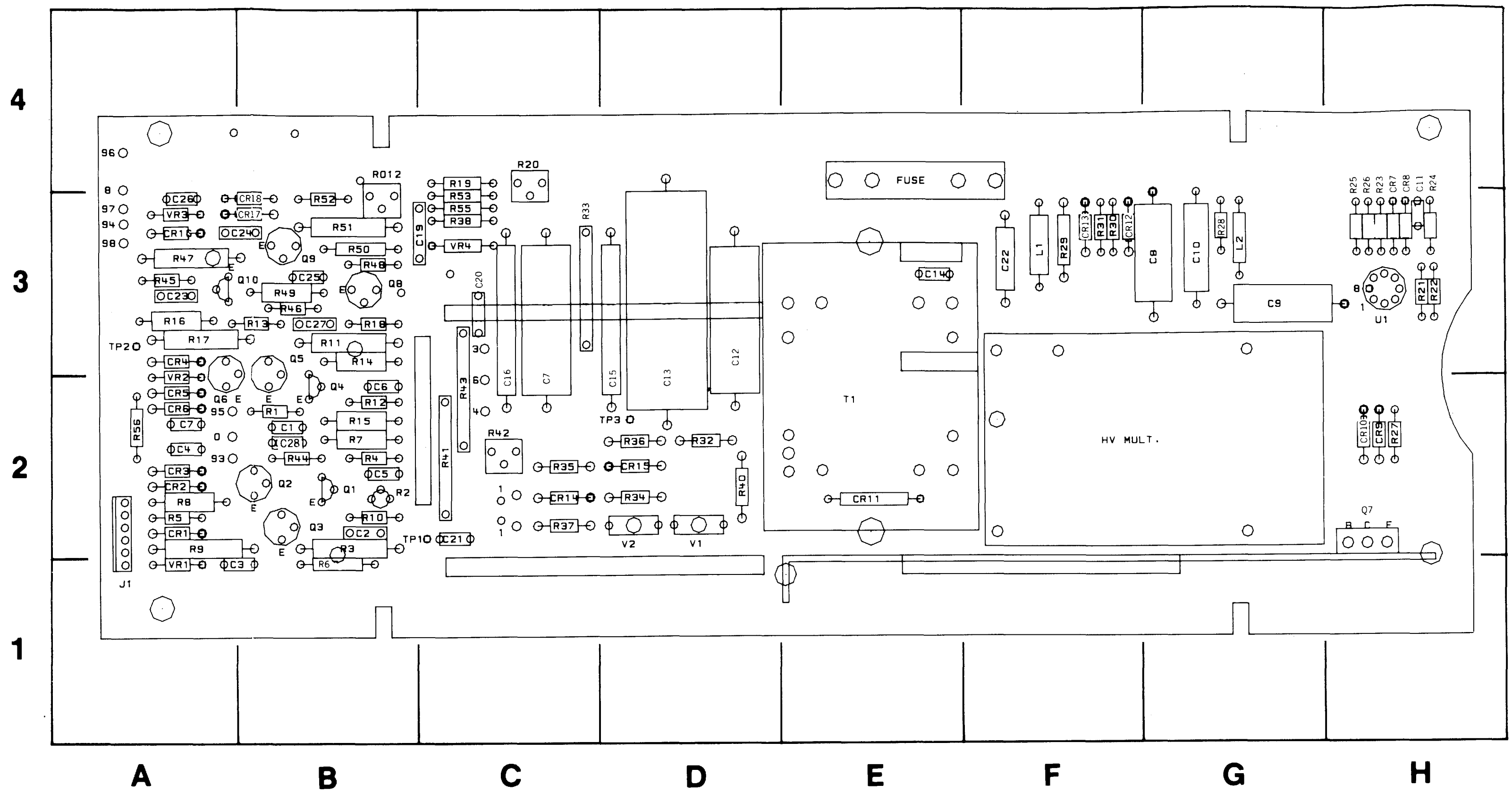
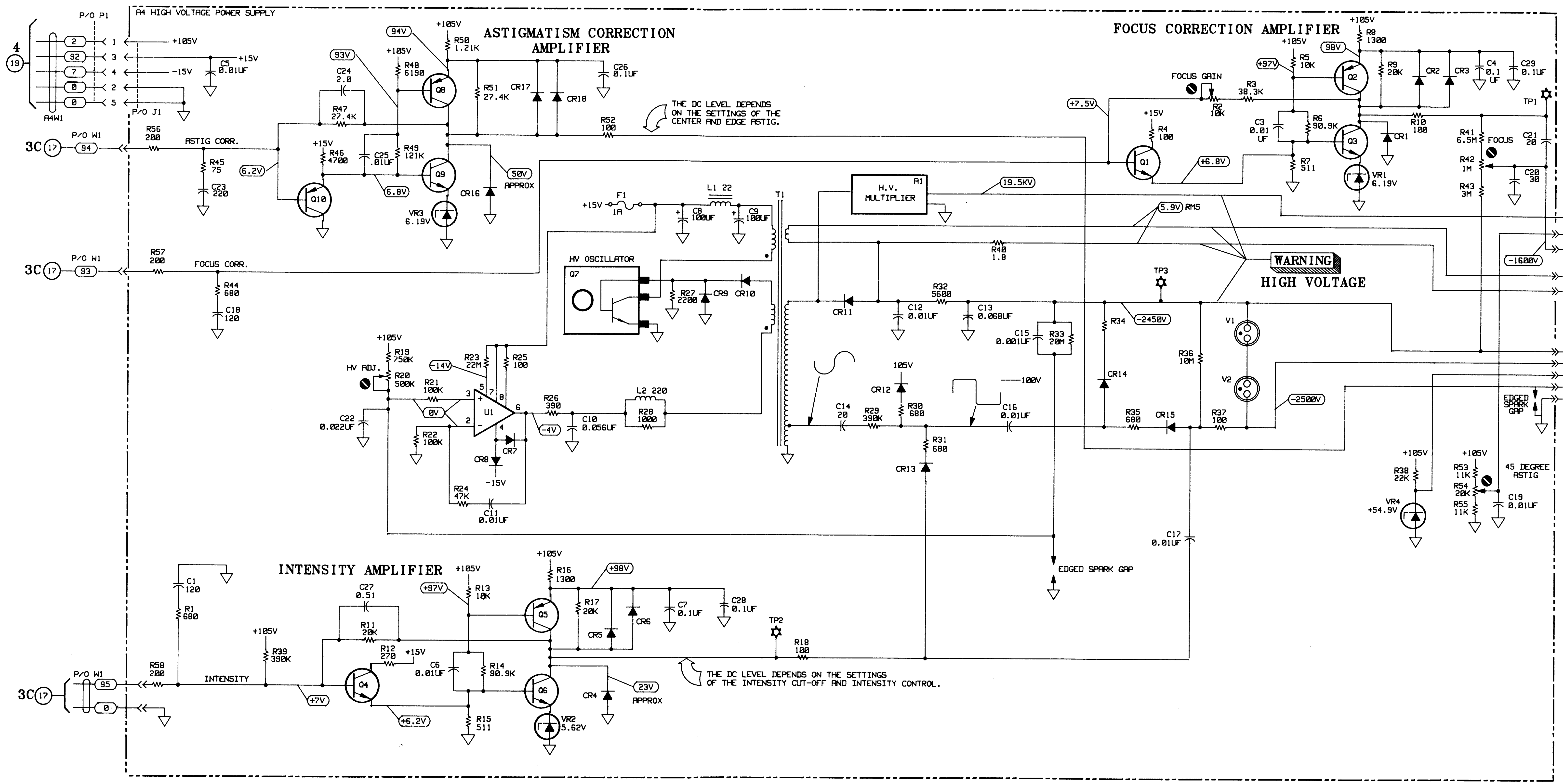


