Errata

Title & Document Type: **1744A Oscilloscope Operating and Service Manual**

Manual Part Number: **01744-90901**

Revision Date: **August 1978**

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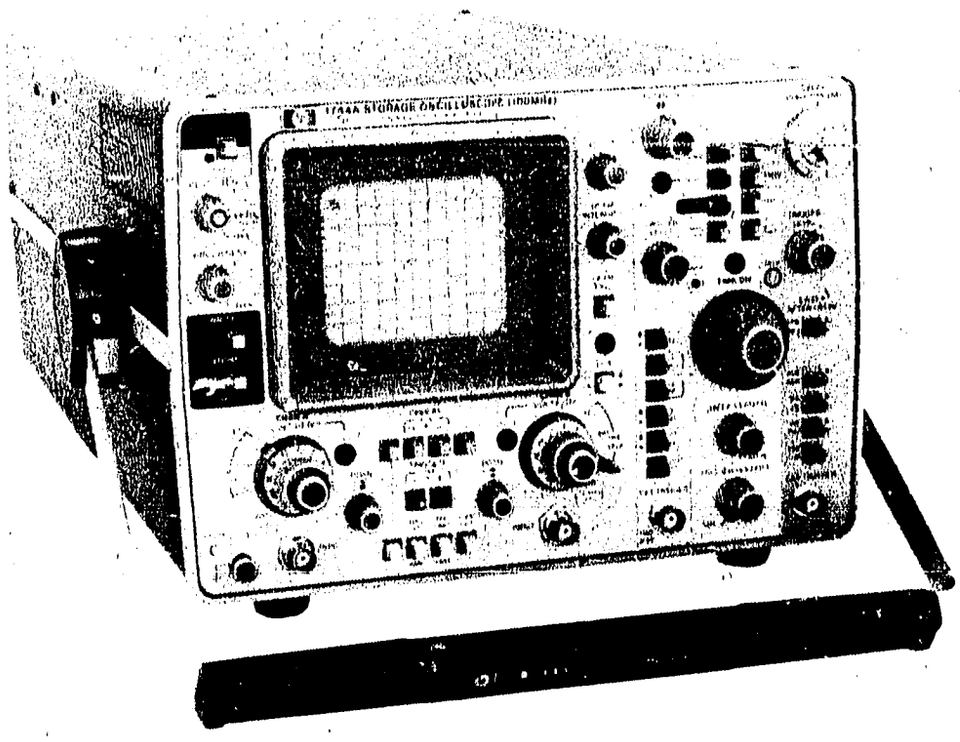
OPERATING AND SERVICE MANUAL

1744A
OSCILLOSCOPE



HEWLETT hp PACKARD

HP 1744A

OPERATING AND SERVICE MANUAL

MODEL 1744A

OSCILLOSCOPE

(Including Options 001, 090, 091, 092, 096, 580, 900, 901, 902, 906, and 910)

SERIALS PREFIXED: 1723A

Refer to Section VII for instruments with other Serial Prefixes.

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Manual Part Number 01744-90901
Microfiche Part Number 01744-90801
Operators Guide Part Number 01744-90902

PRINTED: AUGUST 1978

channel A and channel B signals. In trigger-view operation, center screen represents the trigger threshold point. With the A vs B control, an X-Y mode of operation is possible. The channel A input (Y-axis) is plotted versus the channel B input (X-axis).

1-16. A trigger-view control provides capability for observing the channel A signal, channel B signal, and an external trigger signal on the same display when operating in ALT or CHOP modes. Automatic storage is provided for capturing single-shot data that occurs at random time. Automatic erase allows repeated erase cycles with continuously variable viewing time between erase cycles. The CRT screen has 8 x 10 major divisions (0.72 cm/div) on an internal graticule.

1-17. OPTIONS.

1-18. The following standard options are available for the 1744A.

OPTION 001: This option provides a fixed ac power cord in lieu of the detachable power cord.

OPTION 090: This option deletes the two 10:1 divider probes normally supplied. Other probes that are more suited for operating requirements may be specified.

OPTION 091: This option supplies two Model 10042A probes in lieu of the two 10:1 divider probes normally supplied.

OPTION 092: This option supplies two Model 10040A probes in lieu of the two 10:1 divider probes normally supplied.

OPTION 096: This option supplies two Model 10096D probes in lieu of the two 10:1 divider probes normally supplied.

OPTION 580: Instrument shipped with CSA (Canadian Standards Association) label indicating compliance with CSA Bulletin 556B.

OPTION 910: Furnishes two Operating and Service Manuals instead of one.

AC POWER CORD OPTIONS. See Section II for ac power cord options available for the 1744A.

1-19. ACCESSORIES SUPPLIED.

1-20. The following accessories are supplied with the 1744A:

One B-scan Jumper Filter, HP Part No. 01744-62101
One Blue Light Filter, HP Part No. 01740-02701
One RFI Filter, HP Model 10173A
One Viewing Hood, HP Model 10140A
One Front-panel Cover, HP Part No. 5040-0516
One Vinyl Accessory Pouch, HP Part No. 1540-0292
Two 10:1 Divider Probes, HP Model 10041A
One 500 mAT Fuse (220/240 Vac Operation), HP Part No. 2110-0202
One AC Power Cable (See Section II for appropriate Part No.)

1-21. EQUIPMENT AVAILABLE.

1-22. The following items are available for use with the 1744A:

HP Model 197A with Option H02/008 Oscilloscope Camera with ultraviolet light
HP Model 10376A Camera Adapter (not required for HP Model 197A with Option H02/008)
HP Model 124A Camera
HP Model 10491B Rack Mount Adapter
HP Model 10002A 50:1 Divider Probe
HP Model 10004D 10:1 Divider Probe
HP Model 10007B 1:1 Divider Probe
HP Model 10020A Resistive Divider Probe Kit
HP Model 1007A Testmobile

1-23. RECOMMENDED TEST EQUIPMENT.

1-24. Equipment required to maintain the 1744A is listed in table 1-3. Other equipment may be substituted if it meets or exceeds the critical specifications listed in the table.

Table 1-1. Specifications

VERTICAL AMPLIFIERS (2)
Bandwidth and Rise Time at all deflection factors from 0°C to +55°C.
BANDWIDTH: 3 dB down from 6 div reference signal.
DC-Coupled: dc to 100 MHz in both 50Ω and 1 MΩ input modes.
AC-Coupled: approx 10 Hz to 100 MHz; 1 Hz with 10:1 divider probes.
BANDWIDTH LIMIT: limit upper bandwidth to approx 20 MHz.
RISE TIME: ≤3.5 ns, measured from 10% to 90% points of a 5-div input step.

DEFLECTION FACTOR
Ranges: 5 mV/div to 20 V/div (12 calibrated positions) in 1, 2, 5 sequence, accurate within 3%.
Vernier: continuously variable between all ranges, extends maximum deflection factor to at least 50 V/div. UNCAL light indicates when vernier is not in CAL position.
POLARITY: channel B may be inverted, front-panel pushbutton.

INPUT RC (selectable)
AC or DC: 1 MΩ ±2% shunted by approx 20 pF.
50 Ohms: 50Ω ±3%.

MAXIMUM INPUT
AC or DC: 250 V (dc + peak ac at 1 kHz or less) or 500 V (p-p ac at 1 kHz or less).
50 Ohms: 5 V rms.

Table 1-1. Specifications (Cont'd)

A+B OPERATION
Amplifier bandwidth and deflection factors are unchanged; channel B may be inverted for A–B operation.
Differential (A–B) Common Mode: CMRR is at least 20 dB from dc to 20 MHz. Common mode signal amplitude equivalent to 6 divisions with one vernier adjusted for optimum rejection.

VERTICAL MAGNIFICATION (X5)

BANDWIDTH: 3 dB down from 6 div reference signal.
DC-Coupled: dc to approx 30 MHz.
AC-Coupled: approx 10 Hz to 30 MHz.
RISE TIME: ≤12 ns (measured from 10% to 90% points of 5-div input step).
DEFLECTION FACTOR: increases sensitivity of the 5 and 10 mV/div deflection factor settings by a factor of 5 for a maximum sensitivity of 1 mV on channels A and B.

TRIGGER SOURCE

Selectable from channel A, channel B, composite, or line frequency.
CHANNEL A: all display modes triggered by channel A signal.
CHANNEL B: all display modes triggered by channel B signal.
COMPOSITE: all display modes triggered by displayed signal except in Chop. In Chop mode, trigger signal is derived from channel A.
LINE FREQUENCY: trigger signal is derived from power line frequency.

TRIGGER VIEW

Displays internal or external trigger signal. In Alternate or Chop mode, channel A, channel B, and the trigger signals are displayed. In channel A or B mode, Trigger View overrides that channel. Internal trigger signal amplitude approximates vertical signal amplitude. External trigger signal deflection factor is approx 100 mV/div or 1 V/div in EXT÷10. Triggering point is approx center screen. With identically timed signals to a vertical input and the Ext trigger input, trigger signal delay is ≤3.5 ns.

MAIN AND DELAYED TIME BASES

RANGES

Main: 50 ns/div to 2 s/div (24 ranges) in 1, 2, 5 sequence.
Delayed: 50 ns/div to 20 ms/div (18 ranges) in 1, 2, 5 sequence.
Accuracy: (over center 8 div)

Sweep Time/Division	*Accuracy		Temperature Range
	X1	X10	
50 ns to 20 ms	±3% ±2% ±3%	±4% ±3% ±4%	0°C to +15°C +15°C to +35°C +35°C to +55°C
*Add 1% for 50 ms to 2 s ranges.			

MAIN SWEEP VERNIER: continuously variable between all ranges, extends slowest sweep to at least 5 s/div. UNCAL light indicates when vernier is not in CAL position.
MAGNIFIER (X10): expands all sweeps by a factor of 10, extends fastest sweep to 5 ns/div.

CALIBRATED SWEEP DELAY

DELAY TIME RANGE: 0.5 to 10 x Main Time/Div settings of 100 ns to 2 s (minimum delay 150 ns).

DIFFERENTIAL TIME MEASUREMENT ACCURACY

Main Time Base Setting	*Accuracy (+15°C to +35°C)
100 ns/div to 20 ms/div	±(0.5% +0.1% of full scale)
50 ms/div to 2 s/div	±(1% +0.1% of full scale)
*Add 1% from 0°C to +15°C and +35°C to +55°C.	

DELAY JITTER: <0.002% (1 part in 50 000) of maximum delay in each step from +15°C to +35°C; <0.005% (1 part in 20 000) from 0°C to +15°C and +35°C to +55°C.

TRIGGERING

INTERNAL: dc to 25 MHz on signals causing 0.3 division or more vertical deflection, increasing to 1 division of vertical deflection at 100 MHz in all display modes (required signal level is increased by 2 when in Chop mode and by 5 when X5 vertical magnifier is used). Triggering on Line frequency is also selectable.
EXTERNAL: dc to 50 MHz on signals of 50 mV p-p or more increasing to 100 mV p-p at 100 MHz (required signal level is increased by 2 when in Chop mode).
EXTERNAL INPUT RC: approx 1 MΩ shunted by approx 20 pF.
MAXIMUM EXTERNAL INPUT: 250 V (dc + peak ac at 1 kHz or less) or 500 V (p-p ac at 1 kHz or less).

LEVEL and SLOPE

Internal: at any point on the positive or negative slope of the displayed waveform.
External: continuously variable from +1 V to –1 V on either slope of the trigger signal, +10 V to –10 V in divide by 10 mode (÷10).
COUPLING: AC, DC, LF REJ, or HF REJ.
AC: attenuates signals below approx 20 Hz.
LF Reject (Main Sweep): attenuates signals below approx 4 kHz.
HF Reject (Main Sweep): attenuates signals above approx 4 kHz.

CALIBRATED MIXED TIME BASE

Dual time base in which the main time base drives the first portion of sweep and the delayed time base

Table 1-1. Specifications (Cont'd)

completes the sweep at the faster delayed sweep. Also operates in single sweep mode. Accuracy, add 2% to main time base accuracy.

A vs B OPERATION

BANDWIDTH

Channel A (Y-AXIS): same as channel A.

Channel B (X-AXIS): dc to 5 MHz.

DEFLECTION FACTOR: 5 mV/div to 20 V/div (12 calibrated positions) in 1, 2, 5 sequence.

PHASE DIFFERENCE BETWEEN CHANNELS: <3°, dc to 100 kHz.

CATHODE-RAY TUBE AND CONTROLS

Z-AXIS INPUT (INTENSITY MODULATION): +4 V, ≥50 ns width pulse blanks trace of any intensity, usable to 10 MHz for normal intensity. Input R, 1 kΩ ±10%. Maximum input ±20 V (dc ± peak ac).

PERSISTENCE

Variable: 100 ms minimum.

STORAGE WRITING SPEED: ≥1800 cm/μs over center 6 x 8 div (with viewing hood).

STORAGE TIME

Display Mode: at least 10s at 22°C.

Store Mode: at least 30s at 22°C.

Wait Time: at least 60s at 22°C.

ERASE TIME: approx 300 ms.

GENERAL

REAR PANEL OUTPUT : main and delayed gates, 0.8 V to >+2.5 V capable of supplying approx 5 mA.

AMPLITUDE CALIBRATOR (0°C to +55°C)

Output Voltage	1 V p-p into >1 MΩ 0.1 V p-p into 50Ω	±1%
Rise Time	≤0.1 μs	
Frequency	approx 1.4 kHz.	

POWER: 100, 120, 220, 240 Vac, ±10%, 48 to 440 Hz; 100 VA max.

WEIGHT: net, 13.8 kg (30.4 lb); shipping, 16.6 kg (36.6 lb).

OPERATING ENVIRONMENT

Temperature: 0°C to +55°C.

Humidity: to 95% relative humidity at +40°C.

Altitude: to 4600 m (15 000 ft).

Vibration: vibrated in three planes for 15 min. each with 0.254 mm (0.010 in.) excursion, 10 to 55 Hz.

Table 1-2. General Characteristics

VERTICAL DEFLECTION

VERTICAL DISPLAY MODES

Channel A; channel B; channels A and B displayed alternately on successive sweeps (ALT); channels A and B displayed by switching between channels at an approximate 250 kHz rate with blanking during switching (CHOP); channel A plus channel B (algebraic addition); and trigger view.

DELAY LINE: input signals are delayed sufficiently to view leading edge of input pulse without advanced trigger.

INPUT COUPLING: selectable AC or DC, 50Ω (dc), or ground. Ground position disconnects input connector and grounds amplifier input.

HORIZONTAL DISPLAY MODES

Main, main intensified, mixed, delayed, mag X10, and A vs B.

TRIGGERING

MAIN SWEEP

Normal: sweep is triggered by internal or external signal.

Automatic: bright baseline displayed in absence of input signal. Above 45 Hz, triggering is same as normal. For stable triggering at approx 45 Hz and below, use Normal triggering.

Single: automatically switches triggering to Normal and the sweep occurs once with same triggering as Normal, reset pushbutton arms sweep and lights indicator. Single sweep is also initiated with Erase pushbutton sweep is armed after the erase cycle.

DELAYED SWEEP (SWEEP AFTER DELAY)

Auto: delayed sweep automatically starts at end of delay.

Trig: delayed sweep is armed and can be triggered at end of delay period.

TRIGGER HOLDOFF (Main Sweep): increases sweep holdoff time in all ranges.

CATHODE-RAY TUBE AND CONTROLS

TYPE: Hewlett-Packard, 12.7 cm (5 in.) rectangular CRT, post accelerator, approx 9.5 kV accelerating potential, aluminized P31 phosphor.

GRATICULE: 8 x 10 div (1 div = 0.72 cm) internal, nonparallax graticule, 0.2 subdivision marking on major horizontal and vertical axes, with markings for rise time measurements.

BEAM FINDER: returns trace to CRT screen regardless of setting of horizontal and vertical controls.

OPERATING MODES: write, store, display, auto store, and auto erase.

REAR-PANEL CONTROLS: astigmatism and trace align.

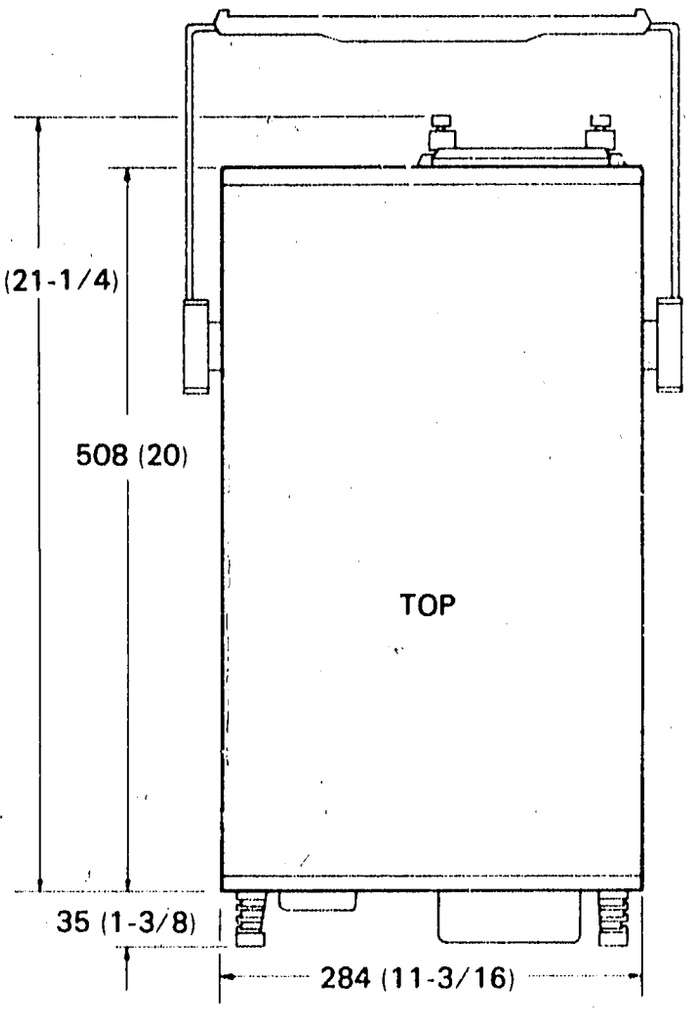
DIMENSIONS: see outline drawing

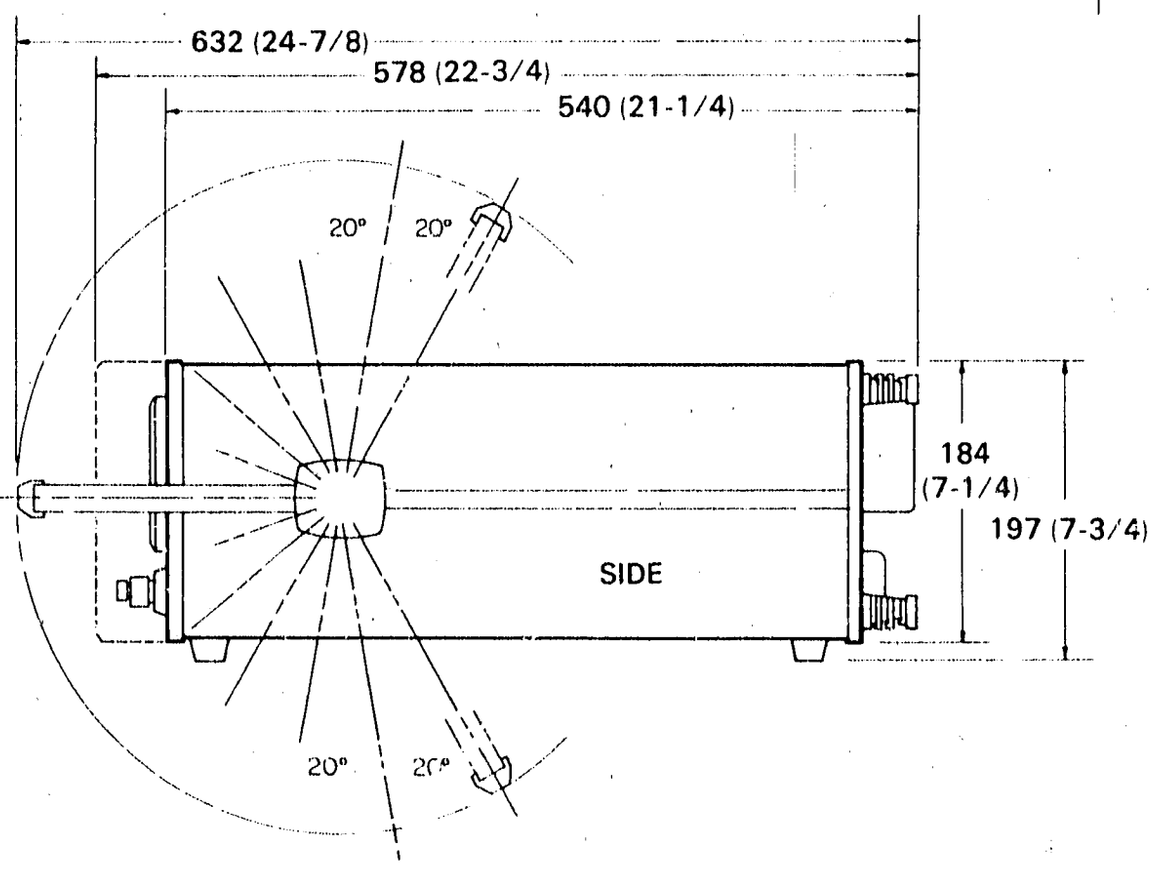
Table 1-2. General Characteristics (Cont'd)

NOTES:

1. DIMENSIONS ARE FOR GENERAL INFORMATION ONLY. IF DIMENSIONS ARE REQUIRED FOR BUILDING SPECIAL ENCLOSURES, CONTACT YOUR HP FIELD ENGINEER.

