OPERATING AND SERVICE MANUAL

MODEL 1345A
DIGITAL DISPLAY

(Including Options 001, 323, 325, 400, 505, 564, 704, and 910.)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed **2250A.**

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Manual Part Number 01345-90908
Microfiche Part Number 01345-90808

PRINTED: JANUARY 1983

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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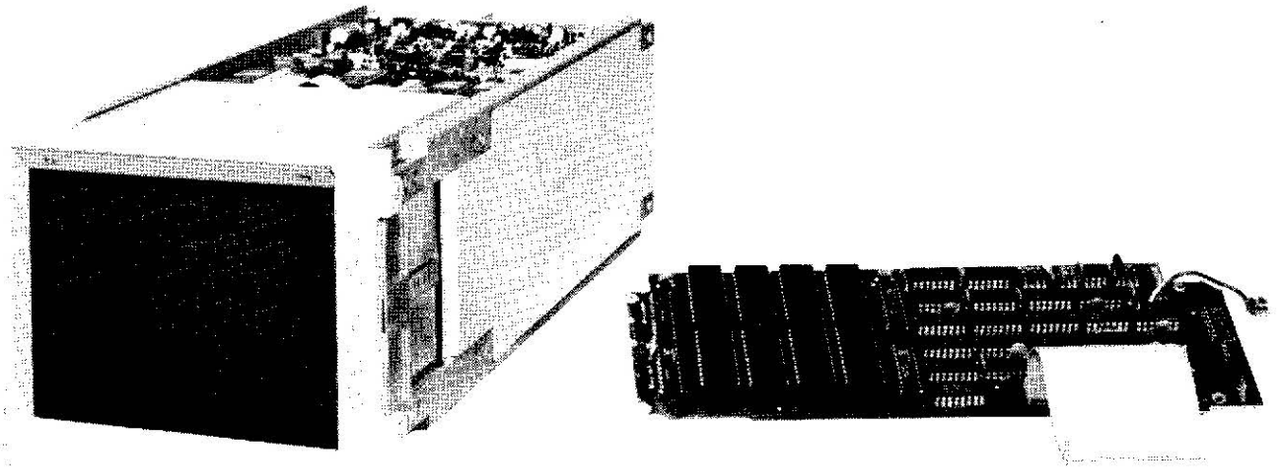


Figure 1-1. 1345A Digital Display with Option 704

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 1345A 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- by 6-inch microfilm transparencies of the manual. Each microfiche contains up to 96 photoduplicates 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 1-3 lists supplemental characteristics. Supplemental characteristics 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 throughout this manual. 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. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified with the manual print date and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

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.

1-13. DESCRIPTION.

1-14. The Hewlett-Packard Model 1345A is a 15.24 cm (6 in.) Display Component. It produces vector graphics on its display screen in response to digital commands from a user processor. Because of its high resolution (2048 x 2048 addressable points), the 1345A can draw both straight and curved lines (curvilinear vectors). Curved lines can be accomplished by a series of short straight vectors. The 1345A draws all vectors in a picture by moving its display beam at the same speed. This constant writing rate ensures a picture of uniform brightness (short vectors do not become brighter than long vectors). Erasing a waveform that intersects other waveforms (vectors) will not leave blank spaces at the intersections. At its faster drawing rate, and at 60 Hz refresh rate, the 1345A can draw a picture that contains up to 3226 inches of vectors. If the refresh rate is slowed to 40 Hz (possible in some applications), then the picture can contain up to 4838 inches of vectors. For labeling or identification of soft-key functions, the 1345A has a built-in set of ASCII characters. The 1345A receives just one word from the user processor and all the vectors necessary to form the character are automatically produced.

Table 1-1. Specifications

INTERFACE

General: 16-bit TTL binary with 2-wire handshake (Option 704: 3-wire handshake), unterminated.
Connector: 26-pin male Ansley type 609-2627.
Recommended Mating Connector: 26-pin female Ansley type 609-2630 with strain relief Ansley type 609-2631. (Note: See Option 325 for mating data cables).

ANALOG OUTPUTS

General: X, Y, and Z analog signals to drive a slave CRT display.
Amplitude: approximately 1 V p-p open circuit.
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: $\geq$ 3 MHz
Z Axis: $\geq$ 10 MHz
Recommended mating connector: Molex 22-01-1023 (See option 323 for factory supplied X-Y-Z output cables)

DISPLAYED IMAGE

Image Size: Factory adjusted to approximately 8.5 cm (3.35 in.) vertically by 11.5 cm (4.53 in.) horizontally.
Resolution: Addressable; 2048 by 2048.
Visible (shrinking raster): $\leq$ 196 lines vertically by 266 lines horizontally (full scale).
Geometric distortion: $\leq$ 2.4 mm error in addressing any location within the image area due to geometric distortions and nonlinearity in CRT and stroke generator.
Repeatability: $\leq$ 0.5 mm position variation in re-addressing any point.
Refresh rate (Option 704): approximately 60 Hz for displayed images containing up to 2000 vectors each 3.3 cm long and 100 characters, at maximum programmable writing speed (approximately 0.5 cm/μsec).
Phosphor: P31 (green).

POWER

Operating Voltages		Max P-P Ripple	Max Current	
Voltage	Tolerance		Standard	Option 704
+15 VDC	+5%	10 MV	1.05 A	1.05 A
-15 VDC	±5%	10 MV	0.3 A	0.3 A
+ 5 VDC	+5 -0%	50 MV	0.75 A	1.8 A

Recommended Mating Connector: AMP type 1-350234-9

Note: See Option 323 for for mating power cable.

Table 1-2. 1345A Functions

GRAPHIC FUNCTIONS

CHARACTERS

Character Sets: 128 Character ANSI ASCII Set 0
HP 9825/9826 Special Keyboard Symbols
Sizes: Four Sizes;

Sizes	Characters/Line	No of Lines	Character Size	
			Graphic Units	MM(approx)
1.0 X	56	28	24 X 36	1.3 X 1.5
1.5 X	37	18	36 X 54	2.0 X 2.2
2.0 X	28	14	48 X 72	2.6 X 3.0
2.5 X	22	11	60 X 90	3.3 X 3.7

Table 1-2. 1345A Functions (Cont'd)

Orientations: 0, 90, 180, 270 degrees CCW relative to horizontal

VECTORS

Line Types:
Solid Line
Solid line with intensified end points
Short dashed line
Long dashed line
Dots at end points only

Velocity:
Four Beam Velocities:
approximately 0.13 cm/μsec
approximately 0.25 cm/μsec
approximately 0.38 cm/μsec
approximately 0.51 cm/μsec

Brightness: Three visible brightness levels plus blank (beam off). Maximum brightness is approximately 170 cd/m^2 at slowest programmable writing speed (approximately 0.13 cm/μsec and 60 Hz refresh rate).

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 1345A is fully operational and provides necessary stimulus for routine calibration. Alternate Test Pattern, invoked by internal jumper change, verifies performance specifications and allows calibration of focus and astigmatism adjustments.

Table 1-3. Supplemental Characteristics

OPERATING ENVIRONMENT

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

NOTE

The 65° C (+130° F) temperature specification reflects the maximum allowable operating temperature with the 1345A enclosed, not the ambient temprature of the system housing. It is recommended that a minimum of 0.28 m^3/min (10 ft^3/min) of air flow is forced around the instrument to ensure that the maximum operating temperature of 65° C (+130° F) is not exeeded.

TEMPERATURE (non-operating): −40° C to +75° C (−40° F to +167° F).

HUMIDITY: to 95% relative humidity up to +40° C (+104° F).

ALTITUDE: (operating) to 4600 m, (15 000); (non-operating) to 15 300 m, (50 000 ft).

SHOCK: 30 g level with 11 ms duration and 1/2 sine-wave shape.

VIBRATION: vibrated in three planes for 15 min. each with 0.38 mm (.01 in.) excursion, 10 to 55 Hz.

SIZE: see outline drawing.

WEIGHT: net, 4.4 kg, shipping weight 5.8 kg (13 lbs).

BEZEL: compatible with HP 197B camera equipped with 10375A adapter (order 197B option 006).

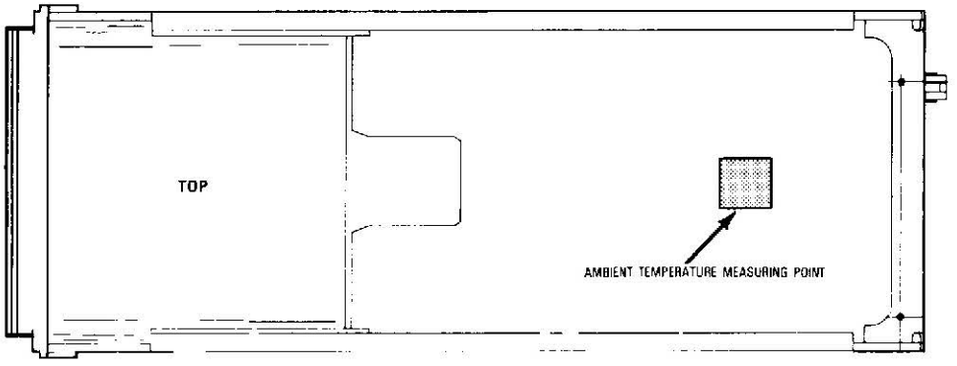


Figure 1-2. Ambient Temperature Measurement

1-15. ACCESSORIES SUPPLIED.

1-16. The following accessories are supplied with the 1345A:

One Operating and Service manual.

One Designers manual.

1-17. OPTIONS.

1-18. Standard options are modifications installed on HP instruments at the factory and are available on request. Table 1-4 lists available options for the 1345A.

Table 1-4. Standard Options

Option	Description
001	Provides external Focus and Intensity controls.
323	This option supplies X-Y-Z output cables for an external display. The cables are 61 cm (24 in.) long.
325	Provides a dc power input cable and an I/O interface cable. The cables are 91.5 cm (36 in.) long.
400	Metric hardware kit for mounting the 1345A.
500	This option deletes Operating and Service manual.
505	Deletes Designers Manual.
564	Provides a blue contrast filter in place of the standard neutral density filter.
704	This option adds 4 K x 16-bit Vector Memory (see service sheet 7).
910	This option provides an extra Operating and Service Manual.

1-19. RECOMMENDED TEST EQUIPMENT.

1-20. Equipment required to test and maintain the 1345A is listed in table 1-5. Other equipment may be substituted if it meets or exceeds the critical specifications listed in the table.

Table 1-5. 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	Adjustments
Digital Voltmeter	HP Model 3465B	Voltage Rating: −15 V to 250 V Accuracy: 0.1% Input Resistance: 10 Mohm	Adjustments
1000:1 Divider Probe	HP Model 34111A	Voltage Rating: 12 kV	Adjustments
10:1 Divider Probe (Qty 2)	HP Model 10041A (supplied with HP Model 1740A)	Input Resistance: 1 Mohm shunted by approx. 12 pf	Adjustments
Power Supply	HP Model 63315D	Output Voltage: 5 V at 1.8 A Output Voltage: +15 V at 0.5 A −15 V at 1.1 A	Performance Checks Adjustments

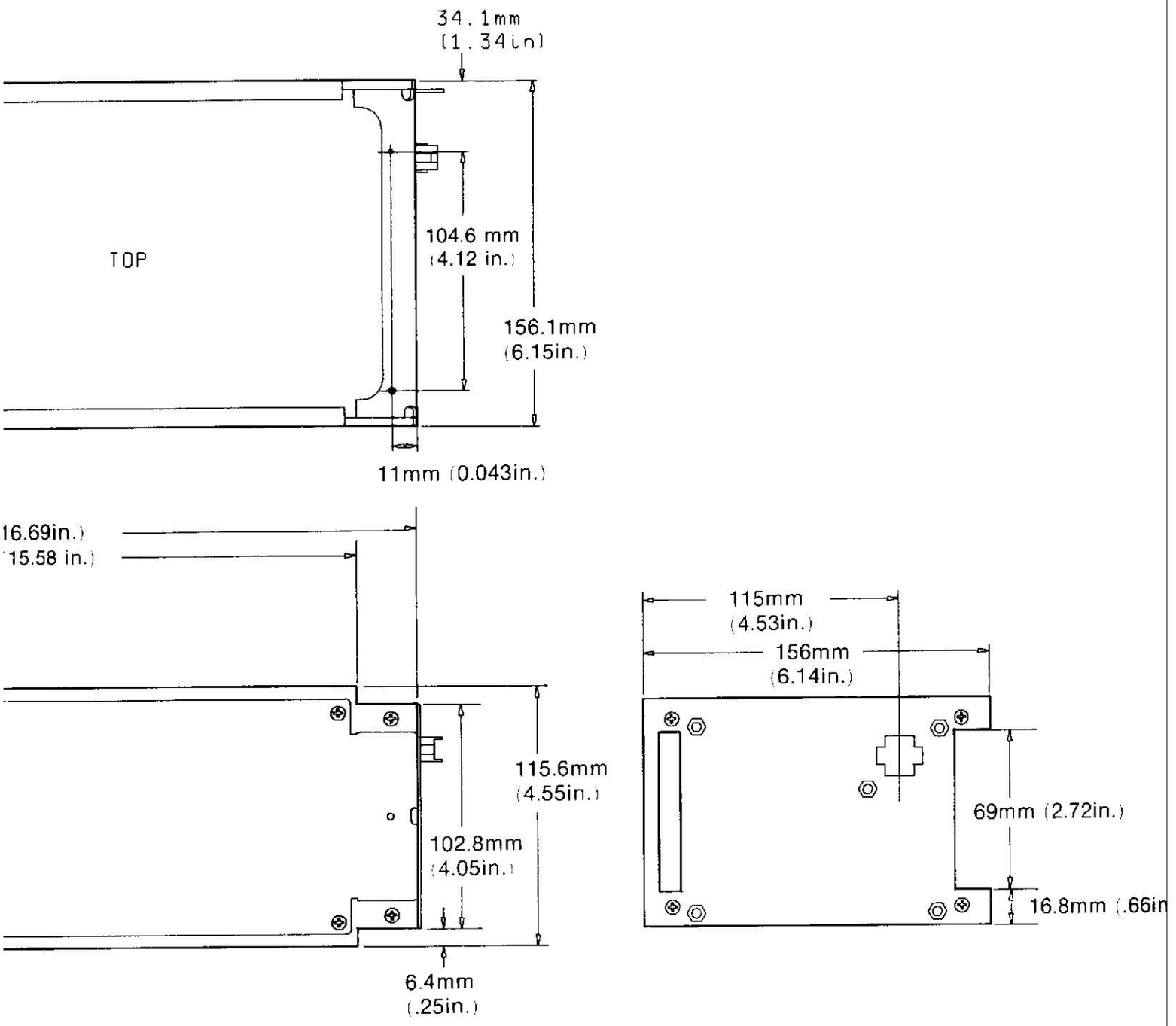
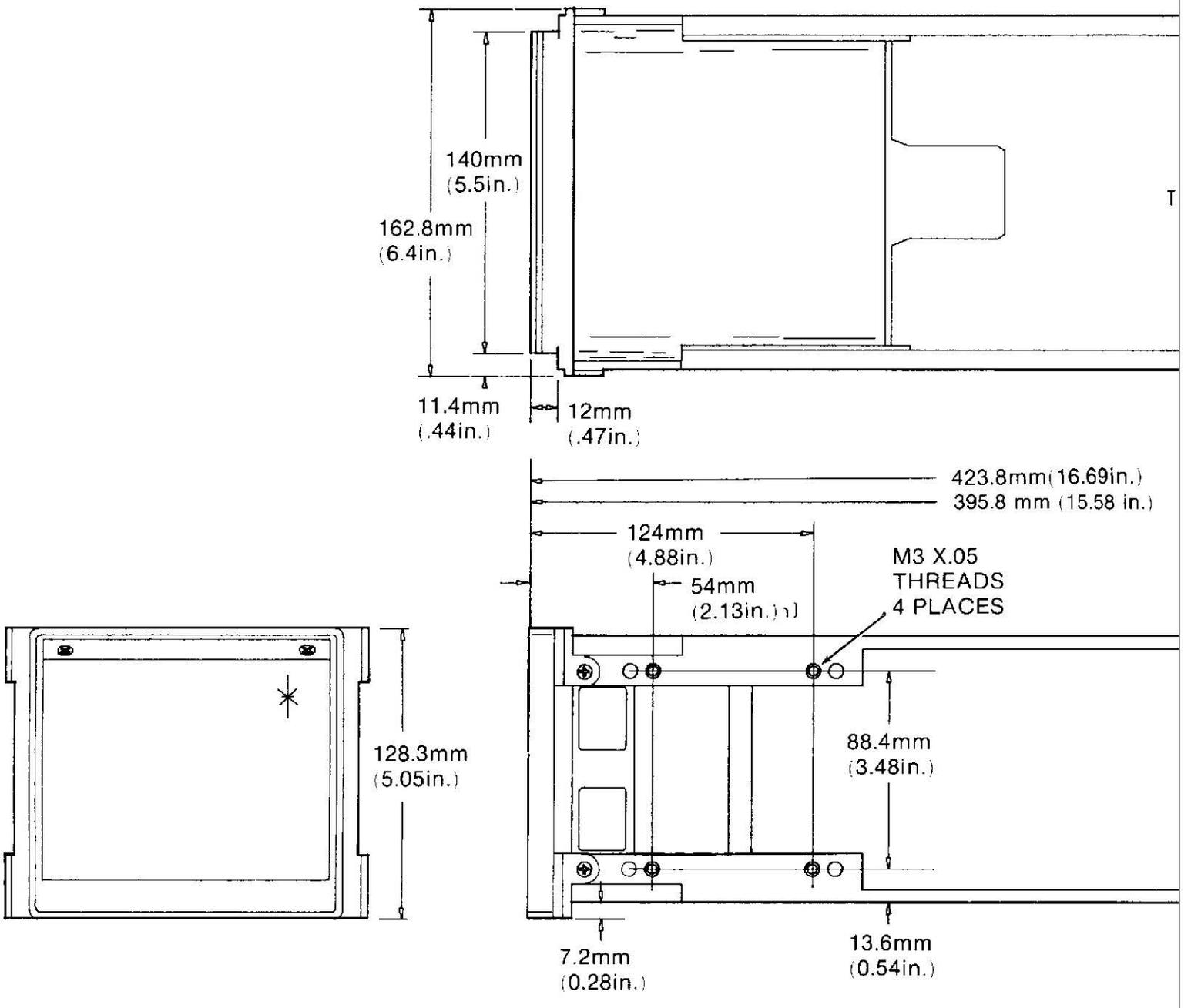


Figure 1-
Dimensional Detail, 1345.


140mm
(5.5in.)
162.8mm
(6.4in.)
11.4mm
(.44in.)
12mm
(.47in.)
423.8mm(16.69in.)
395.8 mm (15.58 in.)
124mm
(4.88in.)
54mm
(2.13in.)
M3 X.05
THREADS
4 PLACES
128.3mm
(5.05in.)
88.4mm
(3.48in.)
7.2mm
(0.28in.)
13.6mm
(0.54in.)

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section provides installation instructions for the Model 1345A Digital Display. This section also includes information about initial inspection and damage claims, preparation for use, 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 imcomplete, 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.

2-6. POWER REQUIREMENTS.

2-7. The 1345A requires the following power supplies for proper operation:

+15 Vdc ± 5% regulated, 1.05 A, <10 mV p-p ripple
+ 5 Vdc + 5% -0% regulated, 0.75 A, <10 mV p-p ripple
-15 Vdc ± 5% regulated, 0.3 A, <10 mV p-p ripple

NOTE

When the 1345A is equipped with Option 704 (Vector Memory), current requirements for the +5 V supply are 1.8 A.

2-8. POWER CONNECTOR.

2-9. A 6 Pin connector (Amphenol 1-350234-9 or equivalent) is required to mate with the rear panel power connector.

2-10. I/O CONNECTOR.

2-11. A 26 pin connector (ANSLEY 609-2630 or equivalent) is required to mate with the rear panel connector. The connector is wired according to the diagram in figure 2-2.

The data transfer rate is controlled by the 1345A and the user processor. The length of each vector influences the rate. The 1345A requires approximately 1.5 to 100 microseconds to process and draw each vector.

2-12. ANALOG OUTPUTS (X, -Y, -Z).

2-13. 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

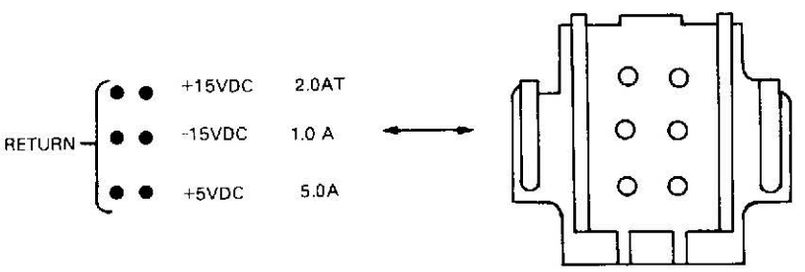


Figure 2-1. Power Connection for 1345A

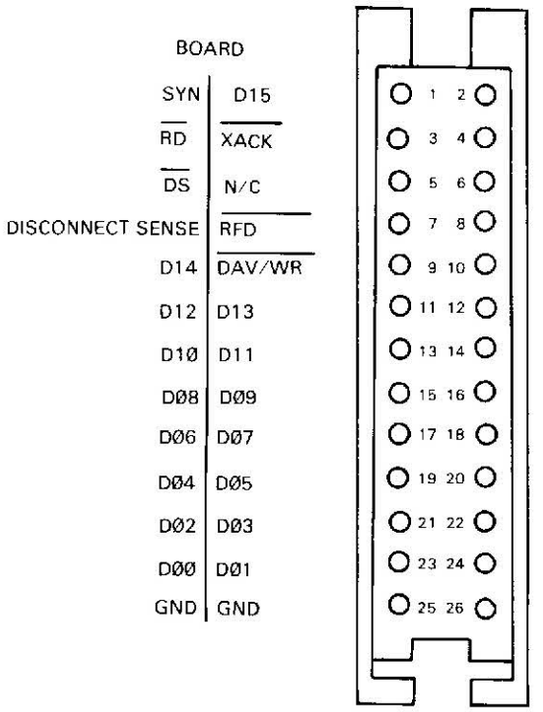


Figure 2-2. 1345A I/O Connector

1 V p-p into 600 ohm loads. The bandwidth of the external X-Y-Z display should be at least 2 MHz or greater and the interface cables should not exceed 1.83 m (6 ft) in length. Use the following table for interfacing:

Ref Desig	Output
A1J3	Z AXIS OUTPUT
A1J4	Y AXIS OUTPUT
A1J5	X AXIS OUTPUT

2-14. OPERATING ENVIRONMENT.

2-15. Temperature. The instrument may be operated in temperatures from 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 1345A enclosed, not the ambient temperature of the system housing. It is recommended that a minimum of 0.28 m^3 per minute (10 ft^3 per minute) of air flow is forced around the instrument to ensure that the maximum operating temperature of 65 degrees C (+149 F) is not exceeded.

Figure 2-3 shows the recommended point where the ambient temperature measurement should be made.

2-16. Humidity. The instrument may be operated in environments with humidity up to 95%. However, the instrument should also be protected from temperature extremes which causes condensation within the instrument.

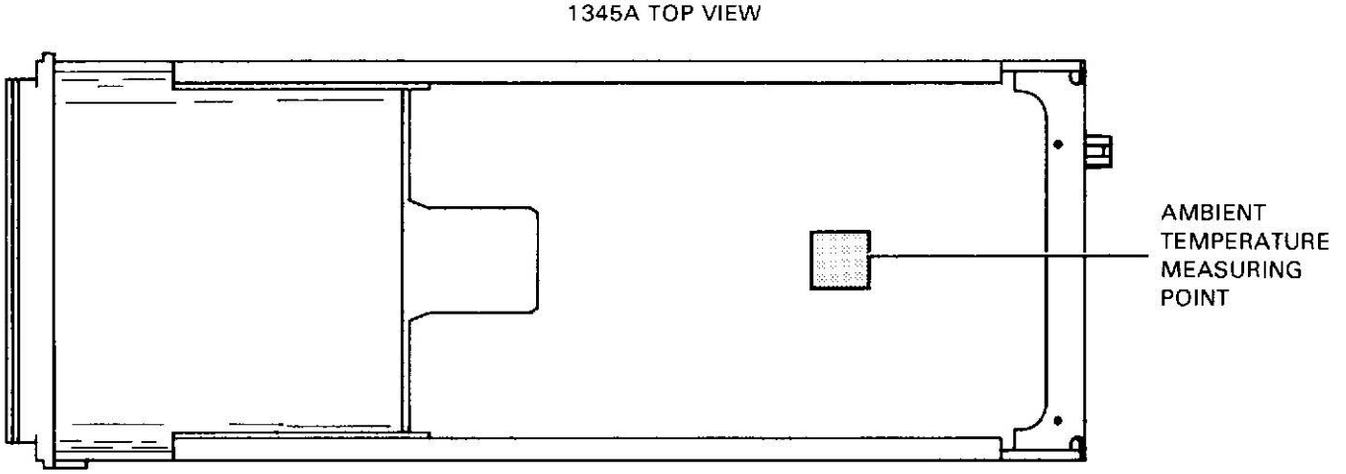
2-17. Altitude. The instrument may be operated at altitudes up to 4600 m (15,000 ft).

2-18. STORAGE AND SHIPMENT.

2-19. Environment. The instrument may be stored or shipped in environments within the following limits:

Temperature	−40 degrees C to +75 C (−40 F to +167 F)
Humidity	up to 95% relative humidity at +40 degrees C (+104 F)
Altitude	15 300 m (50 000 ft)

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



2-20. PACKAGING.

2-21. 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.

2-22. Other Packaging. The following general instructions should be used for re-packing with commercially available materials.

a. Wrap instrument in heavy paper or 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.)

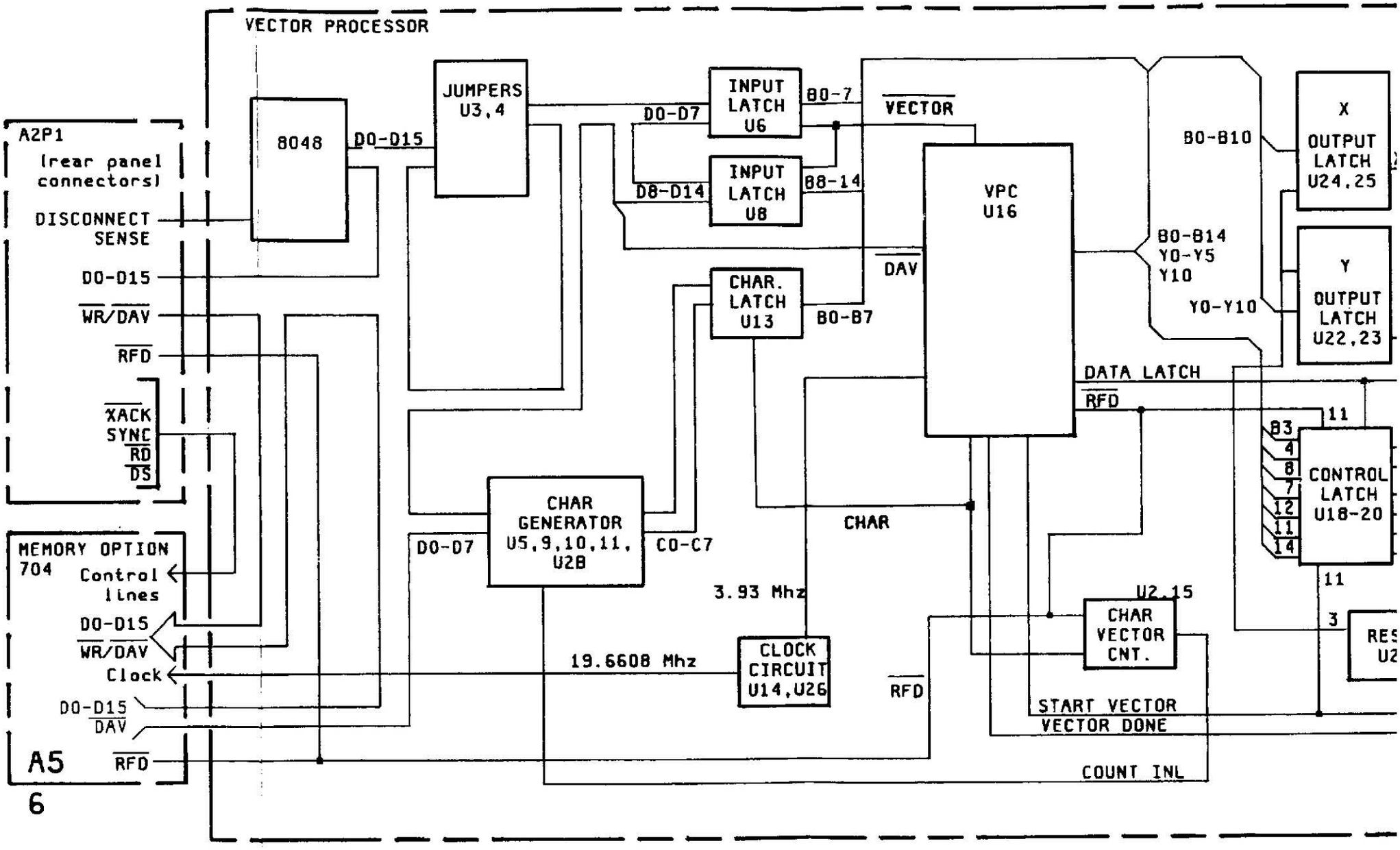
b. Use a strong shipping container. A double-wall carton made of 350-pound test material is adequate.

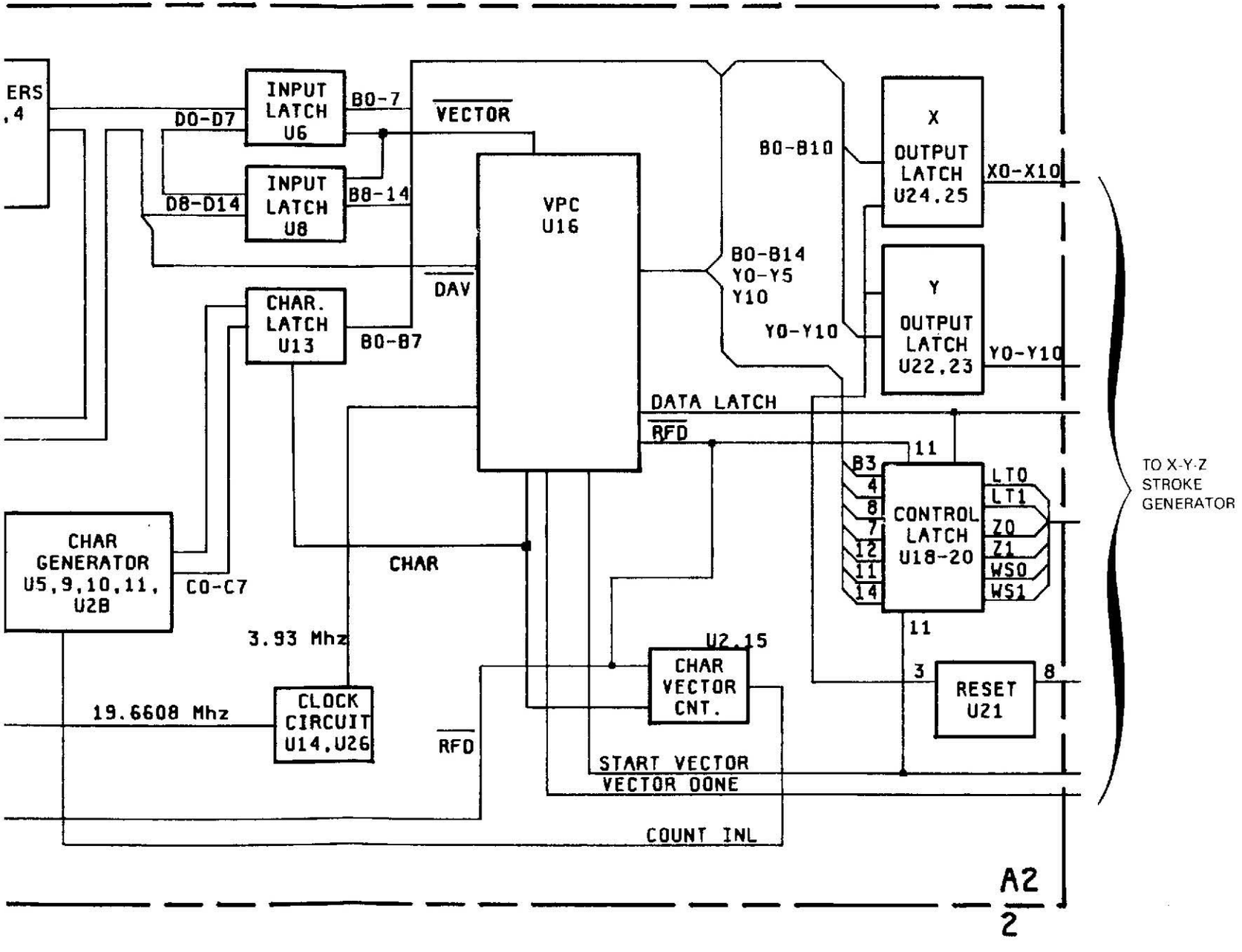
c. Use a layer of shock-absorbing material 70 to 100 mm (3 to 4 inch) thick around all sides of the instrument to provide firm cushioning and prevent movement inside the container. Protect control panel with cardbord.

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.


VECTOR PROCESSOR
A2P1
(rear panel connectors)
DISCONNECT SENSE
D0-D15
WR/DAV
RFD
XACK
SYNC
RD
DS
MEMORY OPTION 704
Control lines
D0-D15
WR/DAV
Clock
D0-D15
DAV
RFD
A5
6
8048
D0-D15
JUMPERS U3,4
INPUT LATCH U6
INPUT LATCH U8
D0-D7
D8-D14
B0-7
B8-14
VECTOR
DAV
CHAR. LATCH U13
B0-B7
CHAR GENERATOR U5,9,10,11, U28
D0-D7
C0-C7
CHAR
3.93 Mhz
19.6608 Mhz
CLOCK CIRCUIT U14,U26
RFD
VPC U16
B0-B10
B0-B14
Y0-Y5
Y10
Y0-Y10
X OUTPUT LATCH U24,25
Y OUTPUT LATCH U22,23
DATA LATCH
RFD
CONTROL LATCH U18-20
B3
4
8
7
12
11
14
11
U2,15
CHAR VECTOR CNT.
3
START VECTOR
VECTOR DONE
COUNT INL


ERS
,4
INPUT LATCH U6
D0-D7
B0-7
VECTOR
INPUT LATCH U8
D8-D14
B8-14
VPC U16
DAV
CHAR. LATCH U13
B0-B7
B0-B10
B0-B14
Y0-Y5
Y10
Y0-Y10
X OUTPUT LATCH U24.25
X0-X10
Y OUTPUT LATCH U22,23
Y0-Y10
DATA LATCH
RFD
11
B3
4
8
7
12
11
14
CONTROL LATCH U18-20
LT0
LT1
Z0
Z1
WS0
WS1
TO X-Y-Z STROKE GENERATOR
CHAR GENERATOR U5,9,10,11, U28
C0-C7
CHAR
3.93 Mhz
U2,15
CHAR VECTOR CNT.
3
RESET U21
8
19.6608 Mhz
CLOCK CIRCUIT U14,U26
RFD
START VECTOR
VECTOR DONE
COUNT INL
A2
2

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 1345A. 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.

3-3. OPERATING CONSIDERATIONS.

Refer to figure 3-1 for the following discussion.

3-4. SIGNAL LINE DEFINITIONS.

D0-D15 D0 through D14 are the vector data lines. (TTL positive logic).
D15 is used only with Option 704 (Vector Memory option).

$\overline{\text{DAV}}$ Data valid signal line: (Active low)
Signal from user to 1345A.
New output data is available on data bus.

$\overline{\text{RFD}}$ Ready for data signal line: (Active low)
Signal from 1345A to user.
1345A 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 is not grounded (held low).

3-5. SIGNAL LINE DEFINITION FOR OPTION 704.

$\overline{\text{SYNC}}$ External display refresh synchronization signal line: A positive-going (TTL) edge on this line starts a display refresh cycle when external sync mode has been selected via a jumper wire on the Vector Memory board (option 704).

$\overline{\text{XACK}}$ Acknowledge signal line: When low, this line indicates to the user processor that the Vector Memory has completed the Read or Write operation commamded by the processor. Since Option 704 (Vector Memory) completes a Read or Write operation in less than 565 nsec, the user processor does not have to use this signal line at all if the data transfer rate of the user processor is less than 1.77 MHz.

$\overline{\text{DS}}$ Device Select signal line: When low this line enables the Vector Memory for communication from or to the user processor (write/read).

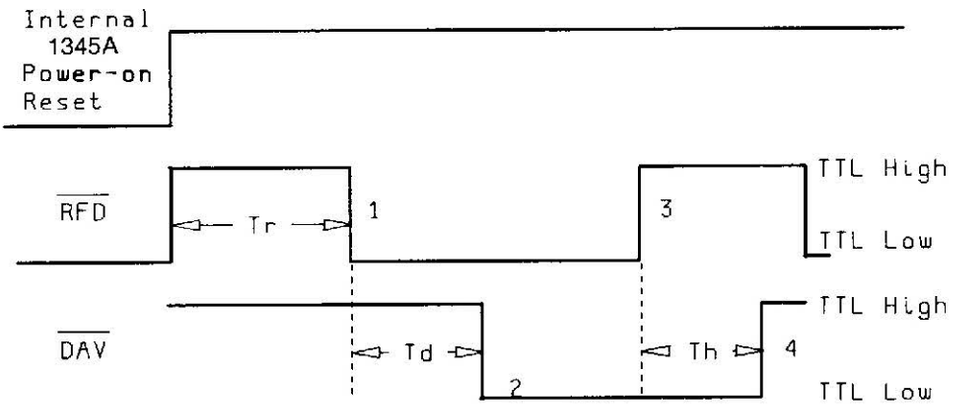
$\overline{\text{WR}}$ Memory Write signal line: When low this line indicates that the 16-bit Data Bus contents are to be written into either the current Vector Memory location (specified by Vector Memory address pointer), or into the Vector Memory address pointer register. The status of A0 will determine the destination of the data on the 16-bit data bus.

$\overline{\text{RD}}$ Memory Read signal line: When low this line indicates that the contents of the current Vector Memory location (as specified by the Vector Memory 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 Vector Memory address pointer auto-increments to the next Vector Memory location (address).

3-6. HANDSHAKE TIMING.



Tr — Ready Time (1345A Power-on delay) ..... 400 nsec min
100 μsec max
(assume DAV is high at Power-on)

Td — Data Valid Delay Time (after RFD goes low) ..... 0 nsec min

Th — Data Valid Hold Time (after RFD goes high) ..... 0 nsec min

Figure 3-2. $\overline{RFD}$ and $\overline{DAV}$ (Ready for Data, Data Valid) Handshake

TRANSFER SEQUENCE:

1. 1345A sets $\overline{RFD}$ low to indicate that it is ready for a word from the 16-bit Data Bus.

2. User processor sets $\overline{DAV}$ low to indicate that the contents of the 16-bit Data Bus are valid.

3. 1345A returns $\overline{RFD}$ high to indicate that it has accepted the word from the 16-Bit Data Bus.

4. User processor returns $\overline{DAV}$ high so that the 1345A can initiate the next transfer.

5. 1345A sets $\overline{RFD}$ low to indicate that it is ready for a word from the 16-bit data bus.

RESTRICTIONS:

a. User processor can set $\overline{DAV}$ low at the same time or after 1345A sets $\overline{RFD}$ low, but NOT BEFORE.

b. User processor can return $\overline{DAV}$ high at the same time or after 1345A returns $\overline{RFD}$ high, but NOT BEFORE.

NOTE

While $\overline{DAV}$ remains low, the 1345A 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.

c. The 1345A will not set $\overline{RFD}$ low unless $\overline{DAV}$ is high.

d. Data on the 16-bit Data Bus must remain valid as long as $\overline{DAV}$ is low.

NOTE

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

3-7. INSTRUCTIONS.

The 1345A 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 1345A references each vector by starting point, ending point, intensity level, line type, and writing speed. The 1345A has the following programming command set.

The 1345A recognizes the 16 bits 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

1. Set Condition Command (B14 = 1, B13 = 1).

With both MSBs (Most Significant Bits) set to one, the 1345A 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.

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

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

* B6 MUST be zero.

X = DON'T CARE

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	0.05 in. per microsecond
1	0	0.10 in. per microsecond
0	1	0.15 in. per microsecond
0	0	0.20 in. 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.

2. Plot Command (B14 = 0, B13 = 0).

With both MSBs set to zero, the 1345A 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 on.

The Plot command will draw all vectors according to the display configuration established by the last Set Condition command received by the 1345A.

Each time that a Y coordinate is received the beam status (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 1345A: (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 (Beam Control Bit)
0 = Move (beam off)
1 = Draw (beam on)

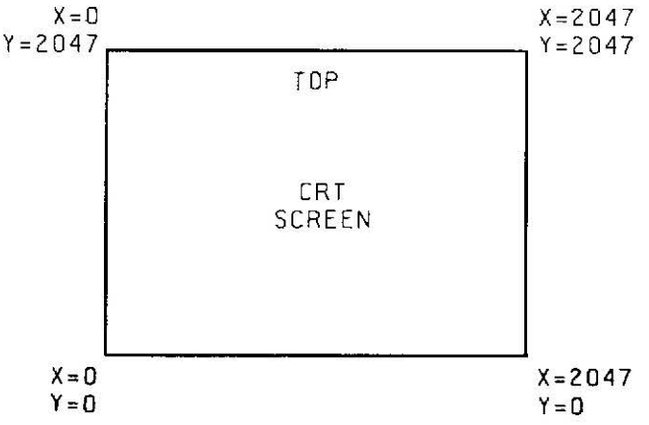


Figure 3-3. Vector Drawing Area

3. Graph Command (B14 = 0, B13 = 1).

With the two MSBs set to zero and one, respectively, the 1345A 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 on. Beam status for the beam movement is established each time that 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 1345A.

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 (Beam Control Bit)
0 = Move (beam off)
1 = Draw (beam on)

Example:

To graph, first move the beam to a starting position P1 (Plot Commands: X value; Y value with beam off). Then send the 1345A:

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.

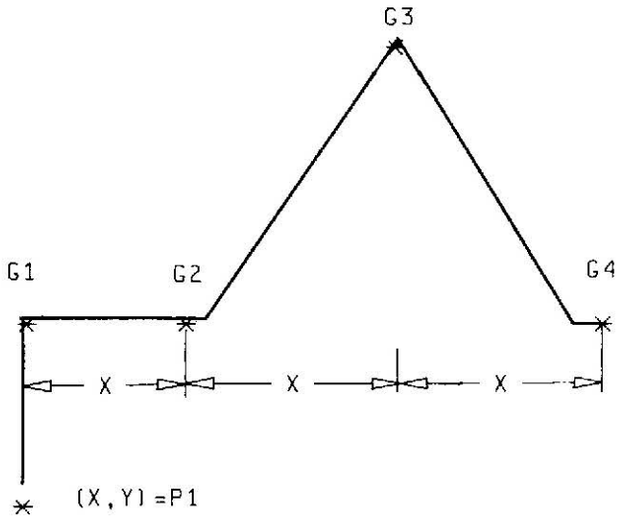


Figure 3-4. Graphing Example

4. Text Command (B14 = 1, B13 = 0).

With the two MSBs set to one and zero, respectively, the 1345A is commanded to draw all the vectors necessary to produce the character specified.

The 1345A automatically provides a space to the right of each character for character spacing.

The Text command will draw the character according to the display configuration established by the last Set Condition command received by the 1345A.

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 1345A has finished drawing a character it automatically advances the beam to the starting point for the next character. In this way the 1345A functions much like a typewriter when presenting text.

The modified ASCII character set for the 1345A 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 1345A display a text character (specified by D0 - D7).

ES (Establish size of character)
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	1 X	24 X 36
0	1	1.5 X	36 X 54
1	0	2 X	48 X 72
1	1	2.5 X	60 X 90

Example:
1 X character spacing (in addressable points)

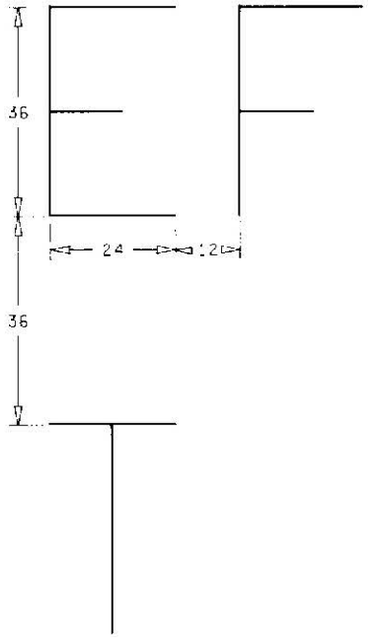


Figure 3-5. Example of Character Spacing

3-8. REFRESH REQUIREMENTS.

The user processor must present all picture data to the 1345A at a minimum rate of approximately 50 Hz. Below a 50 Hz refresh rate the display may begin to flicker. Recommended refresh rate is approximately 60 HZ.

3-9. POTPOURRI.

1. Octal (and Hexadecimal) Ranges for 1345A Commands.

1345A 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

2. Vector Drawing Examples.

Example 1.
To draw a square on the display, use the following procedure.

a. Send the 1345A a Set Condition command to configure display brightness, line type, and writing rate.

b. Send the 1345A a Plot X1 command.

c. Send the 1345A a Plot Y1 command with the beam off. This moves the beam to the starting point of the square.

d. Send the 1345A 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 1345A a Plot X2 command, then a Plot Y2 (beam on) command. This moves the beam to X2,Y2 (draws vector "2").

f. Send the 1345A a Plot Y1 command with the beam on. This moves the beam to X2,Y1 (draws vector "3").

g. Send the 1345A a Plot X1 command, then a Plot Y1 (beam on) command. This moves the beam back to the starting point (draws vector "4").

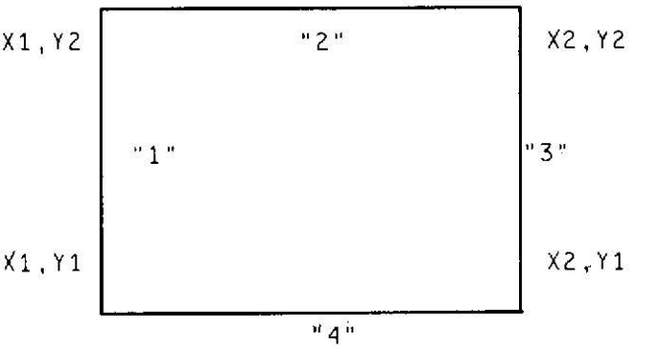


Figure 3-6. Drawing a Square on the Display

Example 2.
To draw two horizontal lines on the display, modify steps "d" and "f" in example 1 so that the 1345A receives the Plot Y command with beam off instead of beam on.

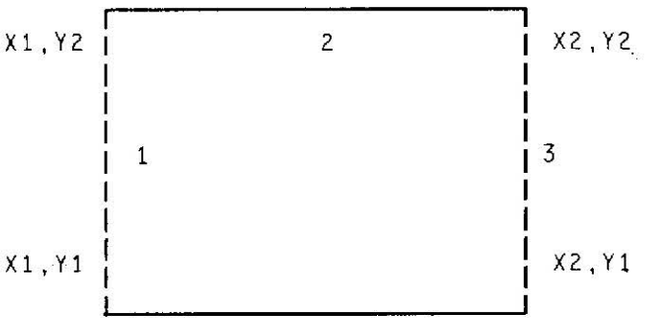


Figure 3-7. Drawing Two Horizontal Lines on the Display

Table 3-1. 1345A Character Set

0		32	Space	64	@	96	
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	106	k
12	1/2 shift up	44	,	76	L	107	l
13	carriage return	45	-	77	M	108	m
14	horizontal tic	46	.	78	N	109	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	AUTO BACK SPACE	127	shaded triangle

3. Calculating the Starting Point for Text.

If we wish to display the characters "1345A" in the center of the display, proceed as follows.

Let's choose the 2.5 X (largest) character size. Each character will be 90 X 90 addressable points.

Calculation:

center screen = 1024,1024 (X,Y)

X = 1024 - (2.5 chars. X 90 points/char.)
= 1024 - 225
= 799
Y = 1024 - (0.5 char. X 90 points/char.)
= 1024 - 45
= 979

Send the 1345A a Plot X command with X = 799. The Octal code to do this is 01437.

Send the 1345A a Plot Y command with the beam off and Y = 979. The Octal code to do this is 01723.

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

4. Optimizing Picture Quality.

Due to differing conditions of ambient light when the 1345A 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 1345A should be set to the highest brightness level and slowest writing speed.

5. Reducing Display Flicker.

The 1345A must receive all data for the picture from the user processor at an approximate rate of once every 16.7 milliseconds (60 Hz refresh rate).

A long vector may require up to 100 microseconds before the 1345A will receive the next command (vector) from the user processor. If the 1345A is drawing a picture with many long vectors, then the refresh rate can be slowed to the point where the operator will perceive flicker.

3-10. OPERATION FOR OPTION 704.

3-11. DESCRIPTION

Model 1345A Option 704 Vector Memory functions as an auxiliary read/write memory (static 4K X 16-bit) for the user processor.

Figure 3-8 shows where the Vectory Memory fits into the 1345A architecture.

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.

The user processor can access any address in the Vector Memory via the Vector Memory address pointer. This allows selected portions of a picture to be changed or sent back to the processor for checking or processing.

The Vector Memory also has a feature whereby the user processor can suppress portions of the picture (such as graticules or labels). Suppressed information is not erased from the Vector Memory. This is done by having the Vector 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.

The TTL digital interface to the Vector Memory is compatible with most microprocessor peripheral interface adaptor chips (like the Motorola 6821). Option 704 Vector Memory interface also meets the Intel MULTIBUS® Interface specifications.

NOTE

The Vector Memory interfaces directly with most 16-bit TTL microprocessors. With demultiplexing, the Vector Memory will also interface with most 8-bit microprocessors.

Vector Memory digital interface consists of:

1. A 16-bit bidirectional Data Bus.
2. A Read signal line $\overline{RD}$ (input).
3. A Write signal line $\overline{WR}$ (input).
4. A Device Select signal line $\overline{DS}$ (input).
5. An Acknowledge signal line $\overline{ACK}$ (output use is optional).
6. An External display Synchronization signal line SYNC (input use is optional).

These signal lines are all explained under Signal Line Definitions. Timing diagrams for user processor interfacing are shown after Signal Line Definitions.

NOTE

When the 1345A is equipped with the Vector Memory, the 2-wire handshake (NRFD & NDAV) is not used. The signal lines used are $\overline{RD}$, $\overline{WR}$, and $\overline{DS}$.

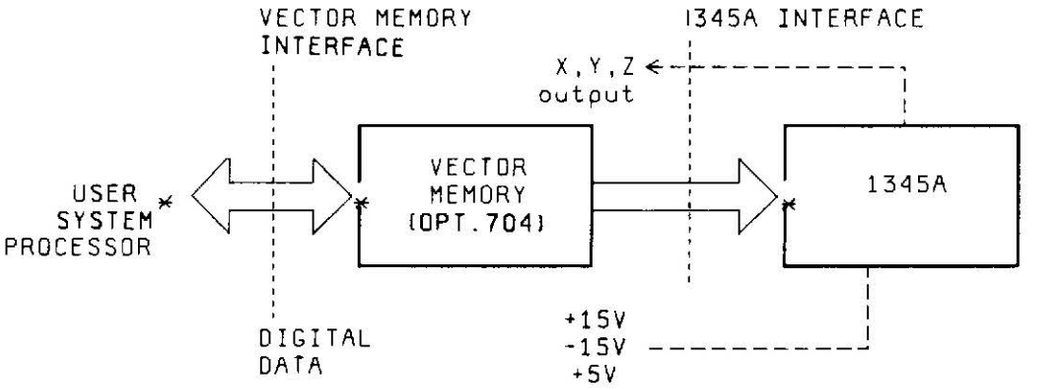
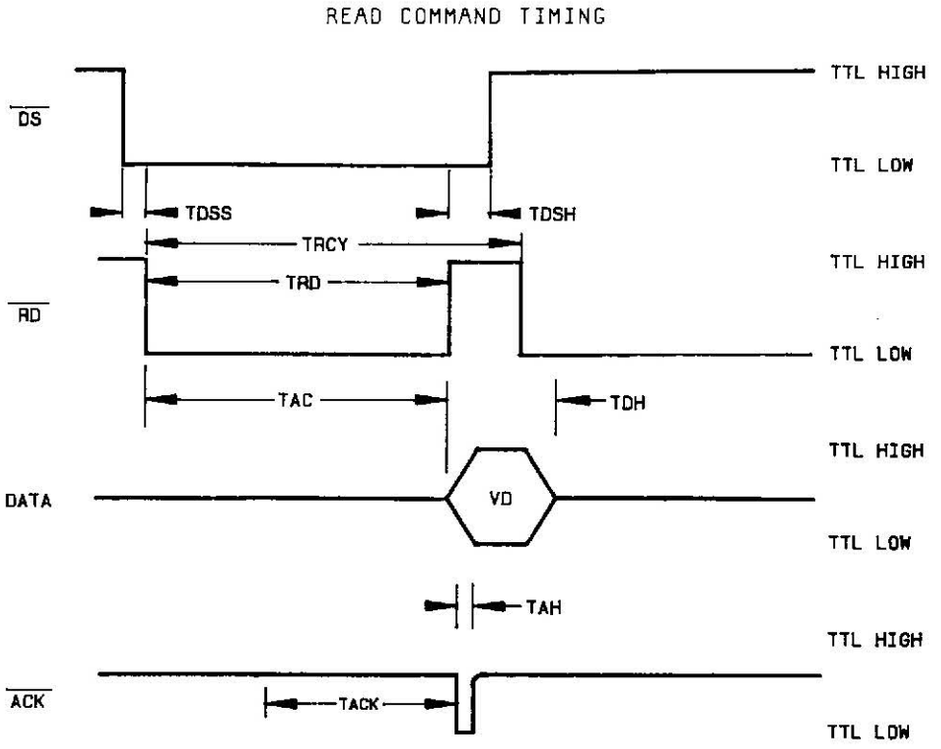


Figure 3-8. Vector Memory Interface (Option 704)

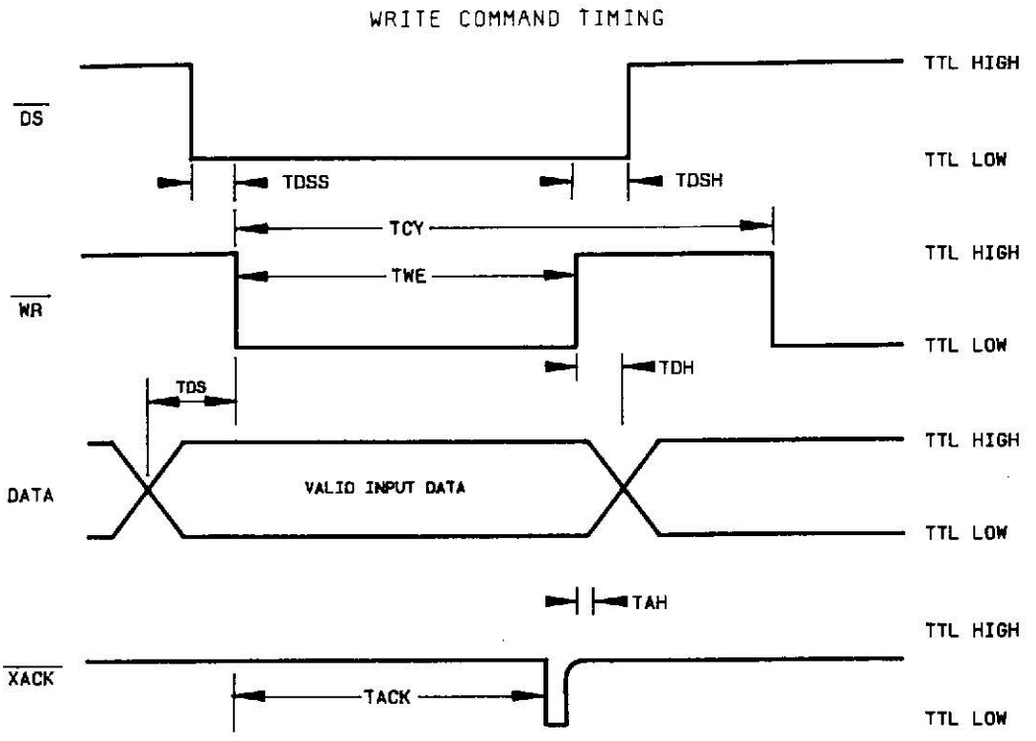
3-12. VECTOR MEMORY READ AND WRITE SIGNAL TIMING SPECIFICATIONS.



Tdss — Device Select Setup Time	0 nsec min	
Tdsh — Device Select Hold Time	0 nsec min	
Trd — Read Pulse Time (ACK not used)	319 nsec min	
(ACK used)	327 nsec min	
Trdp — Read Precharge Time	75 nsec min	
Tac — Read Access Time	319 nsec max	
Tdh — Read Data Hold Time	11 nsec min	
Tah — Acknowledge Hold Time	17 nsec min	
	82 nsec max	
Tack — Acknowledge Delay Time	327 nsec min	
	459 nsec max	

NOTE: Display refreshing is inhibited when $\overline{RD}$ is low.

Figure 3-9. Read Command Timing



Tdss — Device Select Setup Time	0 nsec min
Tdsh — Device Select Hold Time	0 nsec min
Tcy — Write Cycle Time	565 nsec min
Twe — Write Command Active Time ..	360 nsec min
Tds — Data In Setup Time.....	0 nsec max
Tdh — Data In Hold Time	50 nsec min
Tack — acknowledge Delay Time	327 nsec min
	459 nsec max
Tah — Acknowledge Hold Time.....	17 nsec min
	82 nsec max

NOTES:
1. Display refreshing is inhibited when $\overline{WR}$ is low.
2. Input data is clocked into the memory buffer by falling edge of $\overline{WR}$.
3. Data is clocked from the buffer into RAM by the rising edge of $\overline{WR}$. Hold time Tdh is very critical.

Figure 3-11. Synchronous Refresh Example

3-13 PROGRAMMING

With Option 704 installed, all commands from the user processor go to Vector Memory. Figure 3-8 is a block diagram of this configuration. A Vector Memory Command is defined as a Read or Write operation initiated by the user processor.

1. 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 1345A Commands covered earlier in this document under Data Bit Definitions for 1345A 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 DATA BIT DEFINITIONS FOR 1345A COMMANDS.)

When the display is refreshed, this data is sent from the Vector Memory to the 1345A for vector character generation. 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 3-10.

INTERNAL JUMP WORD. When M15 is high and M14 is low, then data bits M11 through M0 designate the address of the next word in Vector Memory that will be sent to the 1345A. This allows the Vector Memory to skip blocks of picture data on each pass through its address range when it is refreshing the display. Certain data in Vector Memory is effectively surpressed until the user processor wants that data to be displayed. Refer to figure 3-13 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.

NOTE

The address specified by an internal jump instruction cannot contain another internal jump instruction (as defined by M15 and M14).

An internal jump does not affect the Vector Memory address pointer.

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 All thru A0 during refresh.

POINTER INSTRUCTION. When bits M15 and M14 are both high, then data bits M11 through M0 designate the address to which the Vector Memory 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 All thru A0.

NOTE

The pointer value is placed in the Vector Memory pointer register, NOT in the Vector Memory.

2. 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 can also be accomplished via a write operation. This allows a selected word to be read from Vector Memory. The Read operation is controlled by the Handshake sequence as presented in figure 3-9.

3. PROGRAMMING SUMMARY.

A programming summary for the 1345A commands and Option 704 instruction is given in table 3-2.

BIT NUMBER M15	M14	M13	1345A COMMAND/OPTION 704 INSTRUCTION
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

Table 3-2, Truth Table for 1345A Commands and Option 704 Instructions.

3-14. REFRESH.

3-15. INTRODUCTION.

Each time that the picture is redrawn by the 1345A, the display is refreshed. This prevents the phosphor light output from expiring.

The Vector Memory sends its data to the 1345A (independent of the user processor) each time that the picture is to be drawn on the display.

The Vector Memory outputs its data to the 1345A either via synchronous or asynchronous operation.

a. Synchronous Refresh Mode.

Synchronous refresh mode is entered when the Vector Memory encounters an Internal Jump to 4095 after it has sent the picture to the 1345A.

In synchronous mode, the Vector Memory waits until a synchronizing (sync) pulse occurs before it will begin its next data output cycle to the 1345A.

The sync pulses can be either internal or external (set by moving a jumper located on the vector memory board).

Internal Sync: an on-board oscillator provides sync pulses at approxomately a 60 Hertz rate.

External Sync: sync pulses (TTL) are supplied from an external source in the user system via the SYNC input signal line.

After the Internal Jump to address 4095 is executed, the Vector Memory waits until the next sync pulse before it will start a new refresh cycle.

b. Asynchronous (free-running) Refresh Mode.

There are two cases where the Vector Memory overrides the sync pulses and refreshes the display asynchronously (in a free-running, continuous manner).

The first case is when the picture cannot be drawn in the time interval between sync pulses. When this occurs, sync pulses are ignored. Refresh rate is controlled by the time required for the Vector Memory to send all its data to the 1345A. Since longer vectors take more time to draw, the 1345A prevents the Vector Memory from sending its next word (to the 1345A) until the current vector is done.

The second case where the sync pulses are ignored occurs when Vector Memory address 4095 is reached during refresh without an internal jump to 4095. It is therefore recommended that the Vector Memory be made to jump to address 4095 at the end of picture data in order to minimize time between refresh cycles.

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.

(1) Synchronous refresh example (Jump to 4095 after picture).

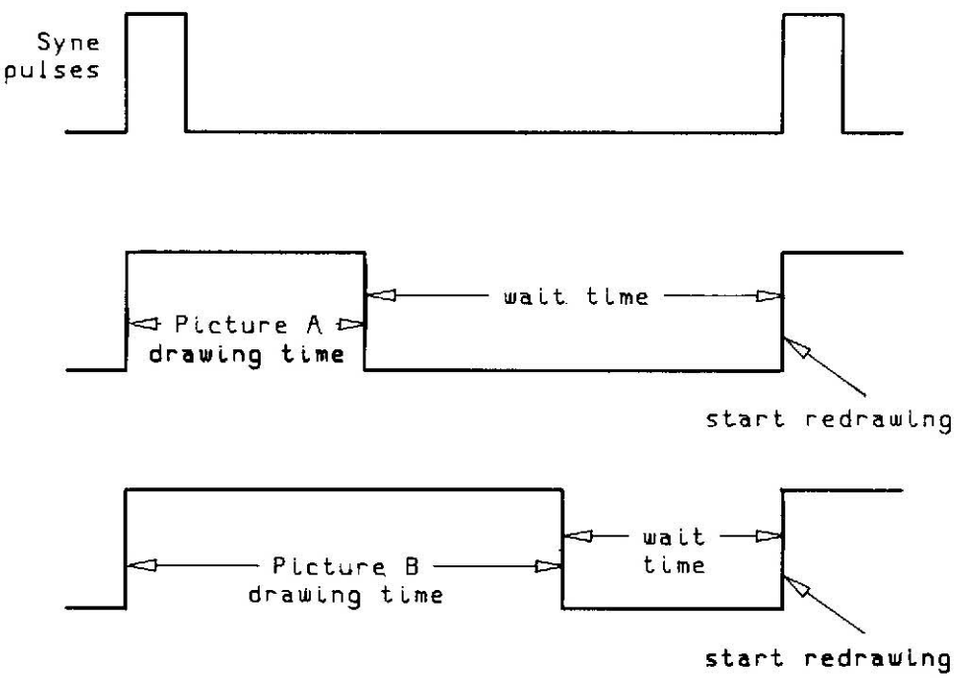


Figure 3-11. Synchronous Refresh Example

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

(2) Asynchronous refresh example.

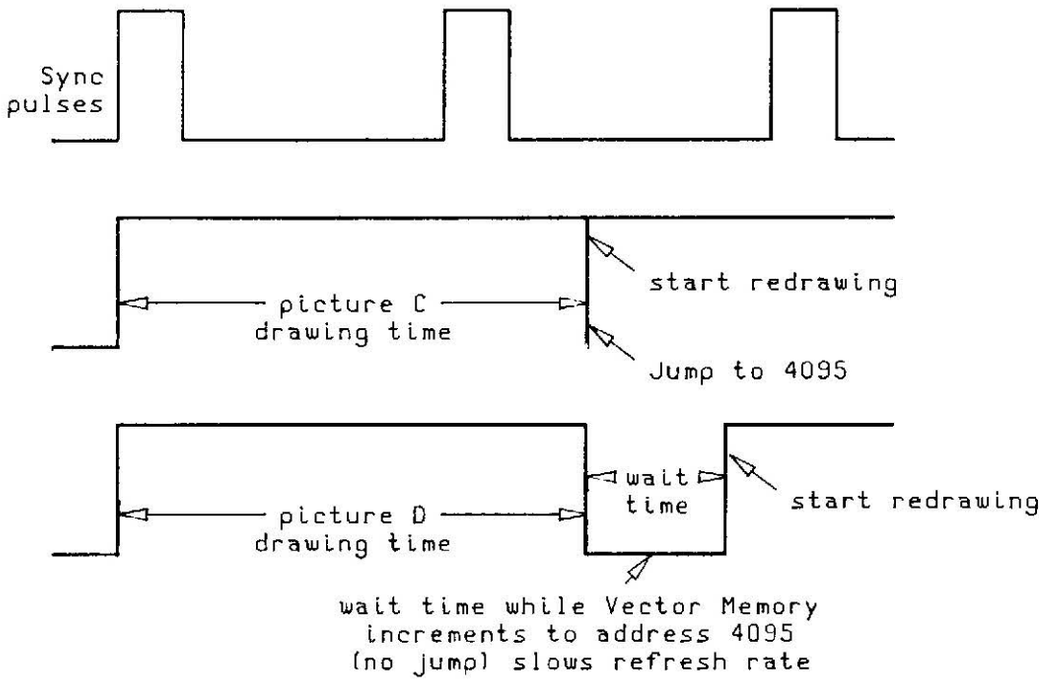


Figure 3-12. Asynchronous Refresh Example

3-16. POTPOURRI.

a. Memory Initialization.

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

Since the only way that the Vector Memory will enter the synchronous refresh mode is when a "jump to 4095" is executed, the user may want to fill the entire Vector Memory with "jump to 095" instructions upon initialization.

NOTE

Other than the case given above, any time that the Vector Memory does a jump to a location containing another jump instruction (illegal), the second jump will not occur. Vector Memory will single step through all the words that would have been bypassed in the second jump.

One 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 4095" 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 1345A, but will draw nothing on screen (effectively a no-op). The drawback to this method is that without a "jump to 4095" the Vector Memory cannot enter the synchronous refresh mode (refresh not optimized).

Also, without a "jump to 4095' each "no-op" will take about one microsecond. Thus 4000 "no-ops" (4000 words in Vector Memory) would waste up to 4 milliseconds of display time, making a dimmer picture.

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 Vector Memory pointer register 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 will not be written into the memory and 011XXXXXX1XXXXXX is illegal.

b. Using the Jump Instruction.

The Internal Jump instruction resides in the Vector Memory. When it is encountered in the course of refreshing the 1345A it is not sent to the 1345A. Instead, it causes the Vector Memory to do an absolute jump to a new location. The Vector Memory then resumes sending data to the 1345A.

This allows the user to store pictures in the Vector Memory but not display them until ready (by jumping past them). See figure 3-13.

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 4095 is the first location sent to the 1345A in each refresh cycle. The Vector Memory then auto-increments to location 0000, 0001, etc.

VECTOR MEMORY

Address	Contents
0000	JUMP TO 1002
0001 to 1000	PICTURE A
1001	JUMP TO 1002
1002 to 2002	PICTURE A
2003	JUMP TO 2062
2004 to 2060	GRATICULE A
2061	JUMP TO 2062
2062 to 2147	GRATICULE B
2148	JUMP TO 4095
2149 to 2255	SET OF LABELS
2256	JUMP TO 4095
2257 to 4094	UNUSED MEMORY
4095	NO-OP (REQUIRED)

Figure 3-13.

SECTION IV

PERFORMANCE CHECKS

4-1. INTRODUCTION.

4-2. The procedures in this section describe an abbreviated test that provides approximately 90% assurance of proper 1345A operation.

4-3. EQUIPMENT REQUIRED.

4-4. Equipment required for the performance tests is listed in Section 1, table 1-5. The performance verification program is internal to the 1345A. This routine is self activating and requires no additional equipment.

4-5. CALIBRATION CYCLE.

4-6. Periodic performance verification is not normally required for this instrument. Performance tests should be performend 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 1345A screen.

EQUIPMENT REQUIRED:

Power Supply
Power Connector (Option 325)

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		Standard	Option 704
+15 VDC	±5%	10 MV	1.05 A	1.05 A
-15 VDC	±5%	10 MV	0.3 A	0.3 A
+ 5 VDC	+5 -0%	50 MV	0.75 A	1.8 A

b. Connect power supply to the 1345A and turn on power. (See figure 4-1 for power connections.)

PERFORMANCE TESTS

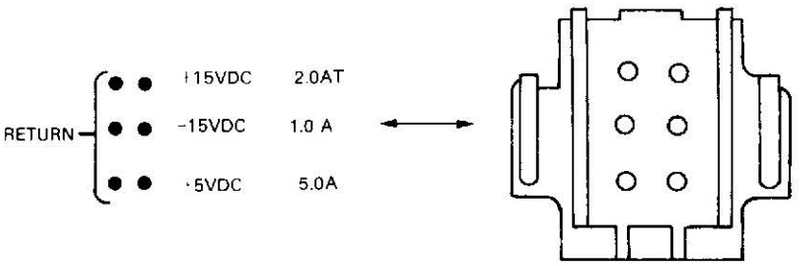


Figure 4-1. Rear Panel Power Connections

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

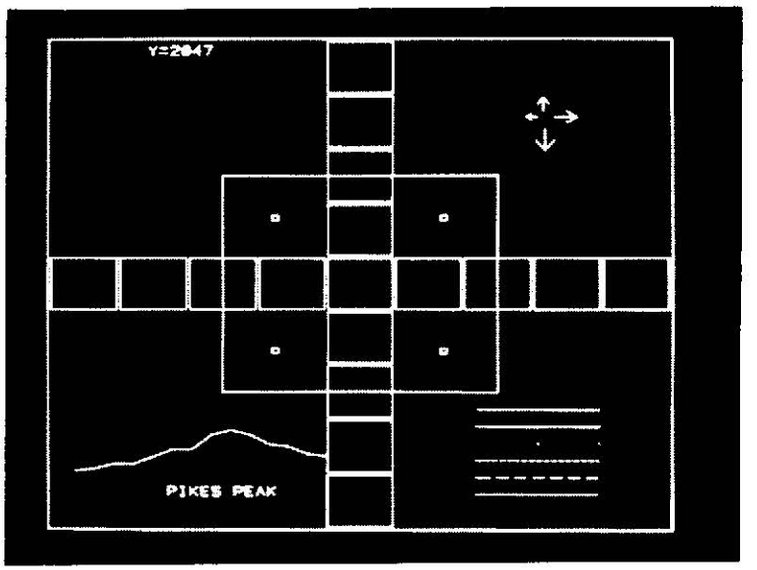


Figure 4-2. Display of Properly Calibrated Pattern

d. If display on screen appears as shown in figure 4-3, refer to Section 5, Adjustments.

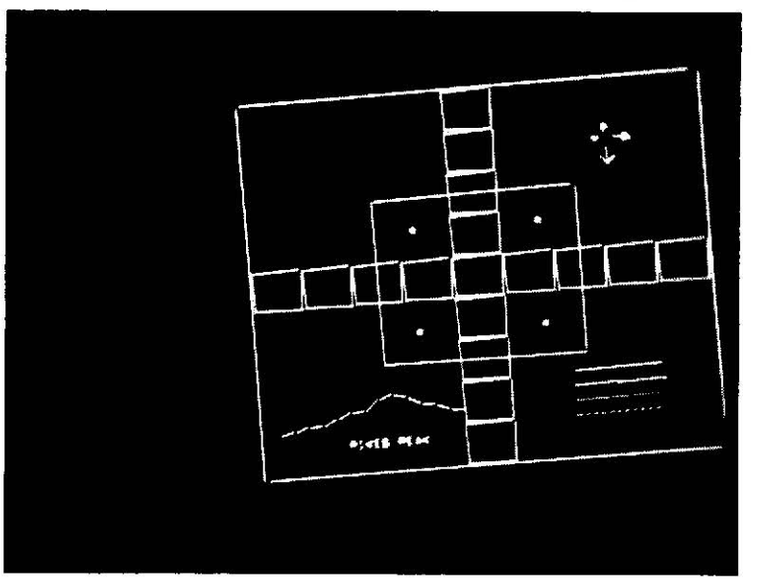


Figure 4-3. Display of an Uncalibrated Verification Pattern

PERFORMANCE TESTS

e. If display on screen appears as shown in figure 4-4, or if no pattern can be obtained, refer to Section 8, Service and Troubleshooting.

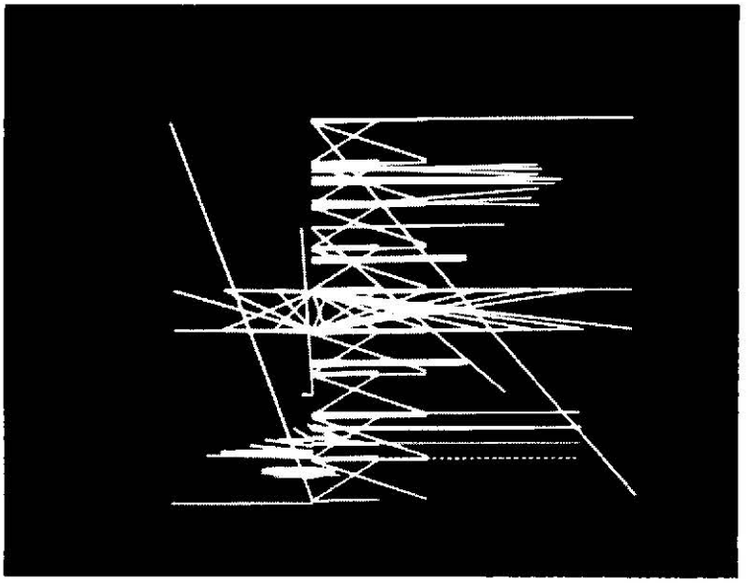


Figure 4-4. 1345A Not Operating Properly

f. If Option 704 is installed, the performance test will verify correct operation automatically. If the memory circuit is defective the display shown in figure 4-5 will appear.

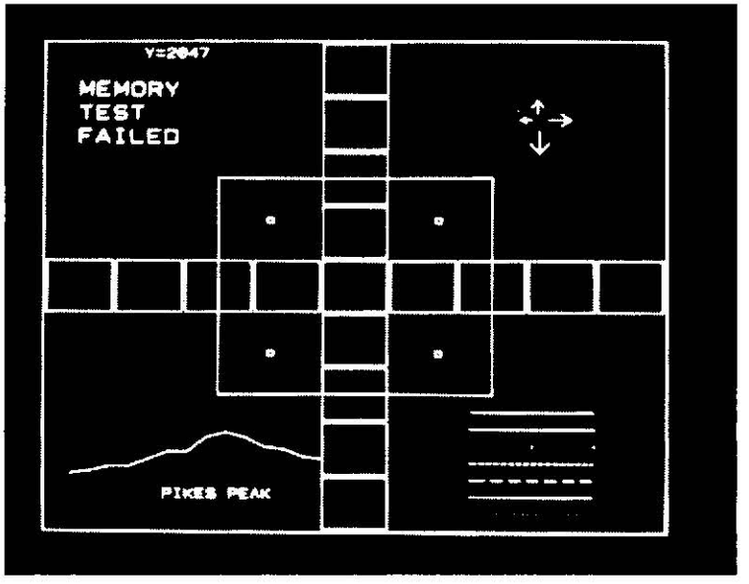


Figure 4-5. Memory Test Fail

g. If Memory Test fails, refer to Section 8, Service and Troubleshooting.

SECTION V

ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section describes adjustments and checks required to return the 1345A 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 intrument 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 1-5. 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 preceding or following adjustments.

5-9. For best results, allow the intrument to warm up for 15 minutes before making adjustments. Adjustment locations for the +105 V supply and high voltage supply are shown in figure 5-2 and 5-3. Adjustment locations for pattern, stroke generator, stroke intensity and focus adjustments are shown in figures 5-5, 5-8, and 5-11.

5-10. ADJUSTMENT PROCEDURES.