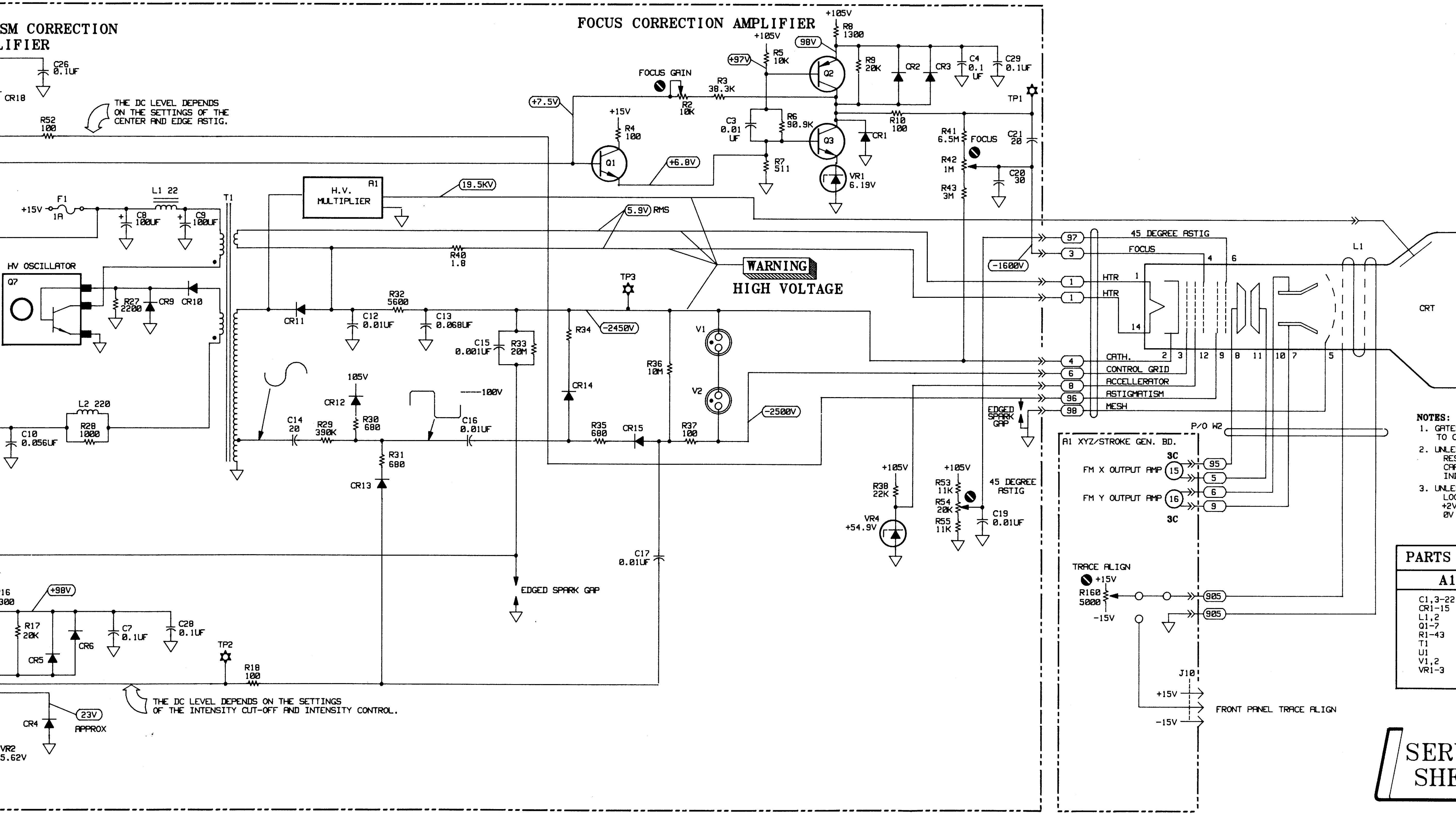
Figure 8-21. High Voltage Power Supply Troubleshooting Flow Chart.



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
A1	G-2	C17	C-3	CR7	H-3	Q2	B-2	R9	A-2	R25	H-3	R40	D-2	R55	C-3
C1	B-2	C18	B-2	CR8	H-3	Q3	B-2	R10	B-2	R26	H-3	R41	C-2	T1	E2
C2	B-2	C19	C-3	CR9	H-2	Q4	B-2	R11	B-3	R27	H-2	R42	C-2	TP1	C-2
C3	B-1	C20	C-3	CR10	H-2	Q5	B-3	R12	B-2	R28	G-3	R43	C-2	TP2	A-3
C4	A-2	C21	C-2	CR11	E-2	Q6	A-3	R13	B-3	R29	F-3	R44	B-2	TP3	D-2
C5	B-2	C22	F-3	CR12	F-3	Q7	H-2	R14	B-3	R30	F-3	R45	A-3	U1	H-3
C6	B-2	C23	A-3	CR13	F-3	Q8	B-3	R15	B-2	R31	F-3	R46	B-3	V1	D-2
C7	A-2	C24	B-3	CR14	C-2	Q9	B-3	R16	A-3	R32	D-2	R47	A-3	V2	D-2
C8	G-3	C25	B-3	CR15	D-2	Q10	A-3	R17	A-3	R33	C-3	R48	B-3	VR1	A-1
C9	G-3	C26	A-3	CR16	A-3	R1	B-2	R18	B-3	R34	D-2	R49	B-3	VR2	A-2
C10	G-3	C27	B-3	CR17	B-3	R2	B-2	R19	C-4	R35	C-2	R50	B-3	VR3	A-3
C11	H-3	CR1	A-2	CR18	B-3	R3	B-2	R20	C-4	R36	D-2	R51	B-3	VR4	C-3
C12	D-3	CR2	A-2	F1	E-1	R4	B-2	R21	H-3	R37	C-2	R52	B-3	VR5	A-2
C13	D-3	CR3	A-2	J1	A-2	R5	A-2	R22	H-3	R38	C-3	R53	C-3	VR6	A-2
C14	E-3	CR4	A-3	L1	F-3	R6	B-1	R23	H-3	R39	A-2	R54	B-3		
C15	D-3	CR5	A-2	L2	G-3	R7	B-2	R24	H-3						
C16	C-3	CR6	A-2	Q1	B-2	R8	A-2								

Figure 8-22. High Voltage Power Supply Component Locator.


A4 HIGH VOLTAGE POWER SUPPLY
ASTIGMATISM CORRECTION AMPLIFIER
FOCUS CORRECTION AMPLIFIER
INTENSITY AMPLIFIER
HV OSCILLATOR
H.V. MULTIPLIER
WARNING
HIGH VOLTAGE
THE DC LEVEL DEPENDS ON THE SETTINGS OF THE CENTER AND EDGE ASTIG.
THE DC LEVEL DEPENDS ON THE SETTINGS OF THE INTENSITY CUT-OFF AND INTENSITY CONTROL.
P/O P1
P/O J1
P/O W1
A4W1
ASTIG CORR.
FOCUS CORR.
INTENSITY
FOCUS GAIN
FOCUS
HV ADJ.
45 DEGREE ASTIG
EDGED SPARK GAP
19.5KV
5.9V RMS
-1600V
-2450V
-2500V
+105V
+15V
-15V
TP1
TP2
TP3
50V APPROX
23V APPROX



NOTES:

1. GATES ARE SYMBOLIZED ACCORDING TO CIRCUIT FUNCTION.
2. UNLESS OTHERWISE NOTED:
   RESISTANCE IN OHMS
   CAPACITANCE IN PICOFARADS
   INDUCTANCE IN MICROHENRIES
3. UNLESS OTHERWISE NOTED:
   LOGIC LEVELS ARE TTL:
   +2V TO +5V=LOGIC"1"=H
   0V TO +0.8V=LOGIC"0"=L

PARTS ON THIS SCHEMATIC	
A1	
C1,3-22 CR1-15 L1,2 Q1-7 R1-43 T1 U1 V1,2 VR1-3	

C1349006/21JUN84

SERVICE SHEET 5

Figure 8-23.
High Voltage Power Supply

8-26. SERVICE SHEET 6A, 6B THEORY OF OPERATION.

MEMORY CONTROL (SERVICE SHEET 6A).

The Memory Control section interpets the user commands and synchronizes the memory operations. The circuit is divided into three functional stages: The Command Decode stage, the Memory Control Latch and the Memory Control ROM.

THE COMMAND DECODER. The Command Decoder Monitors the status of the memory operations. The user commands (LRD, LWR, LDS), the memory status lines and the next state control lines specify in which of the two modes the memory is to operate. The two states are: Read/Write and Screen Refresh. To read data from memory, control lines LDS and LRD are used. To write data into memory, control lines LDS and LWR are used. When control line LDS is set high by the user, the display will be refreshed at the sync rate according to the instructions stored in memory. Internal Sync is generated by the 60 Hz clock A5U1 and A5U32B, unless held-off by LCLR SYNC being set low. LCLR SYNC will also hold off the MAX ADRSL line. The MAX ADRSL line indicates when the end of the display memory is reached. When User Data lines UD14 and UD15 are high, SET ADRS is set high indicating that the Read/Write pointer is to be set to the address defined by UD0 through UD11. SXACK clocks the status of the user commands through A5U32A to A5U36. The output at A5U36 pin 11 (LXACK) is fed back to the user to acknowledge that the command has been received. Signal line LMRDIS disables the Memory Read Latches (A5U10, U11).