2. DIMENSIONS ARE IN MILLIMETRES AND (INCHES).





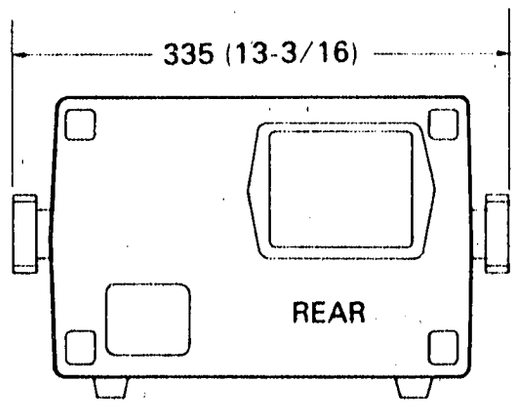


Table 1-3. Recommended Test Equipment

Instrument		Required Characteristics	Required For
Type	**Model**		
Digital Voltmeter	HP Model 3465A/B	Accuracy: 0.02%	A
Oscilloscope	HP Model 1740A	Bandwidth: 100 MHz 10:1 divider probe	A
Oscillator	HP Model 204C	1 kHz to 500 kHz, 1 V p-p	A
Signal Generator	HP Model 3200B	100 MHz, 800 mV p-p	P, A
Time-mark Generator	HP Model 226A	Time Marks 2 s to 5 ns	P, A
LCR Meter	HP Model 4332A	20 pF range	A
Pulse Generator	HP Model 8013B	10-kHz square wave 3 V pk	A
Fast-rise Pulse Generator	HP Model 1105A and 1108A	Rise time: less than 500 ps 50-ohm output Variable amplitude Overshoot less than 3%	P, A
DC Standard	HP Model 740B	40 mV to 160 V Accuracy: 0.1%	P, A
RF Voltmeter	HP Model 3406A with 11063A 50-ohm Tee	Monitor Signal Generator output	P, A
Feedthrough Termination	HP Model 10100C	50-ohm, male BNC at one end, female BNC at other end	P
1000:1 Divider Probe	HP 34111A	1000-megohm input Z: 1000:1 division	A
Power Divider	General Radio Model 874 TPD	50-ohm at all connections	P, A

Note: P = Performance Tests; A = Adjustment Procedure

INSTALLATION

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section provides installation instructions for the Model 1744A Oscilloscope. It also includes information about initial inspection and damage claims, preparation for using the 1744A, and repacking for shipment information.

2-3. INITIAL INSPECTION.

WARNING

To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the front or rear panel, or outer covers. Also, read the Safety Summary at the front of this manual before installing or operating the instrument.

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. Contents of the shipment should be as listed in the "Accessories Supplied" paragraph in Section I. Procedures for checking electrical performance are given in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the oscilloscope 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. The HP office will arrange for repair or replacement at HP option without waiting for claim settlement.

2-5. PREPARATION FOR USE.

2-6. POWER REQUIREMENTS. The 1744A requires a power source of 100, 120, 220, or 240 Vac, ±10%, 48 to 440 Hz single phase. Power consumption is 100 VA (maximum).

CAUTION

Instrument damage may result if the line voltage selection switch is not correctly set for the proper input power source.

2-7. LINE VOLTAGE SELECTION. The instrument is normally set at the factory for 120-V operation. To operate the instrument from any other ac power source, proceed as follows:

a. Disconnect ac input power cord from instrument.

b. Stand instrument on rear panel legs.

c. Through opening in bottom cover, set power selector switches to proper position for input power source. Figure 2-1 shows switches set for 120 V operation.

d. For 220 V - 240 V input sources, replace rear-panel fuse F1 with the 0.5 A slow-blow fuse supplied with the instrument.

e. Connect 1744A power cable to input power source.

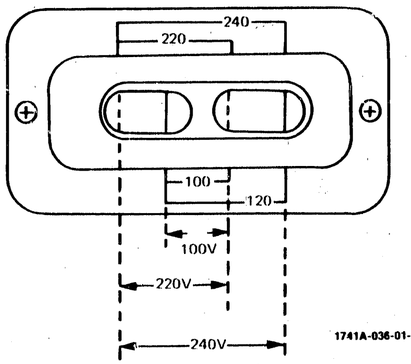


Figure 2-1. Line Voltage Selection Switch Settings

2-8. POWER CABLE. This instrument is equipped with a three-wire power cable. When connected to an appropriate ac power receptacle, this cable grounds the instrument cabinet. The type of power cable plug shipped with each instrument depends on the country of destination. Figure 2-2 lists the part-numbers (and associated Option Numbers) for the power cables and plug configurations available.

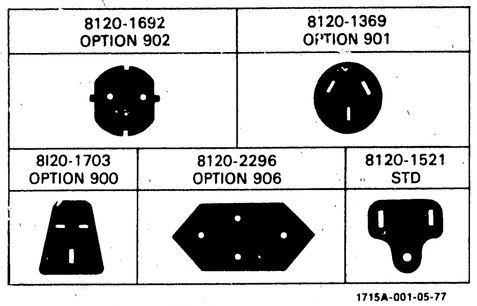


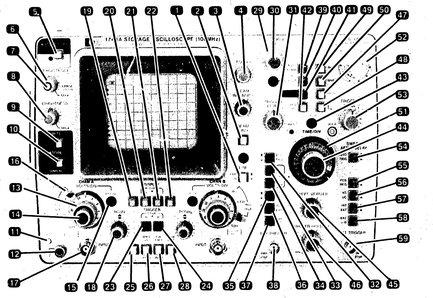
Figure 2-2. Power Receptacles

2-9. REPACKING FOR SHIPMENT.

2-10. If the instrument is to be shipped to a Hewlett-Packard office for service or repair, attach a tag showing owner (with address), complete instrument serial number, and a description of the service required.

2-11. Use the original shipping carton and packing material. If the original packing material is not available, the Hewlett-Packard office will provide information and recommendations on material to use.

OPERATION



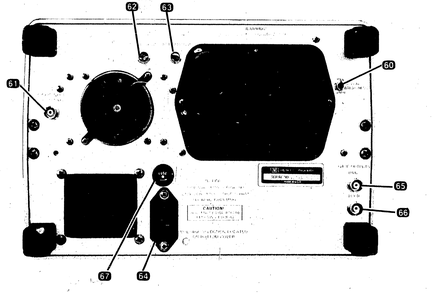


Figure 3-1.
Controls and Connectors

CRT CONTROLS

1 LINE OFF/ON. Switch turns power on and off. Indicator lights when power is ON.

2 BEAM FIND. Restricts the display to the viewing area regardless of control settings. Permits the operator to determine what action is necessary to return the beam to the viewing area (reduce input signal amplitude, change deflection factor, increase intensity, change position controls, etc.).

3 BEAM INTENSITY. Determines intensity of the electron beam as it writes on the storage mesh.

4 FOCUS. Adjusts the writing beam for sharp, well-defined trace. Keep FOCUS adjusted to avoid internal CRT damage.

5 AUTO ERASE/AUTO STORE. Two-function pushbutton to select either AUTO STORE or AUTO ERASE mode of operation. Respective lamps light to indicate which mode is selected. The AUTO ERASE lamp is green.
AUTO ERASE. In auto erase, the 1744A operates in a repetitive single-shot mode, even when a continuous signal is available. This mode is also helpful during setup for capture of single-shot events by making it easier to obtain optimum focus and intensity for a particular signal. In addition, if you are viewing more than one trace, such as two or three channels, the 1744A will wait for the required number of sweeps to be displayed before automatically erasing the display. Operating at high drive levels in variable persistence and storage modes may cause the storage mesh to retain residual images. These residual images may appear as a cluttered display when BRIGHTNESS 4 is at or near maximum. Residual traces are conveniently removed by operating the 1744A in the auto erase mode for a few minutes with INTENSITY 3 fully ccw.

NOTE

Pressing ERASE 7 terminates the AUTO ERASE cycle allowing the operator to vary the cycle time at slower rates.

AUTO STORE. Used to set up the 1744A for applications requiring capture of random single-shot events. AUTO STORE is selected by pressing SINGLE 33. AUTO STORE 5, and WRITE 9 to prevent self-triggering. When the random event occurs, the 1744A automatically triggers, sweeps, and switches from WRITE mode to STORE mode. To capture another event, press write 9 and RESET 32 or ERASE 7 to arm trigger circuit. AUTO STORE allows the operator to capture high-speed, single-shot, random transients. After trigger occurs the 1744A switches to store. At slower writing rates, the time the operator can view the image before it fades will increase. Therefore, it is to the operator's advantage to use the lowest BRIGHTNESS setting in viewing and storing traces.

6 PERSISTENCE/VIEW TIME. Two-function potentiometer to vary persistence or viewing time of signal, depending on operating mode selected.
PERSISTENCE. Variable persistence allows you to adjust the trace retention for optimum display when viewing low repetition rate, fast rise time signals. By adjusting persistence to match the sweep rate, you can cause the trace to refresh and provide a continuous display of hard-to-view signals such as low duty-cycle pulse trains.
VIEW TIME. In AUTO ERASE 5 mode, the VIEW TIME control establishes the time that the trace is retained on the display before another erase cycle is initiated.

7 ERASE. Pushbutton which initiates the erase cycle to remove stored traces from the CRT storage mesh. Inoperative when STORE/DISPLAY indicators are on to prevent accidental erasure of the stored signal. In auto store mode, ERASE may be pressed to arm the trigger circuit.

8 BRIGHTNESS. Adjusts brightness of stored images. Store time is inversely proportional to BRIGHTNESS setting. BRIGHTNESS is also used in the WRITE 9 mode to vary the writing rate.

9 WRITE. Conditions the 1744A to write applied signals on the display in storage and variable persistence operation. WRITE lamp lights when WRITE is selected.

10 STORE/DISPLAY. Engaging this pushbutton when the 1744A is operating in the WRITE 9 mode stores the trace being written, and lights the STORE lamp. Pressing the pushbutton again causes both STORE and DISPLAY lamps to light and displays the stored trace on screen. Brightness of the display is increased by rotating the BRIGHTNESS 8 control cw. After the trace has been examined, press the pushbutton again to enter STORE mode to achieve longest store time.

VERTICAL AMPLIFIER CONTROLS

11 CAL 1 V. Provides a 1 V peak-to-peak (±1%) square-wave signal with a frequency of approximately 1.4 kHz (100 mV p-p when terminated in 50 ohms).

12 ⏚. Provides convenient front-panel chassis ground.

13 CHAN A (B) VOLTS/DIV. Selects the vertical deflection factor in a 1, 2, 5 sequence from 0.005 V/div to 20 V/div, accurate within 3% with vernier 15 in CAL detent.

14 Vernier. Provides continuous control of the deflection factor between calibrated ranges. Vernier range is at least 2.5:1.

15 UNCAL. Lights when Vernier (either CHAN A or CHAN B) is out of CAL detent. Indicates that VOLTS/DIV setting is uncalibrated.

16 Coupling. Selects the input coupling and impedance for the vertical amplifiers. In the AC position, the dc component of the input signal is blocked. The lower 3-dB limit is approximately 10 Hz.
GND. The input signal is disconnected from the amplifier, and the amplifier input is grounded.
DC. All elements of the input signal are passed to the vertical amplifier. The input impedance is approximately 1 megohm shunted by 20 pF, 50Ω. The input signal is dc coupled, and the input impedance is 50Ω. Pull the lever forward and down to select this position. Do not apply more than 5 V rms to the input connector.

17 INPUT. BNC connector to apply external signals to the channel A (Y) and channel B (X) amplifier. Impedance and coupling are selectable by 16. Do not apply more than 250 V (dc + peak ac at 1 kHz or less) or more than 500 V (p-p ac at 1 kHz or less).

18 POSN ▲▼. Controls the vertical position of the display.

19 ALT. Channel A and B signals are displayed alternately on consecutive sweeps.
20 Channel A. Displays the channel A input signal.

21 Channel B. Displays the channel B input signal.
A + B. Pressing both channel A 20 and channel B 21 displays the algebraic sum of the channel A and channel B input signals. If the channel B display is inverted (press CH B INVT 28), an A minus B display results.

22 CHOP. Channel A and B signals are displayed simultaneously by switching between channels at 250-kHz rate.

23 TRIGGER A. Selects a sample of the channel A signal as the trigger signal when INT/EXT 35 is INT.

24 TRIGGER B. When in INT 35, a sample of the channel B signal is selected as the trigger signal.

COMP. When display mode is set for channel A, channel B, A + B, or ALT, and both 23 and 24 are pressed, the sweep is triggered by the displayed signal. When display is set to CHOP, sweep is triggered by channel A signal only.

25 TRIG VIEW. Displays the selected internal trigger signal with approximately the same sensitivity indicated on the corresponding channel VOLTS/DIV 13 control. A selected external trigger signal is displayed with a fixed sensitivity of approximately 100 mV/div with INT/EXT 35 set to EXT (1 V/div if EXT ÷ 10 37 engaged). TRIGGER LEVEL 31 positions the trigger signal vertically about the center horizontal graticule line. Center screen indicates the trigger threshold level with respect to the trigger signal. In ALT 19 or CHOP 22 modes, three signals appear on the same display: channel A, the selected trigger signal (at center screen), and channel B, with no need for erasing between each display. This is extremely useful in applications such as digital circuits where it is necessary to use external trigger sources to maintain proper timing relationships and to know the time relationship of the trigger signal to the displayed events. TRIG VIEW is also helpful in establishing discrete trigger levels.

26 MAG X5. Magnifies the vertical presentation five times, and increases the maximum sensitivity to 1 mV/div. The bandwidth is decreased to 30 MHz.

27 BW LIMIT. Reduces the bandwidth of channel A and channel B to approximately 20 MHz.

28 CH B INVT. Inverts the polarity of the channel B signal. In A + B 22 & 23 mode, pressing CH B INVT 28 results in an A minus B display.

MAIN TIME BASE CONTROLS

29 & 30 POSITION ◀▶. Coarse 29 and FINE 30 adjustments position the trace horizontally.

31 MAIN TRIGGER LEVEL. Selects the voltage level on the input trigger signal where the main sweep is triggered. With external trigger signals, the trigger level is continuously variable from +1.0 V to -1.0 V on either slope of the input trigger signal; +10 V to -10 V in EXT ÷ 10 37 mode. With internal trigger signals, the trigger level control selects any point on the displayed vertical waveform.

32 POS/NEG. Two-position pushbutton used to select either the positive or negative slope of the trigger signal as the starting point for the sweep.

33 LF REJ. Attenuates internal or external trigger signals below approximately 4 kHz. This is useful to condition high-frequency signals for best synchronization by eliminating unwanted low-frequency signals such as power line interference.

34 HF REJ. Attenuates internal or external trigger signals above approximately 4 kHz. This is useful to condition low-frequency signals for best synchronization by eliminating unwanted high-frequency signals such as RF.
LINE. Selecting both LF REJ 33 and HF REJ 34 removes all EXT 35 input or INT 35 displayed signals from the trigger circuit and applies a power line frequency signal for triggering.

35 AC/DC. Selects ac or dc coupling of the signal applied to the trigger circuit. The DC position must be selected for signals below approximately 20 Hz.

36 INT/EXT. INT selects a sample of the internal vertical signal chosen by the TRIGGER source 23 or 24 while EXT selects the signal at the EXT TRIGGER 38 input for application to the main trigger circuit. Internal signals from dc to 25 MHz displaying 0.3-div amplitude or more are sufficient for stable triggering, increasing to 1 div of amplitude at 100 MHz. Externally applied signals 50 mV p-p from dc to 50 MHz, increasing to 100 mV p-p at 100 MHz are sufficient for stable triggering.

37 EXT ÷ 10. Attenuates EXT TRIGGER 38 input signal by a factor of 10.

38 EXT TRIGGER. BNC connector for external trigger input. Input impedance is approximately one megohm shunted by approximately 20 pF. Do not apply more than 250 V (dc + peak ac at 1 kHz or less) or 500 V (p-p ac at 1 kHz or less).

39 AUTO/NORM. AUTO sweep mode (pushbutton out). A free-running sweep provides a bright display in the absence of a trigger signal. A trigger signal input (internal or external) of 45 Hz or more overrides AUTO operation and sweep triggering is the same as in the NORM mode.

40 RESET. Momentary pushbutton that arms the trigger circuit in the single-sweep mode. After RESET, the sweep can be triggered by an internal trigger signal or by rotating the TRIGGER LEVEL control 31 through zero. RESET lamp lights to indicate circuit is armed for next trigger signal. Pressing ERASE 7 will also reset the sweep.

41 SINGLE. Sweep occurs once with the same triggering as in NORM. After each sweep, the trigger circuit must be manually RESET 40. SINGLE must also be pressed in conjunction with WRITE 9 and AUTO STORE 5 to condition the 1744A for AUTO STORE operation.

42 MAG X10. Magnifies the horizontal display 10 times, and expands the fastest sweep time to 5 ns/div, maintaining a sweep accuracy within 3% at room temperature.

43 UNCAL. Lights when SWEEP VERNIER 45 is out of the CAL detent, and indicates that the sweep is not calibrated.

44 MAIN TIME/DIV. The inner knob controls the main sweep rate, which is indicated by the numbers displayed in the knob skirt opening. Sweep accuracy is within 2% (unmagnified) at room temperatures.

45 SWEEP VERNIER. Provides continuous adjustment of main sweep TIME/DIV between calibrated positions, extending the slowest sweep to 5 s/div.

46 TRIGGER HOLDOFF. Increases the time between sweeps and aid triggering on complex displays such as digital words.

47 MAIN. Selects main sweep for horizontal display. Sweep rate and triggering are selected by the main-sweep controls 29 - 45.

48 A vs B. Selects an X-Y mode of operation with channel A input (Y-axis) plotted versus channel B input (X-axis). Vertical positioning is adjusted by channel A POSN 18, and horizontal positioning is adjusted by POSITION 29 and FINE 30.

DELAYED TIME BASE CONTROLS

49 DLY'D. Selects delayed sweep for horizontal display.

50 MIXED. Selects main and delayed sweeps for the horizontal display. The first portion of the sweep is at the main sweep rate, and the second portion of the sweep (starting point chosen by DELAY 52) is at the delayed-sweep rate. See Mixed Sweep Display under Obtaining Basic Displays for more information.