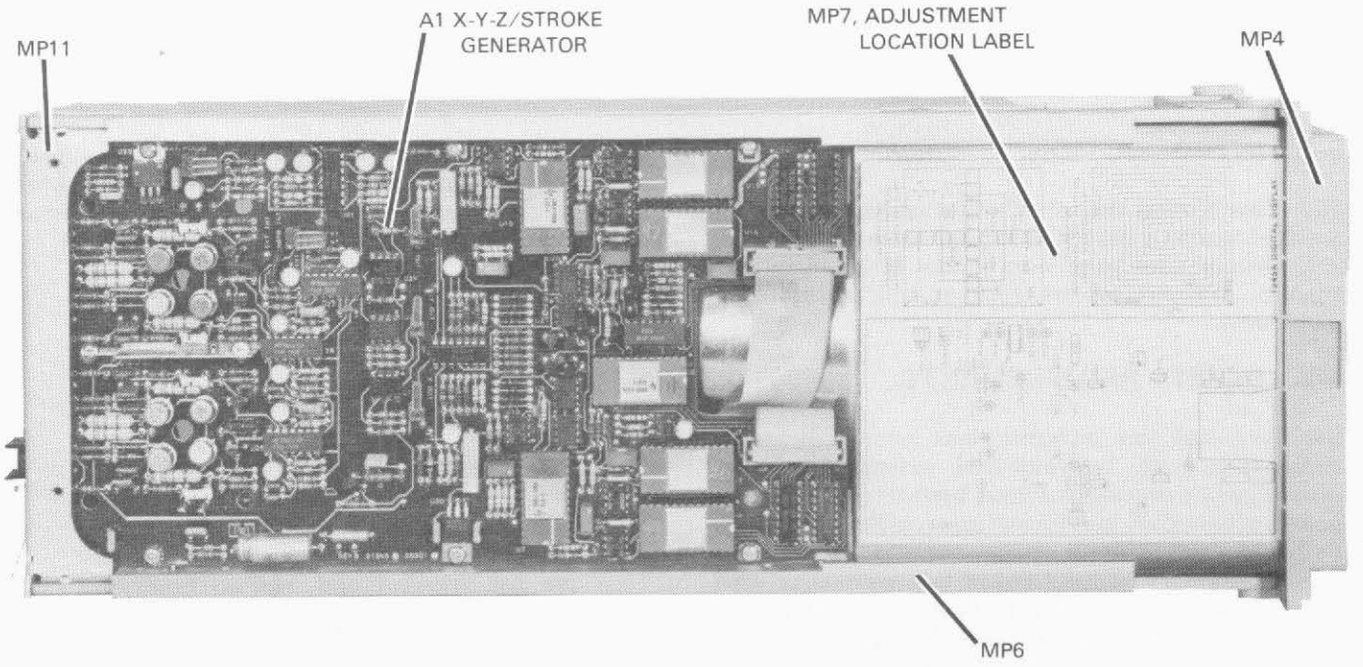
WARNING

ELECTRICAL SHOCK HAZARD

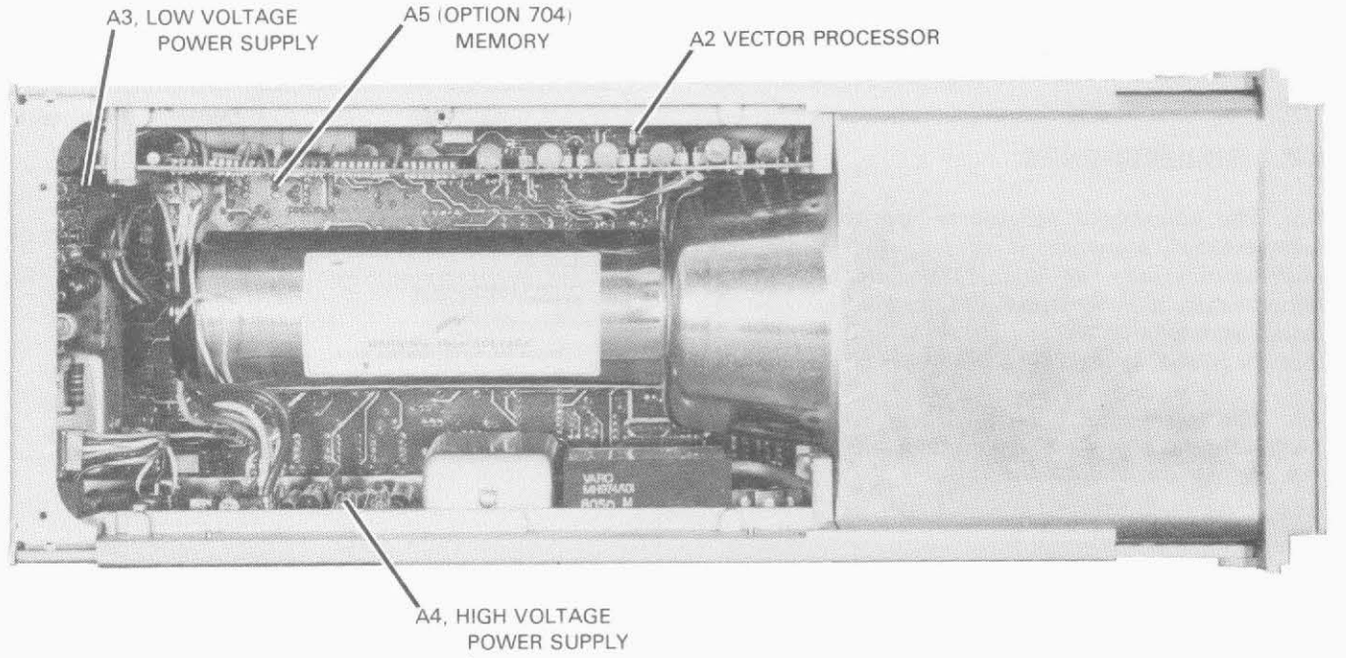
This instrument is designed and manufactured for OEM systems. Protective covers are not provided and internal hazardous voltages are exposed when power is applied. Voltages up to 2.4 kV are present around the CRT and HVPS areas and are capable of causing serious injury or death. Component replacement, 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	5-11
High Voltage Power Supply	2	5-12
Pattern	3	5-13
Stroke Generator	4	5-14
Stroke Intensity	5	5-14
Focus and Resolution	6	5-16
Writing Rate	7	5-17
Astigmatism and Pattern	8	5-18
Auxiliary X-Y-Z Output	9	5-19



1345A TOP VIEW



1345A BOTTOM VIEW

Figure 5-1. 1345A Assembly Location Identification

ADJUSTMENTS

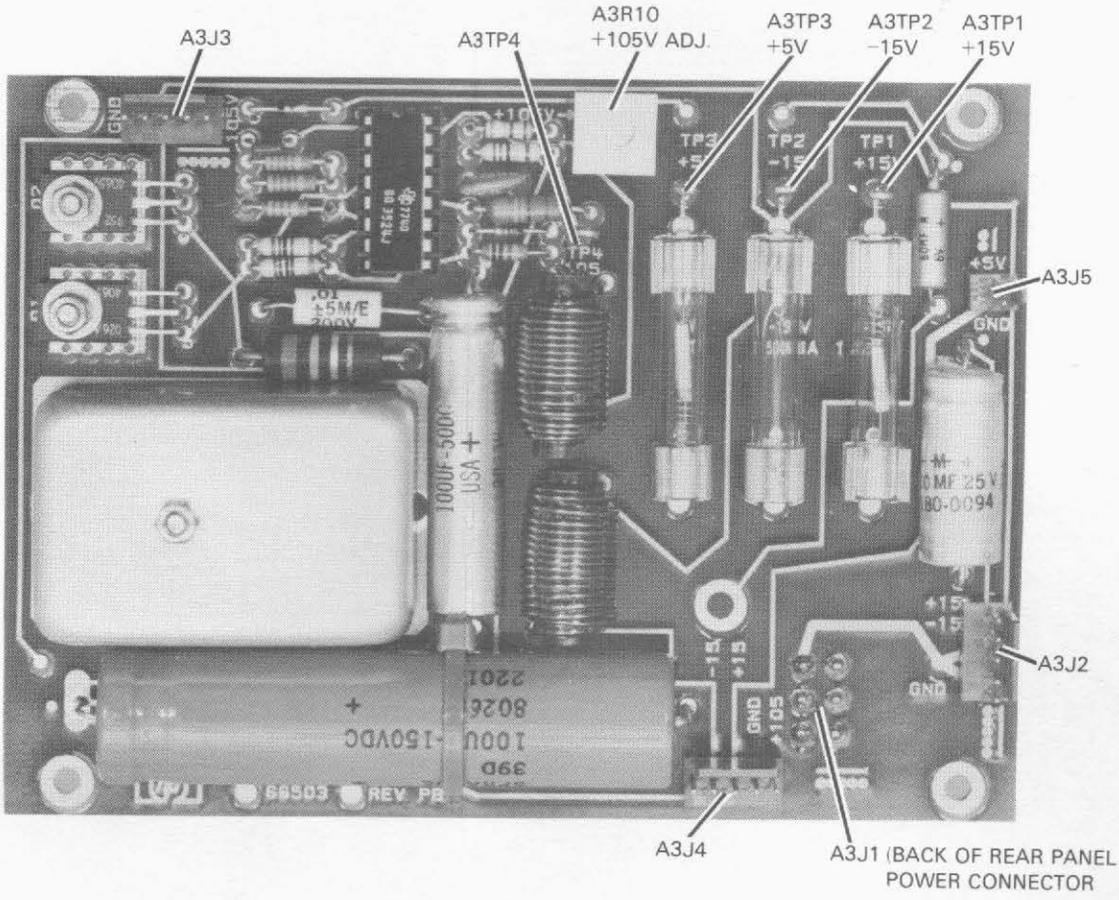


Figure 5-2. Low Voltage Power Supply Adjustment Locations

Table 5-1. +105 V Adjustment

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A3R10	+105 V ADJUST	5-11, c	4	Adjust for +105 V ± 250 mV

ADJUSTMENTS

5-11. LOW VOLTAGE POWER SUPPLY ADJUSTMENTS.

REFERENCE:
Service Sheet 4

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

EQUIPMENT:
Digital Voltmeter
Power Supply
Power Connector (Option 325)

PROCEDURE:
a. If connected, disconnect power plugs to the Stroke Generator Board (A1J8), Vector Processor Board (A1J5), and High Voltage Power Supply Board (A4J1) (see figure 5-2).

b. Apply power to the rear panel power connector and check input power supplies as indicated below:

Monitor	Supply	Test Limits
A4TP1	+15 V	± 750 mV
A4TP2	+ 5 V	± 250 mV
A4TP3	+15 V	± 750 mV

c. Monitor A3TP4 and adjust the +105 V (A3R10) Power Supply for 105 V ± 250 mV. Turn off power supply and reconnect power cable to the Stroke Generator Board (A4J8).

d. Turn on power and monitor internally regulated power supplies as indicated below.

Monitor	Supply	Test Limits
A1TP2	+ 15 V	±750 mV
A1TP3	+ 10 V	±500 mV
A1TP6	+ 7 V	±350 mV
A1TP4	-3.1 V	±150 mV
A1TP5	- 8 V	±400 mV
A1TP1	- 15 V	±750 mV

e. Turn off power supply and reconnect power cable to Vector Processor Board (A2J5). Turn on power and monitor internally regulated power supplies as indicated below:

Monitor	Supply	Test Limits
A2U15 PIN 34	+7 V	±350 mV
A2U19 PIN 16	+5 V	±250 mV
A2U15 PIN 14	+5 V	±250 mV
A2U15 PIN 21	-2 V	±100 mV

ADJUSTMENTS

12. HIGH VOLTAGE POWER SUPPLY ADJUSTMENT.

EFERENCE:
Service Sheet 5.

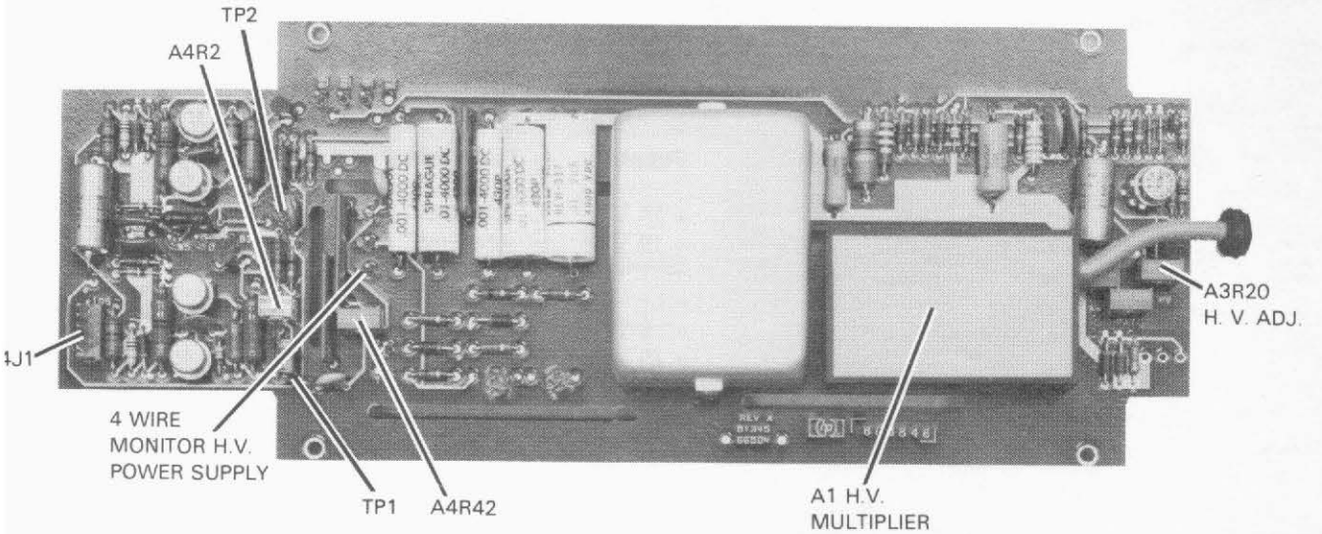
ESCRIPTION:
This procedure describes the Cathode Voltage adjustment. The Cathode Voltage is set to –2450 V, ± 100 V.

QUIPMENT REQUIRED:
Digital Voltmeter
1000:1 Divider Probe
Power Supply
Power Connector (Option 325)

ROCEDURE:
a. Adjust Intensity Cut Off Level (A1R131) and Intensity control (A1R129) to the CCW stop.

b. Connect power cable to High Voltage Power Supply Board (A4J1) and turn on power.

c. Monitor the cathode voltage (yellow wire on A4) using the 1000:1 divider probe and adjust High Voltage Adjust (A4R20) for –2350 V, ±100 V.



NOTE: THE HIGH VOLTAGE POWER SUPPLY CAN BE MONITORED ON THE CIRCUIT SIDE OF THE BOARD. PROBE AT THE TRACE MARKED –2450V.

Figure 5-3. High Voltage Power Supply Adjustment Locations

Table 5-2. High Voltage Adjust

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A4R20	HIGH VOLTAGE ADJUST	5-12, c	5	Adjust for –2350 V ± 100 V

ADJUSTMENTS

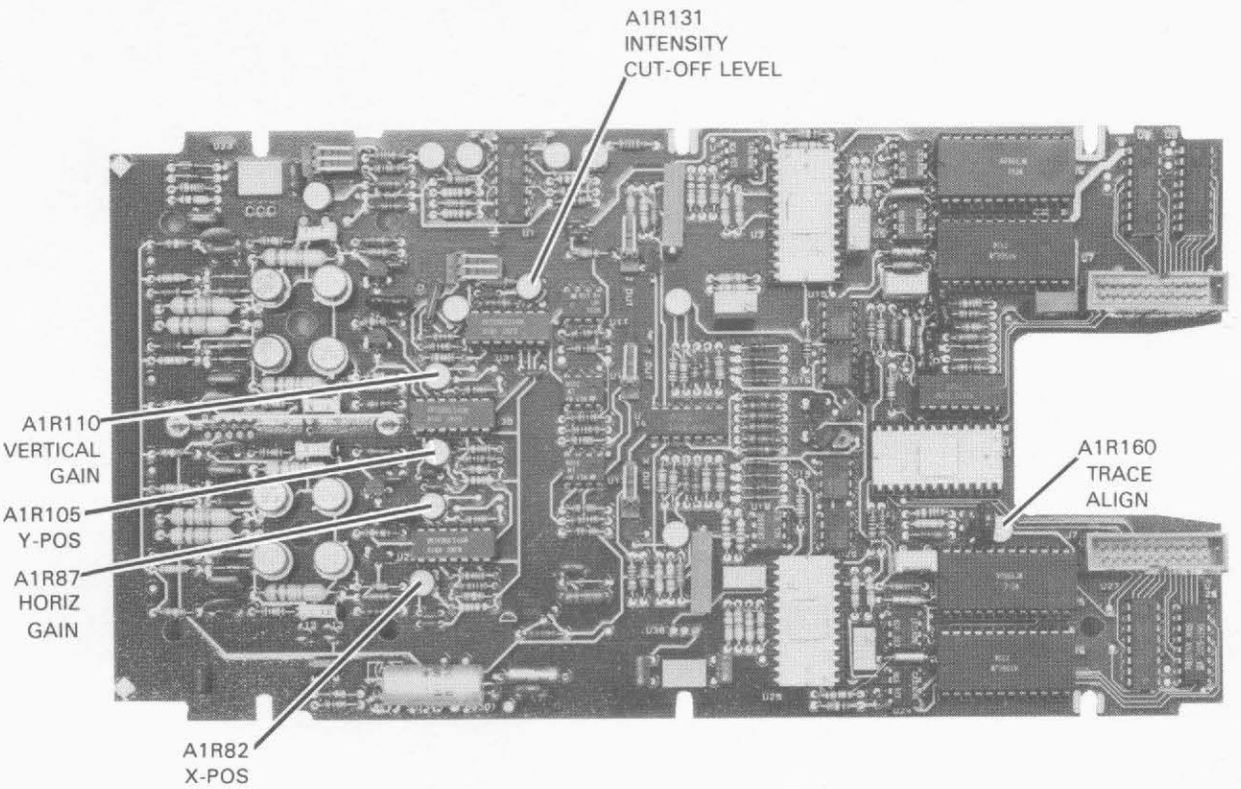


Figure 5-5. Primary Test Pattern Adjustment Locations

Table 5-3. Pattern Adjustment

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R131	INTENSITY CUT-OFF LEVEL	5-13, a	3C	Adjust for minimum intensity of bright dots in pattern
A1R110	VERTICAL GAIN	5-13, b	3C	Adjust for 8.5 cm high pattern
A1R87	HORIZONTAL GAIN	5-13, b	3C	Adjust for 11.2 cm wide pattern
A1R160	TRACE ALIGN	5-13, c	5	Adjust for a horizontally aligned Pattern
A1R82	HORIZONTAL POSITION	5-13, b	3C	As required
A1R105	VERTICAL POSITION	5-13, b	3C	As required

5-13. PATTERN ADJUSTMENT.

REFERENCE:
Service sheet 3C.

DESCRIPTION:
This procedure describes the adjustments necessary to obtain the internal pattern on screen.

EQUIPMENT REQUIRED:
Power Supply
Power Connector (Option 325)

PROCEDURE:

a. Apply power to the rear panel power connector and adjust Intensity Cut-off Level (A1R131) and Intensity Control (A1R129) until bright dots in the pattern are just extinguished.

b. Adjust Vertical Gain (A1R110) and Horizontal Gain (A1R87) for an 8.5 cm by 11.2 cm size pattern. It may be necessary to adjust Horizontal Position (A1R82) and Vertical Position (A1R105) for proper positioning.

c. Adjust Trace Align (A1R160) to align trace hotizontally. Check for a pattern on screen as shown in figure 5-4.

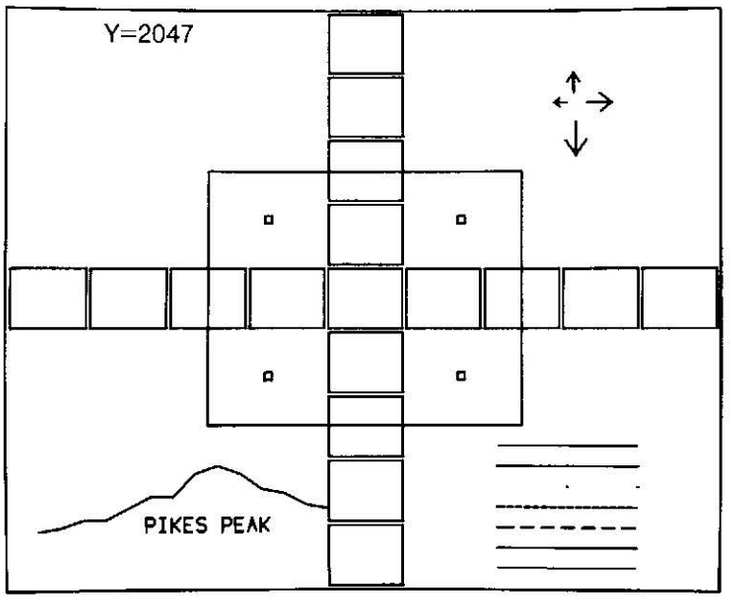


Figure 5-4. Primary Test Pattern Adjustment

ADJUSTMENTS

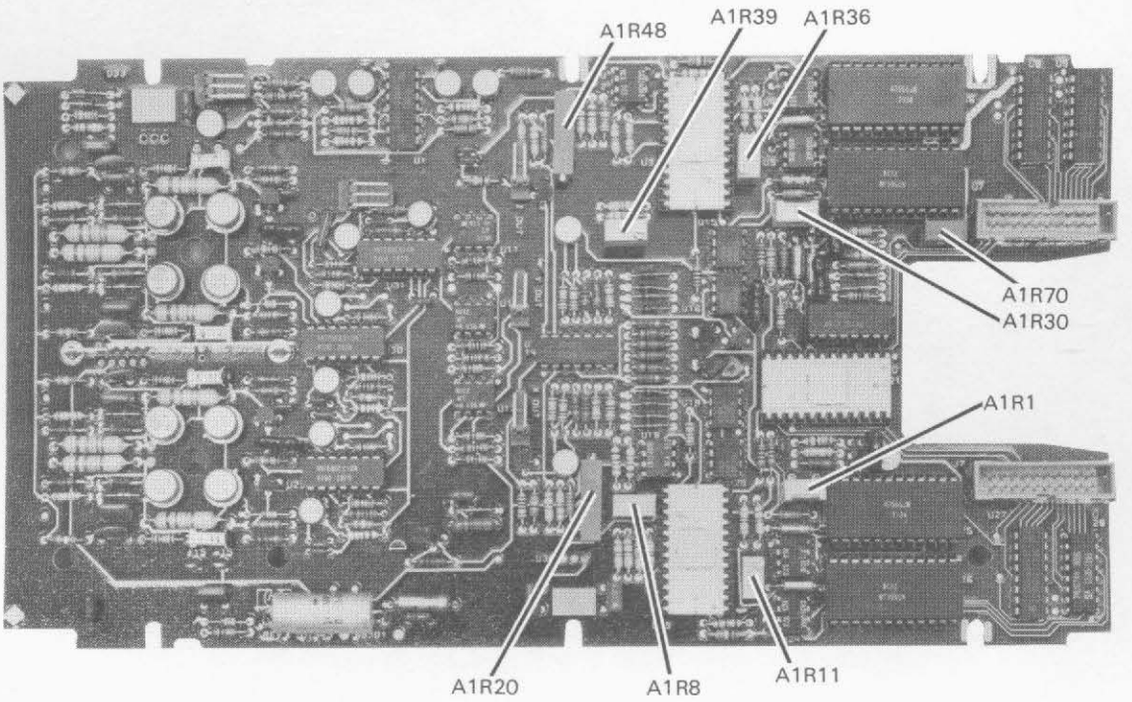


Figure 5-8. Stroke Generator and Stroke Length Adjustment Locations

Table 5-4. Stroke Generator Adjustment

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R70	WRITING SPEED	5-14, b	3B	Adjust for seven segment line (figure 5-6)
A1R36	Y-STROKE OFFSET	5-14, c	3A	Parallel lines of bottom boxes in the test pattern (figure 5-6)
A1R30	Y-DAC GAIN	5-14, d	3A	Parallel line of top boxes in the test pattern (figure 5-6)
A1R8	X-STROKE OFFSET	5-14, e	3A	Parallel lines of left boxes in the test pattern (figure 5-6)
A1R1	X-DAC GAIN	5-14, f	3A	Parallel lines of right boxes in the test pattern (figure 5-6)
A1R39	Y-RAMP OFFSET	5-14, h	3A	Left vertical line starts at bottom horizontal line in the test pattern (figure 5-7)
A1R48	Y-STROKE LENGTH	5-14, i	3A	Left vertical Line Length ends at top horizontal line in the test pattern (figure 5-7)
A1R11	X-RAMP OFFSET	5-14, j	3A	Top horizontal line starts at left vertical line in the test pattern (figure 5-7)
A1R20	X-STROKE LENGTH	5-14, k	3A	Top horizontal line ends at right vertical line in the test pattern (figure 5-7)

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

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

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

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

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

NOTE

The following procedures are referenced to figure 5-7. Perform the following adjustment steps in the sequence outlined below.

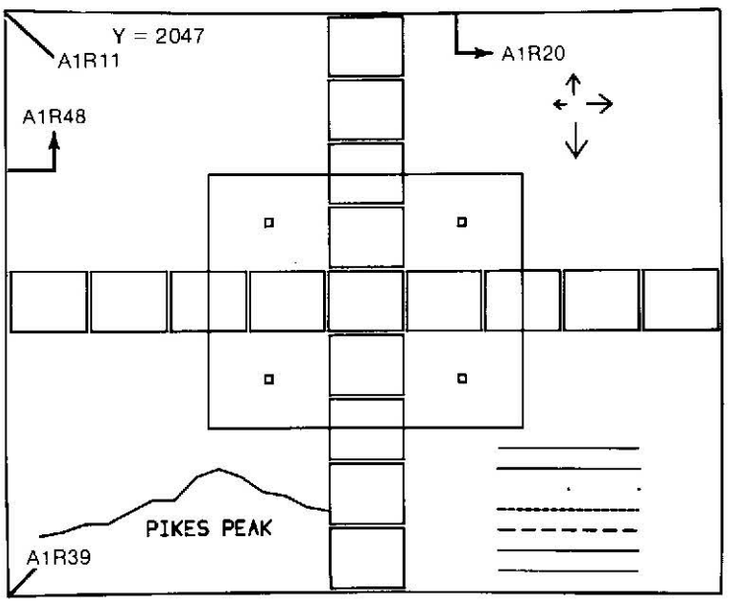


Figure 5-7. Test Pattern for Stroke Length Adjustment

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

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

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

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

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

5-14. STROKE GENERATOR ADJUSTMENTS.

REFERENCE:
Service Sheets 3A, 3B.

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

EQUIPMENT REQUIRED:
Power Supply
Power Connector (Option 325)

PROCEDURE:

NOTE

The following procedures are referenced to figure 5-6. Perform the following adjustment steps in the same sequence as outlined below:

a. Display the primary test pattern as shown in figure 5-6.

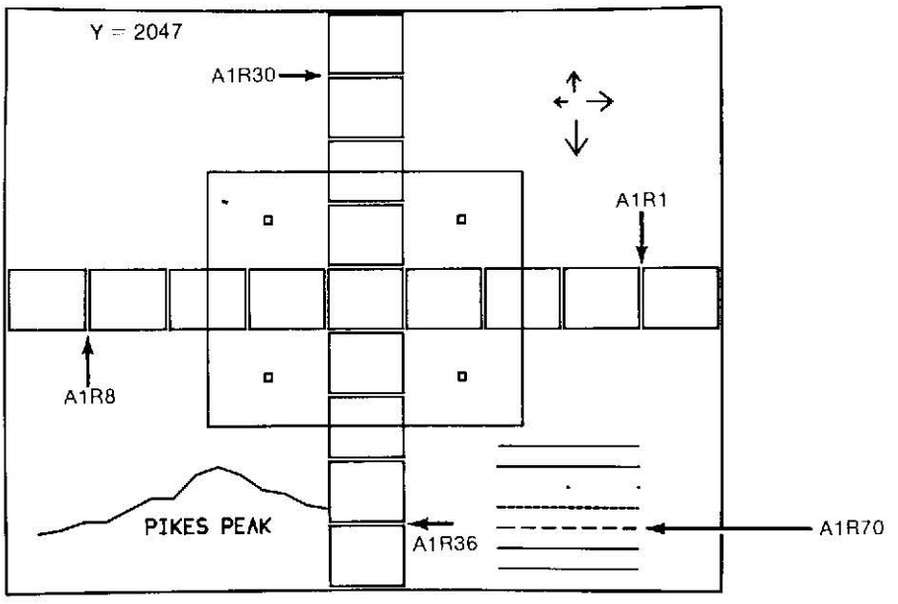


Figure 5-6. Stroke Generator Adjustment

b. Adjust A1R70 for the seven line segments. This step is a coarse adjustment for writing speed.

c. A

d. A

e. A

f. A

g. A

h. A pattern

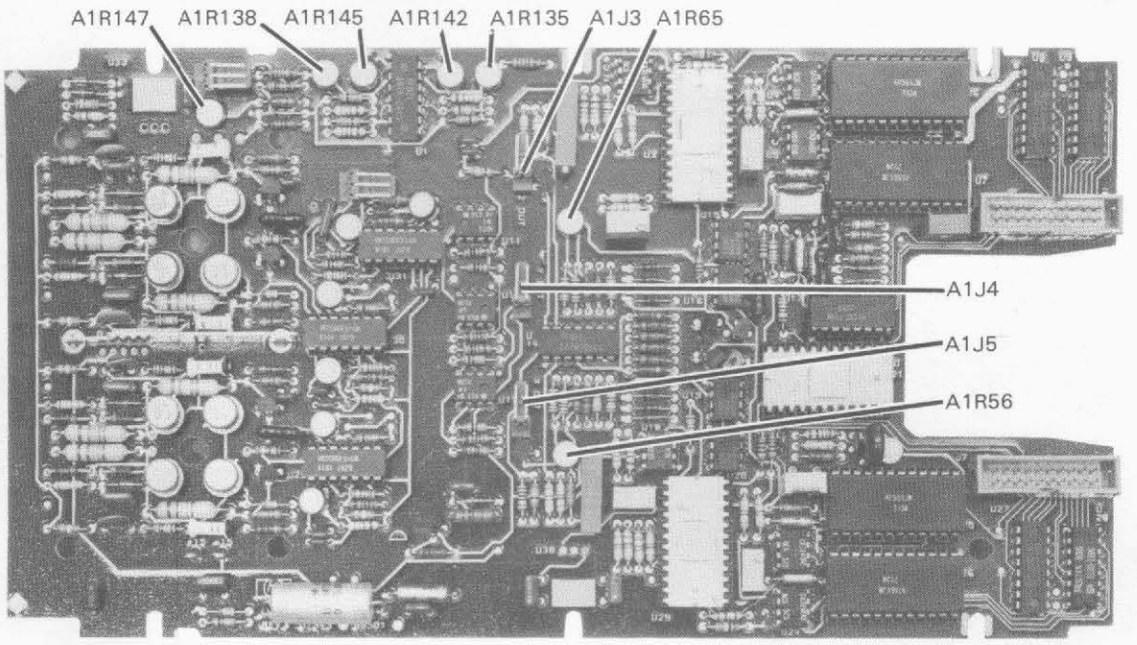
i. A

j. A

k. A

l. T

ADJUSTMENTS



NOTE: A4R2 AND A4R42 ARE LOCATED ON FIGURE 5-3.

Figure 5-11. Stroke Intensity and Focus Adjustment Locations

Table 5-6. Z-Axis Drive and Focus Adjustments

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R131	INTENSITY CUT-OFF LEVEL	5-16, e	3C	Adjust so that all dots in pattern are extinguished.
A1R129	INTENSITY CONTROL	5-16, f	3C	Adjust for a +40 V p-p waveform.
A1R138	Y-FOCUS OFFSET	5-16, d	3C	Monitor at A1TP9, adjust for a DC level as in step c (approx +7 V)
A1R135	X-FOCUS OFFSET	5-16, e	3C	Monitor at A1TP11, adjust for a DC level as in step c (approx. +7 V)
A1R147	FOCUS FINE ADJUST	5-16, f	3C	Monitor at A4TP1, adjust for base line level of +50 V
A4R42	FOCUS	5-16, g	5	Adjust for optimum focused test pattern.
A4R2	FOCUS GAIN	5-16, h	5	Adjust so that pattern stays focused over intensity range (A1R129)
A1R142	X-FOCUS GAIN	5-16, j	3C	Optimum focus of right and left edges of the secondary test pattern (figure 5-10)
A1R145	Y-FOCUS GAIN	5-16, k	3C	Optimum focus of top and bottom of the secondary test pattern (figure 5-10)

g. Turn Intensity Control, A1R129, over its range of adjustment. The display should stay focused. If not, adjust cus Gain A4R2 until pattern stays focused over the entire intensity range.

i. Adjust X-Gain, A1R142, for best focus at left and right edges of the pattern.

. Adjust Y-Gain, A1R145, for best focus at top and bottom edges of the pattern. Steps h and i are interactive, erefore repeat those steps until optimum focus of all edges of the pattern is achieved.

. Compare the pattern on screen with that shown in figure 5-10.

Checking CRT Resolution

a. Ensure that all the Z-Axis Drive and Focus adjustments have been performed.

). A 1345A passes the Resolution Test if all of the individual lines in all 13 boxes of the pattern can be resolved. If e Resolution Test fails, repeat the Z-Axis Drive Adjustment and the Focus Adjustment Procedures. If the Resolution st fails again, contact the Colorado Springs Division or your nearest Sales and Service Office for additional sistance.

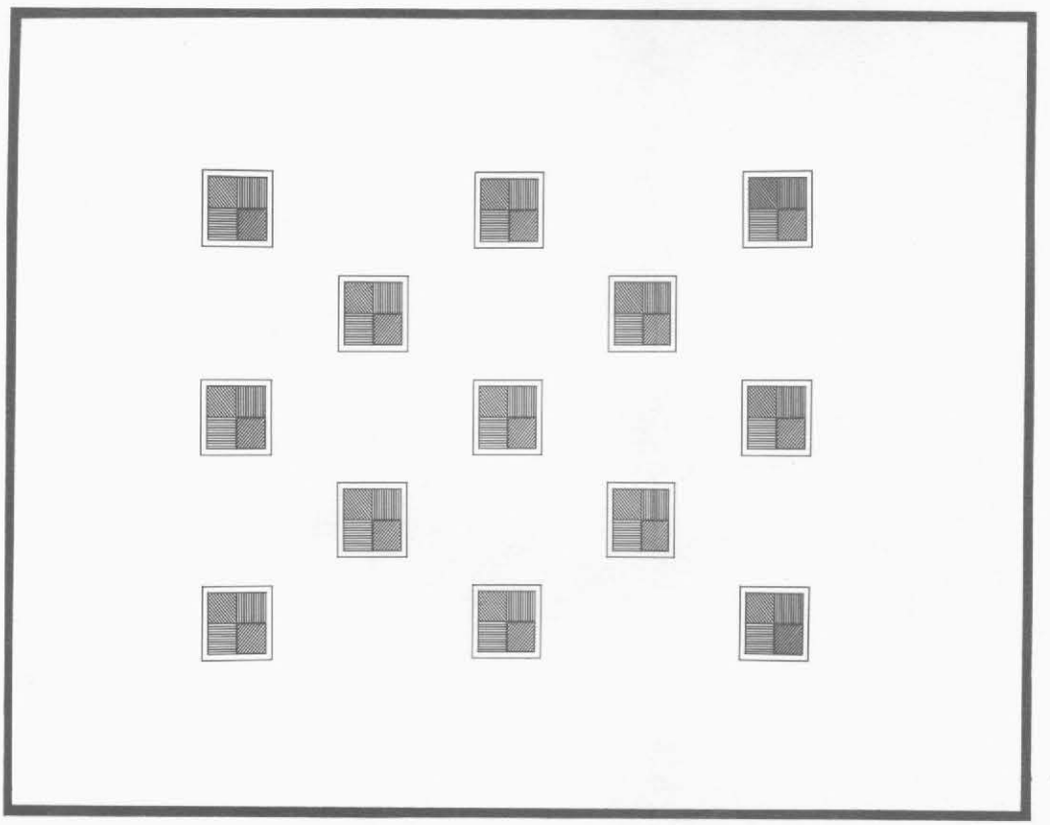


Figure 5-10. Test Pattern for Focus Adjustment

5-16. FOCUS ADJUSTMENT AND RESOLUTION CHECK

REFERENCE:
Service Sheets 3C, 5.

DESCRIPTION:
These procedures provide the necessary adjustments for optimum focus of the display. To obtain an accurate resolution check, follow the steps in the same sequence as described below. The Focus Adjustment and Resolution Check consists of three parts:

1. Adjusting the Z-Axis Drive to +40 V.
2. Adjusting Focus using the Secondary Test Pattern.
3. Determining Resolution using the Secondary Test Pattern.

EQUIPMENT REQUIRED:
Power Supply
Power Connector (Option 325)
Oscilloscope
10:1 Divider Probe

PROCEDURE:
1. Adjusting Z-Axis Drive to +40 V.

a. Disconnect I/O Port and apply power to the 1345A. The Primary Test Pattern should be displayed.

b. Monitor Test Point A4TP2 with an oscilloscope.

c. Set oscilloscope sweep speed to 2 milliseconds/div and vertical attenuator to 1 V/div. Use a 10:1 divider probe to obtain a 10 V/div deflection factor.

d. Turn Intensity Control (A1R129) fully counterclockwise.

e. Adjust Intensity Cut-Off Level (A1R131) so that all dots in the pattern are just extinguished. Shade the CRT face to make sure that dots are not visible.

f. Disregarding overshoot, adjust Intensity Control (A1R129) for a +40 V p-p waveform. If +40 V cannot be obtained, set Intensity Control fully clockwise.

2. Focus Adjustment Procedure.

a. Short A2TP1 to Ground to display the Secondary Test Pattern.

b. Monitor Test Point A1TP10 with an oscilloscope and note the DC voltage (should be approximately 7.0 V). In making this measurement, DC couple the oscilloscope's vertical attenuator.

c. Monitor Test Point A1TP9 and adjust Y-Offset, A1R138, so that the baseline of the monitored signal is at the same DC level as noted in step b.

d. Connect oscilloscope to Test Point A1TP11 and adjust X-Offset A1R135, until the baseline of the monitored signal is at the same DC level as in step b.

e. Using a 10:1 divider probe to obtain a 10 V/div deflection factor, set oscilloscope attenuator to 1 V/div, dc coupled and sweep speed to 5 milliseconds/div. Monitor Test Point A4TP1 and adjust Fine Focus, A1R147, so that the baseline of displayed signal is at +50 V.

f. Adjust Focus, A4R42, for optimum focus of displayed pattern.

ADJUSTMENTS

5-15. 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
Power Connector (Option 325)

PROCEDURE:
a. Turn on power and obtain primary test pattern on screen.

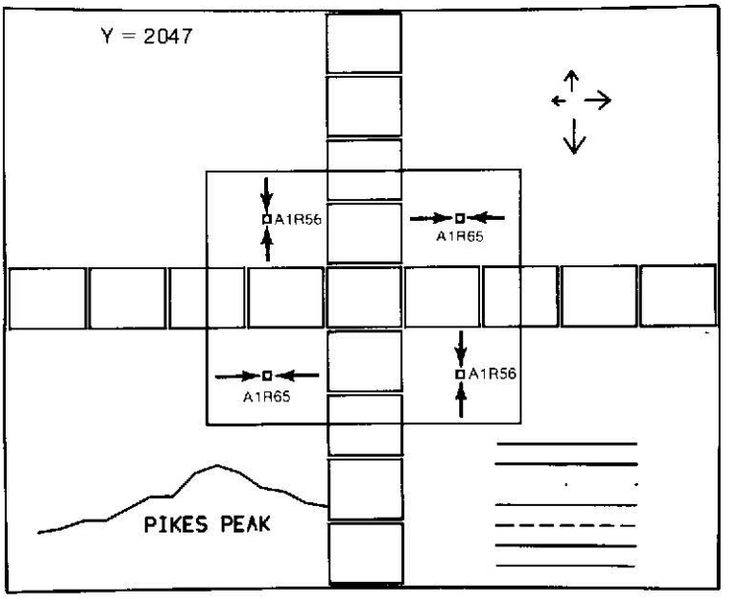


Figure 5-9. Stroke Intensity Adjustment

b. Adjust A1R56 so that the horizontal lines of the four small boxes in the test pattern are of equal intensity (see figure 5-9).

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

Table 5-5. Stroke Intensity Adjustments

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R56	X-CURRENT OFFSET	5-15, b	3B	Equal intensity of horizontal lines of four small boxes in the test pattern (figure 5-4)
A1R65	Y-CURRENT OFFSET	5-15, c	3B	Equal intensity of vertical lines of four small boxes in the test pattern (figure 5-4)

5-17. WRITING RATE ADJUSTMENT.

REFERENCE:
Service Sheet 3B.

DESCRIPTION:
This procedure describes the adjustments for writing speed.

EQUIPMENT REQUIRED:
Power Supply
Power Connector (Option 325)
Oscilloscope
10:1 Divider Probes

PROCEDURE:
a. Short A2TP1 to Ground and turn on power to obtain the secondary test pattern on screen.

b. Monitor A1TP12 with the oscilloscope and adjust A1R70 so that the length of the second positive pulse in the frame is 90 μs ($\pm$2 μs) long.

c. Verify that the first pulse in the frame is approximately 117 μs long.

Table 5-6. Writing Rate Adjustment

Reference Designator	Adjustment Name	Adjustment Paragraph	Service Sheet	Description
A1R70	WRITING SPEED	5-17, b	3B	Monitor at A1TP12, adjust for 90 μs length of second positive pulse in the frame.

5-18. ASTIGMATISM AND PATTERN ADJUSTMENT.

REFERENCE:
Service Sheet 4.

DESCRIPTION:
These adjustment procedures are the "fine touch" adjustment for Astigmatism and Pattern.

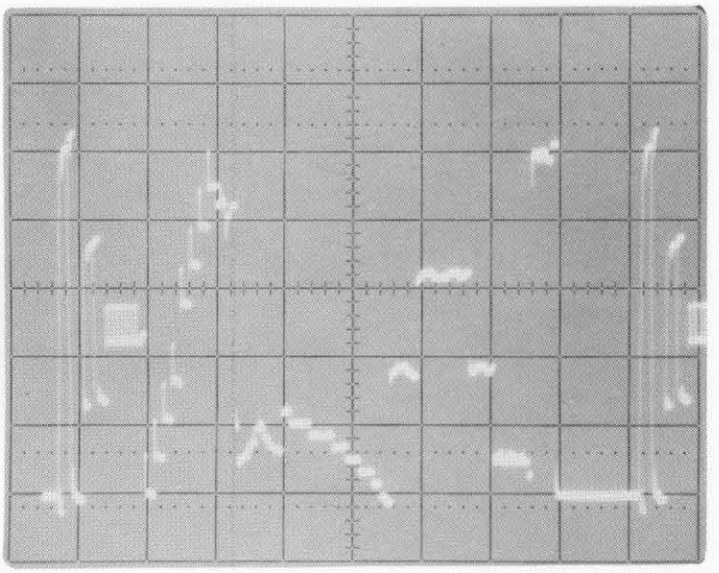
EQUIPMENT REQUIRED:
Power Supply
Power Connector (Option 325)

PROCEDURE:
a. Turn on power and display the primary test pattern.

b. Adjust A4R40 for optimum pattern on the outer box of the primary test pattern.

c. Adjust A4R39 so that the astigmatism at the corners of the inner box of the test pattern optimally adjusted.

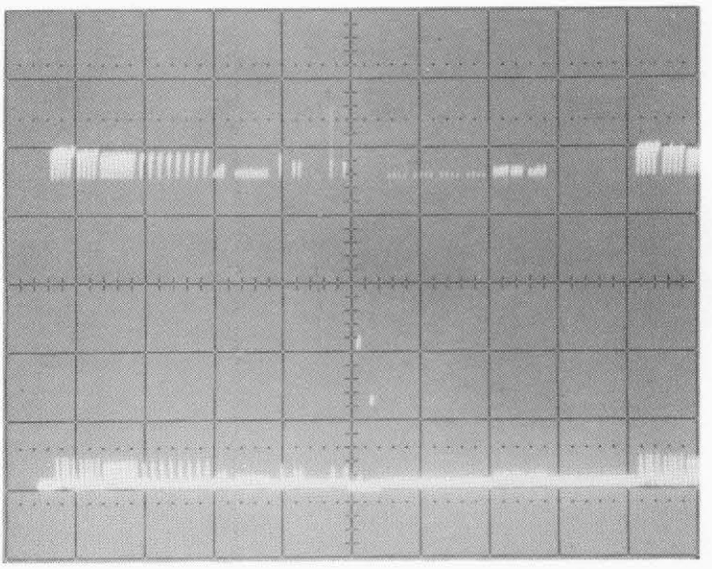
c. Monitor A1J4 Pin 2 and check oscilloscope for a display as shown in figure 5-13.



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

Figure 5-13. Y-Amplifier Auxiliary Output

d. Monitor A1J3 Pin 2 and check for a display on the oscilloscope as shown in figure 5-14.



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

Figure 5-14. 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. Comlete 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 separtely 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 wae 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

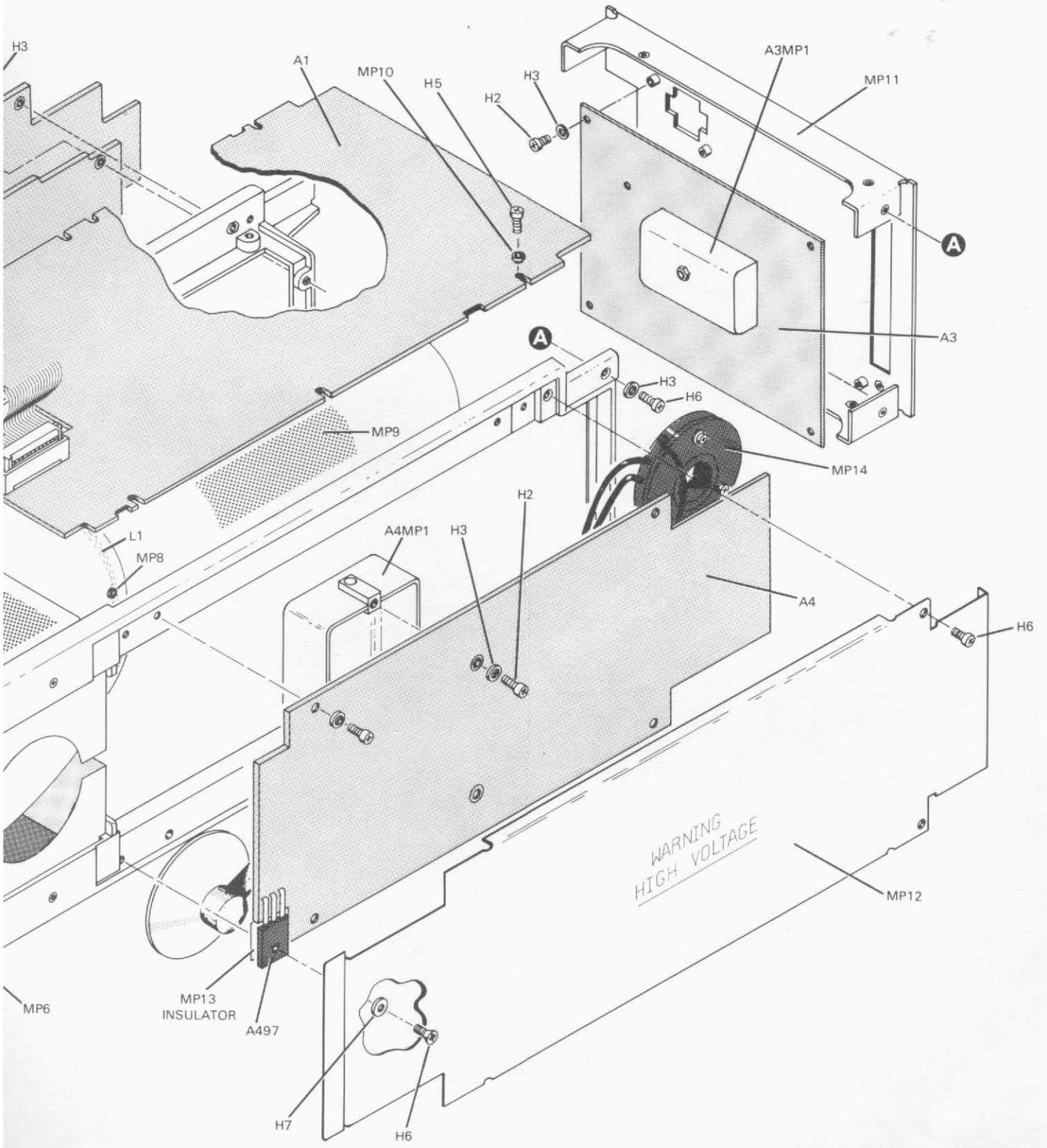


Figure 6-1.
Chassis Parts and Board Assembly Identification

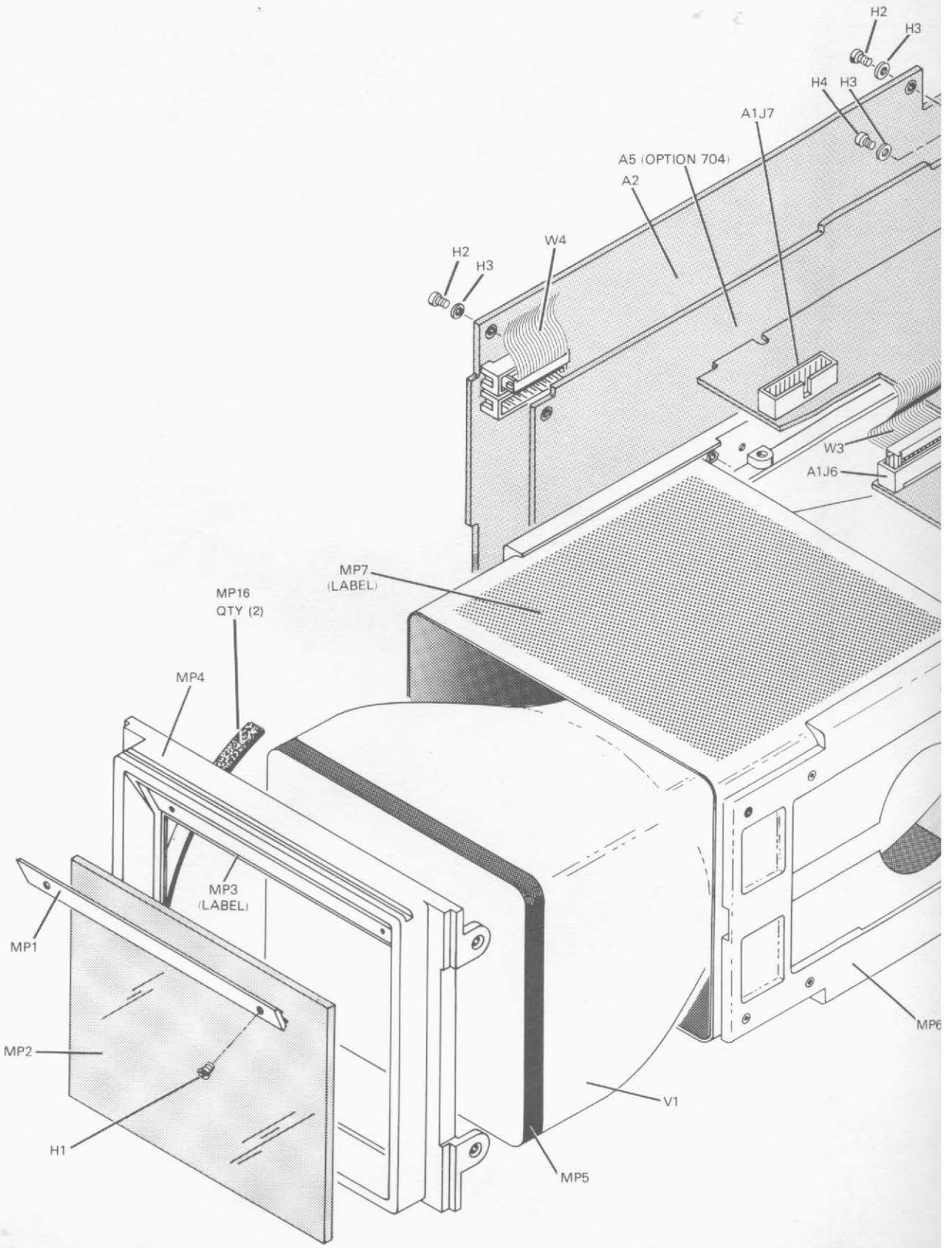

H2
H3
H4
H3
A1J7
A5 (OPTION 704)
A2
H2
H3
W4
W3
A1J6
MP7
(LABEL)
MP16
QTY (2)
MP4
MP3
(LABEL)
MP1
MP2
H1
V1
MP5
MP6

Table 6-2. Replaceable Parts

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	01345-66510	9	1	BOARD-XY STR GEN	28480	01345-66510
A2	01345-66514	3	1	BOARD-VECT PROC	28480	01345-66514
A3	01345-66509	6	1	BOARD ASSEMBLY-LV	28480	01345-66509
A4	01345-66504	1	1	BOARD ASSEMBLY HV	28480	01345-66504
A5 (OPTION 704)	01345-66511	0	1	MEMORY BOARD	28480	01345-66511
H1	0520-0164	1	1	SCREW-MACH 2 56 .25 IN-LG 82 DEG	28480	0520 0164
H2	0515-0055	8	17	SCREW-MACH M3 X 0 5 6MM-LG PAN-HD	28480	0515 0055
H3	2190-0005	0	17	WASHER-LK EXT T NO 4 .116 IN-ID	28480	2190 0005
H4	0515-0077	4	1	SCREW-MACH M3 × 0.5MM LG	28480	0515-0077
H5	0515-0105	9	2	SCREW-MACH M3 X 0.5 12MM-LG PAN-HD	28480	0515-0105
H6	0515-0219	3	1	SCREW-MACH M3 X 0.5 6MM-LG 90-DEG-FLH-HD	28480	0515-0219
H7	3050-0098	6	3	WASHER-FL MTLC NO .2 .094-IN-ID	28480	3050-0098
H8	3050-1039	7	1	WASHER-FL	28480	3050-1039
H9	0624-0289	1	3	SCREW-TPG 2-28 .312-IN-LG PAN-HD-POZI	28480	0624-0289
H10	2190-0045	8	3	WASHER-LK HLCL NO .2 .088-IN-ID	28480	2190-0045
H11	2190-0584	0	2	WASHER-LK HLCL 3 1MM-ID	28480	2190-0584
H12	3050-0105	6	2	WASHER-FL	28480	3050-0105
L1	01340-66001	8	1	TR ALIGN COIL	28480	01340-66001
MP1	01340-04101	9	1	FILTER-RETAINER	28480	01340-04101
MP2	1000-0645	2	1	CONTRAST-FILTER	28480	1000-0645
MP3	7120-3812	1	1	LABEL-WARNING 1-IN-WD 2 6-IN-LG MYLAR	28480	7120-3812
MP4	5040-8381	7	1	BEZEL-FRONT PANEL	28480	5040-8381
MP5	4320-0311	0	1	RUBBER SHOCK	28480	4320-0311
MP6	01345-60603	9	1	SHIELD-SUP SUB ASSEMBLY	28480	01345-60603
MP7	7121-4219	6	1	LABEL-CAL	28480	7121-4219
MP8	0400-0009	9	1	GROMMET-RND .125-IN-ID .25-IN-GRV-OD	28480	0400-0009
MP9	7121-2139	5	1	LABEL-INFO	28480	7121-2139
MP10	0340-0977	2	2	INSULATOR-FLG BSHG NYLON	28480	0340 0977
MP11	01345-00202	8	1	PANEL-REAR	28480	01345 00202
MP12	01345-00601	1	1	SHIELD-OUTER HV	28480	01345 00601
MP13	0340-0564	3	1	INSULATOR XSTR THRM-CNDCT	28480	0340-0564
MP14	5040-7648	7	1	PLATE-COVER, CRT	28480	5040-7648
MP15	01345-41201	3	1	SPACER-PC BOARD (OPTION 704)	28480	01345-41201
MP16	0340 1031	1		SHOCK MOUNT-FRT	28480	0340-1031
V1	5083 6251	6	1	CRT-P31 ALIGN	28480	5083-6251
W1	01345 61604	2	2	CABLE ASSEMBLY POWER	28480	01345-61604
W2	01345-61604	2		CABLE ASSEMBLY POWER	28480	01345-61604
W3	01345-61601	9	1	CABLE ASSEMBLY	28480	01345-61601
W4	01345-61602	0	1	CABLE ASSEMBLY	28480	01345-61602
W5	01345-61605	3	1	CABLE ASSEMBLY POWER	28480	01345-61605
W6	01345-61607	5	1	CABLE ASSEMBLY-DATA	28480	01345-61607
W7	01345-61608	6	1	CABLE ASSEMBLY POWER	28480	01345-61608
W8	01345-61609	7	1	CABLE ASSEMBLY	28480	01345-61609
W9	01345-61610	0	1	CABLE ASSEMBLY	28480	01345-61610
W10	01345-61611	1	1	CABLE ASSEMBLY	28480	01345-61611

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	01345-66510	9	1	BOARD-XY/STR GEN	28480	01345-66510
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	2	CAPACITOR FXD 100UF±10% 20VDC TA	56289	150D106X9020B2
A1C6	0160-2204	0	3	CAPACITOR FXD 100PF ±5% 300VDC MICA	28480	0160-2204
A1C7	0160-3443	1	18	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	0140-0192	9	2	CAPACITOR FXD 68PF ±5% 300VDC MICA	72136	DM15F680J0300WV1CR
A1C16	0160 2237	9	4	CAPACITOR FXD 1.2PF 500VDC CER	28480	0160-2237
A1C17	0160-2055	9	52	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	0140-0192	9		CAPACITOR FXD 68PF ±5% 300VDC MICA	72136	DM15E680J0300WV1CR
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	4	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	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A1C45	0160-3443	1		CAPACITOR-FXD .1UF +80- 20% 50VDC CER	28480	0160-3443
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 0.10F -80 20% 50VDC CER	28480	0160-3443
A1C53	0160-3443	1		CAPACITOR-FXD 0.10F -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	10	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	18	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	6	DIODE SWITCHING 120V 50MA 100NS	28480	1901-0096
A1CR14	1901-0096	7		DIODE-SWITCHING 120V 50MA 100NS	28480	1901-0096
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

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
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	10	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	4	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	4	CONNECTOR 20-PIN M POST TYPE	28480	1251-6823
A1J7	1251-6823	1		CONNECTOR 20-PIN M POST TYPE	28480	1251-6823
A1J8	1251-5863	7	6	CONNECTOR 5 PIN M METRIC POST TYPE	28480	1251-5863
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
A1MP1	1600-1038	1	1	SHIELD-AMPLIFIER	28480	1600-1038
A1MP2	1600-1148	4	1	SHIELD	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	6	TRANSISTOR PNP SI TO 39 PD=1W FT=100MHZ	28480	1853 0038
A1Q9	1854-0419	7	6	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		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	16	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	10	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
A1R16	0757-0428	1	6	RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-T0-1621-F
A1R17	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-F
A1R18	0698-3154	8	2	RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-T0-4221-F
A1R19	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-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
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-T0-1001-F
A1R22	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A1R23	0757-0411	2	3	RESISTOR 332 1% .125W F TC=0±100	24546	C4-1/8-T0-332R-F
A1R24	0757-0416	7	1	RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-5112-F
A1R25	0757-0402	1	1	RESISTOR 110 1% .125W F TC=0±100	24546	C4-1/8-T0-111-F
A1R26	0757-0409	8	2	RESISTOR 274 1% .125W F TC=0±100	24546	C4-1/8-T0-274R-F
A1R27	0698-3427	0	1	RESISTOR 13.3 1% .125W F TC=0±100	03888	PME55-1/8-T0-13R3-F
A1R28	0698-3443	0	1	RESISTOR 287 1% .125W F TC=0±100	24546	C4-1/8-T0-287R-F
A1R29	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0±100	24546	C4-1/8-T0-51R1-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-T0-619R-F
A1R32	0757-1094	9		RESISTOR 1.47K 1% .125W F TC=0±100	24546	C4-1/8-T0-1471-F
A1R33	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-F
A1R34	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-F
A1R35	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-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-T0-3321-F
A1R38	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-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-T0-3321-F
A1R41	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0±100	24546	C4-1/8-T0-6811-F
A1R42	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-T0-4221-F
A1R43	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-T0-4221-F
A1R44	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-T0-1621-F
A1R45	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-F
A1R46	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-T0-4221-F
A1R47	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-F
A1R48	2100-3161	6		RESISTOR-TRMR 20K 10% C SIDE ADJ 17-TRN	28480	2100-3161
A1R49	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A1R50	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A1R51	0757-0411	2		RESISTOR 332 1% .125W F TC=0±100	24546	C4-1/8-T0-332R-F
A1R52	0757-0453	2	4	RESISTOR 30.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-3012-F
A1R53	0757-0431	6	2	RESISTOR 2.43K 1% .125W F TC=0±100	24546	C4-1/8-T0-2431-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-T0-3012-F
A1R56	2100-2497	9	5	RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	73138	82PR2K
A1R57	0757-0465	6	10	RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A1R58	0698-3443	0		RESISTOR 287 1% .125W F TC=0±100	24546	C4-1/8-T0-287-F
A1R59	0698-3443	0		RESISTOR 287 1% .125W F TC=0±100	24546	C4-1/8-T0-287-F
A1R60	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A1R61	0757-0453	2		RESISTOR 30.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-3012-F
A1R62	0698-3151	7	2	RESISTOR 2.87K 1% .125W F TC=0±100	24546	C4-1/8-T0-2871-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-T0-3012-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-T0-1003-F
A1R67	0698-3443	0		RESISTOR 287 1% .125W F TC=0±100	24546	C4-1/8-T0-287-F
A1R68	0698-3443	0		RESISTOR 287 1% .125W F TC=0±100	24546	C4-1/8-T0-287-F
A1R69	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-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-T0-7502-F
A1R72	0757-0409	8		RESISTOR 274 1% .125W F TC=0±100	24546	C4-1/8-T0-274R-F
A1R73	0757-0459	8	1	RESISTOR 56.2K 1% .125W F TC=0±100	24546	C4-1/8-T0-5622-F
A1R74	0698-3151	7		RESISTOR 2.87K 1% .125W F TC=0±100	24546	C4-1/8-T0-2871-F
A1R75	0757-0439	4		RESISTOR 6.81K 1% .125W F TC=0±100	24546	C4-1/8-T0-6811-F
A1R76	0757-0406	5	1	RESISTOR 182 1% .125W F TC=0±100	24546	C4-1/8-T0-182R-F
A1R77	0698-3156	2	1	RESISTOR 14.7K 1% .125W F TC=0±100	24546	C4-1/8-T0-1472-F
A1R78	0757-0442	9	6	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A1R79	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A1R80	0757-0408	7	2	RESISTOR 243 1% .125W F TC=0±100	24546	C4-1/8-T0-243R-F
A1R81	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-T0-4221-F
A1R82	2100-1788	9	2	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-T0-6191-F
A1R84	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A1R85	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-T0-1621-F
A1R86	0757-0416	7	7	RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A1R87	2100-1986	9	3	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	0698-3438	3	2	RESISTOR 147 1% .125W F TC=0±100	24546	C4-1/8-T0-147R-F
A1R90	0757-0448	5	4	RESISTOR 18.2K 1% .125W F TC=0±100	24546	C4-1/8-T0-1822-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
A1R91	0757-0419	0	5	RESISTOR 681 1% .125W F TC=0±100	24546	C4-1/8 TO 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 TO 6191-F
A1R94	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+100	24546	C4 1/8-TO-1003-F
A1R95	0757-0317	7	4	RESISTOR 1.33K 1% .125W F TC=0±100	24546	C4-1/8 TO 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-TO-1331-F
A1R99	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+100	24546	C4-1/8-TO-1003-F
A1R100	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0±100	19701	MF4C1/8-TO-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 TO 681R-F
A1R103	0757-0448	5		RESISTOR 18.2K 1% .125W F TC=0+100	24546	C4 1/8 TO 1822-F
A1R104	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0+100	24546	C4-1/8-TO-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-TO-6191-F
A1R107	0757-0280	3		RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-TO-1001 F
A1R108	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+100	24546	C4-1/8-TO-1621 F
A1R109	0757-0416	7		RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-TO-511R F
A1R110	2100-1986	9		RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	73138	82PR1K
A1R111	0757-0472	6		RESISTOR 200K 1% .125W F TC=0+100	24546	C4 1/8-TO-2003-F
A1R112	0698-3438	3		RESISTOR 147 1% .125W F TC=0+100	24546	C4 1/8-TO-147R-F
A1R113	0757-0448	5		RESISTOR 18.2K 1% .125W F TC=0+100	24546	C4 1/8-TO-1822-F
A1R114	0757-0419	0		RESISTOR 681 1% .125W F TC=0+100	24546	C4 1/8-TO-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-TO-6191-F
A1R117	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-TO-1003-F
A1R118	0757-0317	7		RESISTOR 1.33K 1% .125W F TC=0±100	24546	C4-1/8-TO-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-TO-1331-F
A1R122	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+100	24546	C4-1/8-TO-1003-F
A1R123	0757-0290	5		RESISTOR 6.19K 1% .125W F TC=0+100	19701	MF4C1/8-TO-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-TO-681R-F
A1R126	0757-0448	5		RESISTOR 18.2K 1% .125W F TC=0+100	24546	C4-1/8 TO 1822-F
A1R127	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-TO-1002-F
A1R128	0757-0442	9		RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-TO-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-TO-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 TO 1301-F
A1R133	0757-0419	0		RESISTOR 681 1% .125W F TC=0+100	24546	C4 1/8 TO 681R-F
A1R134	0757-0416	7		RESISTOR 511 1% .125W F TC=0+100	24546	C4-1/8-TO-511R-F
A1R135	2100-2216	0	4	RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	73138	82PR5K
A1R136	0757-0273	4	3	RESISTOR 3.01K 1% .125W F TC=0±100	24546	C4-1/8-TO-3011-F
A1R137	0757-0416	7		RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-TO-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-TO-3011-F
A1R140	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-TO-4221-F
A1R141	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-TO-4221-F
A1R142	2100-2497	9		RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	73138	82PR2K
A1R143	0757-0408	7		RESISTOR 243 1% .125W F TC=0±100	24546	C4-1/8-TO-243R F
A1R144	0757-0416	7		RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-TO-511R-F
A1R145	2100-2497	9		RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	73138	82PR2K
A1R146	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-TO-4221-F
A1R147	2100-2216	0		RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	73138	82PR5K
A1R148	0757-0283	6	2	RESISTOR 2K 1% .125W F TC=0±100	24546	C4-1/8-TO-2001 F
A1R149	0757-0283	6		RESISTOR 2K 1% .125W F TC=0±100	24546	C4-1/8-TO-2001-F
A1R150	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+100	24546	C4-1/8 TO 1001-F
A1R151	0757-0407	6	4	RESISTOR 200 1% .125W F TC=0±100	24546	C4-1/8-TO-201-F
A1R152	0757-0407	6		RESISTOR 200 1% .125W F TC=0±100	24546	C4-1/8-TO-201-F
A1R153	0757-0407	6		RESISTOR 200 1% .125W F TC=0±100	24546	C4-1/8-TO-201 F
A1R154	0757-0407	6		RESISTOR 200 1% .125W F TC=0+100	24546	C4-1/8-TO 201-F
A1R155	0757-0428	1		RESISTOR 1.62K 1% .125W F TC=0+100	24546	C4-1/8 TO 1621-F
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

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
A1TP1	0360-0535	0	8	TERMINAL TEST POINT PCB	24840	0360-0535
A1TP2	0360-0535	0		TERMINAL TEST POINT PCB	28480	0360-0535
A1TP3	0360-0535	0		TERMINAL TEST POINT PCB	28480	0360-0535
A1TP4	0360-0535	0		TERMINAL TEST POINT PCB	28480	0360-0535
A1TP5	0360 0535	0		TERMINAL TEST POINT PCB	28480	0360-0535
A1TP6	0360 0535	0		TERMINAL TEST POINT PCB	28480	0360-0535
A1U1	1820-1196	8	8	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	1826-0465	4	6	IC OP AMP8-DIP-P PKG	0192B	CA3140E
A1U6	1826-0465	4		IC OP AMP8-DIP-P PKG	0192B	CA3140E
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	1826-0465	4		IC OP AMP8-DIP-P PKG	0192B	CA3140E
A1U11	1826-0208	3	3	IC OP AMP GP 8-DIP-P PKG	27014	LM310N
A1U12	1826-0665	6		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	1826-0465	4		IC OP AMP8-DIP-P PKG	0192B	CA3140E
A1U18	1826-0465	4		IC OP AMP8-DIP-P PKG	0192B	CA3140E
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	1826-0465	4		IC OP AMP8 DIP P PKG	0192B	CA3140E
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	1826-0818	1	1	IC 16 DIP-C PKG	28480	1826-0818
A1U26	1NB4-5004	5	1	RAMP GENERATOR	28480	1NB4-5004
A1U27	1826-0871	6		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	MC7915CT
A1U31	1826-0665	6	2	IC OP AMP LOW-BIAS-H-IMPD QUAD 14-DIP-P	27014	LF347BN
A1U32				NOT ASSIGNED		
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
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	16	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	01345 66514	3	1	BOARD-VFCT PROD	28480	01345-66514
A2C1	0160-2264	2	3	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		CAPACITOR-FXD 10UF ±10% 20VDC TA	56289	150D106X9020B2
A2C4	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A2C5	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A2C6	0160-3451	1	12	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C7	0160-3443	1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
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	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
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	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2C18	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A2CR1	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A2CR2	1901-1065	2	1	DIODE-PWR RECT 400V 1A	28480	1901-1065
A2H1	2190-0005	0	2	WASHER-LK EXT T NO. 4 .116-IN-ID	28480	2190-0005
A2H2	0515-0403	0	2	SCREW-MACH 2.5 × .48 × 8MM	00000	ORDER BY DESCRIPTION
A2H3	0535-0008	3	2	NUT-HEX-DBL-CHAM M 2.5 × 0.45 - 2MM	28480	0535-0008
A2J1	1251-6905	0	1	CONNECTOR 44-PIN M POST TYPE	28480	1251-6905
A2J2	1251-6823	1		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		CONNECTOR 16-PIN M RIGHT ANGLE	28480	1251-7229
A2J5	1251-5863	7		CONNECTOR 5-PIN M METRIC POST TYPE	28480	1251-5863
A2L1	9100-1629	4	1	INDUCTOR RF-CH-MLD 47UH 5% .166DX 386LG	28480	9100-1629
A2Q1	1854-0300	5	1	TRANSISTOR NPN SI PD=.21W FT=10MHZ	28480	1854-0300
A2Q2	1854-0215	1	3	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A2R1	0683-1035	1	7	RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A2R2	0683-1025	9	16	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A2R3	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A2R4	0757-0280	3		RESISTOR 1K 1% .125W F TC=0+100	24546	C4-1/8-T0-1001-F
A2R5	0698-3394	0	1	RESISTOR 31.6 1% .5W F TC=0+100	28480	0698-3394
A2R6	0757-0159	5	1	RESISTOR 1K 1% .5W F TC=0±100	28480	0757-0159
A2R7	0698-3154	0		RESISTOR 4.22K 1% .125W F TC=0±100	24546	C4-1/8-T0-4221-F
A2R8	0761-0035	5	1	RESISTOR 150 5% 1W MO TC=0±200	28480	0761-0035
A2R9	0757-0416	7		RESISTOR 511 1% .125W F TC=0+100	24546	C4-1/8-T0-511R-F
A2R10	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A2R11	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A2R12	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A2R13	0683-0275	9		RESISTOR 2.7 5% .25W FC TC=-400/+500	28480	0683-0275
A2R14	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A2R15	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1025
A2R16	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A2R17	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A2R18	0757-0449	6	3	RESISTOR 20K 1% .125W F TC=0±100	24546	C4-1/8-T0-2002-F
A2R19	0757-0416	7		RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A2R20	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A2R21	0757-0273	4		RESISTOR 3.01K 1% .125W F TC=0±100	24546	C4-1/8-T0-3011-F
A2R22	0683-1025	9	1	RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A2R23	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A2R24	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A2R25	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+600	01121	CB1035
A2R26	0757-0273	4	1	RESISTOR 3.01K 1% .125W F TC=0±100	24546	C4-1/8-T0-3011-F
A2R27	0757-0280	3	1	RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A2U1	01347-80004	8	1	IC MCU 8048	28480	01347-80004
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		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
A2U11	1820-1432	5		IC CNTR TTL LS BIN SYNCHRO POS EDGE TRIG	01295	SN74LS163AN
A2U12	01347-80001	5	1	IC NMOS 16384-16K ROM300-NS 3-S	28480	01347-80001

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
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		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
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	3	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	1200-0641
A2XU16	1200-0654	7		SOCKET-IC 40-CONT DIP DIP-SLDR	28480	1200-0654

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	01345-66509	6	1	BOARD ASSEMBLY-LV	28480	01345-66509
A3C1	0180-0094	4		CAPACITOR-FXD 100UF+75-10% 25VDC AL	56289	30D107G025DD2
A3C2	0160 3443	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		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
A3E1	0360-0535	0		TERMINAL TEST POINT PCB	28480	0360-0535
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	1	FUSEHOLDER-CLIP TYPE 25D-FUSE	28480	2110-0269
A3H3	2190-0030	1	1	WASHER-LK HLCL NO 4 .115-IN-ID	28480	2190-0030
A3H4	2200-0141	8		SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	28480	2200-0141
A3H5	2200-0153	2	2	SCREW-MACH 4-40 .875-IN-LG PAN-HD-POZI	28480	2200-0153
A3H6	3050-0105	6	1	WASHER-FL MTLC NO 4 .125-IN-ID	28480	3050-0105
A3J1	1251-4308	3	1	CONNECTOR 6-PIN M UTILITY	28480	1251-4308
A3J2	1251-5863	7		CONNECTOR 5-PIN M METRIC POST TYPE	28480	1251-5863
A3J3	1251 5863	7		CONNECTOR 5-PIN M METRIC POST TYPE	28480	1251-5863
A3J4	1251-5863	7		CONNECTOR 5-PIN M METRIC POST TYPE	28480	1251-5863
A3J5	1251-6091	5	1	CONNECTOR 2-PIN M METRIC POST TYPE	28480	1251-6091
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
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		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
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

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
A4	01345-66504	1	1	BOARD ASSEMBLY HV	28480	01345-66504
A4A1	0960-0629	5	1	MULTIPLIER H.V.	28480	0960-0629
A4C1	0160-2205	1	1	CAPACITOR-FXD 120PF ±5% 300VDC MICA	28480	0160-2205
A4C2	0160-2234	6	1	CAPACITOR-FXD .51PF ±.25PF 500VDC CER	28480	0160-2234
A4C3	0160-2055	9		CAPACITOR-FXD .01UF +80 -20% 100VDC CER	28480	0160-2055
A4C4	0160-3638	6	2	CAPACITOR-FXD .22UF +80 -20% 200VDC CER	28480	0160-3638
A4C5	0160-2055	9		CAPACITOR-FXD .01UF +80 -20% 100VDC CER	28480	0160-2055
A4C6	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A4C7	0160-3638	6		CAPACITOR-FXD .22UF +80-20% 200VDC CER	28480	0160-3638
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		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160 3443
A4C12	0160-4051	9	3	CAPACITOR-FXD .01UF ±20% 4KVDC	28480	0160 4051
A4C13	0160-4051	9		CAPACITOR-FXD .01UF ±20% 4KVDC	28480	0160 4051
A4C14	0160-2264	2		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	0160-3665	9	2	CAPACITOR FXD .01UF +80-20% 500VDC CER	28480	0160-3665
A4C19	0160 3665	9		CAPACITOR-FXD .01UF +80 -20% 500VDC CER	28480	0160-3665
A4C20	0160-5337	6	1	CAPACITOR	28480	0160-5337
A4C21	0160-5336	5	1	CAPACITOR	28480	0160-5336
A4C22	0160-0162	5	1	CAPACITOR-FXD .022UF ±10% 200VDC POLYE	28480	0160 0162
A4CR1	1901-0028	5		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		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
A4E1	0360-0535	0		TERMINAL TEST POINT PCB	28480	0360-0535
A4E2	0360-1653	5		CONNECTOR-SGL CONT PIN .045 IN-BSC-SZ SQ	28480	0360-1653
A4H1	0515 0055	8	3	SCREW-MACH M3 X 0.5 6MM-LG PAN HD	28480	0515-0055
A4H2	0515-0055	8		SCREW MACH M3 X 0.5 6MM-LG PAN-HD	28480	0515-0055
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
A4Q1	1854-0215	1		TRANSISTOR NPN SI PD-350MW FT=300MHZ	04713	2N3904
A4Q2	1853-0038	4		TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A4Q3	1854-0419	7		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
A4R1	0684-6811	3	5	RESISTOR 680 10% .25W FC TC=-400/+600	01121	CB6811
A4R2	2100-2489	9	1	RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	30983	ET50X502
A4R3	0757-0844	5	1	RESISTOR 16.2K 1% .5W F TC=0=100	28480	0757-0844
A4R4	0684-1011	5	6	RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A4R5	0757-0442	9		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	0684 1011	5		RESISTOR 100 10% .25W FC TC= 400/+500	01121	CB1011
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

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
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	2100-3357	2	3	RESISTOR TRMR 500K 10% C SIDE ADJ 1-TRN	28480	2100-3357
A4R21	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-TO-1003-F
A4R22	0757-0465	6		RESISTOR 100K 1% .125W F TC=0+100	24546	C4-1/8-TO-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	0757-0449	6		RESISTOR 20K 1% .125W F TC=0±100	24546	C4-1/8-TO-2002-F
A4R39	2100-3357	2		RESISTOR-TRMR 500K 10% C SIDE-ADJ 1 TRN	28480	2100-3357
A4R40	2100-3357	2		RESISTOR-TRMR 500K 10% C SIDE-ADJ 1 TRN	28480	2100-3357
A4R41	0699-0974	8	1	RESISTOR 7.5M 5% 1W C TC=0±250	28480	0699-0974
A4R42	2100-3358	3	1	RESISTOR-TRMR 1M 20% C SIDE-ADJ 1 TRN	28480	2100-3358
A4R43	0699-0172	8	1	RESISTOR 3M 5% 1W C TC=0±250	28480	0699-0172
A4T1	01345-61101	4	1	HV TRANSFORMER	28480	01345-61101
A4U1	1826-0167	3	1	IC OP AMP PRGMBL TO-99 PKG	01928	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	1902-3354	8	1	DIODE-ZNR 54.9V 5% DO-7 PD=.4W TC=+.081%	28480	1902-3354

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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
A5 (OPTION 704)	01345-66511	0	1	MEMORY BOARD	28480	01345 66511
A5C1	0180-0648	4	1	CAPACITOR-FXD 1UF±10% 35VDC TA	90201	TDC104K035NSE
A5C2	0160-3470	4	1	CAPACITOR-FXD 0.01 +80 20% 50VDC CER	28480	0160-3470
A5C3	0160-3456	6	1	CAPACITOR-FXD 1000PF ±10% 1KVDC CER	28480	0160-3456
A5C4	0160-2201	7	1	CAPACITOR-FXD 36PF ±5% 300VDC MICA	28480	0160-2201
A5C5	0160-2198	1	1	CAPACITOR-FXD 20PF ±5% 500VDC MICA	28480	0160-2198
A5C6	0140-0208	8	1	CAPACITOR-FXD 680PF ±5% 300VDC MICA	72136	DM15F681J0300WV1CR
A5C7	0180-0229	7	1	CAPACITOR-FXD 33UF ±10% 10VDC TA	56289	150D336X9010B2
A5C8	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C11	0160 2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C13	0160 2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C14	0160 2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C15	0160 2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C16	0160 2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C17	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C18	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C19	0160-2055	9		CAPACITOR-FXD .01UF +80 20% 100VDC CER	28480	0160-2055
A5C20	0160 2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C22	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C23	0160-2055	9		CAPACITOR-FXD .01UF +80 20% 100VDC CER	28480	0160-2055
A5C24	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C25	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C26	0160 2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C27	0160 2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C28	0160 2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C29	0160-2055	9		CAPACITOR FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C30	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C31	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C32	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C33	0140-0196	3		CAPACITOR-FXD 51PF 300V MI	28480	0140-0196
A5J2	1251-4322	1	2	CONNECTOR 3-PIN M POST TYPE	28480	1251-4322
A5J3	1251-4322	1		CONNECTOR 3-PIN M POST TYPE	28480	1251-4322
A5R1	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A5R2	0683-1025	9		RESISTOR 1K 5% .25W FC TC= 400/+600	01121	CB1025
A5R3	0683-1025	9		RESISTOR 1K 5% .25W FC TC= 400/+600	01121	CB1025
A5R4	0683-1025	9		RESISTOR 1K 5% .25W FC TC= 400/+600	01121	CB1025
A5R5	0683-1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A5R6	0683-1025	9		RESISTOR 1K 5% .25W FC TC= 400/+600	01121	CB1025
A5R7	0683-1035	1		RESISTOR 10K 5% .25W FC TC= 400/+700	01121	CB1035
A5R8	0683-1245	5	1	RESISTOR 120K 5% .25W FC TC=-800/+900	01121	CB1245
A5R9	0683-1515	2	1	RESISTOR 150 5% .25W FC TC=-400/+600	01121	CB1515
A5R10	0683 1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A5R11	0683-2725	8	1	RESISTOR 2.7K 5% .25W FC TC= 400/+700	01121	CB2725
A5R12	0683-2025	1	1	RESISTOR 2K 5% .25W FC TC= 400/+700	01121	CB2025
A5R13	0683-1035	1		RESISTOR 10K 5% .25W FC TC=-400/+700	01121	CB1035
A5R14	0683 1025	9		RESISTOR 1K 5% .25W FC TC=-400/+600	01121	CB1025
A5U1	1820 1112	8	2	IC FF TTL LS D TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A5U2	1820-1425	6	1	IC SCHMITT-TRIG TTL LS NAND QUAD 2 INP	01295	SN74LS132N
A5U3	1820-1199	1	1	IC INV TTL LS HEX 1-INP	01295	SN74LS04N
A5U4	1820-0579	9	1	IC MV TTL LS MONOSTBL RETRIG DUAL	28480	1820-0579
A5U5	1820-1208	3	2	IC GATE TTL LS OR QUAD 2-INP	01295	SN74LS32N
A5U6	1820-1112	8		IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A5U7	1820-1433	6	1	IC SHF-RGTR TTL LS R-S SERIAL-IN PRL-OUT	01295	SN74LS164N
A5U8	1826 0180	0	1	IC TIMER TTL MONO/ASTBL	01295	NE555P
A5U9	1820 1470	1	3	IC MUXR/DATA-SEL TTL LS 2-TO-1-LINE QUAD	01295	SN74LS157N
A5U10	1820-1278	7	6	IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS191N
A5U11	1920 1278	7		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS191N
A5U12	1820-1208	3		IC GATE TTL LS OR QUAD 2-INP	01295	SN74LS32N
A5U13	1820-1470	1		IC MUXR/DATA SEL TTL LS 2 TO 1 LINE QUAD	01295	SN74LS157N
A5U14	1820-1278	7		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS191N
A5U15	1820-1278	7		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS191N
A5U16	1820-1201	6	1	IC GATE TTL LS AND QUAD 2 INP	01295	SN74LS08N
A5U17	1820-1449	4	1	IC GATE TTL S OR QUAD 2-INP	01295	SN74S32N
A5U18	1820-1281	2	1	IC DCDR TTL LS 2-TO-4-LINE DUAL 2-INP	01295	SN74LS139N
A5U19	1820-1470	1		IC MUXR/DATA-SEL TTL LS 2 TO 1-LINE QUAD	01295	SN74LS157N
A5U20	1820-1278	7		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS191N
A5U21	1820-1278	7		IC CNTR TTL LS BIN UP/DOWN SYNCHRO	01295	SN74LS191N

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
A5U22	1820-1197	9	2	IC GATE TTL LS NAND QUAD 2 INP	01295	SN74LS00N
A5U23	1820-1568	8	1	IC BFR TTL LS BUS QUAD	01295	SN74LS125AN
A5U24	1820-2075	4	2	IC MISC TTL LS	01295	SN74LS245N
A5U25	1820-2075	4		IC MISC TTL LS	01295	SN74LS245N
A5U26	1818-1178	1	8	IC NMOS 8192 (8K) RAM STAT 200-NS	50088	MK4118N-3
A5U27	1818-1178	1		IC NMOS 8192 (8K) RAM STAT 200-NS	50088	MK4118N-3
A5U28	1818-1178	1		IC NMOS 8192 (8K) RAM STAT 200-NS	50088	MK4118N-3
A5U29	1818-1178	1		IC NMOS 8192 (8K) RAM STAT 200-NS	50088	MK4118N-3
A5U30	1818-1178	1		IC NMOS 8192 (8K) RAM STAT 200-NS	50088	MK4118N-3
A5U31	1818-1178	1		IC NMOS 8192 (8K) RAM STAT 200-NS	50088	MK4118N-3
A5U32	1818-1178	1		IC NMOS 8192 (8K) RAM STAT 200-NS	50088	MK4118N-3
A5U33	1818-1178	1		IC NMOS 8192 (8K) RAM STAT 200-NS	50088	MK4118N-3
A5U34	1820-1858	9	2	IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A5U35	1820-1858	9		IC FF TTL LS D-TYPE OCTL	01295	SN74LS377N
A5U36	1820-1197	9		IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A5W1	01345-61603	1		DATA CABLE	28480	01345-61603
A5W2	01345-61606	4		POWER CABLE	28480	01345-61606
A5XU26	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A5XU27	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A5XU28	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A5XU29	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A5XU30	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A5XU31	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541
A5XU32				NOT ASSIGNED		
A5XU33	1200-0541	1		SOCKET-IC 24-CONT DIP DIP-SLDR	28480	1200-0541

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
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
74100	BUSSMAN MFG DIV OF MCGRAW-EDISON CO	ST LOUIS	MO	63107
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
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 contains information for adapting this manual to instruments for which the content does not apply directly.