REFRESH SYNC. The display refresh is synchronized by either an internal clock or the sync signal can be provided by a user clock.

INTERNAL SYNC. When in Internal Sync mode, an on-board oscillator (A5U1) provides sync pulses at approximately a 60Hz rate. The user processor can send all picture producing data to the Vector Memory at one time. The Vector Memory will then continuously refresh the display screen by redrawing the picture at regular intervals. This reduces overhead time for the user processor.

EXTERNAL SYNC. Sync pulses (TTL) must be supplied from an external source in the user system via the SYNC input signal line at W1 pin 4.

MEMORY CONTROL LATCH. On the positive edge of the OP FETCH line, the status of the six state request line and the two status signals are latched and held at the Memory Control Latch (MA2-MA9). The six state request signals are: INTXACK, LWRITE, LREAD, INTRFD, MD15 and SET ADRS. The two status signals are MAX ADRS and MEM SYNC.

MEMORY CONTROL ROM. The output of the Memory Control ROMS (A5U18, U23) are the eleven memory control signals and the five state control signals. The Memory Control signals are: VPC ADRS LOAD, VPC ADRS CLK, VPC DATA CLK, USER ADRS LOAD, USER ADDRESS CLK, USER DATA LATCH, MW DATA EN, HUSER/LVPC ADDRESS SELECT, LMARD EN, MEMORY OE and MEMORY WRITE. The five state control signals are: MCA0, MCA1, OP FETCH, LCLAR SYNC, and SXACK. The states of the Memory Control signals are determined by the data stored in the Memory Control ROMS (A5U18, U23). The Memory Control Address specified by MCA0-MCA9 will at the positive edge of the control clock determine the state of the Memory Control Signals.

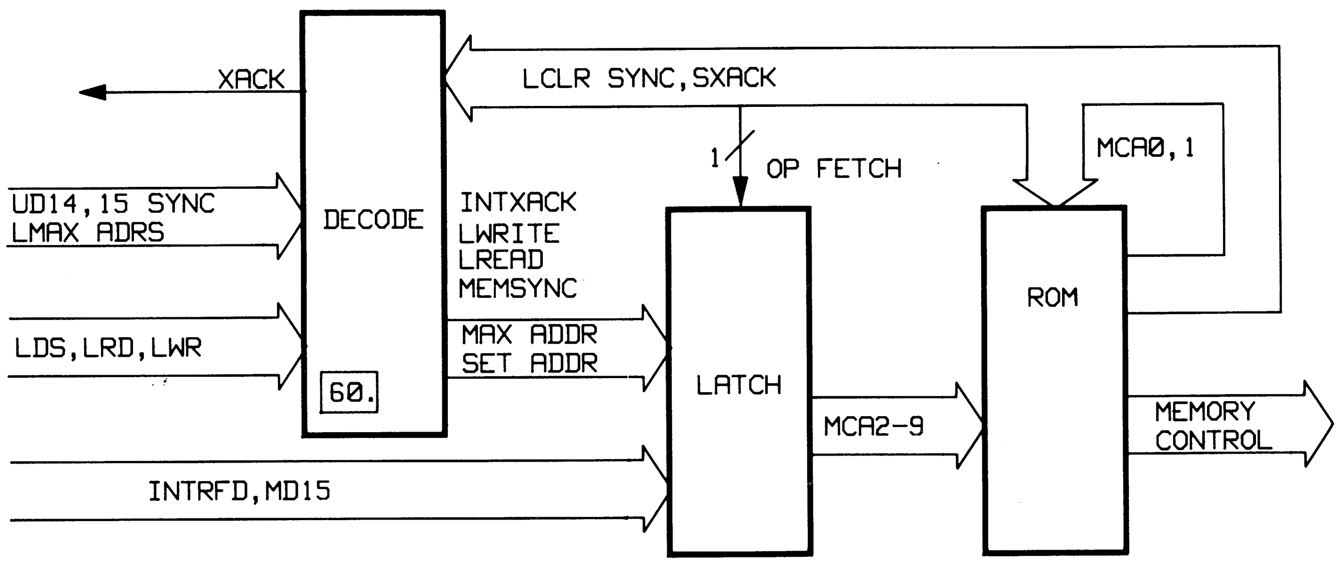


Figure 8-24. Read/Write Mode.

6A

MEMORY CIRCUIT (SERVICE SHEET 6B).

The following circuit description refers to the two modes of operation of the memory circuit: The Read/Write mode and the Screen Refresh mode.

READ/WRITE MODE. The user can do a Read/Write operation without setting the Read/Write Pointer. However, it is recommended that the user knows which location in memory is being accessed (read from or written into). There are two steps in a read or write operation: Setting the Read/Write Pointer, and read from or write into Vector Memory.

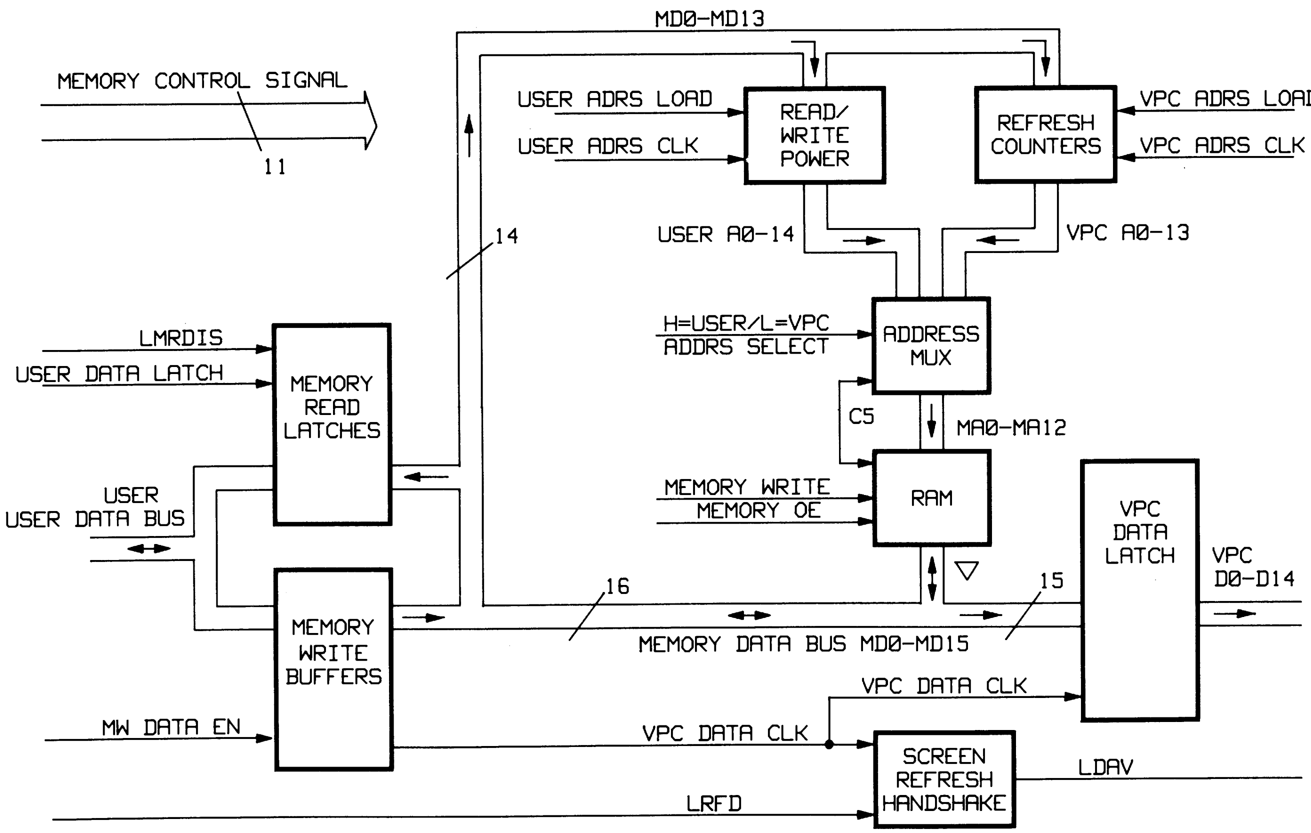
SET POINTER. The value in the Read/Write Pointer specifies the next address in Vector Memory that will be written into or read from by the user processor. When the user sends a Set Pointer Command, the USER ADRS LOAD line is set low and the data specified by bits MD0-MD13 is preloaded into the Read/Write Pointer. The outputs of the Pointer (USER A0-USER A13) are selected by the Address Multiplexers (A5U15, U16, U33, U34) as the next Memory Address.