51 DLY'D TIME/DIV. The outer rotating ring selects the delayed sweep rate, which is indicated by the marker on the ring. Sweep accuracy is the same as with MAIN TIME/DIV 44. An interlock is incorporated so the delayed sweep is always faster than the main sweep. When rotated from the OFF position in the MAIN 47 mode, a portion of the main sweep is intensified in brightness indicating the length and delayed position of the delayed sweep with respect to the main sweep.

52 DELAY. The DELAY control provides a variable delay time from 0.5 to 10 X the MAIN TIME/DIV 44 settings of 100 ns to 2 s. See the Application Section for more information.

53 DELAYED TRIGGER LEVEL. Selects the voltage level on the input trigger signal where the delayed sweep is triggered. With external trigger signals, the trigger level is continuously variable from +1.0V to -1.0V on either slope of the input trigger signal; +10 V to -10 V in EXT ÷ 10 37 mode. With internal trigger signals, the trigger level selects any point on the displayed vertical waveform.

54 SWEEP AFTER DELAY AUTO/TRIG. Selects the method of starting the delayed sweep when in main intensified, delayed, or mixed mode operation. In AUTO (pushbutton released), delayed sweep starts immediately after the delay interval, which is the product of the DELAY 52 dial reading (div) and the MAIN TIME/DIV 44 reading. In TRIG (pushbutton pressed), the delayed trigger circuit is armed after the delay interval and delayed sweep must be triggered by either an internal or external trigger signal. See pulse jitter in the Application Section for more information.

55 POS/NEG. Refer to POS/NEG 32.

56 AC/DC. Refer to AC/DC 35.

57 INT/EXT. Refer to INT/EXT 36.

58 EXT ÷ 10. Refer to EXT ÷ 10 37.

59 EXT TRIGGER. Refer to EXT TRIGGER 38.

REAR PANEL CONTROLS

60 DISPLAY BRIGHTNESS. When switch is in NORMAL position, the CRT floodgun is pulsed on and off. In MAX position, the CRT floodgun is always on.

61 Z-AXIS INPUT. A BNC connector allowing input of a signal to modulate CRT beam intensity.

62 TRACE ALIGN. Aligns horizontal trace parallel to the horizontal graticule lines.

63 ASTIGMATISM. Controls roundness of displayed spot. (Interacts with FOCUS 4.)

64 Line Input. Power cord connector.

65 MAIN GATE OUTPUT. Provides a rectangular output of approximately +2.5 V coincident with the main gate.

66 DLY'D GATE OUTPUT. Provides a rectangular output of approximately +2.5 V coincident with the delayed gate.

67 LINE FUSE. AC power-input fuse.

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. This operating section explains the function of controls, indicators, and connectors on the 1744A. It describes typical operating modes in a measurement system and includes operator's checks and warmup information.

3-3. PANEL FEATURES.

3-4. Front- and rear-panel features are described in figure 3-1. Description numbers match the numbers on the illustration. In addition, description numbers used after control and connector names in the following text are keyed to figure 3-1.

3-5. OPERATOR'S CHECK.

WARNING

Before the instrument is switched on, be sure that the input ac protective earth ground is connected (through ac power cable to ac outlet). Any interruption of the protective earth grounding may cause a potential shock hazard that could result in personal injury.

3-6. The checks that follow allow the operator to make a quick evaluation of the instrument's main functions prior to use. If trouble is suspected, refer to the service sheets in Section VIII to isolate the problem.

CAUTION

Before the instrument is switched on, it must be set to the voltage of the power source, or damage to the instrument may result. See Section II for proper switch selections.

3-7. INITIAL TURN-ON PROCEDURE. To place the 1744A into operation and avoid CRT damage, accomplish the following steps in the sequence listed.

a. Set BEAM INTENSITY 3 fully counterclockwise.

b. Set PERSISTENCE/VIEW TIME 6 fully counterclockwise.

c. Set BRIGHTNESS 8 fully counterclockwise.

d. Set all verniers 15 and 45 to CAL detent position.

e. Set main 31 and delayed 53 TRIGGER LEVEL controls to 12 o'clock position.

f. Set horizontal POSITION 29 to 12 o'clock position.

g. Set vertical POSN 18 to 12 o'clock position.

h. Set TRIGGER HOLDOFF 46 to MIN position.

i. Set delayed TIME/DIV 51 to OFF position.

j. Set main TIME/DIV 44 to .05 μs/div position.

k. Engage DISPLAY A 20, TRIGGER A 23, and MAIN 47 pushbutton switches. All other pushbutton switches should be disengaged.

l. Engage LINE 1 switch; LINE indicator lamp should light.

m. Press WRITE 9 pushbutton switch; WRITE indicator lamp should light.

n. Slowly adjust BEAM INTENSITY 3 clockwise until free-running trace is observed on CRT. Adjust BEAM INTENSITY 3 for comfortable viewing level; adjust FOCUS 4 for sharpest trace.

3-8. TRACE ALIGNMENT. The trace align adjustment compensates for external magnetic fields that may affect alignment of the horizontal trace with respect to the graticule. When the instrument is moved to a new location, trace alignment should be checked and adjusted if necessary. To align the trace horizontally proceed as follows:

a. Obtain trace as described in initial turn-on procedure.

b. Using channel A POSN 18, set trace to center horizontal graticule line.

c. Using nonmetallic alignment tool, adjust TRACE ALIGN 62 (rear panel) for best alignment of trace with horizontal graticule line.

3-9. FOCUS AND ASTIGMATISM ADJUSTMENTS. To adjust focus and astigmatism, proceed as follows:

a. Obtain trace as described in initial turn-on procedure.

b. Set BEAM INTENSITY 3 fully counterclockwise.

c. Select A vs B 48 mode of operation.

d. Adjust BEAM INTENSITY 3 to observe spot.

e. Position spot near center of CRT using vertical POSN 18 and horizontal POSITION 29 controls.

f. Adjust FOCUS 4 (front panel) and ASTIGMATISM 63 (rear panel) for best defined spot.

3-10. PROBE COMPENSATION. To adjust a divider probe that has a compensation adjustment, proceed as follows:

a. Obtain trace as described in initial turn-on procedure.

b. Connect divider probe to channel A INPUT connector 17.

c. Connect divider probe tip to CAL 1 V terminal 11.

d. Set channel A INPUT coupling 16 to DC.

e. Set channel A VOLTS/DIV 13 for square-wave display with two to three divisions of vertical deflection.

f. Set main TIME/DIV 44 for horizontal display of a least two full square waves (0.2 mSEC range).

g. Adjust divider probe compensation for correct display (see figure 3-2).

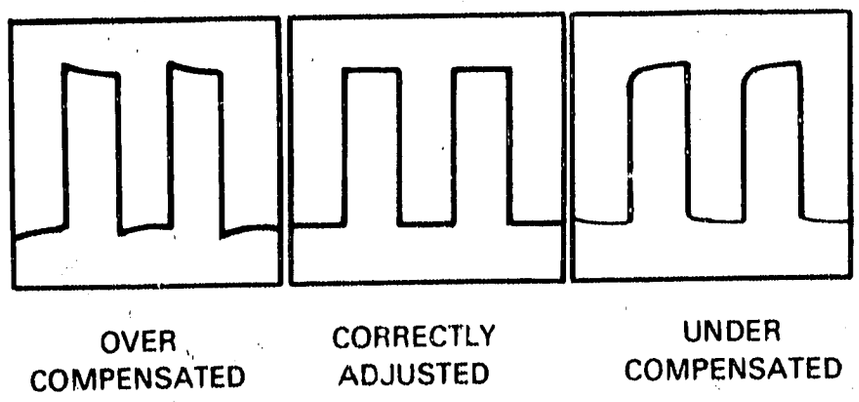


Figure 3-2. Divider Probe Adjustment Display

3-11. VERTICAL ACCURACY CHECK. To check vertical accuracy, proceed as follows:

a. Accomplish initial turn-on procedure.

b. Connect CAL 1 V 11 output to channel A INPUT connector 17 using BNC to banana plug adapter and test lead with alligator clips.

c. Set channel A VOLTS/DIV 13 to 0.2 V/DIV range.

d. Set main TIME/DIV 44 to 0.2 mSEC range.

e. Square-wave amplitude of displayed waveform should be five major divisions (±4%).

3-12. SWEEP TIME ACCURACY. To check horizontal sweep accuracy, proceed as follows:

a. Accomplish initial turn-on procedure.

b. Connect time-mark generator to channel A INPUT connector 17.

c. Set main TIME/DIV 44 to 0.5 μSEC position.

d. Set time-mark generator for 0.5 μs markers.

e. Using horizontal POSITION controls 29 and 30, set one marker on far left graticule line.

f. Markers should line up (approximately) with each vertical graticule line across CRT.

g. Marker on far right-hand side of CRT should be within 0.2 major division of last vertical graticule line.

3-13. OPERATING INSTRUCTIONS.

3-14. The following procedures provide additional information concerning operation of the instrument.

3-15. AUTO VERSUS NORM 39. In AUTO operation, there will always be a recurring sweep (baseline trace), except under triggered conditions. A trigger of 45 Hz or higher overrides AUTO operation and a stable presentation is displayed. Adjustment of main TRIGGER LEVEL 31 may be necessary for a stable display. If the trigger signal is less than 45 Hz, NORM operation must be used. A trigger signal is always needed in NORM operation to generate a sweep.

3-16. SWEEP AFTER DELAY 54. In AUTO mode, delayed sweep starts immediately after the delay interval which is the product of the DELAY 52 setting and the main TIME/DIV 44 setting. In TRIG mode, the delayed trigger circuit is armed after the delay interval and the delayed sweep must be triggered internally or externally by a trigger signal.

3-17. OBTAINING BASIC DISPLAYS. These procedures will aid the operator in becoming more familiar with the instrument. Before performing the procedures, complete the initial turn-on procedures. In addition, set the 1744A front-panel controls as follows:

Coupling (CH A) 16	DC
VOLTS/DIV (Ch A) 13	.02
Main TIME/DIV 44	.5 mSEC
DELAY 52	fully ccw

3-18. NORMAL SWEEP DELAY.

a. Connect CAL 1 V terminal 11 to channel A INPUT connector 17 using 10:1 divider probe supplied.

b. Adjust channel A POSN 18 to align base of square-wave display on second horizontal graticule line from bottom. Adjust main TRIGGER LEVEL 31 for stable display.

c. Observe square-wave display with amplitude of five divisions and approximately seven positive-going pulses.

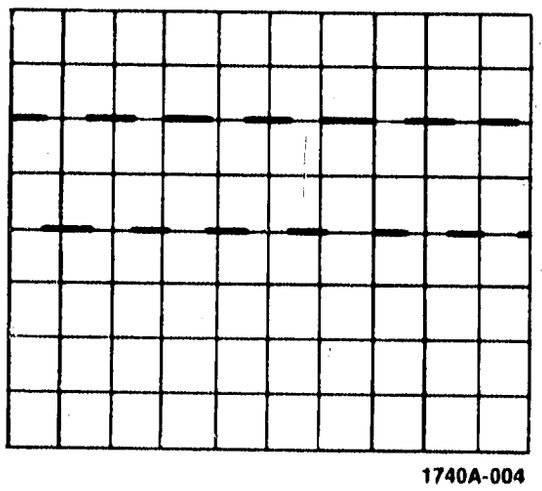
3-19. MAGNIFIED SWEEP DISPLAY.

a. Obtain normal sweep display.

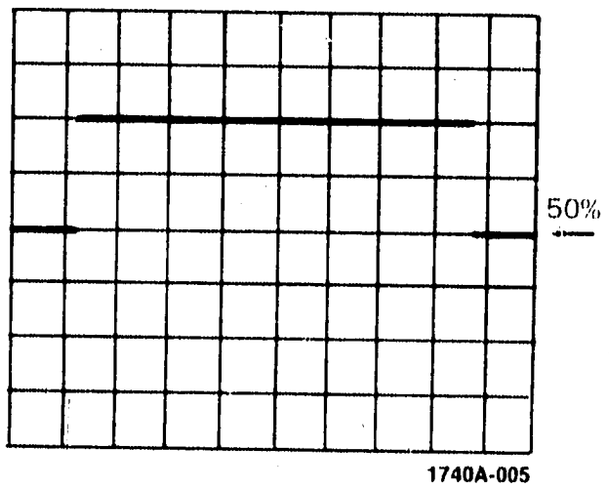
b. Adjust horizontal POSITION 29 to place portion of waveform to be magnified on center graticule of CRT (figure 3-3a).

c. Engage MAG X10 switch 42.

d. Adjust fine horizontal POSITION 30 for precise placement of magnified display (figure 3-3b).



a. Normal Display



b. Magnified display

Figure 3-3. Magnified Sweep

3-20. DELAYED SWEEP DISPLAY.

a. Obtain normal sweep display.

b. Set delayed TIME/DIV 51 to 20 μSEC.

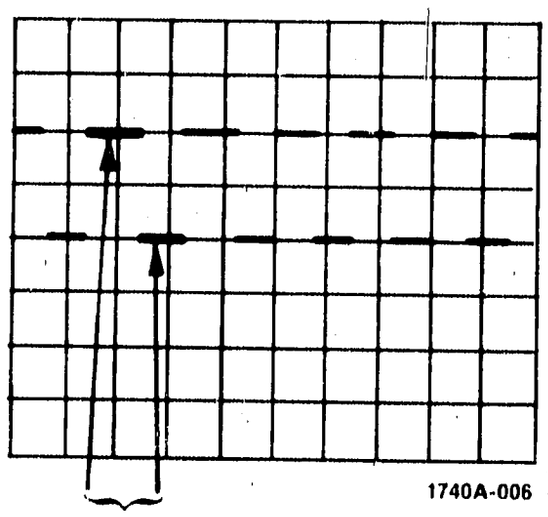
c. Observe intensified portion of square-wave display.

d. Adjust BEAM INTENSITY 3 for comfortable viewing level.

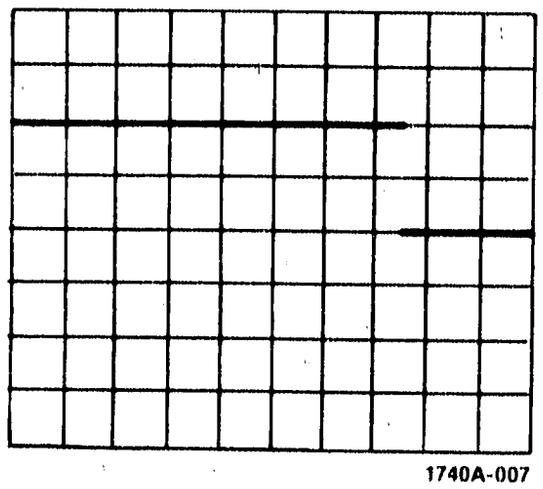
e. Adjust DELAY 52 until intensified portion of trace is over display segment under investigation (figure 3-4a).

f. Engage DLY'D switch 49 and note intensified portion of trace is now displayed across entire CRT (figure 3-4b).

g. Adjust DELAY 52 to observe other pulses in pulse train.



a. Normal Display with Intensified Area



b. Delayed Sweep Display

Figure 3-4. Delayed Sweep

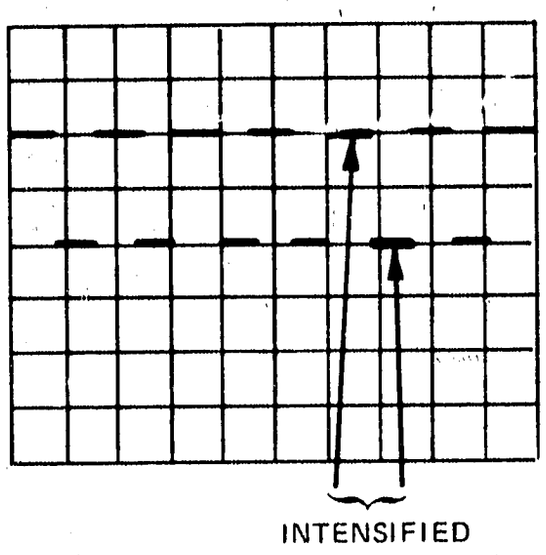
3-21. A VS B DISPLAY.

a. Apply vertical (Y-axis) signal to channel A INPUT connector 17.

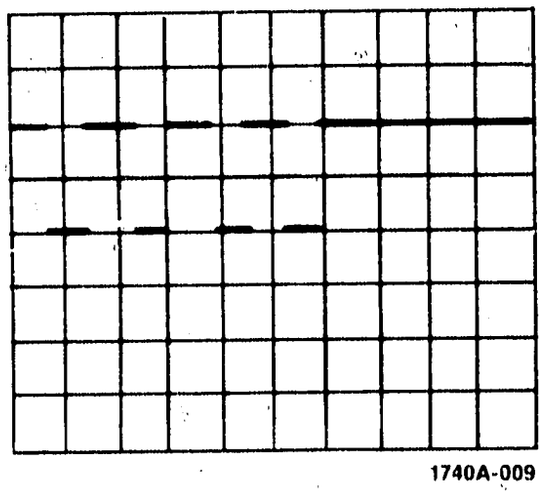
b. Apply horizontal (X-axis) signal to channel B INPUT connector 17.

c. Engage A vs B switch 48.

d. Adjust channel A and channel B VOLTS/DIV controls 13 for desired vertical and horizontal scale factor.



a. Normal Display with Intensified Area



b. Mixed Sweep Display

Figure 3-5. Mixed Sweep Display

NOTE

Channel A POSN 18 will adjust vertical position of the display. Horizontal POSITION controls 29 and 30 will adjust horizontal position of the display.

e. If display is not visible, engage BEAM FIND switch 2 to locate display. Make necessary adjustments to return display to center of CRT.

3-22. MIXED SWEEP DISPLAY. Obtain mixed sweep display as follows:

a. Obtain normal sweep display.

b. Set delayed TIME/DIV 51 to 50 μSEC position. Observe portion of square wave that is intensified.

c. Adjust BEAM INTENSITY 3 for comfortable viewing level.

d. Adjust DELAY 52 until intensified portion of waveform is in second half of CRT (see figure 3-5a).

e. Engage MIXED 50 switch. Verify that first portion of display is at main TIME/DIV 44 sweep speed and second portion of display is at delayed TIME/DIV 51 sweep speed (see figure 3-5b).

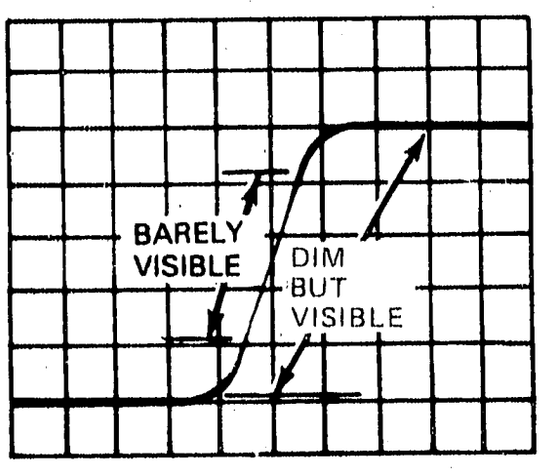
3-23. VARIABLE PERSISTENCE DISPLAY. Obtain variable persistence display as follows:

a. Accomplish initial turn-on procedure.

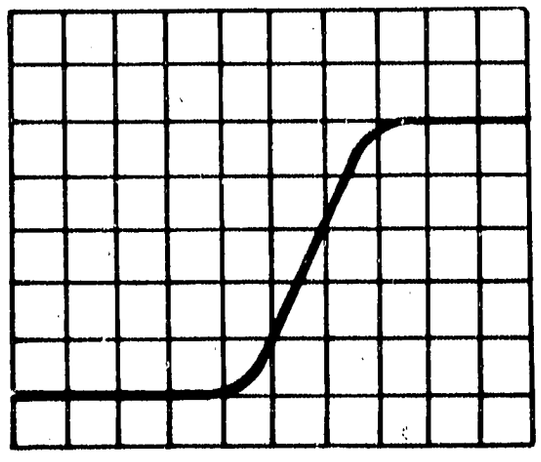
b. Using signal generator, apply fast rise time, low repetition rate signal to channel A INPUT 17 connector.

c. Note waveform transition gives very faint trace as in figure 3-6a.

d. Turn PERSISTENCE 6 slowly clockwise. Observe transition portion of waveform gradually integrates up to bright, easily observed trace (see figure 3-6b).



a. Fast Rise Time, Low Repetition Rate Signal (Normal)



b. Fast Rise Time, Low Repetition Rate Signal "Integrated Up" with Persistence Control.