7-3. MANUAL CHANGES.

7-4. To adapt this manual to your instrument, refer to table 7-1 and make all manual changes listed for your instrument serial prefix number. Perform these changes in the sequence listed. If your instrument serial prefix number is not listed on the title page or in table 7-1, it may be documented in a yellow MANUAL CHANGE supplement. For additional information about serial number coverage, refer to INSTRUMENTS COVERED BY MANUAL in Section I.

Table 7-1. Manual Changes by Serial Prefix Number

Serial Prefix Number	Make Manual Changes
2112A	2, 1
2227A	2

7-5. MANUAL CHANGE INSTRUCTIONS.

CHANGE 1

SECTION VI. REPLACEABLE PARTS,
Table 6-2. Replaceable Parts,
Change: A5 (MEMORY OPTION BOARD) HP and Mfr Part Nos. to 01345-66506 (2 places).
Change: A5C4 (CAPACITOR 36PF, M1 .300V) HP and Mfr Part Nos. to 0160-2308.
Delete: A5C33.
Change: A5U4 (IC, MONOSTBL TTL) HP and Mfr Part Nos. to 1820-1423.

SECTION VIII. SERVICE,
Schematic 6. Memory Option 704,
Change value of A5C4 from 51PF to 36PF.
Delete: A5C33.

CHANGE 2

SECTION I. GENERAL INFORMATION,
Table 1-2. 1345A Functions,
Line Types:,
Delete: Dots at end points only.

SECTION III. OPERATION,
Replace pages 3-3 and 3-4 with pages 7-3 and 7-4 of this section.

SECTION VI. REPLACEABLE PARTS,
Table 6-2. Replaceable Parts,
Change: A1 (PC BOARD X-Y/STR GEN) HP and Mfr Part Nos. to 01345-66501 (2 places).
Change: A2 (PC BOARD-VECT PROCESSOR) HP AND MFR PART NOS. TO 01345-66502 (2 places).
Change: A3 (PC BOARD-LOW VOLTAGE POWER SUPPLY) HP and Mfr Part Nos. to 01345-66503 (2 places).
Change: MP7 (LABEL-CAL) HP and Mfr Part Nos. to 7140-2140.
Change: MP11 (PANEL-REAR) HP and Mfr Part Nos. to 01345-00201.
Delete: A1E11.
Delete: A1J9.
Delete: A1J10.
Delete: A1R161.
Delete: A1R162.
Change: A1U30 (IC V RGLTR) HP and Mfr Part Nos. to 1826-0214.
Delete: A1VR8.
Delete: A1VR9.
Delete: A1VR10.
Delete: A1VR11.
Change: A2U1 (IC 8748) HP and Mfr Part Nos. to 1820-2663.
Change: A2U12 (IC NMOS 16K ROM) HP and Mfr Part Nos. to 1818-1632.
Delete: A2U27.
Change: A3F1 (FUSE 1.5AT) HP and Mfr Part Nos. to 2110-0304.
Change: A3F2 (FUSE 3.0AT) HP and Mfr Part Nos. to 2110-0029.
Change: A3F3 (FUSE .5A) HP and Mfr Part Nos. to 2110-0012.

SECTION VIII. SERVICE,
Replace pages 8-5 through 8-10 with pages 7-5 through 7-10 of this section.
Service Sheet 4. Low Voltage Power Supply,
Change current rating of A3F1 to 1.5A.
Change current rating of A3F2 to 3.0A.
Change current rating of A3F3 to 0.5A.

1. Set Condition Command (B14 = 1, B13 = 1).

With both MSBs (Most Significant Bits) set to one, the 1345A 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.

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

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

* B6 MUST be zero.

X = DON'T CARE

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

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

W1	W0	(Writing Speed)
1	1	0.05 in. per microsecond
1	0	0.10 in. per microsecond
0	1	0.15 in. per microsecond
0	0	0.20 in. 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.

2. Plot Command (B14 = 0, B13 = 0).

With both MSBs set to zero, the 1345A 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 on.

The Plot command will draw all vectors according to the display configuration established by the last Set Condition command received by the 1345A.

Each time that a Y coordinate is received the beam status (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 1345A: (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 (Beam Control Bit)
0 = Move (beam off)
1 = Draw (beam on)

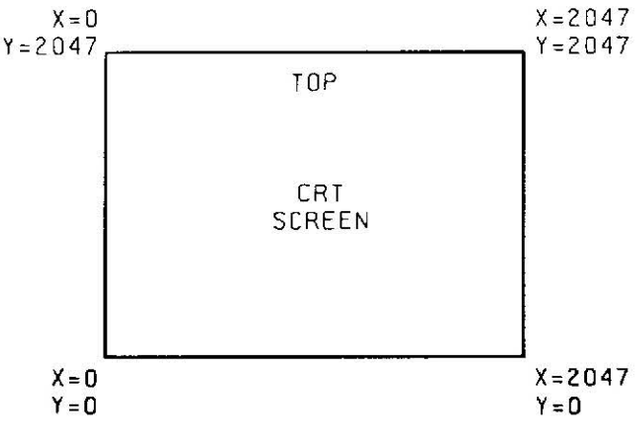


Figure 7-1. Vector Drawing Area

3. Graph Command (B14 = 0, B13 = 1).

With the two MSBs set to zero and one, respectively, the 1345A 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 on. Beam status for the beam movement is established each time that 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 1345A.

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 (Beam Control Bit)
0 = Move (beam off)
1 = Draw (beam on)

Example:

To graph, first move the beam to a starting position P1 (Plot Commands: X value; Y value with beam off). Then send the 1345A:

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.

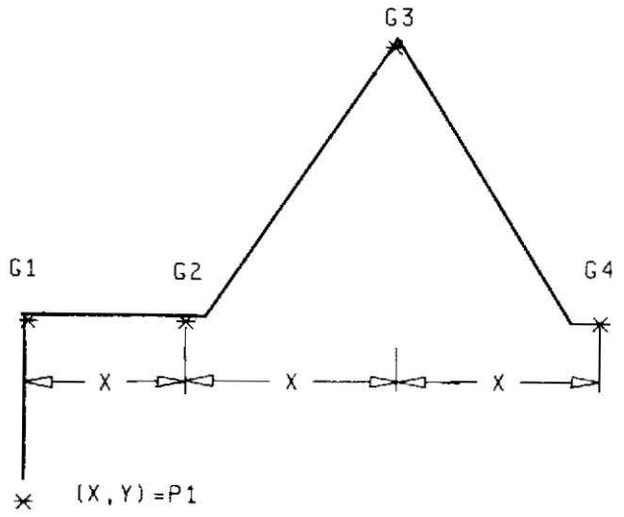


Figure 7-2. Graphing Example

4. Text Command (B14 = 1, B13 = 0).

With the two MSBs set to one and zero, respectively, the 1345A is commanded to draw all the vectors necessary to produce the character specified.

The 1345A automatically provides a space to the right of each character for character spacing.

The Text command will draw the character according to the display configuration established by the last Set Condition command received by the 1345A.

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 1345A has finished drawing a character it automatically advances the beam to the starting point for the next character. In this way the 1345A functions much like a typewriter when presenting text.

The modified ASCII character set for the 1345A is shown in table 3-1.

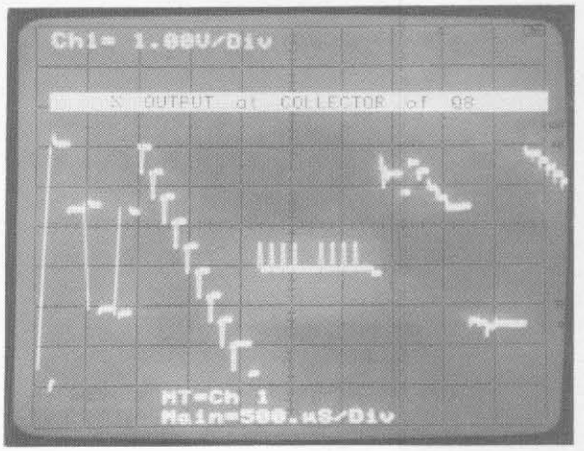
B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
1	0	S1	S0	R1	R0	ES	D7	D6	D5	D4	D3	D2	D1	D0

CHARACTER MSB — LSB

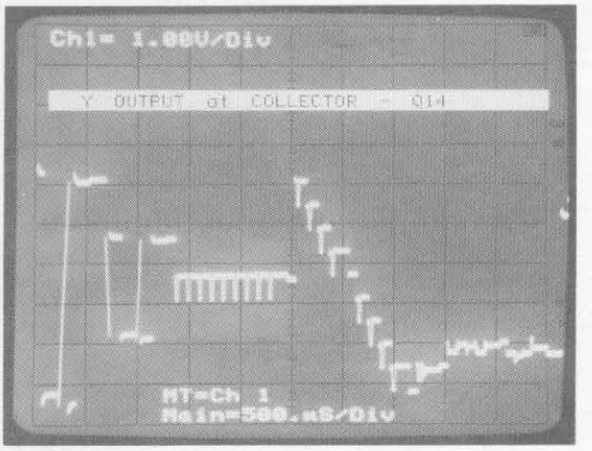
B14 = 1, B13 = 0: commands that the 1345A display a text character (specified by D0 - D7).

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

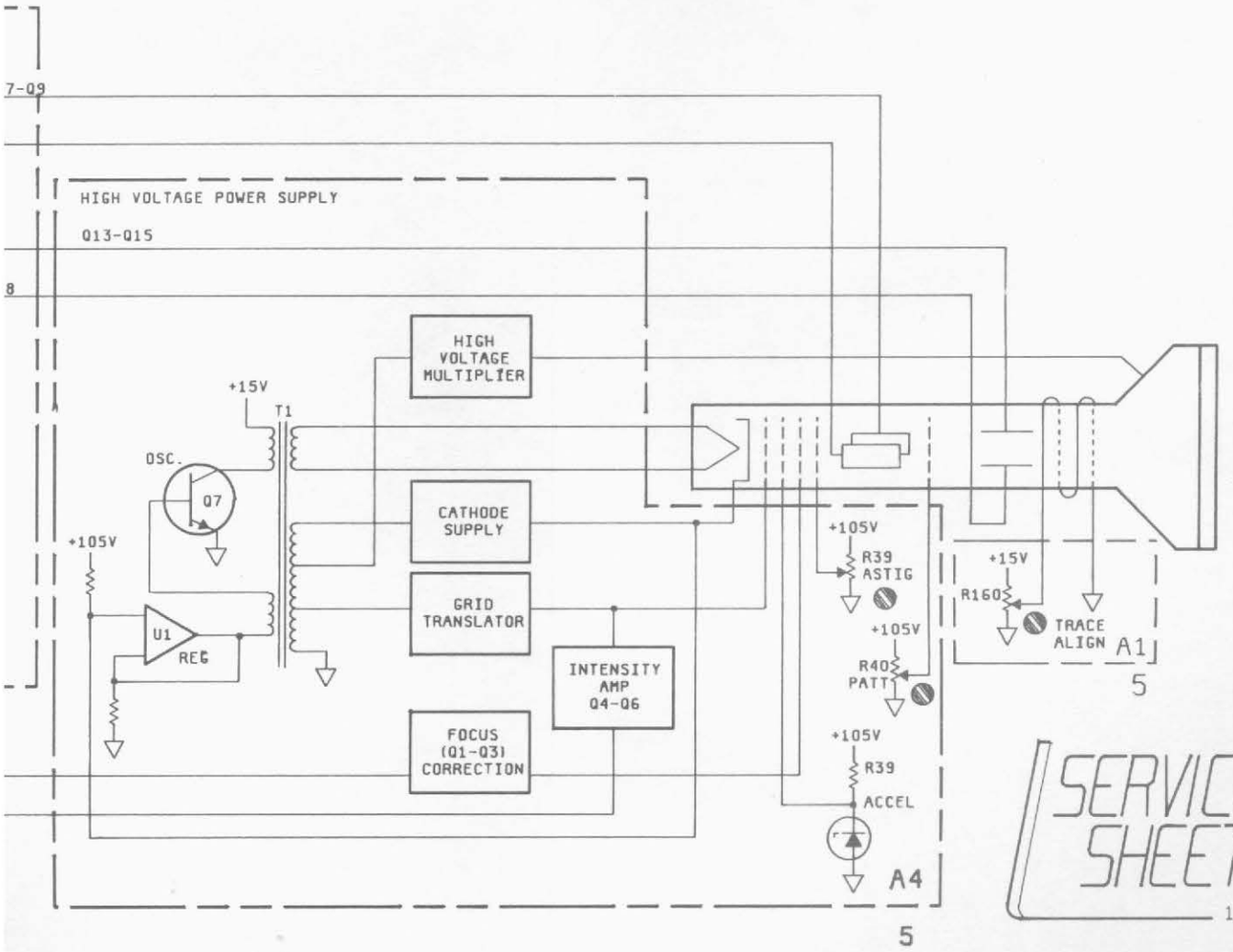
R1	R0	(Character Rotation (CCW))
0	0	0 degrees
0	1	90 degrees
1	0	180 degrees
1	1	270 degrees



X OUTPUT AT A1 COLLECTOR OF Q8
(TO HORIZONTAL CRT DEFLECTION PLATES)



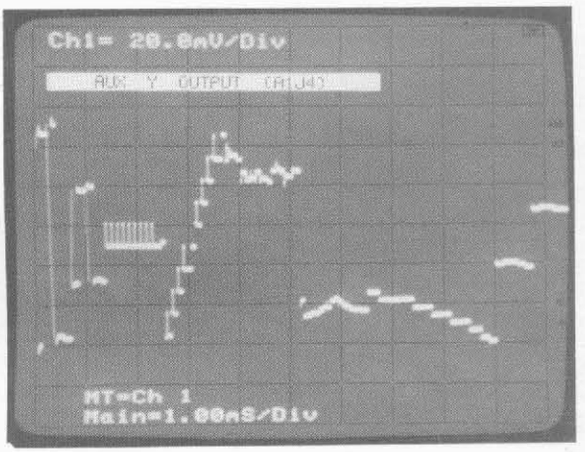
Y OUTPUT AT A1 COLLECTOR OF Q14
(TO VERTICAL CRT DEFLECTION PLATES)



SERVICE SHEET 1

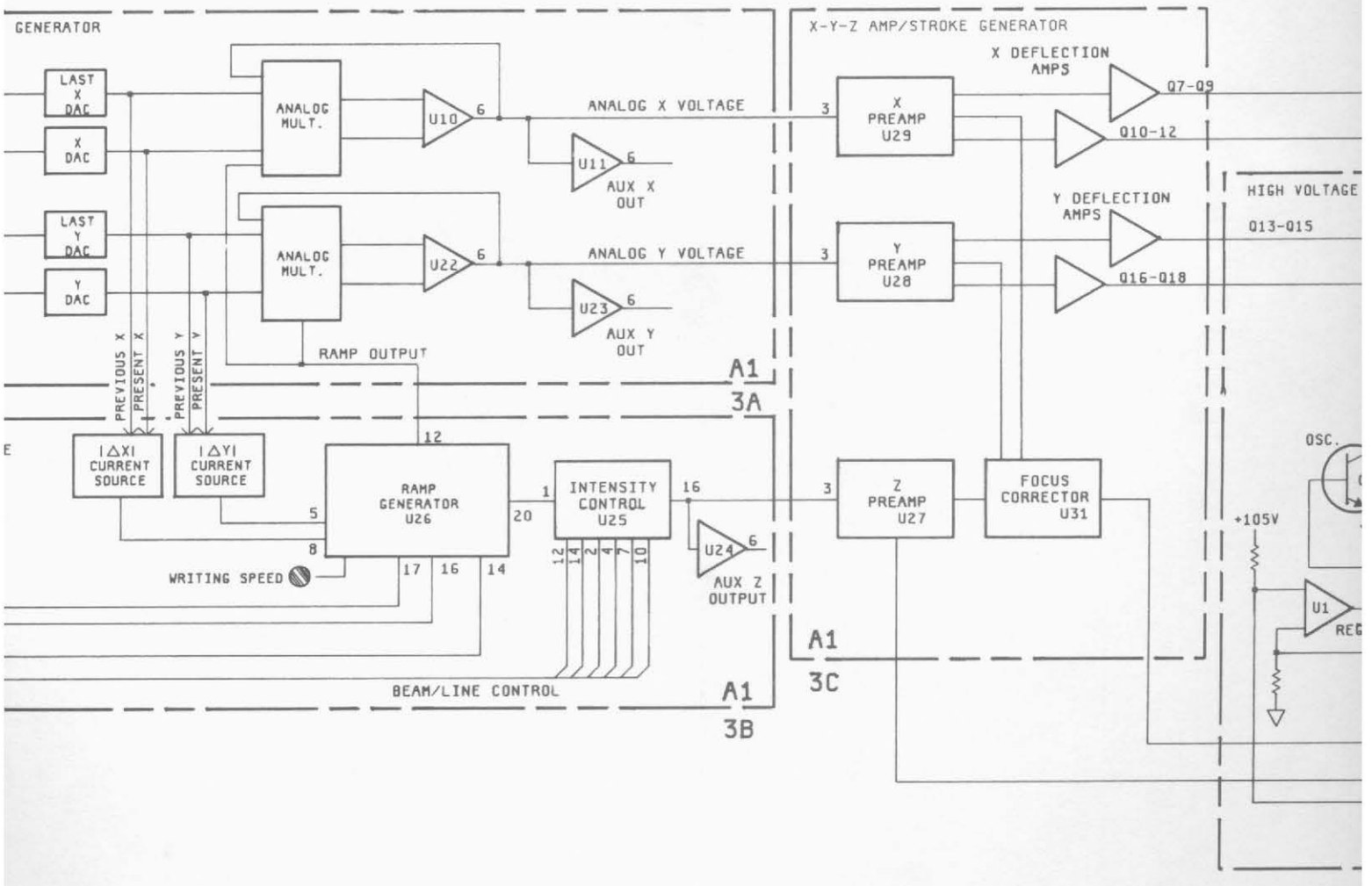
1345/123/CJF/07/

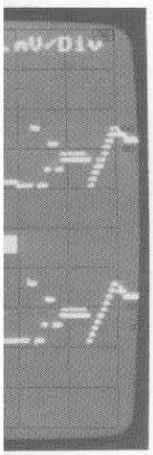
Figu
Service Sheet 1, Block Di



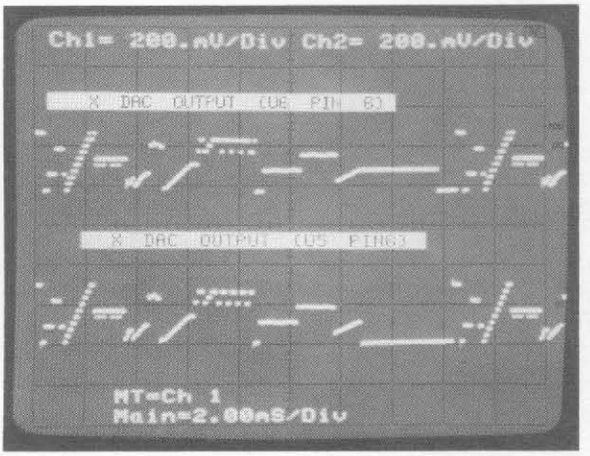
Y AUX OUTPUT AT A1J4

Z AUX OUTPUT AT A1J3

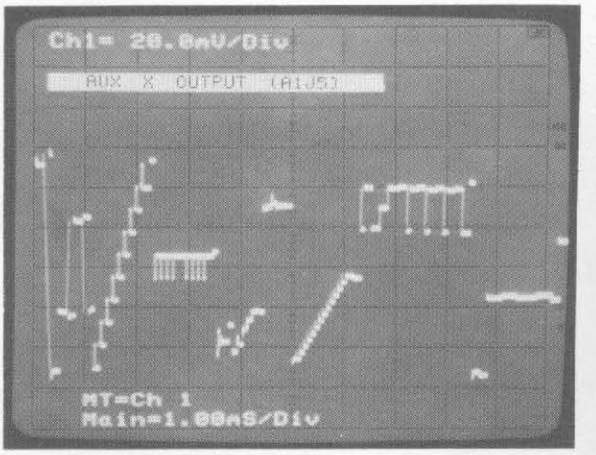




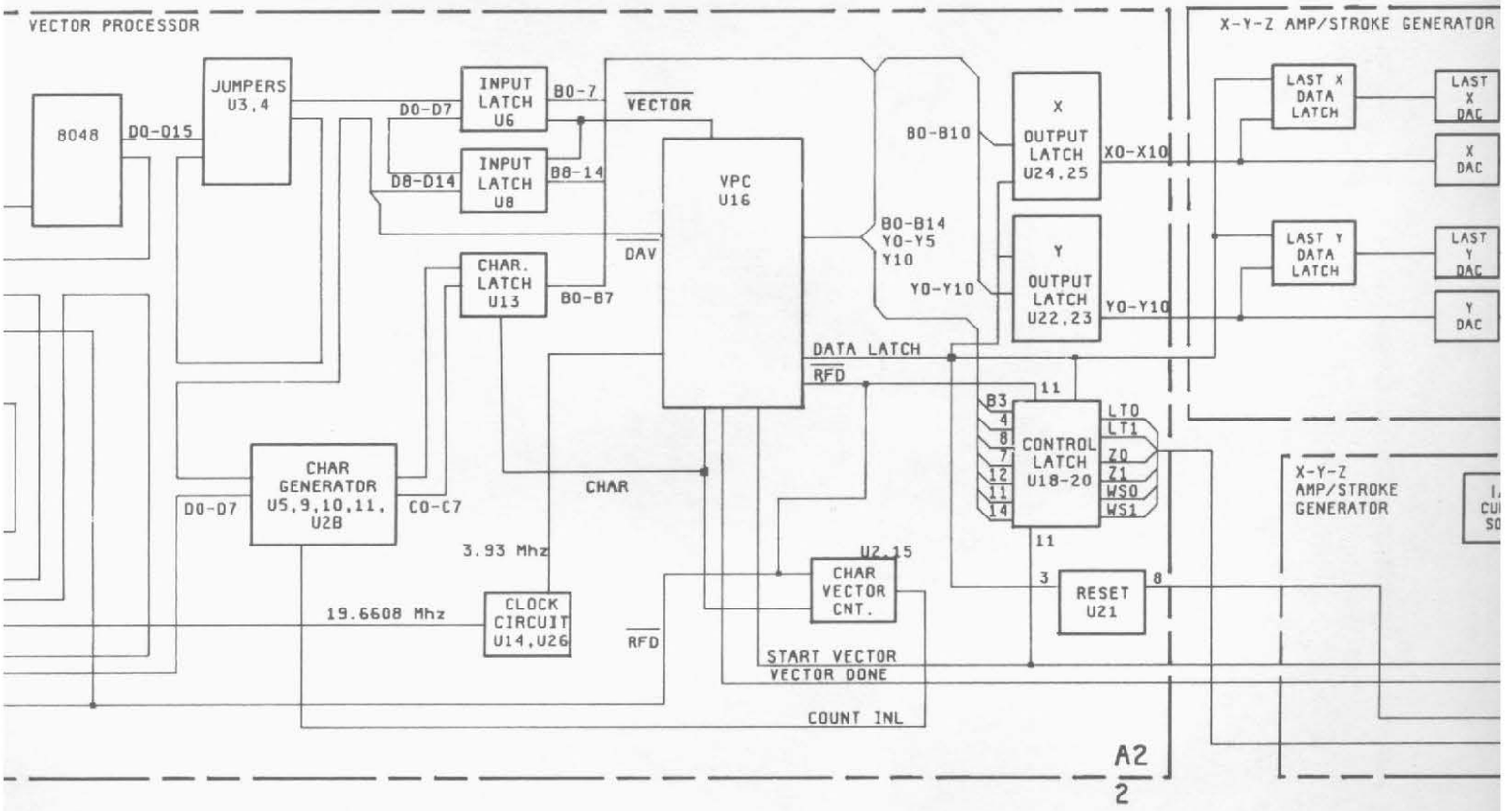
6
PIN 6

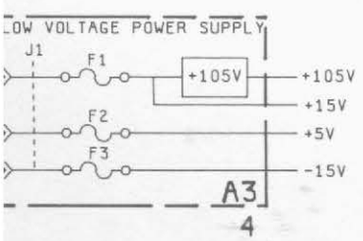


TOP: X DAC OUTPUT A1, U6 PIN 6
BOTTOM: X DAC OUTPUT A1, U5 PIN 6

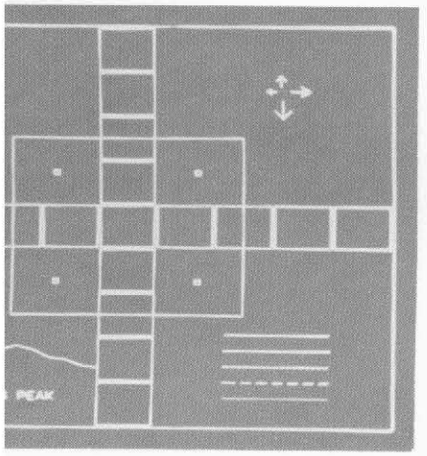


X AUX OUTPUT AT A1J5

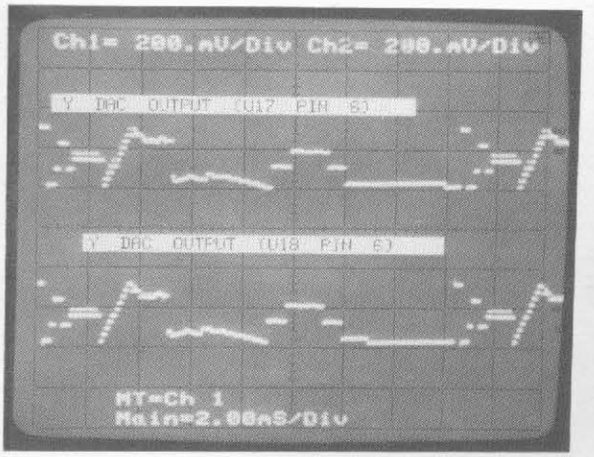




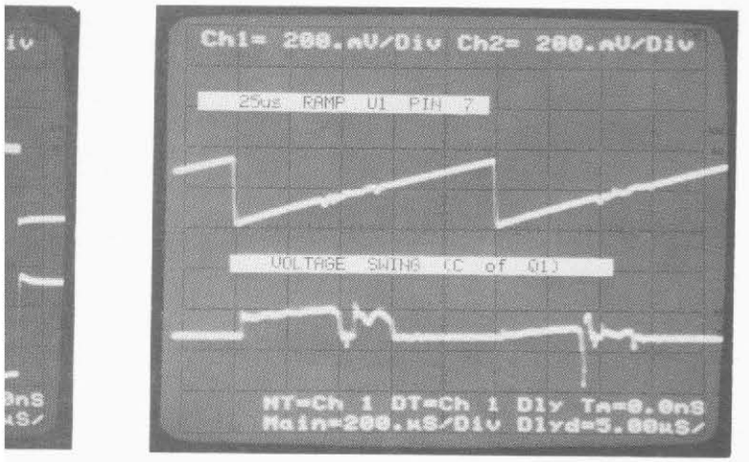
M MEASUREMENT CONDITION



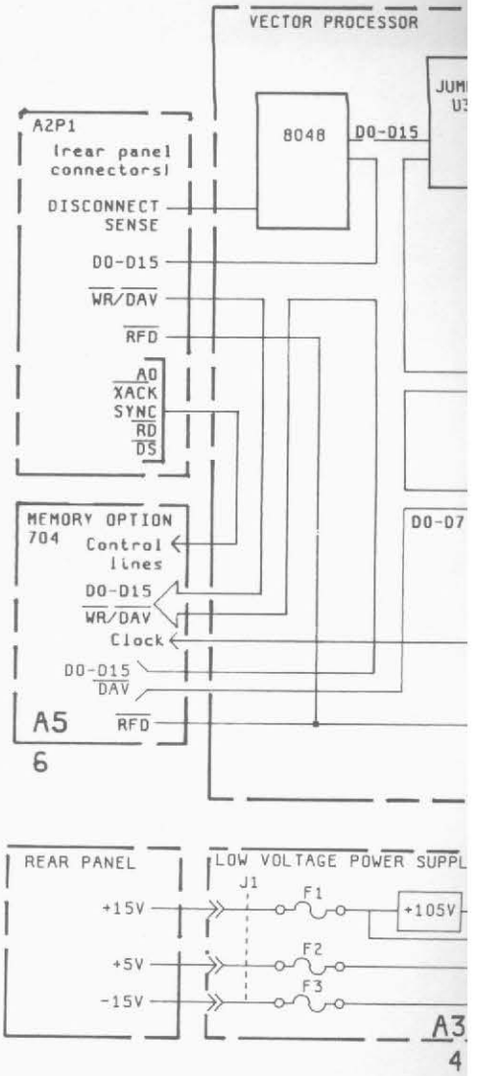
.RY TEST PATTERN AS SHOWN ABOVE



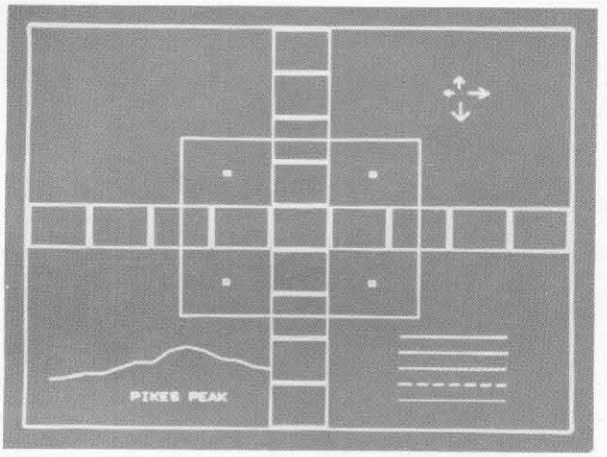
TOP: Y DAC OUTPUT A1, U17 PIN 6
BOTTOM: Y DAC OUTPUT A1, U18 PIN 6



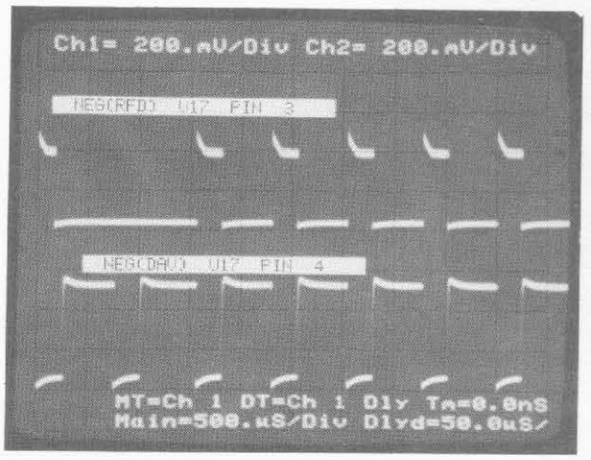
TOP: A4, U1 PIN 7
BOTTOM: A3, Q1 COLLECTOR



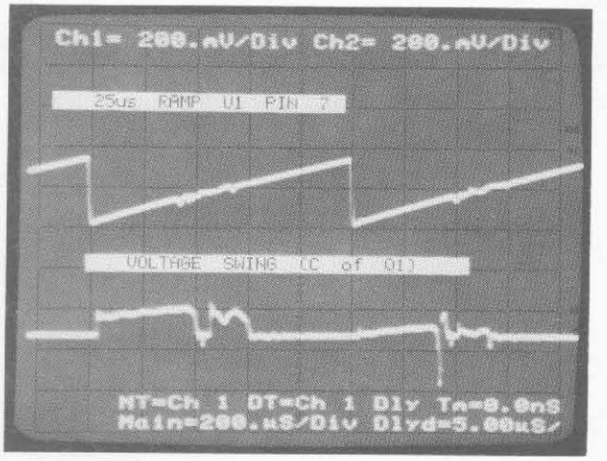
WAVEFORM MEASUREMENT CONDITION



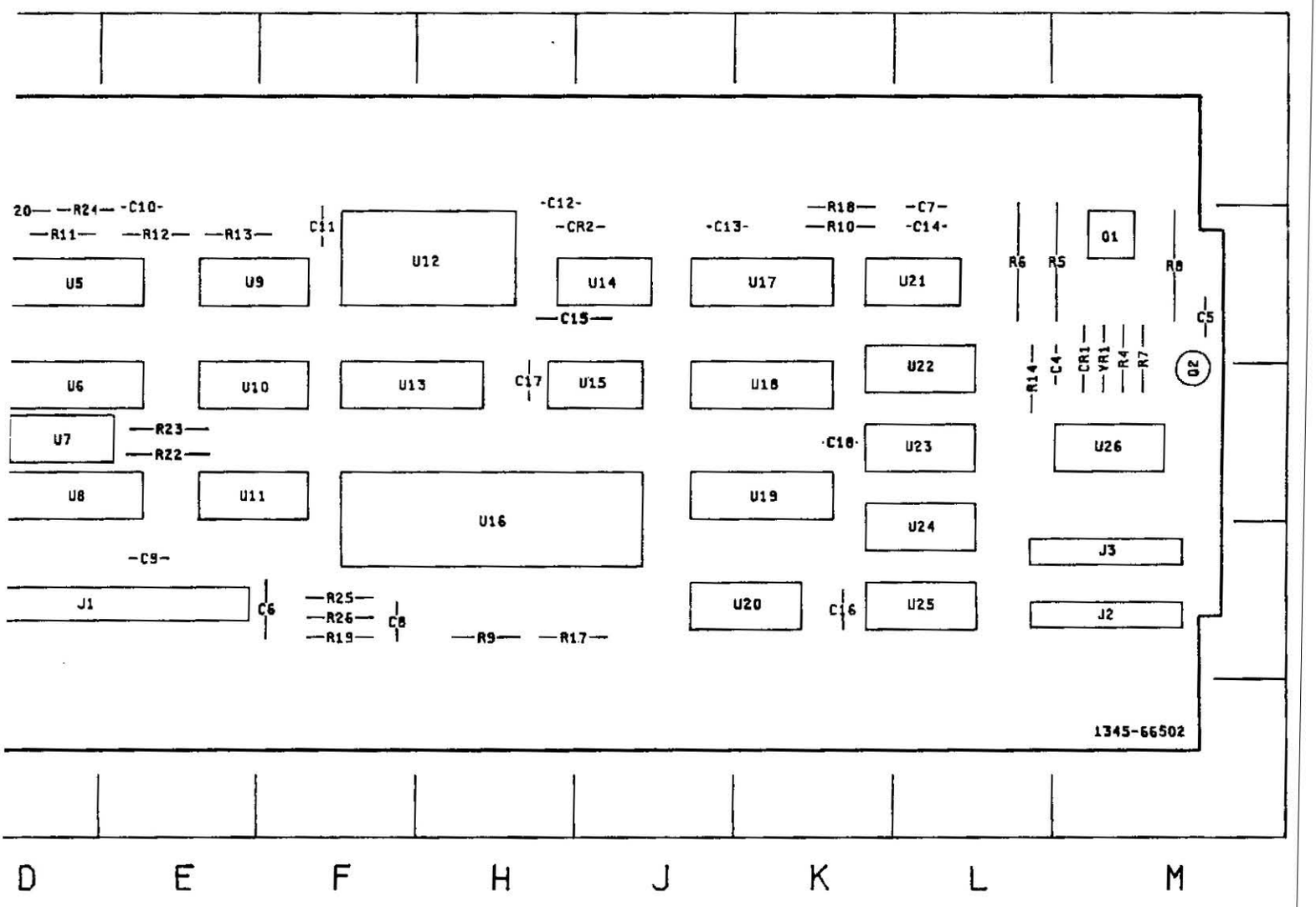
OBTAIN PRIMARY TEST PATTERN AS SHOWN ABOVE



TOP: $\overline{\text{RFD}}$ A2, U17 PIN 3
BOTTOM: $\overline{\text{DAV}}$ A2, U17 PIN 4

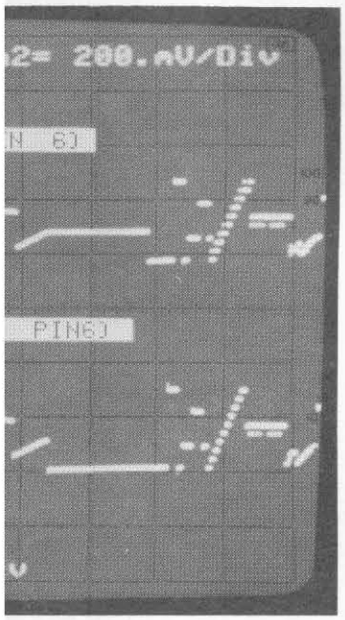


TOP: A4, U1 PIN 7
BOTTOM: A3, Q1 COLLECTOR

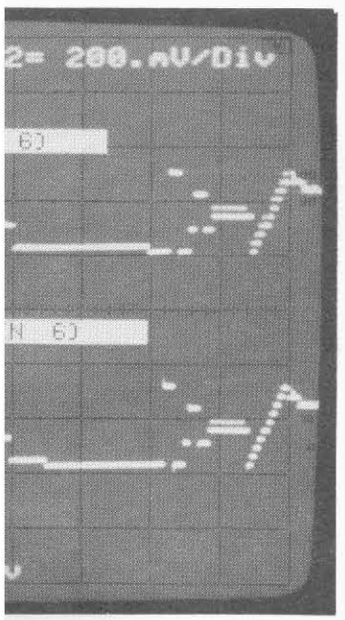


REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-4	J2	M-2	R15	B-4	U8	D-3
C2	C-4	J3	M-2	R16	D-4	U9	E 2
C3	C-4	J4	A-3	R17	J-2	U10	E-3
C4	M-4	J5	C-3	R18	K-3	U11	E 3
C5	M-4	L1	C-4	R19	F-2	U12	H-4
C6	F-2	Q1	M-4	R20	D-4	U13	F 3
C7	L-4	Q2	M-3	R21	C-2	U14	J-4
C8	F-2	R1	B-4	R22	E-3	U15	J-3
C9	E-2	R2	B-4	R23	E-3	U16	H-2
C10	E-4	R3	C-5	R24	D-4	U17	K-4
C11	F-4	R4	M-4	R25	F-2	U18	K-3
C12	H-5	R5	M-4	R26	F-2	U19	K-3
C13	J-4	R6	L-4	TP1	B-4	U20	K-2
C14	L-4	R7	M-4	U1	B-3	U21	L 4
C15	J-4	R8	M-4	U2	C-4	U22	L 3
C16	K-2	R9	H-2	U3	C-4	U23	L-3
C17	H-3	R10	K-4	U4	C-3	U24	L-2
C18	K-3	R11	D-4	U5	D-4	U25	L-2
CR1	M-4	R12	E-4	U6	D-3	U26	M-3
CR2	J-4	R13	E-4	U7	D-3	VR1	M-4
J1	D-2	R14	C-4				

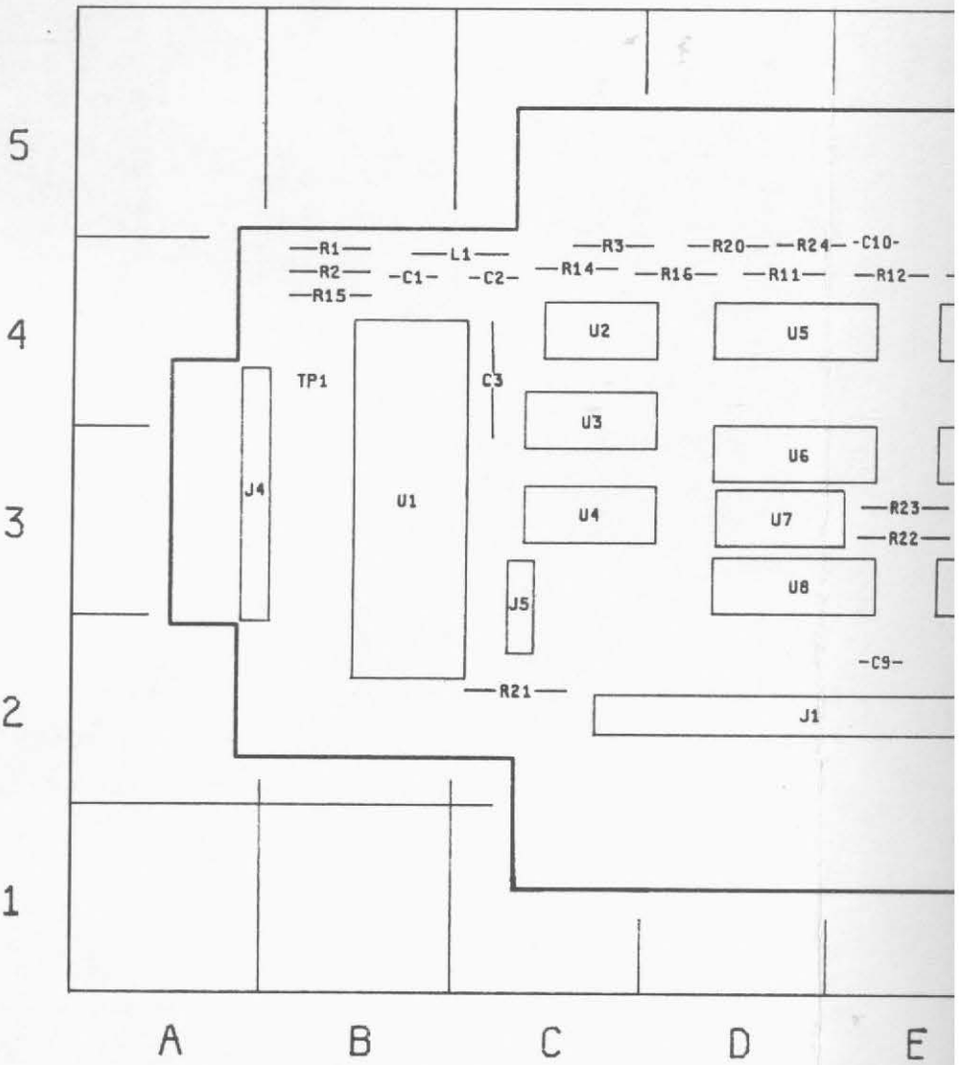
P/O Service Sheet 2, Vector Processor (A2)



U6 PIN 6
A1 U5 PIN 6

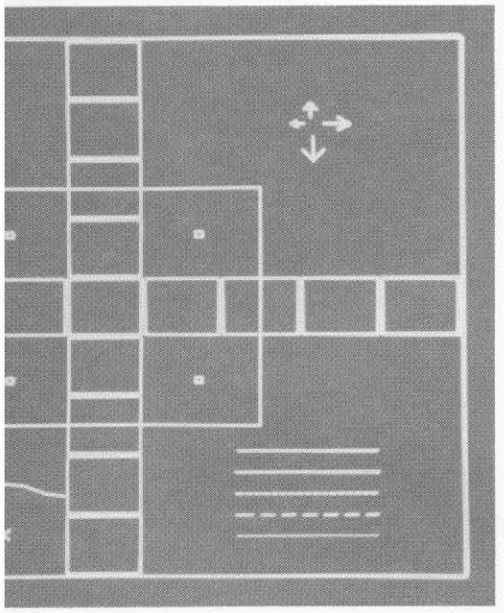


017 PIN 6
A1 U18 PIN 6

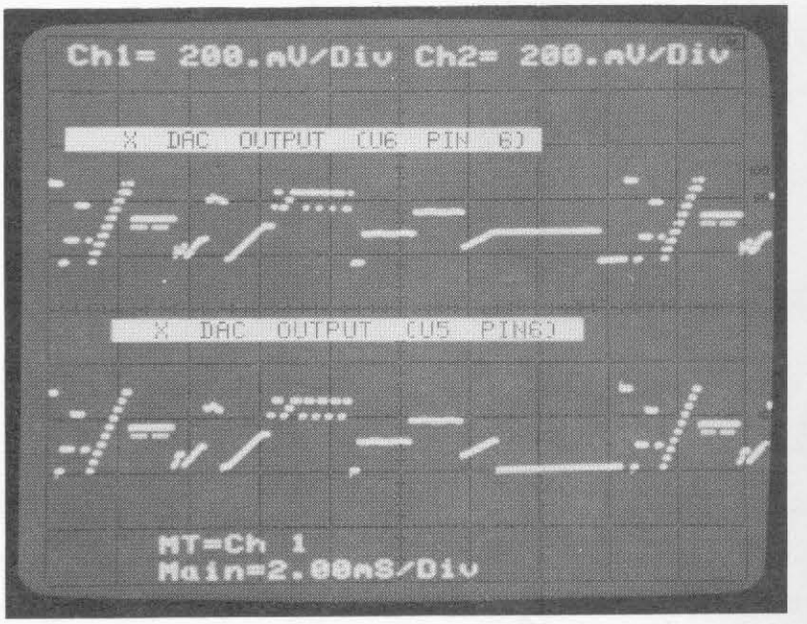


REF DESIG	GR LO
C1	B
C2	C
C3	C
C4	M
C5	M
C6	F-
C7	L-
C8	F-
C9	E-
C10	E-
C11	F-
C12	H-
C13	J-
C14	L-
C15	J-
C16	K-
C17	H-
C18	K-
CR1	M-
CR2	J-
J1	D-

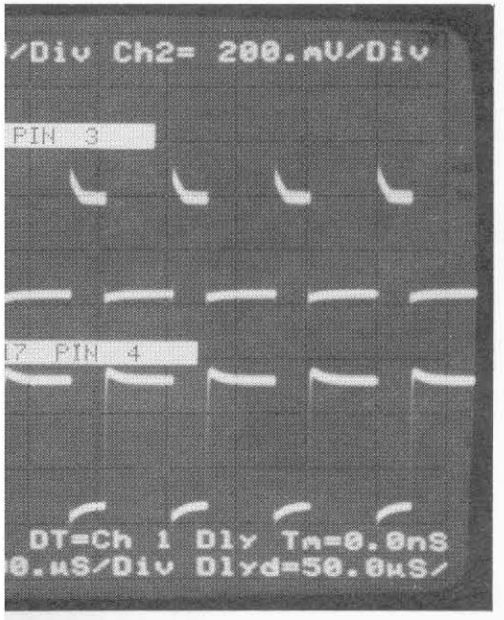
MEASUREMENT CONDITION



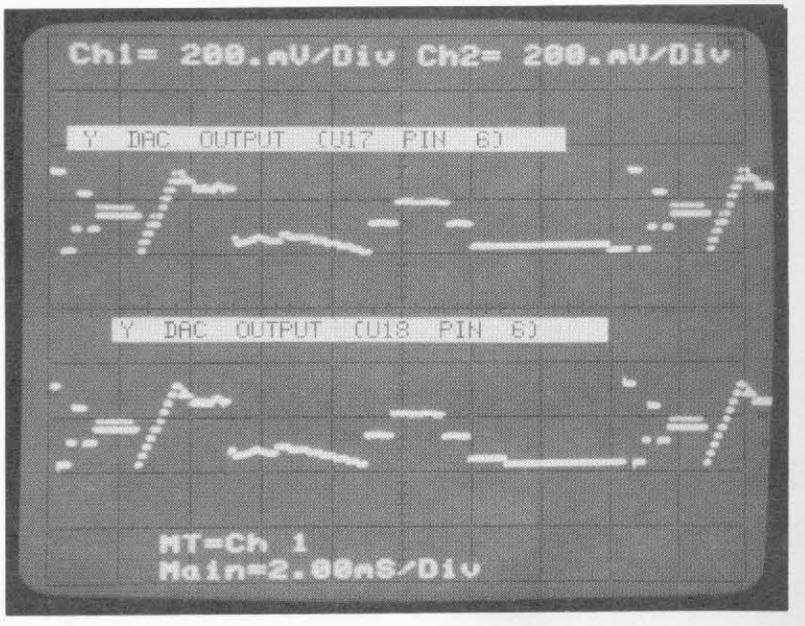
Y TEST PATTERN AS SHOWN ABOVE



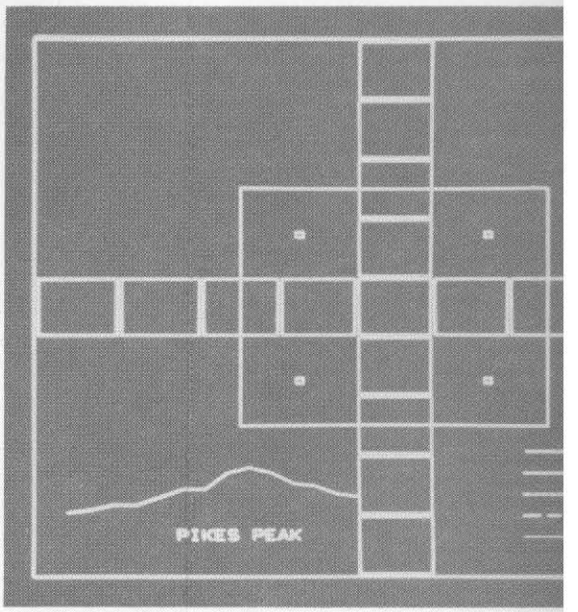
TOP: X DAC OUTPUT A1 U6 PIN 6
BOTTOM: X DAC OUTPUT A1 U5 PIN 6



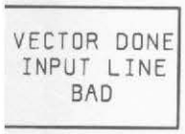
$\overline{RFD}$ A2, U17 PIN 3
TOM: $\overline{DAV}$ A2, U17 PIN 4

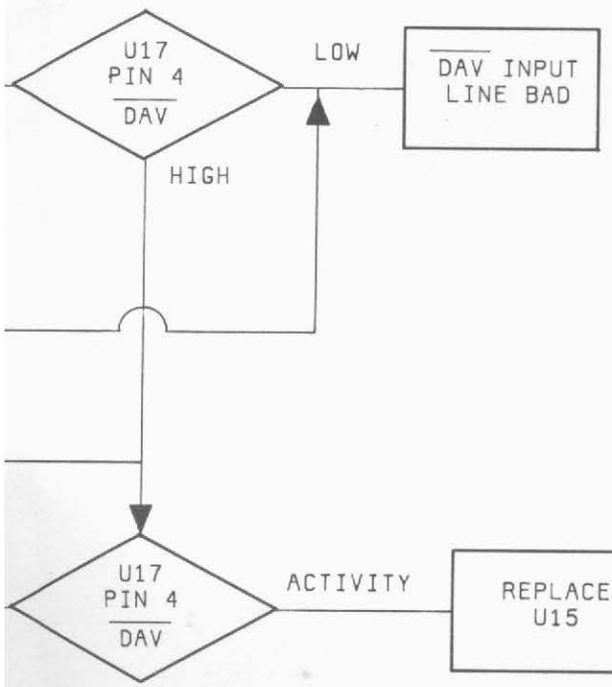


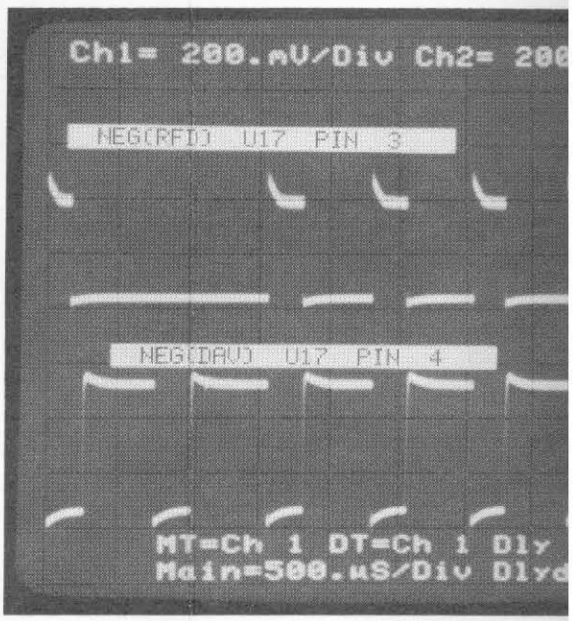
TOP: Y DAC OUTPUT A1 U17 PIN 6
BOTTOM: Y DAC OUTPUT A1 U18 PIN 6



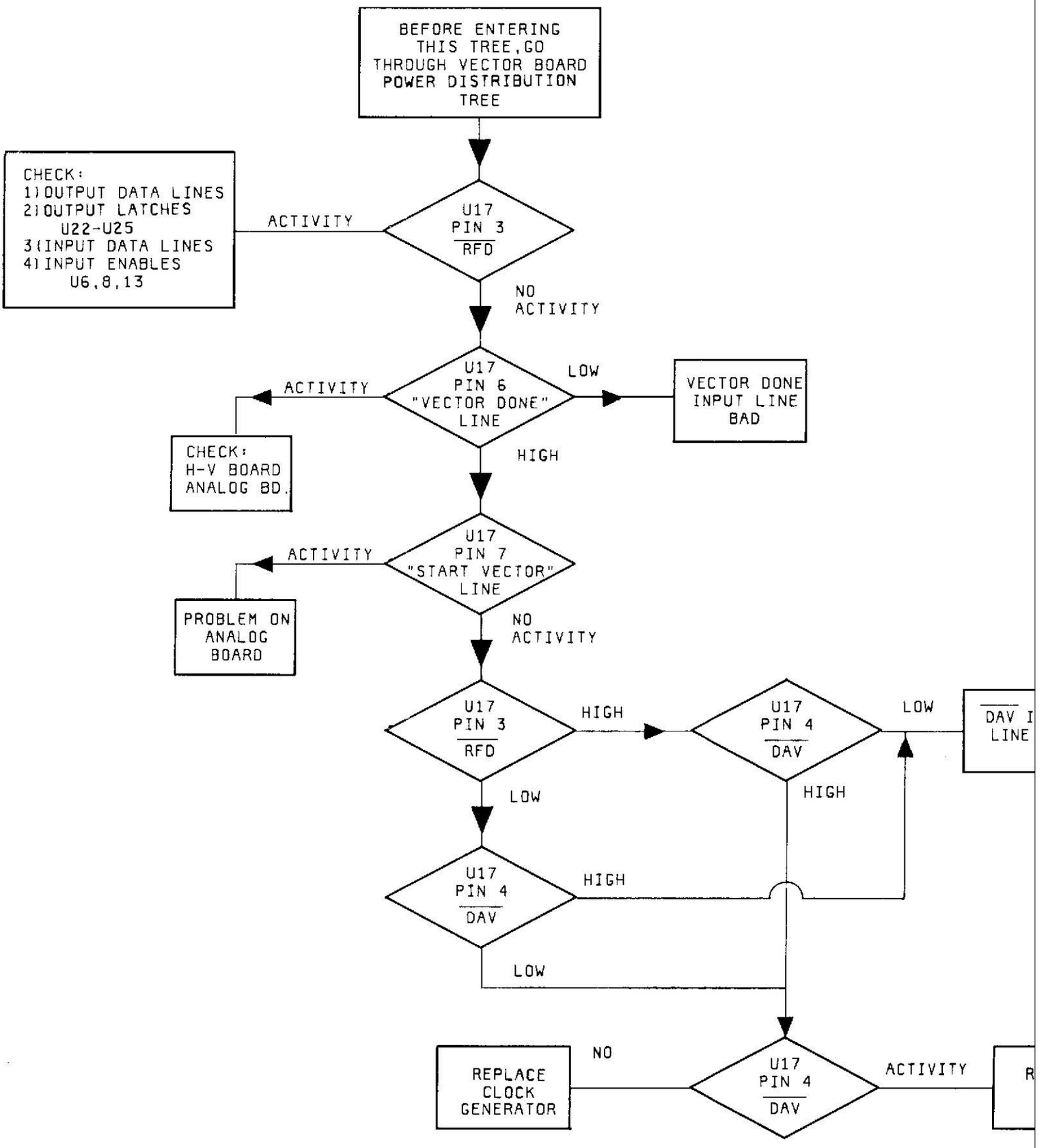
OBTAIN PRIMARY TEST PATTERN AS SHOW

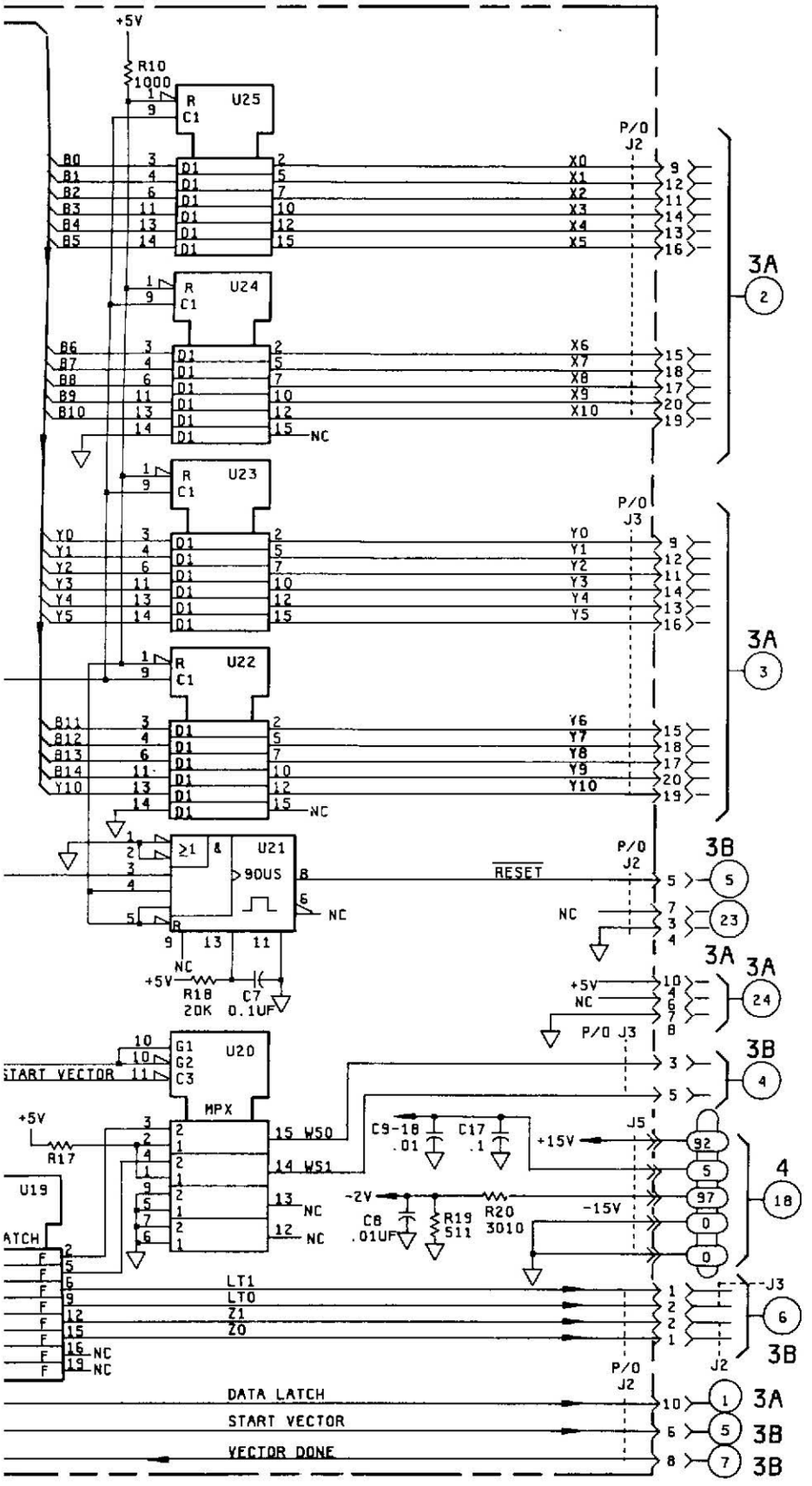




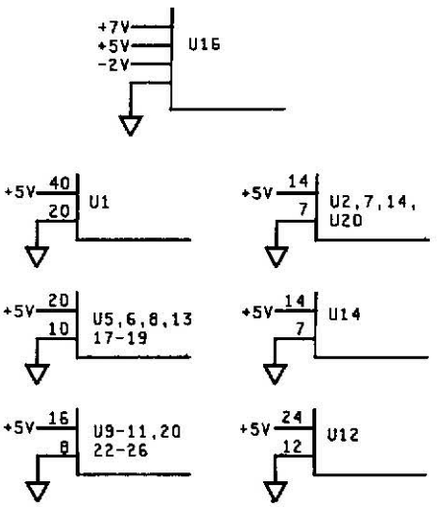


TOP: $\overline{\text{RFD}}$ A2, U17 PIN 3
BOTTOM: $\overline{\text{DAV}}$ A2, U17 PIN 4


BEFORE ENTERING THIS TREE, GO THROUGH VECTOR BOARD POWER DISTRIBUTION TREE
U17 PIN 3 RFD
ACTIVITY
CHECK:
1) OUTPUT DATA LINES
2) OUTPUT LATCHES U22-U25
3) INPUT DATA LINES
4) INPUT ENABLES U6,8,13
NO ACTIVITY
U17 PIN 6 "VECTOR DONE" LINE
ACTIVITY
LOW
VECTOR DONE INPUT LINE BAD
CHECK: H-V BOARD ANALOG BD.
HIGH
U17 PIN 7 "START VECTOR" LINE
ACTIVITY
PROBLEM ON ANALOG BOARD
NO ACTIVITY
U17 PIN 3 RFD
HIGH
U17 PIN 4 DAV
LOW
DAV I LINE
LOW
HIGH
U17 PIN 4 DAV
HIGH
LOW
REPLACE CLOCK GENERATOR
NO
U17 PIN 4 DAV
ACTIVITY
R



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. R13 SHOWN IN POSITION FOR 16K ROM. USE ALTERNATE POSITION FOR 32K ROM.
5. WHEN OPTION 704 IS INSTALLED, JUMPERS U3, AND U4 MUST BE REMOVED.

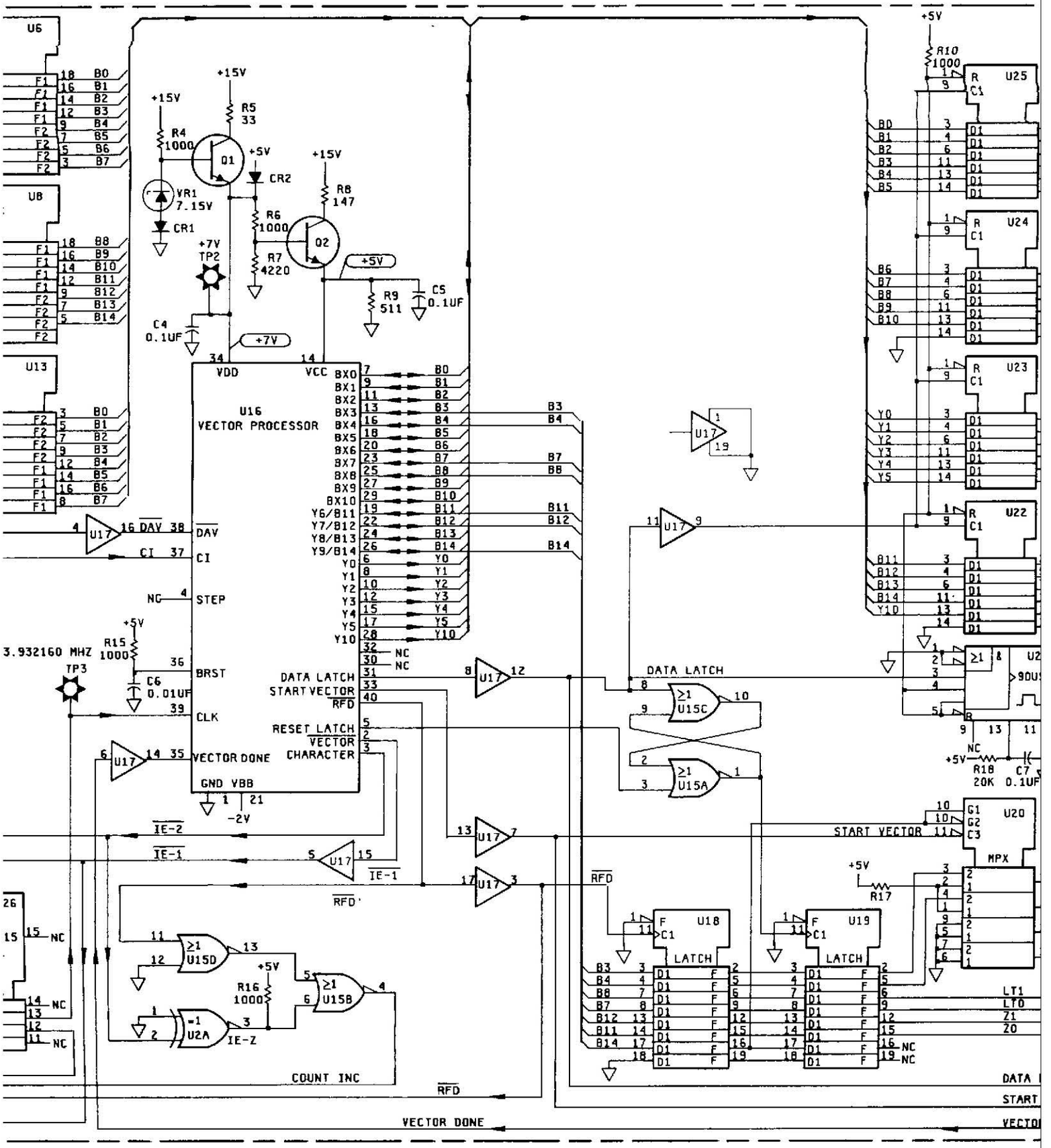
PARTS ON THIS SCHEMATI

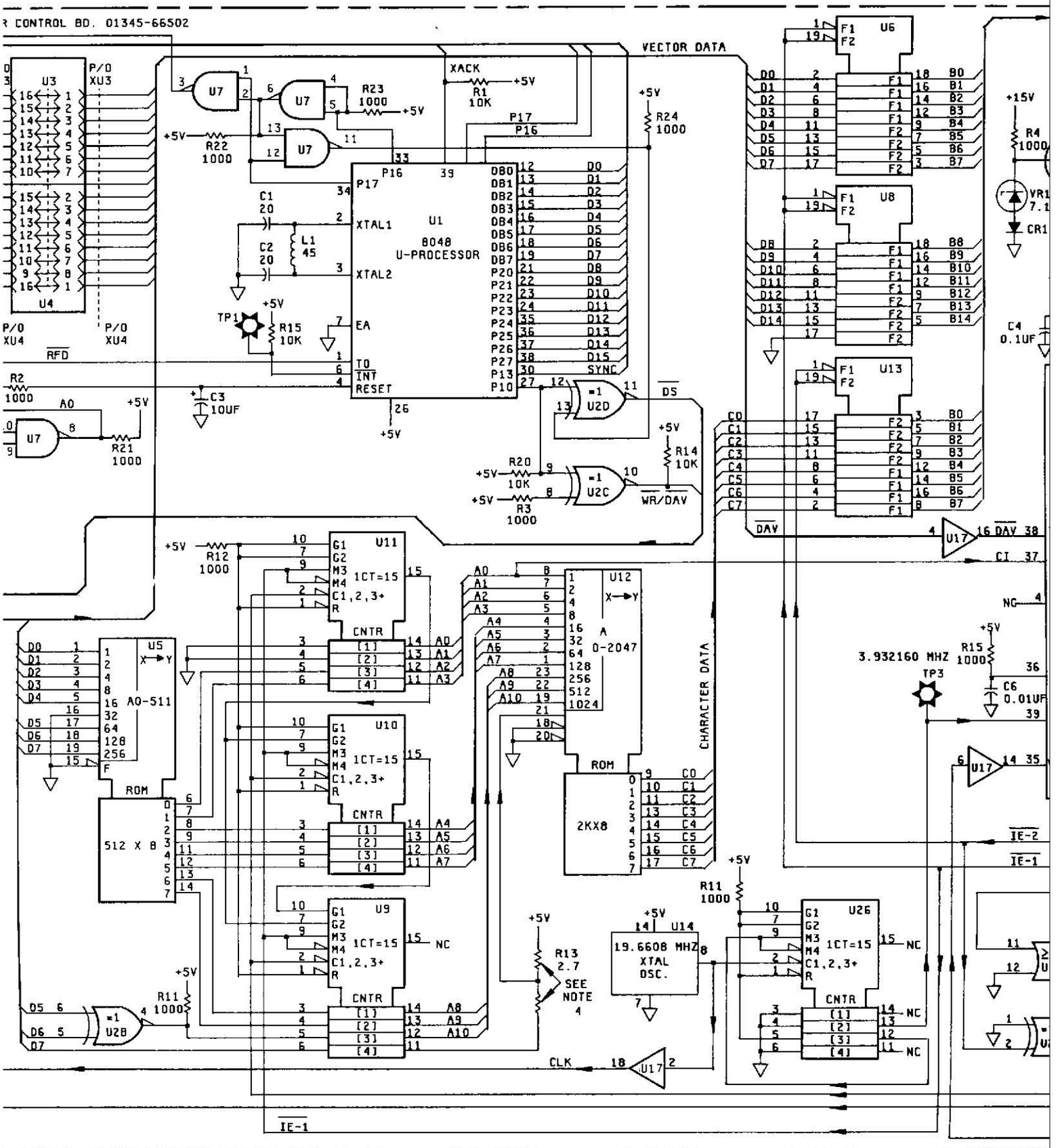
A2	
C1-8,17	R1-23
CR1,2	U1-26
J1-3,5	VR1
L1	W1
P1	XU3,XU4
Q1,2	

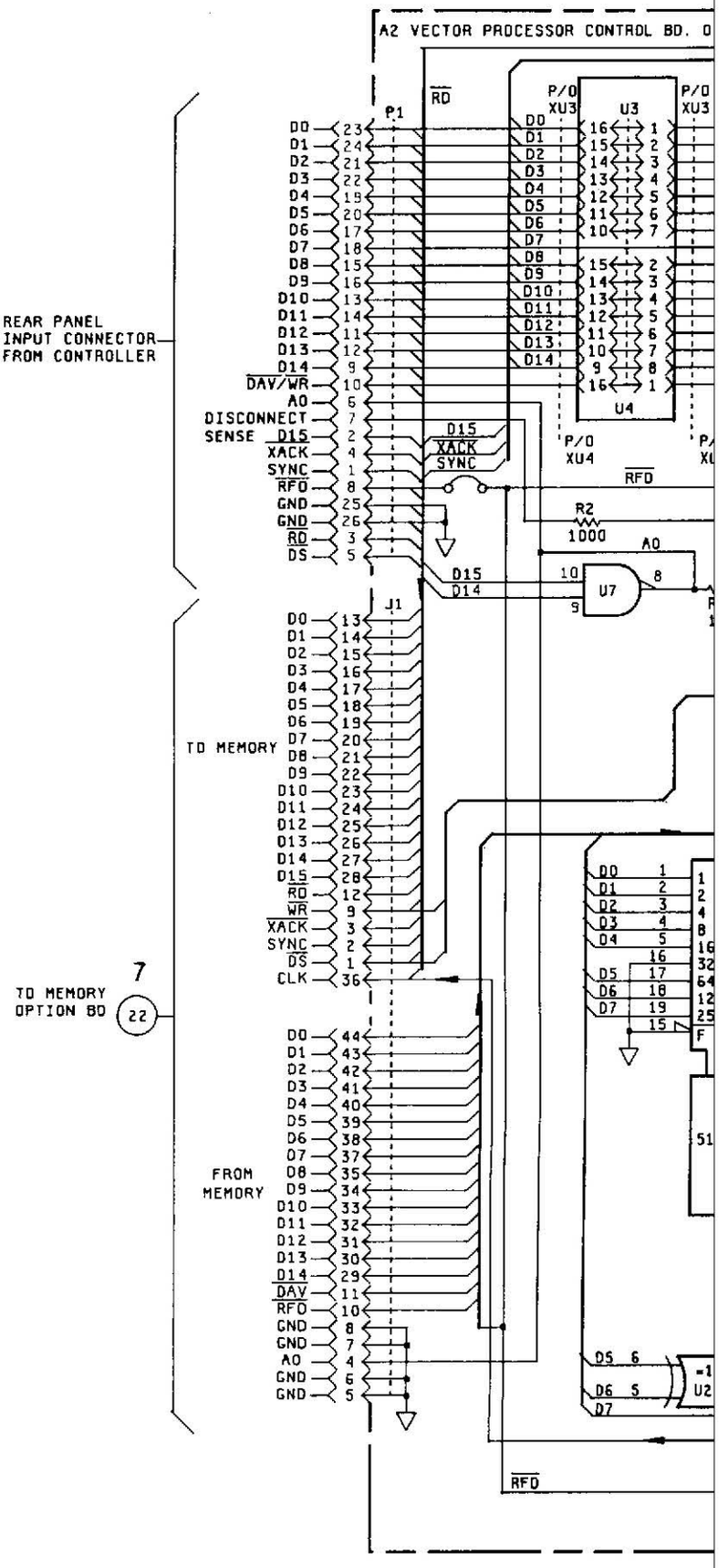
SERVICE SHEET

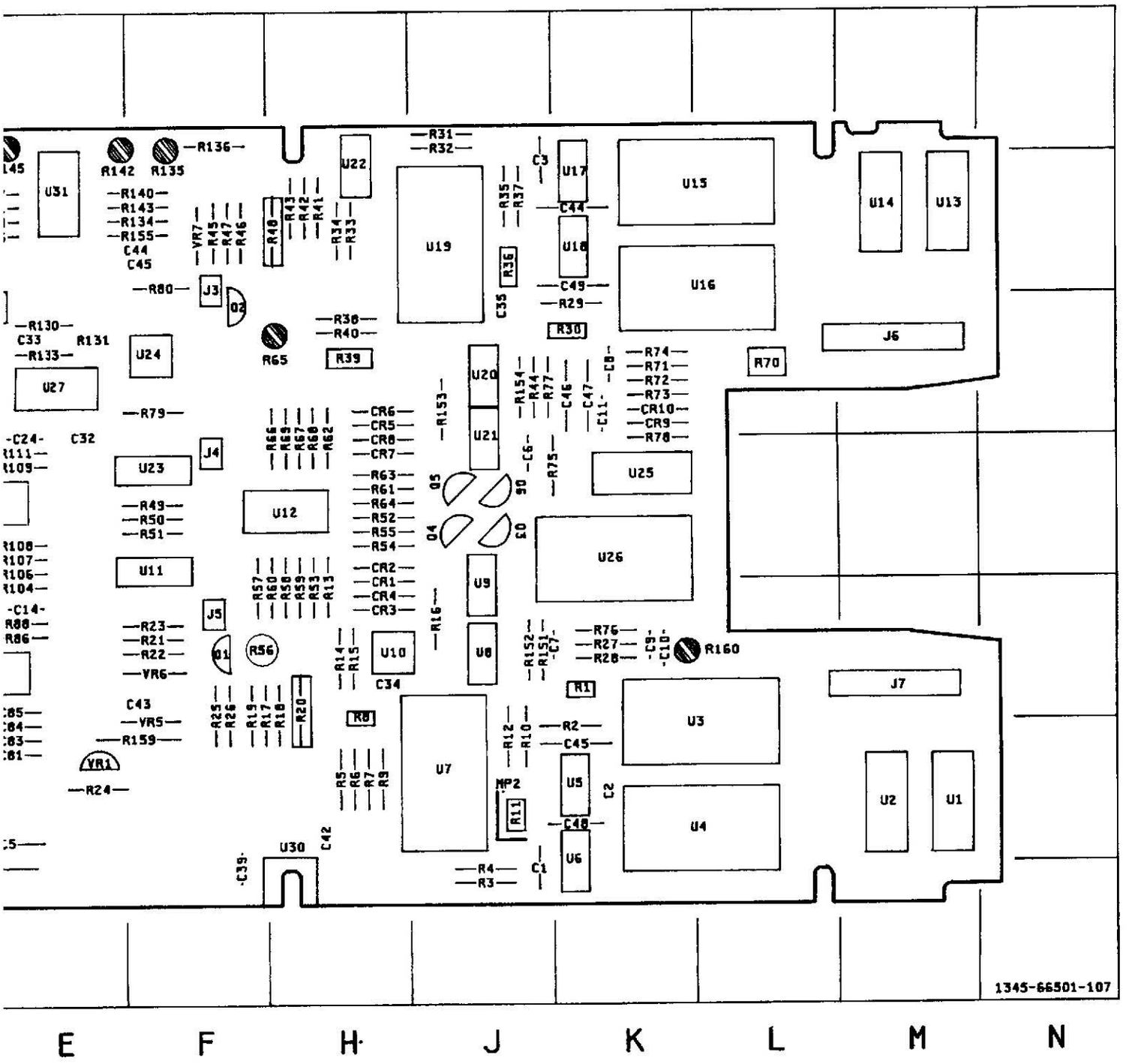
1345/106/CLG/04-16-

Figure 7
Service Sheet 2, Vector Processor (A

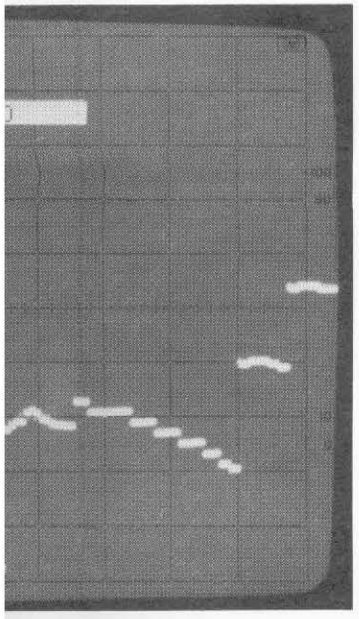

U16
VECTOR PROCESSOR
VDD
VCC
GND VBB
DAV
CI
STEP
BRST
CLK
VECTOR DONE
DATA LATCH
START VECTOR
RFD
RESET LATCH
VECTOR CHARACTER
BX0
BX1
BX2
BX3
BX4
BX5
BX6
BX7
BX8
BX9
BX10
Y6/B11
Y7/B12
Y8/B13
Y9/B14
Y0
Y1
Y2
Y3
Y4
Y5
Y10
U5
U6
U8
U13
U17
U15A
U15B
U15C
U15D
U18
U19
U20
U23
U24
U25
U2A
Q1
Q2
CR1
CR2
VR1
7.15V
R4
1000
R5
33
R6
1000
R7
4220
R8
147
R9
511
R10
1000
R15
1000
R16
1000
R17
R18
20K
C4
0.1UF
C5
0.1UF
C6
0.01UF
C7
0.1UF
TP2
TP3
+15V
+7V
+5V
-2V
3.932160 MHZ
LATCH
MPX
IE-2
IE-1
IE-Z
COUNT INC
VECTOR DONE
START VECTOR
LT1
LT0
Z1
Z0


R CONTROL BD. 01345-66502
VECTOR DATA
U1
8048
U-PROCESSOR
XTAL1
XTAL2
RESET
INT
EA
SYNC
XACK
R1
10K
R23
1000
R22
1000
R24
1000
R2
1000
R21
1000
R20
10K
R3
1000
R14
10K
R15
10K
C1
20
C2
20
L1
45
C3
10UF
TP1
RFD
WR/DAV
DS
DAV
U2D
U2C
U2B
U3
U4
P/O
XU3
P/O
XU4
U5
A0-511
ROM
512 X 8
U6
U8
U13
U17
U9
U10
U11
U12
CNTR
1CT=15
A
0-2047
2KX8
CHARACTER DATA
U14
19.6608 MHZ
XTAL
OSC.
R13
2.7
SEE
NOTE
4
R11
1000
R12
1000
R4
1000
CR1
C4
0.1UF
C6
0.01UF
TP3
3.932160 MHZ
CLK
IE-1
IE-2
NC