READ/WRITE. After the vector memory address has been selected, a Read/Write operation can be performed. To read data from Vector Memory, the user sets LDS and LRD lines low. Control line MEMORY OE will set low and the information at the address specified will be placed on the Data Bus. At the same time that LDS and LRD were set low, the Memory Read Latches (A5U10, U11) were enabled to transfer the data from the Memory Data Bus to the User Data Bus (UD0-UD15).

When a write operation is performed, signal lines LDS and LWR are set low, and LDR is set high. As a result, the MEMORY WRITE line is set low and the information on the Data Bus is written into Vector Memory at the address specified. The data flow through the Memory Buffers (A5U24, U25) is controlled by the MW DATA EN line. When this line is low, data is transferred from the User Data Bus to the Memory Data Bus.

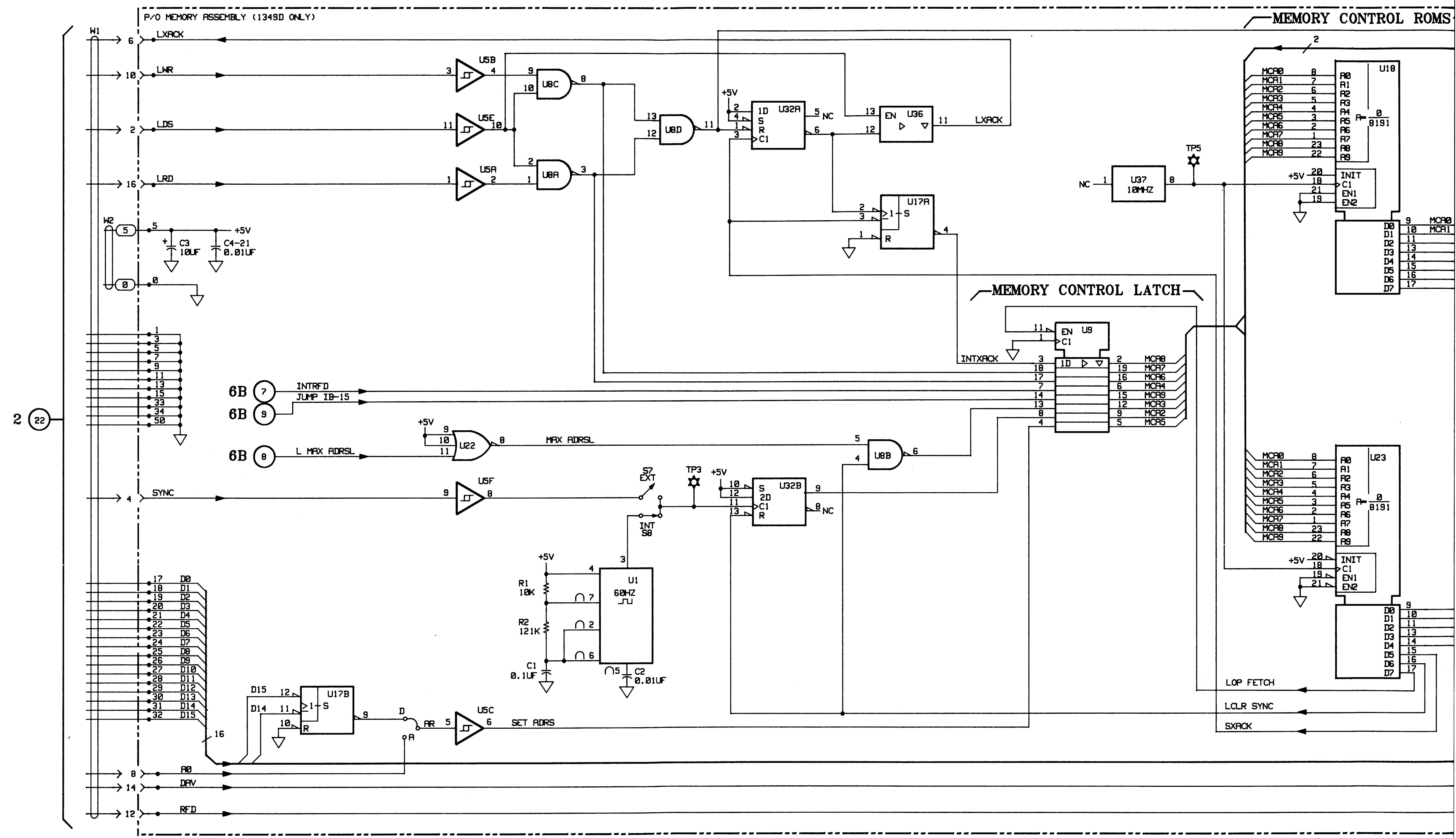
REFRESH MODE. The refresh sync signal may be provided by either the internal refresh circuit, or an external source. To select the required mode of operation, set the A5S1 in the memory board as shown in Section III, figure 3-3.

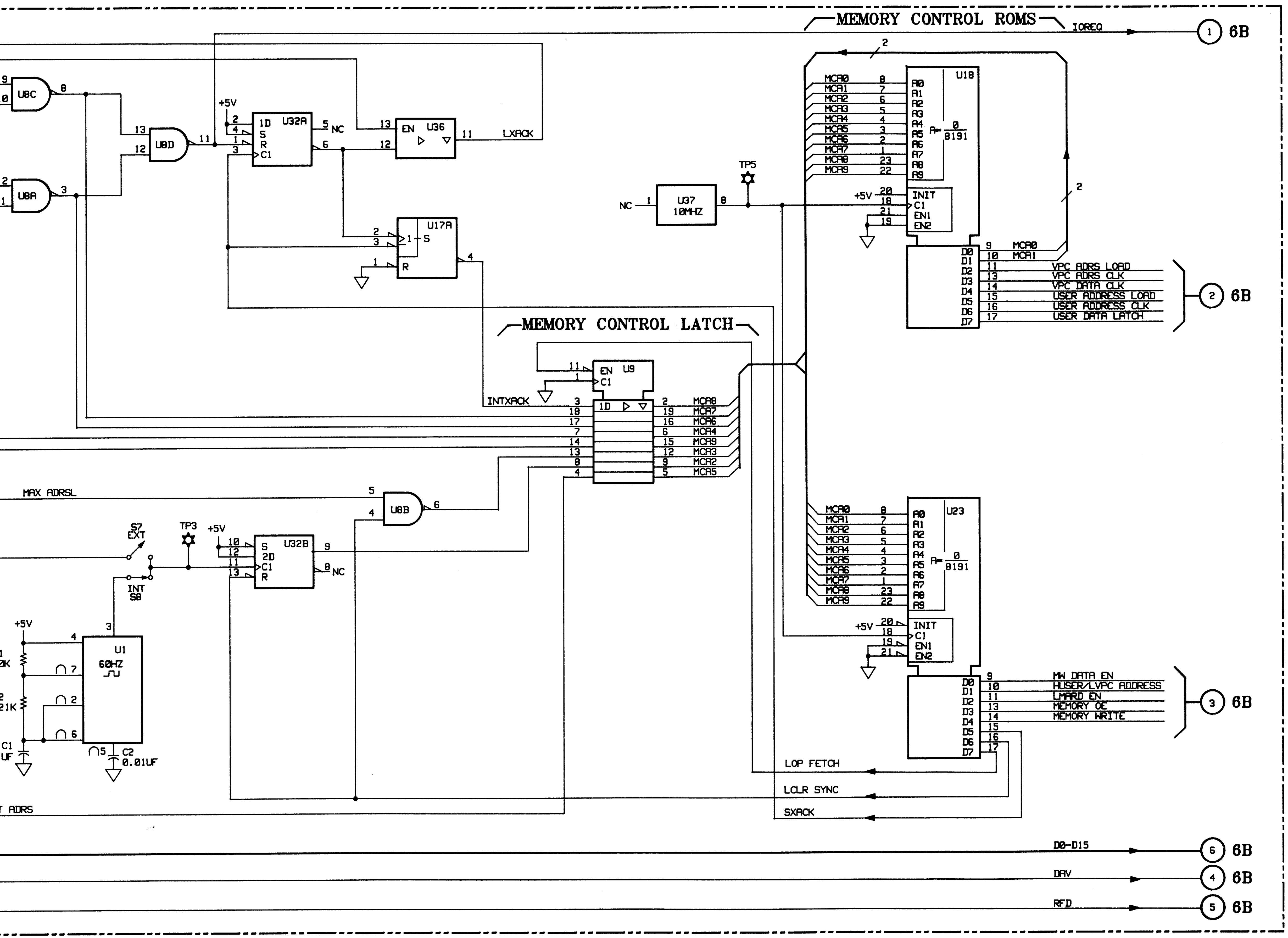
The VPC ADRS LOAD, ADRS CLK, and DATA CLK control the memory address and therefore the data transfer to the VPC circuit during screen refresh. The rate of data transfer is controlled by the LRFD and LDAV handshake rate. HUSER/LVPC ADDRESS SELECT is low during this operation.