Figure 3-6. Variable Persistence Display

3-24. STORING A TRACE. The procedure for storing a trace is to press the STORE/DISPLAY 10 pushbutton. The STORE indicator will light, signifying that the display has been stored. The 1744A will switch to the STORE mode of operation only after all sweeps are completed. For example, in the ALT-TRIG VIEW mode of operation (with three waveforms displayed), the 1744A will switch to the STORE mode after the third waveform is written. To view the stored waveform(s), press the STORE/DISPLAY 10 pushbutton again. The 1744A will then switch to the DISPLAY mode of operation.

NOTE

In the STORE mode of operation, the left side of the CRT will flash every second or so. This flashing is normal for the expansion - storage CRT used and has no adverse effect on the STORE mode of operation.

3-25. DISPLAY BRIGHTNESS CONTROL. Brightness of the CRT display can be increased by a rear-panel switch (DISPLAY BRIGHTNESS 60). Typically, the instrument is operated with the DISPLAY BRIGHTNESS 60 switch set to NORMAL. In this mode of operation, the CRT floodgun is pulsed on and off. Dim displays can be brightened by placing the DISPLAY BRIGHTNESS 60 switch to its MAX position. In this mode of operation, the CRT floodgun is always on. This enhances the display with a corresponding decrease in view time.

3-26. B-SCAN. When images have been deeply written on the CRT storage mesh due to too high INTENSITY setting, long-exposure to repetitive signals, etc., it is best to remove these images while in B-SCAN mode of operation. To accomplish B-SCAN, proceed as follows:

a. Set 1744A controls as follows:

BEAM INTENSITY 3	fully ccw
PERSISTENCE/VIEW TIME 6	fully ccw
BRIGHTNESS 8	fully ccw
TRIGGER HOLDOFF	minimum
MAIN TIME/DIV 44	0.2 s/div
DELAYED TIME/DIV 5	OFF
All Verniers 14 45	Cal detent
DISPLAY A 20	Engaged
All others	Disengaged or midrange

b. Using filter accessory (HP Part No. 01744-62101) furnished with 1744A, connect output from 1744A calibrator 11 to channel A input connector 17.

c. Adjust BEAM INTENSITY 3 for medium intensity (approximately eleven o'clock position).

d. Adjust channel A VOLTS/DIV 13 control and channel A Vernier 14 so that vertical deflection is slightly greater than full screen.

e. Allow oscilloscope to operate in this mode (B-SCAN) for one hour, checking in display mode for removal of deeply written image.

f. After removal of deeply written images, disconnect filter (HP Part No. 01744-62101) from channel A input connector 17.

NOTE

Some deeply written images may required longer than one hour of B-SCAN operation to be removed.

PERFORMANCE CHECK

SECTION IV

PERFORMANCE TESTS

4-1. INTRODUCTION.

4-2. The procedures in this section test the instrument's electrical performance using the published specifications as the performance standards. All tests can be performed without access to the interior of the instrument. A simpler operational test is included in the Operator's Guide supplied with the instrument.

4-3. EQUIPMENT REQUIRED.

4-4. Equipment required for the performance tests is listed in table 1-3, Section I. Any equipment that satisfies critical specifications given in the table may be substituted for the recommended model(s). For best results use recently calibrated test equipment.

4-5. TEST RECORD.

4-6. Results of the performance tests may be tabulated on the Performance Test Record at the end of this section. The record lists all of the tested specifications and their acceptable limits. The results recorded at incoming inspection can be used for comparison during periodic maintenance and troubleshooting and after repairs or adjustments.

4-7. CALIBRATION CYCLE.

4-8. The 1744A requires periodic verification of performance. Depending on use and environmental conditions, the instrument should be checked using the following performance tests at least every 2000 hours of operation or every six months, whichever comes first.

4-9. OPERATION VERIFICATION.

4-10. To assure that the instrument is performing properly without testing all specifications listed in table 1-1, an abbreviated performance test using procedures indicated in table 4-1 is recommended.

4-11. INITIAL CONTROL SETTINGS.

4-12. The control settings listed below must be used for each performance check. Exceptions to these settings will be noted as they occur. After completing a check, return 1744A controls to the following settings:

CONTROL	SETTING
All Pushbuttons (except as noted below)	out position
VOLTS/DIV (Channels A and B)	.1
CAL (Channels A and B)	detent (full cw)
Coupling (Channels A and B)	DC
POSN (Channels A and B)	midrange
DISPLAY	A
TRIGGER	A
FOCUS	best trace
BEAM INTENSITY	10 - 11 o'clock
LINE	ON
POSITION (horizontal)	midrange
TRIGGER LEVEL (Main and Delayed)	3 o'clock
Sweep Mode	MAIN
DELAY	fully ccw
MAIN TIME/DIV	.1 mSEC
DELAYED TIME/DIV	OFF
SWEEP VERNIER	CAL
TRIGGER HOLDOFF	MIN
WRITE mode	engaged
PERSISTENCE	fully ccw
BRIGHTNESS	fully ccw

Table 4-1. Recommended Test Abridgements

Paragraph No.	Performance Test	Alteration	Remarks
4-23	Sweep Time Accuracy	None	Check accuracy from .05 μSEC
4-33	Deflection Factor	None	Check deflection factor on .005 V/div through 20 V/div ranges
4-35	Maximum Brightness	None	Check writing rate equivalent to 1800 cm/μSEC
4-35	Store Time	None	Display store for 10 s

4-13. PERFORMANCE TEST PROCEDURES.

4-14. BANDWIDTH.

3 dB down from a 6-division reference signal; dc to 100 MHz, 10 Hz to 100 MHz ac coupled.

DESCRIPTION:

This test measures bandwidth of the input amplifiers. A signal generator is used to provide the reference signal. An rf voltmeter is used to monitor the signal level at the input connector to verify that the signal amplitude remains constant.

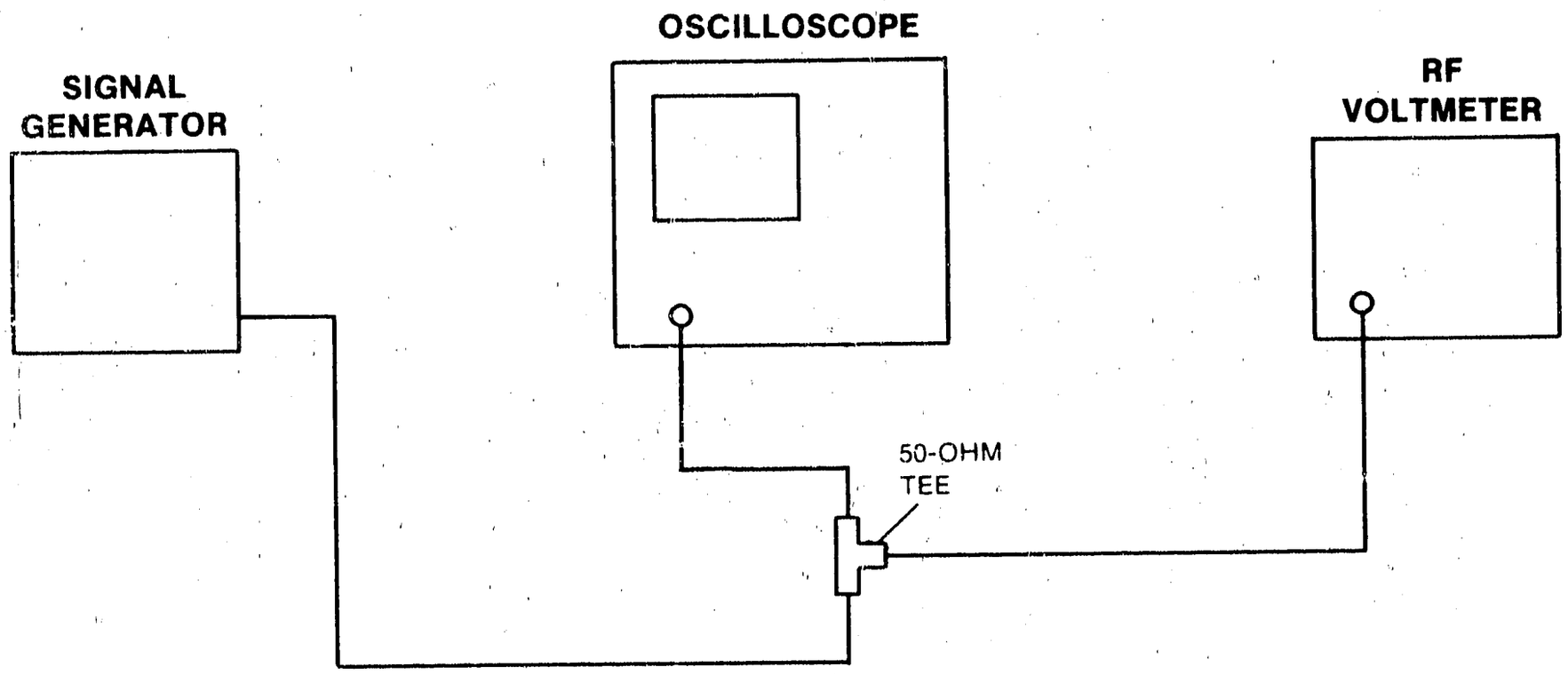


Figure 4-1. Bandwidth Test Setup

EQUIPMENT:

Signal Generator	HP 3200B
RF Voltmeter	HP 3406A

PROCEDURE:

a. Connect signal generator and rf voltmeter as shown in figure 4-1.

b. Set 1744A controls as follows:

Coupling (both channels)	50Ω
Channel A VOLT/DIV	.01
MAIN TIME/DIV	1 μSEC

c. Set signal generator frequency for approximately 10 MHZ with exactly 6 divisions of vertical deflection on oscilloscope.

d. Note rf voltmeter indication.

e. Increase signal generator frequency until the display amplitude drops to 4.2 divisions while maintaining the signal generators output at the same level as noted in the previous step.

f. The frequency of the signal generator is the 3 dB bandwidth and should be recorded in the Performance Test Record.

g. Set 1744A controls as follows:

DISPLAY	B
TRIGGER	B

h. Connect signal generator to channel B INPUT and repeat steps b through f for channel B.

PERFORMANCE TESTS

4-15. COMMON MODE REJECTION RATIO (CMRR).

SPECIFICATION:

CMRR is at least 20 dB from dc to 20 MHz. Common mode signal amplitude is equivalent to 6 divisions with one vernier adjusted for optimum rejection.

DESCRIPTION:

Identical signals are applied to both channels with channel B operated in the inverted mode. The displayed signal is the common mode signal.

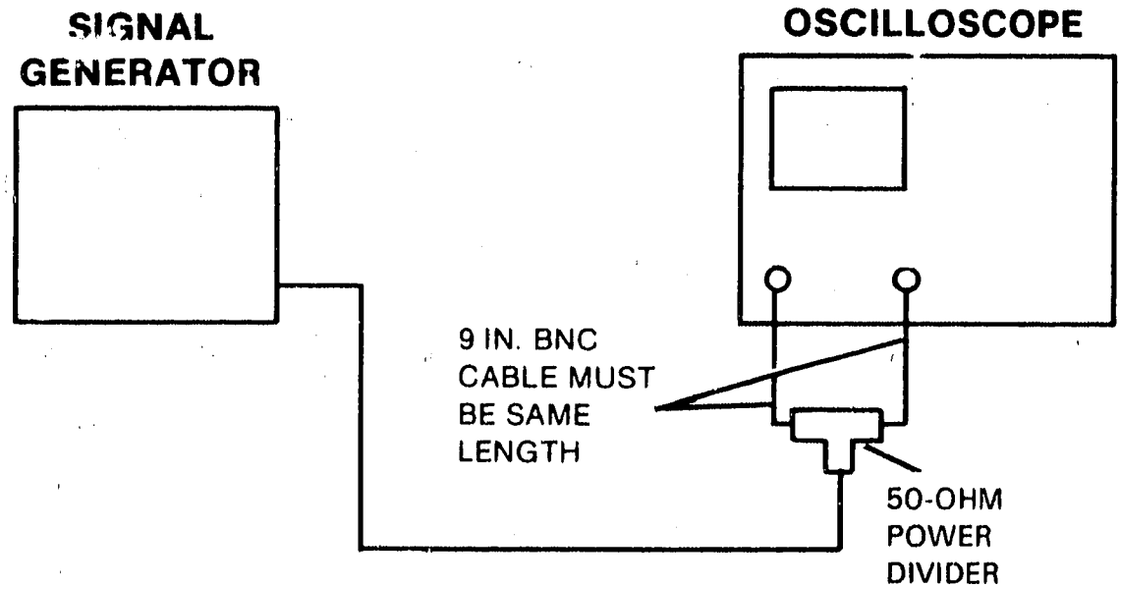


Figure 4-2. CMRR Test Setup

EQUIPMENT:

Signal Generator ..... HP 3200B
50-ohm Power Divider ..... Model 874 TPD

PROCEDURE:

a. Connect equipment as shown in figure 4-2.

b. Set 1744A controls as follows:

MAIN TIME/DIV ..... 1 μSEC
Coupling (both channels) 50Ω

c. Set signal generator controls to observe 20-MHz signal, 6-division amplitude display.

d. Set 1744A controls as follows:

CH B INVT ..... engaged
DISPLAY ..... A + B

e. Adjust either channel vernier (whichever is most effective) to achieve minimum deflection.

f. Deflection should be less than 0.6 division (20 dB).

$$dB = 20 \log \frac{6 \text{ div}}{\text{CMRR defl. (div)}}$$

PERFORMANCE TESTS

4-16. TRIGGER (INTERNAL).

SPECIFICATION:
DC to 25 MHz on signals causing 0.3 division of vertical deflection, increasing to 1 division at 100 MHz.

DESCRIPTION:
The output of a signal generator is applied to the vertical input to check internal triggering.

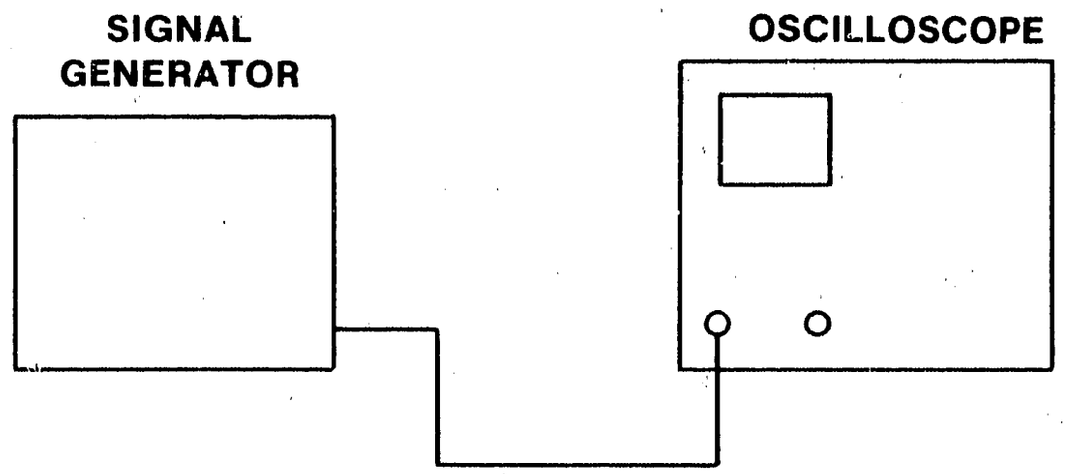


Figure 4-3. Internal Triggering Test Setup

EQUIPMENT:
Signal Generator ..... HP 3200B

PROCEDURE:
a. Connect equipment as shown in figure 4-3.

b. Set 1744A controls as follows:

Channel A Coupling	50Ω
MAIN TIME/DIV	.05 μSEC

c. Set signal generator to obtain 25-MHz signal with 0.3-division amplitude.

d. Adjust main TRIGGER LEVEL to obtain stable display. Stable display confirms proper triggering.

e. Set signal generator to obtain 1-division signal at 100 MHz.

f. Readjust main TRIGGER LEVEL to obtain stable display. Stable display confirms proper triggering.

g. Change 1744A controls as follows:

MAIN TIME/DIV	.1 μSEC
DELAYED TIME/DIV	.05 μSEC
SWEEP AFTER DELAY	TRIG
Sweep Display	DLY'D

h. Adjust delayed TRIGGER LEVEL to obtain stable display (slight readjustment of main TRIGGER LEVEL may be required).

i. Set signal generator output to 0.3-division amplitude at 25 MHz.

j. Readjust delayed TRIGGER LEVEL (and main TRIGGER LEVEL if necessary) to obtain stable display.

PERFORMANCE TESTS

4-17. TRIGGER (EXTERNAL).

SPECIFICATION:
Main Sweep: dc to 50 MHz on signals of 50 mV p-p or more, increasing to 100 mV p-p at 100 MHz.

DESCRIPTION:
The output of a signal generator is applied to the EXT TRIGGER INPUT connector to check external triggering.

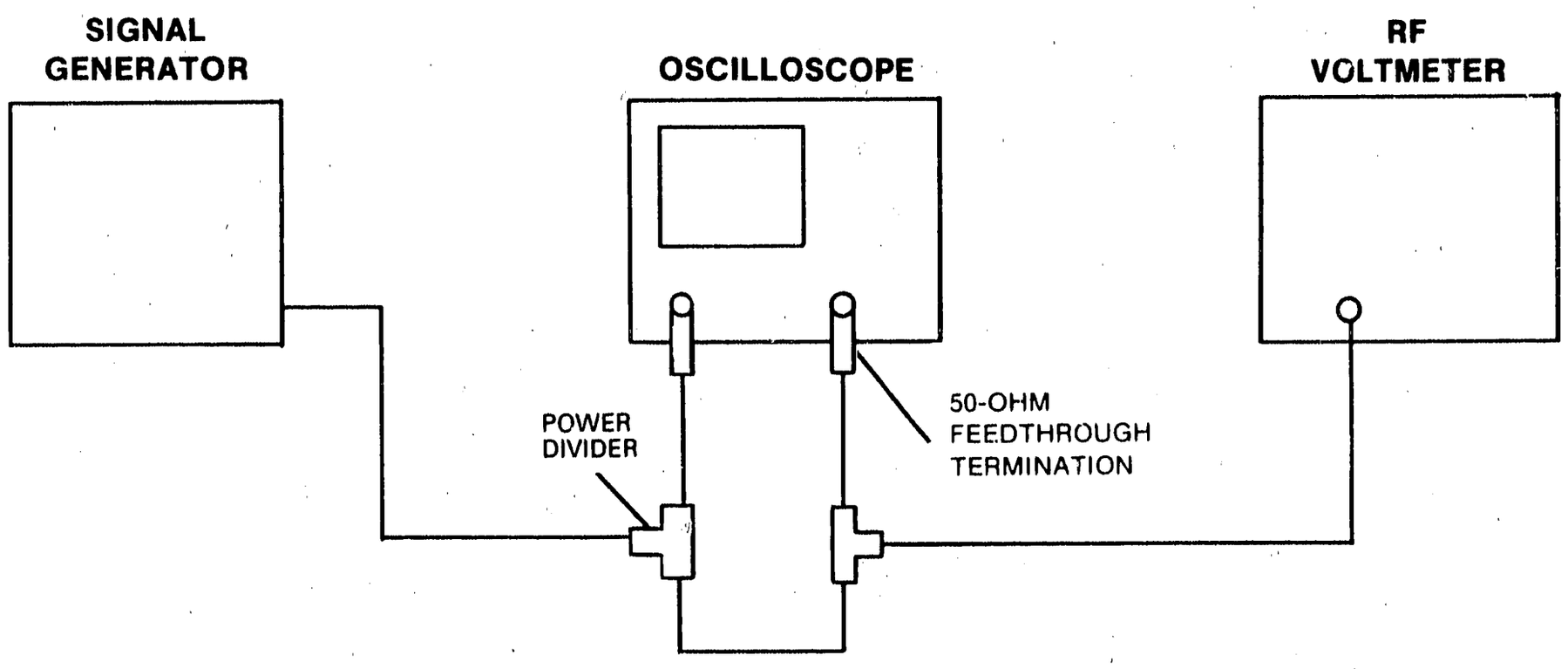


Figure 4-4. External Triggering Test Setup

EQUIPMENT:

Signal Generator	HP 3200B
RF Voltmeter	HP 3406A
50-ohm Feed-through Termination	HP 10100C
50-ohm Power Divider	Model 874 TPD

PROCEDURE:

a. Connect equipment as shown in figure 4-4.

b. Set 1744A controls as follows:

CH A COUPLING	50Ω
CH A VOLTS/DIV	.01
TRIG VIEW	engaged
MAIN TIME/DIV	.1 μSEC
MAG X10	engaged
Main INT/EXT	EXT

c. Set signal generator controls to obtain 50-MHz, 50-mV p-p signal. (Indication on RF Voltmeter should be 17.7 mV rms.)

d. Adjust main TRIGGER LEVEL to obtain stable triggering.

e. Set signal generator controls to obtain 100-MHz, 100-mV p-p signal. (Indication on RF Voltmeter should be 35.3 mV rms.)

f. Adjust main TRIGGER LEVEL to obtain stable triggering.