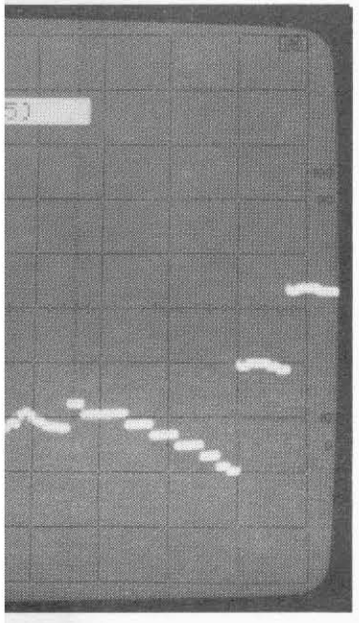

A2 VECTOR PROCESSOR CONTROL BD. 0
REAR PANEL
INPUT CONNECTOR
FROM CONTROLLER
P1
RD
P/O XU3
U3
U4
P/O XU4
RFD
R2
1000
A0
U7
J1
TO MEMORY
FROM MEMORY
TO MEMORY OPTION BD
7
22
DISCONNECT SENSE
XACK
SYNC
DAV/WR
DAV
RFO
GND
DS
CLK
WR



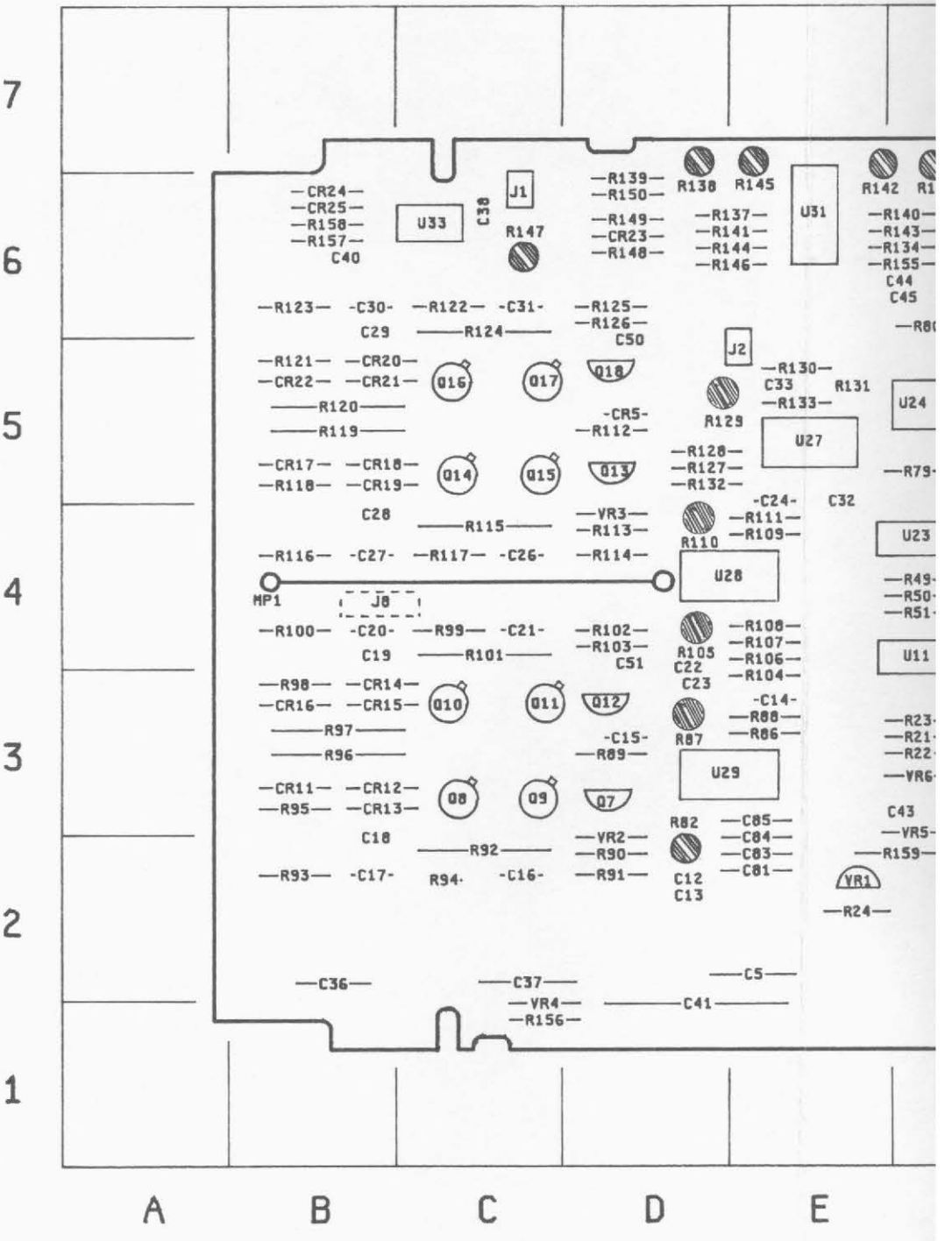
P/O Service Sheet 3A, X-Y-Z Amp/Stroke Generator (A1)



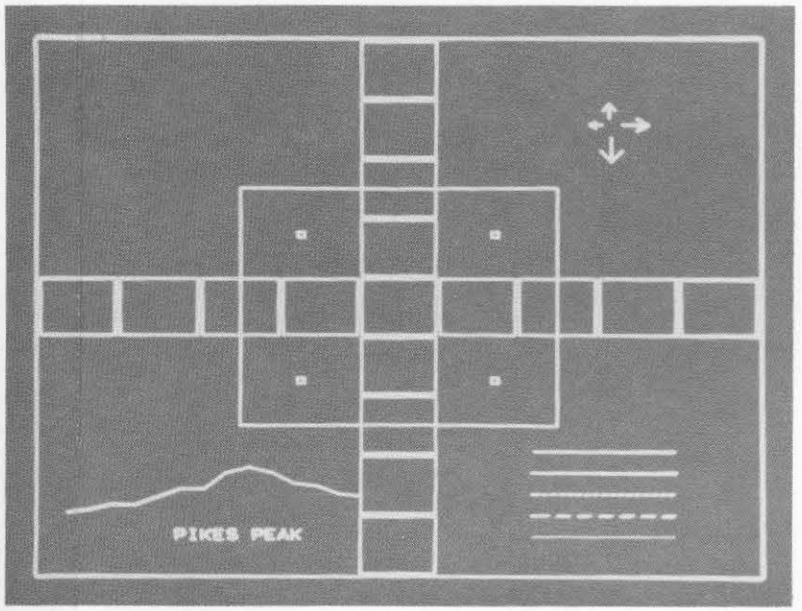
AT A1J4



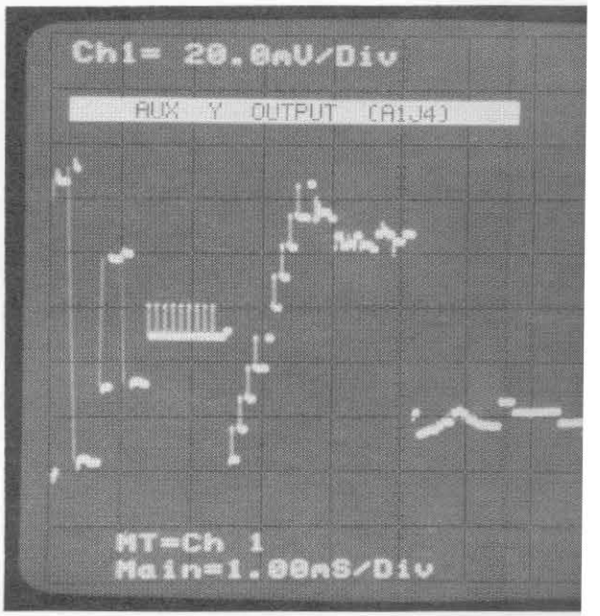
AT A1J5



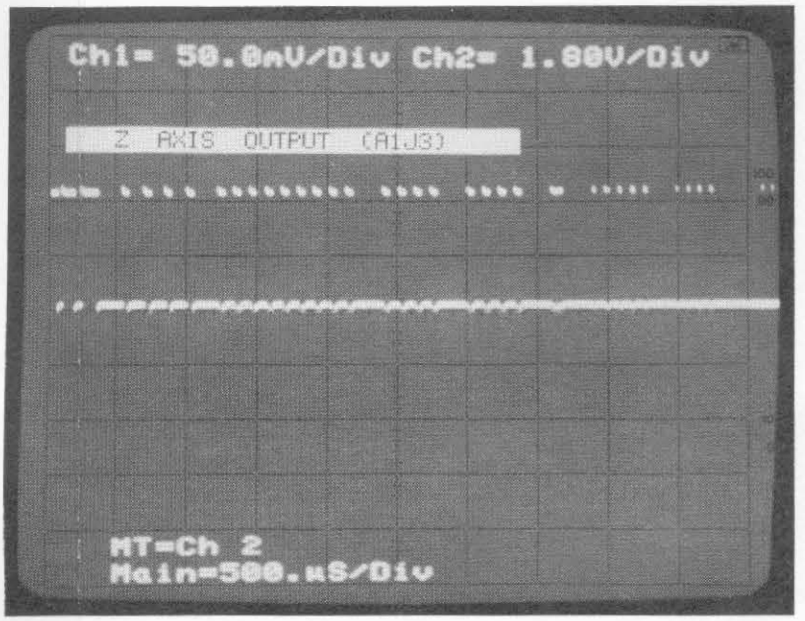
WAVEFORM MEASUREMENT CONDITION



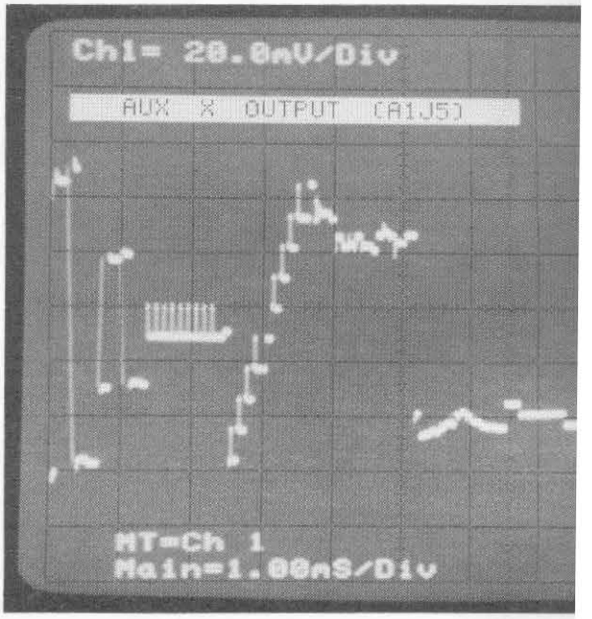
OBTAIN PRIMARY TEST PATTERN AS SHOWN ABOVE



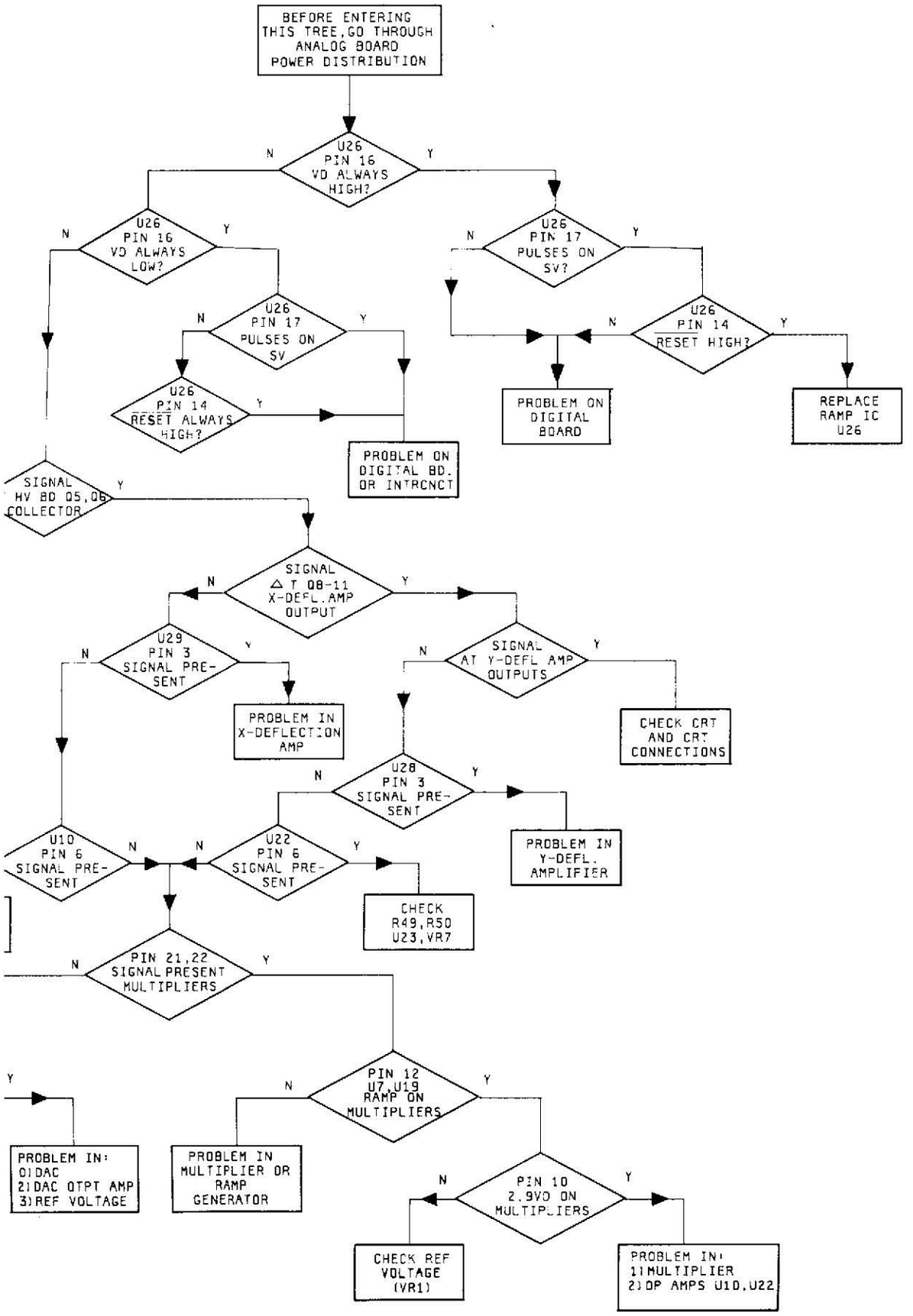
Y AUX OUTPUT AT A1J4

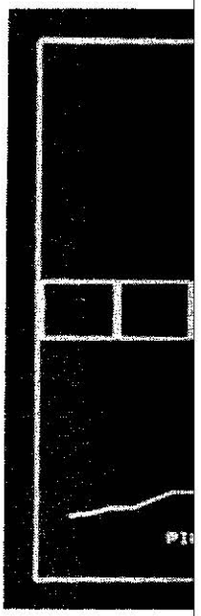


Z AUX OUTPUT AT A1J3



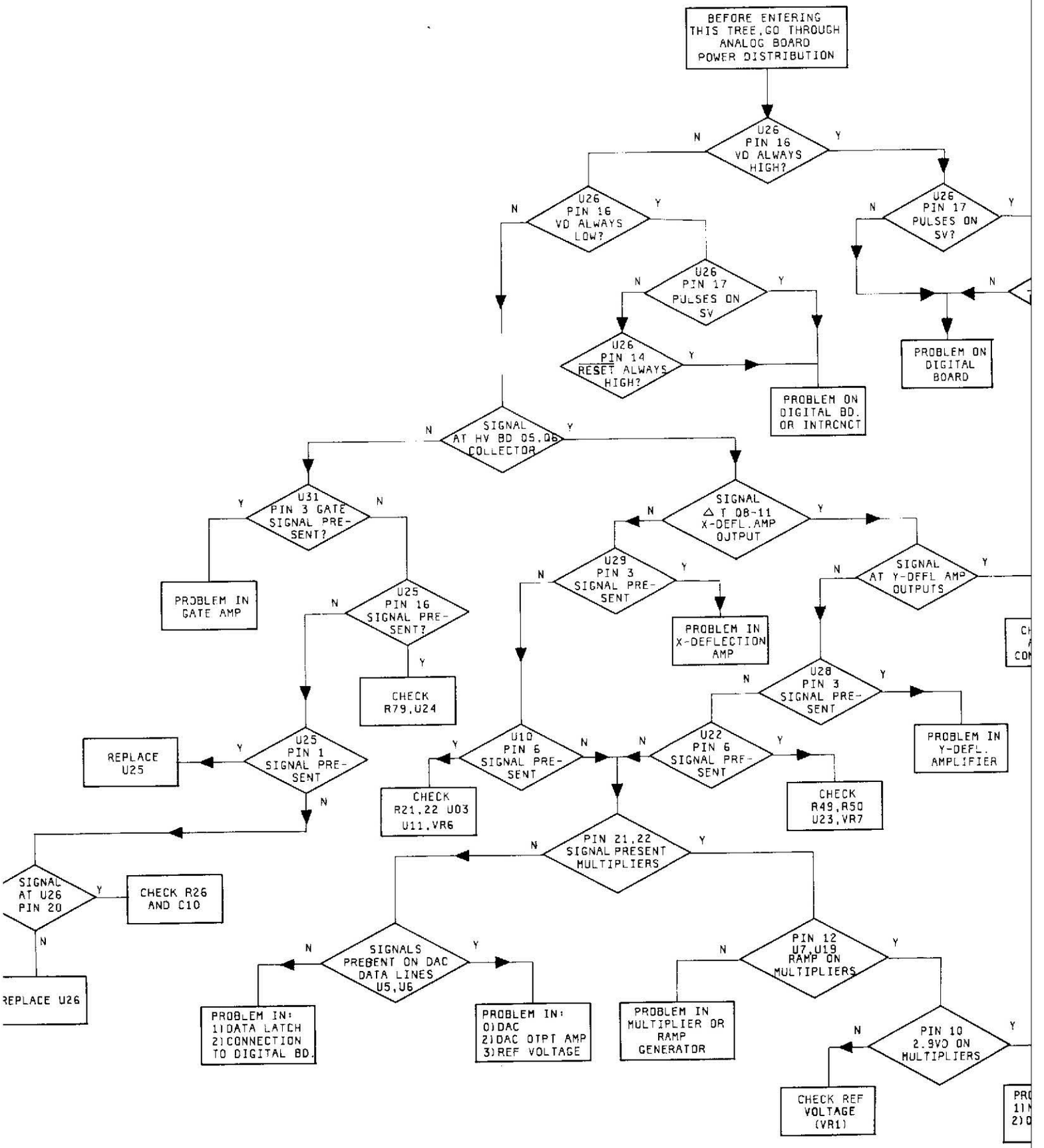
X AUX OUTPUT AT A1J5

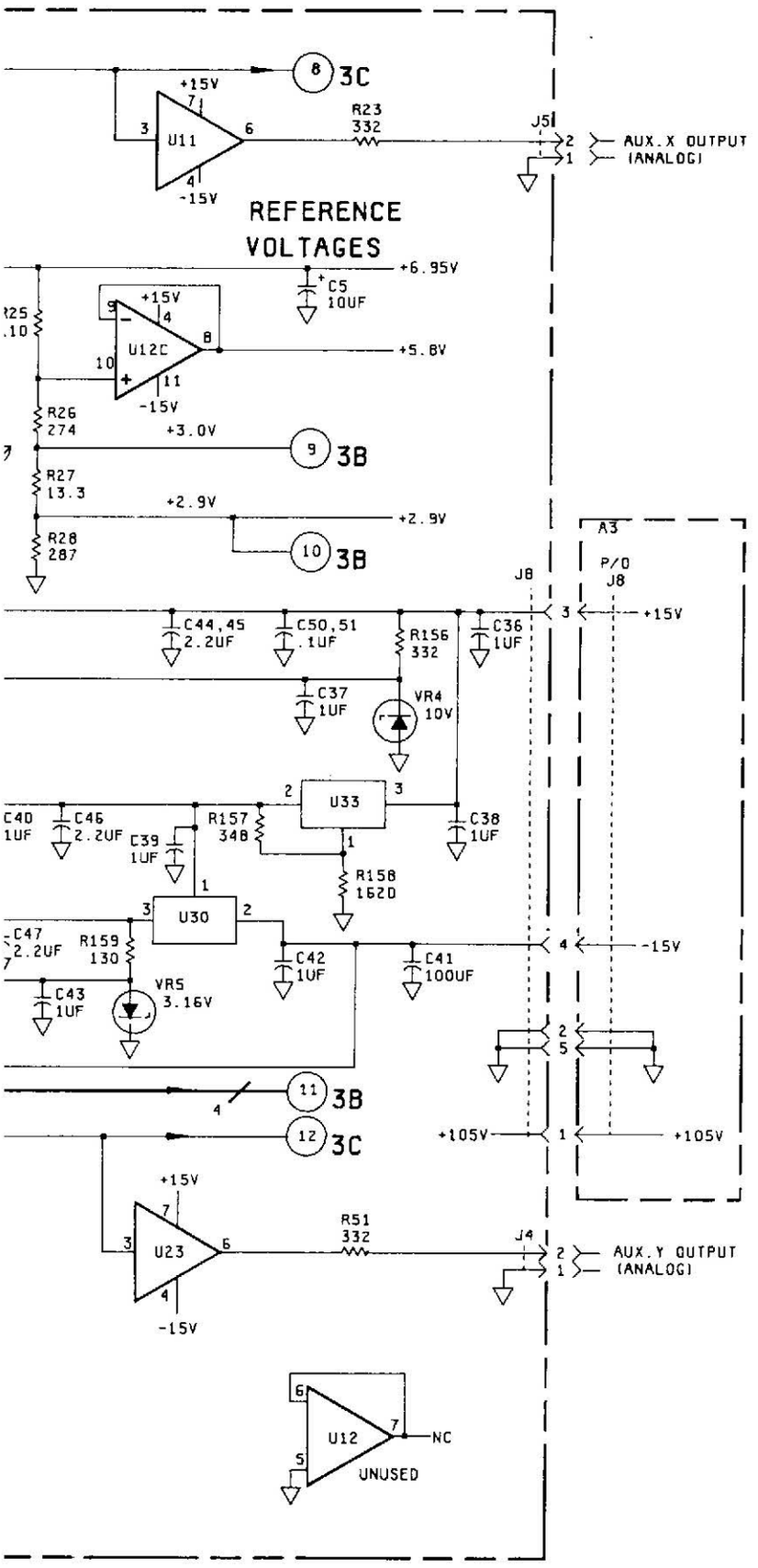

BEFORE ENTERING THIS TREE, GO THROUGH ANALOG BOARD POWER DISTRIBUTION
U26 PIN 16 VD ALWAYS HIGH?
U26 PIN 16 VD ALWAYS LOW?
U26 PIN 17 PULSES ON SV?
U26 PIN 17 PULSES ON SV
U26 PIN 14 RESET ALWAYS HIGH?
U26 PIN 14 RESET HIGH?
PROBLEM ON DIGITAL BOARD
REPLACE RAMP IC U26
PROBLEM ON DIGITAL BD. OR INTRCNCT
SIGNAL HV BD Q5,Q6 COLLECTOR
SIGNAL △ T Q8-11 X-DEFL.AMP OUTPUT
U29 PIN 3 SIGNAL PRE-SENT
PROBLEM IN X-DEFLECTION AMP
SIGNAL AT Y-DEFL AMP OUTPUTS
CHECK CRT AND CRT CONNECTIONS
U28 PIN 3 SIGNAL PRE-SENT
PROBLEM IN Y-DEFL. AMPLIFIER
U10 PIN 6 SIGNAL PRE-SENT
U22 PIN 6 SIGNAL PRE-SENT
CHECK R49,R50 U23,VR7
PIN 21,22 SIGNAL PRESENT MULTIPLIERS
PIN 12 U7,U19 RAMP ON MULTIPLIERS
PROBLEM IN: 0)DAC 2)DAC OTPT AMP 3)REF VOLTAGE
PROBLEM IN MULTIPLIER OR RAMP GENERATOR
PIN 10 2.9VD ON MULTIPLIERS
CHECK REF VOLTAGE (VR1)
PROBLEM IN: 1)MULTIPLIER 2)OP AMPS U1D,U22
N
Y



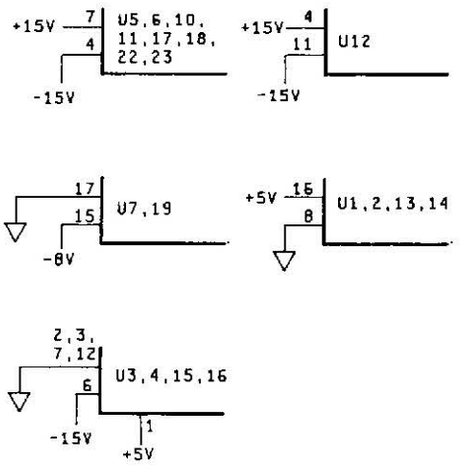
OBTAIN


Ch1= 5
MT=C
Main=


BEFORE ENTERING THIS TREE, GO THROUGH ANALOG BOARD POWER DISTRIBUTION
U26 PIN 16 VD ALWAYS HIGH?
N
Y
U26 PIN 16 VD ALWAYS LOW?
U26 PIN 17 PULSES ON SV?
U26 PIN 17 PULSES ON SV
U26 PIN 14 RESET ALWAYS HIGH?
PROBLEM ON DIGITAL BOARD
PROBLEM ON DIGITAL BD. OR INTRCNCT
SIGNAL AT HV BD Q5,Q6 COLLECTOR
U31 PIN 3 GATE SIGNAL PRE-SENT?
PROBLEM IN GATE AMP
U25 PIN 16 SIGNAL PRE-SENT?
CHECK R79,U24
SIGNAL △ T Q8-11 X-DEFL.AMP OUTPUT
U29 PIN 3 SIGNAL PRE-SENT
PROBLEM IN X-DEFLECTION AMP
SIGNAL AT Y-DEFL AMP OUTPUTS
U28 PIN 3 SIGNAL PRE-SENT
PROBLEM IN Y-DEFL. AMPLIFIER
U25 PIN 1 SIGNAL PRE-SENT
REPLACE U25
U10 PIN 6 SIGNAL PRE-SENT
CHECK R21,22 U03 U11,VR6
U22 PIN 6 SIGNAL PRE-SENT
CHECK R49,R50 U23,VR7
PIN 21,22 SIGNAL PRESENT MULTIPLIERS
SIGNAL AT U26 PIN 20
CHECK R26 AND C10
REPLACE U26
SIGNALS PRESENT ON DAC DATA LINES U5,U6
PROBLEM IN: 1)DATA LATCH 2)CONNECTION TO DIGITAL BD.
PROBLEM IN: 0)DAC 2)DAC OTPT AMP 3)REF VOLTAGE
PIN 12 U7,U19 RAMP ON MULTIPLIERS
PROBLEM IN MULTIPLIER OR RAMP GENERATOR
PIN 10 2.9VD ON MULTIPLIERS
CHECK REF VOLTAGE (VR1)



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

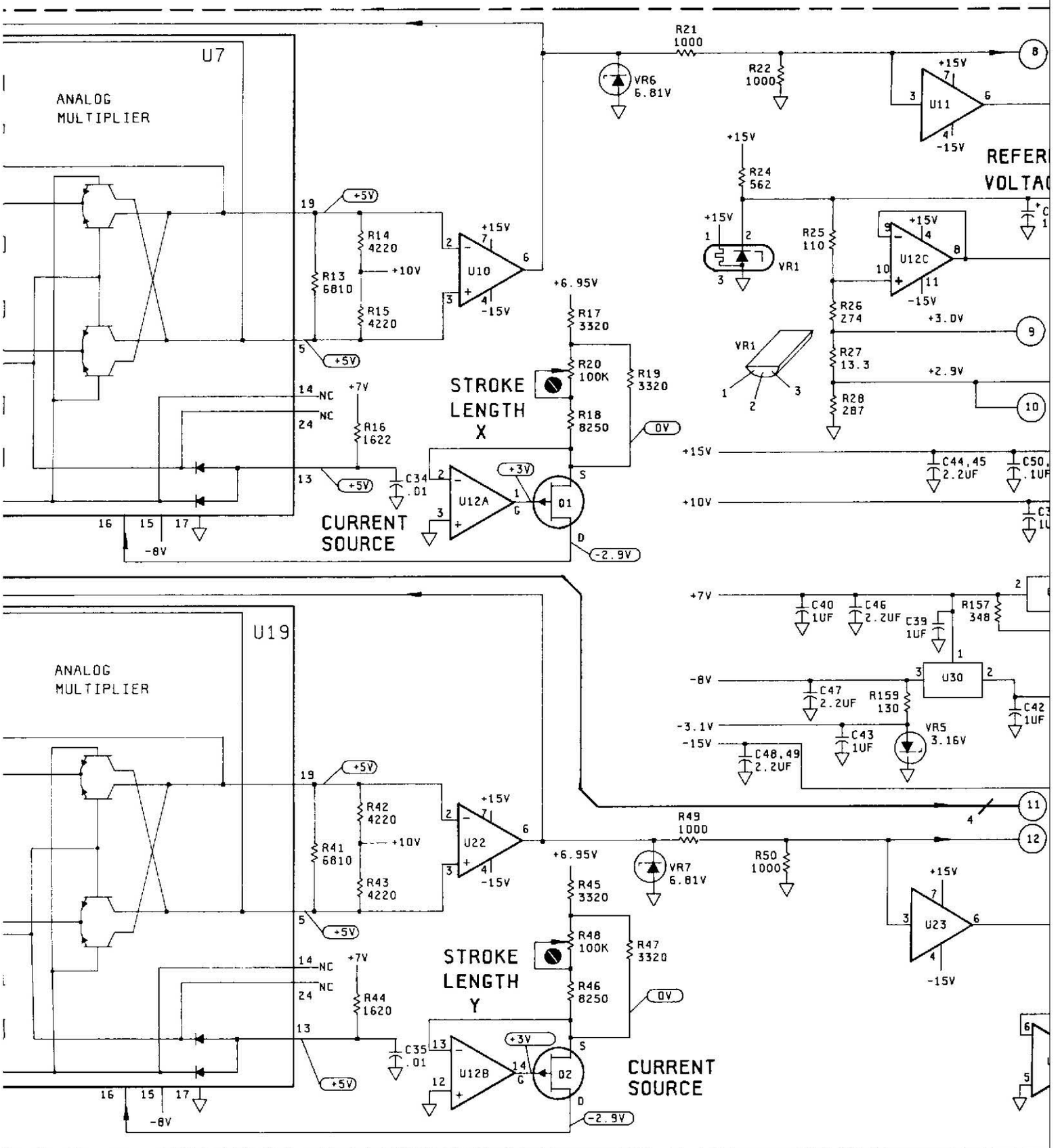
P/O A1

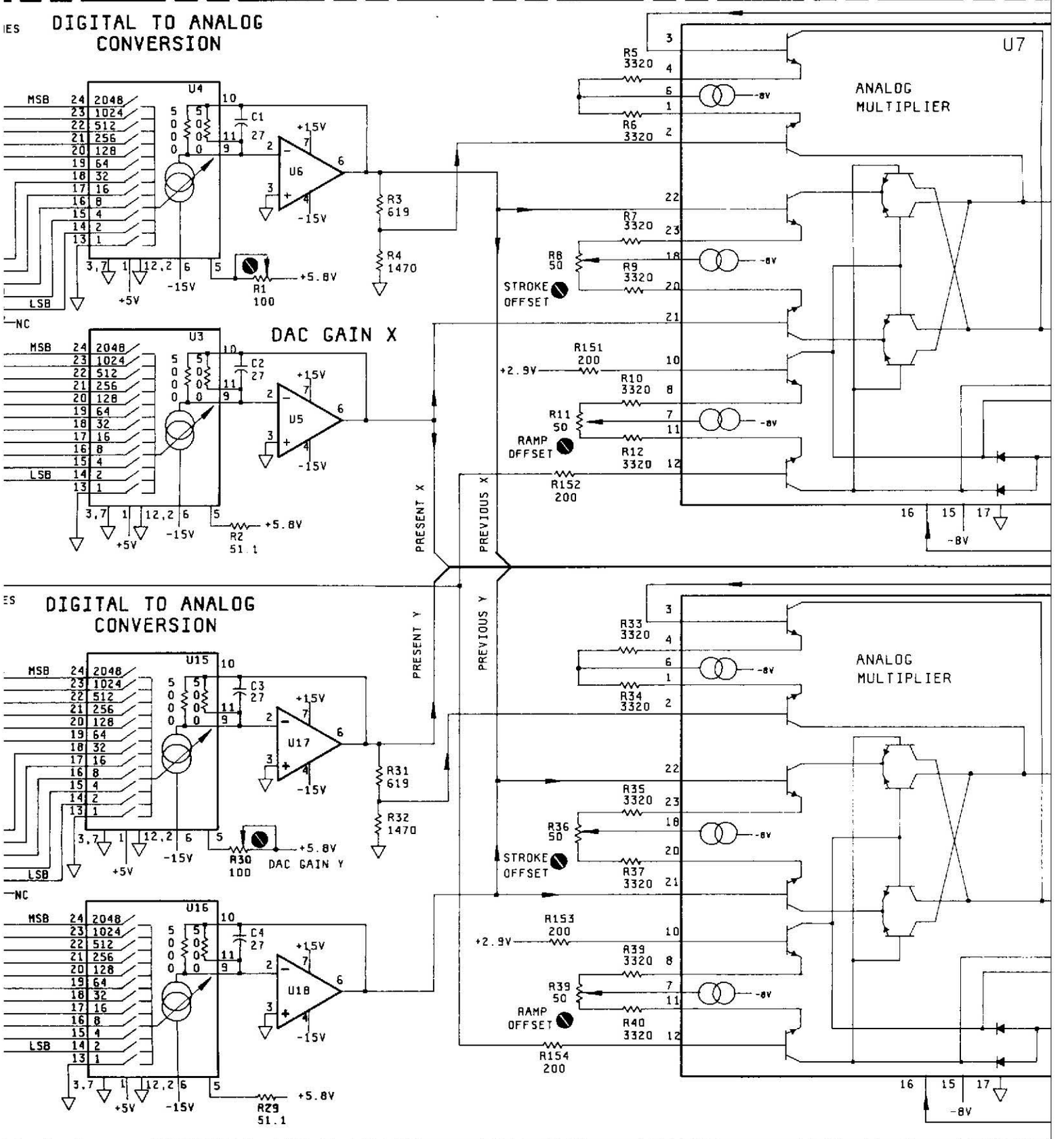
C1-5,34-51
J4-7
Q1,2
R1-51,151-154,156-159
U1-7,10-19,22,23,30,33
VR1,4,5

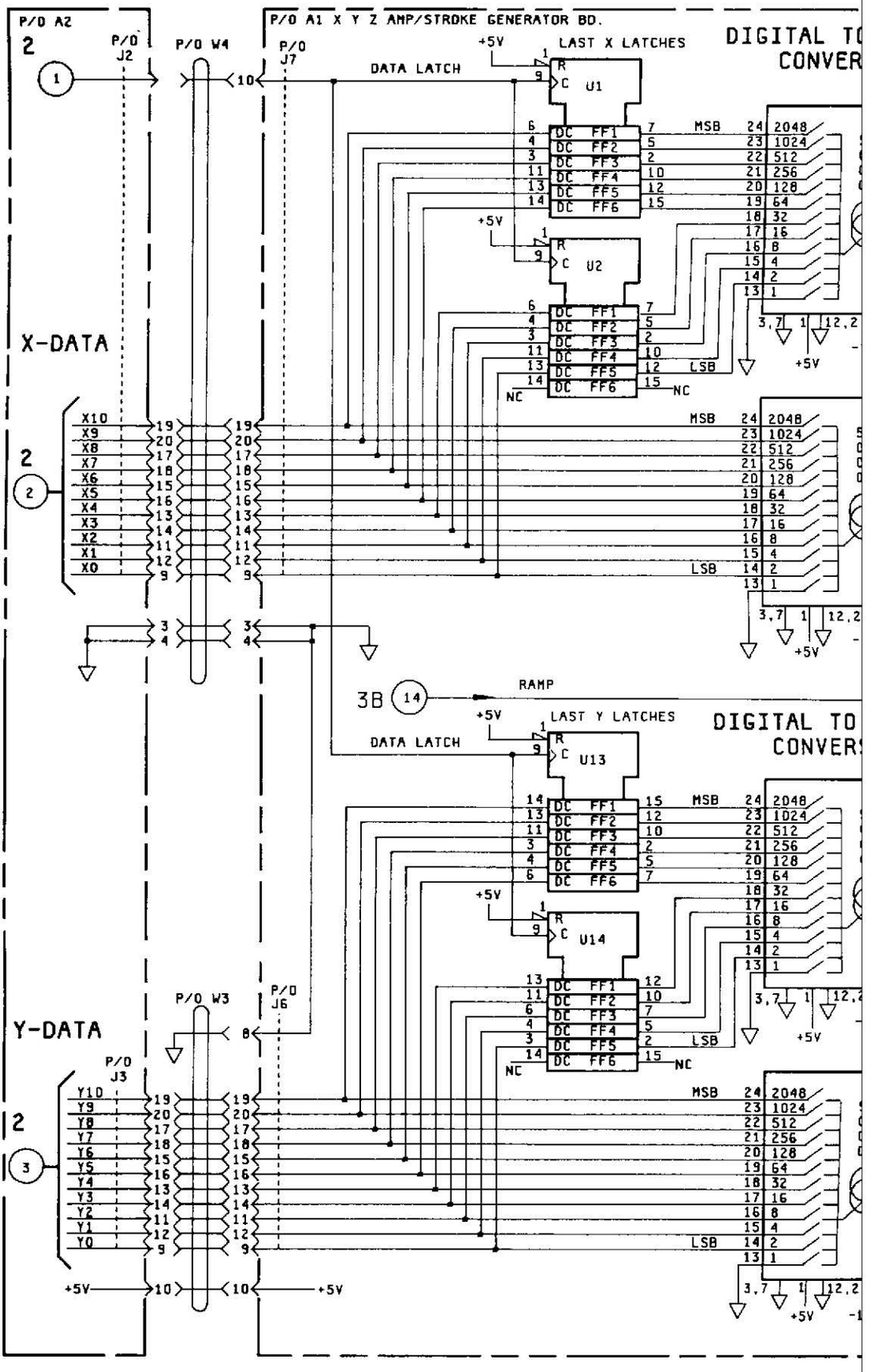
SERVICE SHEET 3A

1345/100/CLG/04-09-81

Figure 7-5.
Service Sheet 3A, X-Y-Z Amp/Stroke Generator (A1)

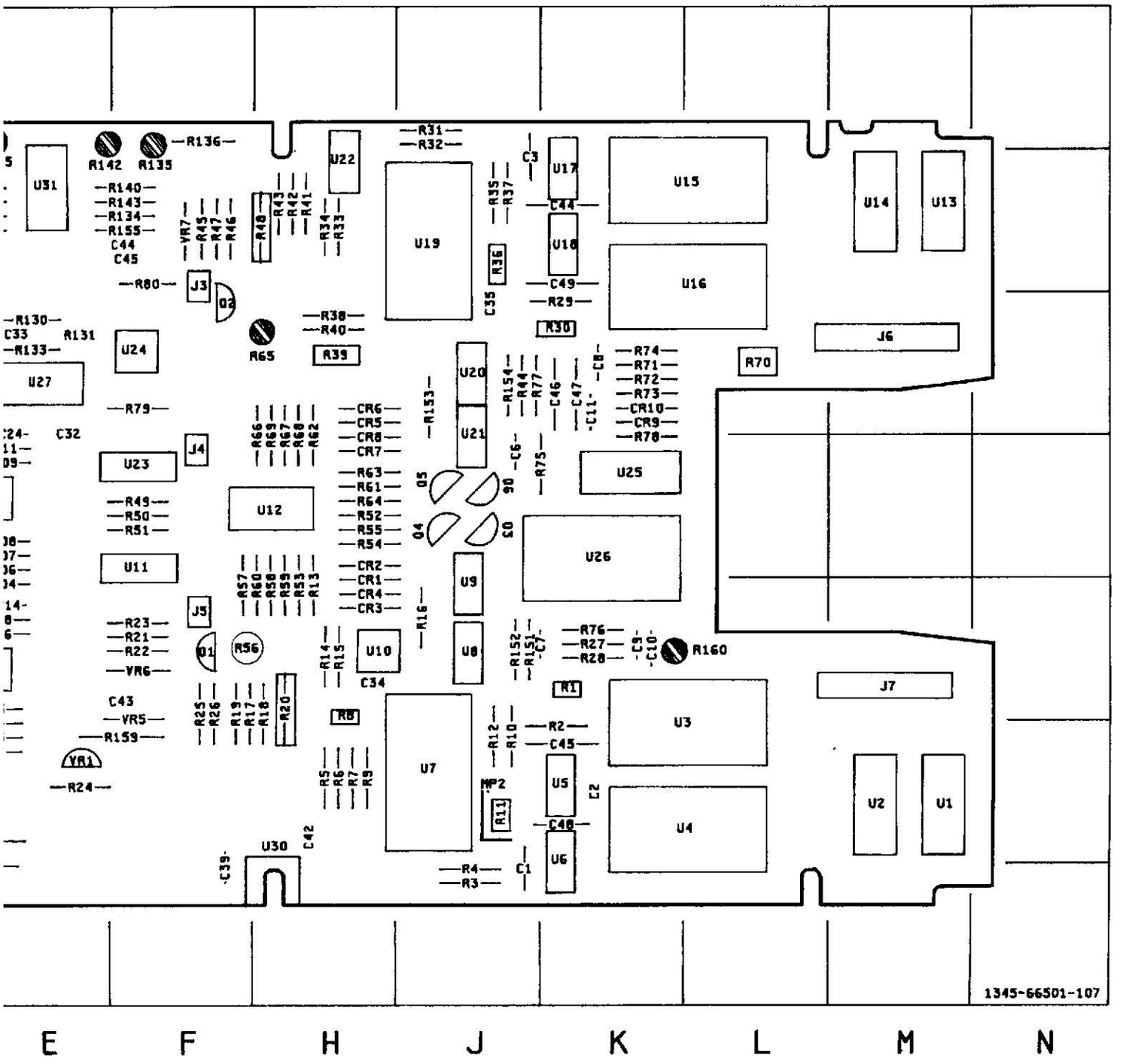

U7
ANALOG
MULTIPLIER
R21
1000
VR6
6.81V
R22
1000
+15V
U11
-15V
REFER
VOLTA
R24
562
R25
110
VR1
U12C
R26
274
+3.0V
R27
13.3
+2.9V
R28
287
19
+5V
R14
4220
R13
6810
+10V
R15
4220
U10
+6.95V
R17
3320
R20
100K
R19
3320
R18
8250
0V
STROKE
LENGTH
X
14
NC
24
NC
+7V
R16
1622
13
C34
.01
U12A
+3V
Q1
S
D
-2.9V
CURRENT
SOURCE
16
15
17
-8V
+15V
C44,45
2.2UF
C50,
.1UF
+10V
+7V
C40
1UF
C46
2.2UF
C39
1UF
R157
348
U30
-8V
C47
2.2UF
R159
130
C42
1UF
-3.1V
VR5
3.16V
-15V
C48,49
2.2UF
C43
1UF
U19
ANALOG
MULTIPLIER
R42
4220
R41
6810
+10V
R43
4220
U22
R49
1000
VR7
6.81V
R50
1000
U23
R45
3320
R48
100K
R47
3320
R46
8250
STROKE
LENGTH
Y
R44
1620
C35
.01
U12B
Q2
CURRENT
SOURCE

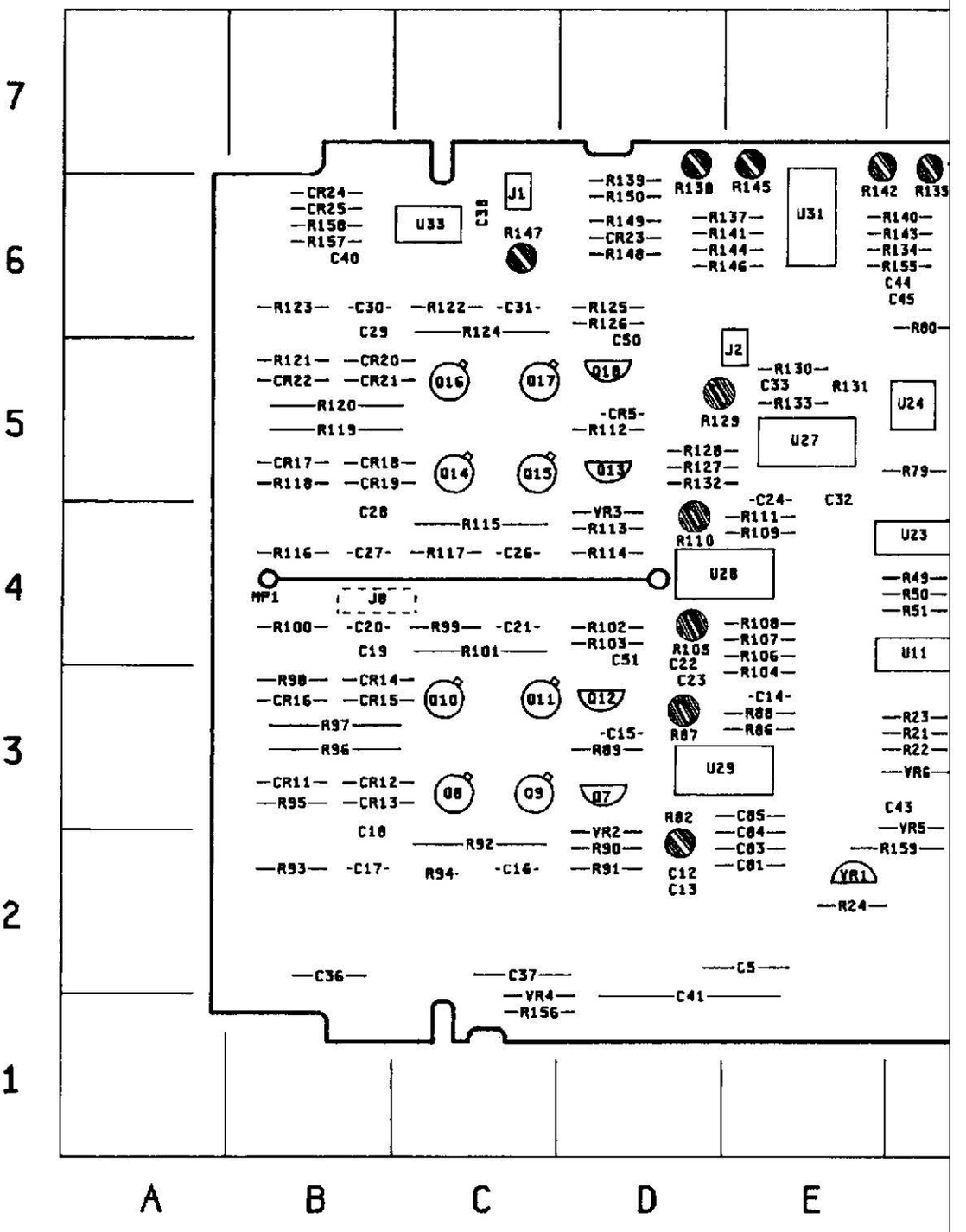

DIGITAL TO ANALOG CONVERSION
U4
MSB
LSB
2048
1024
512
256
128
64
32
16
8
4
2
1
C1
27
U6
+15V
-15V
R3
619
R4
1470
R1
100
+5.8V
+5V
-15V
U3
C2
U5
R2
51.1
DAC GAIN X
PRESENT X
PREVIOUS X
U7
ANALOG MULTIPLIER
R5
3320
R6
R7
R8
50
R9
STROKE OFFSET
R151
200
+2.9V
R10
R11
RAMP OFFSET
R12
R152
-8V
DIGITAL TO ANALOG CONVERSION
U15
U17
R31
R32
R30
DAC GAIN Y
U16
U18
R29
PRESENT Y
PREVIOUS Y
R33
R34
R35
R36
R37
R153
R39
R40
R154

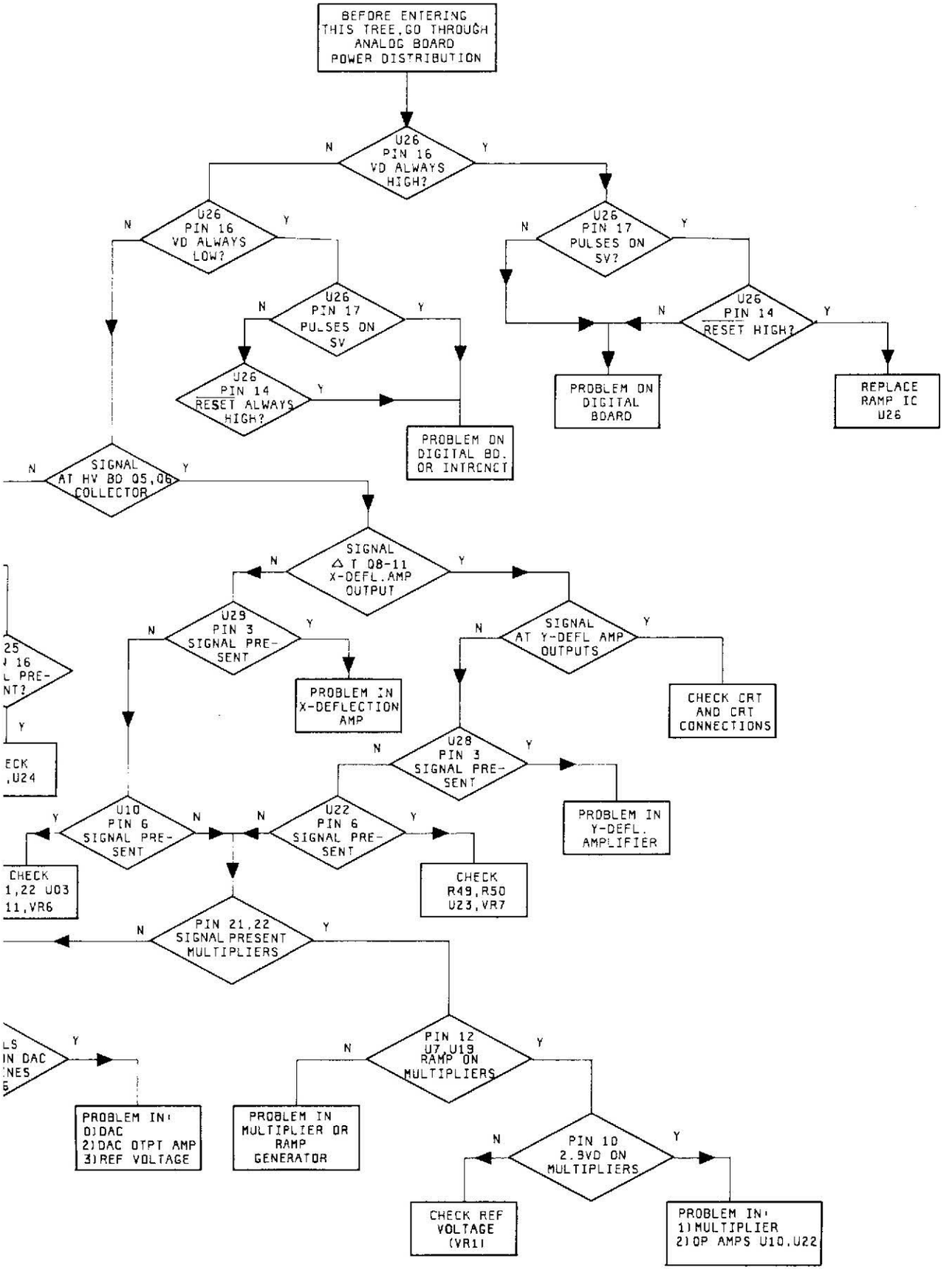

P/O A2
P/O A1 X Y Z AMP/STROKE GENERATOR BD.
P/O J2
P/O W4
P/O J7
DATA LATCH
+5V
LAST X LATCHES
DIGITAL TO
CONVER
U1
U2
MSB
LSB
NC
X-DATA
RAMP
3B
LAST Y LATCHES
U13
U14
P/O W3
P/O J6
Y-DATA
P/O J3

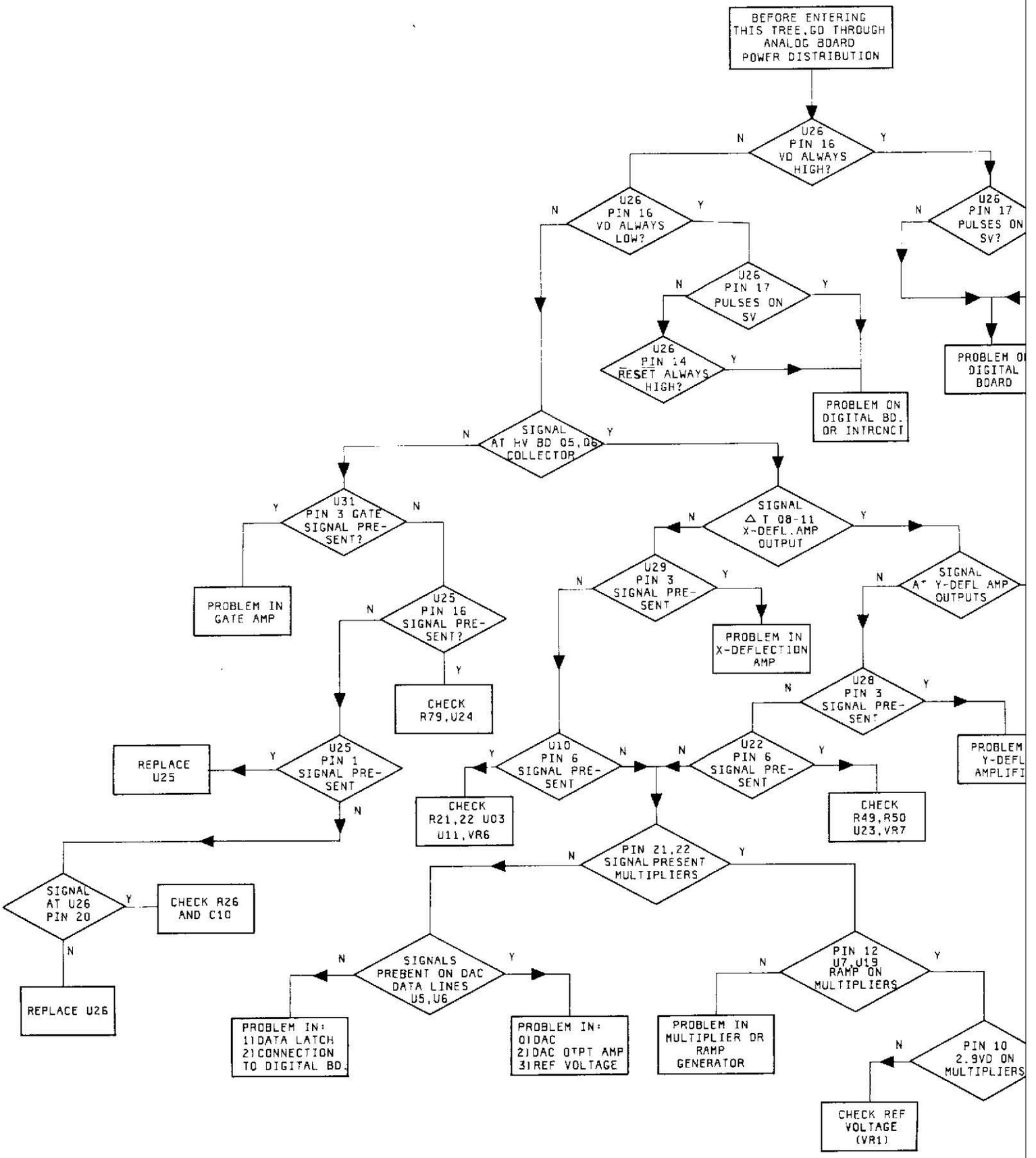
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	J-1	CR11	B-3	R19	F-3	R80	F-6	R140	F-6
C2	K-2	CR12	B-3	R20	H-3	R81	E-2	R141	E-6
C3	J-6	CR13	B-3	R21	F-3	R82	D-3	R142	E-6
C4	J-6	CR14	B-3	R22	F-3	R83	E-2	R143	F-6
C5	E-2	CR15	B-3	R23	F-3	R84	E-2	R144	E-6
C6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

P/O Service Sheet 3B, X-Y-Z Amp/Stroke Generator (A1)


U31
R142
R135
R136
R140
R143
R134
R155
C44
C45
U22
R31
R32
U19
R35
R37
C3
U17
U15
U14
U13
C44
U18
R36
C35
U16
R80
J3
Q2
R49
C49
R29
R130
C33
R131
R133
U24
R65
R38
R40
R39
R30
J6
U27
U20
R154
R44
R77
C46
C47
C11
C8
R74
R71
R72
R73
CR10
CR9
R78
R70
R79
C32
J4
U21
R153
C6
R75
U23
CR6
CR5
CR8
CR7
R66
R69
R67
R68
R62
U25
R63
R61
R64
R52
R55
R54
Q5
Q6
Q4
Q3
R49
R50
R51
U12
U26
U11
CR2
CR1
CR4
CR3
R57
R60
R58
R59
R53
R13
U9
J5
R16
R23
R21
R22
VR6
Q1
R56
R14
R15
U10
C34
U8
R152
R151
C7
R76
R27
R28
C9
C10
R160
R1
J7
C43
VR5
R159
R25
R26
R19
R17
R18
R20
R8
U3
R12
R10
R2
C45
U7
R5
R6
R7
R9
U5
MP2
R11
C2
U2
U1
VR1
R24
C40
U4
U30
C42
C39
U6
R4
R3
C1
1345-66501-107
E
F
H
J
K
L
M
N


7
6
5
4
3
2
1
A
B
C
D
E
J1
J2
J8
MP1
U33
U31
U24
U27
U28
U23
U11
U29
C38
R147
R138
R145
R142
R135
R129
R110
R105
R87
R82
C12
C13
C40
C29
C28
C19
C18
C50
C51
C33
C32
C44
C45
C43
C22
C23
C36
C37
C41
C5
VR4
R156
VR1
R24
R80
R79
R49
R50
R51
R23
R21
R22
VR6
VR5
R159
Q16
Q17
Q18
Q14
Q15
Q13
Q10
Q11
Q12
Q8
Q9
Q7


BEFORE ENTERING THIS TREE, GO THROUGH ANALOG BOARD POWER DISTRIBUTION
U26 PIN 16 VD ALWAYS HIGH?
U26 PIN 16 VD ALWAYS LOW?
U26 PIN 17 PULSES ON 5V?
U26 PIN 17 PULSES ON 5V
U26 PIN 14 RESET ALWAYS HIGH?
U26 PIN 14 RESET HIGH?
PROBLEM ON DIGITAL BOARD
REPLACE RAMP IC U26
PROBLEM ON DIGITAL BD. OR INTRCNCT
SIGNAL AT HV BD Q5,Q6 COLLECTOR
SIGNAL AT T Q8-11 X-DEFL.AMP OUTPUT
U29 PIN 3 SIGNAL PRE-SENT
PROBLEM IN X-DEFLECTION AMP
SIGNAL AT Y-DEFL AMP OUTPUTS
CHECK CRT AND CRT CONNECTIONS
U28 PIN 3 SIGNAL PRE-SENT
PROBLEM IN Y-DEFL. AMPLIFIER
U10 PIN 6 SIGNAL PRE-SENT
U22 PIN 6 SIGNAL PRE-SENT
CHECK R49,R50 U23,VR7
PIN 21,22 SIGNAL PRESENT MULTIPLIERS
PIN 12 U7,U19 RAMP ON MULTIPLIERS
PROBLEM IN: 0)DAC 2)DAC OTPT AMP 3)REF VOLTAGE
PROBLEM IN MULTIPLIER OR RAMP GENERATOR
PIN 10 2.9VD ON MULTIPLIERS
CHECK REF VOLTAGE (VR11
PROBLEM IN: 1)MULTIPLIER 2)OP AMPS U10,U22


BEFORE ENTERING THIS TREE, GO THROUGH ANALOG BOARD POWER DISTRIBUTION
U26 PIN 16 VD ALWAYS HIGH?
U26 PIN 16 VD ALWAYS LOW?
U26 PIN 17 PULSES ON 5V?
U26 PIN 17 PULSES ON 5V
U26 PIN 14 RESET ALWAYS HIGH?
PROBLEM ON DIGITAL BD. OR INTRCNCT
PROBLEM O DIGITAL BOARD
SIGNAL AT HV BD Q5,Q6 COLLECTOR
U31 PIN 3 GATE SIGNAL PRESENT?
PROBLEM IN GATE AMP
U25 PIN 16 SIGNAL PRESENT?
CHECK R79,U24
U25 PIN 1 SIGNAL PRESENT
REPLACE U25
SIGNAL AT U26 PIN 20
CHECK R26 AND C10
REPLACE U26
SIGNAL △T Q8-11 X-DEFL.AMP OUTPUT
U29 PIN 3 SIGNAL PRESENT
PROBLEM IN X-DEFLECTION AMP
SIGNAL AT Y-DEFL AMP OUTPUTS
U28 PIN 3 SIGNAL PRESENT
PROBLEM Y-DEFL AMPLIFI
U10 PIN 6 SIGNAL PRESENT
CHECK R21,22 U03 U11,VR6
U22 PIN 6 SIGNAL PRESENT
CHECK R49,R50 U23,VR7
PIN 21,22 SIGNAL PRESENT MULTIPLIERS
SIGNALS PRESENT ON DAC DATA LINES U5,U6
PROBLEM IN: 1)DATA LATCH 2)CONNECTION TO DIGITAL BD.
PROBLEM IN: 0)DAC 2)DAC OTPT AMP 3)REF VOLTAGE
PIN 12 U7,U19 RAMP ON MULTIPLIERS
PROBLEM IN MULTIPLIER OR RAMP GENERATOR
PIN 10 2.9VD ON MULTIPLIERS
CHECK REF VOLTAGE (VR1)

SECTION VIII

SERVICE

8-1. INTRODUCTION.

8-2. This section provides instructions for troubleshooting and repairing the Model 1345A Digital Display.

8-3. Component locators 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 Digital Display.

8-4. THEORY OF OPERATION.

8-5. Overall theory of operation appears opposite the block diagram (Service Sheet 1). Each section of the diagram refers to service sheets where schematics and troubleshooting information are present. Figure 8-1 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 conventions defines a logic "1" as the more positive voltage (high) and a logic "0" as the more negative voltage (low).

8-7. LOGIC SYMBOLOGY. The logic symbology used in this manual is based on ANSI Y32.14-1973. The purpose of these symbols is to graphically represent device functions so that operation can be understood without having to "look up" how a device works. Basic logic symbols and examples of symbols are shown in figure 8-2. Table 8-2 provides an explanation of function labels used in the schematics.

8-8. TROUBLESHOOTING.

WARNING

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

8-9. INITIAL TROUBLESHOOTING PROCEDURE. Before troubleshooting the 1345A in detail, try to perform the adjustment procedures listed 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.

8-10. DC VOLTAGES AND WAVEFORMS. DC voltages, waveforms, and conditions for making these measurements are given on, or 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.

8-11. RECOMMENDED TEST EQUIPMENT.

8-12. Test equipment required for maintaining the 1345A is listed in Section I, table 1-4. Equipment other than that listed may be used if it meets the listed specifications.

8-13. REPAIR.

8-14. ASSEMBLY REMOVAL. Instructions for removing major assemblies are contained in the service sheet instructions for that particular assembly. 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-Z- Amplifier, Stroke Generator	3A, 3B, 3C
A2	Vector Processor Control	2
A3	Low Voltage Power Supply	4
A4	High Voltage Power Supply	5
A5	Memory (Option 704)	6

8-15. PREVENTIVE MAINTENANCE. Painted surfaces can be cleaned with a commercial, spray-type window cleaner or with a mild soap and water solution.

CAUTION

Do not use chemical cleaning agents that might damage the plastics used in this instrument. Recommended cleaning agents are isopropyl alcohol, kelite (1 part kelite, 20 parts water), or a solution of 1% mild detergent and 99% water.

8-16. Corroded spots are best removed with soap and water. Stubborn residue can be removed with a fine abrasive. Protect such areas from further corrosion with an application of silicone resin such as GE DRIFILM 88.

REFER TO ANSI Y 32.2 FOR GRAPHIC SYMBOLS NOT LISTED IN THIS TABLE

CIRCUIT ASSEMBLY BORDERLINE

FRONT-PANEL MARKING

REAR-PANEL MARKING

MAIN SIGNAL PATH

PRIMARY FEEDBACK PATH

SINGLE-PIN CONNECTOR ON BOARD

PIN OF PLUG-IN BOARD OR CABLE

COAXIAL CABLE CONNECTED TO SNAP-ON JACK

COAXIAL CONNECTOR CONNECTED DIRECTLY TO BOARD

BREAKDOWN DIODE (ZENER)

SCHOTTKY (HOT-CARRIER) DIODE

STEP-RECOVERY DIODE

VARACTOR DIODE (VARICAP)

TRIAC

TEMPERATURE SENSOR

DUAL TRANSISTOR

DUAL FIELD-EFFECT TRANSISTOR (N-TYPE BASE)

FERRITE BEAD

THERMISTOR

SOLENOID-ACTUATED SWITCH

GLOW LAMP

TOROIDAL TRANSFORMER

SLIDE SWITCH

RESISTOR JUMPER

COMMON CONNECTIONS. ALL LIKE-DESIGNATED POINTS ARE CONNECTED

CHASSIS GROUND

SOLDER OR MECHANICAL CONNECTION

ELASTOMERIC CONNECTOR

TOOL-AIDED ADJUSTMENT

TP1 NUMBERED TEST POINT. MEASUREMENT AID PROVIDED

LETTERED TEST POINT. NO MEASUREMENT AID PROVIDED

146 SIGNAL REFERENCE

15 SCHEMATIC REFERENCE

INDICATES MULTIPLE PATHS REPRESENTED BY ON ONE LINE. LETTERS OR NAMES IDENTIFY INDIVIDUAL PATHS. NUMBERS INDICATE NUMBER OF PATHS REPRESENTED BY THE LINE.

925 WIRE COLORS ARE GIVEN BY ENCLOSED NUMBERS USING THE RESISTOR COLOR CODE.

(925) IS WHT-RED-GRN)

0 - BLACK	5 - GREEN
1 - BROWN	6 - BLUE
2 - RED	7 - VIOLET
3 - ORANGE	8 - GRAY
4 - YELLOW	9 - WHITE

Figure 8-1. Schematic Diagram Symbols

8-17. PRINCIPLES OF OPERATION.

8-18. INTRODUCTION.

The simplified block diagram (figure 8-5) shows the major functional stages of the 1345A, and their respective service sheets. The theory of operation of each stage is described below.

8-19. VECTOR PROCESSOR CONTROL BOARD (Assembly A2, Service Sheet 2).

The purpose of the Vector Processor Control is to convert the digital 16 bit input data to absolute coordinate vector data for the Stroke Generator (A1). This is accomplished by interfacing a host processor or refresh memory system with the circuit board. The 8048 processor (A2U1) is used for storing the primary and secondary test pattern. 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, A2U10, A2U11, A2U12).
4. Timing Circuits (A2U14, A2U26).
5. Vector Processor (A2U16).

INPUT DATA LATCHES. The Input Data Latches provide buffering for the Vector Processor (A2U16). The input data is held in these latches until 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 latching of the data by using the signal lines $\overline{\text{VECTOR}}$ and CHARACTER.

OUTPUT DATA 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 transferred by the Data Latch signal into the Output Latches. Control Latches (A2U18-A2U20) contain the last Set Condition commands.

CHARACTER GENERATOR. The Character Generator translates character data into vector data for the VPC. ROM A2U12 contains the stroke information for the modified ASCII character set (see table 3-1 for list of characters). The character size and rotation is processed by the VPC for proper vector generation.

TIMING CIRCUIT. The clock circuit (A2U14, A2U26) provides two clock frequencies. A2U14 generates the 19.66 MHz signal for the optional Memory Circuit (A5). A2U14 divides the 19.66 MHz signal by 5 to generate the required 3.93 MHz clock 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 the Most Significant Bits of an input word (B14, B13), 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 latches A2U18-A2U20 until a new Set Condition Command is received.

PLOT COMMAND. When the Most Significant Bits (B14,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 incoming 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 bit 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.

8-20. STROKE GENERATOR AND X-Y OUTPUT AMPLIFIERS (Assembly A1, Service Sheets 3A, 3B, 3C).

8-21. STROKE GENERATOR. The Stroke Generator converts binary data 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)

The X and Y Stroke Generator circuits are identical, therefore only the X Stroke Generator will be described below.

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 voltage output 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 are multiplied. 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 8-3).

RAMP GENERATOR. The Ramp Generator (A1U26) provides two signals: a ramp for X-Y beam movement; 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 8-4 for the current definitions).

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.

8-22. X-Y AMPLIFIERS (Assemblies A1, A4, Service Sheets 3C, 5).

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 below.

The X amplifier consists 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 are set by A1R86 and A1R82 respectively.

8-23. Z-AXIS AMPLIFIER (Assemblies A1, A4, Service Sheets 3C, 5).

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

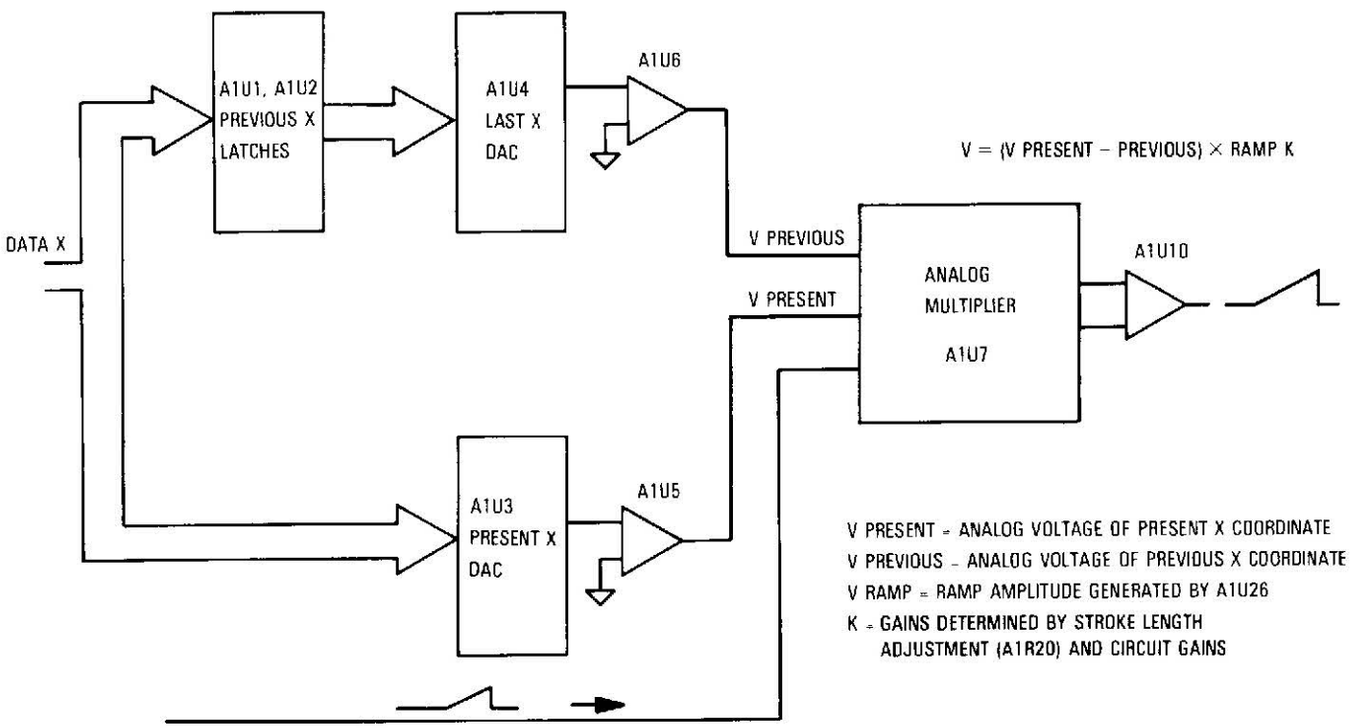


Figure 8-3. Simplified Block Diagram for Analog Multiplier

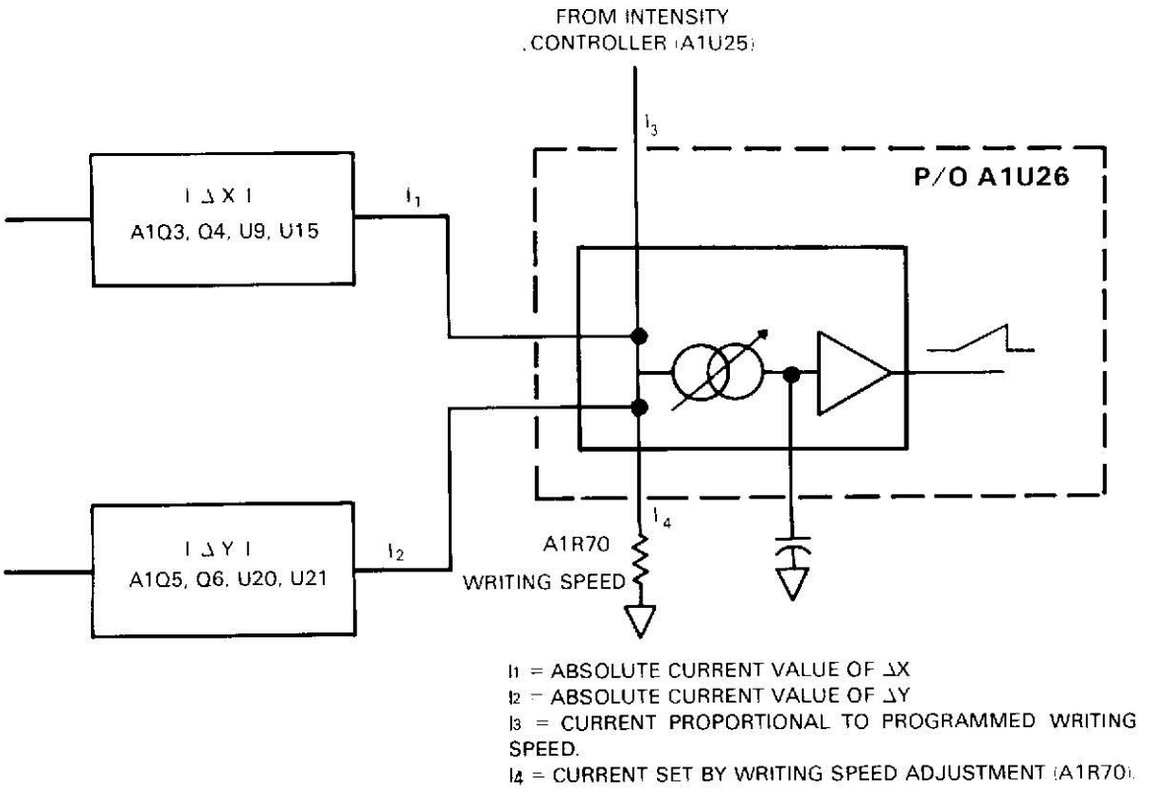


Figure 8-4. Current Definition for Ramp Generator

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.

8-24. FOCUS CORRECTION AMPLIFIER (Assemblies A1, A4, Service Sheets 3C, 4).

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 identically to the Intensity Amplifier.

8-25. LOW AND HIGH VOLTAGE POWER SUPPLIES (Assemblies A3, A4, Service Sheets 4, 5).

8-26. LOW VOLTAGE POWER SUPPLY. The Low Voltage Power Supply consists of only one primary circuit — the +105 V supply. All other required operating supplies must be provided by an external supply (see table 1-1, Input Power Requirements). The +105 V 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 +105 V supply.

8-27. HIGH VOLTAGE POWER SUPPLY. 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 +105 V 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.

8-28. MEMORY CIRCUIT, OPTION 704 (Assembly A5, Service Sheet 6).

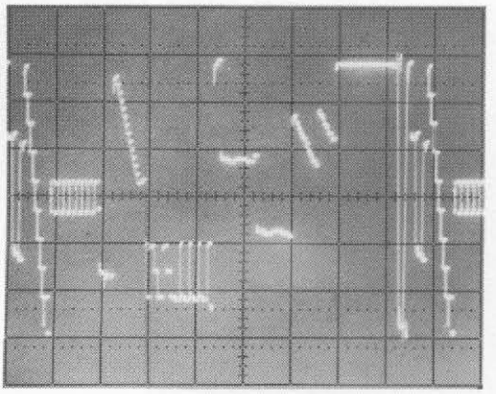
NOTE

When Option Memory Board is installed Jumper Packs A2U3 and A2U4 must be removed.

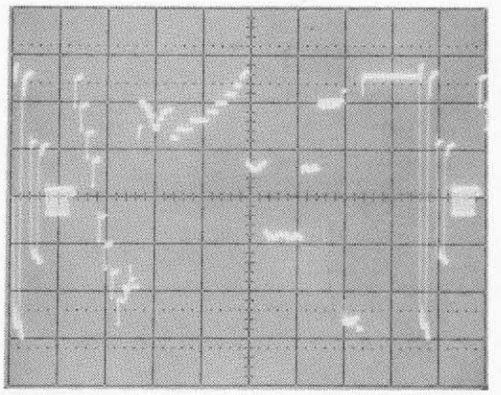
The Vector Memory option functions as as auxiliary read/write memory for the user processor (static 4K x 16 bit), and provides a means for automatic display refresh in order to "free up" the controller.

8-29. READ/WRITE MODE. There are two read/write modes In one mode, all the vector information in memory is sequentially displayed. In the second mode, a jump instruction is used to display only selected portions of vector information in the vector memory. When data bit D15 is a "1" then the input data is recognized as a jump command. When bit D15 is a "0" then all the vector information in memory is sequentially displayed. Control of data flow between the user processor and the 1345A is accomplished via the $\overline{RD}$, $\overline{WR}$, $\overline{DS}$, $\overline{XACK}$ signal lines.

8-30. REFRESH MODES. There are two modes of refresh control: In the first mode, if a "jump 4095" command is not encountered during a complete memory scan, the next screen refresh (frame) begins immediately. In the second mode, if a "jump 4095" is encountered, the next frame begins when either an external sync pulse is received, or the internal 60 Hz sync pulse generator times out.