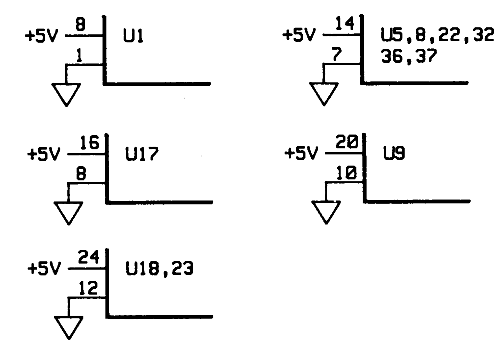
6B

Figure 8-25. Picture Refresh Mode.


P/O MEMORY ASSEMBLY (1349D ONLY)
MEMORY CONTROL ROMS
MEMORY CONTROL LATCH
LXACK
LWR
LDS
LRD
SYNC
INTRFD
JUMP IB-15
L MAX ADRSL
MAX ADRSL
INTXACK
SET ADRS
LOP FETCH
LCLR SYNC
SXACK
DAV
RFD
U37 10MHZ
U1 60HZ
U18
U23
U9
U22
U32A
U32B
U36
U17A
U17B
TP5
TP3
S7 EXT
INT S8
C3 10UF
C4-21 0.01UF
R1 10K
R2 121K
C1 0.1UF
C2 0.01UF
W1
W2
6B
+5V
NC



IC DEVICE POWER CONNECTIONS



NOTES:

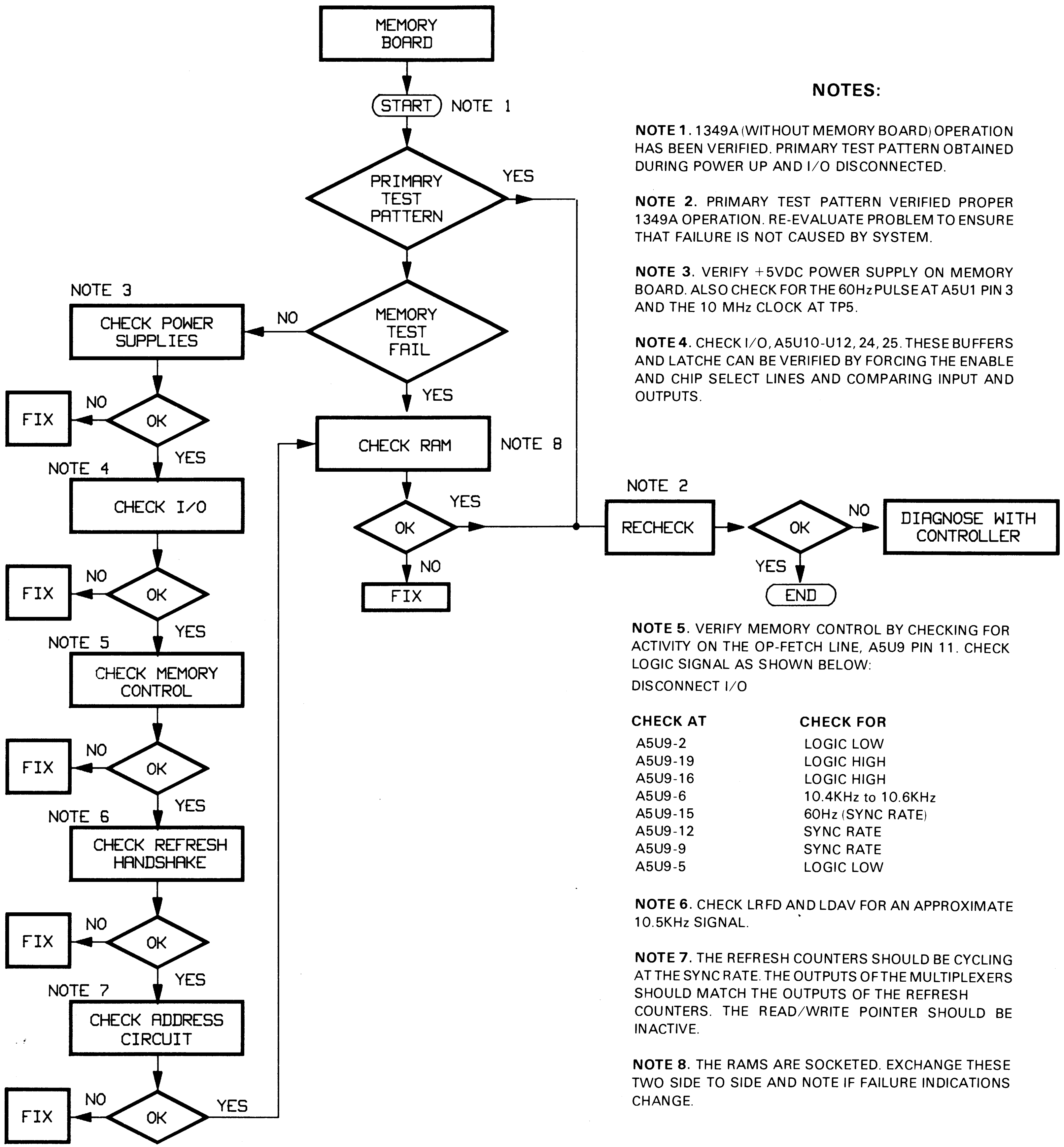
1. GATES ARE SYMBOLIZED ACCORDING TO CIRCUIT FUNCTION.
2. UNLESS OTHERWISE NOTED:
   RESISTANCE IN OHMS
   CAPACITANCE IN PICOFARADS
   INDUCTANCE IN MICROHENRIES
3. UNLESS OTHERWISE NOTED:
   LOGIC LEVELS ARE TTL:
   +2.0V TO +5.0V=LOGIC"1"=H
   0V TO +0.8V=LOGIC"0"=L

PARTS ON THIS SCHEMATIC	
A5	CHASSIS
C1-24 R1,2 TP3,5 U1,5,8,9,17,18,22, U23,32,36,37 W1,2	

C1349011/05-21-84

SERVICE SHEET 6A

Figure 8-26.
P/O Memory Circuit (1349D Only)



NOTES:

NOTE 1. 1349A (WITHOUT MEMORY BOARD) OPERATION HAS BEEN VERIFIED. PRIMARY TEST PATTERN OBTAINED DURING POWER UP AND I/O DISCONNECTED.

NOTE 2. PRIMARY TEST PATTERN VERIFIED PROPER 1349A OPERATION. RE-EVALUATE PROBLEM TO ENSURE THAT FAILURE IS NOT CAUSED BY SYSTEM.

NOTE 3. VERIFY +5VDC POWER SUPPLY ON MEMORY BOARD. ALSO CHECK FOR THE 60Hz PULSE AT A5U1 PIN 3 AND THE 10 MHz CLOCK AT TP5.

NOTE 4. CHECK I/O, A5U10-U12, 24, 25. THESE BUFFERS AND LATCHE CAN BE VERIFIED BY FORCING THE ENABLE AND CHIP SELECT LINES AND COMPARING INPUT AND OUTPUTS.