PERFORMANCE TESTS

g. Set 1744A controls as follows:

MAIN INT/EXT	INT
DELAYED INT/EXT	EXT
SWEEP AFTER DELAY	TRIG
DELAYED TIME/DIV	.05 μSEC
Sweep Display	DLY'D

h. Disconnect signal from main EXT TRIGGER and reconnect to delayed EXT TRIGGER input.

i. Adjust delayed TRIGGER LEVEL to obtain stable display (main TRIGGER LEVEL may also require adjustment).

j. Set signal generator controls to obtain 50-MHz, 50-mV p-p signal. (Indication on RF Voltmeter should be 17.7 mV rms.)

k. Adjust TRIGGER LEVEL(S) as necessary to obtain stable triggering.

l. Set signal generator controls to obtain 100-MHz, 100-mV p-p signal. (Indication on RF Voltmeter should be 35.3 mV rms.)

m. Adjust TRIGGER LEVEL(S) as neccessary to obtain stable triggering.

4-18. SWEEP TIME ACCURACY.

SPECIFICATION:

(+15°C to +35°C) ±2% in unmagnified mode and ±3% in the MAG X10 mode of operation. Refer to table 1-1 for other variations in ambient temperatures. In the 50-ms to 2-s ranges, add 1% error.

DESCRIPTION:

This test verifies the sweep time accuracy over the center 8 divisions of the CRT using a time-mark generator as a standard for the input signal.

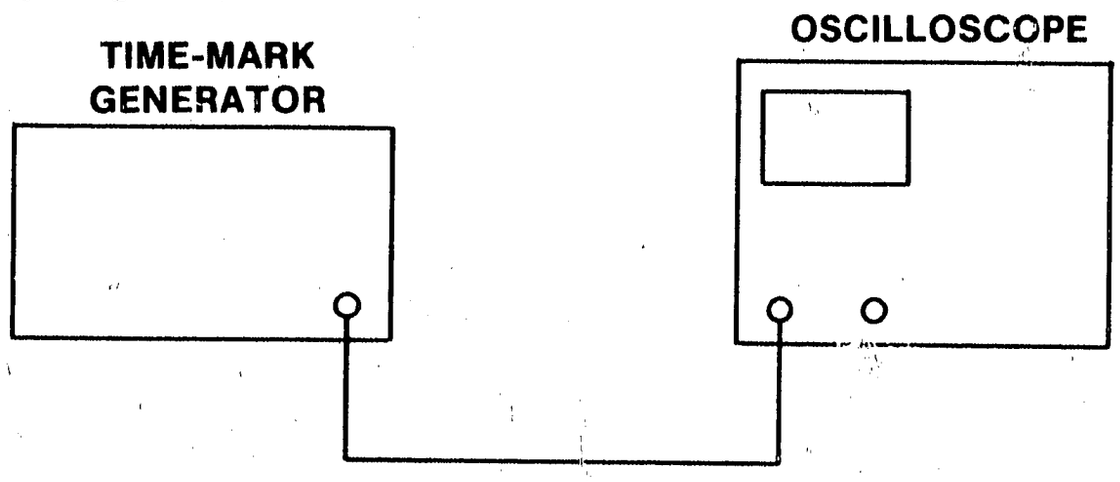


Figure 4-5. Sweep Time Accuracy Test Setup

EQUIPMENT:

Time-mark Generator	HP 226A

PROCEDURE:

a. Connect equipment as shown in figure 4-5.

b. Set time-mark generator and main TIME/DIV controls as shown in table 4-2 and check accuracy as indicated.

NOTE

It may be necessary to adjust DELAY dial slightly to align markers with graticule lines.

c. Change 1744A sweep display to DLY'D.

d. Set main and delayed TIME/DIV controls as indicated in table 4-3 and check accuracy.

Table 4-2. Main TIME/DIV Accuracy

Main TIME/DIV Settings	Time-mark Generator Settings	Accuracy (+15°C to +35°C) (over center 8 divisions of CRT)	
		X1 (1 mark/div)	X10
.05 µSEC	50 nSEC	±2% full scale	±3% full scale
.1 µSEC	.1 µSEC	±2% full scale	±3% full scale
.2 µSEC	.2 µSEC	±2% full scale	±3% full scale
.5 µSEC	.5 µSEC	±2% full scale	±3% full scale
1 µSEC	1 µSEC	±2% full scale	±3% full scale
2 µSEC	2 µSEC	±2% full scale	±3% full scale
5 µSEC	5 µSEC	±2% full scale	±3% full scale
10 µSEC	10 µSEC	±2% full scale	±3% full scale
20 µSEC	20 µSEC	±2% full scale	±3% full scale
50 µSEC	50 µSEC	±2% full scale	±3% full scale
.1 mSEC	.1 mSEC	±2% full scale	±3% full scale
.2 mSEC	.2 mSEC	±2% full scale	±3% full scale
.5 mSEC	.5 mSEC	±2% full scale	±3% full scale
1 mSEC	1 mSEC	±2% full scale	±3% full scale
2 mSEC	2 mSEC	±2% full scale	±3% full scale
5 mSEC	5 mSEC	±2% full scale	±3% full scale
10 mSEC	10 mSEC	±2% full scale	±3% full scale
20 mSEC	20 mSEC	±2% full scale	±3% full scale
50 mSEC	50 mSEC	±2% full scale	±3% full scale
.1 SEC	.1 SEC	±3% full scale	±4% full scale
.2 SEC	.2 SEC	±3% full scale	±4% full scale
.5 SEC	.5 SEC	±3% full scale	±4% full scale
1 SEC	1 SEC	±3% full scale	±4% full scale
2 SEC	2 SEC	±3% full scale	±4% full scale

Table 4-3. Delayed TIME/DIV Accuracy

Main TIME/DIV Settings	Delayed TIME/DIV Settings	Time-mark Generator Settings	Accuracy (+15°C to +35°C) (over center 8 divisions of CRT)	
			X1 (1 mark/div)	X10
.1 µSEC	.05 µSEC	50 nSEC	±2% full scale	±3% full scale
.2 µSEC	.1 µSEC	.1 µSEC	±2% full scale	±3% full scale
.5 µSEC	.2 µSEC	.2 µSEC	±2% full scale	±3% full scale
1 µSEC	.5 µSEC	.5 µSEC	±2% full scale	±3% full scale
2 µSEC	1 µSEC	1 µSEC	±2% full scale	±3% full scale
5 µSEC	2 µSEC	2 µSEC	±2% full scale	±3% full scale
10 µSEC	5 µSEC	5 µSEC	±2% full scale	±3% full scale
20 µSEC	10 µSEC	10 µSEC	±2% full scale	±3% full scale
50 µSEC	20 µSEC	20 µSEC	±2% full scale	±3% full scale
.1 mSEC	50 µSEC	50 µSEC	±2% full scale	±3% full scale
.2 mSEC	.1 mSEC	.1 mSEC	±2% full scale	±3% full scale
.5 mSEC	.2 mSEC	.2 mSEC	±2% full scale	±3% full scale
1 mSEC	.5 mSEC	.5 mSEC	±2% full scale	±3% full scale
2 mSEC	1 mSEC	1 mSEC	±2% full scale	±3% full scale
5 mSEC	2 mSEC	2 mSEC	±2% full scale	±3% full scale
10 mSEC	5 mSEC	5 mSEC	±2% full scale	±3% full scale
20 mSEC	10 mSEC	10 mSEC	±2% full scale	±3% full scale
50 mSEC	20 mSEC	20 mSEC	±2% full scale	±3% full scale

PERFORMANCE TESTS

4-19. DIFFERENTIAL TIME ACCURACY.

SPECIFICATION:
Main Time Base: 100 nSEC/div to 20 mSEC/div, ±(0.5% +0.1% of full scale) at ambient temperature of +15°C to +35°C. Refer to table 1-1 for complete specifications.

DESCRIPTION:
In delayed sweep mode of operation, a time-mark genertor is used to check the differential time accuracy of the instrument.

EQUIPMENT:
Time-mark Generator ..... HP 226A

PROCEDURE:
a. Connect equipment as shown in figure 4-6.

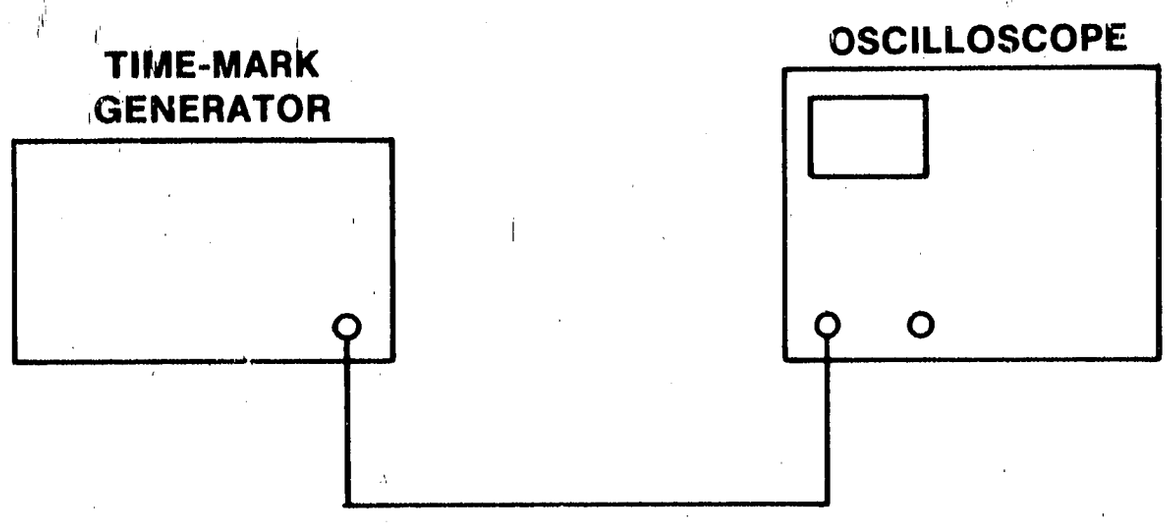


Figure 4-6. Differential Time Accuracy Test Setup

b. Set 1744A controls as follows:

MAIN TIME/DIV	1 mSEC
DELAYED TIME/DIV	10 μSEC
Channel A Coupling	50Ω

c. Set time-mark generator for 1 mSEC marker.

d. Adjust DELAY dial to intensify second time marker from left.

e. Set sweep display to DLY'D.

f. Adjust DELAY dial to place visible time markers exactly on center vertical graticule line.

g. Record DELAY dial reading _____.

h. Set sweep display to MAIN.

i. Adjust DELAY dial to intensify 10th time marker from left.

j. Set sweep display to DLY'D.

k. Adjust DELAY dial to place visible time marker exactly on center vertical graticule line.

l. Record DELAY dial reading _____.

m. Substract DELAY dial reading obtained in step g from reading in step 1; difference should be 8 ±0.05.

PERFORMANCE TESTS

4-20. DELAY JITTER.

SPECIFICATION:
<0.002% (1 part in 50 000) of maximum delay in each step (+15°C to +35°C).

DESCRIPTION:
Delay jitter is checked by expanding the sweep by 50 000 and visually monitoring the jitter.

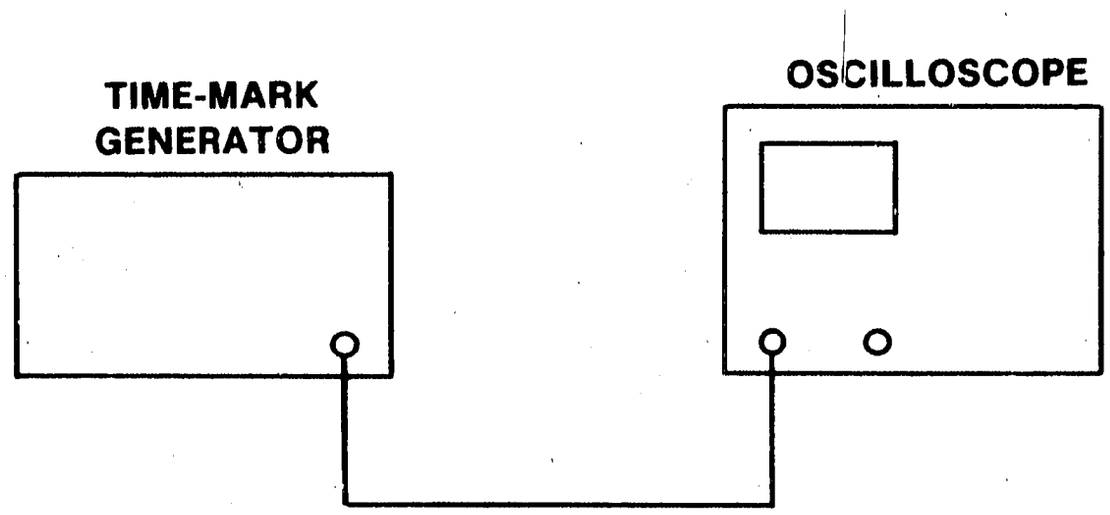


Figure 4-7. Delay Jitter Test Setup

EQUIPMENT:
Time-mark Generator ..... HP 226A

PROCEDURE:
a. Connect equipment as shown in figure 4-7.

b. Set time-mark generator output for 1 ms markers.

c. Set 1744A controls as follows:

MAIN TIME/DIV	1 mSEC
DELAYED TIME/DIV	.2 μSEC
Channel A VOLTS/DIV	.5
Channel A Coupling	50Ω

d. Adjust DELAY dial to position intensified portion of sweep on 11th time marker.

e. Set sweep display to DLY'D, and observe horizontal axis jitter on time marker. Jitter should be less than 1 division (corresponds to 1:50 000).

$$\text{Delay Jitter} = \frac{\text{Jitter (Number of Divisions Deflected)}}{\frac{\text{Main TIME/DIV}}{\text{DELAY TIME/DIV}}} \text{ X(N-1) Pulse Observed}$$

PERFORMANCE TESTS

4-21. RISE TIME.

SPECIFICATION:

≤3.5 ns, measured from 10% to 90% points of a 5-division input step, and ≤12 ns in X5 vertical magnification mode.

DESCRIPTION:

A fast-rise pulse generator signal is applied to the vertical input. The displayed rise time is then checked for specification requirements.

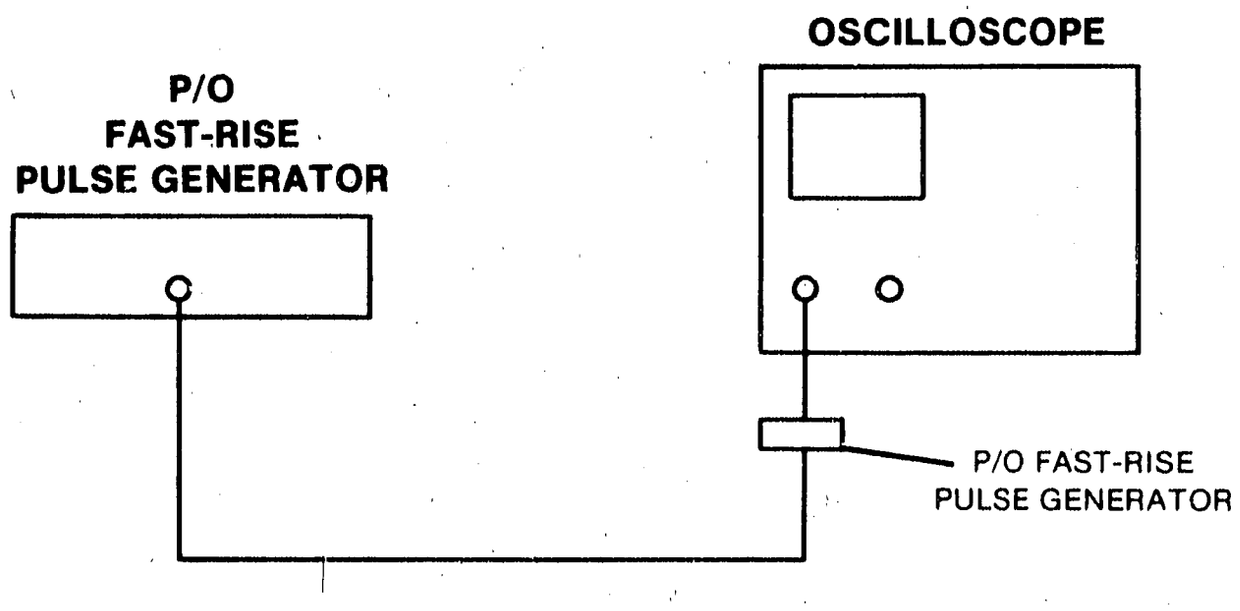


Figure 4-8. Rise Time Test Setup

EQUIPMENT:

Fast-rise Pulse Generator	HP 1105A with HP 1108A

PROCEDURE:

a. Connect equipment as shown in figure 4-8.

b. Set 1744A controls as follows:

MAIN TIME/DIV	.05 μSEC
MAG X10	engaged
Channel A Coupling	50Ω

c. Set channel A VOLTS/DIV and pulse generator controls to obtain 5 divisions of vertical deflection.

d. Using channel A POSN control, center 5-division display on CRT.

e. Adjust horizontal POSITION as necessary to measure rise time between 10% and 90% points. Rise time should be equal to or less than 3.5 ns.

NOTE

If the fast-rise pulse generator has a rise time slower than the recommended 500 ps, the observed rise time will be slower also. To compensate for pulse generator rise time, use the following formula:

$$T_r\,(\text{observed}) = \sqrt{T_r^2(\text{oscilloscope}) + T_r^2(\text{pulse generator})}$$

or

$$T_r\,(\text{oscilloscope}) = \sqrt{T_r^2\,(\text{observed}) - T_r^2\text{pulse generator})}$$

PERFORMANCE TESTS

For example, a pulse generator with a 2 ns rise time would cause a properly operating oscilloscope with a rise time of 3.5 ns to display a rise time of 4.03 ns.

$$T_r \text{ (observed)} = \sqrt{3.5^2 + 2^2} = 4.03 \text{ ns}$$

f. Engage vertical MAG X5 switch.

g. Reset channel A VOLTS/DIV and pulse generator controls to obtain 5-division display.

h. Center display on CRT. Rise time should be equal to or less than 12 ns.

i. Connect fast-rise pulse generator to channel B input and repeat steps b through h for channel B.

4-22. Z-AXIS BLANKING.

SPECIFICATION:
+4V, >50-ns wide pulse blanks trace of any intensity, usable to 10 MHz for normal intensity.

DESCRIPTION:
A +4V signal is applied to the Z-axis input and the CRT is monitored to verify blanking.