X OUTPUT AT A1Q8 COLLECTOR
(TO HORIZONTAL CRT DEFLECTION PLATES)
10 V/DIV, 2 ms/DIV



Y OUTPUT AT A1Q14 COLLECTOR
(TO VERTICAL CRT DEFLECTION PLATES)
10 V/DIV, 2 ms/DIV

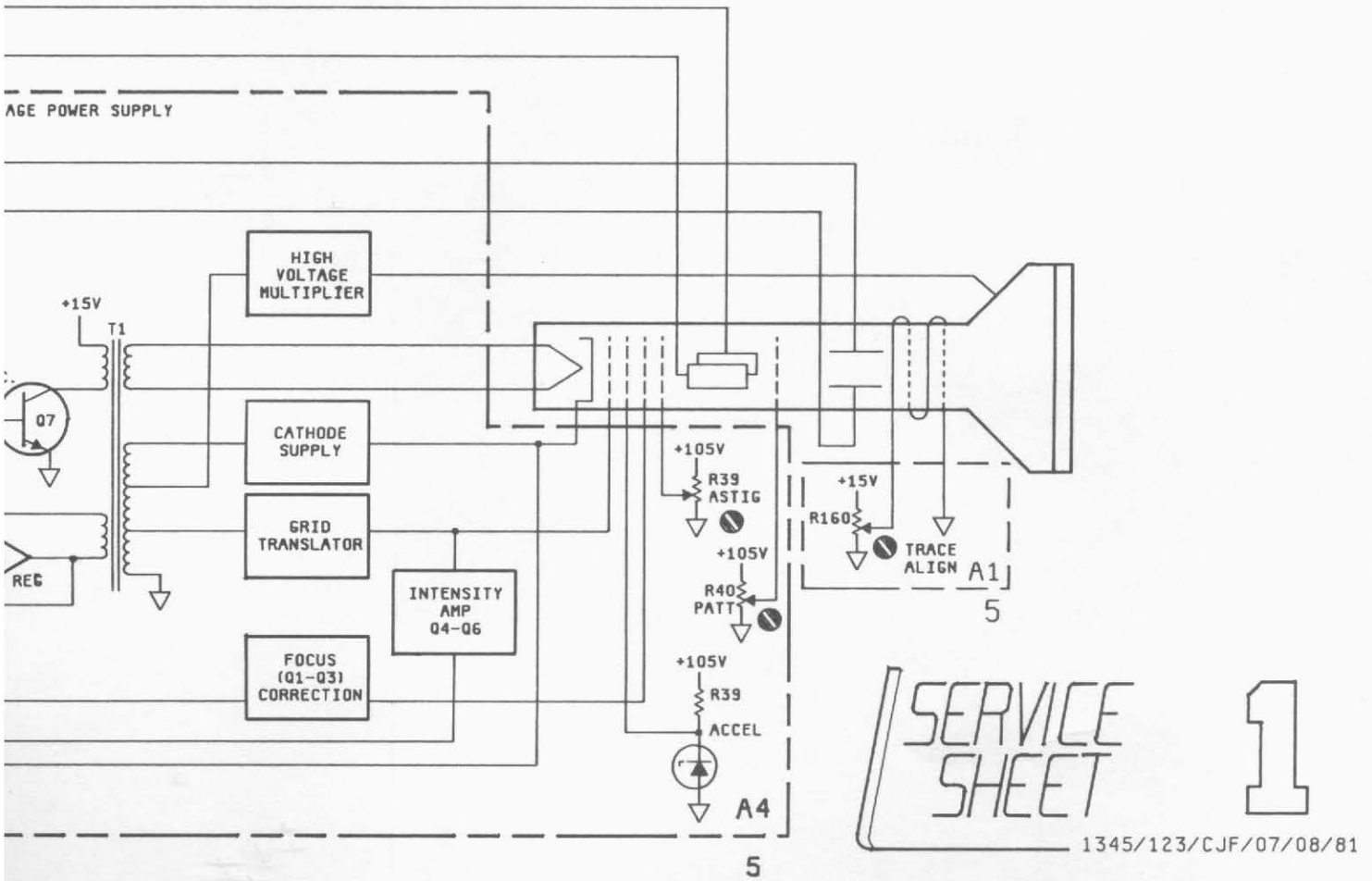
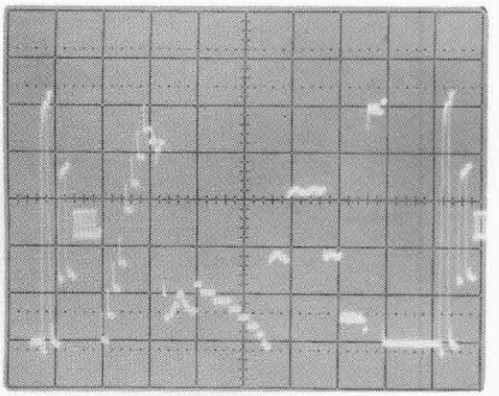
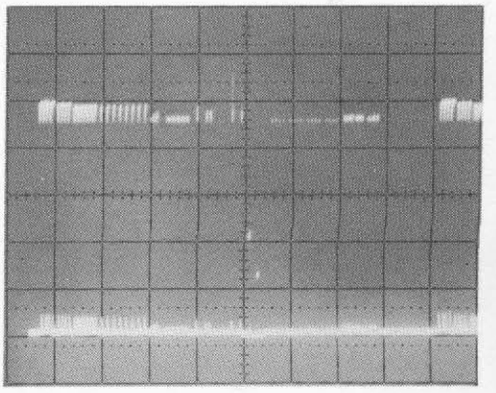


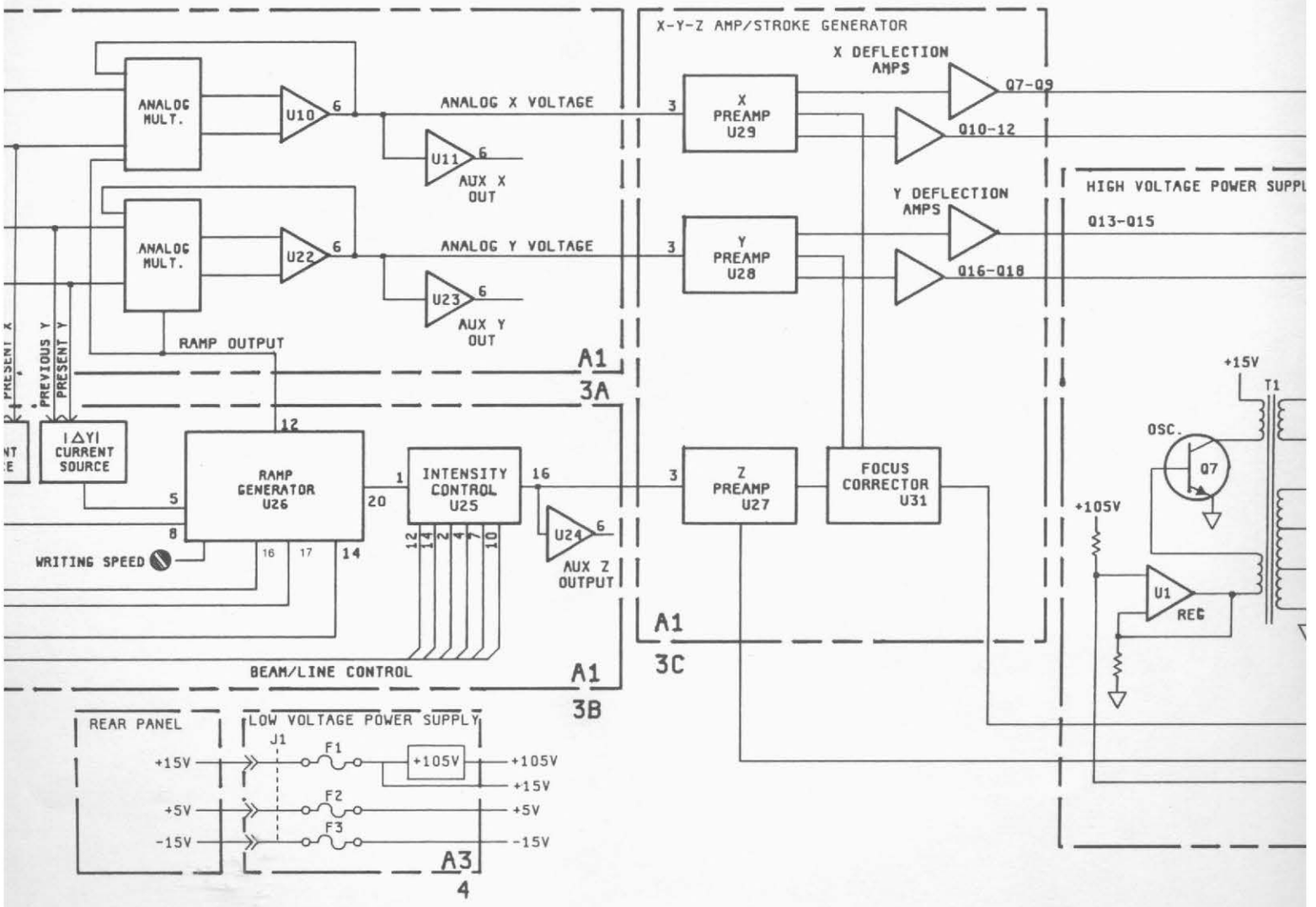
Figure 8-5.
Service Sheet 1, Block Diagram

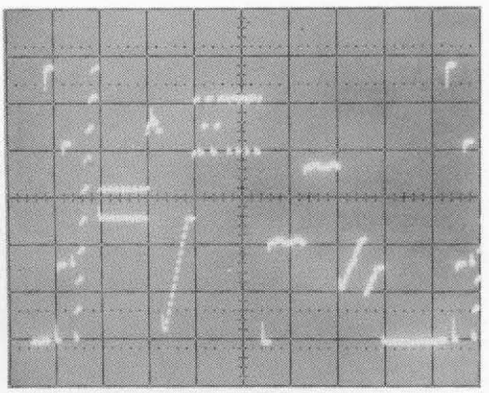


AUXILIARY Y OUTPUT AT A1J4
.2 V/DIV, 2 ms/DIV

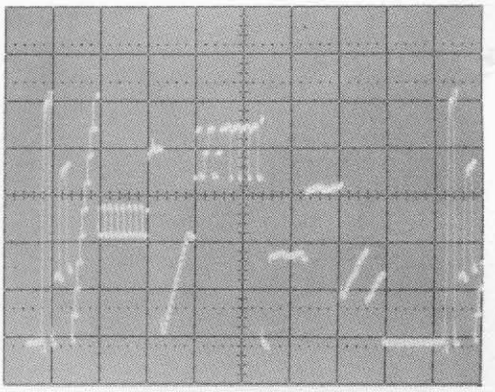


AUXILIARY Z OUTPUT AT A1J3
.2 V/DIV, 2 ms/DIV

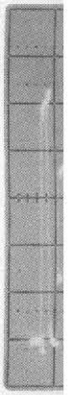




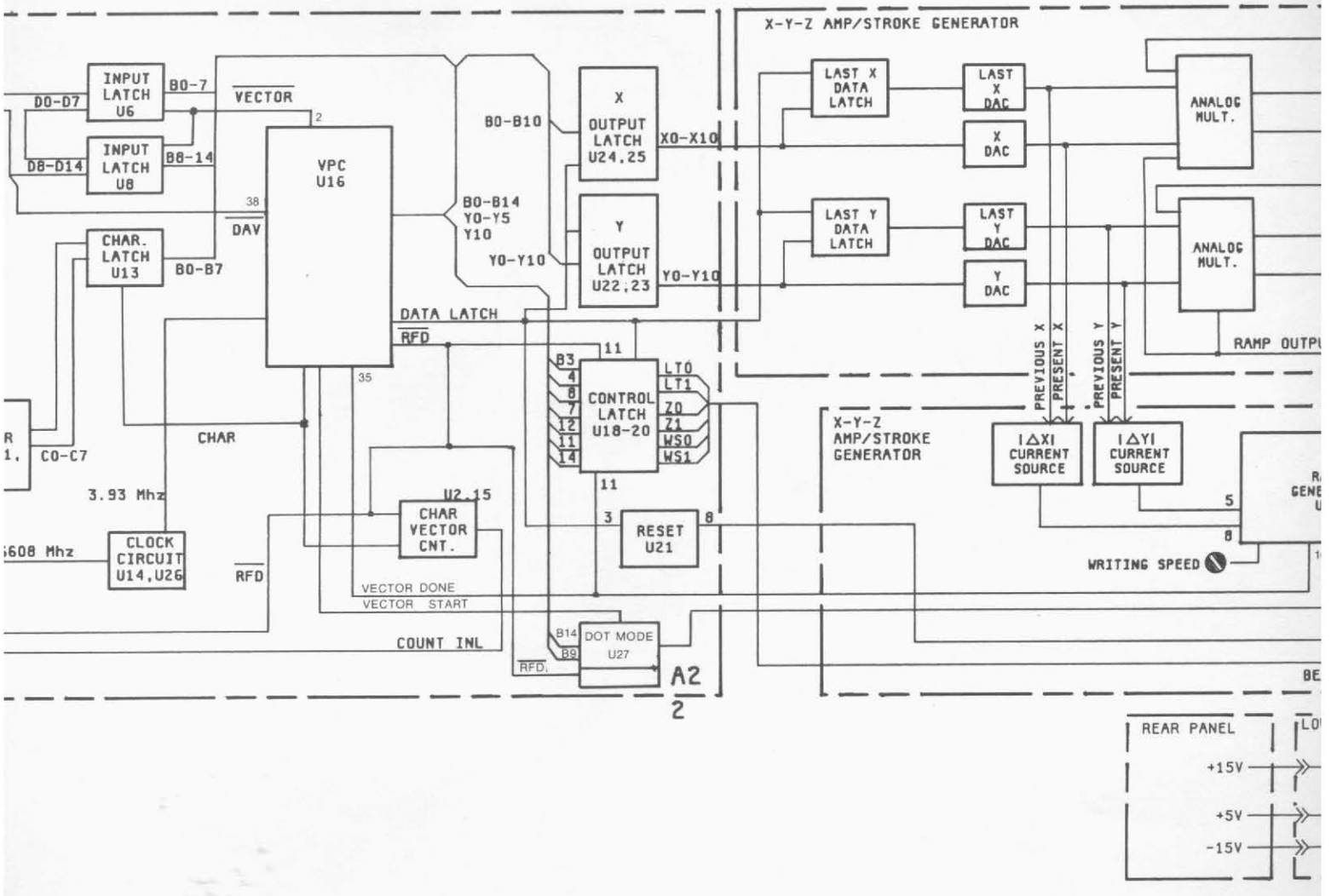
XDAC OUTPUT
.05 V/DIV, 2 ms/DIV



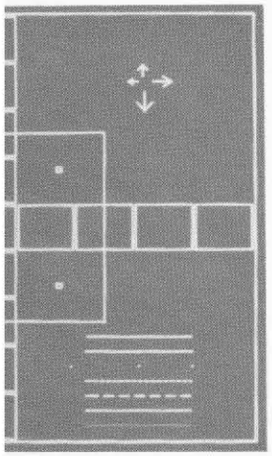
AUXILIARY X OUTPUT AT A1J5
.2 V/DIV, 2 ms/DIV



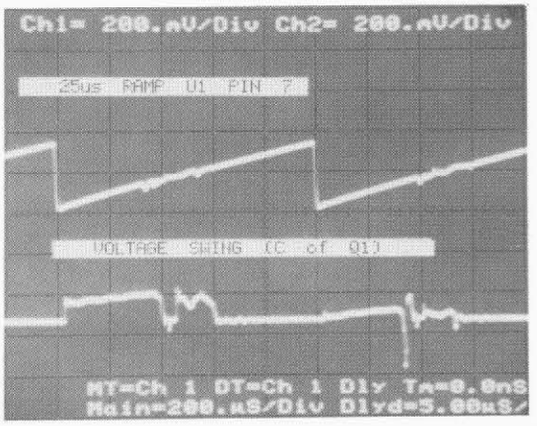
AUXIL
.2 V/D



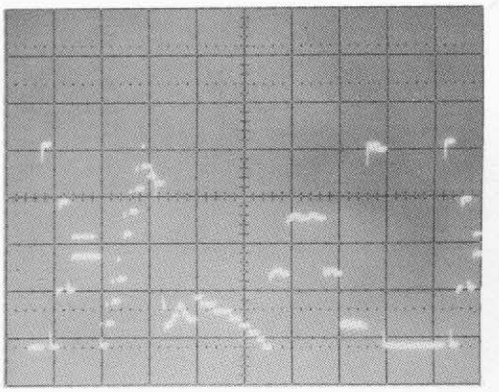
REMENT CONDITION



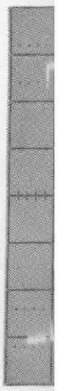
TERN AS SHOWN ABOVE



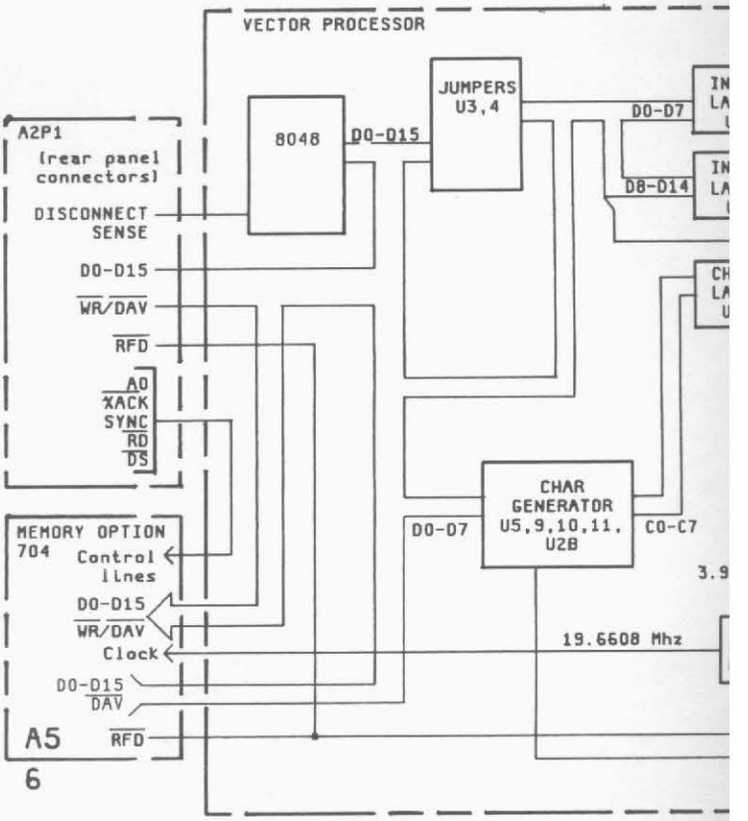
TOP: A4, U1 PIN 7
BOTTOM: A3, Q1 COLLECTOR



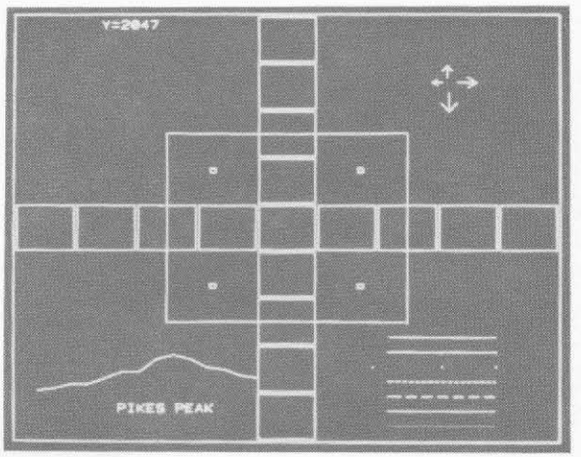
Y DAC OUTPUT
.05 V/DIV, 2 ms/DIV



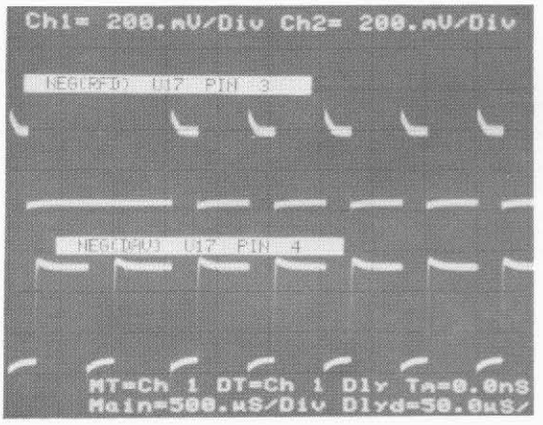
XDAC
.05 V



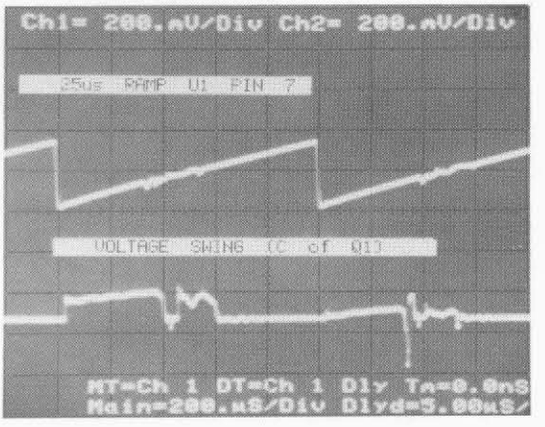
WAVEFORM MEASUREMENT CONDITION



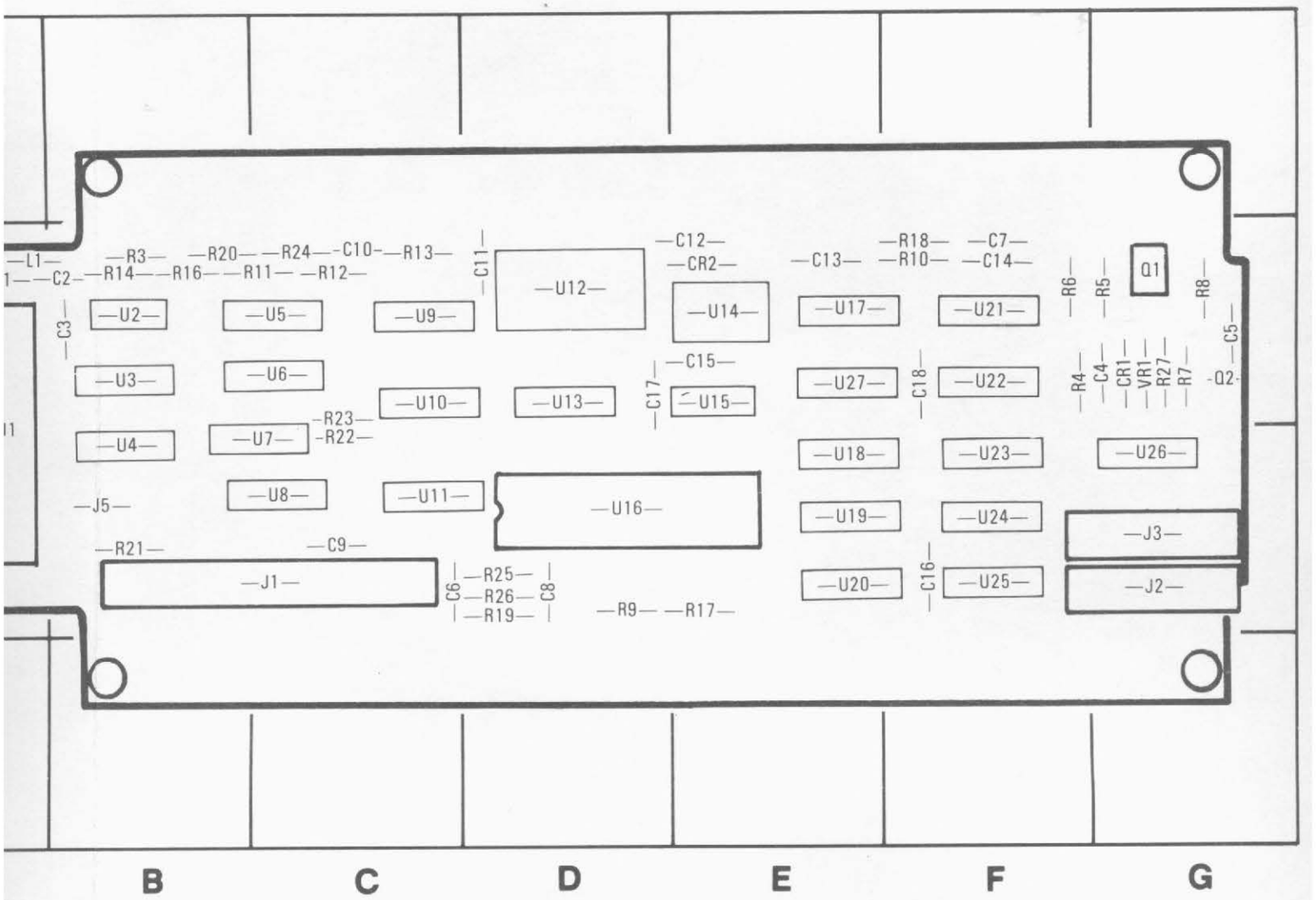
OBTAIN PRIMARY TEST PATTERN AS SHOWN ABOVE



TOP: $\overline{\text{RFD}}$ A2, U17 PIN 3
BOTTOM: $\overline{\text{DAV}}$ A2, U17 PIN 4

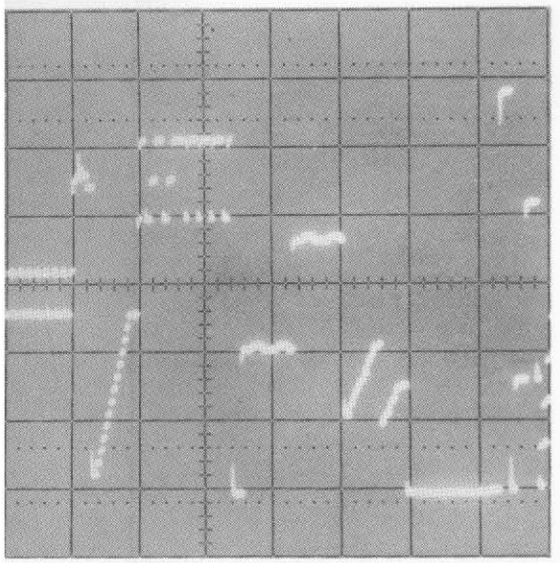


TOP: A4, U1 PIN 7
BOTTOM: A3, Q1 COLLECTOR

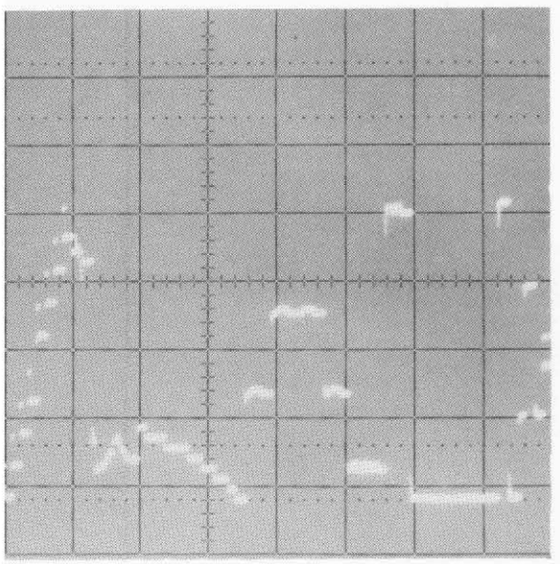


REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	A-3	C18	F-3	R6	F-3	R23	C-3	U12	D-3
C2	B-3	CR1	G-3	R7	G-3	R24	C-3	U13	D-3
C3	B-2	CR2	E-3	R8	G-3	R25	D-2	U14	E-3
C4	G-3	E1	A-3	R9	D-2	R26	D-2	U15	E-3
C5	G-3	J1	C-2	R10	F-3	R27	G-3	U16	D-2
C6	C-2	J2	G-3	R11	C-3	TP1	A-3	U17	E-3
C7	F-3	J3	G-2	R12	C-3	U1	A-2	U18	E-2
C8	D-2	J4	A-2	R13	C-3	U2	B-3	U19	E-2
C9	C-2	J5	B-2	R14	B-3	U3	B-3	U20	E-2
C10	C-3	L1	A-3	R15	A-3	U4	B-2	U21	F-3
C11	D-3	Q1	G-3	R16	B-3	U5	C-3	U22	F-3
C12	E-3	Q2	G-3	R17	E-2	U6	C-3	U23	F-2
C13	E-3	R1	A-3	R18	F-3	U7	C-2	U24	F-2
C14	F-3	R2	A-3	R19	D-2	U8	C-2	U25	F-2
C15	E-3	R3	B-3	R20	B-3	U9	C-3	U26	G-2
C16	F-2	R4	F-3	R21	B-2	U10	C-3	U27	E-3
C17	D-3	R5	G-3	R22	C-2	U11	C-2	VR1	G-3

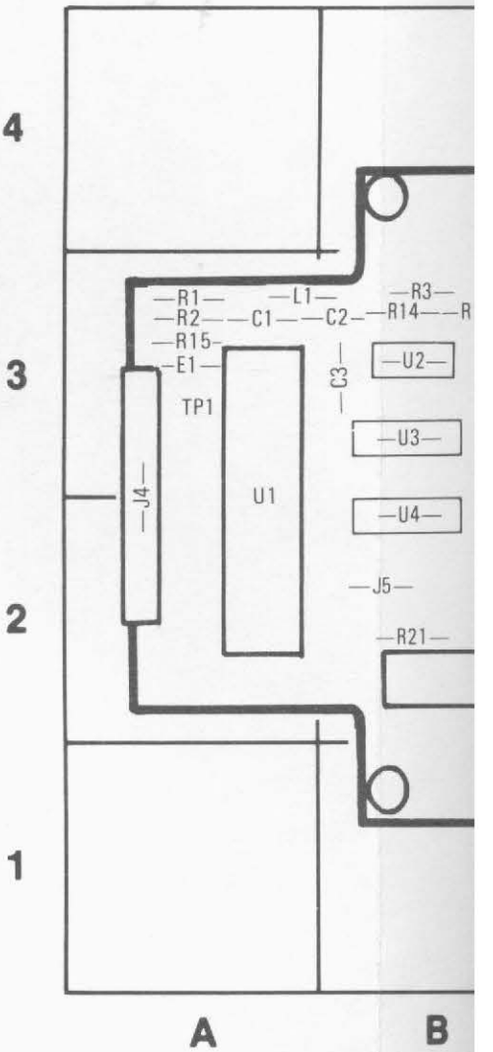
P/O Service Sheet 2, Vector Processor (A2)



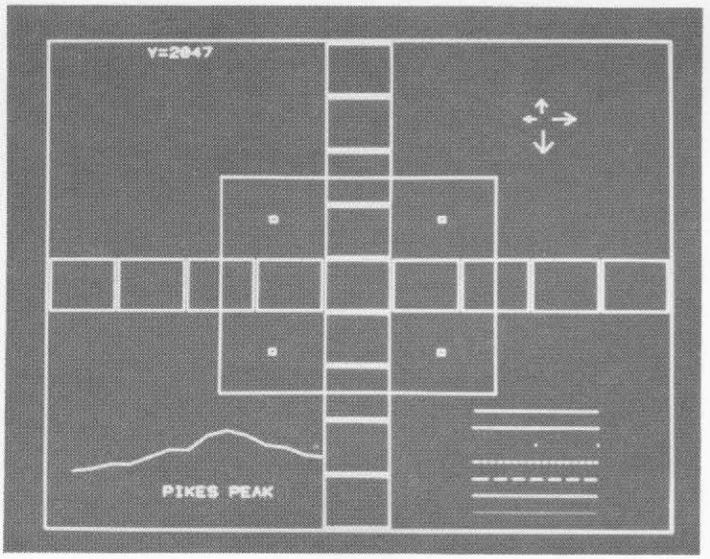
X DAC OUTPUT
.05 V/DIV, 2 ms/DIV



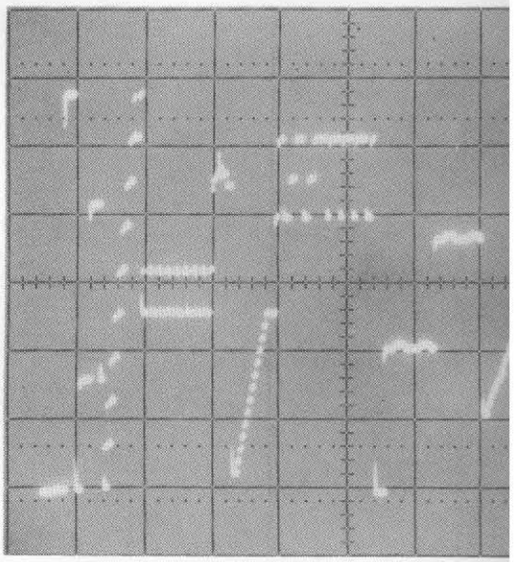
Y DAC OUTPUT
.05 V/DIV, 2 ms/DIV



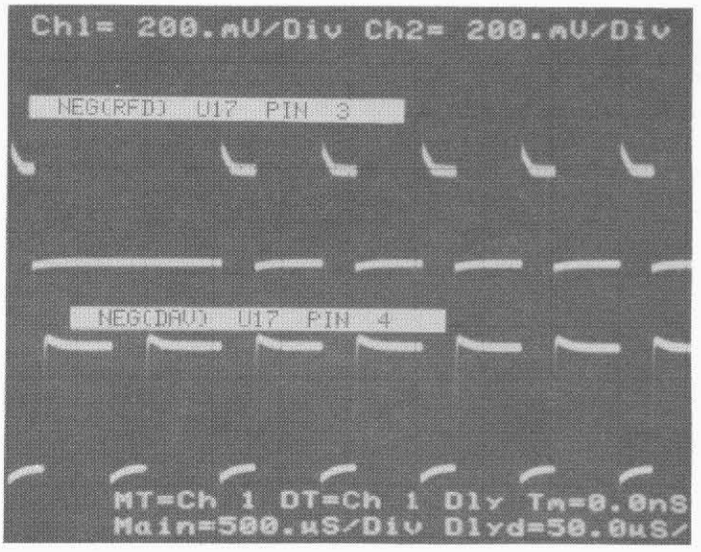
WAVEFORM MEASUREMENT CONDITION



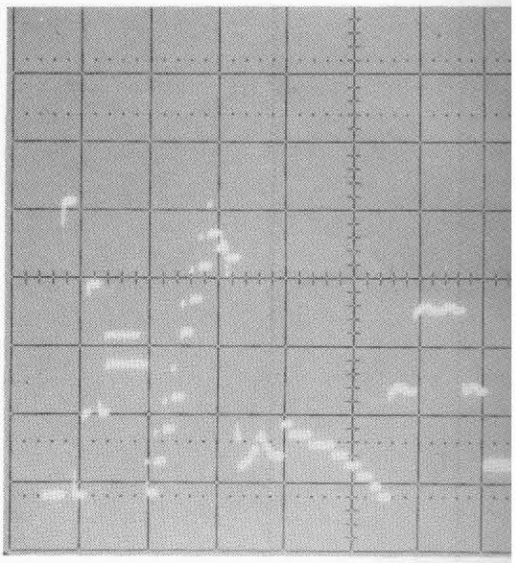
OBTAIN PRIMARY TEST PATTERN AS SHOWN ABOVE



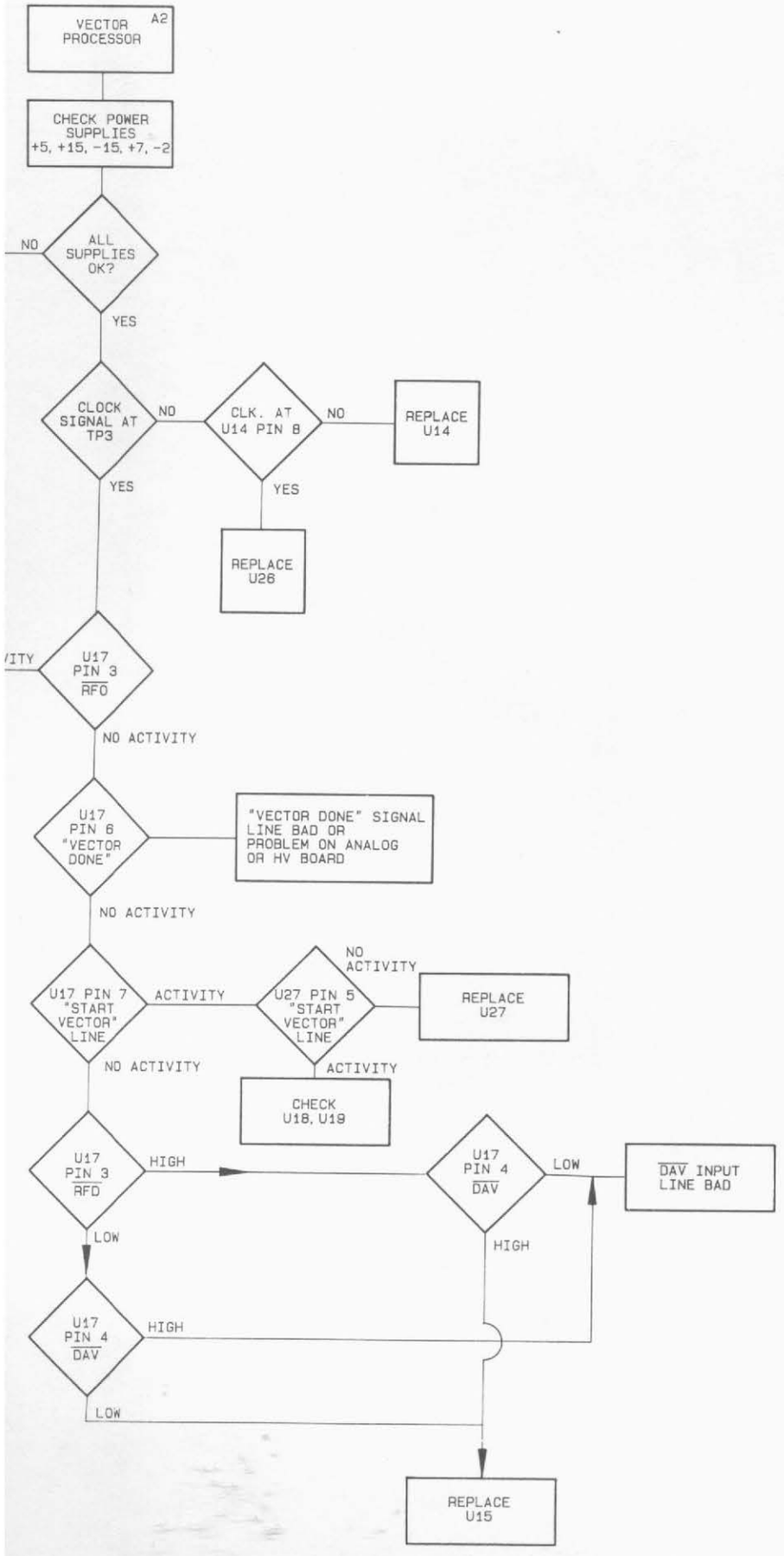
X DAC OUTPUT
.05 V/DIV, 2 ms/DIV

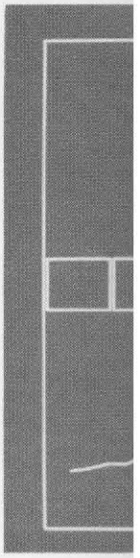


TOP: RFD A2, U17 PIN 3
BOTTOM: DAV A2, U17 PIN 4

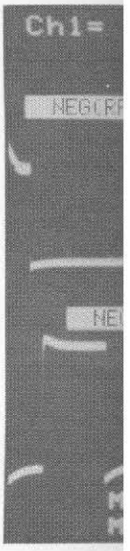


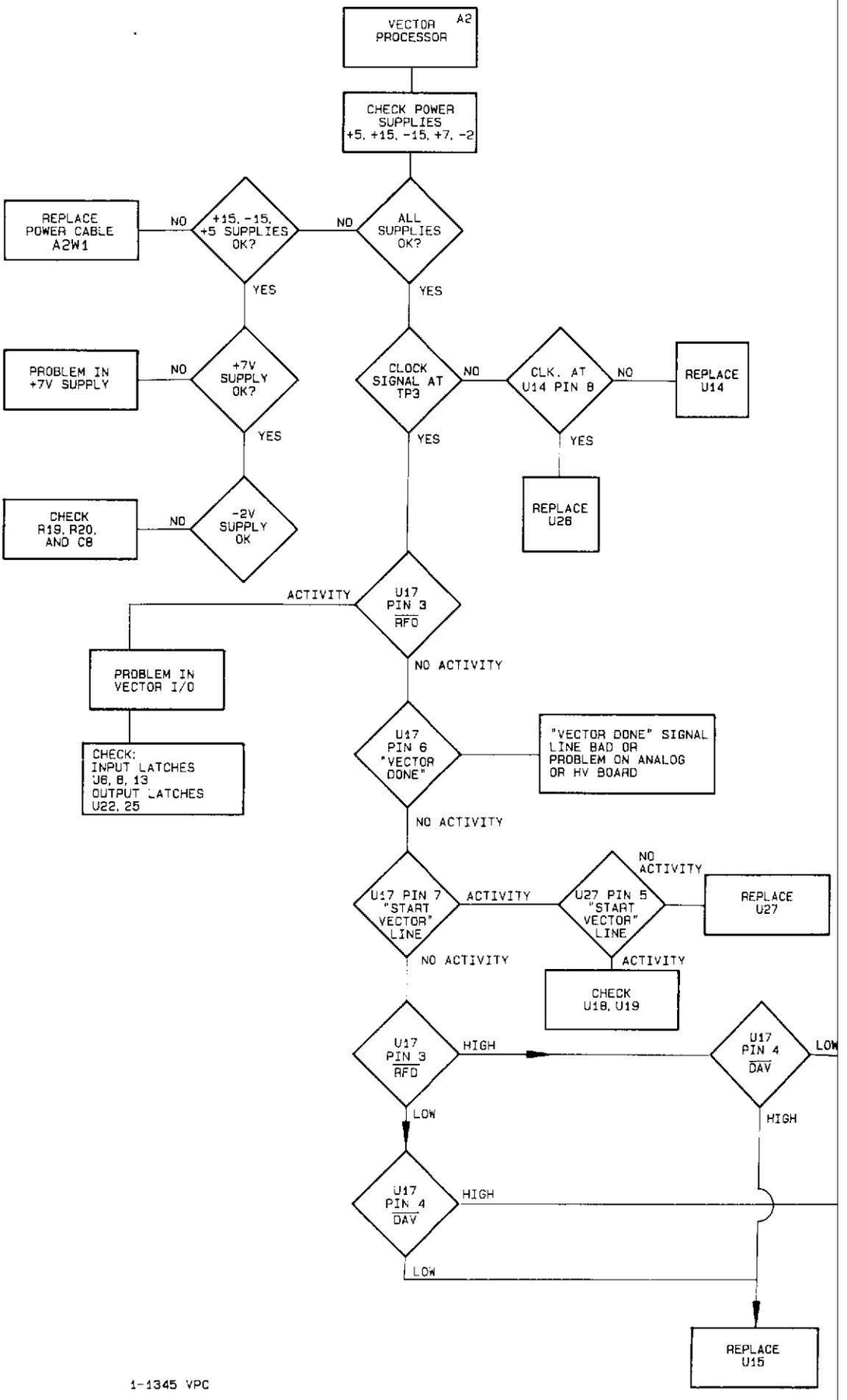
Y DAC OUTPUT
.05 V/DIV, 2 ms/DIV

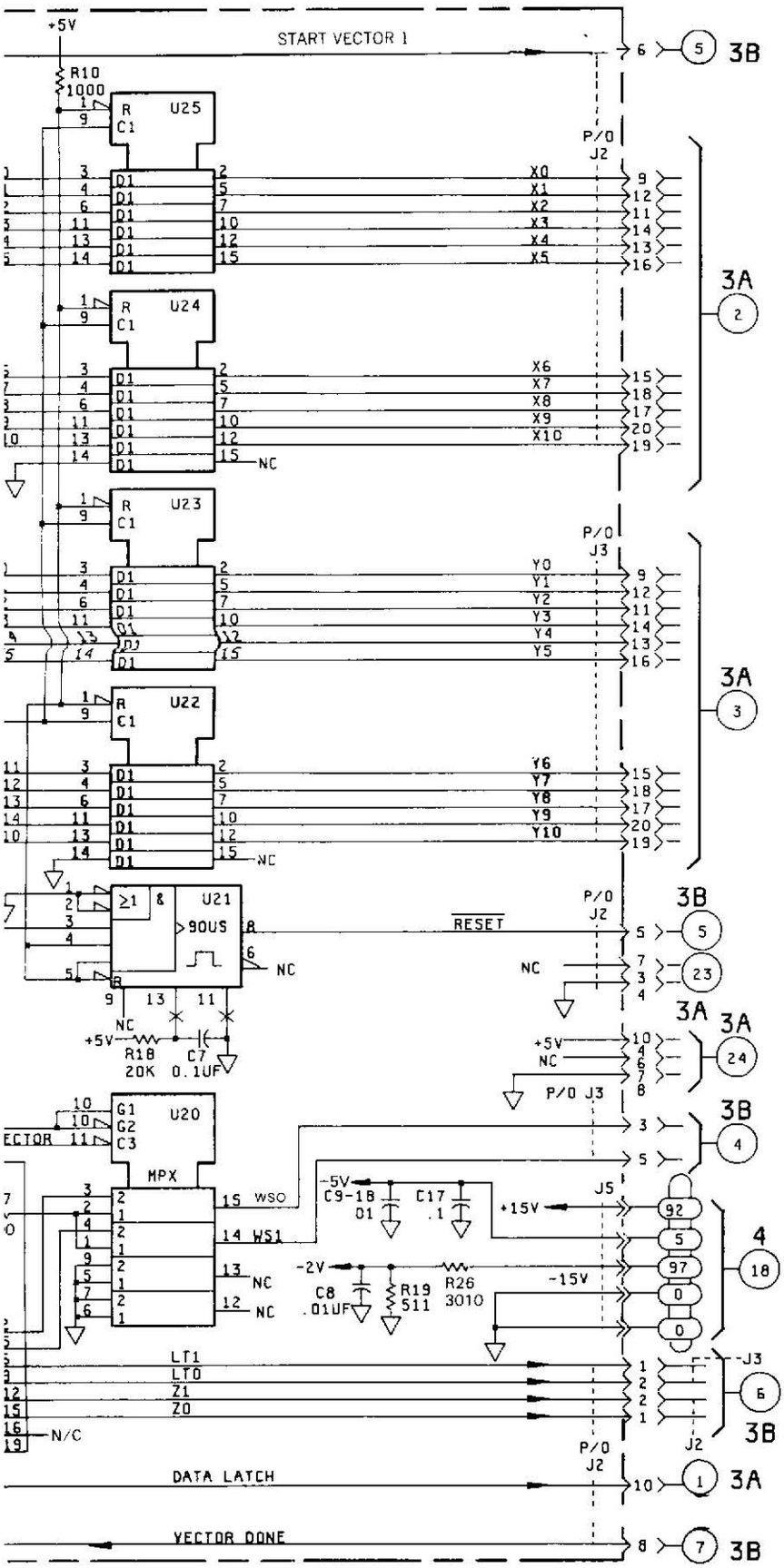

VECTOR PROCESSOR A2
CHECK POWER SUPPLIES +5, +15, -15, +7, -2
NO
ALL SUPPLIES OK?
YES
CLOCK SIGNAL AT TP3
NO
CLK. AT U14 PIN 8
NO
REPLACE U14
YES
YES
REPLACE U26
U17 PIN 3 RFO
NO ACTIVITY
U17 PIN 6 "VECTOR DONE"
"VECTOR DONE" SIGNAL LINE BAD OR PROBLEM ON ANALOG OR HV BOARD
NO ACTIVITY
U17 PIN 7 "START VECTOR" LINE
ACTIVITY
U27 PIN 5 "START VECTOR" LINE
NO ACTIVITY
REPLACE U27
NO ACTIVITY
ACTIVITY
CHECK U18, U19
U17 PIN 3 RFD
HIGH
U17 PIN 4 DAV
LOW
DAV INPUT LINE BAD
LOW
HIGH
U17 PIN 4 DAV
HIGH
LOW
REPLACE U15



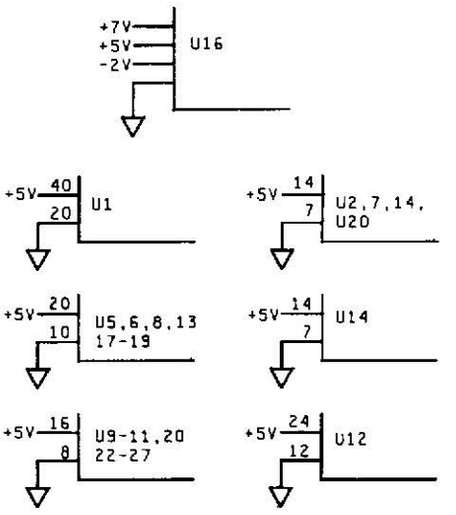
OBTA


Ch1=


VECTOR PROCESSOR A2
CHECK POWER SUPPLIES +5, +15, -15, +7, -2
ALL SUPPLIES OK?
NO
+15, -15, +5 SUPPLIES OK?
NO
REPLACE POWER CABLE A2W1
YES
YES
CLOCK SIGNAL AT TP3
NO
CLK. AT U14 PIN 8
NO
REPLACE U14
YES
REPLACE U26
+7V SUPPLY OK?
NO
PROBLEM IN +7V SUPPLY
YES
-2V SUPPLY OK
NO
CHECK R19, R20, AND C8
YES
U17 PIN 3 RFD
ACTIVITY
NO ACTIVITY
PROBLEM IN VECTOR I/O
CHECK: INPUT LATCHES U6, 8, 13 OUTPUT LATCHES U22, 25
U17 PIN 6 "VECTOR DONE"
"VECTOR DONE" SIGNAL LINE BAD OR PROBLEM ON ANALOG OR HV BOARD
NO ACTIVITY
U17 PIN 7 "START VECTOR" LINE
ACTIVITY
U27 PIN 5 "START VECTOR" LINE
NO ACTIVITY
REPLACE U27
NO ACTIVITY
ACTIVITY
CHECK U18, U19
U17 PIN 3 RFD
HIGH
U17 PIN 4 DAV
LOW
LOW
HIGH
U17 PIN 4 DAV
HIGH
LOW
REPLACE U15



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. R13 SHOWN IN POSITION FOR 16K ROM. USE ALTERNATE POSITION FOR 32K ROM.
5. WHEN OPTION 704 IS INSTALLED, JUMPERS U3, AND U4 MUST BE REMOVED.

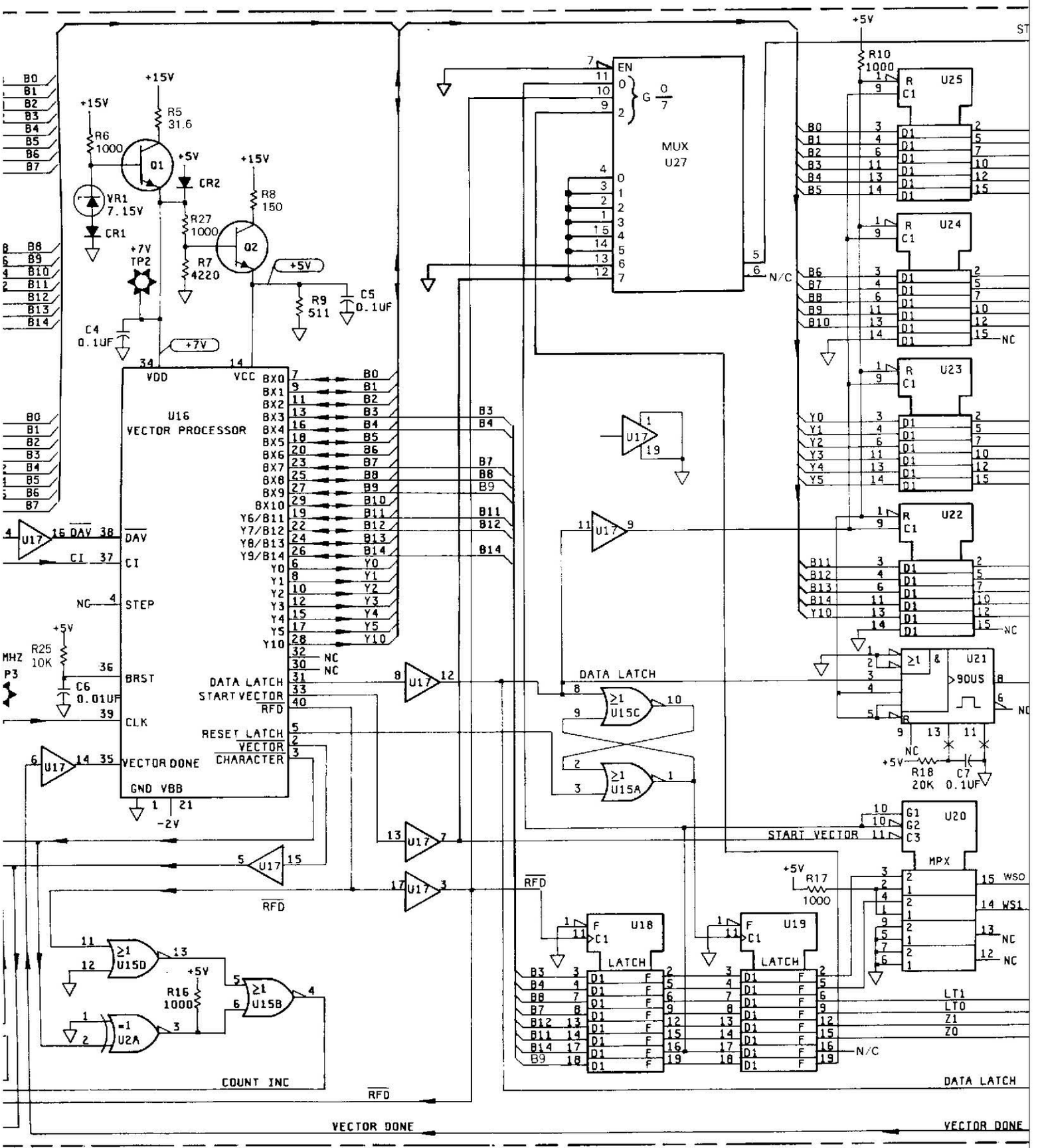
PARTS ON THIS SCHEMATIC

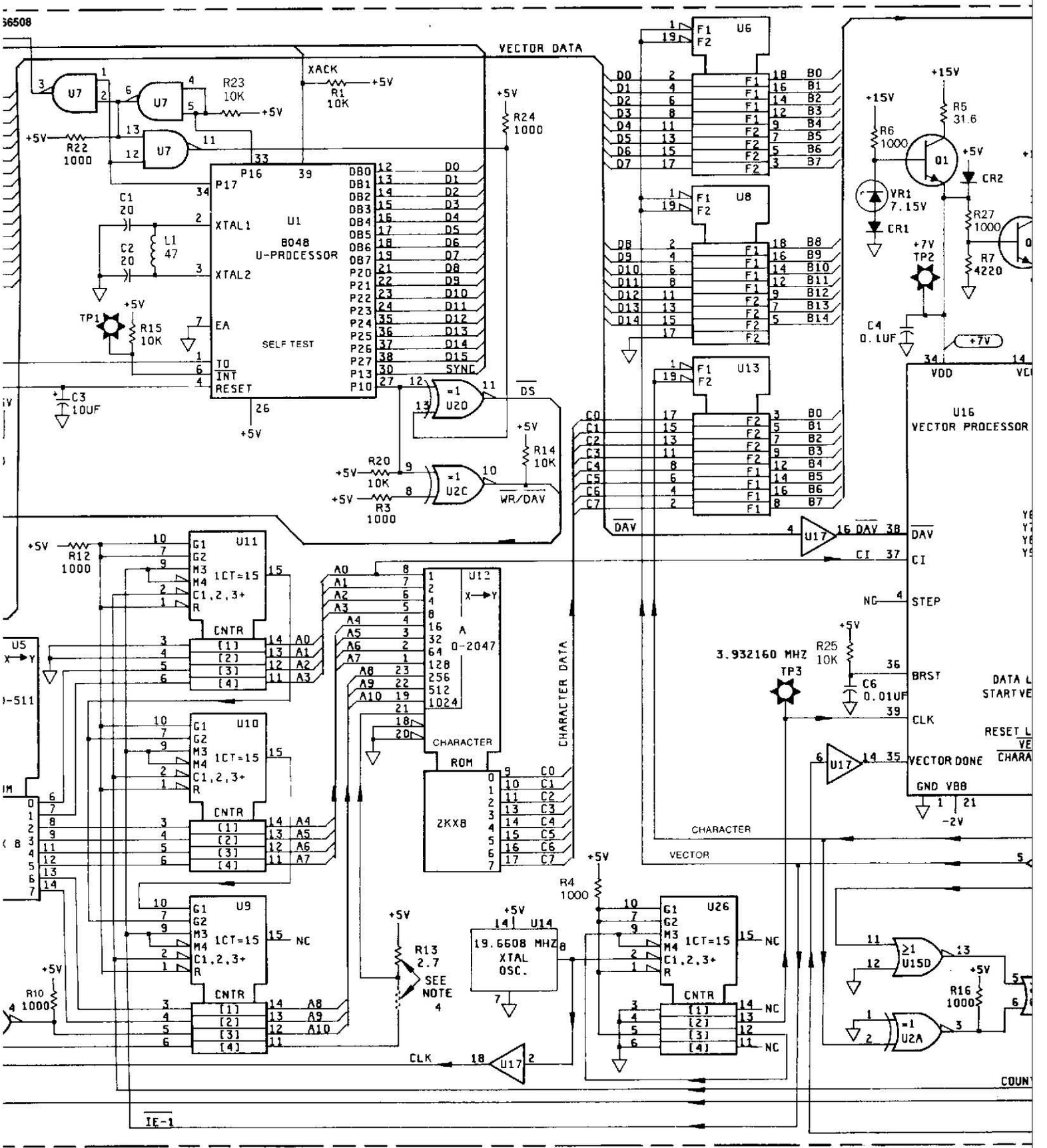
A2	
C1-18 CR1,2 E1 J1-5 L1 Q1,2	R1-21 U1-27 VR1 W1 XU3,XU4

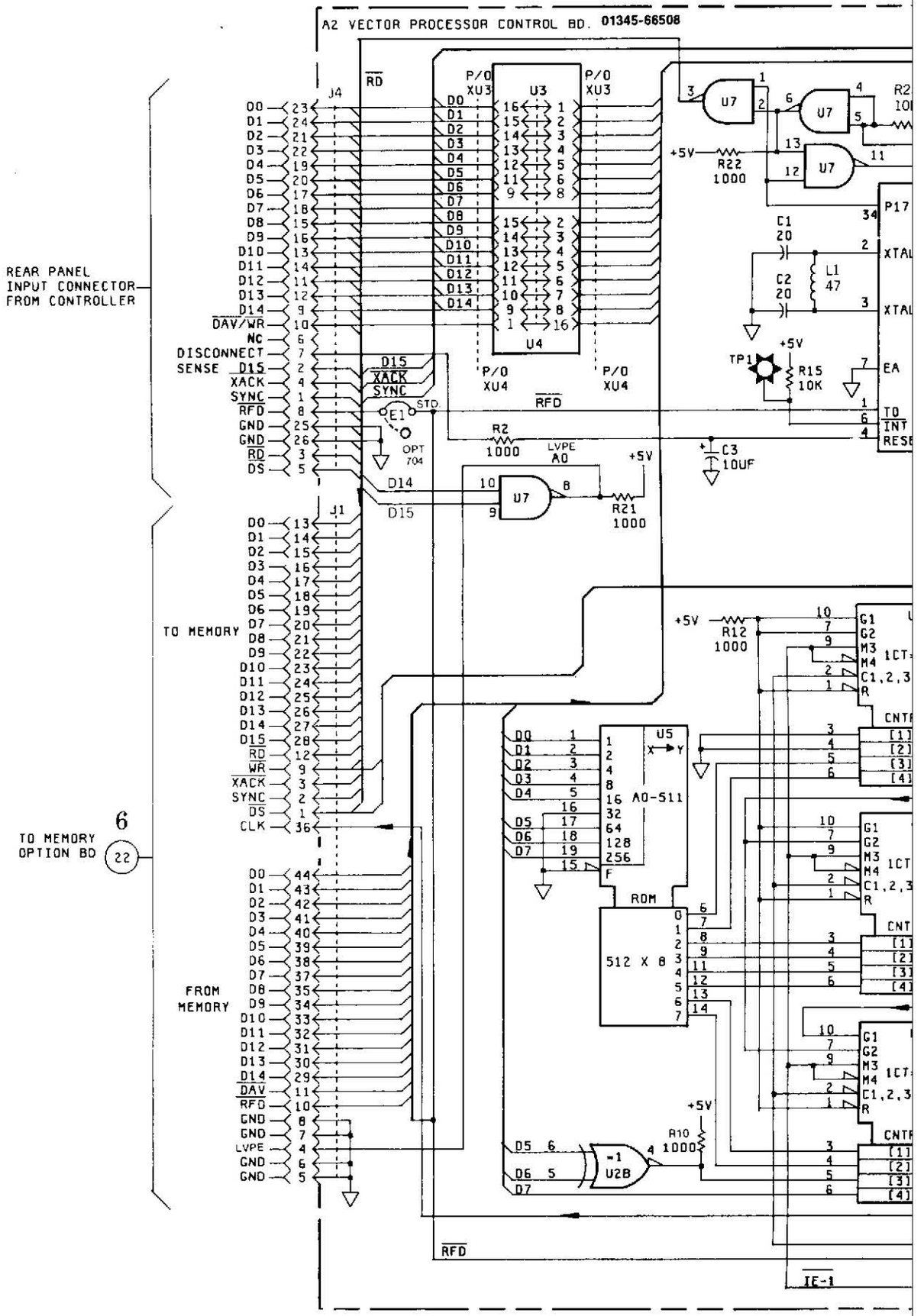
SERVICE SHEET 2

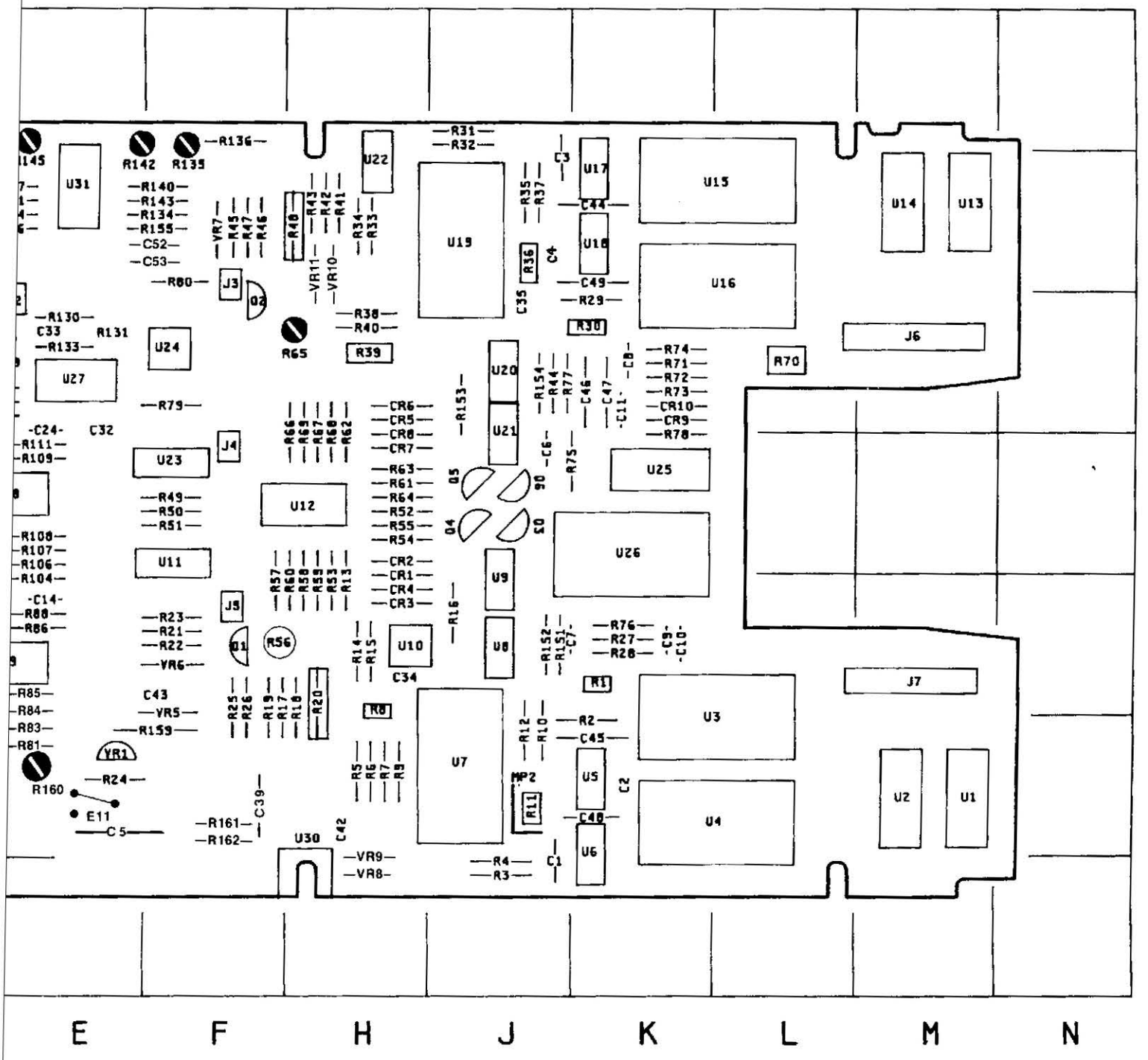
1345/106/CLG/04-16-81

Figure 8-6.
Service Sheet 2, Vector Processor (A2)

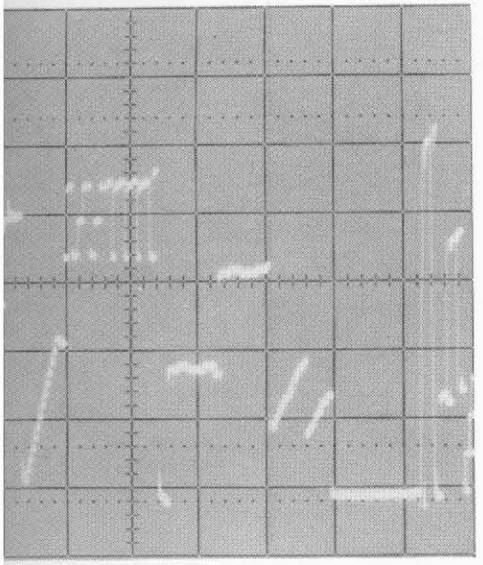

U16
VECTOR PROCESSOR
VDD
VCC
VBB
GND
DAV
CI
STEP
BRST
CLK
VECTOR DONE
DATA LATCH
START VECTOR
RFD
RESET LATCH
VECTOR CHARACTER
MUX U27
U25
U24
U23
U22
U21
U20
MPX
U18 LATCH
U19 LATCH
U15A
U15B
U15C
U15D
U2A
U17
Q1
Q2
CR1
CR2
VR1 7.15V
TP2
R5 31.6
R6 1000
R7 4220
R8 150
R9 511
R10 1000
R16 1000
R17 1000
R18 20K
R25 10K
R27 1000
C4 0.1UF
C5 0.1UF
C6 0.01UF
C7 0.1UF
+15V
+7V
+5V
-2V
COUNT INC
LT1
LT0
Z1
Z0
WSO
WS1
N/C
NC


VECTOR DATA
XACK
R1 10K
R23 10K
R22 1000
R24 1000
U1 8048 U-PROCESSOR
SELF TEST
C1 20
C2 20
L1 47
C3 10UF
R15 10K
TP1
U6
U8
U13
U20
U2C
R20 10K
R3 1000
R14 10K
WR/DAV
DS
DAV
U16 VECTOR PROCESSOR
U17
U11
U12
U10
U9
U26
U14 19.6608 MHZ XTAL OSC.
R13 2.7 SEE NOTE 4
R12 1000
R10 1000
R4 1000
CHARACTER ROM 2KX8
CHARACTER DATA
CHARACTER VECTOR
R5 31.6
R6 1000
R7 4220
R27 1000
Q1
CR1
CR2
VR1 7.15V
TP2
C4 0.1UF
3.932160 MHZ
TP3
R25 10K
C6 0.01UF
U15D
U2A
R16 1000
VECTOR DONE
GND VBB
IE-1

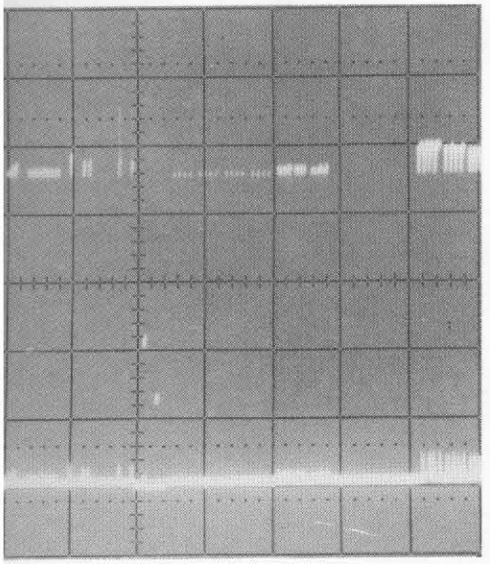

A2 VECTOR PROCESSOR CONTROL BD. 01345-66508
REAR PANEL INPUT CONNECTOR FROM CONTROLLER
TO MEMORY
FROM MEMORY
TO MEMORY OPTION BD
6
22
J4
J1
U3
U4
U5
U7
U2B
ROM
512 X 8
A0-511
P/O XU3
P/O XU4
R22 1000
R21 1000
R12 1000
R10 1000
R2 1000
R15 10K
C1 20
C2 20
C3 10UF
L1 47
TP1
E1
OPT 704
STD
LVPE
A0
+5V
RFD
XACK
SYNC
P17
XTAL
EA
INT
RESE
CNTR
1CT=



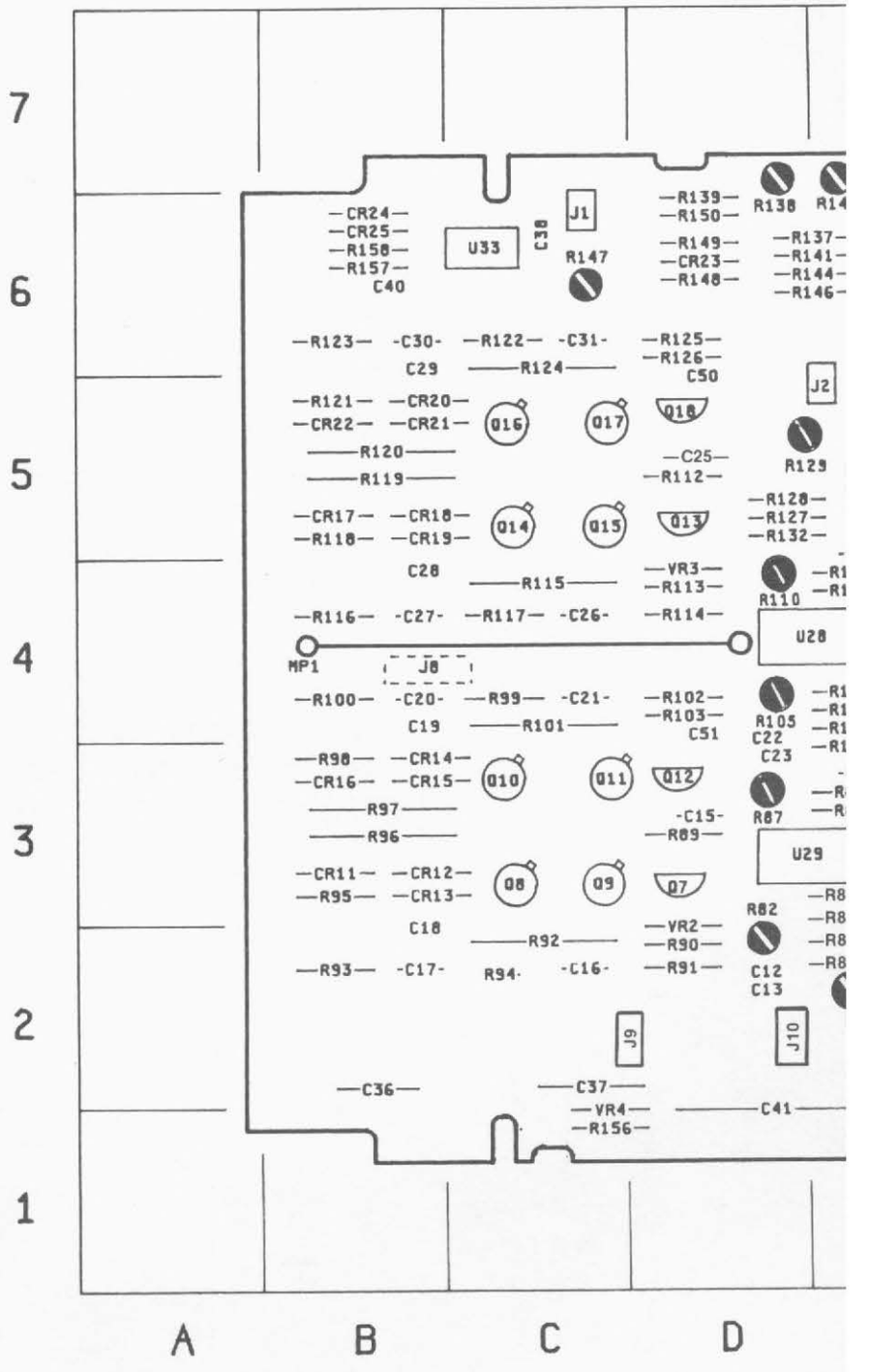
P/O Service Sheet 3A, X-Y-Z Amp/Stroke Generator (A1)



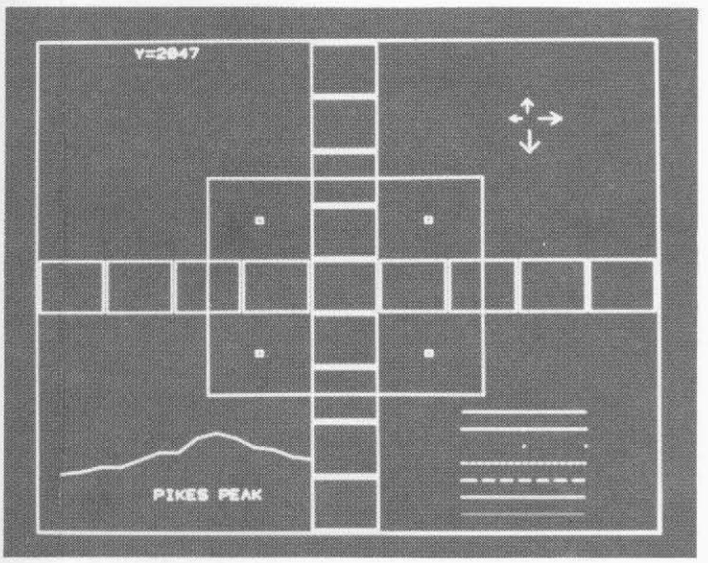
UXILIARY X OUTPUT AT A1J5
V/DIV, 2 ms/DIV



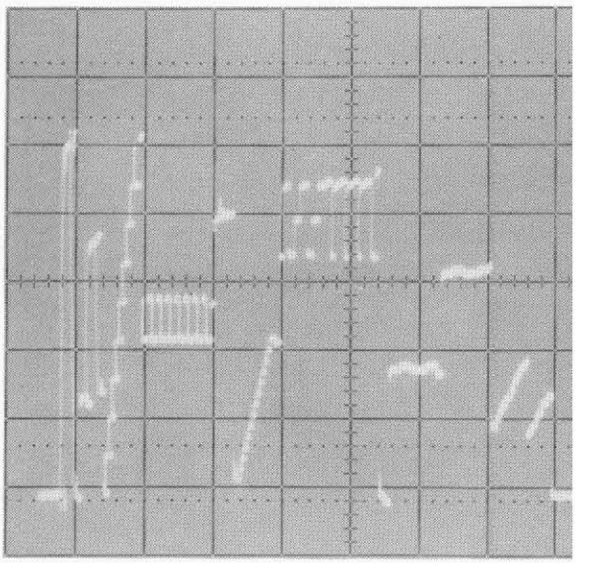
UXILIARY Z OUTPUT AT A1J3
V/DIV, 2 ms/DIV



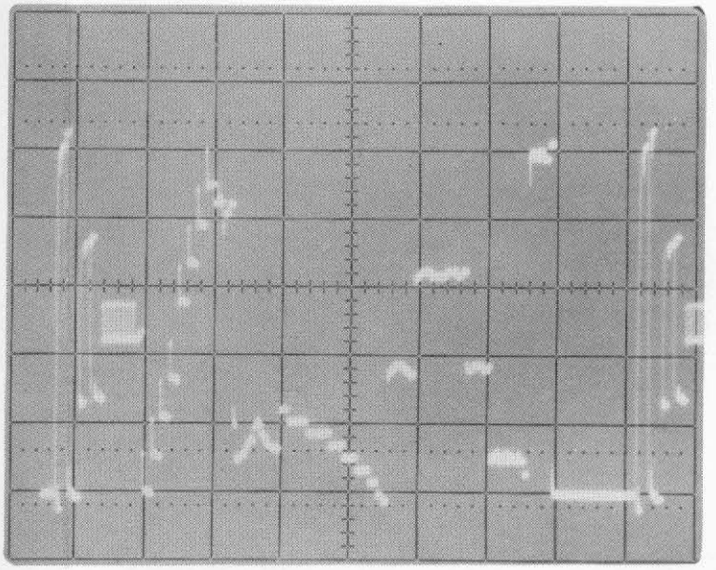
WAVEFORM MEASUREMENT CONDITION



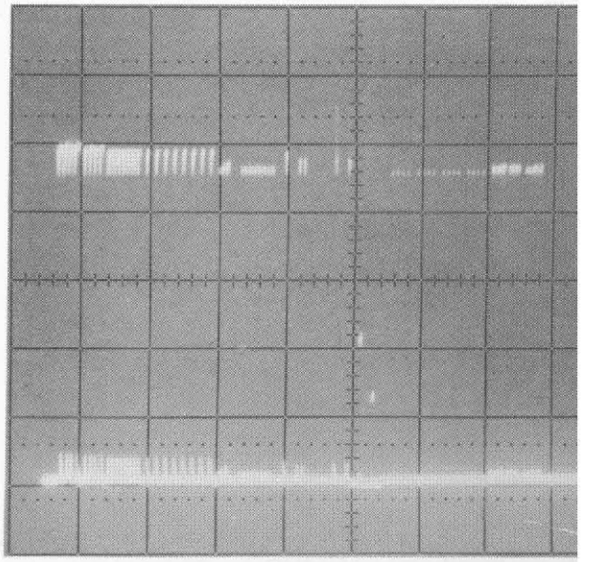
OBTAIN PRIMARY TEST PATTERN AS SHOWN ABOVE



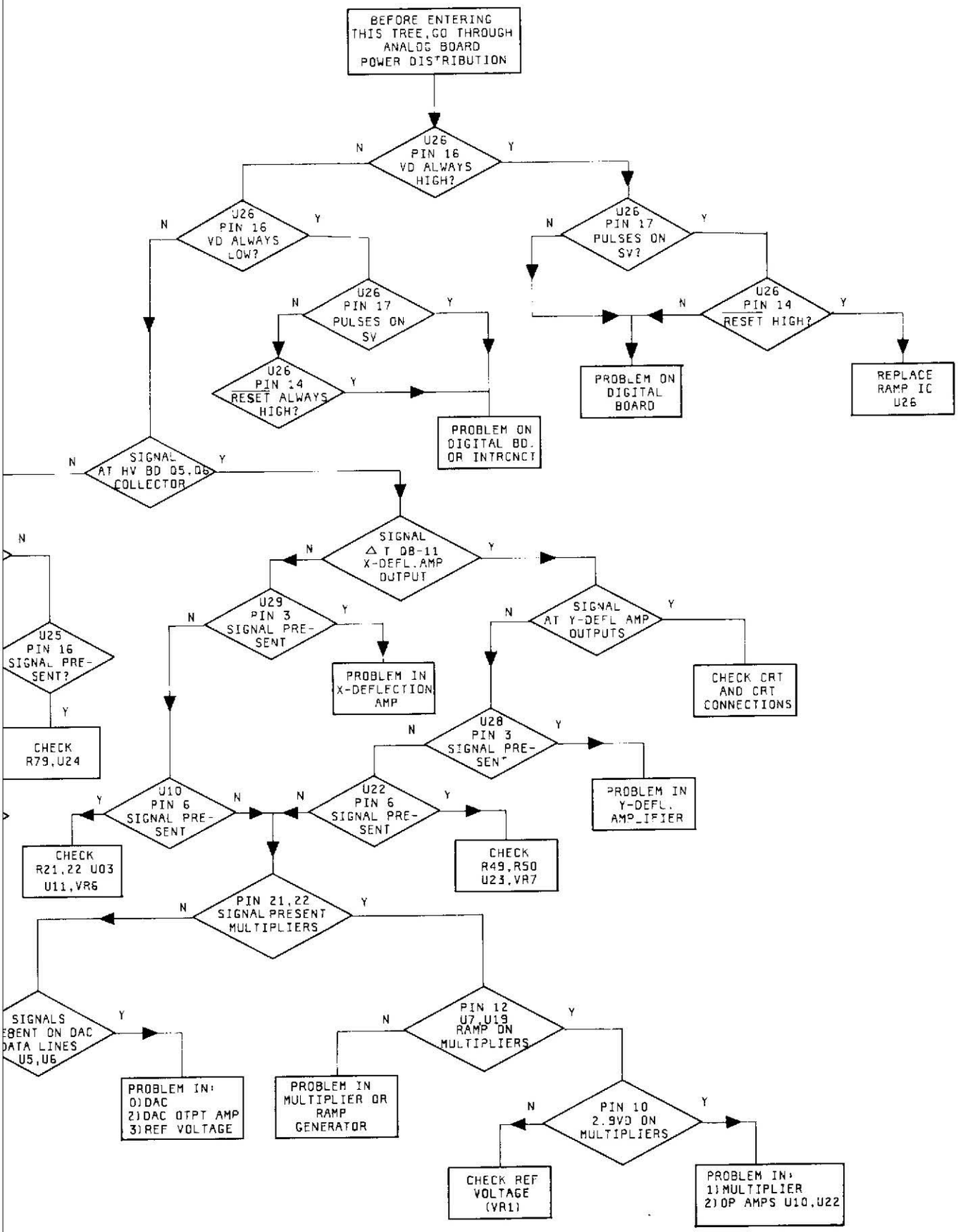
AUXILIARY X OUTPUT AT A1J5
.2 V/DIV, 2 ms/DIV