NOTE 5. VERIFY MEMORY CONTROL BY CHECKING FOR ACTIVITY ON THE OP-FETCH LINE, A5U9 PIN 11. CHECK LOGIC SIGNAL AS SHOWN BELOW:
DISCONNECT I/O

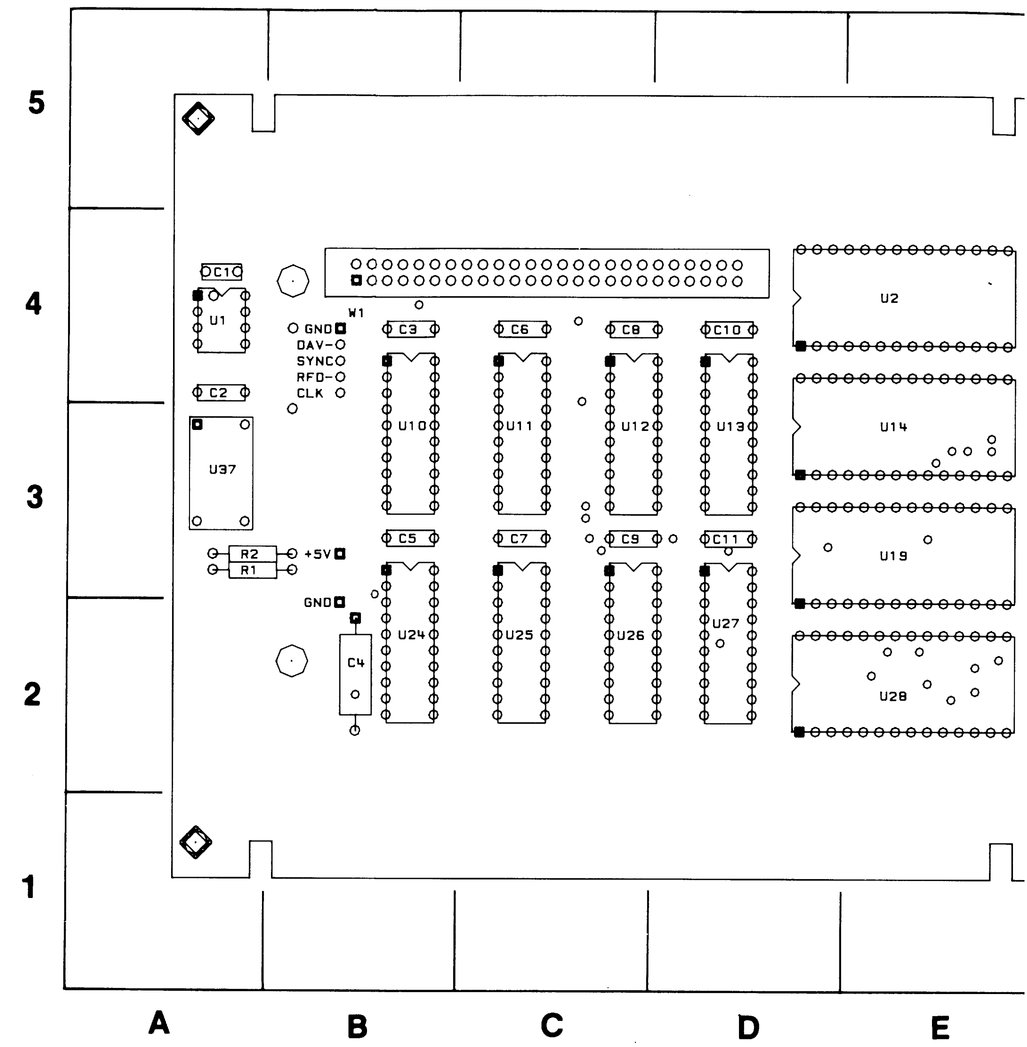
CHECK AT	CHECK FOR
A5U9-2	LOGIC LOW
A5U9-19	LOGIC HIGH
A5U9-16	LOGIC HIGH
A5U9-6	10.4KHz to 10.6KHz
A5U9-15	60Hz (SYNC RATE)
A5U9-12	SYNC RATE
A5U9-9	SYNC RATE
A5U9-5	LOGIC LOW

NOTE 6. CHECK LRFD AND LDAV FOR AN APPROXIMATE 10.5KHz SIGNAL.

NOTE 7. THE REFRESH COUNTERS SHOULD BE CYCLING AT THE SYNC RATE. THE OUTPUTS OF THE MULTIPLEXERS SHOULD MATCH THE OUTPUTS OF THE REFRESH COUNTERS. THE READ/WRITE POINTER SHOULD BE INACTIVE.

NOTE 8. THE RAMS ARE SOCKETED. EXCHANGE THESE TWO SIDE TO SIDE AND NOTE IF FAILURE INDICATIONS CHANGE.

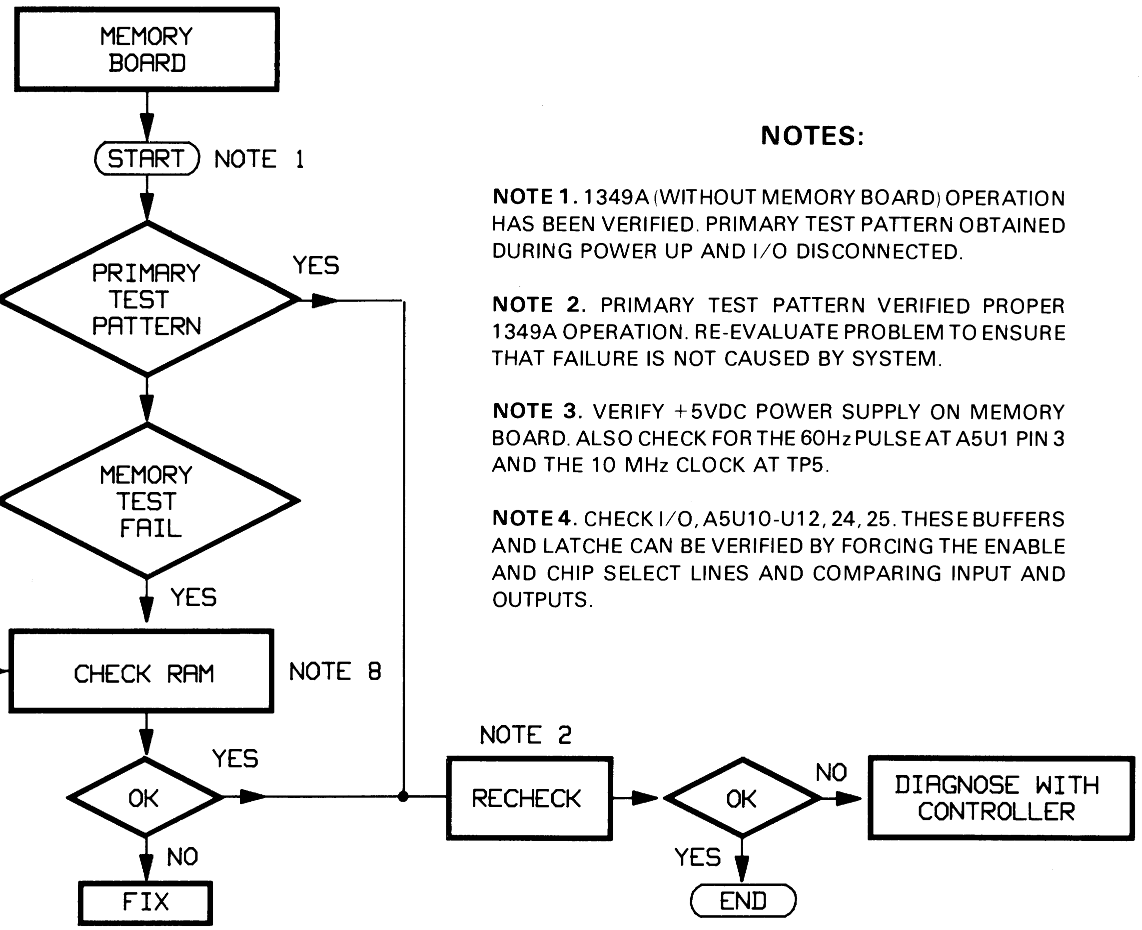
Figure 8-27. Memory Circuit Troubleshooting Flow Chart.