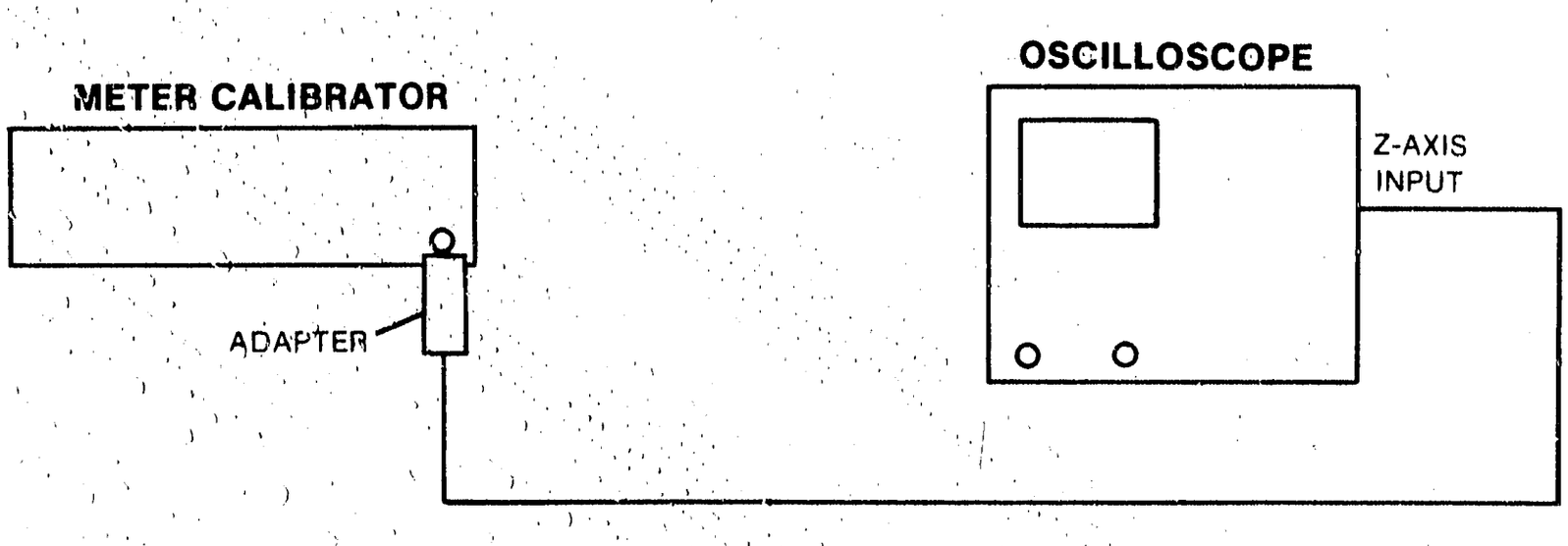


Figure 4-9. Z-axis Blanking Test Setup

EQUIPMENT:
DC Standard ..... HP 740B

PROCEDURE:
a. Connect equipment as shown in figure 4-9.

b. Set dc standard for +4 Vdc.

c. Verify that free-running baseline is blanked, regardless of INTENSITY setting.

4-23. DEFLECTION FACTOR.

SPECIFICATION:
Accuracy ±3% on all ranges.

DESCRIPTION:
A dc power supply is connected to the vertical inputs and deflection is checked on all ranges.

PERFORMANCE TESTS

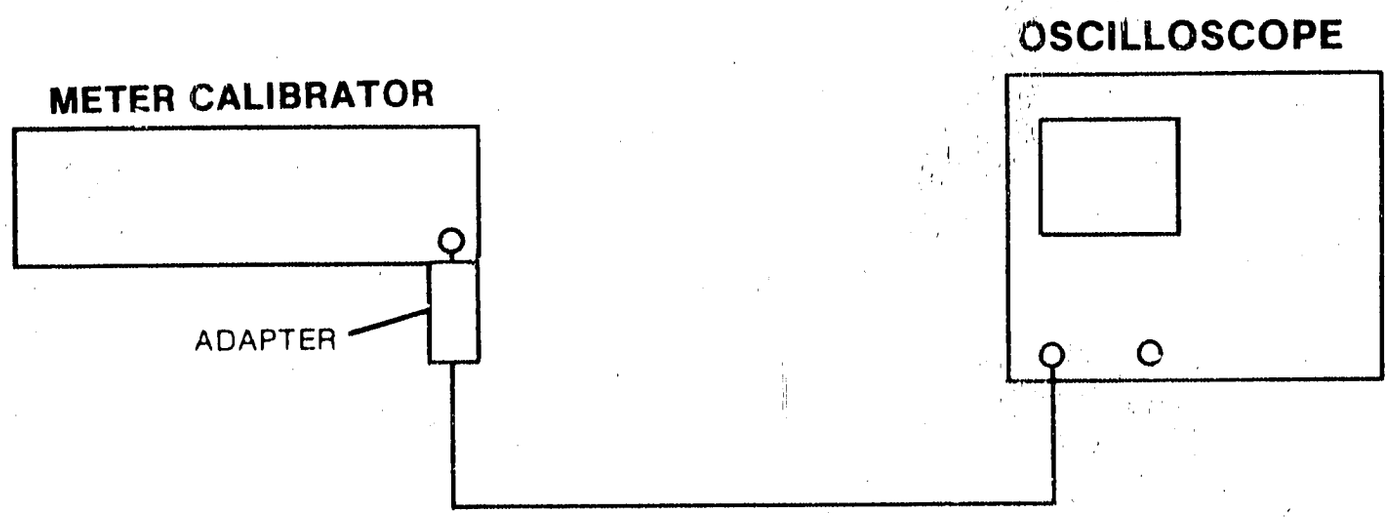


Figure 4-10. Deflection Factor Test Setup

EQUIPMENT:

DC Standard ..... HP 740B

PROCEDURE:

a. Connect equipment as shown in figure 4-10.

b. Set channel A VOLTS/DIV and dc standard as indicated in table 4-4. Deflection should be 6-divisions ±3% for each checkpoint.

Table 4-4. Deflection Factor Accuracy

VOLTS/DIV Settings	DC Standard Settings	DEFLECTION (Divisions)
20	120 V	19.4 to 20.6 V/div
10	60 V	9.7 to 10.3 V/div
5	30 V	4.85 to 5.15 V/div
2	12 V	1.94 to 2.06 V/div
1	6 V	.97 to 1.03 V/div
.5	3 V	.485 to .515 V/div
.2	1.2 V	.194 to .206 V/div
.1	0.6 V	97 to 103 mV/div
.05	0.3 V	48.5 to 51.5 mV/div
.02	0.12 V	19.4 to 20.6 mV/div
.01	0.06 V	9.7 to 10.3 mV/div
.005	0.03 V	4.85 to 5.15 mV/div

c. Change DISPLAY to B.

d. Repeat steps a and b for Channel B.

PERFORMANCE TESTS

4-24. WRITING RATE AND STORE TIME.

SPECIFICATION:

Maximum writing rate (brightness control near maximum) results in a writing rate of 1800 cm/μs. Store time in a view mode shall be at least 10 s.

DESCRIPTION:

A 100 MHz, 8-division signal is applied to the oscilloscope. The signal is stored and then viewed for 10 seconds.

EQUIPMENT:

Signal Generator ..... HP 3200B

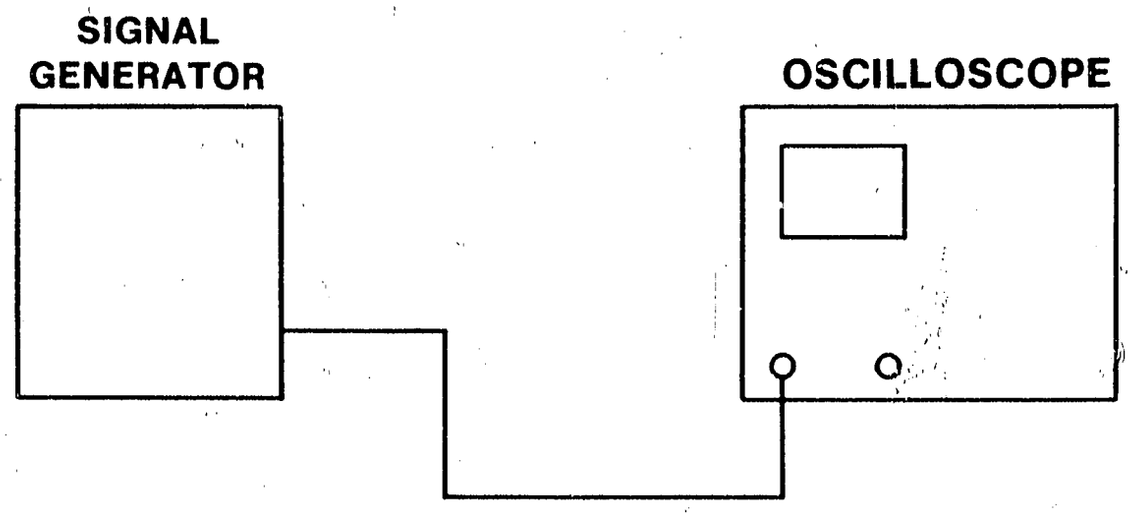


Figure 4-11. Writing Rate Test Setup

PROCEDURE:

a. Connect equipment as shown in figure 4-11.

b. Set 1744A controls as follows:

PERSISTENCE	fully cw
BRIGHTNESS	as required
SINGLE	engaged
MAIN TIME/DIV	.05 μs/div

c. Set signal generator output for 8-divisions, 100 MHz.

d. Engaged MAG X10 pushbutton switch.

e. Observe waveform on CRT using viewing hood. Adjust BRIGHTNESS control until waveform is just visible over quality area of CRT (6-div x 8-div).

NOTE

Keep BRIGHTNESS control at minimum setting that still allows trace to be viewed.

f. Push ERASE pushbutton a minimum of four times.

g. Resultant waveform must be visible over quality area of CRT for minimum of 10 seconds (using viewing hood).

h. Repeat steps e and f and immediately switch to STORE mode.

i. Wait 30 seconds and switch to STORE DISPLAY mode.

j. Waveform should still be visible over quality area (use viewing hood).

NOTE

Adjust BRIGHTNESS as necessary for optimum view time.

PERFORMANCE TEST RECORD

HEWLETT-PACKARD

MODEL 1744A

OSCILLOSCOPE **Tested by** _____

SERIAL NO. _____ **Date** _____

Test		Specification	Measured
BANDWIDTH		3 dB at 100 MHz	_____
CMRR (Common mode rejection ratio)		>20 dB to 20 MHz	_____
TRIGGERING			
Internal MAIN	.3 div 25 MHz	stable display	_____
	1 div 100 MHz	stable display	_____
DLY'D	1 div 100 MHz	stable display	_____
	.3 div 25 MHz	stable display	_____
External MAIN	50 mV p-p 50 MHz	stable display	_____
	100 mV p-p 100 MHz	stable display	_____
DLY'D	100 mV p-p 100 MHz	stable display	_____
	50 mV p-p 50 MHz	stable display	_____

Sweep Time Accuracy (at room temperature)			X1	X10
MAIN				
.05	µSEC	±2%, ±3% in X10	_____	_____
.1	µSEC	±2%, ±3% in X10	_____	_____
.2	µSEC	±2%, ±3% in X10	_____	_____
.5	µSEC	±2%, ±3% in X10	_____	_____
1	µSEC	±2%, ±3% in X10	_____	_____
2	µSEC	±2%, ±3% in X10	_____	_____
5	µSEC	±2%, ±3% in X10	_____	_____
10	µSEC	±2%, ±3% in X10	_____	_____
20	µSEC	±2%, ±3% in X10	_____	_____
50	µSEC	±2%, ±3% in X10	_____	_____
.1	mSEC	±2%, ±3% in X10	_____	_____
.2	mSEC	±2%, ±3% in X10	_____	_____
.5	mSEC	±2%, ±3% in X10	_____	_____
1	mSEC	±2%, ±3% in X10	_____	_____
2	mSEC	±2%, ±3% in X10	_____	_____
5	mSEC	±2%, ±3% in X10	_____	_____
10	mSEC	±2%, ±3% in X10	_____	_____
20	mSEC	±2%, ±3% in X10	_____	_____
50	mSEC	±3%, ±4% in X10	_____	_____
.1	SEC	±3%, ±4% in X10	_____	_____
.2	SEC	±3%, ±4% in X10	_____	_____
.5	SEC	±3%, ±4% in X10	_____	_____
1	SEC	±3%, ±4% in X10	_____	_____
2	SEC	±3%, ±4% in X10	_____	_____
DLY'D				
.05	SEC	±2%, ±3% in X10	_____	_____
.1	µSEC	±2%, ±3% in X10	_____	_____
.2	µSEC	±2%, ±3% in X10	_____	_____
.5	µSEC	±2%, ±3% in X10	_____	_____
1	µSEC	±2%, ±3% in X10	_____	_____
2	µSEC	±2%, ±3% in X10	_____	_____

PERFORMANCE TEST RECORD (Cont'd)

Test	Specification	Measured
Sweep Time Accuracy (Cont'd)		X1 X10
5 µSEC	±2%, ±3% in X10	_____ _____
10 µSEC	±2%, ±3% in X10	_____ _____
20 µSEC	±2%, ±3% in X10	_____ _____
50 µSEC	±2%, ±3% in X10	_____ _____
.1 mSEC	±2%, ±3% in X10	_____ _____
.2 mSEC	±2%, ±3% in X10	_____ _____
.5 mSEC	±2%, ±3% in X10	_____ _____
1 mSEC	±2%, ±3% in X10	_____ _____
2 mSEC	±2%, ±3% in X10	_____ _____
5 mSEC	±2%, ±3% in X10	_____ _____
10 mSEC	±2%, ±3% in X10	_____ _____
20 mSEC	±2%, ±3% in X10	_____ _____
DIFFERENTIAL TIME ACCURACY		
Dial 8.00	±0.05	_____
DELAY JITTER	$\frac{1}{< 50\,000}$	_____
RISE TIME		
Ch A	≤ 3.5 nSEC	_____
Ch A MAG X5	≤12 nSEC	_____
Ch B	≤ 3.5 nSEC	_____
Ch B MAG X5	≤12 nSEC	_____
Z-AXIS BLANKING	+4 V BLANKS TRACE √	_____
DEFLECTION FACTOR		CH A CH B
20 V/div	19.4 to 20.6 V/div	_____ _____
10 V/div	9.7 to 10.3 V/div	_____ _____
5 V/div	4.85 to 5.15 V/div	_____ _____
2 V/div	1.94 to 2.06 V/div	_____ _____
1 V/div	.97 to 1.03 V/div	_____ _____
.5 V/div	.485 to .515 V/div	_____ _____
.2 V/div	.194 to .206 V/div	_____ _____
.1 V/div	97 to 103 mV/div	_____ _____
.05 V/div	48.5 to 51.5 mV/div	_____ _____
.02 V/div	19.4 to 20.6 mV/div	_____ _____
.01 V/div	9.7 to 10.3 mV/div	_____ _____
.005 V/div	4.85 to 5.15 mV/div	_____ _____
WRITING RATE AND STORE TIME		
WRITE RATE	1800 cm/µs	_____
VIEW TIME	10 s	_____
STORE/DISPLAY TIME	30 s	_____

ADJUSTMENTS

SECTION V

ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section contains step-by-step procedures for making all internal adjustments to return the instrument to peak operating capabilities when repairs have been made.

5-3. SAFETY REQUIREMENTS.

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

5-5. EQUIPMENT REQUIRED.

5-6. A complete list of required test equipment and accessories is given in table 1-3 (Section I). The 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. While most adjustments may be made independently, it is suggested that they be made in the recommended sequence because several adjustments are directly related to preceding or following adjustments. Refer to table 5-1 for a list of adjustable components and their functions.

5-9. In addition to complete step-by-step adjustment procedures, a condensed adjustment procedure is provided in table 5-6 for the convenience of the technicians who have sufficient experience with the 1744A. For best results, adjustments should be performed at normal room temperature. Adjustment locations are shown in figure 5-1 at the rear of this section.

Table 5-1. Adjustable Components

REFERENCE DESIGNATOR	ADJUSTMENT NAME	ADJUSTMENT PARAGRAPH	SCHEMATIC NUMBER	DESCRIPTION
A16R26	+15 V ADJ	5-13	2	Adjusts +15 Vdc supply to within ±10 mV.
A15R38	HV ADJ	5-14	3	Adjusts CRT filament voltage for proper value.
A12R12/ A12C8	Gate Response	5-15	4	Adjusts for best gate pulse response.
A12R16	Y-ALIGN	5-17	4	Align signal with vertical axis of CRT.
A3R116	CALIB AMPL	5-18	7	Adjust calibrator output for 1 V p-p.
A7R20	TRIG SENS (Main)	5-19	8	Adjust for symmetrical triggering of main TRIGGER LEVEL control.
A10R9	TRIG SENS (Delayed)	5-19	10	Adjust for symmetrical triggering of delayed TRIGGER LEVEL control.
A7R41	SYNC ZERO	5-20	8	Compensate for sync signal AC/DC coupling.
A3R86	TRIG VIEW BAL	5-21	5	Center trigger view display on CRT.
A7R169	DLYD SWP START	5-22	10	Adjusts start of delayed sweep with reference to main sweep and DELAY dial setting.

Table 5-1. Adjustable Components (Cont'd)

REFERENCE DESIGNATOR	ADJUSTMENT NAME	ADJUSTMENT PARAGRAPH	SCHEMATIC NUMBER	DESCRIPTION
A7R93	X1 CAL	5-23	11	Adjust X1 gain of horizontal amplifier.
A8R43	.05-2 μSEC	5-23	9	Adjust sweep range.
A7R117	X10 CAL	5-23	12	Adjust X10 gain of horizontal amplifier.
A7R105	MAG CENTER	5-24	12	Balance display around center screen when magnifier is engaged.
A11R10 A11R15	LIN 1 LIN 2	5-25	12	Adjust for best horizontal linearity.
A9R28 A9R10 A9R11	.05-2 μSEC 5-200 μSEC 0.5-20 mSEC	5-27	11	Delayed sweep adjustments.
A8R43 A8R12 A8R13 A8R14	.05-2 μSEC 5-200 μSEC 0.5-20 mSEC .05-2 SEC	5-28	9	Main sweep adjustments.
A3R11 A3R31	FET BAL (Channel A) FET BAL (Channel B)	5-29	5	Input channel balance adjustment to vertical preamplifier.
A3R18 A3R77	5 mV BAL (Channel A) 5 mV BAL (Channel B)	5-29	5	Calibrate vertical amplifier balance on 5-mV range.
A3R19 A3R76	50 mV BAL (Channel A) 50 mV BAL (Channel B)	5-29	5	Calibrate vertical amplifier balance on 50-mV range.
A3R90	POL BAL	5-29	5	Balance channel B polarity selection.
A3R79	A SYNC BAL	5-30	5	Balance channel A sync signal with channel B input signal.
A3R58 A3R32	A POSN B POSN	5-30	5	Compensates for position variations between normal and MAG X5 operation.
A3C2 A3C17	0.5 V COMP (Channel A) 0.5 V COMP (Channel B)	5-31	5	Adjusts for best input response on .5 V range.

Table 5-1 Adjustable Components (Cont'd)

REFERENCE DESIGNATOR	ADJUSTMENT NAME	ADJUSTMENT PARAGRAPH	SCHEMATIC NUMBER	DESCRIPTION
A3C4 A3C19	0.5 V INPUT CAP (Channel A) 0.5 V INPUT CAP (Channel B)	5-31	5	Adjust input capacitance for 0.5 V range.
A3R49 A3R46	A GAIN B GAIN	5-32	5	Equalizes vertical gain of each channel.
A3R65	GAIN	5-32	5	Adjusts overall gain of vertical preamplifier.
A17R21 A17R19 A17R22 A17C6	HF 4 HF 3 HF 2 HF 1	5-33	6	Vertical output pulse response adjustments.
A3R22	B HF ADJ	5-33	5	Matches Ch B response with Ch A.
A7R97	A VS B CAL	5-34	8	Calibrates channel A versus channel B.
A17R112 A17R115 A16R41 A17R103 A12R19	ACC ADJ LV COLL ADJ HV COLL ADJ FGG1 PATT	5-36	2, 4, 17	Adjust collimation and floodgun pattern.
A16R42 A16R44	LENS 1 ADJ LENS 2 ADJ	5-37	2	Adjusts focus lens of CRT.
A17R53	Window ADJ	5-38	17	Adjusts crossover point between fade positive and fade negative.
A18R3	WRA	5-39	17	Adjust CRT to prefogged condition.
A15R2	INTENSITY LIMIT ADJ	5-39	3	Insure spot is extinguished with minimum intensity.
A12R3	CURRENT LIMIT	5-40	4	Adjusted for discernible display.
A12R24	AMP LIMIT	5-41	4	Adjust gate output amplitude.
A15R32 A15R39	KNEE SLOPE	5-41	3	Adjustments to compensate for interaction between INTENSITY and FOCUS controls.