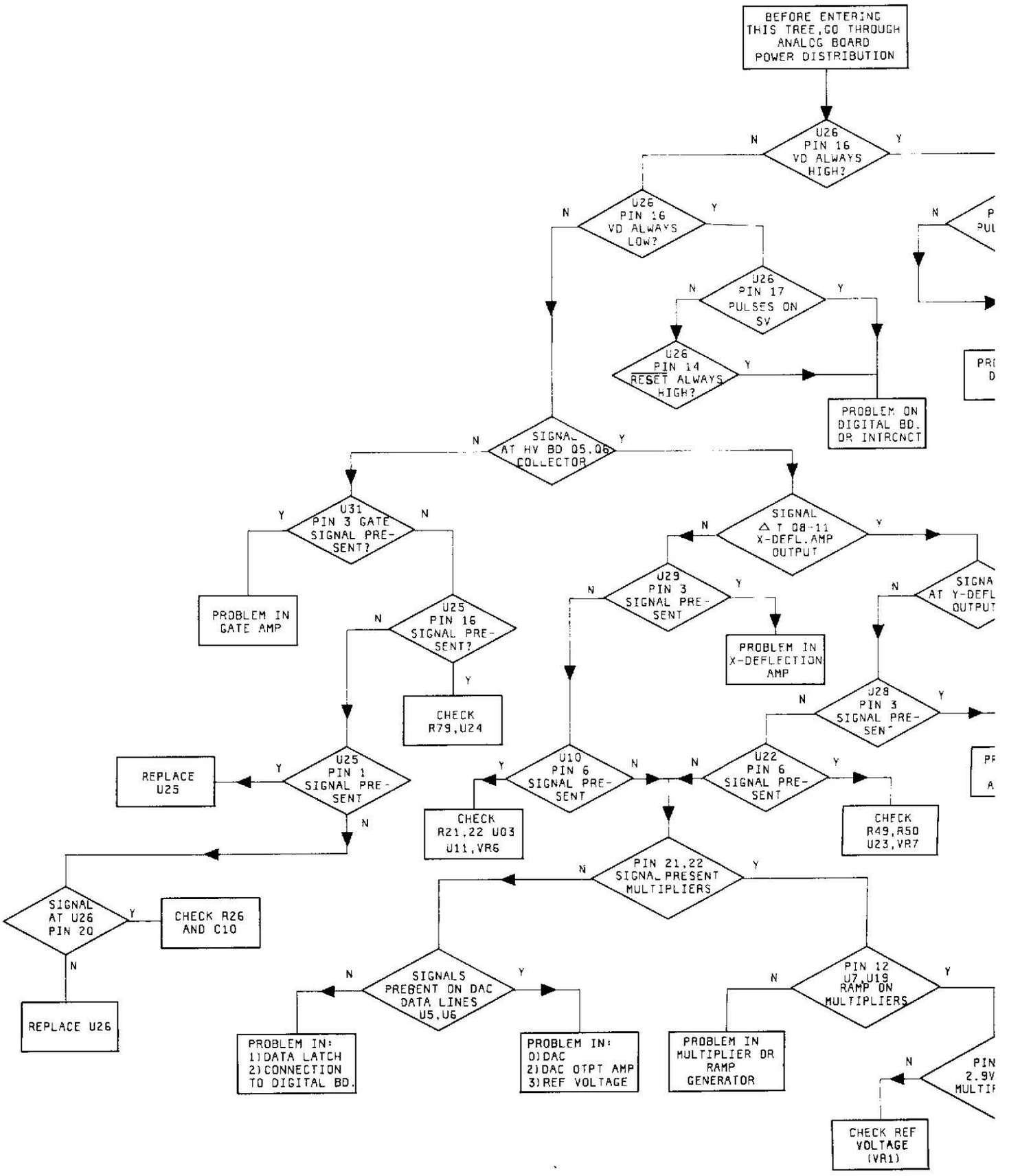


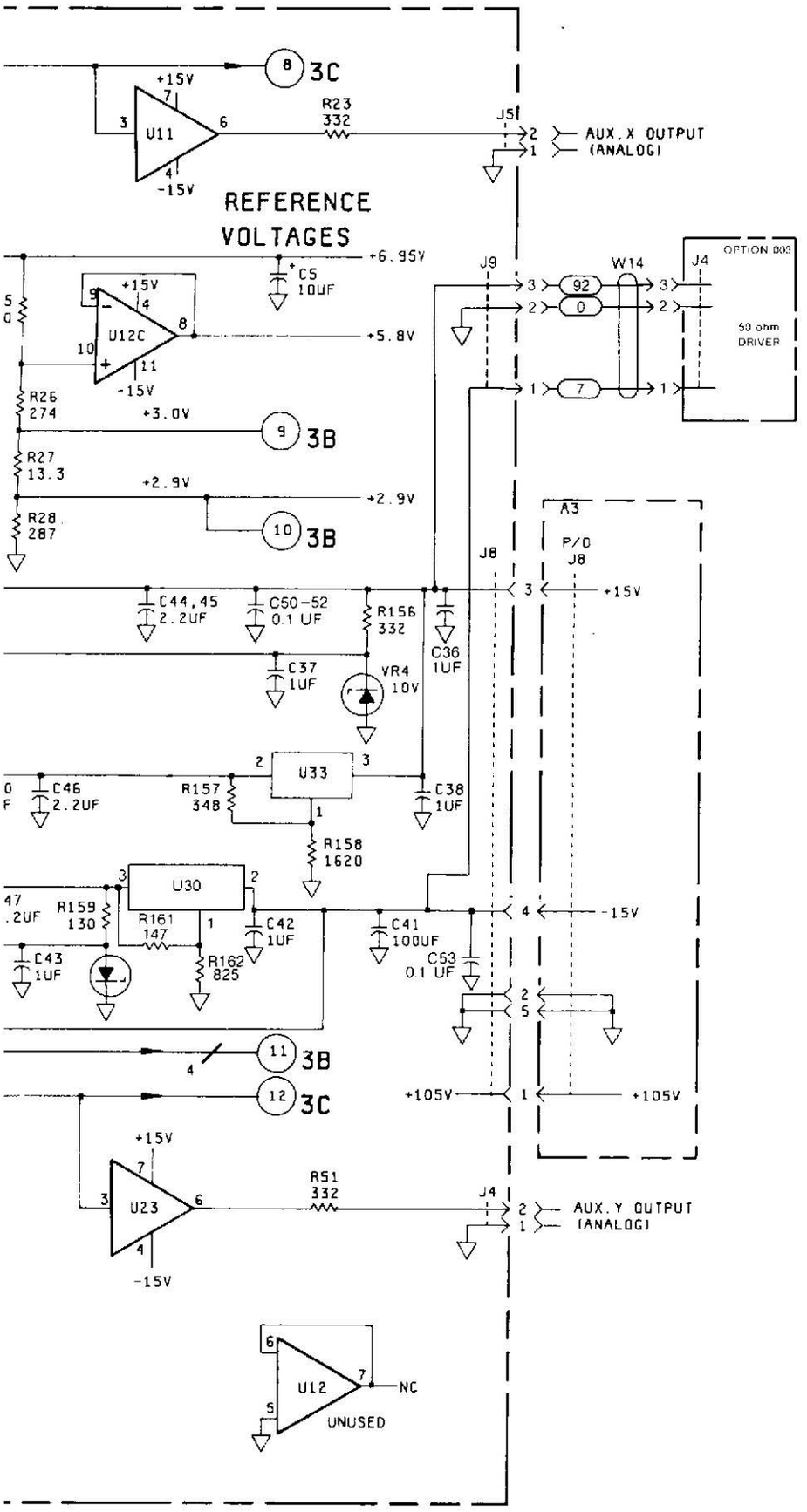
AUXILIARY Y OUTPUT AT A1J4
.2 V/DIV, 2 ms/DIV



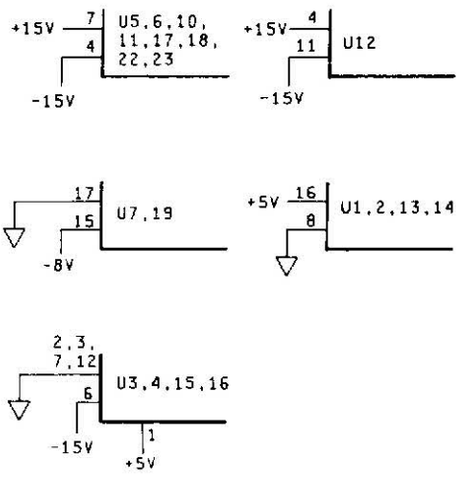
AUXILIARY Z OUTPUT AT A1J3
.2 V/DIV, 2 ms/DIV


BEFORE ENTERING THIS TREE, GO THROUGH ANALOG BOARD POWER DISTRIBUTION
U26 PIN 16 VD ALWAYS HIGH?
U26 PIN 16 VD ALWAYS LOW?
U26 PIN 17 PULSES ON 5V?
U26 PIN 17 PULSES ON 5V
U26 PIN 14 RESET ALWAYS HIGH?
U26 PIN 14 RESET HIGH?
PROBLEM ON DIGITAL BOARD
REPLACE RAMP IC U26
PROBLEM ON DIGITAL BD. OR INTRCNCT
SIGNAL AT HV BD Q5,Q6 COLLECTOR
SIGNAL Δ T DB-11 X-DEFL. AMP OUTPUT
U29 PIN 3 SIGNAL PRE-SENT
PROBLEM IN X-DEFLECTION AMP
SIGNAL AT Y-DEFL AMP OUTPUTS
CHECK CRT AND CRT CONNECTIONS
U25 PIN 16 SIGNAL PRE-SENT?
CHECK R79, U24
U28 PIN 3 SIGNAL PRE-SENT
PROBLEM IN Y-DEFL. AMPLIFIER
U10 PIN 6 SIGNAL PRE-SENT
U22 PIN 6 SIGNAL PRE-SENT
CHECK R21,22 U03 U11,VR6
CHECK R49,R50 U23,VR7
PIN 21,22 SIGNAL PRESENT MULTIPLIERS
SIGNALS ENT ON DAC DATA LINES U5,U6
PROBLEM IN: 0)DAC 2)DAC OTPT AMP 3)REF VOLTAGE
PIN 12 U7,U19 RAMP ON MULTIPLIERS
PROBLEM IN MULTIPLIER OR RAMP GENERATOR
PIN 10 2.9VD ON MULTIPLIERS
CHECK REF VOLTAGE (VR1)
PROBLEM IN: 1)MULTIPLIER 2)OP AMPS U10,U22


BEFORE ENTERING THIS TREE, GO THROUGH ANALOG BOARD POWER DISTRIBUTION
U26 PIN 16 VD ALWAYS HIGH?
U26 PIN 16 VD ALWAYS LOW?
U26 PIN 17 PULSES ON 5V
U26 PIN 14 RESET ALWAYS HIGH?
PROBLEM ON DIGITAL BD. OR INTRCNCT
SIGNAL AT HV BD Q5,Q6 COLLECTOR
U31 PIN 3 GATE SIGNAL PRESENT?
PROBLEM IN GATE AMP
U25 PIN 16 SIGNAL PRESENT?
CHECK R79,U24
U25 PIN 1 SIGNAL PRESENT
REPLACE U25
SIGNAL AT U26 PIN 20
CHECK R26 AND C10
REPLACE U26
SIGNAL △T Q8-11 X-DEFL.AMP OUTPUT
U29 PIN 3 SIGNAL PRESENT
PROBLEM IN X-DEFLECTION AMP
U10 PIN 6 SIGNAL PRESENT
CHECK R21,22 U03 U11,VR6
U22 PIN 6 SIGNAL PRESENT
CHECK R49,R50 U23,VR7
U28 PIN 3 SIGNAL PRESENT
PIN 21,22 SIGNAL PRESENT MULTIPLIERS
SIGNALS PRESENT ON DAC DATA LINES U5,U6
PROBLEM IN: 1)DATA LATCH 2)CONNECTION TO DIGITAL BD.
PROBLEM IN: 0)DAC 2)DAC OTPT AMP 3)REF VOLTAGE
PIN 12 U7,U19 RAMP ON MULTIPLIERS
PROBLEM IN MULTIPLIER OR RAMP GENERATOR
CHECK REF VOLTAGE (VR1)



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

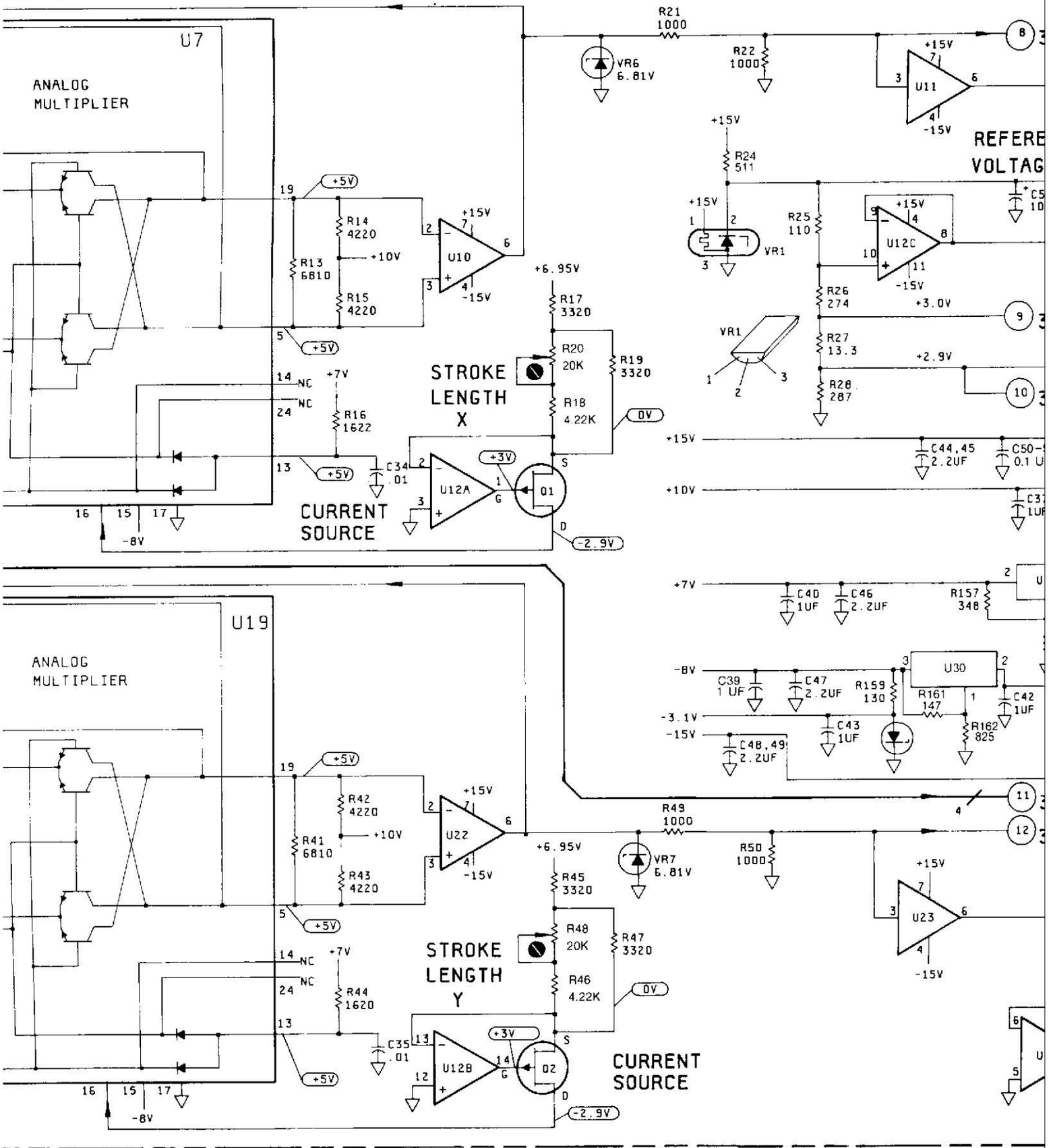
P/O A1

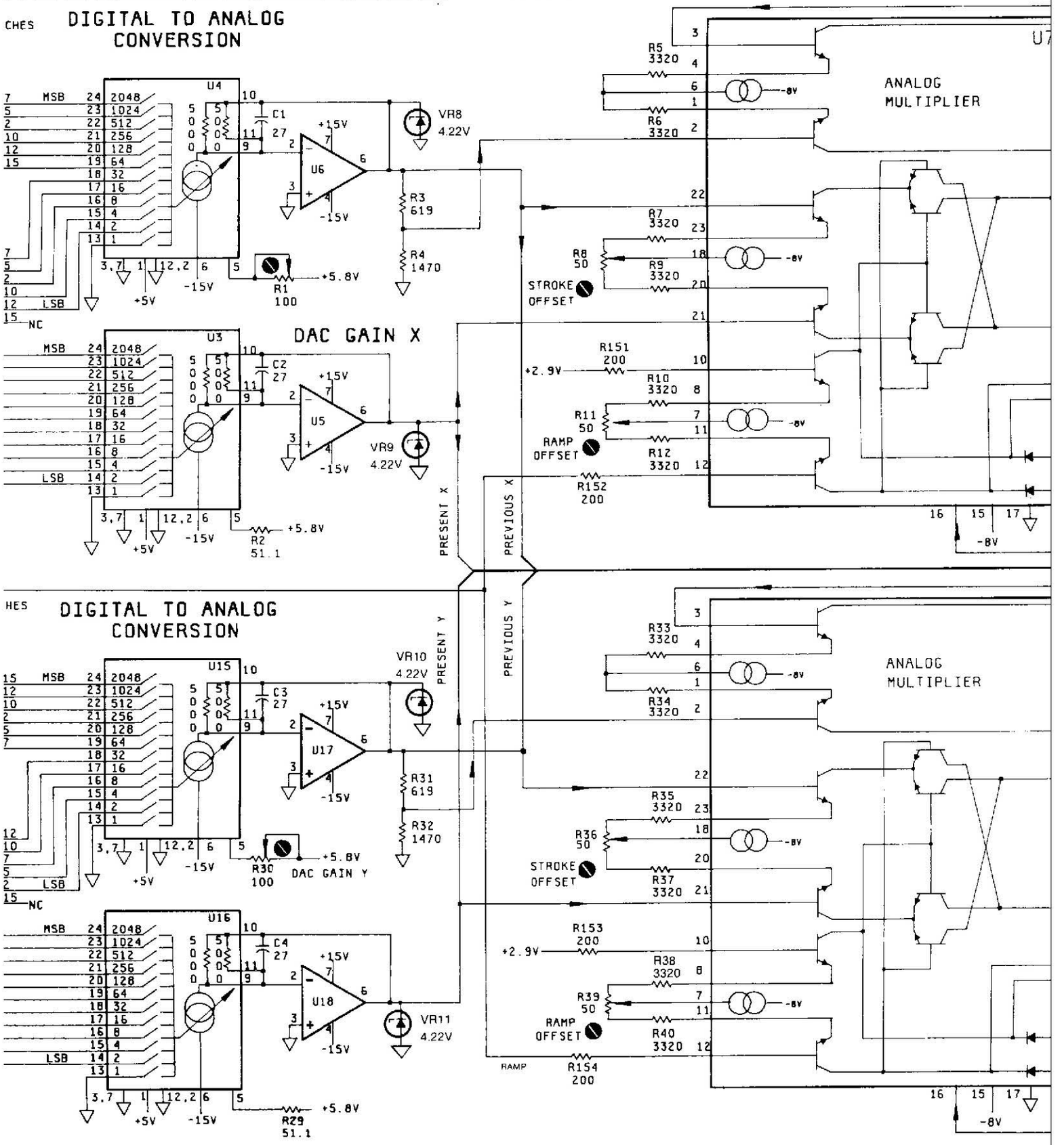
C1-5, 34-51
J4-7
Q1, 2
R1-51, 151-154, 156-159
U1-7, 10-19, 22, 23, 30, 33
VR1, 4-11

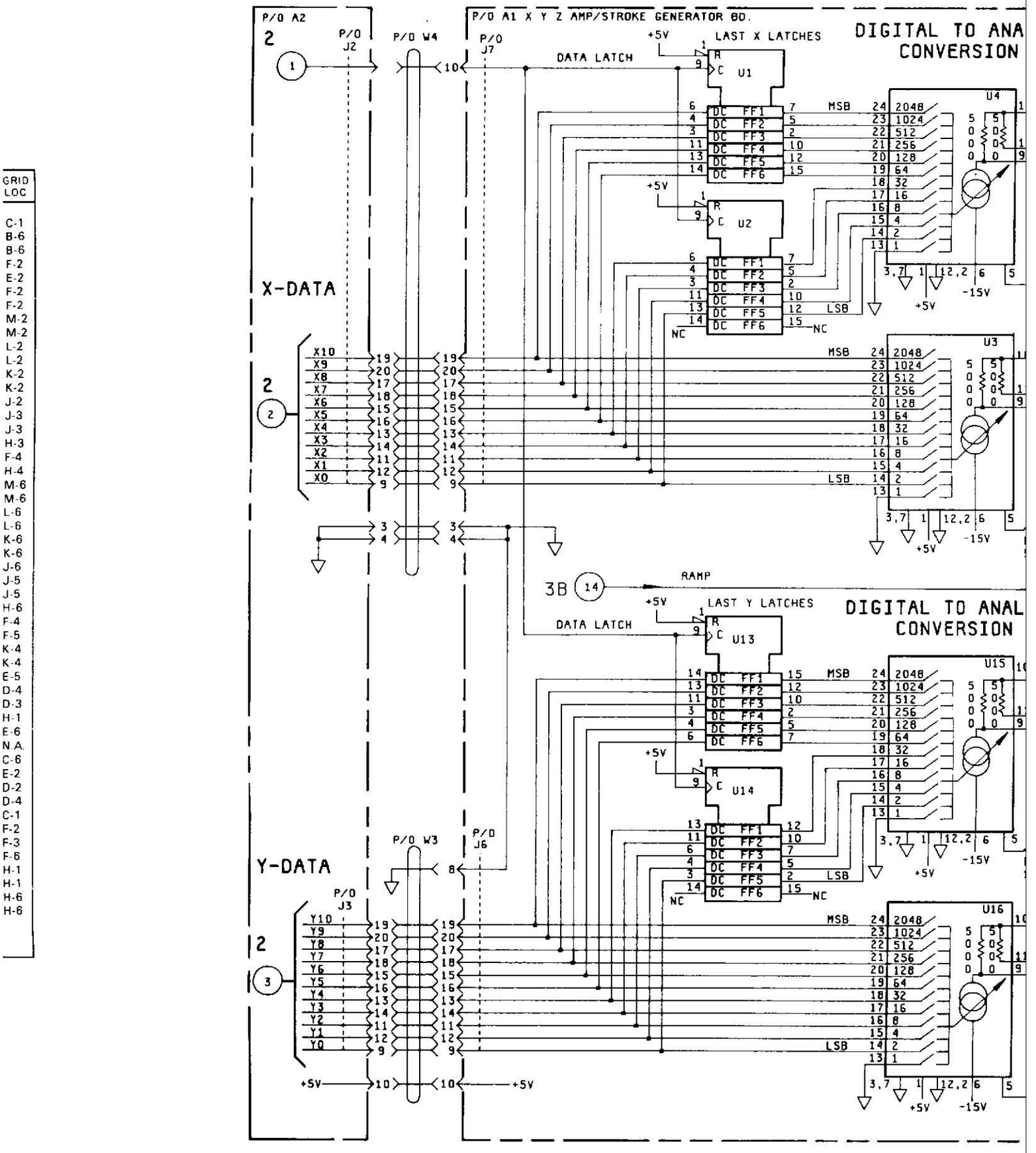
SERVICE SHEET 3A

1345/100/CLG/04-09-81

Figure 8-7.
Service Sheet 3A, X-Y-Z Amp/Stroke Generator (A1)


U7
ANALOG
MULTIPLIER
R21
1000
VR6
6.81V
R22
1000
U11
+15V
-15V
REFERE
VOLTAG
R24
511
R25
110
U12C
VR1
R26
274
+3.0V
R27
13.3
+2.9V
R28
287
R14
4220
R13
6810
R15
4220
+10V
U10
+6.95V
R17
3320
R20
20K
R19
3320
R18
4.22K
0V
STROKE
LENGTH
X
+7V
R16
1622
NC
NC
+5V
C34
.01
U12A
+3V
Q1
CURRENT
SOURCE
-2.9V
-8V
+15V
+10V
C44,45
2.2UF
C40
1UF
C46
2.2UF
R157
348
-8V
C39
1 UF
C47
2.2UF
R159
130
U30
R161
147
C42
1UF
-3.1V
-15V
C43
1UF
C48,49
2.2UF
R162
825
U19
ANALOG
MULTIPLIER
R42
4220
R41
6810
R43
4220
U22
R49
1000
VR7
6.81V
R50
1000
R45
3320
R48
20K
R47
3320
R46
4.22K
STROKE
LENGTH
Y
R44
1620
C35
.01
U12B
Q2
CURRENT
SOURCE
U23

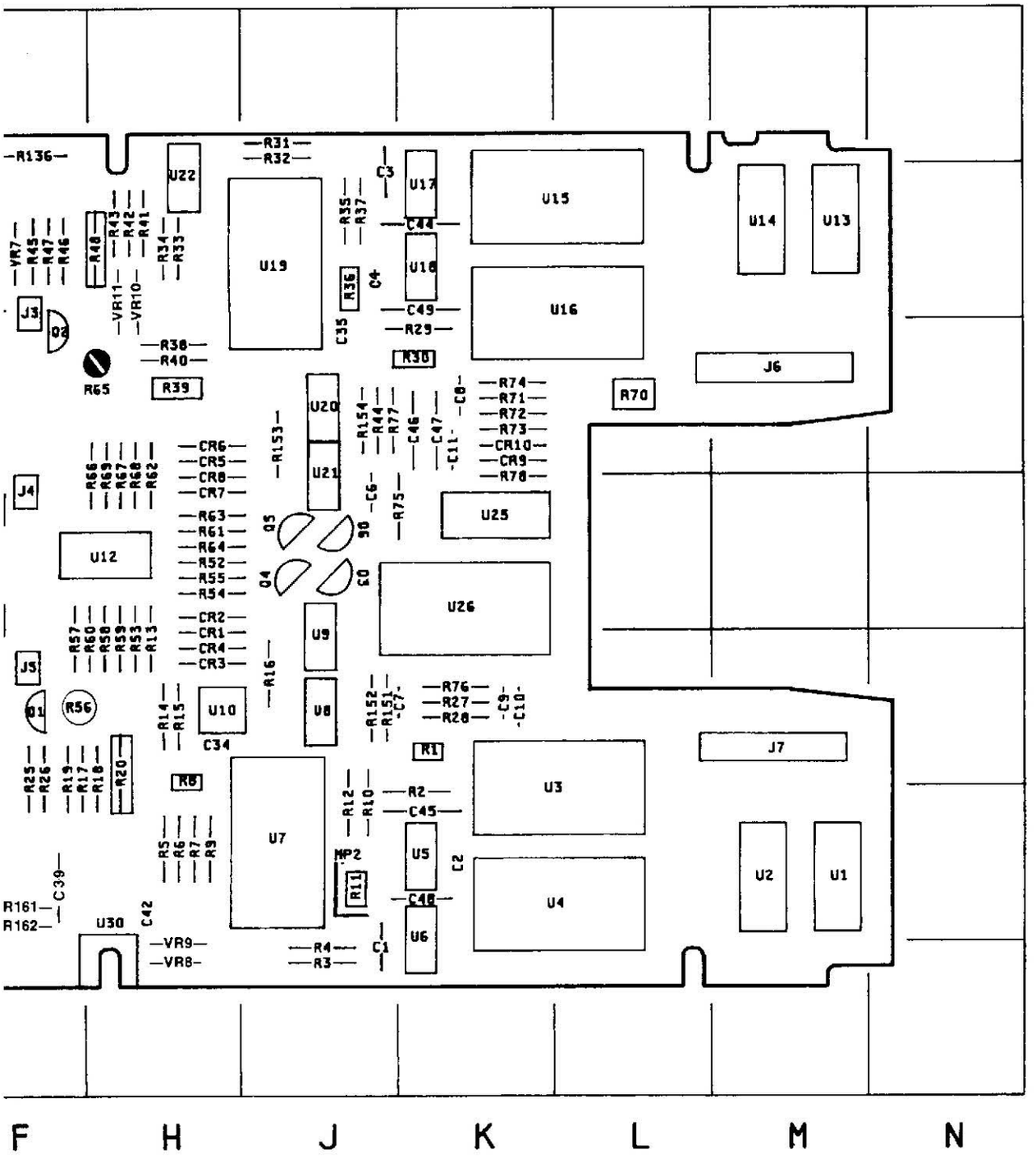

CHES
DIGITAL TO ANALOG CONVERSION
U4
MSB
LSB
NC
2048
1024
512
256
128
64
32
16
8
4
2
1
C1
27
+15V
-15V
U6
VR8
4.22V
R3
619
R4
1470
R1
100
+5.8V
+5V
U3
DAC GAIN X
C2
U5
VR9
R2
51.1
PRESENT X
PREVIOUS X
U7
ANALOG MULTIPLIER
R5
3320
R6
R7
R8
50
R9
STROKE OFFSET
R151
200
+2.9V
R10
R11
RAMP OFFSET
R12
R152
-8V
HES
DIGITAL TO ANALOG CONVERSION
U15
C3
U17
VR10
4.22V
R31
619
R32
1470
R30
100
DAC GAIN Y
U16
C4
U18
VR11
4.22V
R29
51.1
PRESENT Y
PREVIOUS Y
R33
3320
R34
R35
R36
50
R37
R153
R38
R39
R40
R154
RAMP



GRID LOC
C-1
B-6
B-6
F-2
E-2
F-2
F-2
M-2
M-2
L-2
L-2
K-2
K-2
J-2
J-3
J-3
H-3
F-4
H-4
M-6
M-6
L-6
L-6
K-6
K-6
J-6
J-5
J-5
H-6
F-4
F-5
K-4
K-4
E-5
D-4
D-3
H-1
E-6
N.A.
C-6
E-2
D-2
D-4
C-1
F-2
F-3
F-6
H-1
H-1
H-6
H-6

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

P/O Service Sheet 3B, X-Y-Z Amp/Stroke Generator (A1)


F
H
J
K
L
M
N
U1
U2
U3
U4
U5
U6
U7
U8
U9
U10
U12
U13
U14
U15
U16
U17
U18
U19
U20
U21
U22
U25
U26
U30
J1
J2
J3
J4
J5
J6
J7
Q1
Q2
Q3
Q4
Q5
Q6
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
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R19
R20
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R26
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R31
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R33
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R41
R42
R43
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R45
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R61
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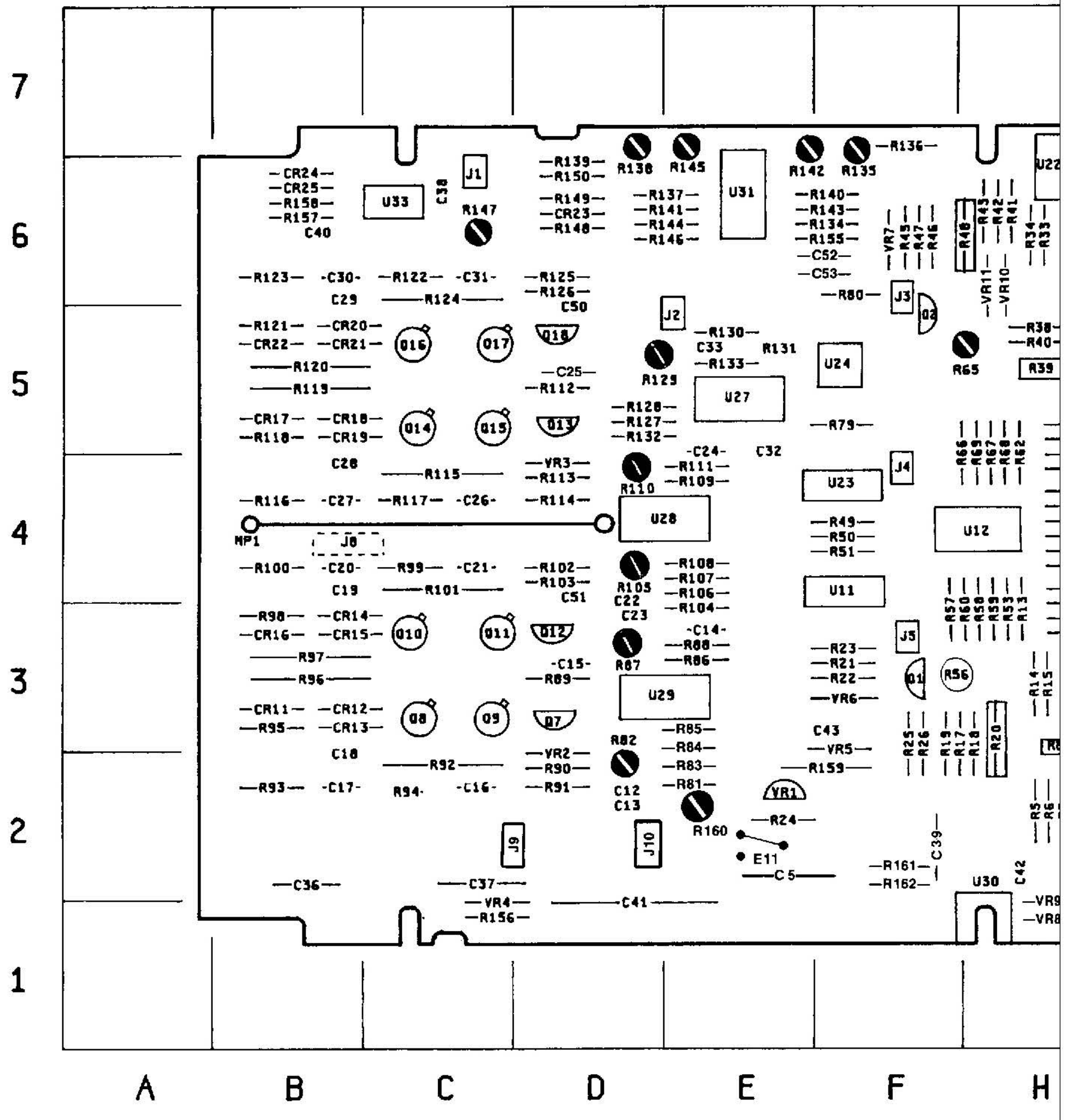
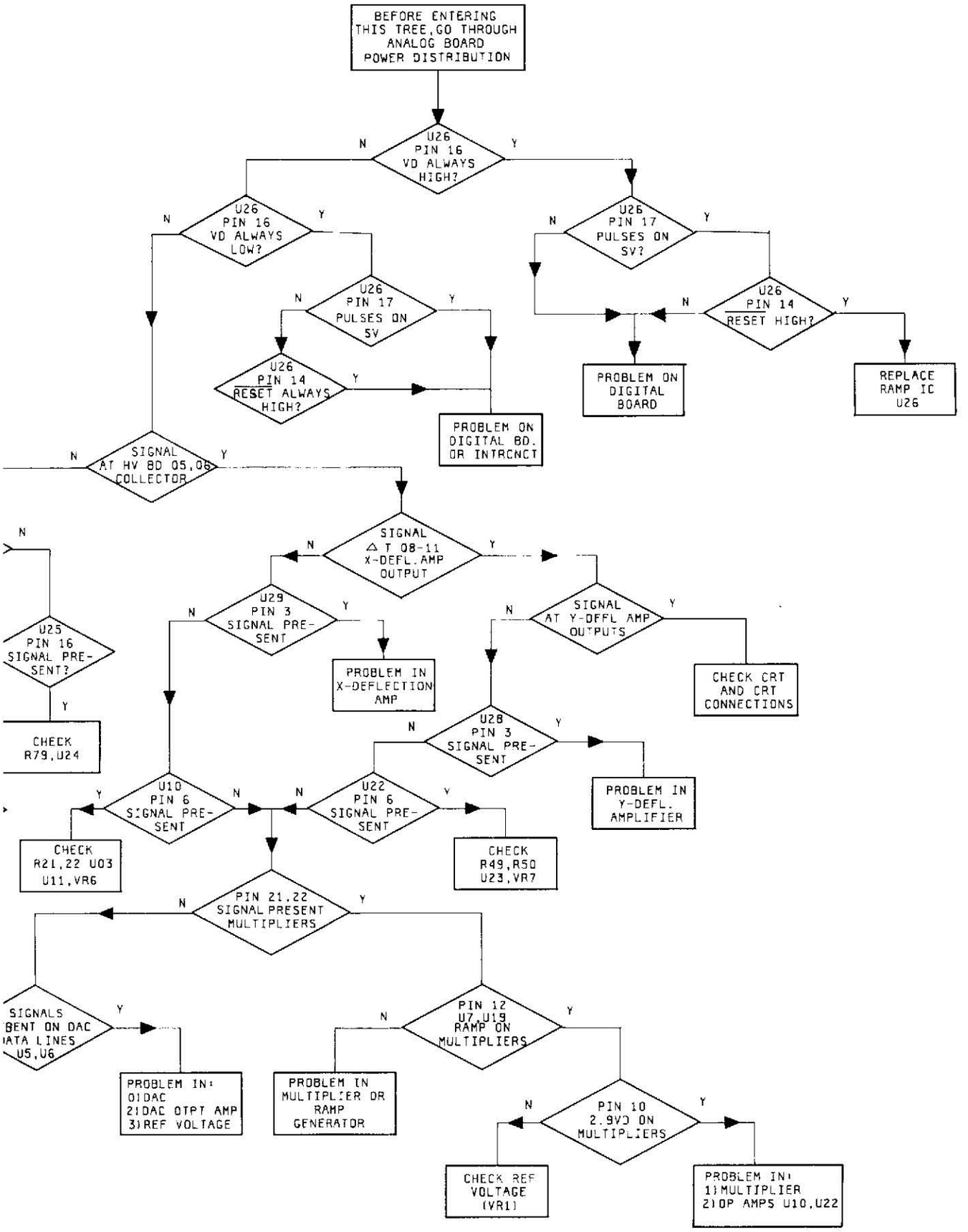
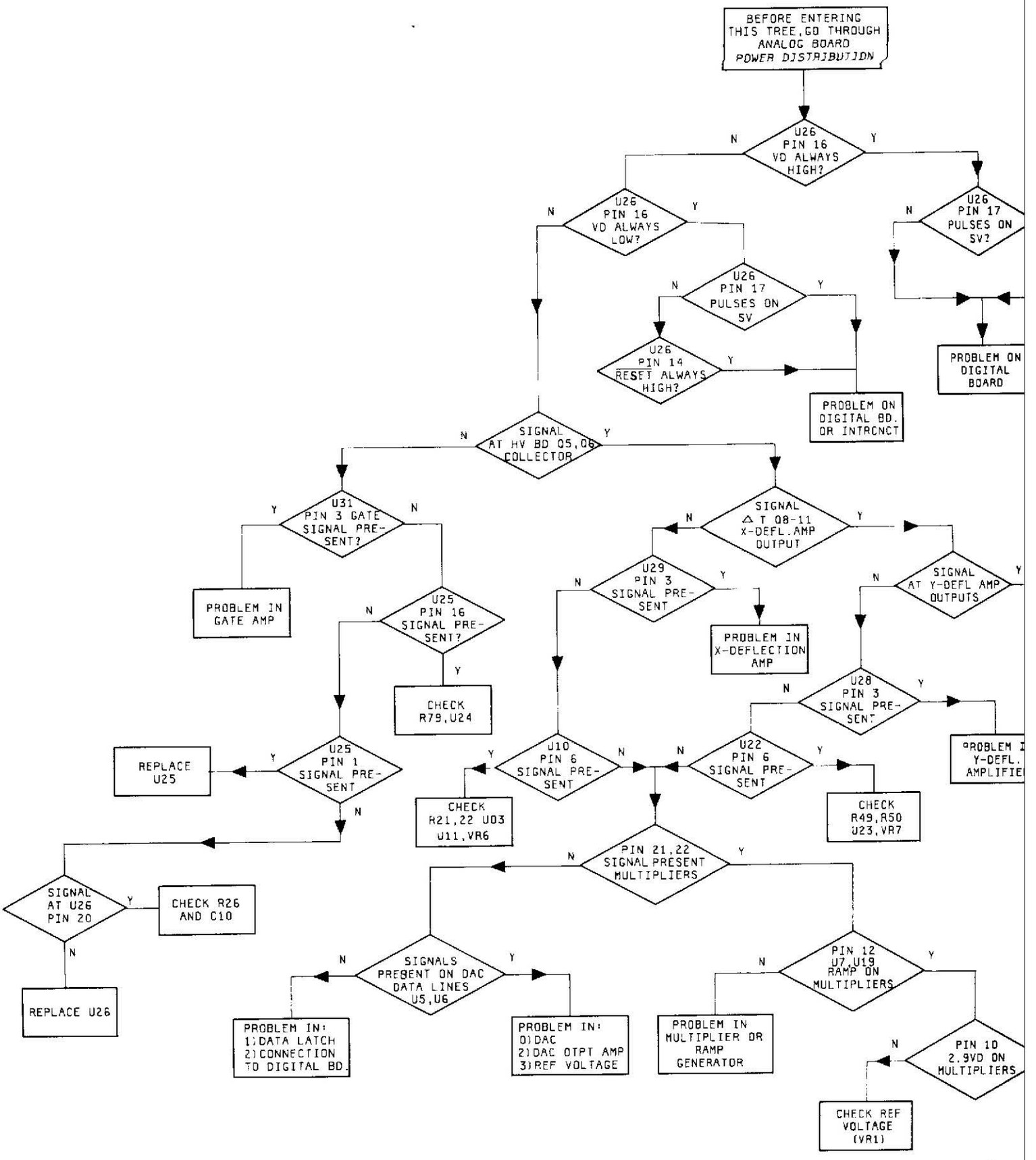
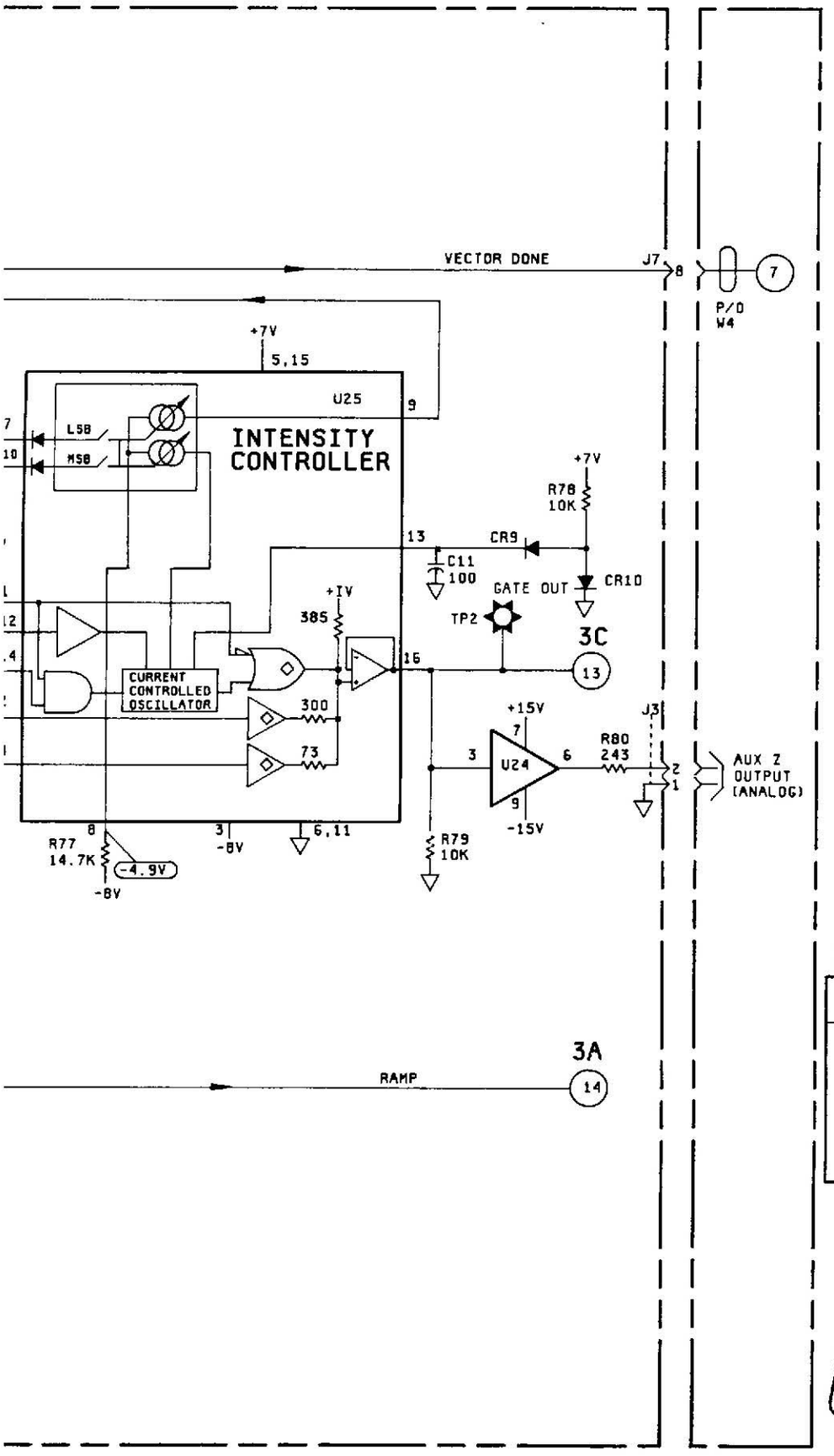
R63
R64
R65
R66
R67
R68
R69
R70
R71
R72
R73
R74
R75
R76
R77
R78
R136
R152
R153
R154
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
C11
C34
C35
C39
C42
C44
C45
C46
C47
C48
C49
CR1
CR2
CR3
CR4
CR5
CR6
CR7
CR8
CR9
CR10
VR7
VR8
VR9
VR10
VR11
R161
R162

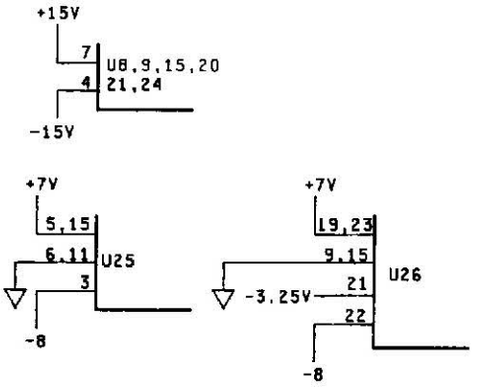

7
6
5
4
3
2
1
A
B
C
D
E
F
H
U33
U31
U27
U24
U28
U23
U12
U11
U29
U30
J1
J2
J3
J4
J5
J8
J9
J10
MP1
E11
R147
R129
R110
R105
R87
R82
R160
R65
R138
R145
R142
R135


BEFORE ENTERING THIS TREE, GO THROUGH ANALOG BOARD POWER DISTRIBUTION
U26 PIN 16 VD ALWAYS HIGH?
U26 PIN 16 VD ALWAYS LOW?
U26 PIN 17 PULSES ON 5V?
U26 PIN 17 PULSES ON 5V
U26 PIN 14 RESET ALWAYS HIGH?
U26 PIN 14 RESET HIGH?
PROBLEM ON DIGITAL BOARD
REPLACE RAMP IC U26
PROBLEM ON DIGITAL BD. OR INTRCNCT
SIGNAL AT HV BD Q5,Q6 COLLECTOR
SIGNAL △ T Q8-11 X-DEFL. AMP OUTPUT
U29 PIN 3 SIGNAL PRE-SENT
PROBLEM IN X-DEFLECTION AMP
SIGNAL AT Y-DFFL AMP OUTPUTS
CHECK CRT AND CRT CONNECTIONS
U25 PIN 16 SIGNAL PRE-SENT?
CHECK R79, U24
U28 PIN 3 SIGNAL PRE-SENT
PROBLEM IN Y-DEFL. AMPLIFIER
U10 PIN 6 SIGNAL PRE-SENT
U22 PIN 6 SIGNAL PRE-SENT
CHECK R21,22 U03 U11, VR6
CHECK R49, R50 U23, VR7
PIN 21,22 SIGNAL PRESENT MULTIPLIERS
SIGNALS BENT ON DAC DATA LINES U5, U6
PROBLEM IN: 0) DAC 2) DAC OTPT AMP 3) REF VOLTAGE
PIN 12 U7, U19 RAMP ON MULTIPLIERS
PROBLEM IN MULTIPLIER OR RAMP GENERATOR
PIN 10 2.9VD ON MULTIPLIERS
CHECK REF VOLTAGE (VR1)
PROBLEM IN: 1) MULTIPLIER 2) OP AMPS U10, U22


BEFORE ENTERING THIS TREE, GO THROUGH ANALOG BOARD POWER DISTRIBUTION
U26 PIN 16 VD ALWAYS HIGH?
U26 PIN 16 VD ALWAYS LOW?
U26 PIN 17 PULSES ON 5V?
U26 PIN 17 PULSES ON 5V
U26 PIN 14 RESET ALWAYS HIGH?
PROBLEM ON DIGITAL BOARD
PROBLEM ON DIGITAL BD. OR INTRONCT
SIGNAL AT HV BD Q5,Q6 COLLECTOR
U31 PIN 3 GATE SIGNAL PRESENT?
PROBLEM IN GATE AMP
U25 PIN 16 SIGNAL PRESENT?
CHECK R79,U24
U25 PIN 1 SIGNAL PRESENT
REPLACE U25
SIGNAL AT U26 PIN 20
CHECK R26 AND C10
REPLACE U26
SIGNAL △T Q8-11 X-DEFL.AMP OUTPUT
U29 PIN 3 SIGNAL PRESENT
PROBLEM IN X-DEFLECTION AMP
SIGNAL AT Y-DEFL AMP OUTPUTS
U28 PIN 3 SIGNAL PRESENT
U10 PIN 6 SIGNAL PRESENT
CHECK R21,22 U03 U11,VR6
U22 PIN 6 SIGNAL PRESENT
CHECK R49,R50 U23,VR7
PIN 21,22 SIGNAL PRESENT MULTIPLIERS
SIGNALS PRESENT ON DAC DATA LINES U5,U6
PROBLEM IN: 1) DATA LATCH 2) CONNECTION TO DIGITAL BD.
PROBLEM IN: 0) DAC 2) DAC OTPT AMP 3) REF VOLTAGE
PIN 12 U7,U19 RAMP ON MULTIPLIERS
PROBLEM IN MULTIPLIER OR RAMP GENERATOR
PIN 10 2.9VD ON MULTIPLIERS
CHECK REF VOLTAGE (VR1)



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

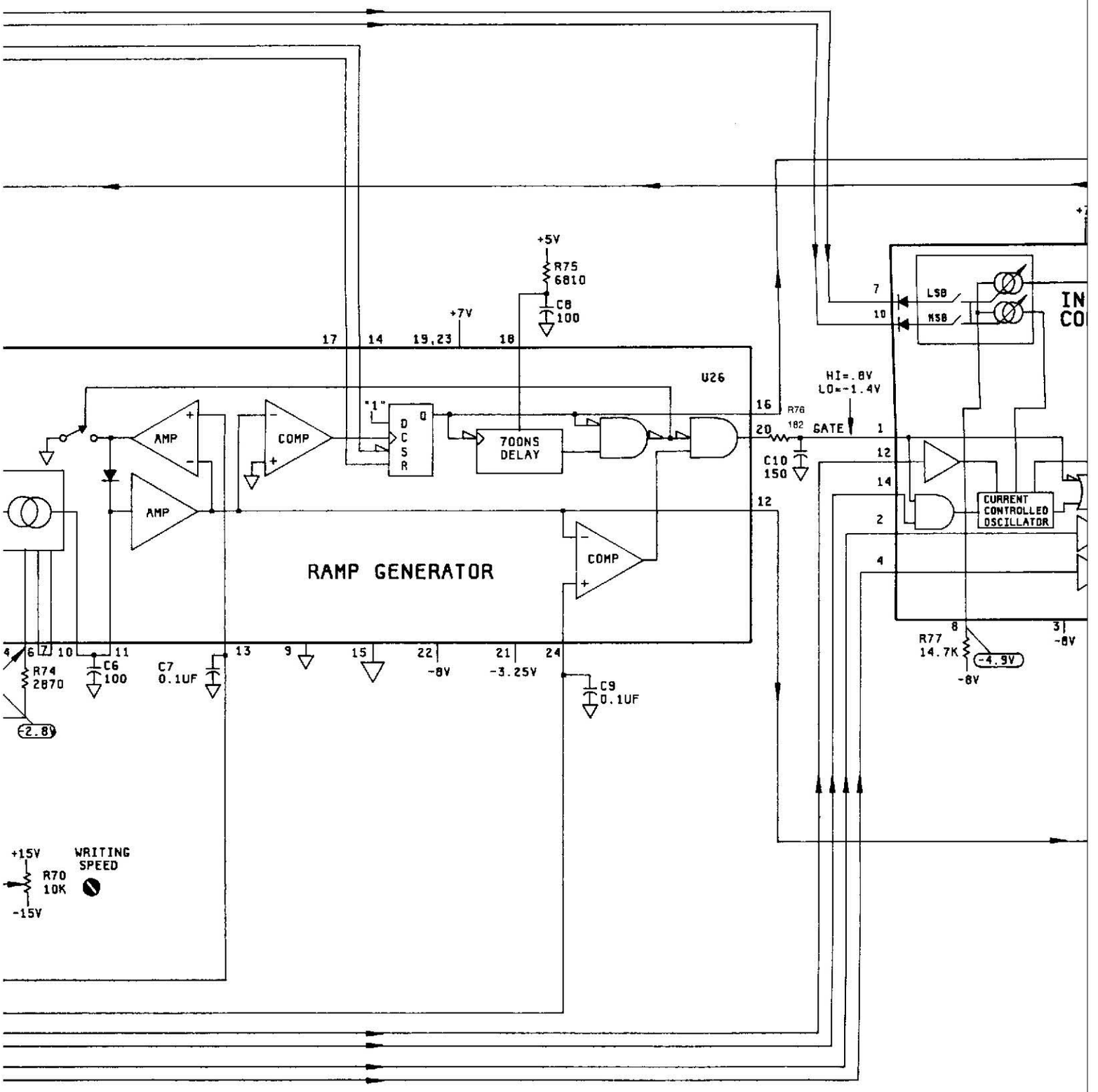
PARTS ON THIS SCHEMATIC

P/O A1	A2	CHASSIS
C6-11		P/O W3
CR1-10		P/O W4
J3,6,7		
Q3-6		
R52-80		
U8,9,20,21,24-26		

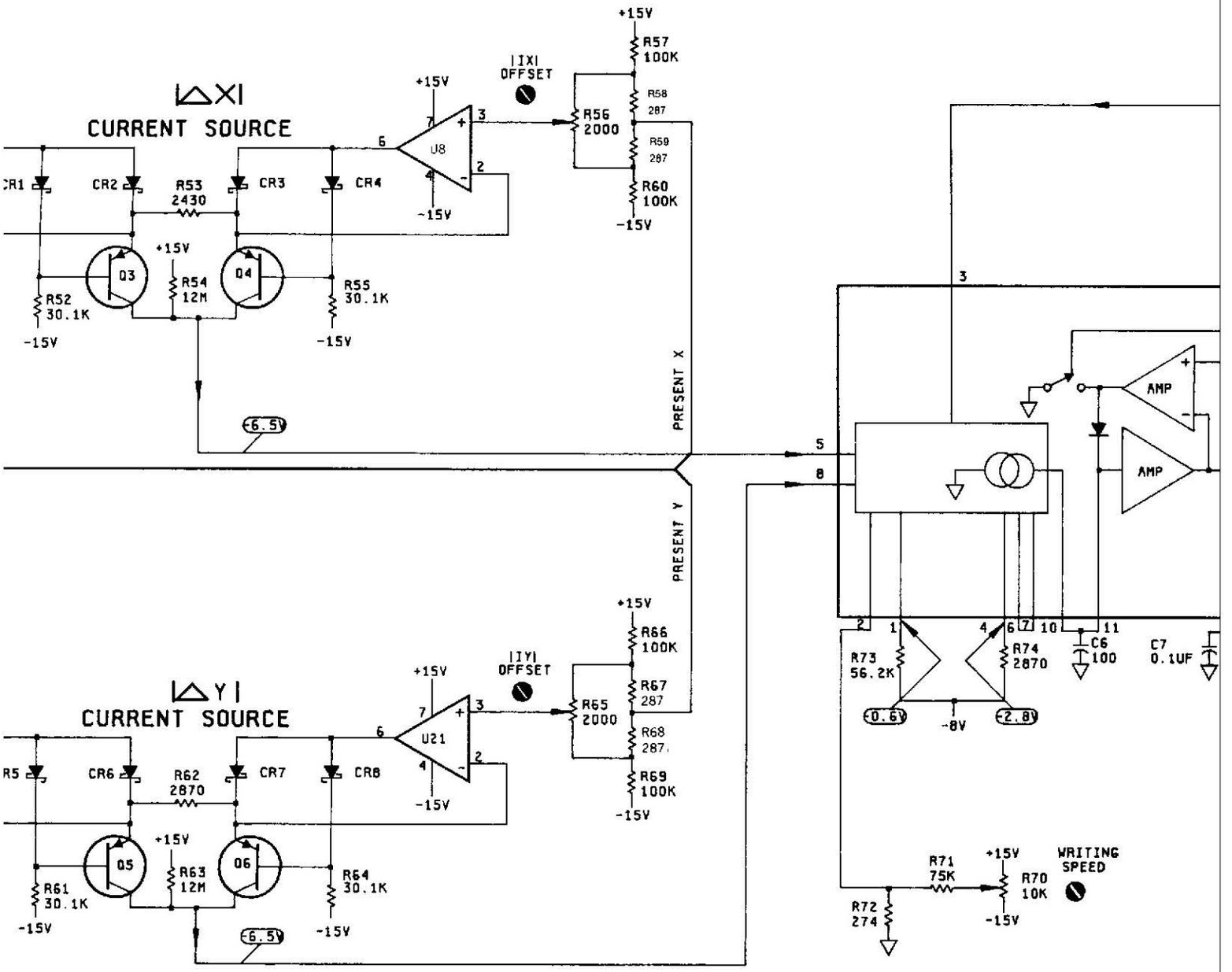
SERVICE SHEET 3B

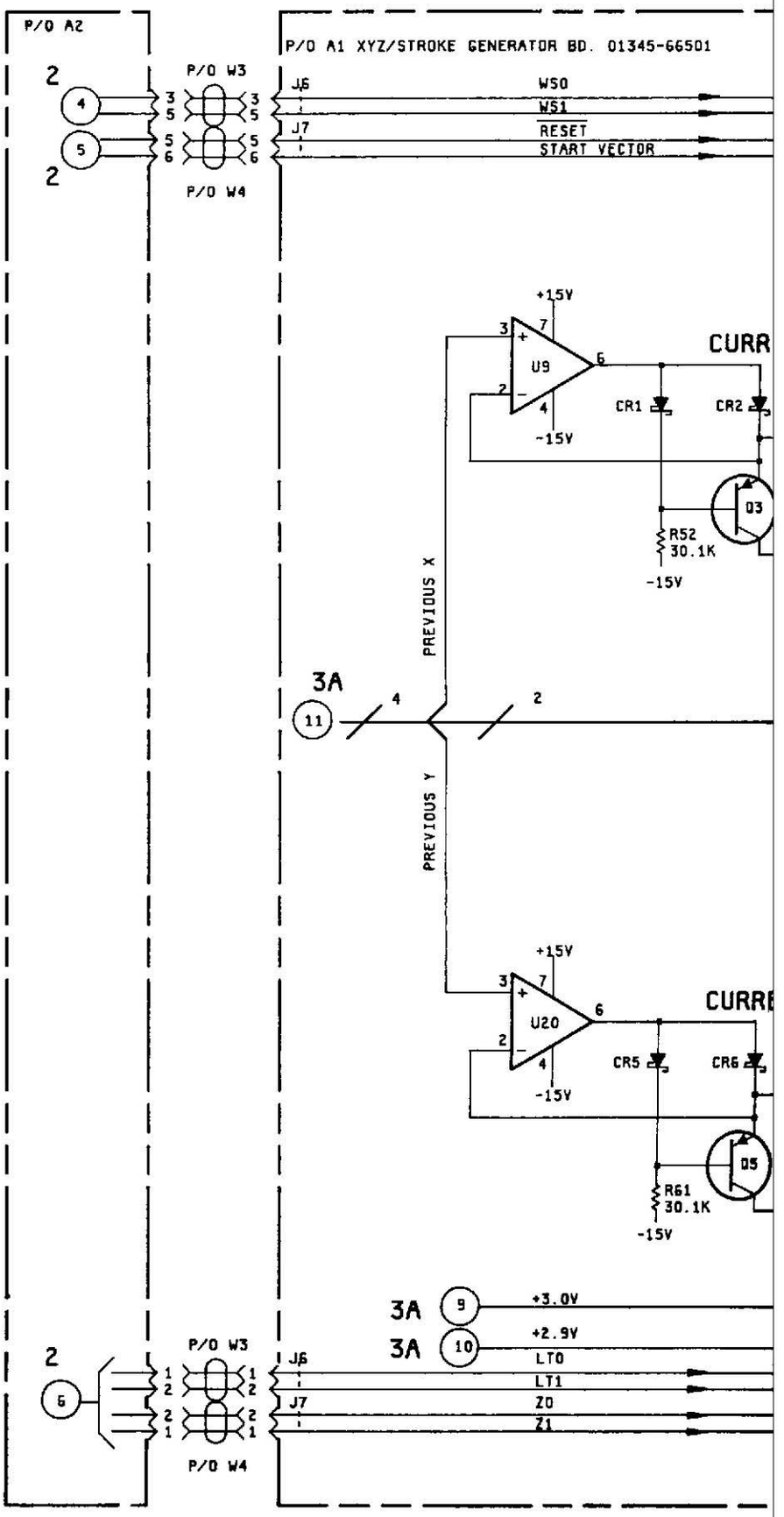
1345/101/CLG/04-15-81

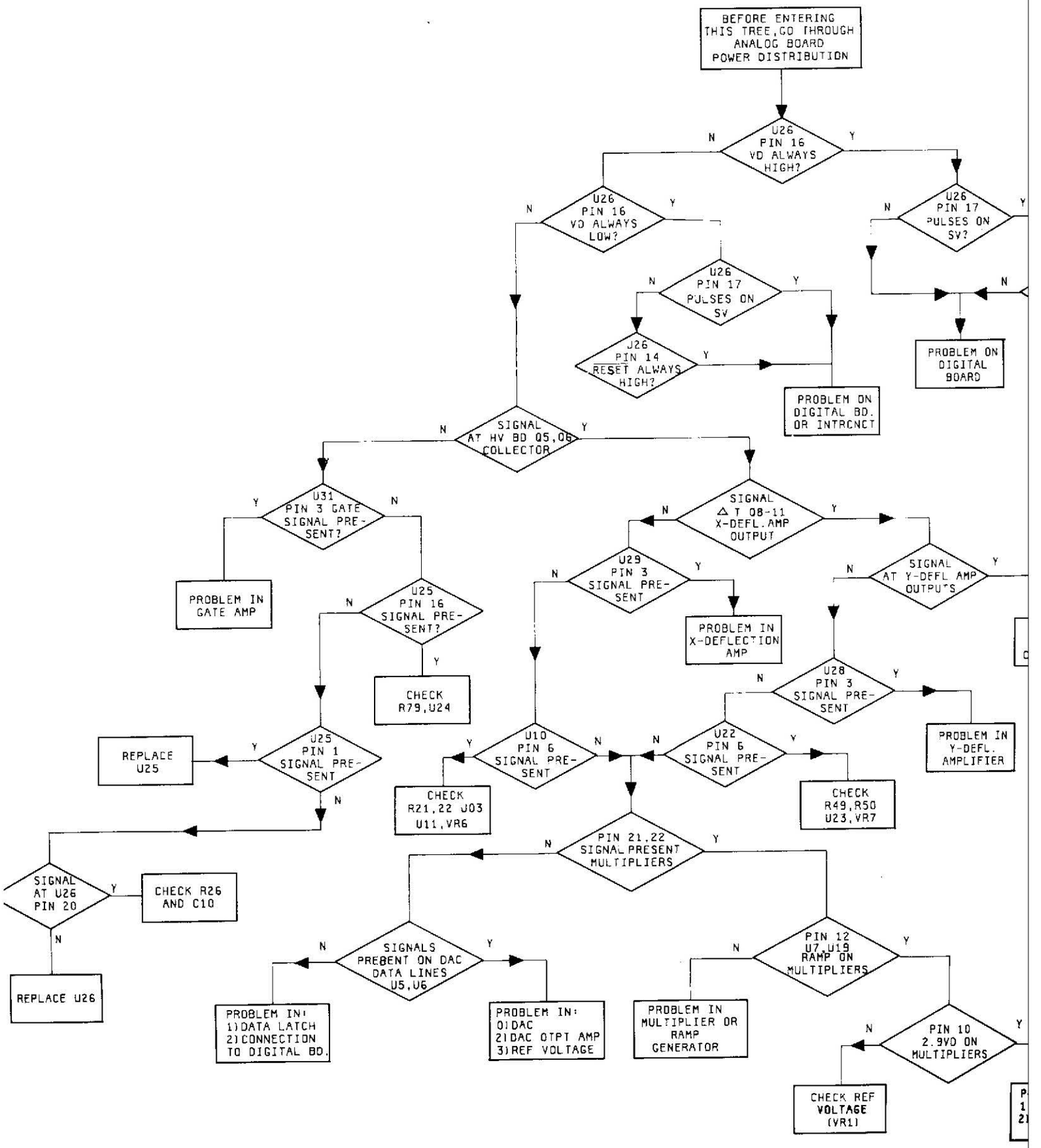
Figure 8-8.
Service Sheet 3B, X-Y-Z Amp/Stroke Generator (A1)

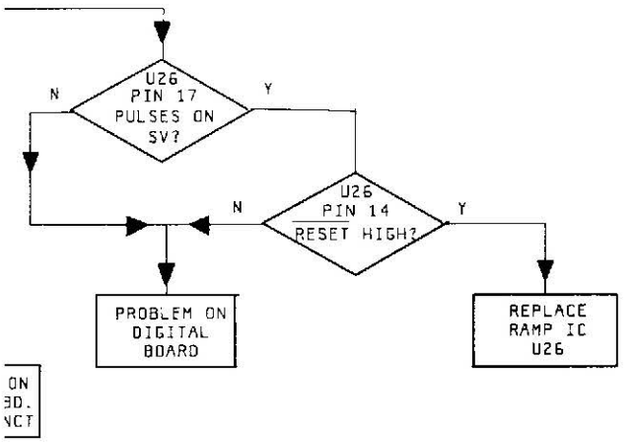

+5V
R75
6810
C8
100
+7V
17
14
19,23
18
U26
"1"
D
C
S
R
Q
AMP
AMP
COMP
700NS
DELAY
RAMP GENERATOR
COMP
16
20
R76
182
GATE
C10
150
HI=.8V
LO=-1.4V
12
14
2
4
LSB
MSB
7
10
CURRENT
CONTROLLED
OSCILLATOR
8
R77
14.7K
-4.9V
-8V
3
-8V
4
6
7
10
11
R74
2870
-2.8V
C6
100
C7
0.1UF
13
9
15
22
-8V
21
-3.25V
24
C9
0.1UF
+15V
R70
10K
-15V
WRITING
SPEED

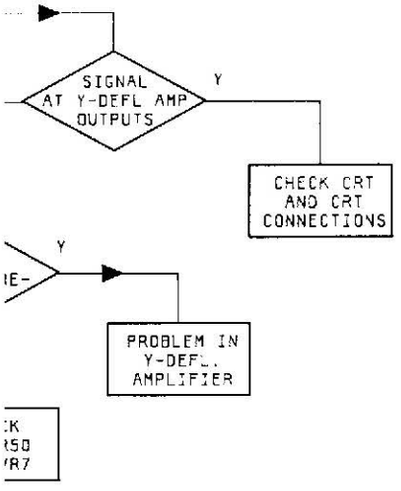
CTOR

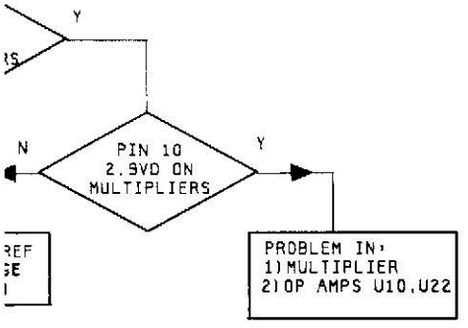

|ΔXI|
CURRENT SOURCE
+15V
|IXI| OFFSET
R57 100K
R58 287
R56 2000
R59 287
R60 100K
-15V
U8
CR1
CR2
R53 2430
CR3
CR4
Q3
Q4
R54 12M
R52 30.1K
R55 30.1K
-6.5V
PRESENT X
PRESENT Y
|ΔYI|
CURRENT SOURCE
U21
|IYI| OFFSET
R66 100K
R67 287
R65 2000
R68 287
R69 100K
CR5
CR6
R62 2870
CR7
CR8
Q5
Q6
R63 12M
R61 30.1K
R64 30.1K
AMP
AMP
R73 56.2K
R74 2870
C6 100
C7 0.1UF
-0.6V
-8V
-2.8V
R71 75K
R70 10K
WRITING SPEED
R72 274

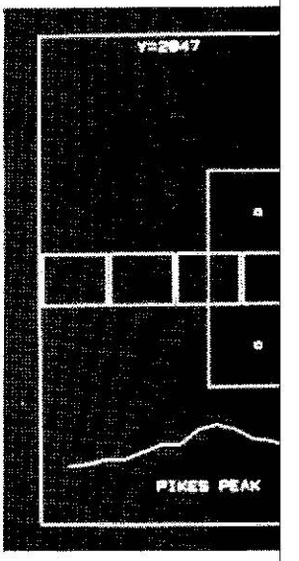

P/O A2
P/O A1 XYZ/STROKE GENERATOR BD. 01345-66501
P/O W3
P/O W4
J6
J7
WS0
WS1
RESET
START VECTOR
+15V
-15V
U9
U20
CR1
CR2
CR5
CR6
Q3
Q5
R52
30.1K
R61
30.1K
PREVIOUS X
PREVIOUS Y
3A
+3.0V
+2.9V
LT0
LT1
Z0
Z1


BEFORE ENTERING THIS TREE, GO THROUGH ANALOG BOARD POWER DISTRIBUTION
U26 PIN 16 VD ALWAYS HIGH?
U26 PIN 16 VD ALWAYS LOW?
U26 PIN 17 PULSES ON SV?
U26 PIN 17 PULSES ON SV
U26 PIN 14 RESET ALWAYS HIGH?
PROBLEM ON DIGITAL BOARD
PROBLEM ON DIGITAL BD. OR INTRCNCT
SIGNAL AT HV BD Q5,Q6 COLLECTOR
U31 PIN 3 GATE SIGNAL PRESENT?
PROBLEM IN GATE AMP
U25 PIN 16 SIGNAL PRESENT?
CHECK R79,U24
SIGNAL △T Q8-11 X-DEFL. AMP OUTPUT
U29 PIN 3 SIGNAL PRESENT
PROBLEM IN X-DEFLECTION AMP
SIGNAL AT Y-DEFL AMP OUTPUTS
U28 PIN 3 SIGNAL PRESENT
PROBLEM IN Y-DEFL. AMPLIFIER
U25 PIN 1 SIGNAL PRESENT
REPLACE U25
U10 PIN 6 SIGNAL PRESENT
CHECK R21,22 U03 U11,VR6
U22 PIN 6 SIGNAL PRESENT
CHECK R49,R50 U23,VR7
SIGNAL AT U26 PIN 20
CHECK R26 AND C10
REPLACE U26
PIN 21,22 SIGNAL PRESENT MULTIPLIERS
SIGNALS PRESENT ON DAC DATA LINES U5,U6
PROBLEM IN: 1) DATA LATCH 2) CONNECTION TO DIGITAL BD.
PROBLEM IN: 0) DAC 2) DAC OTPT AMP 3) REF VOLTAGE
PIN 12 U7,U19 RAMP ON MULTIPLIERS
PROBLEM IN MULTIPLIER OR RAMP GENERATOR
PIN 10 2.9VD ON MULTIPLIERS
CHECK REF VOLTAGE (VR1)

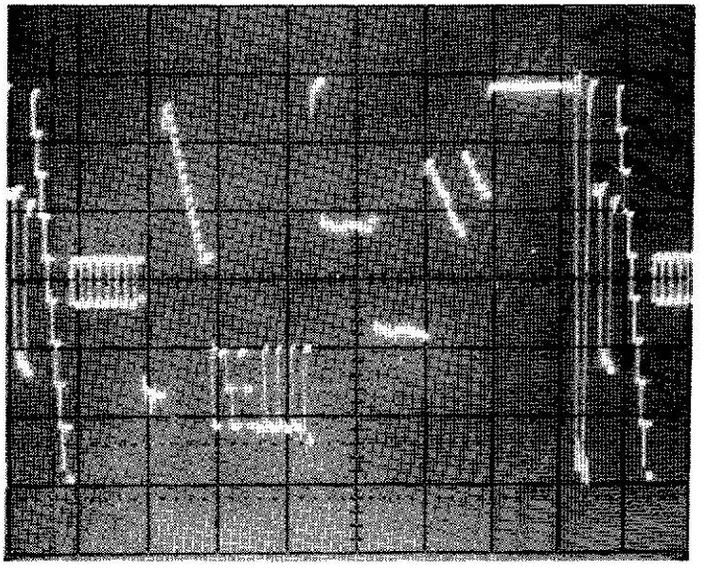






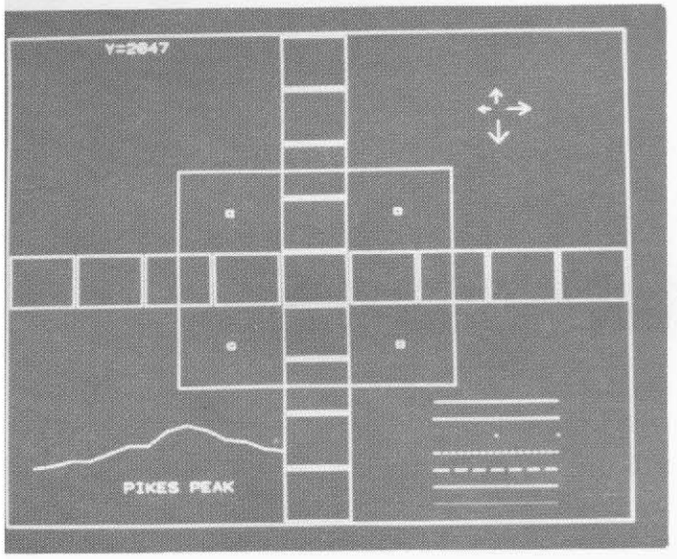


OBTAIN PRIMARY TE

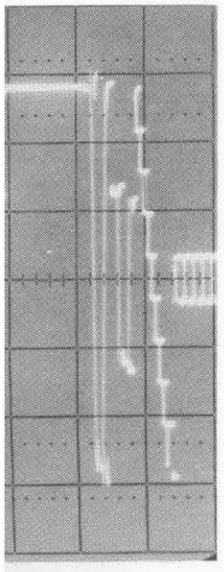


X OUTPUT AT A1Q8 COLLECTOR
(TO HORIZONTAL DEFLECTION PLATES)
10 V/DIV, 2ms/DIV

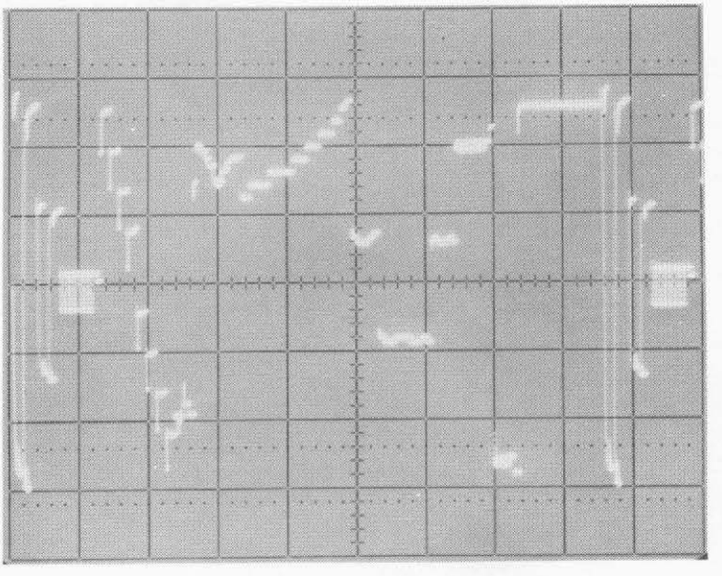
WAVEFORM MEASUREMENT CONDITION



OBTAIN PRIMARY TEST PATTERN AS SHOWN ABOVE



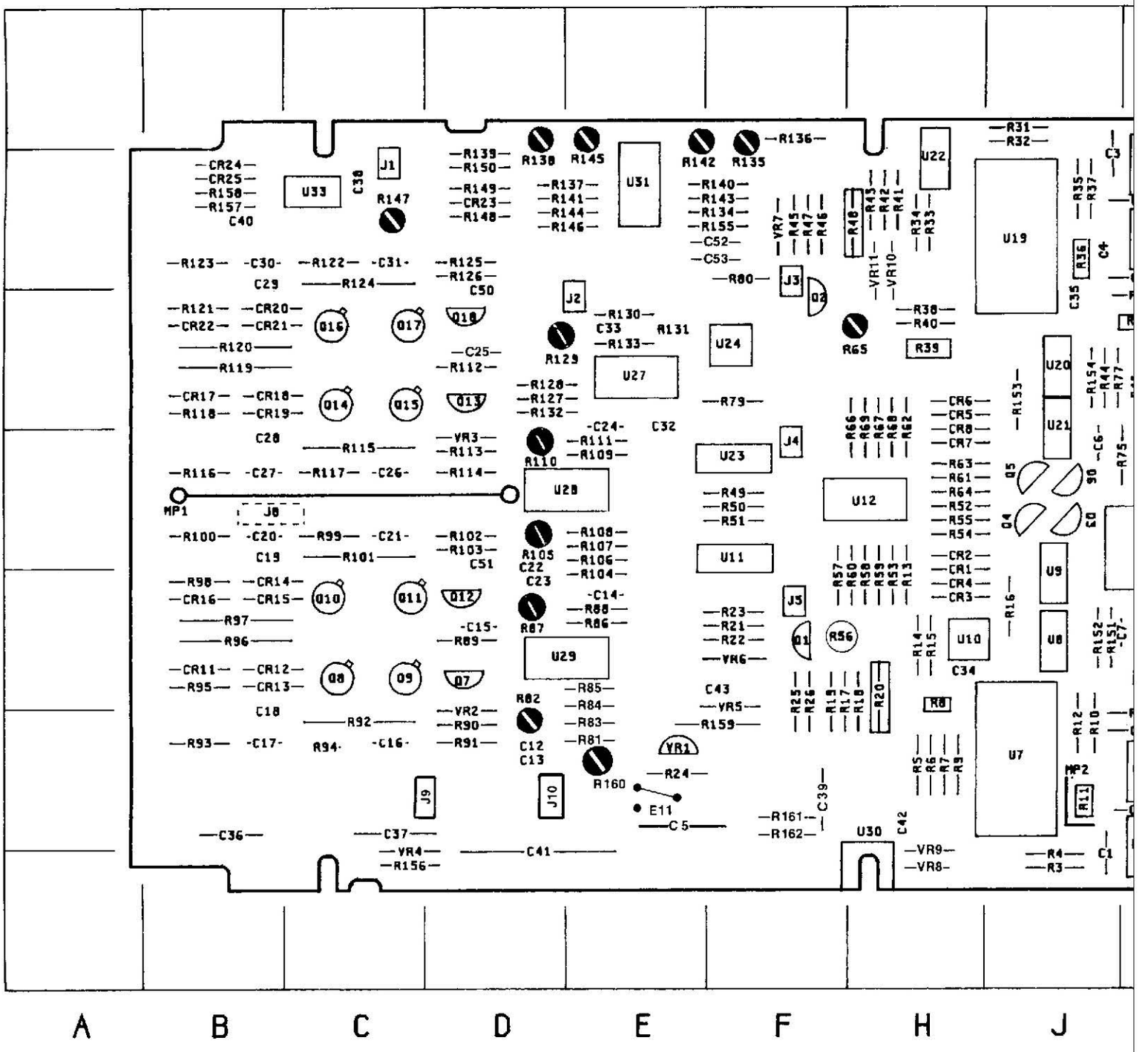
LATES)