REF DESIG	GRID LOC	R DE
C1	A-4	C1
C2	A-4	C1
C3	B-4	C1
C4	B-2	C2
C5	B-3	C2
C6	C-4	R1
C7	C-3	R2
C8	C-4	R3
C9	C-3	R4
C10	D-4	S1
C11	D-3	U1
C12	G-4	U2
C13	G-4	U3
C14	G-3	U4
C15	G-3	U5
C15	G-3	U6
C16	G-2	

THEORY

Figure 8-28. M



NOTES:

NOTE 1. 1349A (WITHOUT MEMORY BOARD) OPERATION HAS BEEN VERIFIED. PRIMARY TEST PATTERN OBTAINED DURING POWER UP AND I/O DISCONNECTED.

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NOTE 3. VERIFY +5VDC POWER SUPPLY ON MEMORY BOARD. ALSO CHECK FOR THE 60Hz PULSE AT A5U1 PIN 3 AND THE 10 MHz CLOCK AT TP5.

NOTE 4. CHECK I/O, A5U10-U12, 24, 25. THESE BUFFERS AND LATCHE CAN BE VERIFIED BY FORCING THE ENABLE AND CHIP SELECT LINES AND COMPARING INPUT AND OUTPUTS.

NOTE 5. VERIFY MEMORY CONTROL BY CHECKING FOR ACTIVITY ON THE OP-FETCH LINE, A5U9 PIN 11. CHECK LOGIC SIGNAL AS SHOWN BELOW:

DISCONNECT I/O

CHECK AT	CHECK FOR
A5U9-2	LOGIC LOW
A5U9-19	LOGIC HIGH
A5U9-16	LOGIC HIGH
A5U9-6	10.4KHz to 10.6KHz
A5U9-15	60Hz (SYNC RATE)
A5U9-12	SYNC RATE
A5U9-9	SYNC RATE
A5U9-5	LOGIC LOW

NOTE 6. CHECK LRFD AND LDAV FOR AN APPROXIMATE 10.5KHz SIGNAL.

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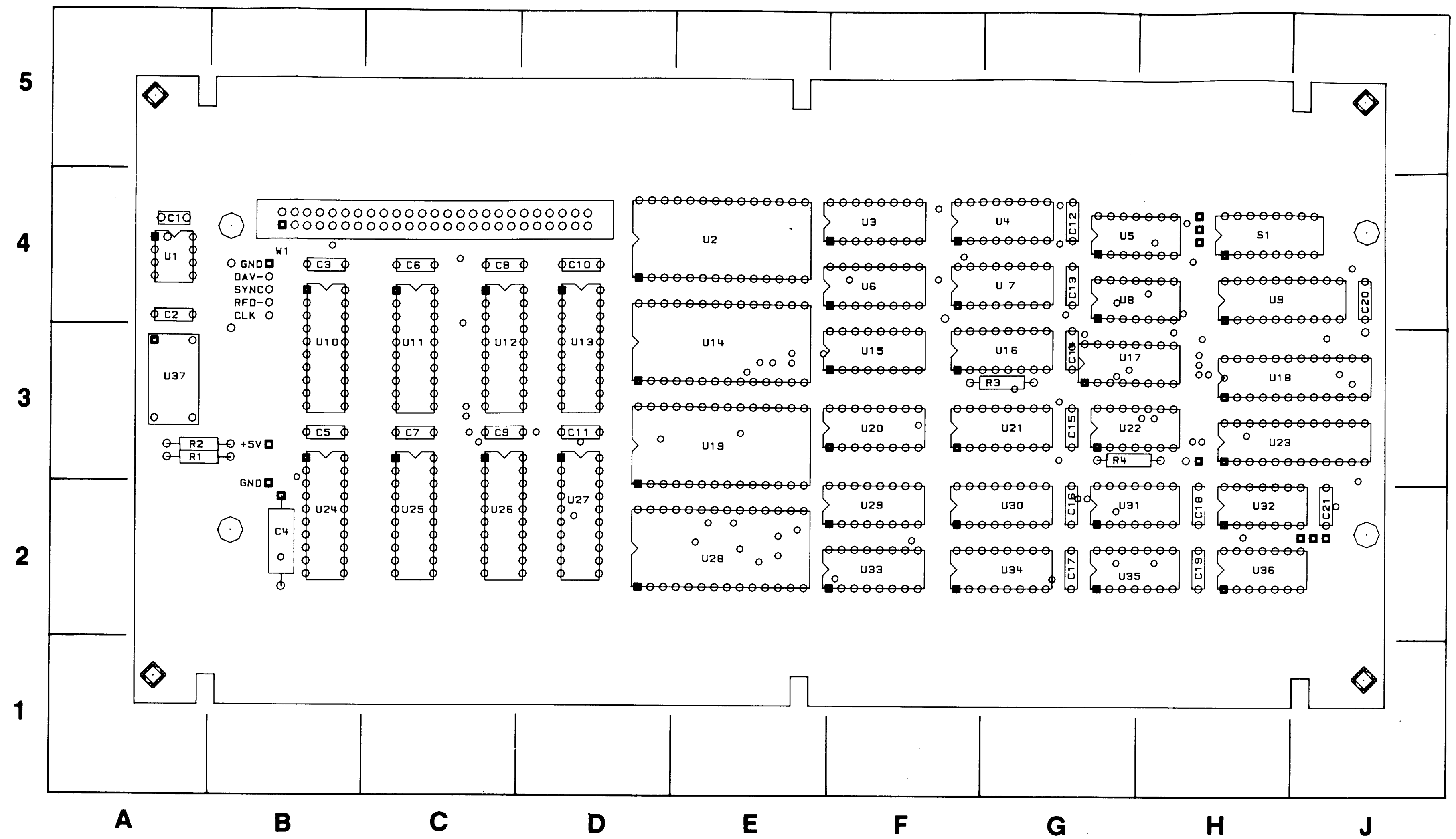
NOTE 8. THE RAMS ARE SOCKETED. EXCHANGE THESE TWO SIDE TO SIDE AND NOTE IF FAILURE INDICATIONS CHANGE.

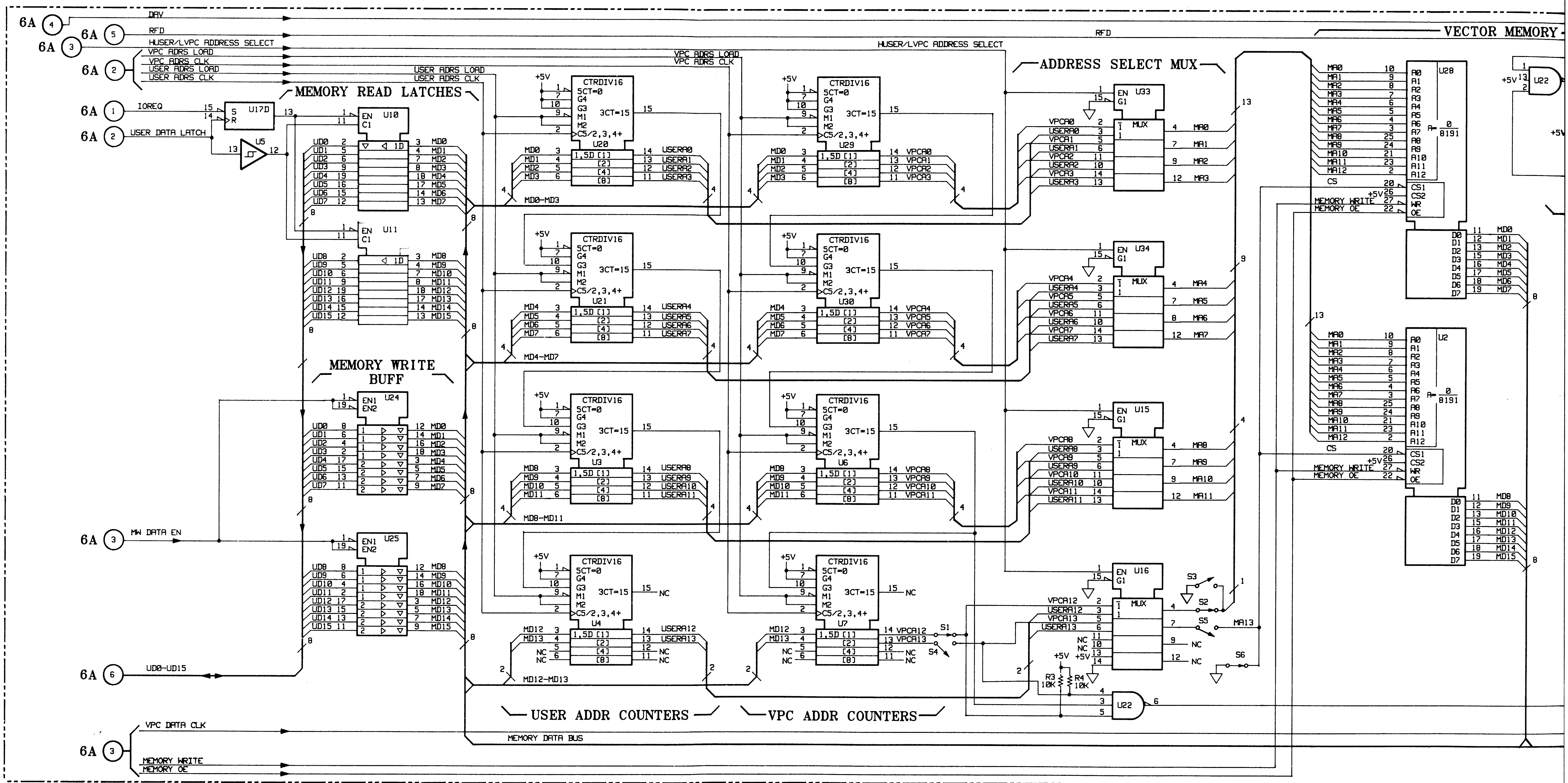
re 8-27. Memory Circuit Troubleshooting Flow Chart.