WARNING

Adjustment procedure described are performed with power applied to the instrument and should be performed only by trained service personnel who are aware of the hazards involved (for example, fire and electrical shock). In addition, read the Safety Summary at the front of this manual before performing adjustment procedures.

5-10. Remove top and bottom covers from the instrument. Apply input power and allow thirty minutes for the instrument to warm up.

5-11. The following front- and rear-panel control settings are to be used for each adjustment procedure. If a control is to be set to another position, it will be listed in the procedure. After completion of each adjustment procedure, reset controls to their original settings.

CONTROL	POSITION
All Pushbuttons (except as noted below)	disengaged
VOLTS/DIV (Channels A and B)	.1
VOLTS/DIV Vernier (Channels A and B)	CAL detent (fully cw)
Coupling (Channels A and B)	DC
POSN (Channels A and B)	midrange
DISPLAY	A
TRIGGER	A
FOCUS	best trace
BEAM INTENSITY	10-11 o'clock
LINE	ON
POSITION	midrange
TRIGGER LEVEL (main and delayed)	3 o'clock
Sweep Mode	MAIN
DELAY	fully ccw
MAIN TIME/DIV	.1 mSEC
DELAYED TIME/DIV	OFF
SWEEP VERNIER	CAL
TRIGGER HOLDOFF	MIN
WRITE mode	engaged
PERSISTENCE/VIEW TIME	ccw (min)
BRIGHTNESS	ccw (min)

ADJUSTMENTS

5-12. LOW-VOLTAGE POWER SUPPLY ADJUSTMENT.

REFERENCE:
Service Sheet 2.

DESCRIPTION:
The +15 Vdc Power Supply is adjusted for an output of +15 V ±10 mV. The remainder of the dc supplies are then checked for proper output.

EQUIPMENT:
DMM (Digital Multimeter) ..... HP 3465A/B

PROCEDURE:
Adjust +15 V low-voltage power supply as follows:

a. Connect DMM between A16TP4 and A16TP3 (ground).

b. Adjust +15 V ADJ A16R26 for +15 Vdc ±10 mV.

c. Check other dc voltages as indicated in table 5-2. Outputs should remain within ripple specifications at both high- and low-line conditions.

Table 5-2. LVPS Ripple Specifications

VOLTAGE	TEST POINT	LIMITS	RIPPLE SPECIFICATION
+15 V	A16TP4	±10 mV (adjustable)	10 mV
−15 V	A16TP1	±150 mV	10 mV
+5 V	A16TP2	±50 mV	5 mV
+48 V	A16TP5	±3 V	5 mV
+120 V	A16TP6	±6 V	10 mV
−100 V	P5 PIN 1	±5 V	100 mV

ADJUSTMENTS

5-13. HIGH-VOLTAGE POWER SUPPLY ADJUSTMENT.

REFERENCE:
Service Sheet 3.

DESCRIPTION:
The HVPS is adjusted to the voltage specified on the high-voltage transformer to assure proper filament voltage for the CRT.

EQUIPMENT:
DMM (Digital Multimeter) ..... HP 3465A/B
1000:1 HV Divider Probe ..... HP 34111A

NOTE

Digital Multimeter must have a 10-megohm input termination to be compatible with the 1000:1 divider probe.

PROCEDURE:
Adjust the hv power supply as follows:

a. Set front-panel INTENSITY control fully ccw.

b. Set LINE switch to OFF position.

WARNING

Voltage capable of causing injury or death are present in the high-voltage power supply. Use an insulated adjustment tool and proceed carefully.

c. Remove hv cover (MP54).

d. Reinstall two, rear, hv cover screws for grounding purposes (see figure 5-1).

e. Note cathode voltage marked on high-voltage transformer.

f. Set front-panel LINE switch to ON position.

g. Connect DMM to test point A16TP6 (+120 V) and note voltage indication.

h. Connect DMM to test point A16TP6 (+120 V) through 1000:1 hv divider probe and note voltage indication.

i. Compute percent of error introduced by hv divider probe (difference between indications noted in step g and step h.

j. Connect DMM through 1000:1 hv divider probe to high-voltage test point A15TP4 on hv power supply assembly A15.

k. Adjust hv adj A15R38 for DMM indication of cathode voltage noted in step e.

NOTE

Final indication on DMM should include percentage of error noted in step i.

l. Disconnect hv divider probe from test point A15TP4.

m. Set front-panel LINE switch to OFF position.

n. Replace hv cover (MP54).

ADJUSTMENTS

5-14. GATE AMPLIFIER RESPONSE ADJUSTMENTS.

REFERENCE:
Service Sheet 4.

DESCRIPTION:
The gate amplifier is adjusted for best square-wave response.

EQUIPMENT:

Monitor Oscilloscope	HP 1740A
10:1 Divider Probe	HP 10041A

PROCEDURE:
Adjust gate amplifier response as follows:

a. Connect monitor oscilloscope through 10:1 divider probe to test point A12TP2.

b. Disconnect input ac power from 1744A (LINE switch to OFF).

c. Disconnect HV Oscillator Q1 (see figure 5-1 for location) from circuit by removing transistor cable connector from Q1. (This disables amplitude limit circuit.)

d. Apply input ac power to 1744A (LINE switch to ON).

e. Adjust front-panel BEAM INTENSITY so that peak amplitude of gate signal at A12TP2 is 25 volts.

f. Set 1744A main TIME/DIV to .05 μs/div.

g. Adjust gate COMP adj A12R12 and A12C8 for best square-wave response. (Overshoot, undershoot, etc., should be less than 3%.)

h. Disconnect input ac power from 1744A (LINE switch to OFF).

i. Reconnect transistor cable connector to HV Oscillator Q1.

j. Apply input ac power to 1744A (LINE switch to ON).

5-15. ASTIGMATISM AND FOCUS ADJUSTMENT.

REFERENCE:
Service Sheet 3.

DESCRIPTION:
Astigmatism and Focus controls are adjusted for smallest, best defined beam spot.

PROCEDURE:
Adjust astigmatism and focus as follows:

a. Set 1744A front-panel controls as follows:

MAIN TIME/DIV	1 SEC
SWEEP VERNIER	fully ccw
BEAM INTENSITY	just visible spot

b. While spot moves slowly across CRT, adjust FOCUS control and ASTIGMATISM control (rear panel) for smallest and best-defined spot at center screen.

ADJUSTMENTS

5-16. Y-AXIS AND TRACE ALIGN ADJUSTMENTS.

REFERENCE:
Service Sheets 3 and 4.

DESCRIPTION:
The instrument is adjusted so that the display is aligned both vertically and horizontally on the CRT screen.

EQUIPMENT:
Oscillator ..... HP 204C

PROCEDURE:
Adjust Y-axis and trace align as follows:

a. Obtain horizontal baseline on CRT.

b. Adjust rear-panel TRACE ALIGN control (A15R27) so that horizontal trace exactly parallels center horizontal graticule line.

c. Set display mode to A vs B.

d. Connect oscillator to channel A INPUT connector.

e. Adjust oscillator output for approximately 1-kHz, 6-division vertical amplitude display.

f. Adjust Y-ALIGN A12R16 so that vertical trace exactly parallels center vertical graticule line.

5-17. CALIBRATOR AMPLITUDE ADJUSTMENT.

REFERENCE:
Service Sheet 7.

DESCRIPTION:
The calibrator output is adjusted for 1 V ±10 mV.

EQUIPMENT:
DMM (Digital Multimeter) ..... HP 3465A/B

PROCEDURE:
Adjust calibrator output as follows:

a. Connect digital voltmeter between CAL 1 V output and ground.

b. Adjust CALIB AMPL A3R116 for indication of 0.500 V ±5 mV. (Since calibrator signal is symmetrical square wave, adjusting for 0.5 V average value gives peak value of calibrator pulse of 1 V ±10 mV.)

5-18. TRIGGER SENSITIVITY ADJUSTMENT.

REFERENCE:
Service Sheets 8 and 10.

DESCRIPTION:
The main and delayed sweeps are adjusted so that they trigger properly on an input signal of 20 mV p-p.

ADJUSTMENTS

EQUIPMENT:

Oscillator ..... HP 204C

PROCEDURE:

Adjust trigger sensitivity as follows:

a. Set 1744A controls as follows:

VOLTS/DIV (Channel A)	.005
Coupling (Channel A)	50Ω
Main INT/EXT	EXT

b. Connect oscillator to both channel A INPUT and main EXT TRIGGER input, using adapter and BNC Tee. Terminate EXT TRIGGER input with 50-ohm feedthrough termination.

c. Set oscillator output for 50-kHz, 15-mV p-p sine wave.

d. Set main AUTO/NORM to NORM.

e. Adjust main trig sens A7R20 fully cw.

f. Slowly turn main TRIGGER LEVEL from one extreme to other. Note one sweep occurs for each direction of rotation.

g. While turning TRIGGER LEVEL, slowly adjust main trig sens A7R20 ccw until sweep occurs for only one direction of rotation of TRIGGER LEVEL.

h. Set main AUTO/NORM to AUTO.

i. Increase oscillator amplitude to 20 mV p-p.

j. Set main AUTO/NORM to NORM.

k. Turn main TRIGGER LEVEL; sweep should occur for each direction of rotation.

l. Change 1744A controls as follows:

Main AUTO/NORM	AUTO
Sweep mode	DLY'D
MAIN TIME/DIV	.1 mSEC
DELAYED TIME/DIV	50 μSEC
Main INT/EXT	INT
Delayed INT/EXT	EXT

m. Disconnect oscillator from main EXT TRIGGER and connect to delayed EXT TRIGGER.

n. Set oscillator output for 50-kHz, 15-mV p-p sine wave.

o. Set SWEEP AFTER DELAY to TRIG position.

p. Adjust delayed trig sens A10R9 fully cw.

q. While turning delayed TRIGGER LEVEL from one extreme to other, adjust A10R9 ccw until sweep occurs for only one direction of rotation or not at all.

r. Set SWEEP AFTER DELAY to AUTO.

s. Increase oscillator output to 20 mV p-p.

t. Set SWEEP AFTER DELAY to TRIG.

u. Turn delayed TRIGGER LEVEL; sweep should occur for each direction of rotation.

ADJUSTMENTS

5-19. SYNC ZERO ADJUSTMENT.

REFERENCE:
Service Sheet 8.

DESCRIPTION:
The main trigger circuit is balanced so that there is little or no shift in the trigger level when changing the sync input coupling.

EQUIPMENT:
Oscillator ..... HP 204C

PROCEDURE:
Adjust sync zero as follows:

a. Connect oscillator to channel A INPUT.

b. Set oscillator output for 1-kHz sine wave at approximately six divisions.

c. Adjust main TRIGGER LEVEL for stable display.

d. Change main trigger coupling between AC and DC and note shift in trigger point.

e. Adjust sync zero A7R41 until no shift occurs.

5-20. TRIGGER VIEW BALANCE ADJUSTMENT.

REFERENCE:
Service Sheet 5.

DESCRIPTION:
Trigger view signal is adjusted for center-screen display.

EQUIPMENT:
Oscillator ..... HP 204C

PROCEDURE:
Adjust trigger view balance as follows:

a. Set 1744A controls as follows:

TRIGGER VIEW	engaged
Main AUTO/NORM	NORM
Main INT/EXT	EXT

b. Connect oscillator to main EXT TRIGGER input.

c. Set oscillator output for approximately 100-mV p-p, 10-kHz sine wave.

d. Adjust main TRIGGER LEVEL for stable display.

e. Decrease oscillator amplitude to lowest amplitude where stable triggering can be maintained.

f. Adjust A3R86, trig. view bal., until trigger view display is centered on middle horizontal graticule line.

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 to 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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ADJUSTMENTS

5-21. DELAYED SWEEP START ADJUSTMENT.

REFERENCE:
Service Sheet 10.

DESCRIPTION:
DELAY control is calibrated to the start of the main sweep.

EQUIPMENT: None.

PROCEDURE:
Adjust delayed sweep start as follows:

a. Set 1744A controls as follows:

Main TIME/DIV	1 mSEC
Delayed TIME/DIV	.05 μSEC
DELAY	.2 (fully ccw)

b. Adjust horizontal POSITION control so that main sweep starts exactly on first vertical graticule line.

c. Adjust delay start adj, A7R169, so that intensified spot is placed exactly 2 mm (1 minor div) after main sweep starting point.

5-22. HORIZONTAL AMPLIFIER GAIN ADJUSTMENTS.

REFERENCE:
Service Sheets 9 and 12.

DESCRIPTION:
The X1 and X10 functions of the main sweep are calibrated to a known standard.

EQUIPMENT:

Time-mark Generator	HP 226A

PROCEDURE:
Adjust horizontal amplifier gain as follows:

a. Set 1744A controls as follows:

Coupling (Channel A)	50Ω
VOLTS/DIV (Channel A)	.5
Delayed TIME/DIV	.05 μSEC
DELAY	1.00

b. Adjust horizontal position control until intensified spot is exactly on second vertical graticule line.

NOTE

A slight reduction in intensity may be helpful.

c. Set DELAY control to 9.00.

d. Adjust A7R93, X1 gain, until intensified spot is on 10th vertical graticule line from left.

e. Set DELAY control to 1.00 position.

ADJUSTMENTS

f. Repeat steps b through e until intensified spot is on second vertical graticule line when DELAY control is at 1.00 position and is on 10th vertical graticule line from left when DELAY control is at 9.00 position.

g. Connect time-mark generator to channel A INPUT connector.

h. Set time-mark generator for .5 μSEC time markers.

i. Set MAIN TIME/DIV to .5 μSEC.

j. Using horizontal POSITION control, align time markers with vertical graticule lines.

k. On main sweep assembly, A8, adjust .05-2 μSEC, A8R43, for exactly one time marker per division (over center 8 divisions of CRT).

l. Set horizontal sweep mode control to MAG X10.

m. Set time-mark generator for .05 μSEC time markers.

n. Using horizontal POSITION control, align one time marker with second left vertical graticule line.

o. On horizontal sweep assembly, A7, adjust A7R117, X10 gain, until one time marker coincides with second left vertical graticule line and one time marker coincides with ninth right vertical graticule line.

5-23. X10 AMPLIFIER BALANCE ADJUSTMENT.

REFERENCE:
Service Sheet 12.

DESCRIPTION:
The X10 horizontal amplifier is adjusted so that the display remains at center screen when X10 mode switch is engaged.

EQUIPMENT:
Time-mark Generator ..... HP 226A

PROCEDURE:
Adjust X10 amplifier balance as follows:

a. Set 1744A controls as follows:

Coupling (Channel A)	50Ω
VOLTS/DIV (Channel A)	.5
Main TIME/DIV	1 μSEC

b. Connect time-mark generator to channel A INPUT connector.

c. Set time-mark generator for 5 μSEC time markers and observe three time marks.

d. Using horizontal POSITION control, center middle time marker on CRT screen.

e. Engage MAG X10 switch and adjust mag center A7R105 to again center time mark.

ADJUSTMENTS

5-24. HORIZONTAL LINEARITY ADJUSTMENT.

REFERENCE:
Service Sheet 12.

DESCRIPTION:
The horizontal output amplifier is adjusted for best overall linearity.

EQUIPMENT:
Time-mark Generator ..... HP 266A

PROCEDURE:
Adjust horizontal linearity as follows:

a. Connect time-mark generator to channel A INPUT.

b. Set 1744A controls as follows:

Coupling (Channel A)	50Ω
VOLTS/DIV (Channel A)	.2
Main TIME/DIV	.05 μSEC
MAG X10	engaged

c. Set time mark generator for 10 ns markers.

d. Set Lin 1, A11R10, and Lin 2, A11R15, fully cw.

e. Adjust both controls, a little at a time, for best overall linearity in center 8 divisions of unmagnified sweep (center 80 divisions of magnified sweep).

5-25. PRELIMINARY MAIN SWEEP CALIBRATION.

REFERENCE:
Service Sheet 9.

DESCRIPTION:
The main time base is adjusted to a known standard.

EQUIPMENT:
Time-mark Generator ..... HP 226A

PROCEDURE:
Accomplish preliminary main sweep calibration as follows:

a. Connect time-mark generator to channel A INPUT connector.

b. Set Main TIME/DIV and time-mark generator as indicated in table 5-3 and make adjustments to obtain one marker/division (over center 8 divisions of CRT).

Table 5-3. Preliminary Main Sweep Calibration

MAIN TIME/DIV Settings	Time-mark Generator Settings	Adjust
1 μSEC	1 μs	A8R43
10 μSEC	10 μs	A8R12
1 mSEC	1 ms	A8R13
50 mSEC	50 ms	A8R14

ADJUSTMENTS

5-26. DELAYED SWEEP ADJUSTMENTS.

REFERENCE:
Service Sheet 11.

DESCRIPTION:
The delayed sweep time base is calibrated to a known standard.

EQUIPMENT:
Time-mark Generator ..... HP 226A

PROCEDURE:
Adjust the delayed sweep ranges as follows:

a. Connect time-mark generator to channel A INPUT connector.

b. Set 1744A controls as follows:

Coupling (Channel A) 50Ω
VOLTS/DIV 5
Sweep Mode ..... DLY'D

c. Set time-mark generator, main TIME/DIV, and delayed TIME/DIV as indicated in table 5-4 and make necessary adjustments. If necessary, compromise so that all ranges controlled by particular adjustments are in specified tolerance.

Table 5-4. Delayed Sweep Calibration Adjustments

MAIN TIME/DIV Settings	DELAYED TIME/DIV Settings	Time-mark Generator Settings	Adjust	Tolerance
.1 µSEC	.05 µSEC	50 ns	A9R28	±2%
.2 µSEC	.1 µSEC	.1 µs		
.5 µSEC	.2 µSEC	.2 µs		
1 µSEC	.5 µSEC	.5 µs		
2 µSEC	1 µSEC	1 µs		
5 µSEC	2 µSEC	2 µs		
10 µSEC	5 µSEC	5 µs	A9R10	±2%
20 µSEC	10 µSEC	10 µs		
50 µSEC	20 µSEC	20 µs		
.1 mSEC	50 µSEC	50 µs		
.2 mSEC	.1 mSEC	.1 mSEC		
.5 mSEC	.2 mSEC	.2 mSEC		
1 mSEC	.5 mSEC	.5 mSEC	A9R11	±2%
2 mSEC	1 mSEC	1 mSEC		
5 mSEC	2 mSEC	2 mSEC		
10 mSEC	5 mSEC	5 mSEC		
20 mSEC	10 mSEC	10 mSEC		
50 mSEC	20 mSEC	20 mSEC		

ADJUSTMENTS

5-27. MAIN SWEEP FINE ADJUSTMENTS.

REFERENCE:
Service Sheet 9.

DESCRIPTION:
These adjustments utilize the accuracy of the DELAY dial to calibrate the main sweep more accurately than is possible using the visual method (paragraph 5-27). These adjustments must be accomplished if the differential accuracy specifications are to be met.

EQUIPMENT:
Time-mark Generator ..... HP 226A

PROCEDURE:
Adjust main sweep as follows:

a. Connect time-mark generator to channel A INPUT connector.

b. Set 1744A front-panel controls as follows:

Coupling (Channel A)	50Ω
VOLTS/DIV (Channel A)	.5
Main TIME/DIV	.5 μSEC
Delayed TIME/DIV	.05 μSEC
Sweep Mode	DLY'D
AUTO/NORM	NORM

c. Set time-mark generator for .5 μs markers.

d. Set DELAY potentiometer to 1.00 position.

e. Using channel A POSN control, center time-mark display vertically on CRT.

f. Using horizontal POSITION control, set leading edge of time-mark to center CRT graticule line.

g. Set DELAY potentiometer to 9.00.

h. Adjusting .05-2 μSEC, A8R43 set leading edge of time marker to center CRT graticule line.

i. Repeat steps d through h until leading edge of time marker can be set to center graticule line with DELAY dial set at 9.00.

j. This completes step 1 in table 5-5. Complete remaining steps in table by repeating above procedure for each step.