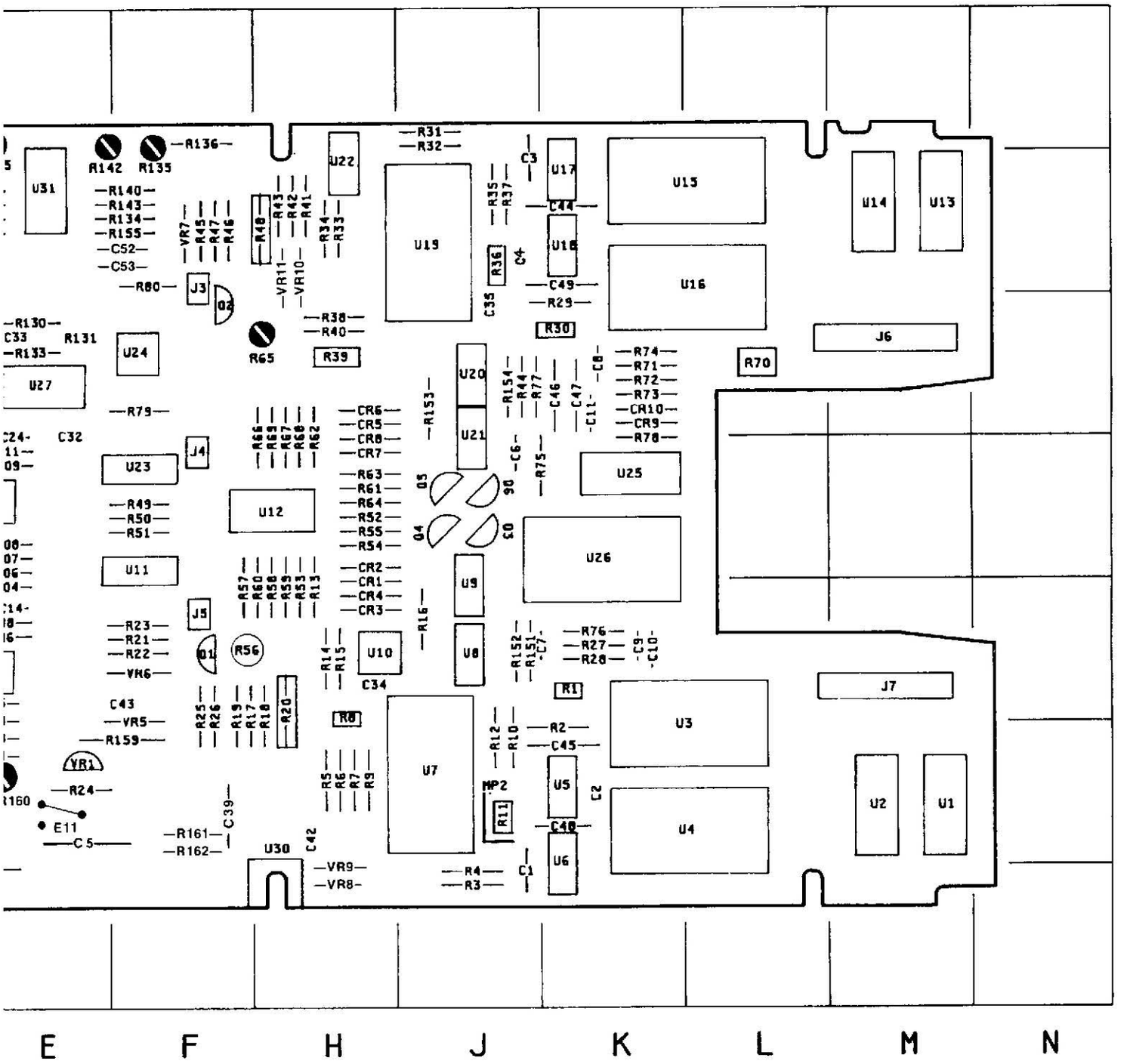
Y OUTPUT AT A1Q14 COLLECTOR
(TO VERTICAL DEFLECTION PLATES)
10 V/DIV, 2 ms/DIV

7
6
5
4
3
2
1

A



P/O Service Sheet 3C,



P/O Service Sheet 3C, X-Y-Z Amp/Stroke Generator (A1)

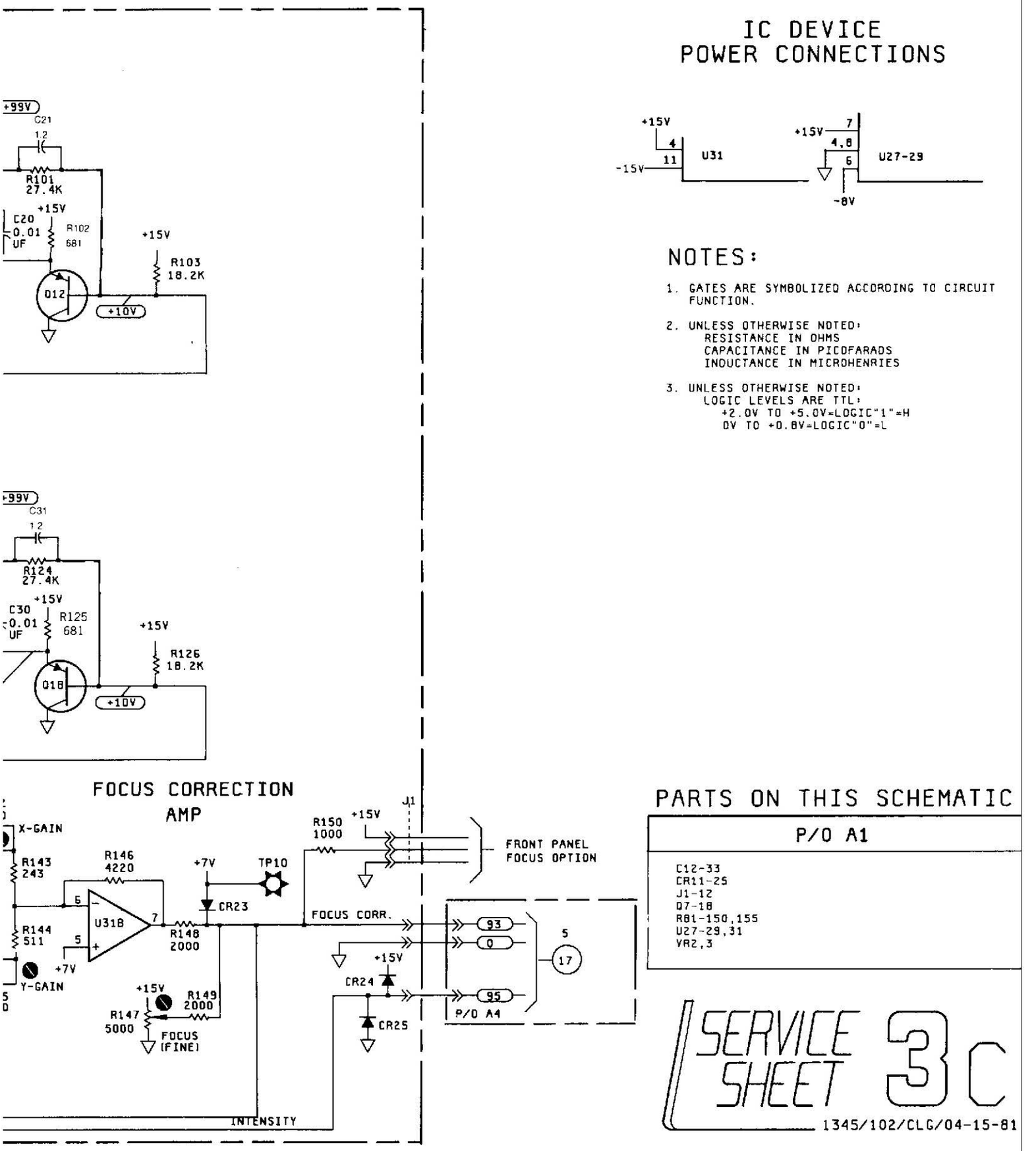
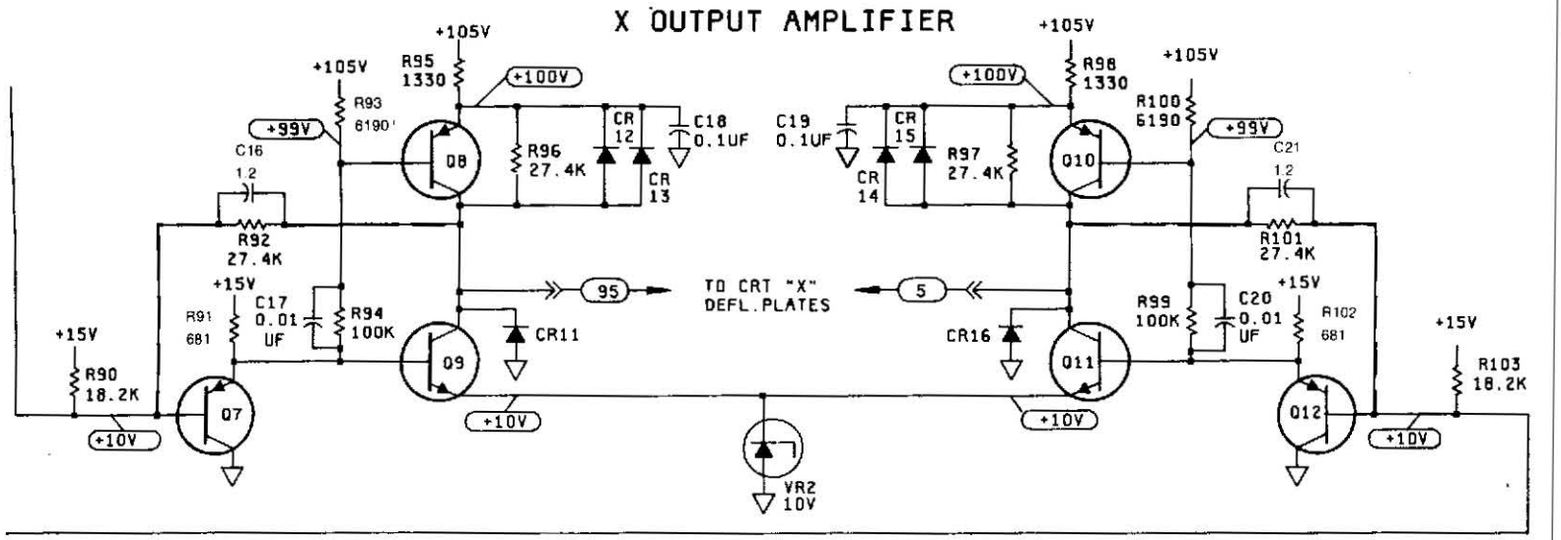
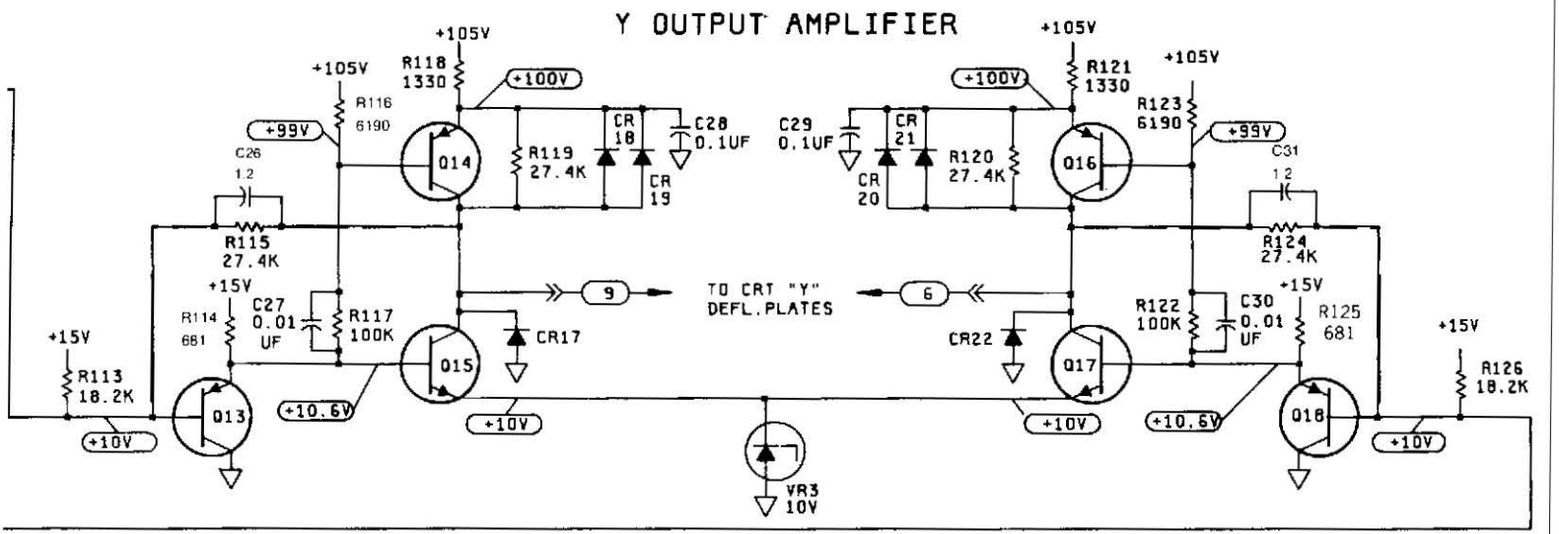
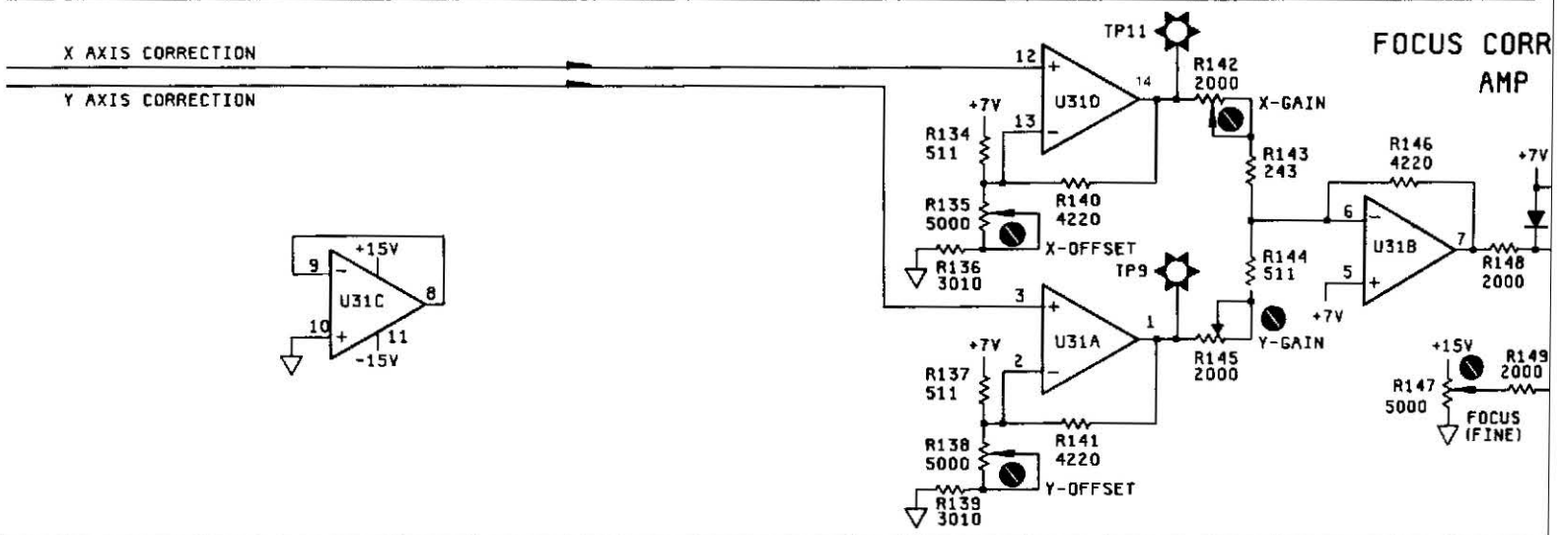
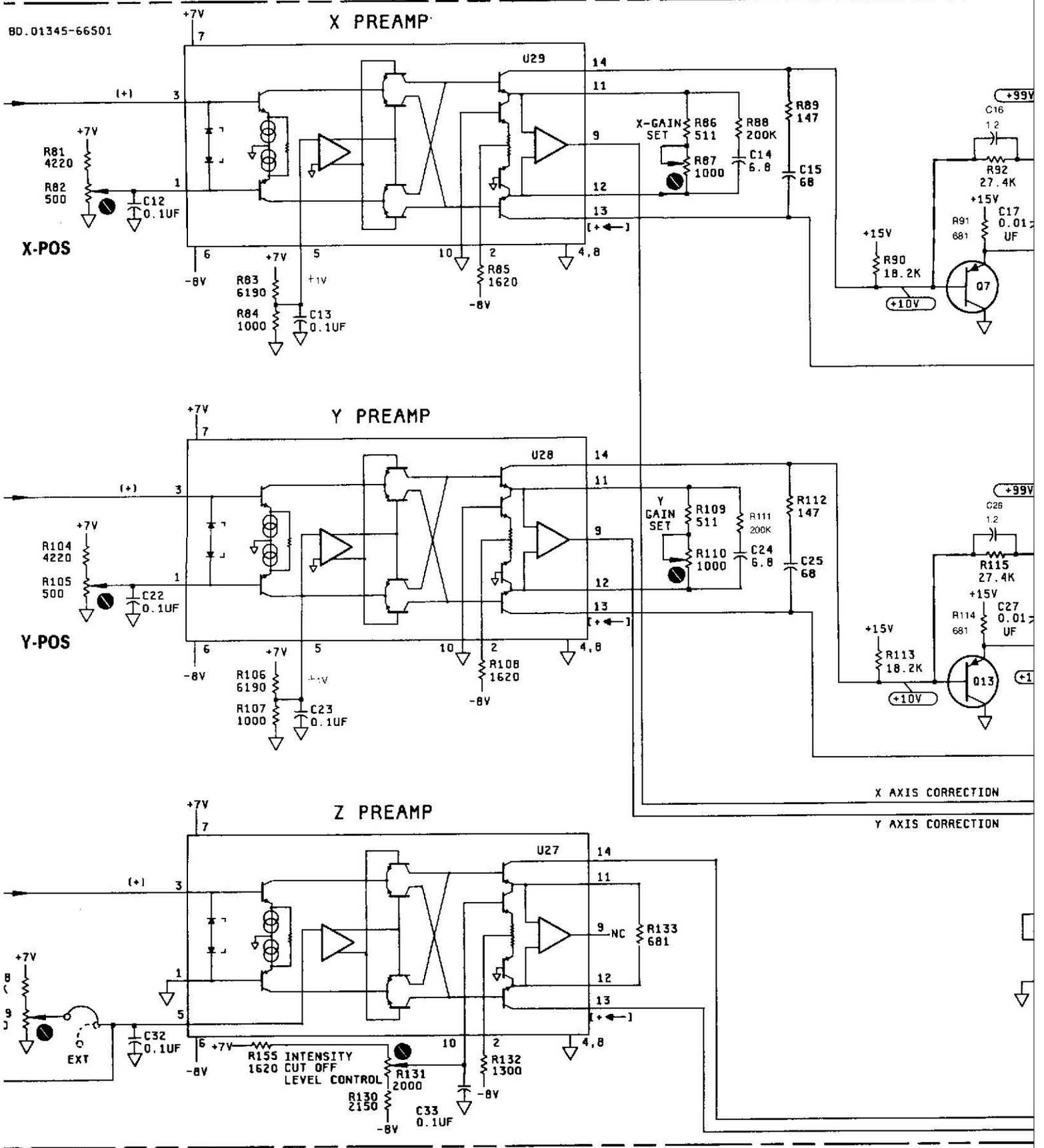


Figure 8-9
Service Sheet 3C, X-Y-Z Amp/Stroke Generator (A1)

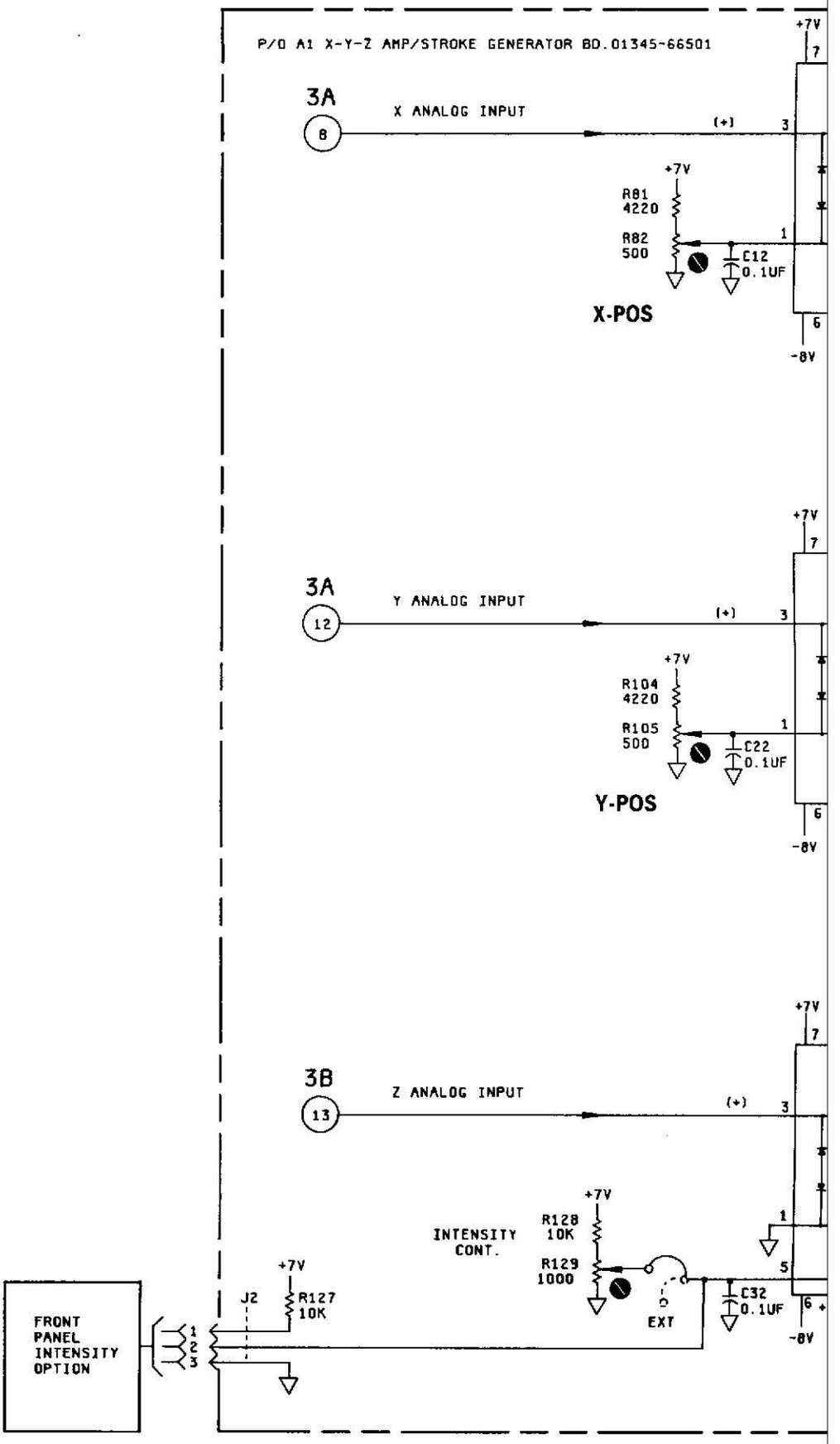

X OUTPUT AMPLIFIER
+105V
R95 1330
+100V
R93 6190
+99V
C16 1.2
Q8
R96 27.4K
CR 12
CR 13
C18 0.1UF
R92 27.4K
+15V
R91 681
C17 0.01 UF
R94 100K
95
TO CRT "X" DEFL.PLATES
CR11
Q9
+10V
+15V
R90 18.2K
Q7
+10V
VR2 10V
C19 0.1UF
CR 14
CR 15
R97 27.4K
R98 1330
Q10
R100 6190
C21 1.2
R101 27.4K
5
CR16
Q11
R99 100K
C20 0.01 UF
R102 681
+15V
R103 18.2K
Q12
+10V

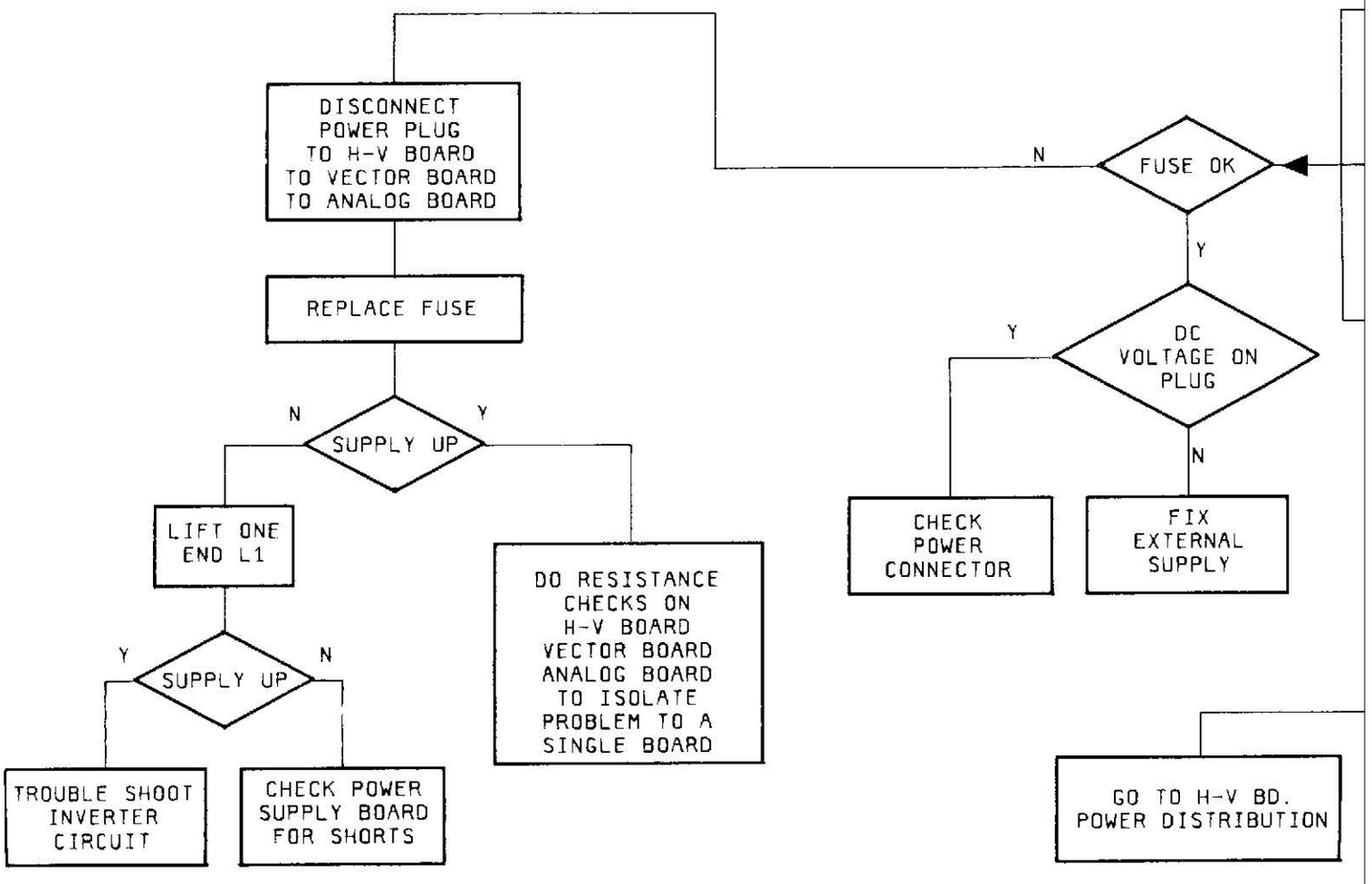

Y OUTPUT AMPLIFIER
+105V
R118 1330
+100V
R116 6190
+99V
C26 1.2
Q14
R119 27.4K
CR 18
CR 19
C28 0.1UF
R115 27.4K
+15V
R114 681
C27 0.01 UF
R117 100K
9
TO CRT "Y" DEFL.PLATES
CR17
Q15
+10.6V
+10V
+15V
R113 18.2K
Q13
+10V
VR3 10V
C29 0.1UF
CR 20
CR 21
R120 27.4K
R121 1330
Q16
R123 6190
C31 1.2
R124 27.4K
6
CR22
Q17
R122 100K
C30 0.01 UF
R125 681
+15V
R126 18.2K
Q18
+10.6V
+10V

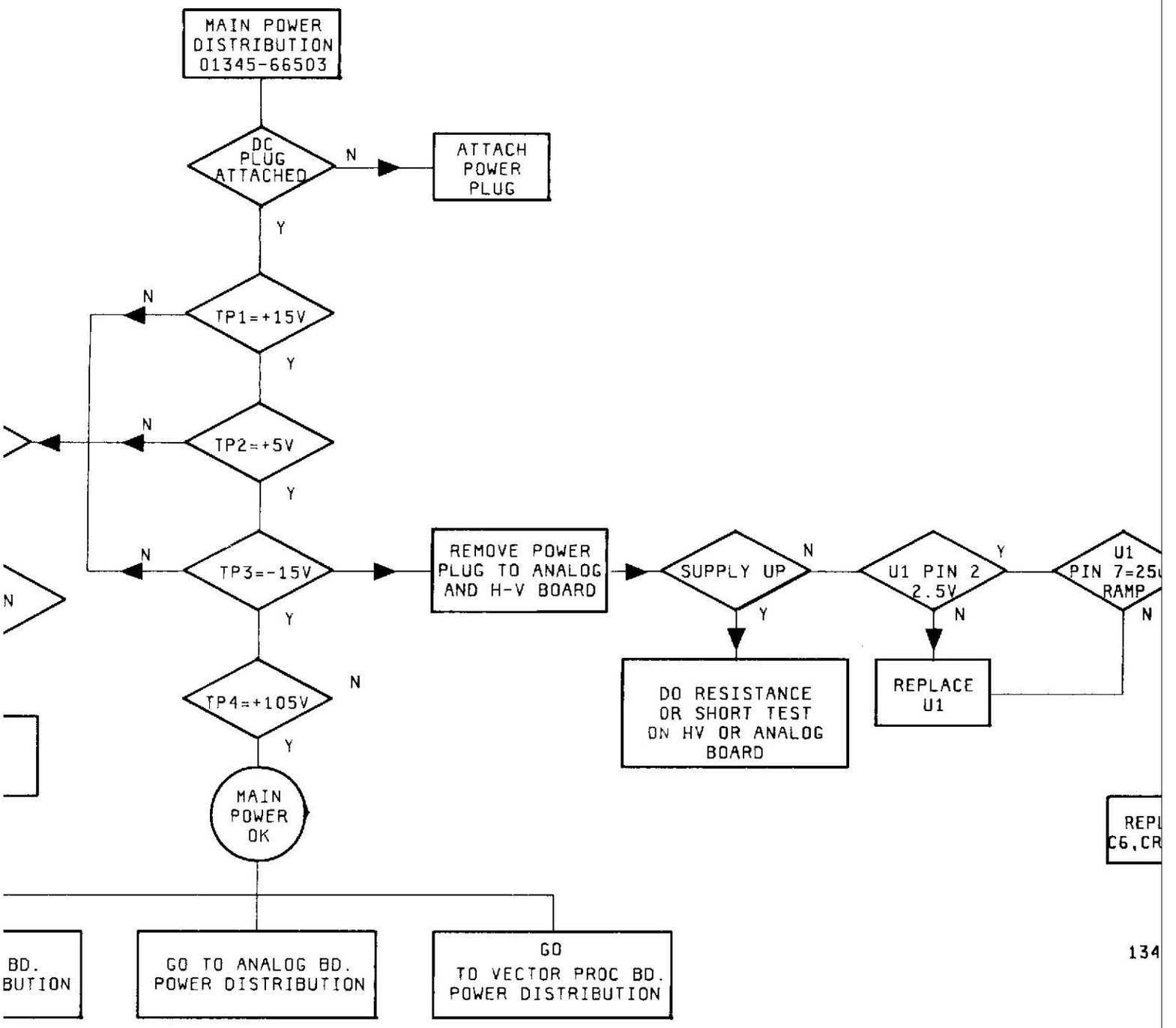

X AXIS CORRECTION
Y AXIS CORRECTION
FOCUS CORR AMP
TP11
U31D
R142 2000
X-GAIN
+7V
R134 511
R135 5000
X-OFFSET
R136 3010
R140 4220
R143 243
R144 511
TP9
U31A
Y-GAIN
R145 2000
R137 511
R138 5000
Y-OFFSET
R139 3010
R141 4220
U31C
+15V
-15V
R146 4220
U31B
R148 2000
R147 5000
R149 2000
FOCUS (FINE)

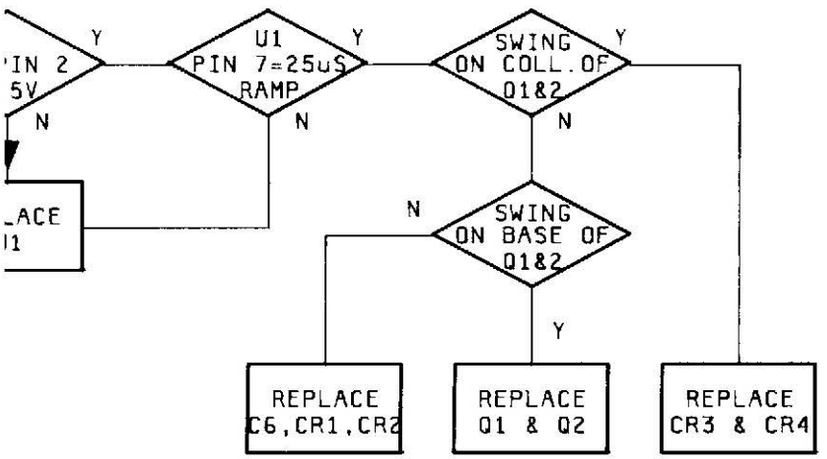

BD.01345-66501
X PREAMP
U29
X-POS
R81 4220
R82 500
C12 0.1UF
R83 6190
R84 1000
C13 0.1UF
R85 1620
X-GAIN SET
R86 511
R87 1000
R88 200K
C14 6.8
R89 147
C15 68
C16 1.2
R92 27.4K
C17 0.01 UF
R90 18.2K
Q7
+99V
+15V
+10V
+7V
-8V
Y PREAMP
U28
Y-POS
R104 4220
R105 500
C22 0.1UF
R106 6190
R107 1000
C23 0.1UF
R108 1620
Y GAIN SET
R109 511
R110 1000
R111 200K
C24 6.8
R112 147
C25 68
C26 1.2
R115 27.4K
C27 0.01 UF
R113 18.2K
Q13
X AXIS CORRECTION
Y AXIS CORRECTION
Z PREAMP
U27
R133 681
NC
R155 INTENSITY 1620
CUT OFF LEVEL CONTROL
R131 2000
R130 2150
R132 1300
C33 0.1UF
C32 0.1UF
EXT

REF DESIG	GRID LOC
R156	C-1
R157	B-6
R158	B-6
R159	F-2
R160	E-2
R161	F-2
R162	F-2
U1	M-2
U2	M-2
U3	L-2
U4	L-2
U5	K-2
U6	K-2
U7	J-2
U8	J-3
U9	J-3
U10	H-3
U11	F-4
U12	H-4
U13	M-6
U14	M-6
U15	L-6
U16	L-6
U17	K-6
U18	K-6
U19	J-6
U20	J-5
U21	J-5
U22	H-6
U23	F-4
U24	F-5
U25	K-4
U26	K-4
J27	E-5
J28	D-4
J29	D-3
J30	H-1
J31	E-6
J32	N.A.
J33	C-6
VR1	E-2
VR2	D-2
VR3	D-4
VR4	C-1
VR5	F-2
VR6	F-3
VR7	F-6
VR8	H-1
VR9	H-1
VR10	H-6
VR11	H-6

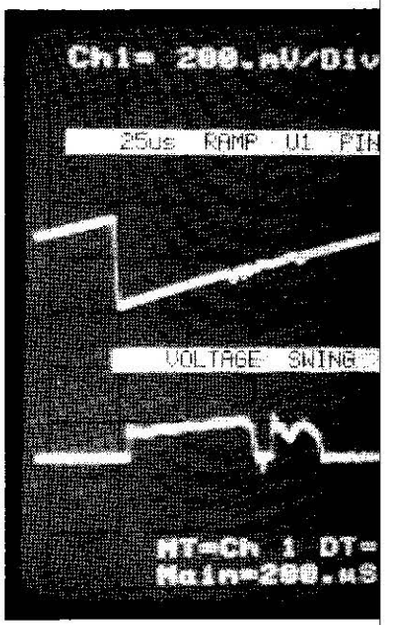



DISCONNECT POWER PLUG TO H-V BOARD TO VECTOR BOARD TO ANALOG BOARD
REPLACE FUSE
N
SUPPLY UP
Y
LIFT ONE END L1
Y
SUPPLY UP
N
TROUBLE SHOOT INVERTER CIRCUIT
CHECK POWER SUPPLY BOARD FOR SHORTS
DO RESISTANCE CHECKS ON H-V BOARD VECTOR BOARD ANALOG BOARD TO ISOLATE PROBLEM TO A SINGLE BOARD
N
FUSE OK
Y
Y
DC VOLTAGE ON PLUG
N
CHECK POWER CONNECTOR
FIX EXTERNAL SUPPLY
GO TO H-V BD. POWER DISTRIBUTION

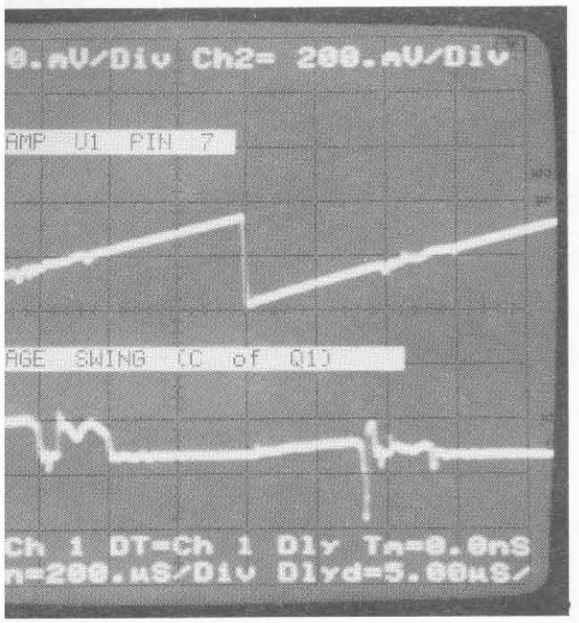

MAIN POWER DISTRIBUTION 01345-66503
DC PLUG ATTACHED
N
ATTACH POWER PLUG
Y
TP1=+15V
N
Y
TP2=+5V
N
Y
TP3=-15V
N
Y
REMOVE POWER PLUG TO ANALOG AND H-V BOARD
SUPPLY UP
N
Y
DO RESISTANCE OR SHORT TEST ON HV OR ANALOG BOARD
U1 PIN 2 2.5V
Y
N
REPLACE U1
U1 PIN 7=25
RAMP
N
TP4=+105V
N
Y
MAIN POWER OK
GO TO ANALOG BD. POWER DISTRIBUTION
GO TO VECTOR PROC BD. POWER DISTRIBUTION



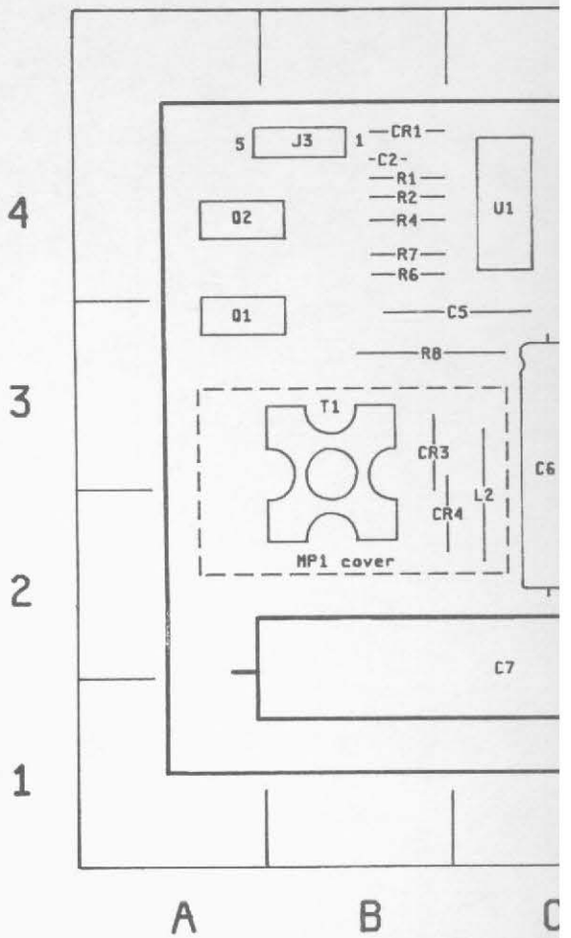
1345.CJF/114



TOP: OSCILLATOR SI
BOTTOM: COLLECTOR

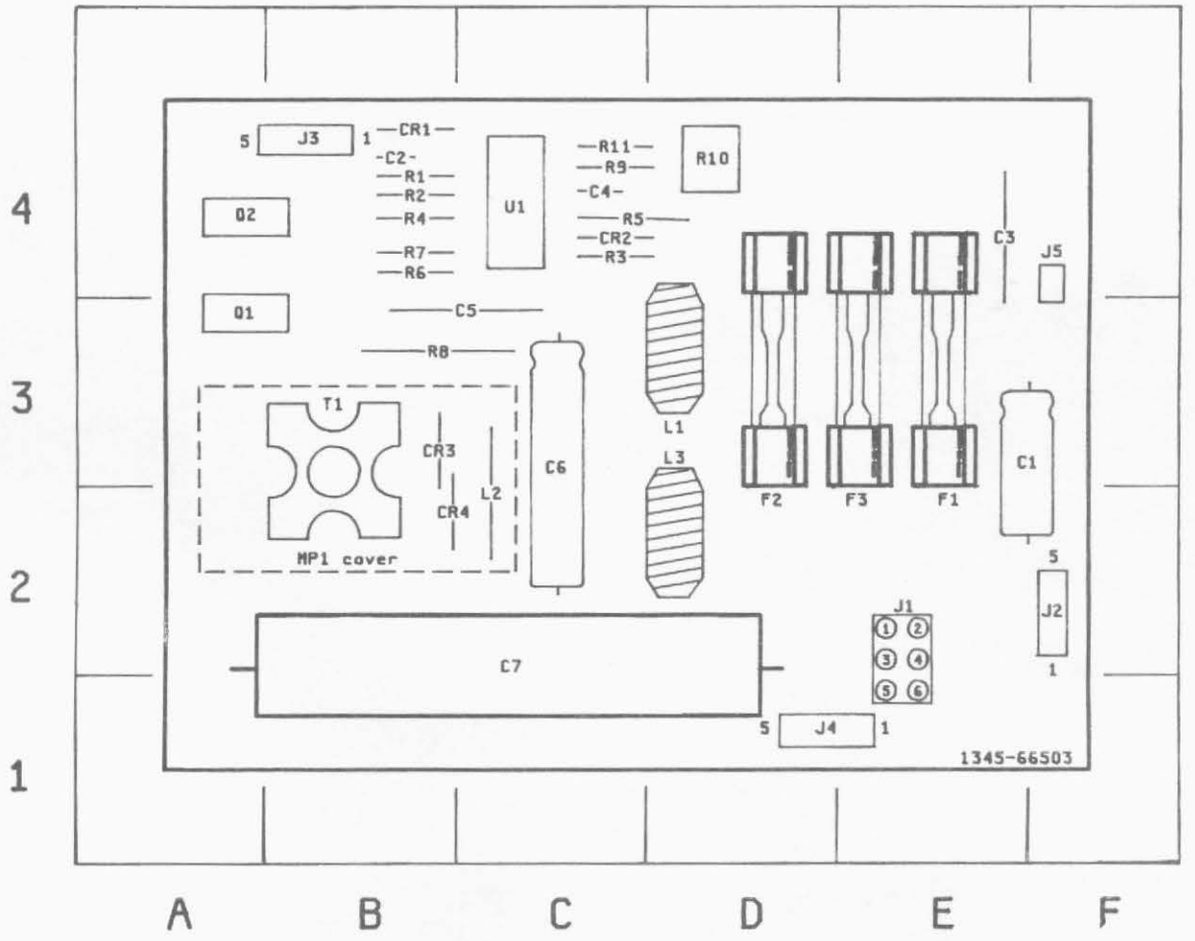


OSCILLATOR SIGNAL AT A3U1, PIN 7
TOM: COLLECTOR OF A3Q1



REF DESIG	G L
C1	E
C2	B
C3	E
C4	C
C5	C
C6	C
C7	C
CR1	B
CR2	C
CR3	B
CR4	B
F1	E
F2	D
F3	E
J1	E
J2	E
J3	B
J4	D
J5	F

P/O Service Sheet 4, Lo



REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	E-3	L1	D-3
C2	B-4	L2	C-3
C3	E-4	L3	D-3
C4	C-4	MP1	B-2
C5	C-3	Q1	A-3
C6	C-3	Q2	A-2
C7	C-2	R1	B-4
CR1	B-4	R2	B-4
CR2	C-4	R3	C-4
CR3	B-3	R4	B-4
CR4	B-2	R5	C-4
F1	E-2	R6	B-4
F2	D-2	R7	B-4
F3	E-2	R8	B-3
J1	E-2	R9	C-4
J2	E-2	R10	D-4
J3	B-4	R11	C-4
J4	D-1	T1	B-3
J5	F-4	U1	C-4

P/O Service Sheet 4, Low Voltage Power Supply (A3)

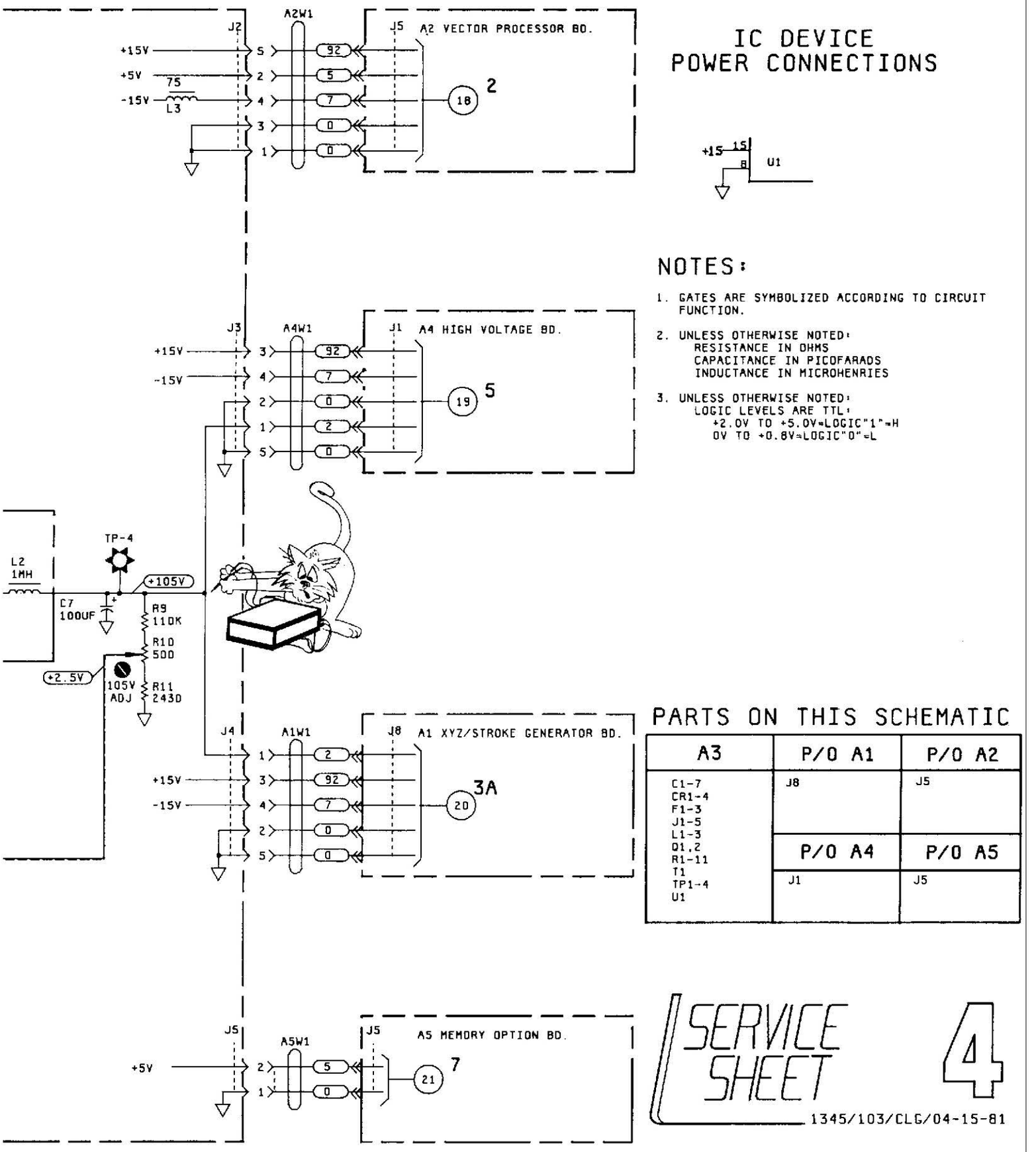
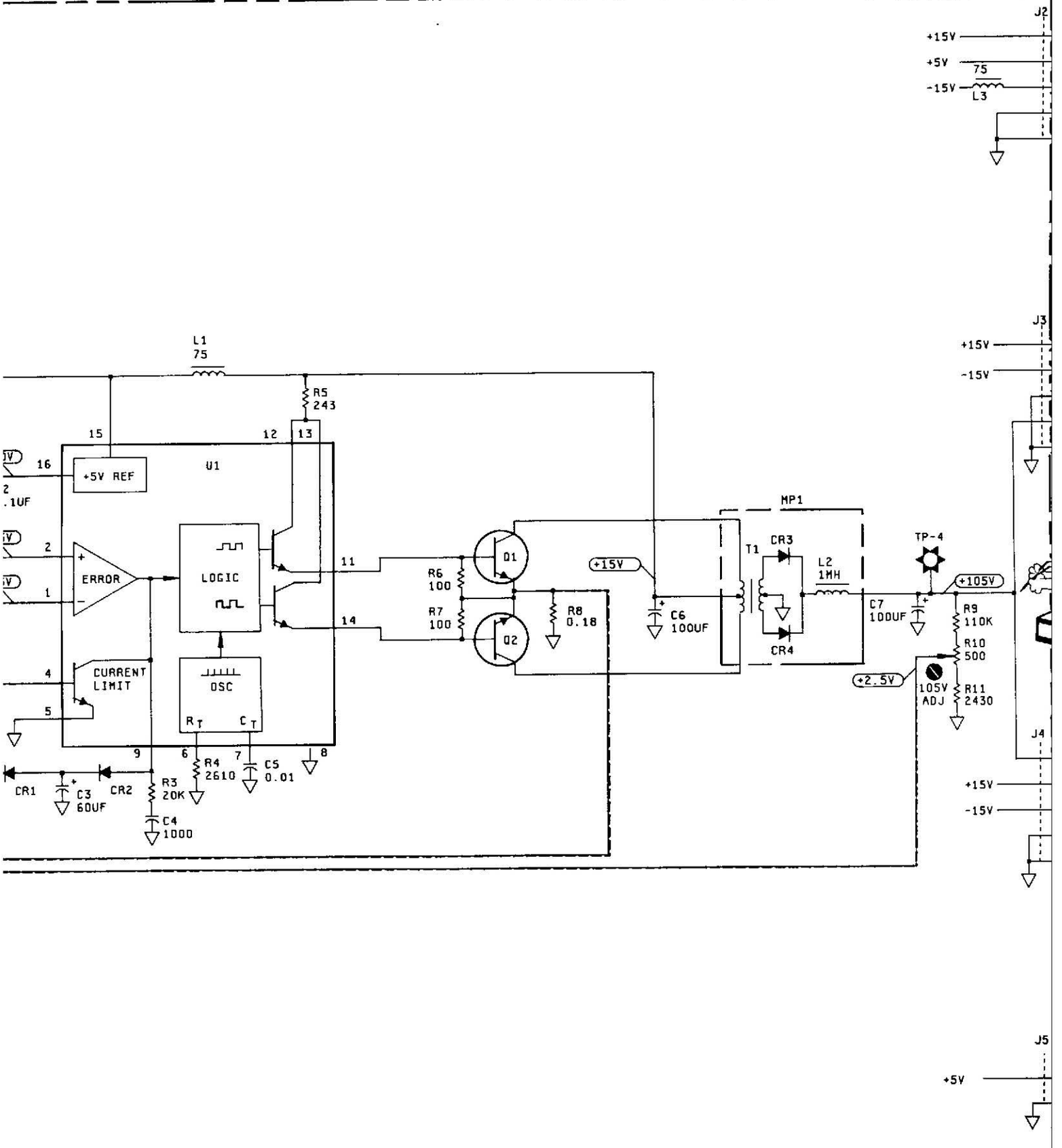
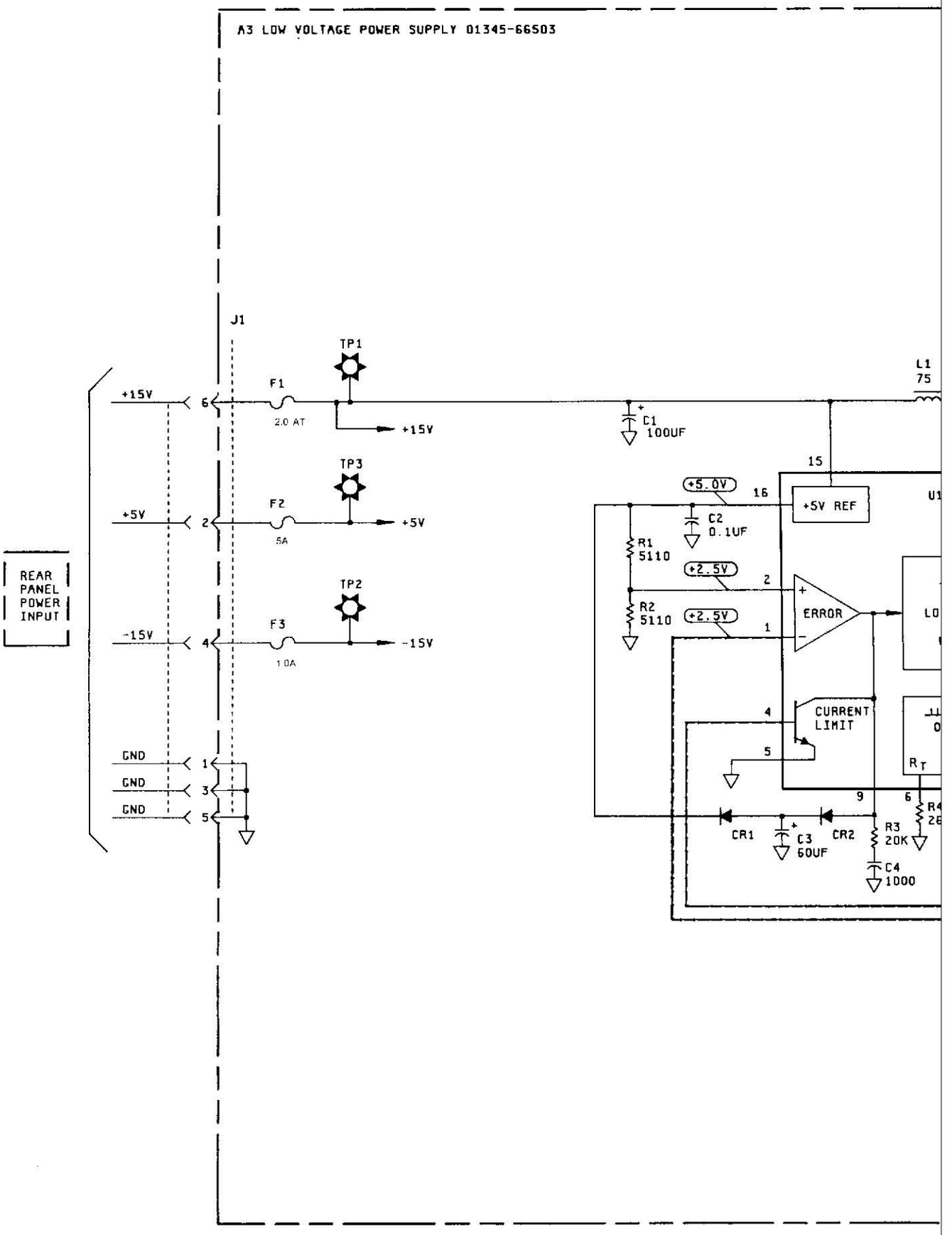
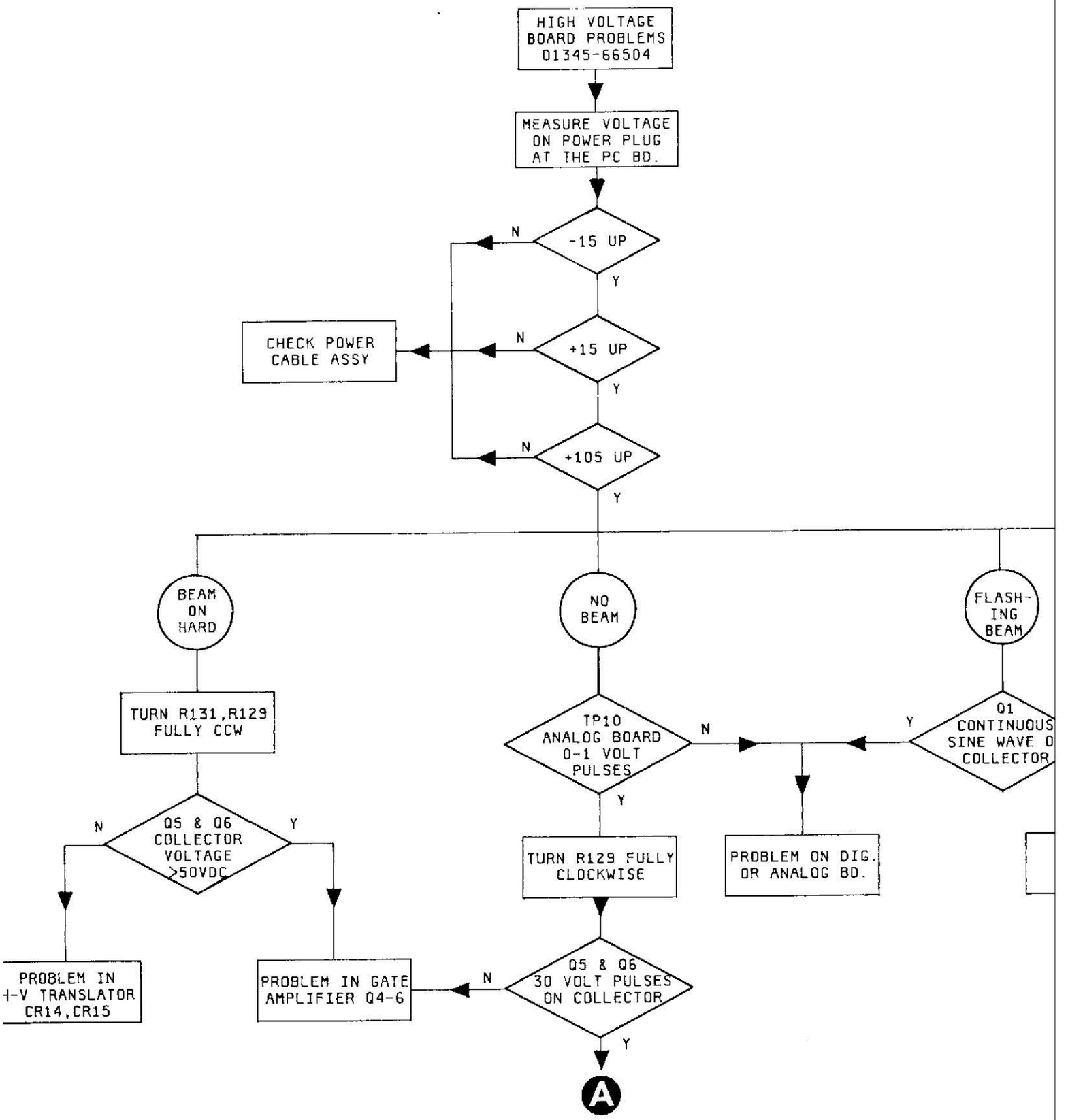
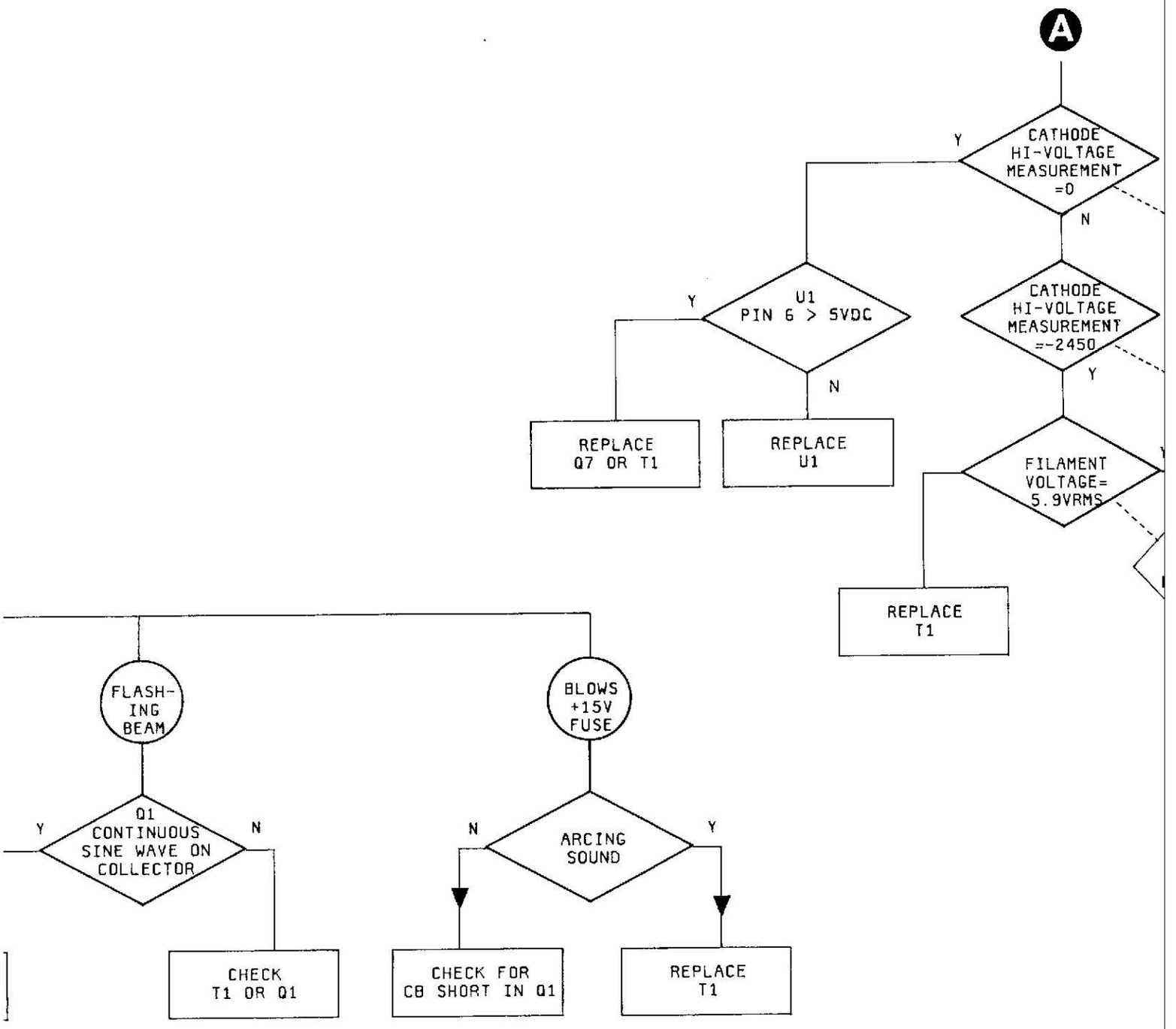


Figure 8-10.
Service Sheet 4, Low Voltage Power Supply (A3)


J2
+15V
+5V
-15V
75
L3
J3
+15V
-15V
L1
75
R5
243
15
12
13
U1
16
+5V REF
.1UF
2
1
ERROR
LOGIC
11
14
4
CURRENT
LIMIT
5
OSC
RT
CT
9
6
7
8
R4
2610
C5
0.01
CR1
C3
60UF
CR2
R3
20K
C4
1000
Q1
Q2
R6
100
R7
100
R8
0.18
+15V
C6
100UF
MP1
T1
CR3
CR4
L2
1MH
C7
100UF
TP-4
+105V
R9
110K
R10
500
+2.5V
105V
ADJ
R11
2430
J4
+15V
-15V
J5
+5V


A3 LOW VOLTAGE POWER SUPPLY 01345-66503
REAR PANEL POWER INPUT
J1
+15V
6
F1
2.0 AT
TP1
+15V
C1
100UF
L1
75
15
+5V
2
F2
5A
TP3
+5V
+5.0V
16
+5V REF
C2
0.1UF
R1
5110
+2.5V
2
R2
5110
+2.5V
1
ERROR
-15V
4
F3
1.0A
TP2
-15V
GND
1
GND
3
GND
5
4
CURRENT LIMIT
5
9
6
CR1
CR2
C3
60UF
R3
20K
C4
1000
RT


HIGH VOLTAGE BOARD PROBLEMS 01345-66504
MEASURE VOLTAGE ON POWER PLUG AT THE PC BD.
-15 UP
N
Y
+15 UP
N
Y
+105 UP
N
Y
CHECK POWER CABLE ASSY
BEAM ON HARD
NO BEAM
FLASH-ING BEAM
TURN R131,R129 FULLY CCW
TP10 ANALOG BOARD 0-1 VOLT PULSES
N
Y
Q1 CONTINUOUS SINE WAVE O COLLECTOR
Y
Q5 & Q6 COLLECTOR VOLTAGE >50VDC
N
Y
TURN R129 FULLY CLOCKWISE
PROBLEM ON DIG. OR ANALOG BD.
PROBLEM IN +-V TRANSLATOR CR14,CR15
PROBLEM IN GATE AMPLIFIER Q4-6
Q5 & Q6 30 VOLT PULSES ON COLLECTOR
N
Y
A


A
CATHODE HI-VOLTAGE MEASUREMENT =0
Y
N
U1 PIN 6 > 5VDC
Y
N
REPLACE Q7 OR T1
REPLACE U1
CATHODE HI-VOLTAGE MEASUREMENT =-2450
Y
FILAMENT VOLTAGE= 5.9VRMS
REPLACE T1
FLASH-ING BEAM
BLOWS +15V FUSE
Q1 CONTINUOUS SINE WAVE ON COLLECTOR
Y
N
ARCING SOUND
N
Y
CHECK T1 OR Q1
CHECK FOR CB SHORT IN Q1
REPLACE T1

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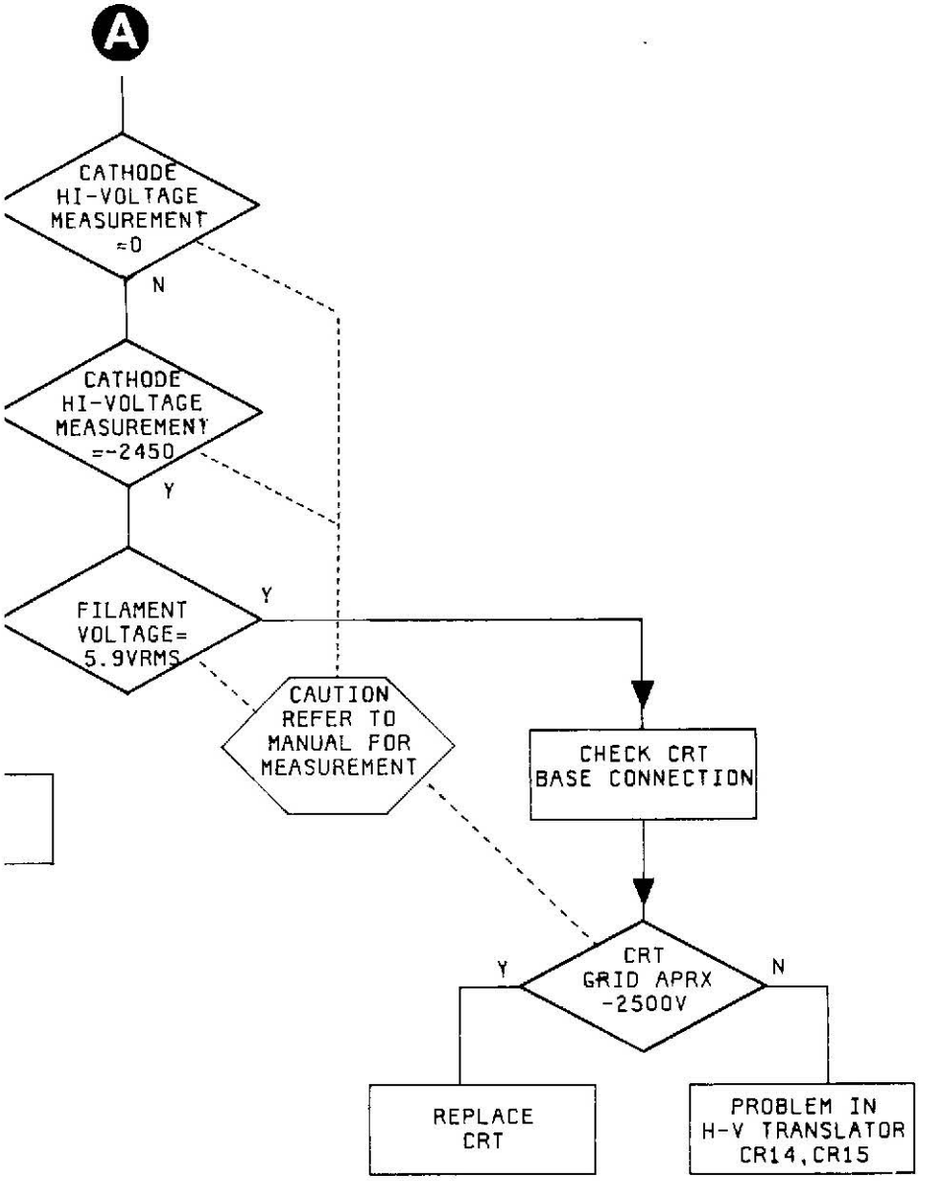
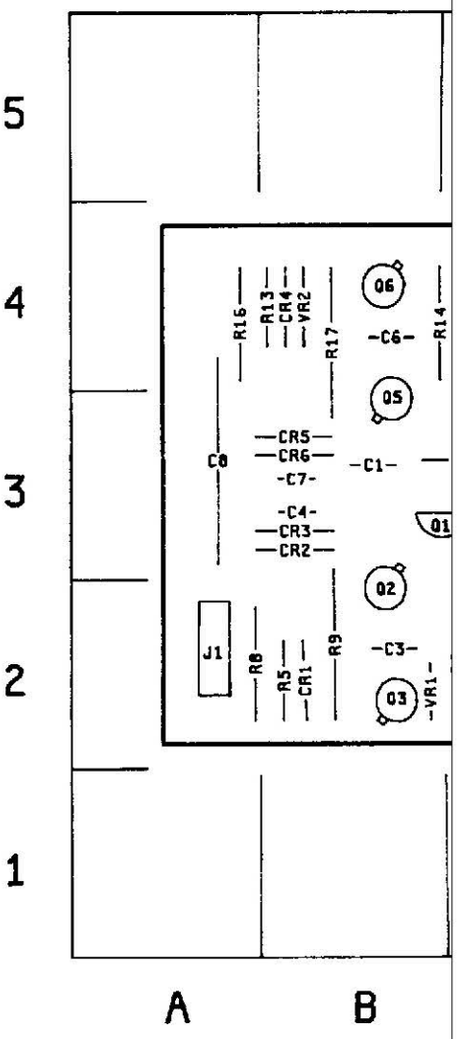
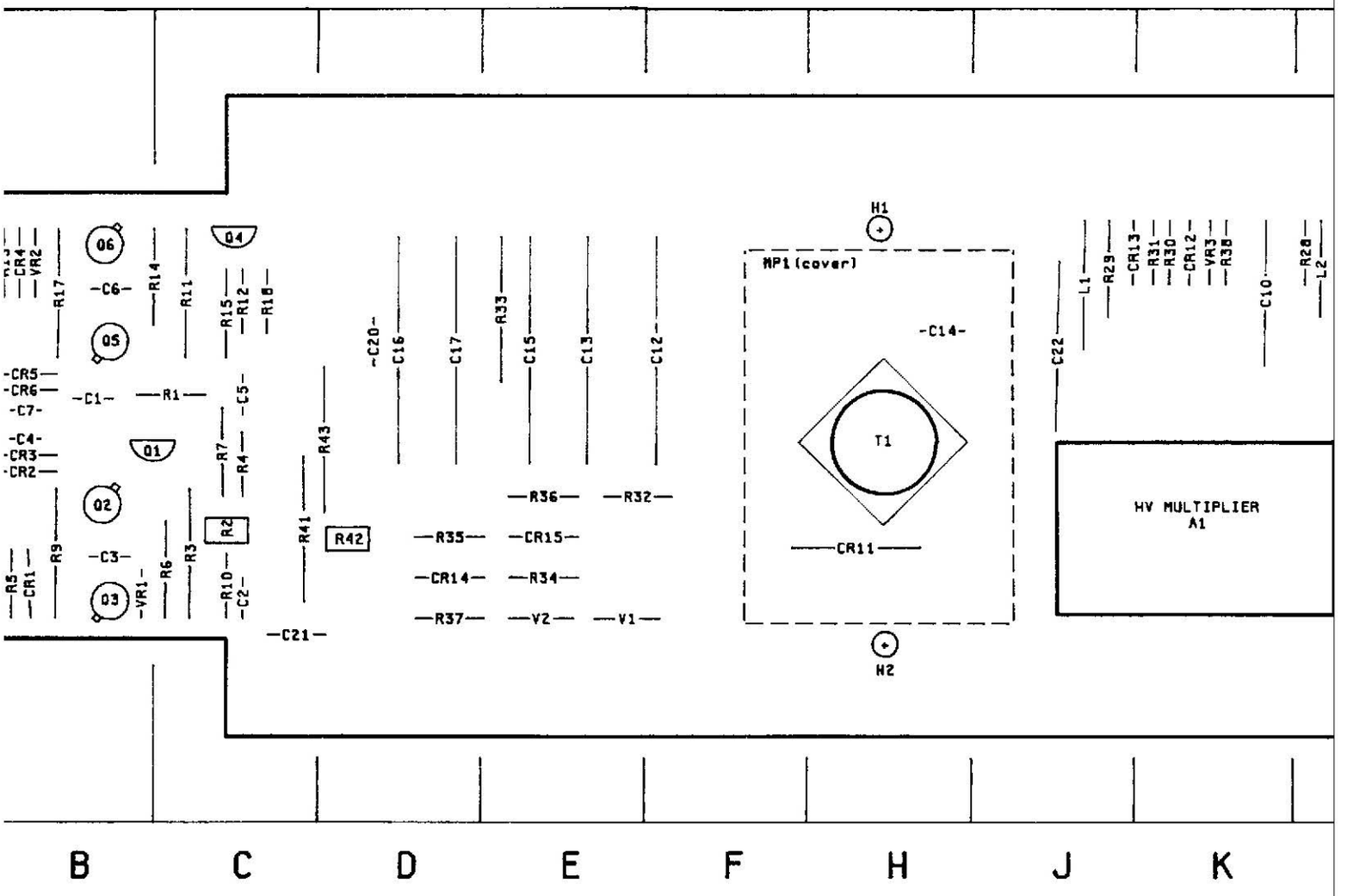
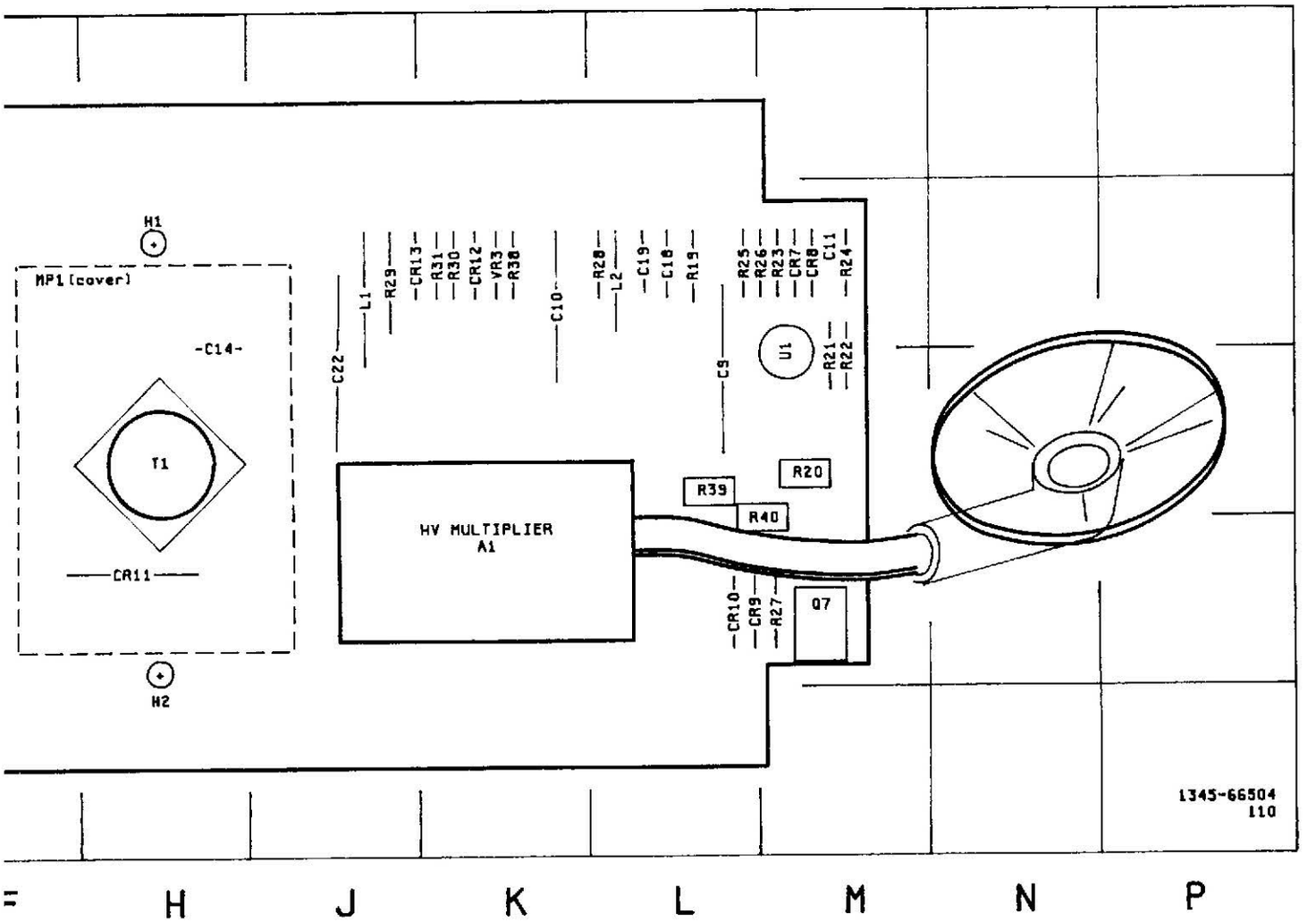

A
CATHODE HI-VOLTAGE MEASUREMENT =0
N
CATHODE HI-VOLTAGE MEASUREMENT =-2450
Y
FILAMENT VOLTAGE= 5.9VRMS
Y
CAUTION REFER TO MANUAL FOR MEASUREMENT
CHECK CRT BASE CONNECTION
CRT GRID APRX -2500V
Y
N
REPLACE CRT
PROBLEM IN H-V TRANSLATOR CR14,CR15