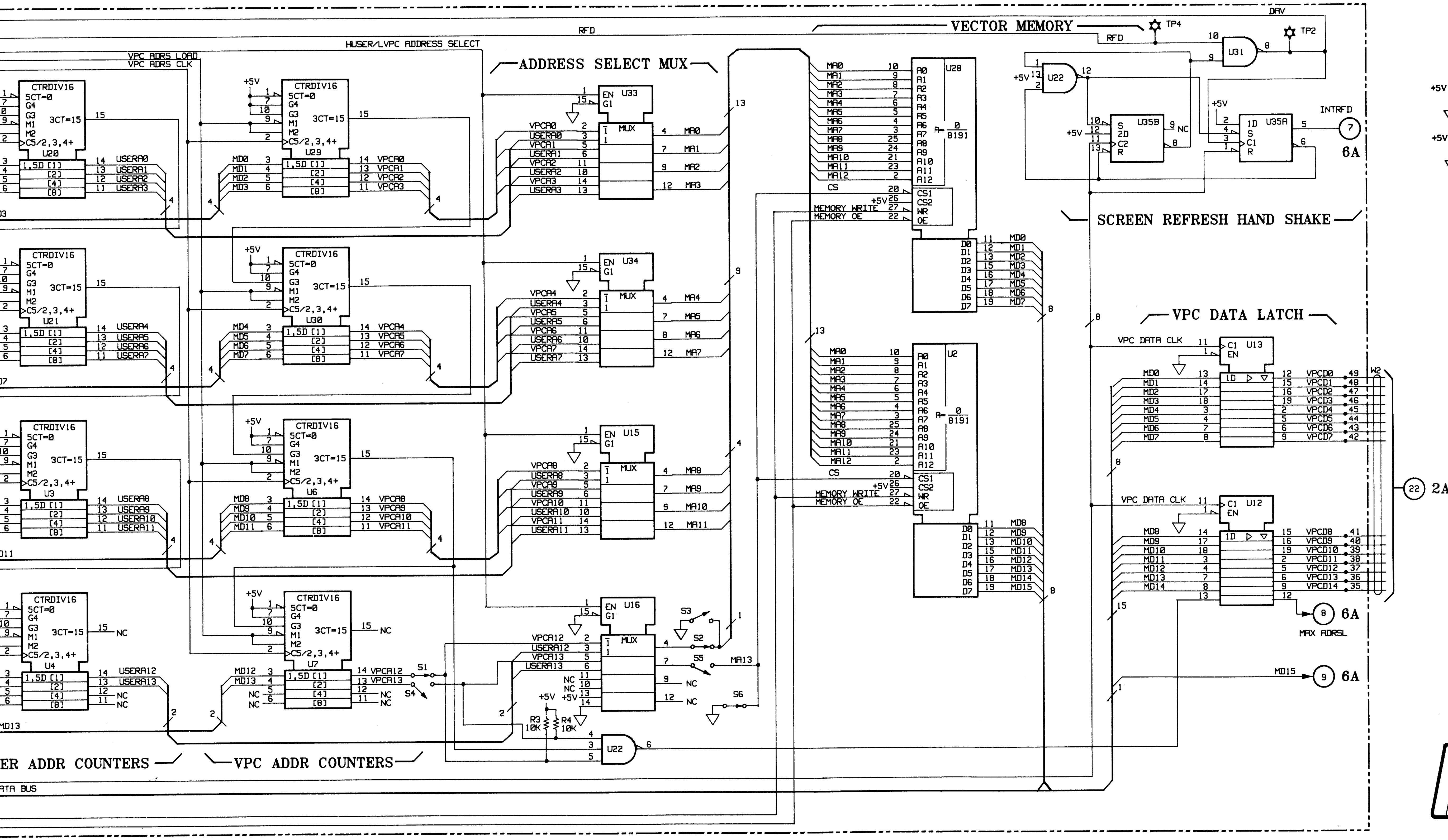
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	A-4	C17	G-2	U7	G-4	U23	H-3
C2	A-4	C18	H-2	U8	G-4	U24	B-2
C3	B-4	C19	H-2	U9	H-4	U25	C-2
C4	B-2	C20	J-4	U10	B-3	U26	C-2
C5	B-3	C21	J-2	U11	C-3	U27	D-2
C6	C-4	R1	A-3	U12	C-3	U28	E-2
C7	C-3	R2	A-3	U13	D-3	U29	F-2
C8	C-4	R3	G-3	U14	E-3	U30	G-2
C9	C-3	R4	G-3	U15	F-3	U31	G-2
C10	D-4	S1	H-4	U16	G-3	U32	H-2
C11	D-3	U1	A-4	U17	G-3	U33	F-2
C12	G-4	U2	E-4	U18	H-3	U34	G-2
C13	G-4	U3	F-4	U19	E-3	U35	G-2
C14	G-3	U4	G-4	U20	F-3	U36	H-2
C15	G-3	U5	G-4	U21	G-3	U37	A-3
C15	G-3	U6	F-4	U22	G-3	W1	B-4
C16	G-2						

THEORY FOR MEMORY CIRCUIT IS ON PAGE 8-24.

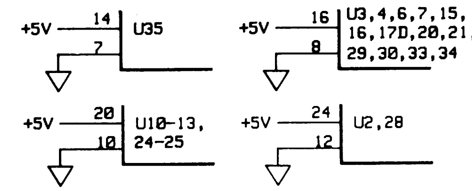
Figure 8-28. Memory Circuit Component Locator.



MEMORY READ LATCHES
MEMORY WRITE BUFF
USER ADDR COUNTERS
VPC ADDR COUNTERS
ADDRESS SELECT MUX
VECTOR MEMORY
DAV
RFD
HUSER/LVPC ADDRESS SELECT
VPC ADRS LOAD
VPC ADRS CLK
USER ADRS LOAD
USER ADRS CLK
IOREQ
USER DATA LATCH
MW DATA EN
UD0-UD15
VPC DATA CLK
MEMORY DATA BUS
MEMORY WRITE
MEMORY OE
CTRDIV16



IC DEVICE POWER CONNECTIONS



NOTES:

1. GATES ARE SYMBOLIZED ACCORDING TO CIRCUIT FUNCTION.
2. UNLESS OTHERWISE NOTED:
   RESISTANCE IN OHMS
   CAPACITANCE IN PICOFARADS
   INDUCTANCE IN MICROHENRIES
3. UNLESS OTHERWISE NOTED:
   LOGIC LEVELS ARE TTL:
   +2.0V TO +5.0V=LOGIC"1"=H
   0V TO +0.8V=LOGIC"0"=L

PARTS ON THIS SCHEMATIC	
A5	CHASSIS
R2,3 U2-7,10-17,19-22 U24-25,28-31 W2	

C1349013/28JUN84

SERVICE SHEET 6B

Figure 8-29.
P/O Memory Circuit (1349D Only)