5
4
3
2
1
A
B
R15
R13
CR4
VR2
R17
Q6
-C6-
R14
Q5
CR5
CR6
-C7-
C8
-C1-
-C4-
CR3
CR2
Q1
Q2
J1
R8
R5
CR1
R9
-C3-
Q3
-VR1-



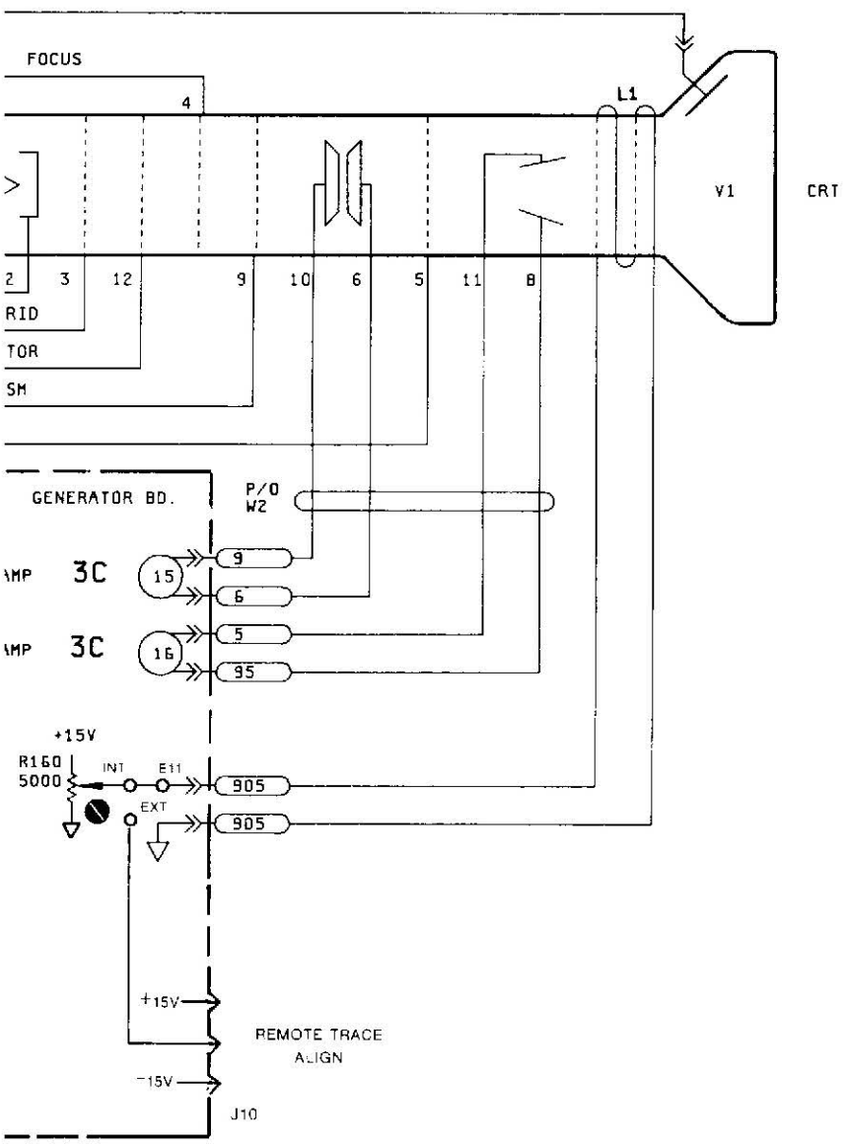
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	R DE
A1	K-2	C21	C-2	L1	J-4	R11	C-4	R31
C1	B-3	C22	J-3	L2	L-4	R12	C-4	R32
C2	C-2	CR1	B-2	MP1	F-4	R13	B-4	R33
C3	B-2	CR2	B-3	Q1	B-3	R14	B-4	R34
C4	B-3	CR3	B-3	Q2	B-2	R15	C-4	R35
C5	C-3	CR4	B-4	Q3	B-2	R16	A-4	R36
C6	B-4	CR5	B-3	Q4	C-4	R17	B-4	R37
C7	B-3	CR6	B-3	Q5	B-3	R18	C-4	R38
C8	A-3	CR7	M-4	Q6	B-4	R19	L-4	R39
C9	L-3	CR8	M-4	Q7	M-2	R20	M-3	R40
C10	K-4	CR9	L-2	R1	C-3	R21	M-3	R41
C11	M-4	CR10	L-2	R2	C-2	R22	M-3	R42
C12	F-3	CR11	H-2	R3	C-2	R23	M-4	R43
C13	E-4	CR12	K-4	R4	C-3	R24	M-4	T1
C14	H-4	CR13	J-4	R5	B-2	R25	L-4	U1
C15	E-4	CR14	D-2	R6	C-2	R26	M-4	V1
C16	D-3	CR15	E-2	R7	C-3	R27	M-2	V2
C17	D-3	J1	A-2	R8	A-2	R28	L-4	VR1
C18	L-4	H1	H-2	R9	B-2	R29	J-4	VR2
C19	L-4	H2	H-1	R10	C-2	R30	K-4	VR3
C20	D-3							

P/O Service Sheet 5,



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
A1	K-2	C21	C-2	L1	J 4	R11	C-4	R31	K-4
C1	B-3	C22	J-3	L2	L 4	R12	C-4	R32	E-3
C2	C-2	CR1	B-2	MP1	F-4	R13	B-4	R33	E-4
C3	B-2	CR2	B 3	Q1	B-3	R14	B-4	R34	E-2
C4	B-3	CR3	B-3	Q2	B-2	R15	C-4	R35	D-2
C5	C-3	CR4	B-4	Q3	B-2	R16	A-4	R36	E-3
C6	B-4	CR5	B-3	Q4	C-4	R17	B-4	R37	D-2
C7	B 3	CR6	B-3	Q5	B-3	R18	C-4	R38	K 4
C8	A 3	CR7	M-4	Q6	B-4	R19	L-4	R39	L 3
C9	L-3	CR8	M-4	Q7	M-2	R20	M-3	R40	M-3
C10	K 4	CR9	L-2	R1	C-3	R21	M-3	R41	C-2
C11	M-4	CR10	L 2	R2	C-2	R22	M-3	R42	D-2
C12	F-3	CR11	H 2	R3	C-2	R23	M-4	R43	D-3
C13	E-4	CR12	K 4	R4	C-3	R24	M-4	T1	H-3
C14	H-4	CR13	J 4	R5	B-2	R25	L-4	U1	M-3
C15	E-4	CR14	D-2	R6	C-2	R26	M-4	V1	E-2
C16	D-3	CR15	E-2	R7	C-3	R27	M-2	V2	E-2
C17	D-3	J1	A-2	R8	A-2	R28	L-4	VR1	B-2
C18	L-4	H1	H-2	R9	B-2	R29	J-4	VR2	B-4
C19	L-4	H2	H-1	R10	C-2	R30	K-4	VR3	K-4
C20	D-3								

P/O Service Sheet 5, High Voltage Power Supply (A4)



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

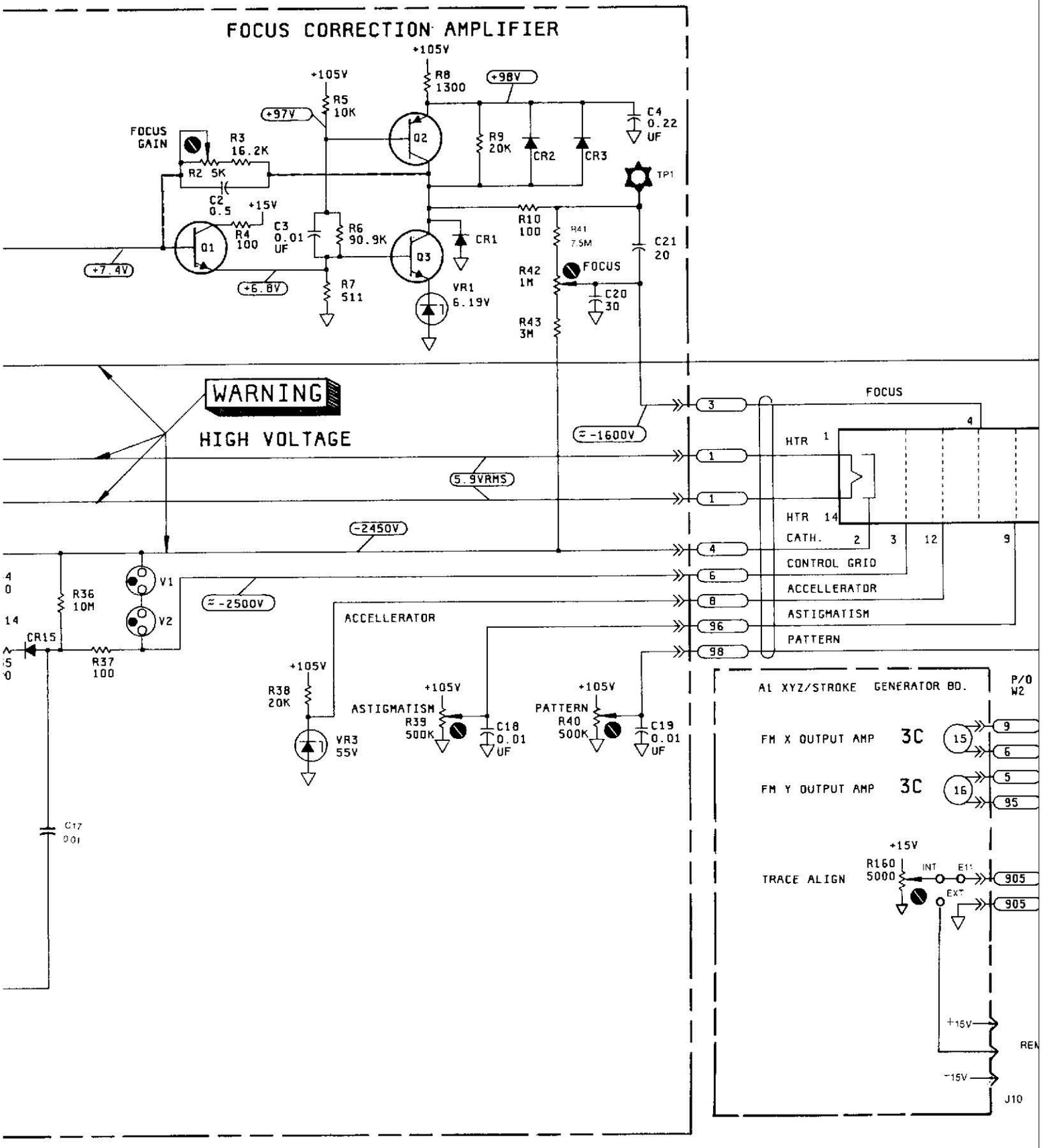
PARTS ON THIS SCHEMATIC

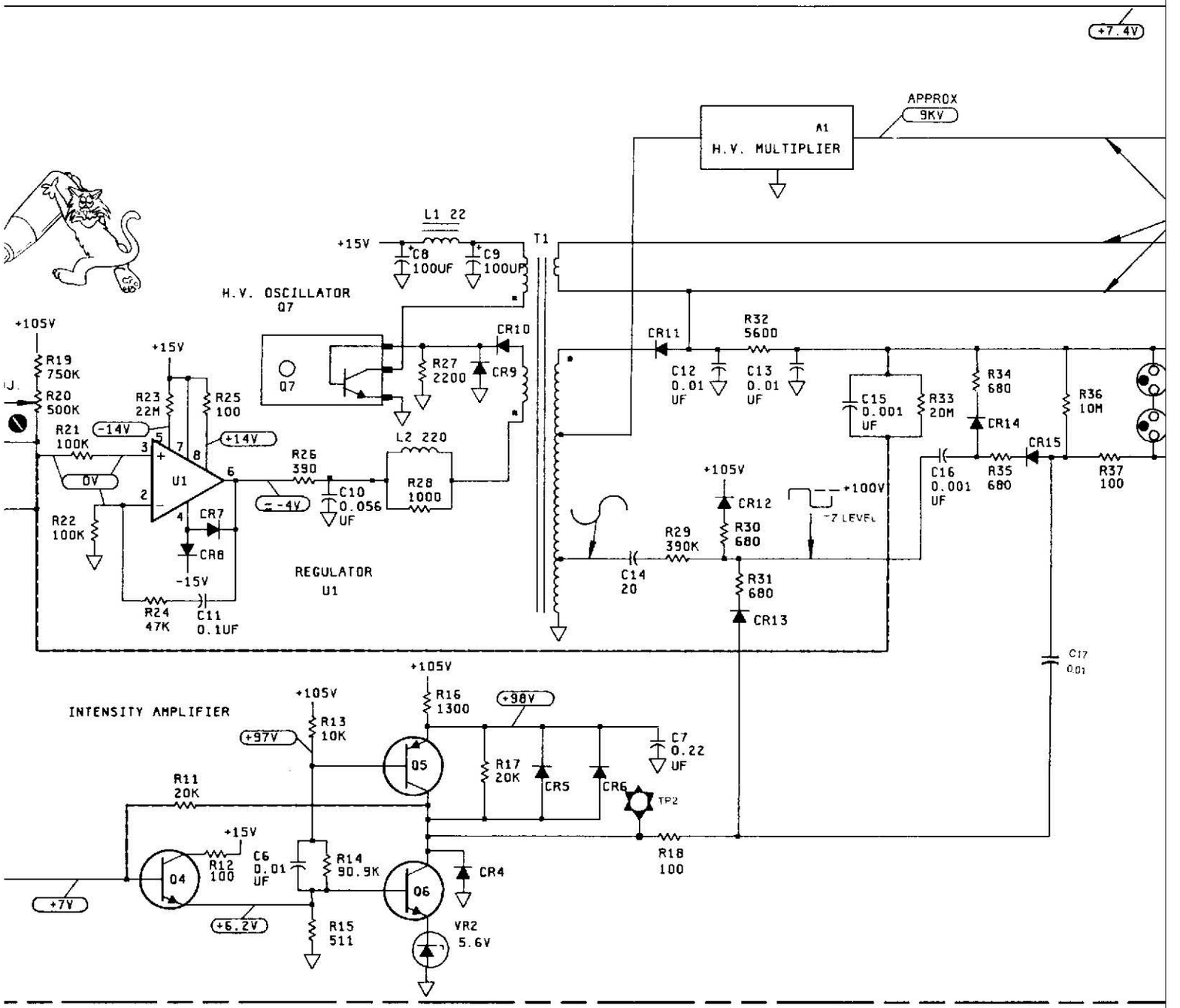
A4	P/O A1	CHASSIS
C1-21 CR1-15 L1,2 Q1-7 R1-43 T1 U1 V1,2 VR1-3	R160	P/O W1 P/O W2 V1 L1

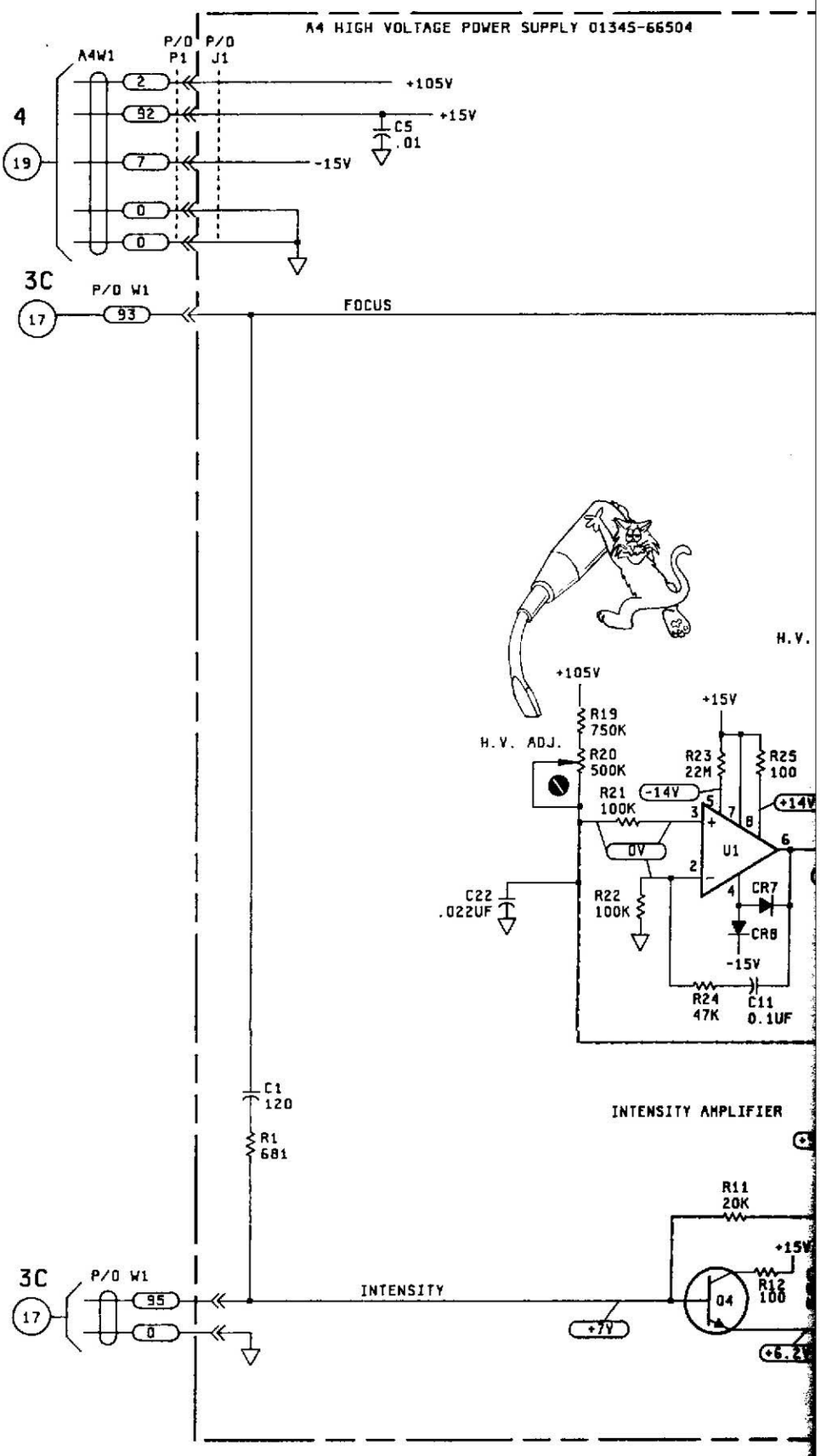
SERVICE SHEET 5

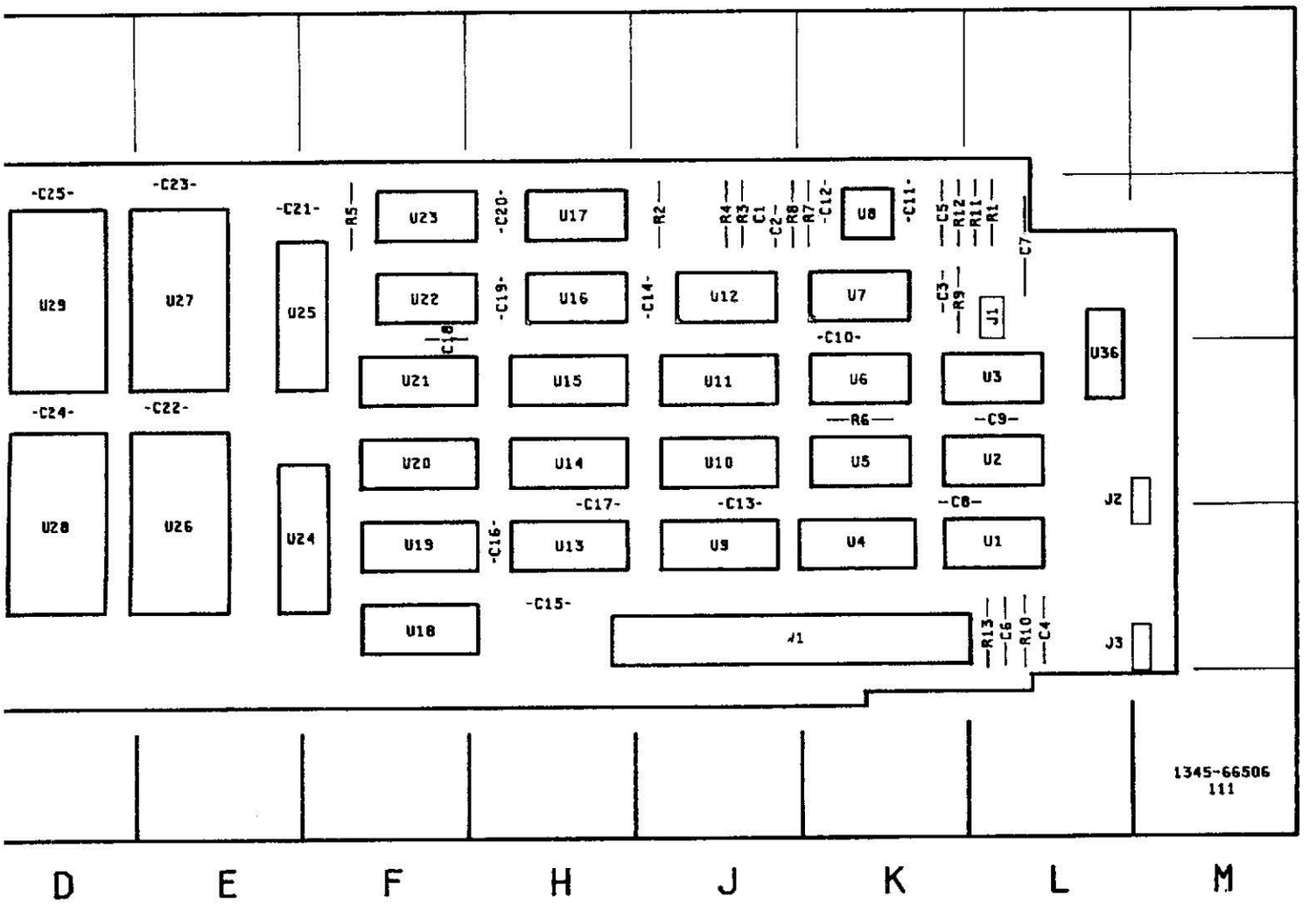
1345/104/CLG/04-15-81

Figure 8-11.
Service Sheet 5, High Voltage Power Supply (A4)


FOCUS CORRECTION AMPLIFIER
+105V
R8 1300
+98V
+105V
R5 10K
+97V
C4 0.22 UF
FOCUS GAIN
R3 16.2K
R2 5K
Q2
R9 20K
CR2
CR3
TP1
C2 0.5
+15V
R10 100
R41 7.5M
C21 20
C3 0.01 UF
R6 90.9K
CR1
R4 100
Q1
Q3
+7.4V
+6.8V
R7 511
VR1 6.19V
R42 1M
FOCUS
C20 30
R43 3M
WARNING
HIGH VOLTAGE
≈-1600V
FOCUS
3
HTR 1
4
1
5.9VRMS
1
HTR 14
-2450V
CATH. 2 3 12 9
4
CONTROL GRID
6
ACCELLERATOR
8
ASTIGMATISM
96
PATTERN
98
R36 10M
V1
V2
≈-2500V
CR15
R37 100
ACCELLERATOR
+105V
R38 20K
+105V
ASTIGMATISM
R39 500K
C18 0.01 UF
+105V
PATTERN
R40 500K
C19 0.01 UF
VR3 55V
C17 001
A1 XYZ/STROKE GENERATOR BD.
P/O W2
FM X OUTPUT AMP
3C
15
9
6
FM Y OUTPUT AMP
3C
16
5
95
+15V
R160 5000
INT
EXT
TRACE ALIGN
905
905
+15V
-15V
J10

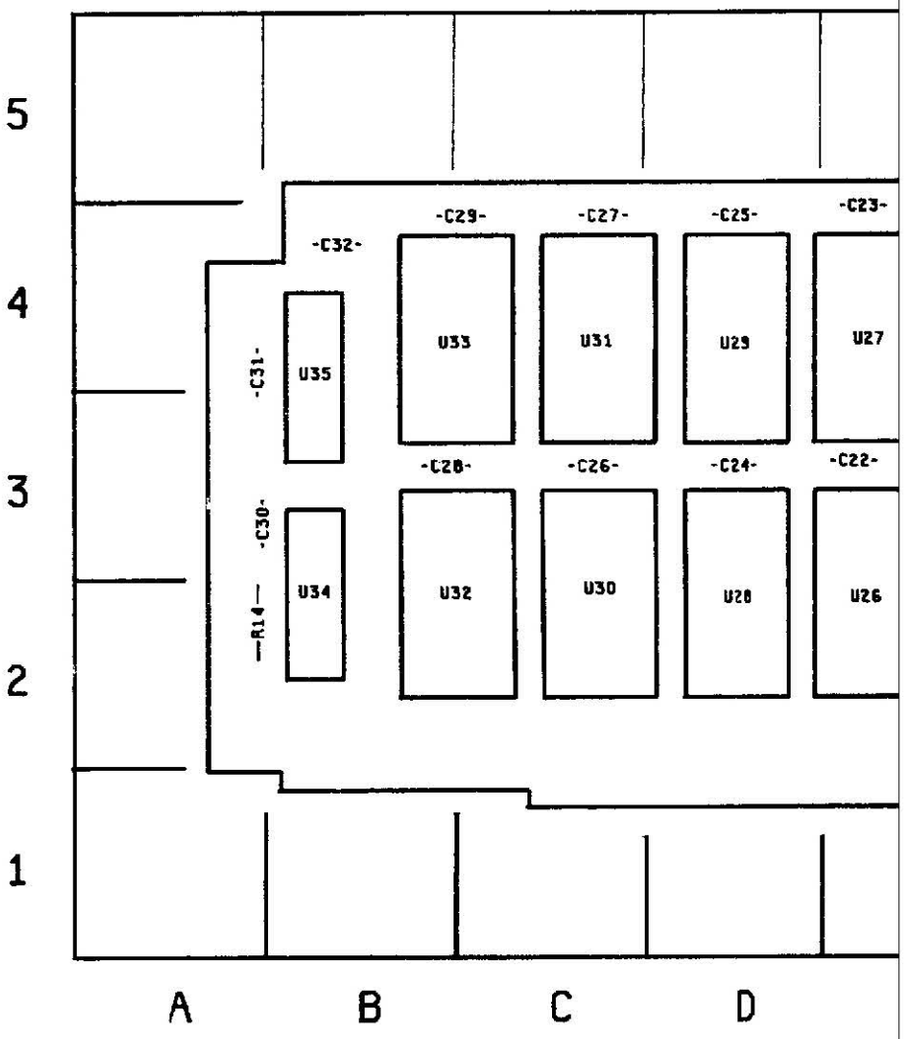

+7.4V
APPROX
9KV
A1
H.V. MULTIPLIER
L1 22
+15V
C8
100UF
C9
100UF
T1
H.V. OSCILLATOR
Q7
CR10
R27
2200
CR9
+105V
R19
750K
R20
500K
R23
22M
+15V
R25
100
R21
100K
-14V
+14V
0V
U1
R22
100K
CR7
CR8
-15V
R24
47K
C11
0.1UF
R26
390
-4V
C10
0.056
UF
L2 220
R28
1000
REGULATOR
U1
CR11
R32
5600
C12
0.01
UF
C13
0.01
UF
C15
0.001
UF
R33
20M
R34
680
CR14
CR15
R36
10M
C16
0.001
UF
R35
680
R37
100
+105V
CR12
+100V
-Z LEVEL
R29
390K
R30
680
C14
20
R31
680
CR13
C17
0.01
INTENSITY AMPLIFIER
+105V
R13
10K
+97V
+105V
R16
1300
+98V
Q5
C7
0.22
UF
R17
20K
CR5
CR6
TP2
R11
20K
+15V
Q4
R12
100
C6
0.01
UF
R14
90.9K
Q6
CR4
R18
100
+7V
+6.2V
R15
511
VR2
5.6V


A4 HIGH VOLTAGE POWER SUPPLY 01345-66504
A4W1
P/O P1
P/O J1
2
92
7
0
0
+105V
+15V
C5 .01
-15V
4
19
3C
P/O W1
17
93
FOCUS
H.V.
+105V
R19 750K
H.V. ADJ.
R20 500K
R21 100K
0V
+15V
R23 22M
R25 100
-14V
+14V
U1
C22 .022UF
R22 100K
CR7
CR8
-15V
R24 47K
C11 0.1UF
INTENSITY AMPLIFIER
C1 120
R1 681
R11 20K
+15V
R12 100
Q4
3C
P/O W1
17
95
0
INTENSITY
+7V
+6.2V

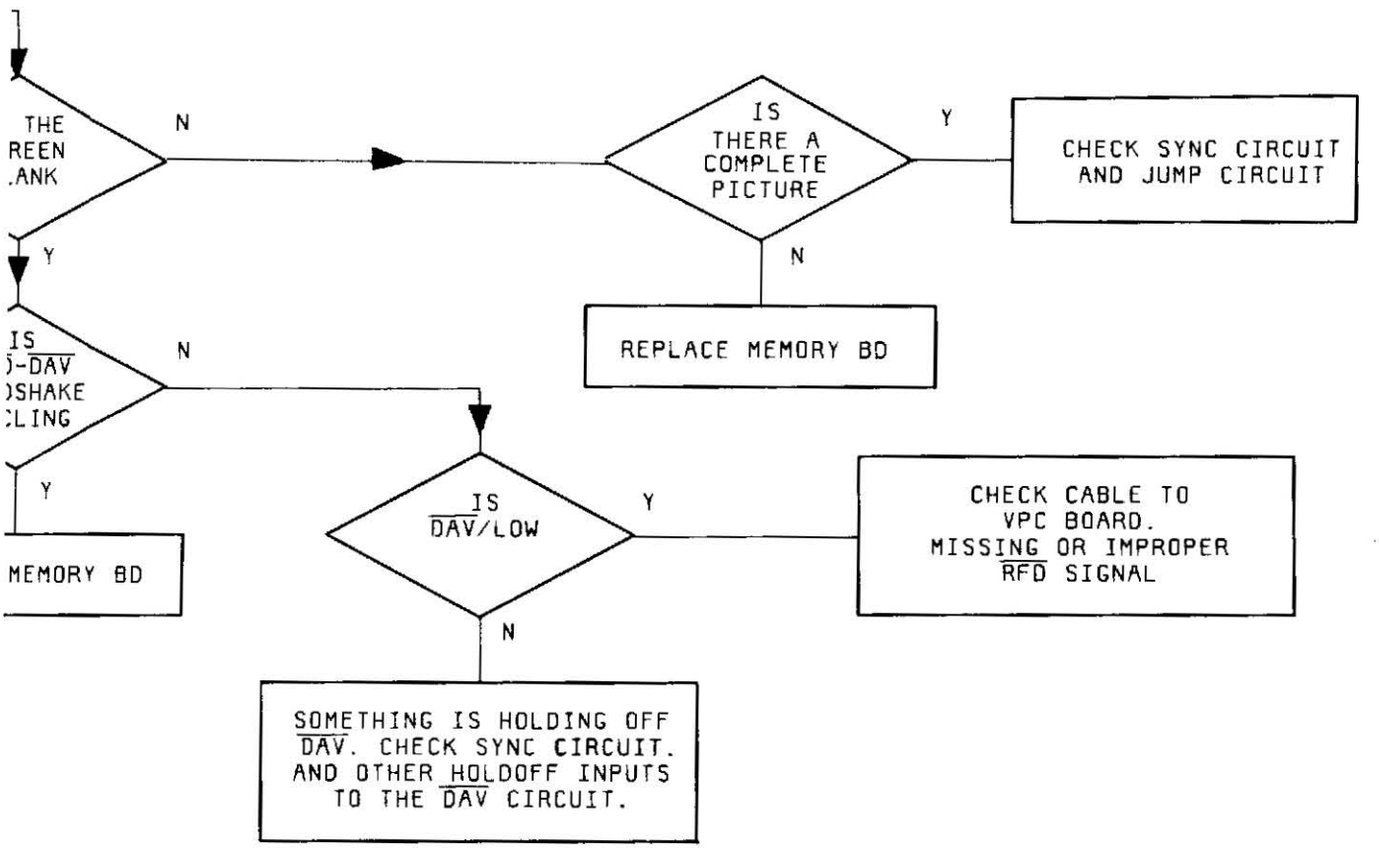


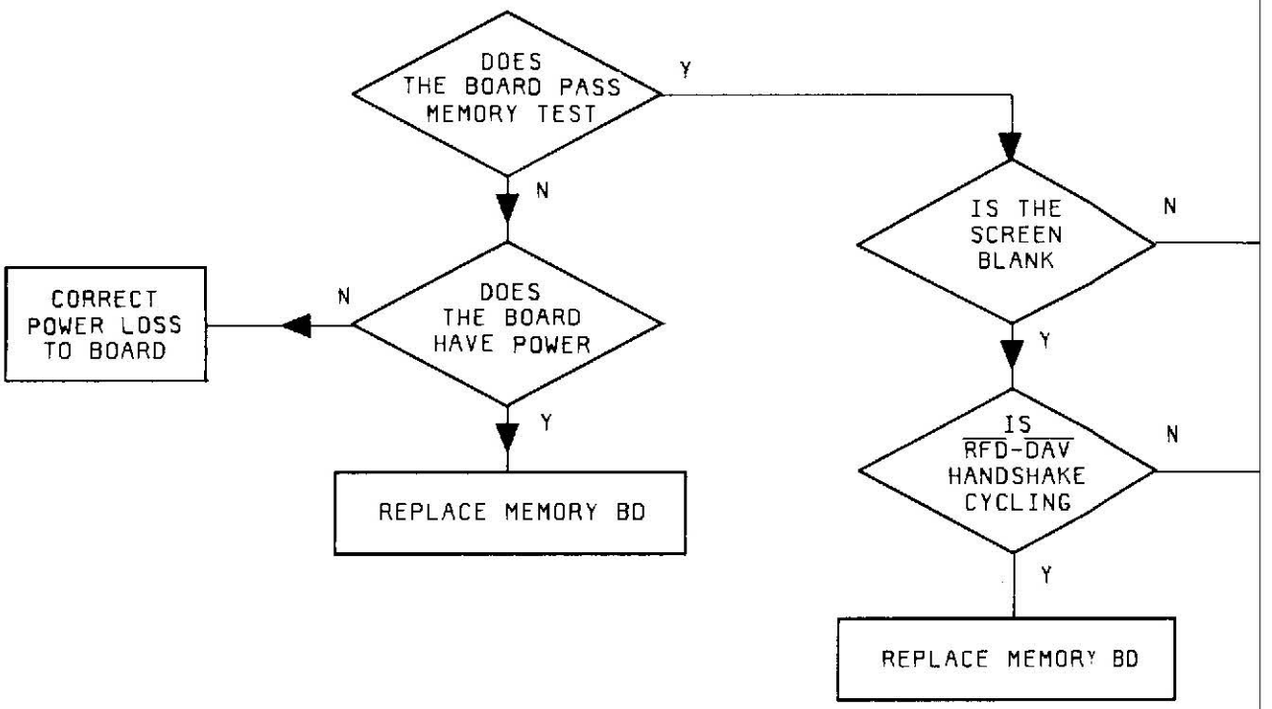
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	J-4	C19	H-4	R1	L-4	U4	K-2	U21	F-3
C2	J-4	C20	H-4	R2	J-4	U5	K-3	U22	F-4
C3	K 4	C21	E-4	R3	J-4	U6	K-3	U23	F-4
C4	L 2	C22	D-3	R4	J-4	U7	K 4	U24	F-2
C5	K-4	C23	E-4	R5	F-4	U8	K 4	U25	E-4
C6	L-2	C24	D 3	R6	K 3	U9	J 2	U26	E-2
C7	L-4	C25	D-4	R7	K-4	U10	J-3	U27	E-4
C8	L-3	C26	C-3	R8	J 4	U11	J-3	U28	D-2
C9	L-3	C27	C-4	R9	K 4	U12	J-4	U29	D-4
C10	K-4	C28	C-3	R10	L 2	U13	H-2	U30	C-2
C11	K-4	C29	C-7	R11	L-4	U14	H-3	U31	C-4
C12	K-4	C30	A-3	R12	K-4	U15	H-3	U32	C-2
C13	J-3	C31	A-4	R13	L-2	U16	H-4	U33	C-4
C14	J-4	C32	B-4	R14	A-2	U17	H-4	U34	B-2
C15	H-2	J1	L-4	U1	L-2	U18	F-2	U35	B-4
C16	H-2	J2	L-2	U2	L-3	U19	F-2	U36	L-3
C17	H-2	J3	L-2	U3	L-3	U20	F-3	W1	J 2
C18	F-4								

P/O Service Sheet 6, Memory (Option 704, A5)



REF DESIG	GRID LOC
C1	J-4
C2	J-4
C3	K-4
C4	L-2
C5	K-4
C6	L-2
C7	L-4
C8	L-3
C9	L-3
C10	K-4
C11	K-4
C12	K-4
C13	J-3
C14	J-4
C15	H-2
C16	H-2
C17	H-2
C18	F-4


THE
REEN
.ANK
N
IS
THERE A
COMPLETE
PICTURE
Y
CHECK SYNC CIRCUIT
AND JUMP CIRCUIT
N
REPLACE MEMORY BD
Y
IS
)-DAV
)SHAKE
:LING
N
Y
MEMORY BD
IS
DAV/LOW
Y
CHECK CABLE TO
VPC BOARD.
MISSING OR IMPROPER
RFD SIGNAL
N
SOMETHING IS HOLDING OFF
DAV. CHECK SYNC CIRCUIT.
AND OTHER HOLDOFF INPUTS
TO THE DAV CIRCUIT.


DOES THE BOARD PASS MEMORY TEST
Y
N
IS THE SCREEN BLANK
N
Y
DOES THE BOARD HAVE POWER
N
CORRECT POWER LOSS TO BOARD
Y
REPLACE MEMORY BD
IS RFD-DAV HANDSHAKE CYCLING
N
Y
REPLACE MEMORY BD

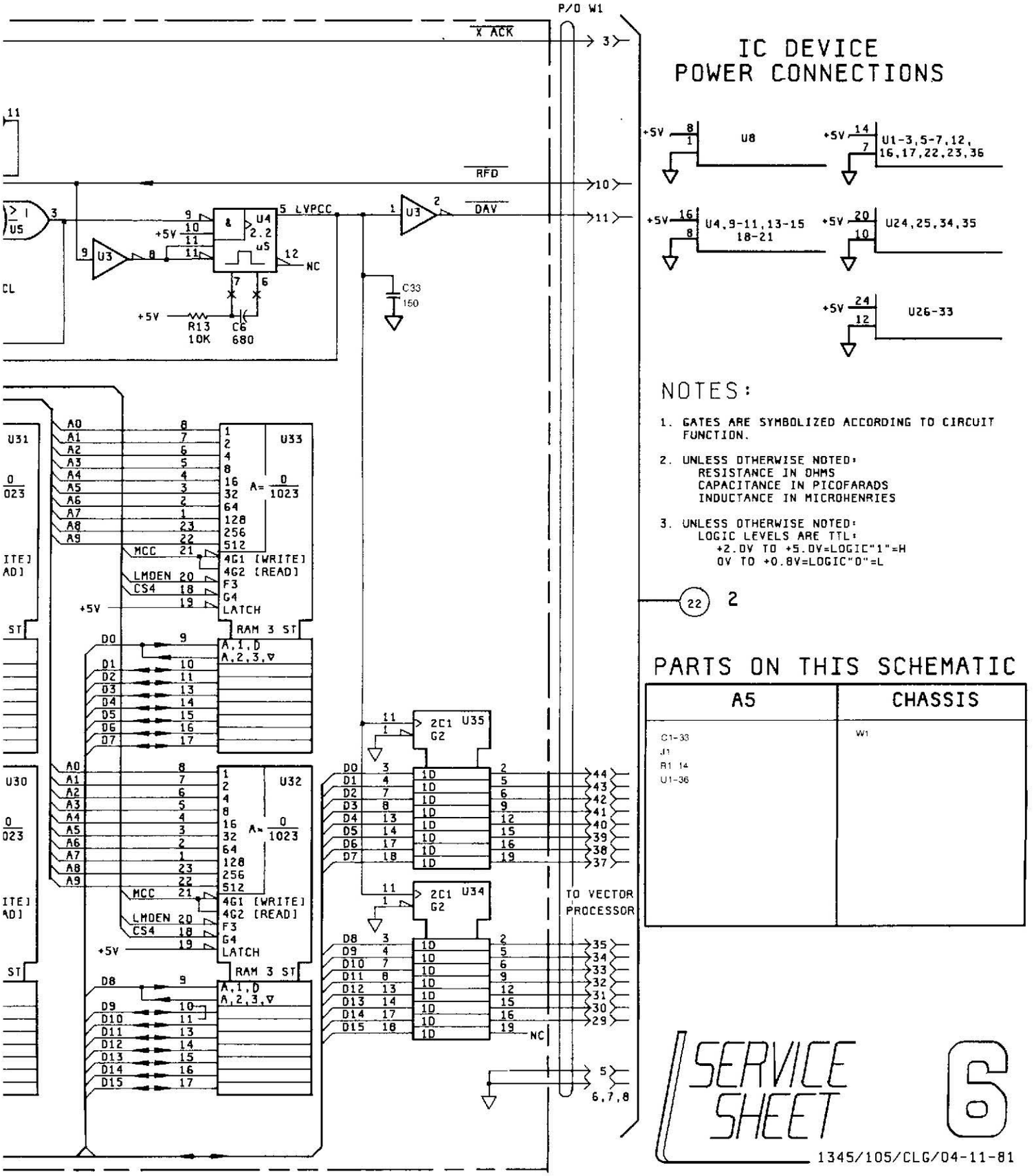
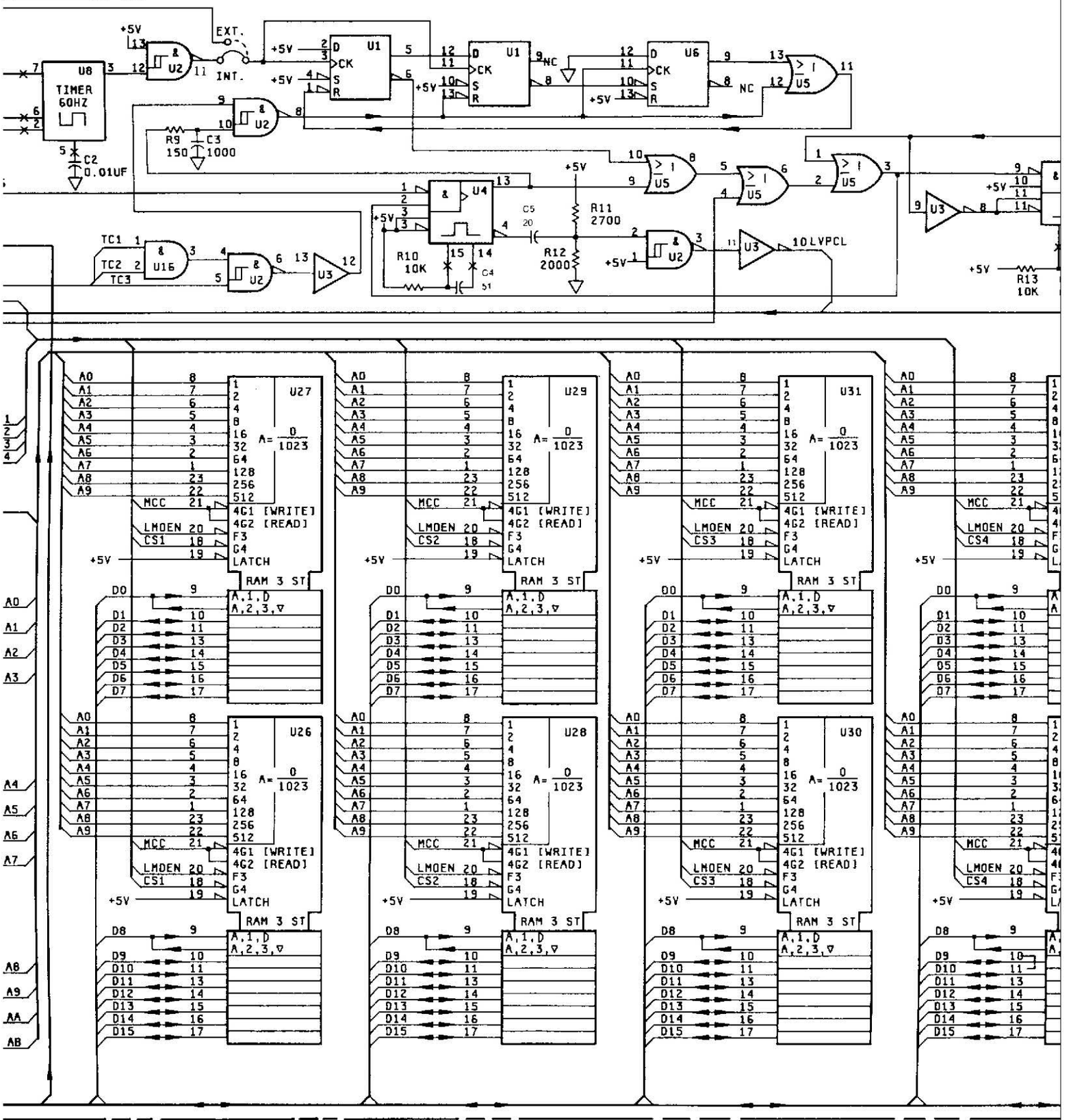
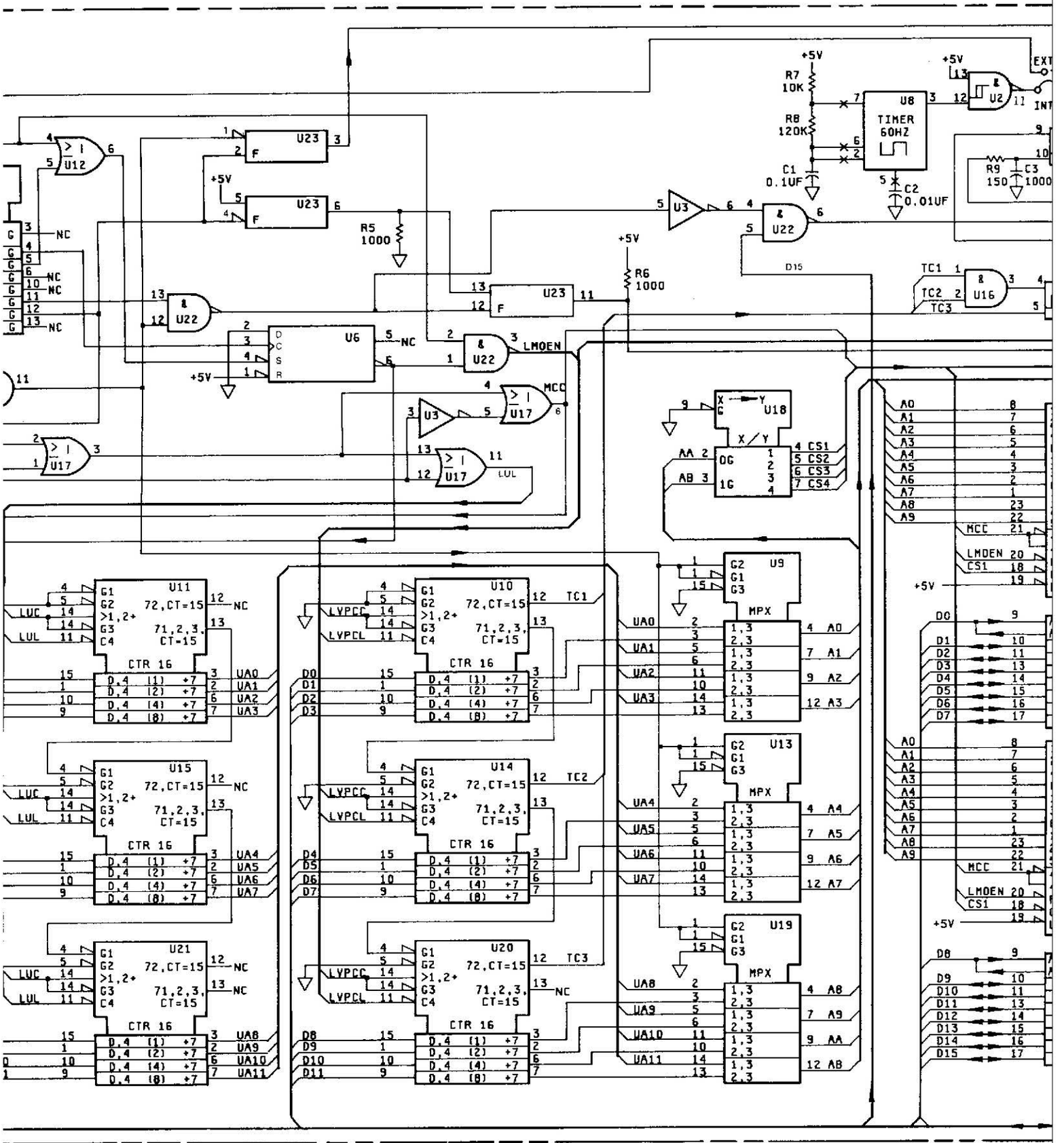
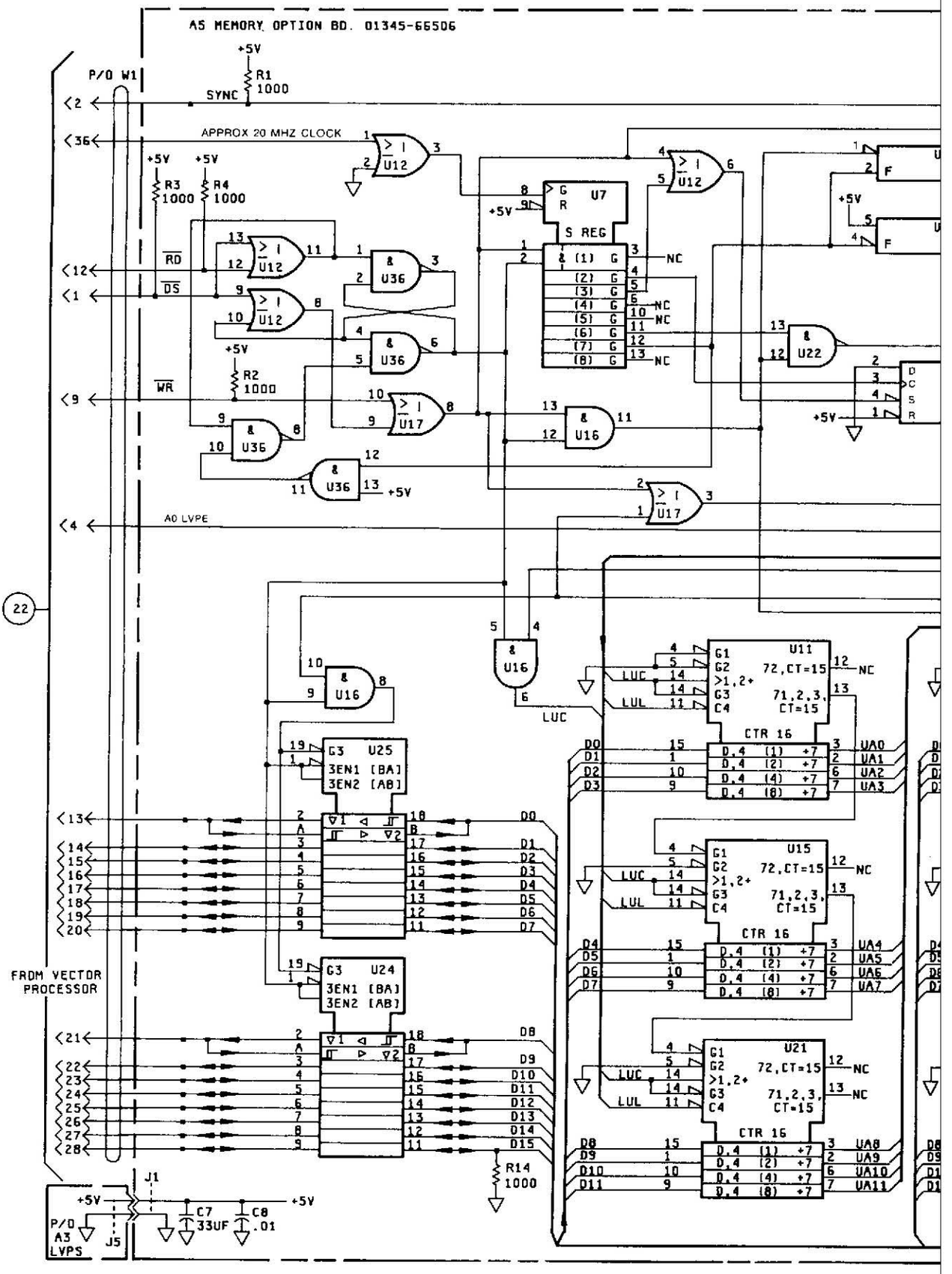


Figure 8-12.
Service Sheet 6, Memory (Option 704, A5)


U8
TIMER
60HZ
EXT.
INT.
U1
U2
U3
U4
U5
U6
U15
U16
R9
150
C3
1000
C2
0.01UF
R10
10K
R11
2700
R12
2000
R13
10K
C4
C5
TC1
TC2
TC3
+5V
NC
10LVPCL
U26
U27
U28
U29
U30
U31
A= 0/1023
4G1 [WRITE]
4G2 [READ]
LATCH
RAM 3 ST
MCC
LMOEN
CS1
CS2
CS3
CS4
F3
G4


+5V
R7 10K
R8 120K
C1 0.1UF
C2 0.01UF
U8 TIMER 60HZ
U2
INT
R9 150
C3 1000
U23
U12
U22
U3
R5 1000
R6 1000
U6
LMOEN
MCC
U17
LUL
U18
CS1
CS2
CS3
CS4
TC1
TC2
TC3
U16
U11
U10
U14
U15
U21
U20
CTR 16
72,CT=15
71,2,3, CT=15
U9
U13
U19
MPX
UA0
UA1
UA2
UA3
UA4
UA5
UA6
UA7
UA8
UA9
UA10
UA11
A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
D0
D1
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15


A5 MEMORY OPTION BD. 01345-66506
P/O W1
SYNC
APPROX 20 MHZ CLOCK
RD
DS
WR
A0 LVPE
FROM VECTOR PROCESSOR
P/O A3 LVPS
J1
J5
R1 1000
R2 1000
R3 1000
R4 1000
R14 1000
C7 33UF
C8 .01
U7 S REG
U11 72,CT=15
U15 72,CT=15
U21 72,CT=15
U25 3EN1 [BA] 3EN2 [AB]
U24 3EN1 [BA] 3EN2 [AB]
CTR 16
LUC
LUL

MANUAL CHANGES

MANUAL IDENTIFICATION

Model Number: 1345A
Date Printed: JANUARY 1983
Part Number: 01345-90908

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections.

Make all appropriate serial number related changes indicated in the tables below.

Serial Prefix or Number	Make Manual Changes
2331A	1
2335A	1,2
2411A	1,2,3

Serial Prefix or Number	Make Manual Changes

▲ NEW ITEM

ERRATA

SECTION VI, REPLACEABLE PARTS

Table 6-2, REPLACEABLE PARTS

Change: A1R24 (RESISTOR, 475 OHMS, 0.125W, 1%) HP and Mfr Part Nos. to 0757-0415.

Change: A5C5 (CAPACITOR 27PF, 300V, MI) HP and Mfr Part Nos. to 0160-2306.

▲ Change: A1U5 (IC, OP AMP) HP and Mfr Part Nos. to 1826-0930.

▲ Change: A1U6 (IC, OP AMP) HP and Mfr Part Nos. to 1826-0930.

▲ Change: A1U10 (IC, OP AMP) HP and Mfr Part Nos. to 1826-0930.

▲ Change: A1U17 (IC, OP AMP) HP and Mfr Part Nos. to 1826-0930.

▲ Change: A1U18 (IC, OP AMP) HP and Mfr Part Nos. to 1826-0930.

▲ Change: A1U22 (IC, OP AMP) HP and Mfr Part Nos. to 1826-0930.

SECTION VIII, SERVICE

Service Sheet 3A, X-Y-Z Amp/Stroke Generator.

Change the value of A1R24 from 511 ohms to 475 ohms.

Service Sheet 6, Memory (Option 704).

Change the value of A5C5 from 20PF to 27PF.

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

HEWLETT PACKARD

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CHANGE 1

SECTION V, ADJUSTMENTS

Figure 5-10.

Replace Figure 5-10 with Figure 1 of this change sheet.

SECTION VI, REPLACEABLE PARTS

Table 6-2, Replaceable Parts.

Change: A1 (BOARD-X Y/STR GEN) HP and Mfr Part Nos. to 01345-66518 (2 places).
Change: A2 (BOARD-VECT PROC) HP and Mfr Part Nos. to 01345-66519 (2 places).
Delete: A1C15.
Delete: A1C25.
Add: A1C54 (CAPACITOR-FXD 0.01UF 100V CER) HP and Mfr Part Nos. 0160-2055.
Add: A1C55 (CAPACITOR-FXD 0.01UF 100V CER) HP and Mfr Part Nos. 0160-2055.
Add: A1J11 (CONNECTOR-WAFER 3 PIN) HP and Mfr Part Nos. 1251-5971.
Add: A1J12 (CONNECTOR-WAFER 3 PIN) HP and Mfr Part Nos. 1251-5971.
Delete: A1R89.
Delete: A1R112.
Add: A1R163 (RESISTOR-FXD 511 OHMS .125W) HP and Mfr Part Nos. 0757-0416.
Add: A1R164 (RESISTOR-FXD 511 OHMS .125W) HP and Mfr Part Nos. 0757-0416.
Add: A1R165 (RESISTOR-FXD 10K OHMS .125W) HP and Mfr Part Nos. 0757-0442.
Add: A1R166 (RESISTOR-FXD 51.1 OHMS .125W) HP and Mfr Part Nos. 0757-0394.
Add: A1R167 (RESISTOR-FXD 10K OHMS .125W) HP and Mfr Part Nos. 0757-0442.
Add: A1R168 (RESISTOR-FXD 51.1 OHMS .125W) HP and Mfr Part Nos. 0757-0394.
Change: A2U1 (SELT TEST μp) HP and Mfr Part Nos. 01347-80010.

SECTION VIII, SERVICE

Service Sheet 3C, X-Y-Z Amp/Stroke Generator.

Replace A1 Component Locator with Figure 2 of this Change Sheet.
Replace Figure 8-9 with Figure 3 of this Change Sheet.

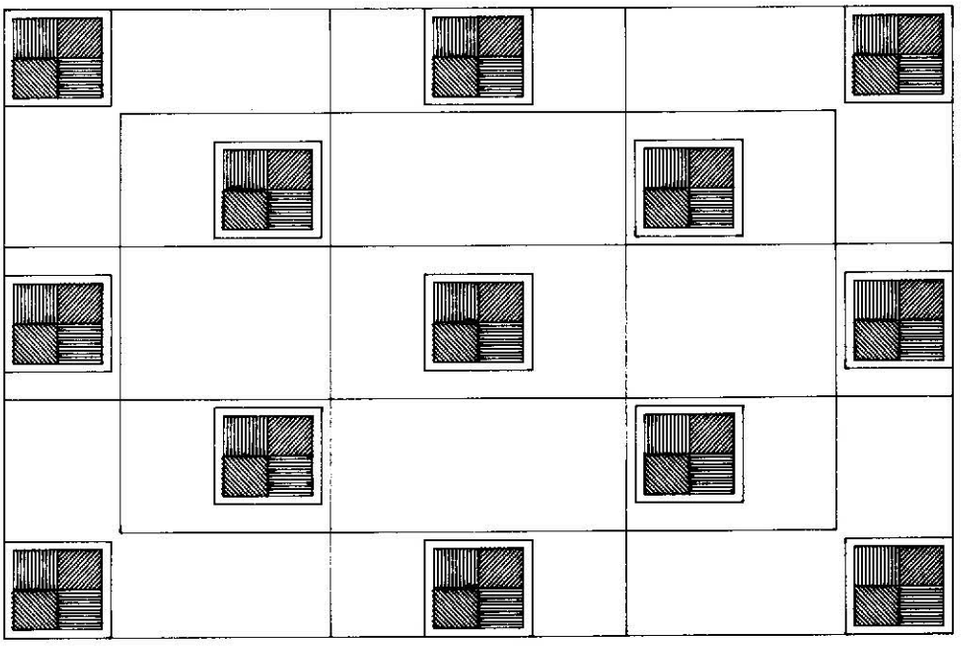


Figure 1. New Focus and Resolution Test Pattern

CHANGE 2

SECTION VI, REPLACEABLE PARTS
Table 6-2, Replaceable Parts
Change: VI (CRT) HP and Mfr Part Nos. to 5083-6451.

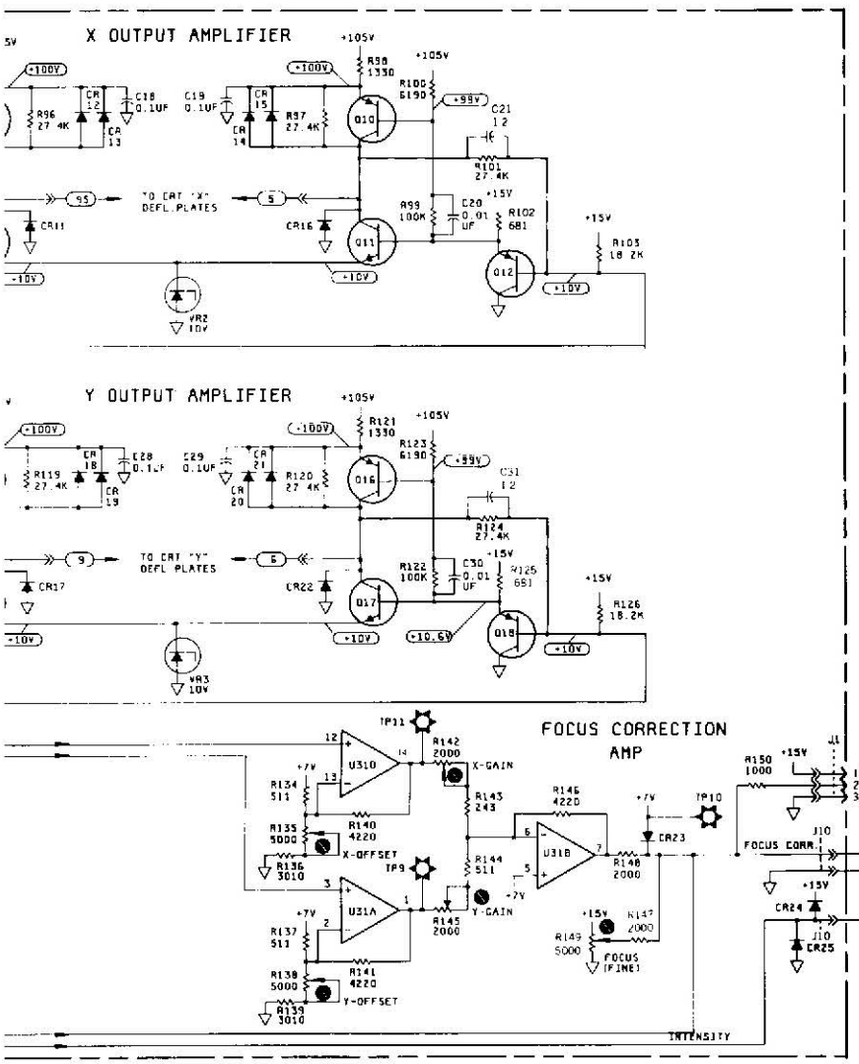
CHANGE 3

SECTION VI, REPLACEABLE PARTS
Table 6-2, Replaceable Parts.
Change: A4 (BOARD ASSY-HIGH VOLTAGE) HP and Mfr. Part Nos. to 01345-66523.
Change: A4C3 (CAPACITOR, 0.01UF, 500VDC) HP and Mfr. Part Nos. to 0160-3665.
Change: A4C6 (CAPACITOR, 0.01UF, 500VDC) HP and Mfr. Part Nos. to 0160-3665.
Add: A4C23 (CAPACITOR, 0.51PF, 500VDC) HP and Mfr. Part Nos. 0160-2234.
Add: A4C24 (CAPACITOR, 0.01UF, 500VDC) HP and Mfr. Part Nos. 0160-3665.
Add: A4J11 (CONNECTOR, 3-PIN M) HP and Mfr. Part Nos. 1251-5951.
Add: A4R44 (RESISTOR, 200 O, 0.125W) HP and Mfr. Part Nos. 0757-0407.
Add: A4R45 (RESISTOR, 78.1K, 0.125W) HP and Mfr. Part Nos. 0698-4508.
Add: A4R46 (RESISTOR, 78.1K, 0.125W) HP and Mfr. Part Nos. 0698-4508.

SERVICE VIII, SERVICE
Service Sheet 5, High Voltage Power Supply.

Replace the High Voltage Power Supply Component Locator with figure 4 of this Change Sheet.

Replace the High Voltage Power Supply Schematic with figure 5 of this Change Sheet.



PARTS ON THIS SCHEMATIC

P/O A1

C12-33
CR11-25
J1-12
Q7-18
R81-150,155
U27-29,31
VR2,3

SERVICE SHEET 3C

1347/102/6-23-83

rator (A1) Schematic

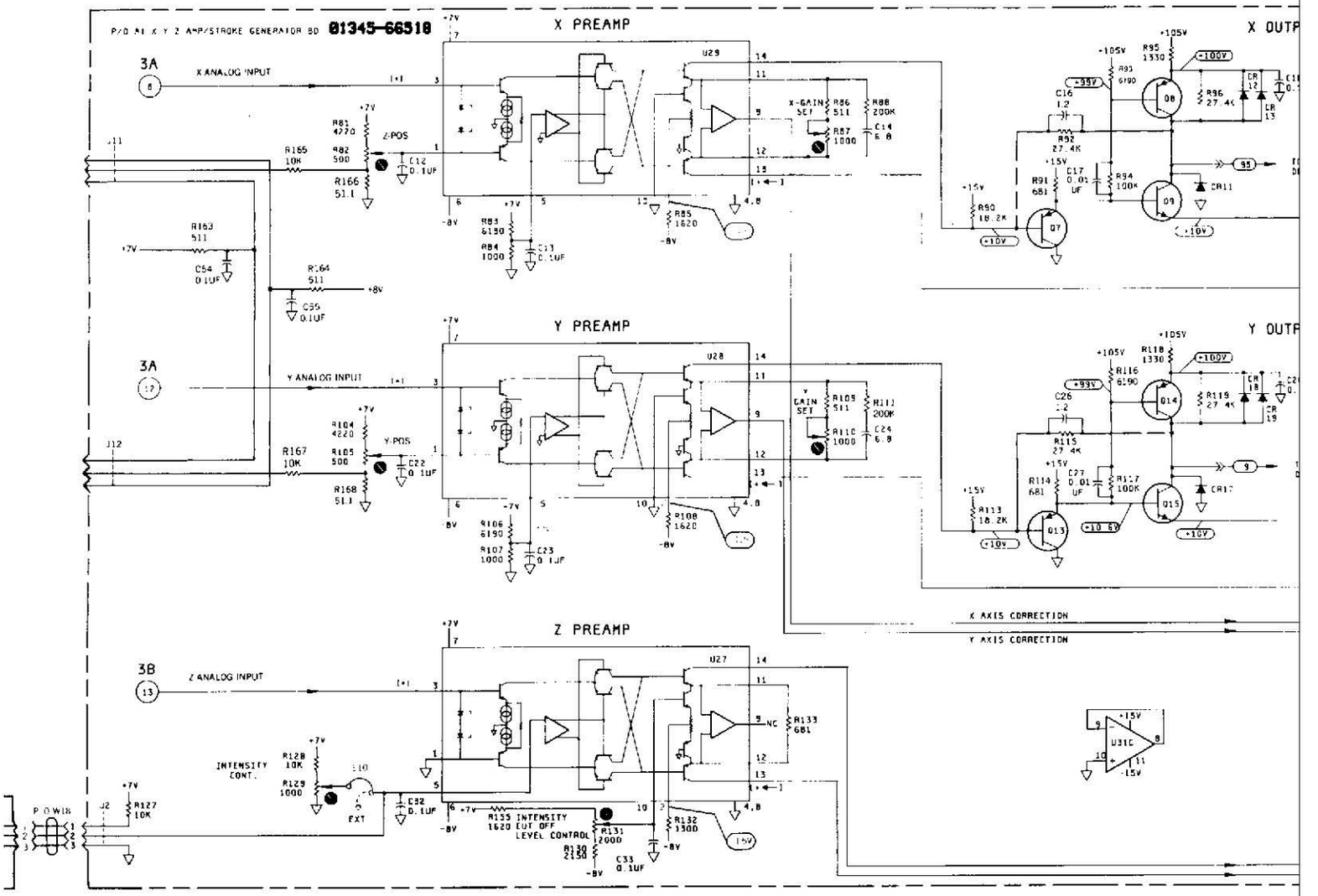


Figure 3. X-Y-Z Amp/Stroke Generator (A1) Sch

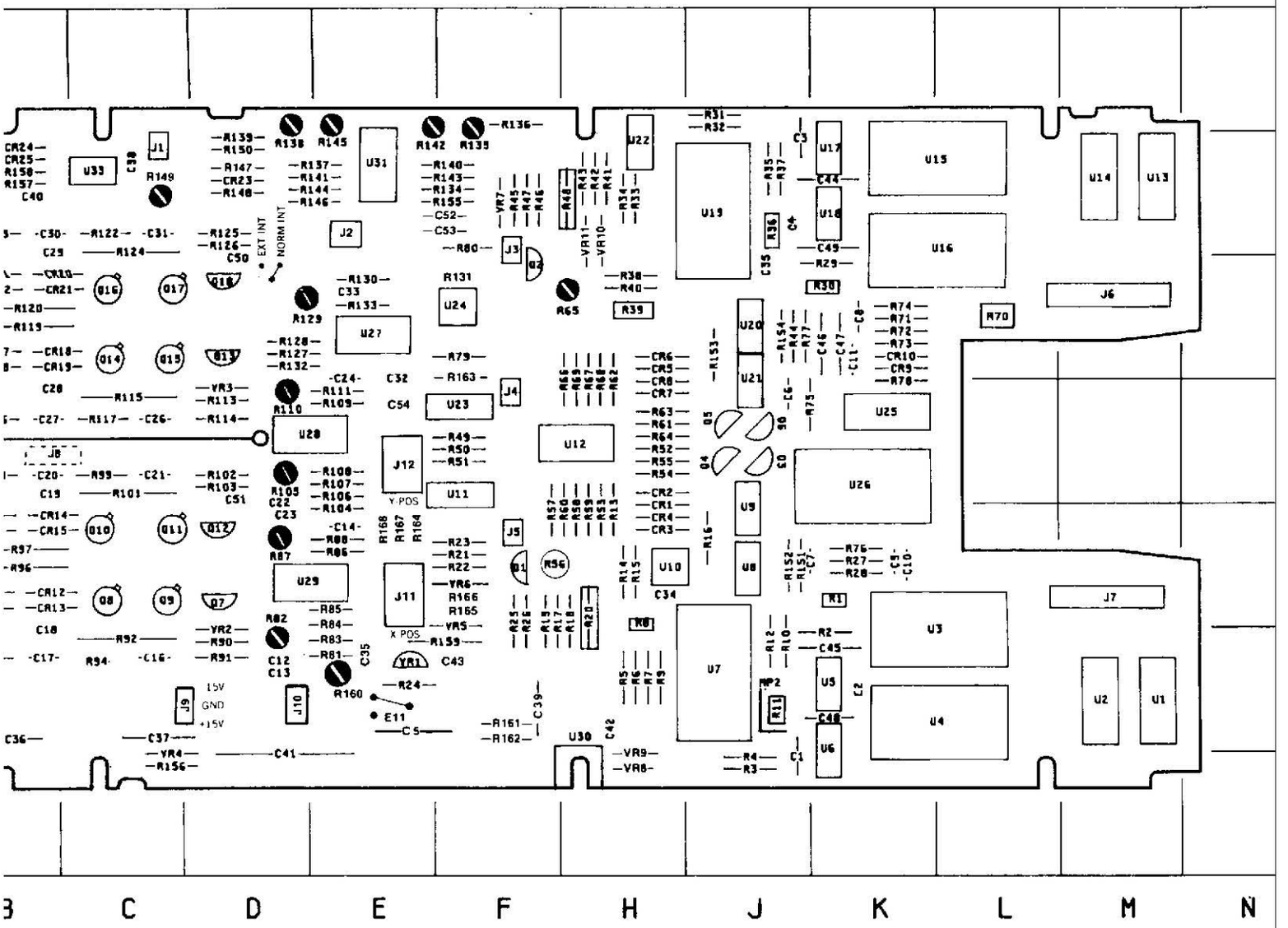
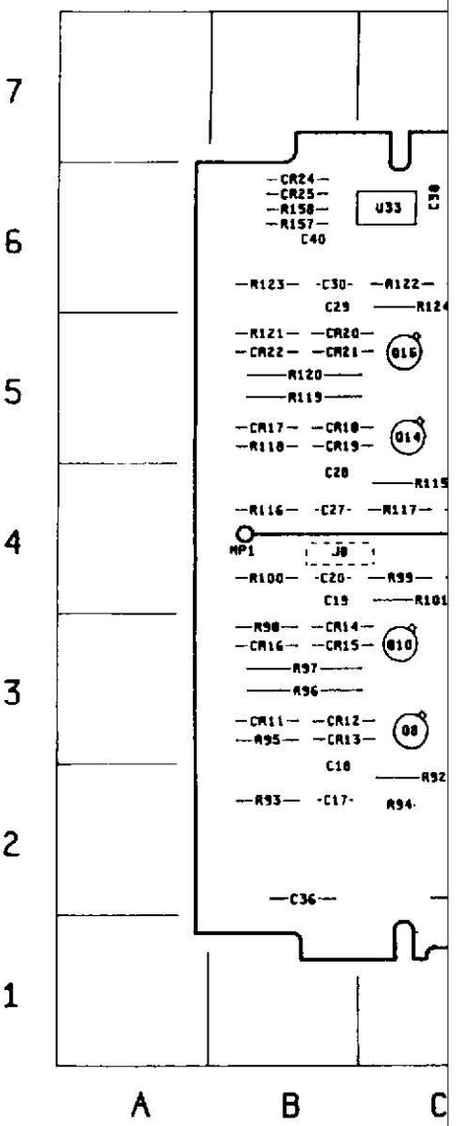
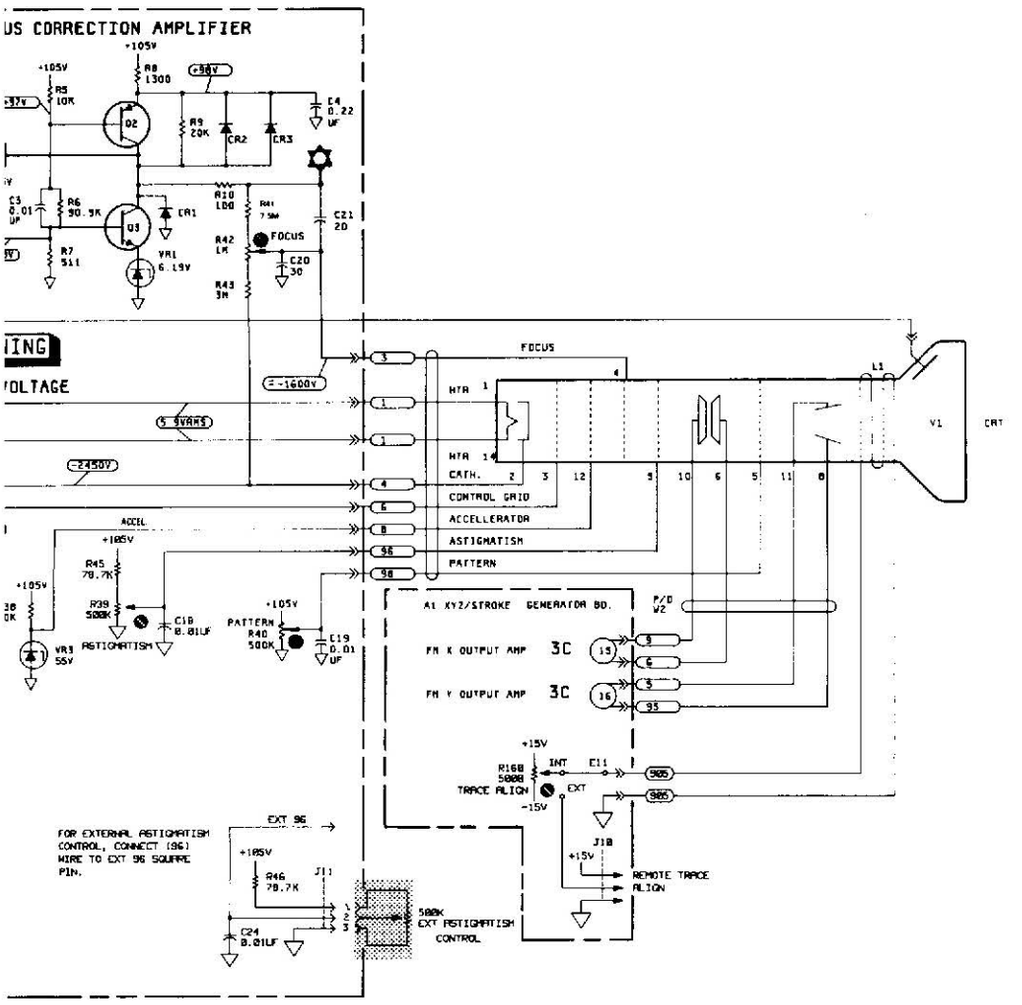


Figure 2. X-Y-Z Amp/Stroke Generator (A1) Component Locator

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





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

A4	P/O A1	CHASSIS
C1-21 CR1-15 L1,2 Q1-7 R1-43 T1 U1 VL,2 VR1-3	R160	P/O W1 P/O W2 Y1 L1

SERVICE SHEET 5

1345/104/CLG/04-15-81

Voltage Power Supply

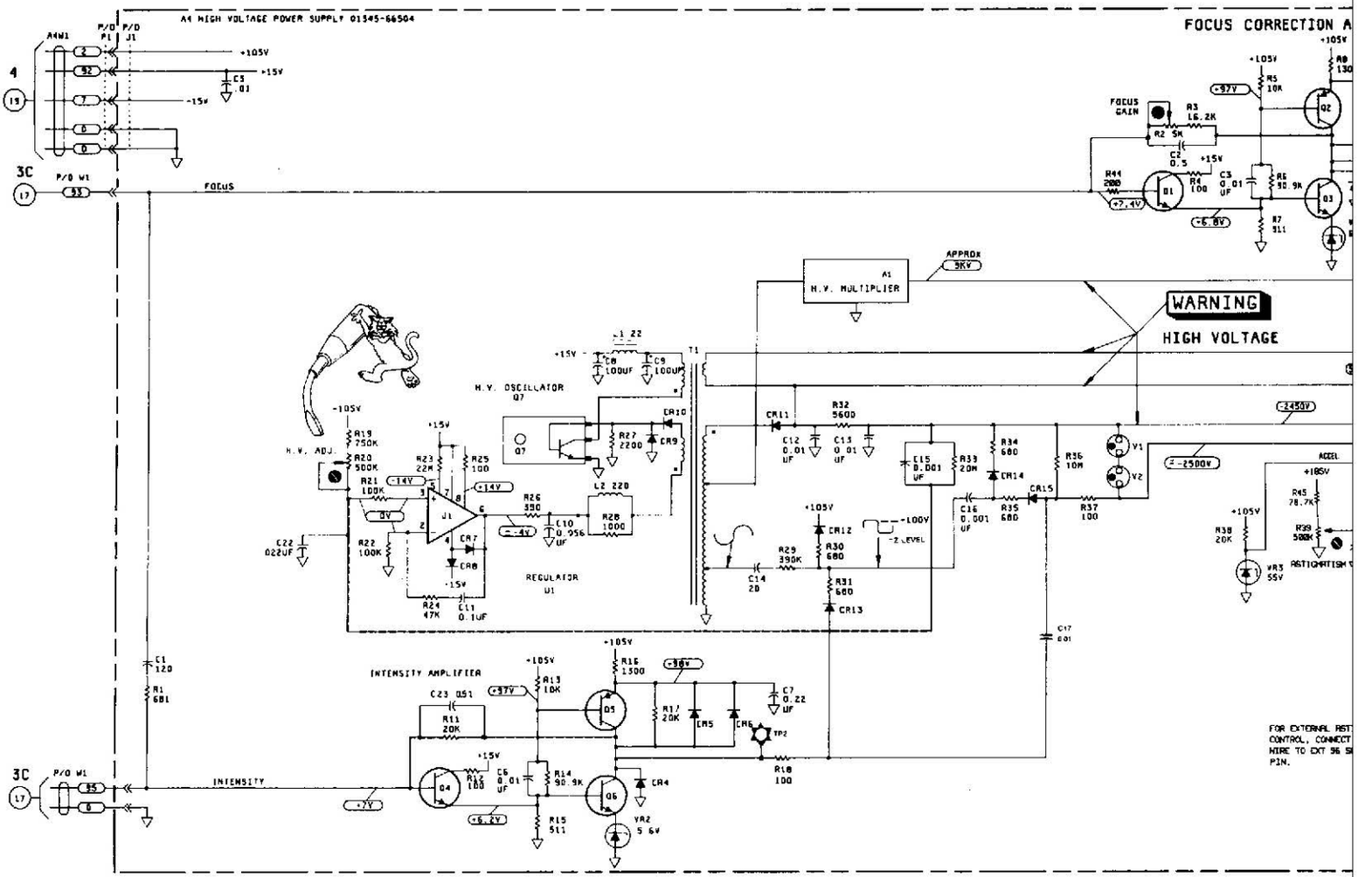


Figure 3. High Voltage Powe