Table 5-5. Main Sweep Fine Adjustment

Step	Time-mark Generator Settings	MAIN TIME/DIV Settings	DELAYED TIME/DIV Settings	Adjust
1	.5 μs	.5 μSEC	.05 μSEC	A8R43
2	10 μs	10 μSEC	1 μSEC	A8R12
3	1 ms	1 mSEC	.1 mSEC	A8R13
4	50 ms	50 mSEC	5 mSEC	A8R14

ADJUSTMENTS

5-28. VERTICAL PREAMPLIFIER BALANCE ADJUSTMENTS.

REFERENCE:
Service Sheet 5.

DESCRIPTION:
These adjustments are set to balance the vertical preamplifier input so that the trace does not shift when attenuators are changed from range to range.

EQUIPMENT:
DMM (Digital Multimeter) ..... HP 3465A/B

PROCEDURE:
Adjust vertical preamplifier balance as follows:

a. Set channel A and B coupling to 50Ω and VOLTS/DIV (channels A and B) to .05.

b. Connect digital voltmeter to A3TP9.

c. Adjust channel A FET balance A3R11 for 0 V ±0.5 mV.

d. Connect digital voltmeter to A3TP10.

e. Adjust channel B FET balance A3R31 for 0 V ±0.5 mV.

f. Disconnect voltmeter.

g. Set channel A and B VOLTS/DIV switches to .005.

h. While changing channel A VOLTS/DIV between .005, .01, and .02, adjust channel A 5-mV balance A3R18 for minimum trace shift between these three ranges.

i. Rotate channel A VOLTS/DIV between .005 and .05 and adjust channel A 50-mV balance A3R19 for minimum trace shift between both ranges.

j. Change DISPLAY to B.

k. Rotate channel B VOLTS/DIV between .005, .01, and .02, and adjust channel B 5-mV balance A3R77 for minimum trace shift between all three ranges.

l. Rotate channel B VOLTS/DIV between .005 and .05 and adjust channel B 50-mV balance A3R76 for minimum trace shift between both ranges.

m. While switching CH B INVT selector between its engaged and disengaged position, adjust polarity balance A3R90 until trace shift is minimal. If A3R90 is changed, recheck steps k and l for correct balance. If additional adjustments are made for k and l, recheck adjustment of A3R90 as described above.

5-29. POSITION AND SYNC BALANCE ADJUSTMENTS.

REFERENCE:
Service Sheet 5.

DESCRIPTION:
The sync balance is adjusted for stable triggering.

EQUIPMENT:
Oscillator ..... HP 204C

ADJUSTMENTS

PROCEDURE:
Adjust position and sync balance as follows:

a. Set 1744A controls as follows:

DISPLAY	B
POSN (Channel B)	12 o'clock

b. Switch between normal and MAG X5 and adjust channel B POSN (A3R32) for minimum trace shift.

c. Charge 1744A controls as follows:

DISPLAY	ALT
TRIGGER	COMP
VOLTS/DIV (both channels)	.01

d. Connect oscillator output to both channel INPUT connectors using BNC tee.

NOTE

Cables between BNC tee and input connectors should be of equal electrical length.

e. Adjust oscillator output for 10 kHz sine wave, 0.5 division of vertical deflection.

f. Adjust sync A bal A3R79 until both channels trigger properly and are in phase. If A3R79 is changed, recheck steps i and k in paragraph 5-28 for correct balance. If additional adjustments are made for i and k, recheck adjustment of A3R79 as described above.

g. Disconnect oscillator.

h. Return 1744A controls to initial settings.

i. Switch between normal and MAG X5 and adjust channel A POSN A3R58 for minimum trace shift.

5-30. INPUT CAPACITANCE AND ATTENUATOR COMPENSATION ADJUSTMENTS.

REFERENCE:
Service Sheet 5.

DESCRIPTION:
The attenuators are adjusted for optimum signal response.

EQUIPMENT:

Pulse Generator	HP 8013B
LCR Meter	HF 4332A

PROCEDURE:
Adjust input capacitance and attenuator compensation as follows:

a. Connect pulse generator to channel A INPUT.

b. Set 1744A controls as follows:

Coupling (Channel A)	50Ω
VOLTS/DIV (Channel A)	.5
Main TIME/DIV	20 μSEC

ADJUSTMENTS

c. Set pulse generator controls to obtain 3-V peak, 5-kHz square wave.

d. Adjust .5 volt comp A3C2 with insulated adjusting tool for best square-wave response.

e. Disconnect pulse generator.

f. Set 1744A controls as follows:

VOLTS/DIV (Channel A)	.2
Coupling (Channel A)	DC

g. Connect LCR meter to channel A INPUT and observe reading (typically 19.5 to 21.5 pF).

h. Set channel A VOLTS/DIV to .5.

i. Adjust A3C4, channel A input cap., to obtain same reading as noted on .2 range (step g).

j. Disconnect LCR meter.

k. Change DISPLAY to B and repeat steps a through j for channel B, by adjusting A3C17 for channel B .5 V input comp. and A3C19 for channel B .5 V cap.

5-31. VERTICAL GAIN ADJUSTMENT.

REFERENCE:
Service Sheet 5.

DESCRIPTION:
The gain of the vertical preamplifier is calibrated using the CAL 1 V output.

EQUIPMENT: None.

PROCEDURE:
Accomplish the vertical gain adjustment as follows:

a. Connect CAL 1 V output to channel A INPUT using test lead and adapter.

b. Set 1744A controls and adjustments as follows:

VOLTS/DIV (both channels)	.2
A3R49, channel A gain	fully cw
A3R46, channel B gain	fully cw

c. Note signal amplitude of channel A.

d. Change DISPLAY and TRIGGER to B and change CAL signal from A to B input.

e. If channel B amplitude is larger than channel A, adjust A3R46 channel B gain ccw until channel gains are equal. If channel A is larger than channel B, turn channel A gain A3R49 ccw until gains are equal.

f. Adjust overall gain A3R65 to display exactly 5 divisions vertically.

ADJUSTMENTS

5-32. PULSE RESPONSE ADJUSTMENTS.

REFERENCE:

Service Sheet 6.

DESCRIPTION:

A pulse of known characteristics (rise time, overshoot, etc.) is applied and the vertical amplifier is adjusted so that the display will resemble the known characteristics.

EQUIPMENT:

Fast-rise Pulse Generator ..... HP 1105A/1108A

PROCEDURE:

Adjust pulse response as follows:

a. Connect fast-rise pulse generator to channel A INPUT.

b. Set 1744A controls as follows:

Coupling (both channels)	50Ω
Main TIME/DIV	.05 μSEC

NOTE

If assembly A17 or vertical output amplifier IC has been replaced, accomplish step c; otherwise, go to step d.

c. Set following adjustments on A17 as indicated:

A17R19	fully ccw
A17R21	fully ccw
A17R22	fully ccw

d. Set channel A VOLTS/DIV and pulse generator controls as necessary to obtain 5-division display. If possible, make adjustments on .01 VOLTS/DIV range.

e. Adjust A17R21 (HF 4) for flattest pulse top (long time constant).

f. Set main TIME/DIV control to 0.2 μSEC.

g. Engage MAG X10 switch.

h. Adjust A17R19 (HF 3) for flattest pulse top (medium time constant).

i. Alternately adjust A17R22 (HF 2) and A17C6 (HF 1) to set leading edge of pulse to that which most resembles its known characteristics.

NOTE

If pulse generator being used is specified for 3% overshoot, do not set adjustments for less than 3% overshoot since this is effectively detuning the vertical amplifier bandwidth.

j. Repeat steps e through i since some interaction will occur.

k. Change DISPLAY to B.

l. Select TRIGGER B mode.

m. Connect fast-rise pulse generator to channel B INPUT connector.

n. Adjust B HF ADJ A3R22 to make channel B display as similar as possible to channel A display.

NOTE

Check bandwidth after accomplishing response adjustments. If bandwidth is low or marginal, a slight readjustment of HF 1 and HF 2 may be necessary.

ADJUSTMENTS

5-33. X-Y GAIN ADJUSTMENT.

REFERENCE:
Service Sheet 8.

DESCRIPTION:
A low frequency signal is applied to channel A and then to channel B. While in the A vs B mode of operation, channel B is adjusted to equal the gain of channel A.

EQUIPMENT:
Oscillator ..... HP 204C

PROCEDURE:
Adjust X-Y gain as follows:

a. Select A vs B mode of operation.

b. Connect oscillator to channel A INPUT connector.

c. Adjust oscillator and channel A VOLTS/DIV for exactly 6 div of vertical deflection.

d. Disconnect oscillator from channel A and connect to channel B.

e. With channel B VOLTS/DIV set to same setting as channel A, adjust A7R97, A—B cal., for exactly 6 divisions of horizontal deflection.

5-34. INITIAL STORAGE ADJUSTMENT SETUP.

PROCEDURE:
If adjustments are for periodic calibration, no initial settings are necessary. However, if Storage Assembly A17 has been replaced or has had major repairs, or if the CRT has been replaced, set internal adjustments as follows:

A17R115 (COLL ADJ)	midrange
A17R103 (FGG1)	clockwise
A18R3 (WRA)	counterclockwise
A12R24 (AMP LIMIT)	clockwise
A12R3 (CURRENT LIM)	clockwise
A12R19 (PATTERN)	midrange
A15R32 (KNEE)	clockwise
A15R39 (SLOPE)	clockwise
A16R42 (LENS 1)	midrange
A16R44 (LENS 2)	midrange
A16R41 (HV COLL)	midrange
A17R53 (WINDOW)	midrange
A17R112 (ACC ADJ)	midrange
A17S1 (FG PULSER)	engaged

Set front panel controls as follows:

AUTO ERASE/AUTO STORE	disengaged
WRITE/STORE/DISPLAY	WRITE
PERSISTENCE/VIEW TIME	counterclockwise
BRIGHTNESS	counterclockwise

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ADJUSTMENTS

5-35. COLLIMATOR AND FLOODGUN ADJUSTMENTS.

REFERENCE:
Service Sheets 2 and 17.

DESCRIPTION:
These adjustments are set to present the most uniform prefog conditions on the CRT screen.

EQUIPMENT: None.

PROCEDURE:

a. If necessary, accomplish Initial Storage Adjustment Setup (paragraph 5-34).

b. Adjust A17R115 (COLL ADJ) until edges of pattern just fill CRT viewing area. This adjustment should be accomplished while alternately erasing pattern.

c. Adjust A16R41 (HV COLL) for best uniformity (electron cloud should be centered on CRT screen).

d. Set PERSISTENCE/VIEW TIME control to maximum (fully clockwise). Adjust BRIGHTNESS control as necessary.

e. Adjust A17R103 (FGG1) and A12R19 (PATT) for most uniform prefog condition. Periodically erase screen while making these adjustments.

NOTE

A prefogged condition is described as one where the CRT is neither completely black nor bright green but somewhere between.

f. Adjust A17R112 (ACC ADJ) as far clockwise as possible and yet present uniform prefog condition that just fills CRT screen.

NOTE

The closer the accelerator is to the ground (clockwise adjustment), the better the writing rate.

5-36. CRT LENS ADJUSTMENT.

REFERENCE:
Service Sheet 2.

DESCRIPTION:
The lenses of the CRT are adjusted for best overall focus over the entire quality area (6 div x 8 div) of the CRT.

EQUIPMENT:
Oscillator ..... HP 204C

PROCEDURE:

a. Set BEAM INTENSITY for normal intensity trace.

b. Connect oscillator to channel B input connector.

c. Adjust oscillator output for approximately 10 MHz sine wave signal.

d. Select ALT mode of display.

ADJUSTMENTS

e. Using channel A and channel B POSN controls, move sine wave and horizontal trace to center of CRT screen.

f. Adjust FOCUS control for best center screen focus.

g. Adjust A16R42 and A16R44 (LENS 1 and LENS 2) for best focus compromise between center screen and outer edge of quality area (6 div x 8 div).

5-37. WINDOW ADJUSTMENT.

REFERENCE:
Service Sheet 17.

DESCRIPTION:
This adjustment sets the CRT crossover point between fade positive and fade negative.

EQUIPMENT: None.

PROCEDURE:

a. Set 1744A front panels controls as follows:

PERSISTENCE/VIEWTIME	fully clockwise
BRIGHTNESS	as required

b. Adjust BRIGHTNESS control for normal prefog condition.

c. Adjust A17R53 (WINDOW) as close as possible to cross-over point between fading positive or fading negative.

NOTE

Clockwise rotation of A17R53 will produce a fade negative condition and counterclockwise rotation will produce a fade positive condition.

5-38. WRITING RATE AND INTENSITY LIMIT ADJUSTMENTS.

REFERENCE:
Service Sheets 3, 4, and 17.

DESCRIPTION:
Adjusts the limit on the INTENSITY and BRIGHTNESS controls.

EQUIPMENT: None.

PROCEDURE:

a. Set PERSISTENCE/VIEWTIME control fully clockwise.

b. Set BRIGHTNESS control to 3 o'clock position.

c. Adjust A18R3 (WRA) so that CRT is in prefogged condition (CRT is neither completely black nor bright green but somewhere between). Alternately erase display while making this adjustment.

d. Set 1744A front-panel controls as follows:

A VS B	engaged
BEAM INTENSITY	fully ccw

e. Adjust INTENSITY LIMIT ADJ A15R2 so that spot is just extinguished with no fade positive of CRT.

ADJUSTMENTS

5-39. CURRENT LIMIT ADJUSTMENT.

CAUTION

CRT damage can result if this adjustment procedure is not followed closely. Avoid high BEAM INTENSITY setting for extended periods.

REFERENCE:
Service Sheet 4.

DESCRIPTION:
The current limit circuit is adjusted so as to protect the CRT at high settings of the INTENSITY control.

EQUIPMENT:
Signal Generator ..... HP 3200B

PROCEDURE:
a. Set 1744A front-panel controls as follows:

PERSISTENCE	fully ccw
BRIGHTNESS	fully ccw
BEAM INTENSITY	12 o'clock
Main TIME/DIV	10 μSEC
MAG X10	X10

b. Connect signal generator to channel A INPUT connector.

c. Set signal generator output for 10 MHz sine wave, 5-division amplitude display.

d. Set BEAM INTENSITY fully clockwise. Note individual lines of sine-wave display are discernible over entire screen. (Keep FOCUS control optimized.)

e. If lines are not discernible, adjust CURRENT LIMIT A12R3 until lines are barely discernible.

f. Set BEAM INTENSITY fully counterclockwise.

5-40. AMPLITUDE LIMIT, KNEE, AND SLOPE ADJUSTMENTS.

REFERENCE:
Service Sheets 3 and 4.

DESCRIPTION:
The amplitude limit and dynamic focus circuits are adjusted for optimum response.

EQUIPMENT:
Monitor Oscilloscope ..... HP 1740A
10:1 Divider Probe ..... HP 10041A
Digital Multimeter ..... HP 3465A/B
1000:1 HV Divider Probe ..... HP 34111A
Signal Generator ..... HP 3200B

PROCEDURE:
a. Disconnect input ac power from 1744A (LINE switch to OFF).

b. Remove high-voltage lead clamp H35.

ADJUSTMENTS

c. Remove high-voltage assembly cover MP54.

d. For grounding purposes, reinstall two long screws that secure rear of high-voltage assembly board to chassis.

WARNING

Contact with the high-voltage power supply voltage can result in injury or death.

e. Set BEAM INTENSITY fully counterclockwise.

f. Apply input ac power to instrument (LINE switch ON).

g. Using digital voltmeter and 1000:1 hv divider probe, measure CRT cathode voltage at test point A15TP4.

h. Using digital voltmeter and 1000:1 hv divider probe, measure CRT grid voltage at test point A15TP5. Note difference between grid voltage and cathode voltage indication obtained in step g.

i. Connect monitor oscilloscope through 1000:1 divider probe to gate output at test point A12TP2.

j. Set 1744A front-panel controls as follows:

Channel A POSN	fully cw
BEAM INTENSITY	fully cw

k. Disconnect input ac power from 1744A (LINE switch to OFF).

l. Disconnect HV Oscillator Q1 (see figure 5-1 for location) from circuit by removing transistor cable connector from Q1.

m. Apply input ac power to 1744A (LINE switch to ON).

n. Adjust AMP LIMIT A12R24 as observed on monitor oscilloscope for gate p-p amplitude signal of one volt less than difference between cathode and grid voltages noted in step h.

o. Disconnect input ac power from 1744A (LINE switch to OFF).

p. Reconnect transistor cable connector to HV Oscillator Q1.

q. Disconnect monitor oscilloscope from test point A12TP2.

r. Apply input ac power to 1744A (LINE switch to ON).

s. Set 1744A front-panel controls as follows:

BEAM INTENSITY	just visible trace
POSN (Channel A)	midrange
PERSISTENCE/VIEW TIME	fully ccw
Main TIME/DIV	1 μSEC

t. Connect signal generator to channel A INPUT connector.

u. Set signal generator output for 10 MHz, 6-division display.

v. Adjust FOCUS control for best focused display.

w. While pressing ERASE pushbutton frequently, increase BEAM INTENSITY control until trace just starts to defocus.

x. Connect digital voltmeter to test point A15TP6.

ADJUSTMENTS

y. Slowly adjust KNEE control A15R32 ccw to point where indicated voltage on digital voltmeter (≈0 V) begins to drop rapidly (goes in a negative direction). Stop adjustment at this point (just before drop begins).

z. Set BEAM INTENSITY fully cw.

aa. While pressing ERASE pushbutton frequently, adjust SLOPE control A15R39 for best focused display.

NOTE

Upon completion of this procedure, check maximum brightness writing rate as outlined in Section IV Performance Checks. View the waveform using a CRT viewing hood and adjust BRIGHTNESS until waveform is just visible over entire quality viewing area of CRT (6-div by 8-div).

ab. If necessary, readjust COLL (A17R115) and FGG1 (A17R103) for best uniformity.

Table 5-6. Condensed Adjustment Procedure

Adjustment	Procedure
+15 V Adj., A16R26	+15 Vdc ±10 mV.
HVPS Adj., A15R38	1. Connect DVM through 1000:1 divider probe to +120 V. 2. Note error of 1000:1 divider probe. 3. Connect DVM through 1000:1 divider probe to test point A15TP4. 4. Adjust A15R38 for voltage stamped on high-voltage transformer.
Gate Resp Adj., A12R12 and A12C8	1. Disconnect HV Oscillator Q1. 2. Set BEAM INTENSITY control for 25 V peak amplitude as measured at test point A12TP2. 3. Adjust A12R12 and A12C8 for best square-wave response.
Trace Align, A15R27, and Y-axis Align, A12R16	1. Perform trace alignment first. 2. Apply 1-kHz, 8-division vertical amplitude signal to channel A while in A vs B mode. 3. Adjust A12R16 for perpendicular line.
Calib Ampl Adj., A3R116	Adjust for 1 V peak ±10 mV.
Main Trig. Sens Adj., A7R20 Delayed Trig. Sens Adj., A10R9	Adjust so both main and delayed trigger circuits recognize a 50-kHz, 20 mV sine wave.
Sync Zero Adj., A7R41	1. Apply 1 kHz sine wave. 2. Adjust A7R41 for no shift in trigger point while switching trigger coupling between AC and DC.
Trig View Bal., A3R86	1. Apply small sine wave to main EXT TRIGGER. 2. Select TRIG VIEW mode. 3. Adjust A3R86 to center trigger view display on middle horizontal graticule line.

Table 5-6. Condensed Adjustment Procedure (Cont'd)

Adjustment	Procedure
DLY'D Swp Start, A7R169	Adjust so that delayed sweep starts 2 mm after main sweep with DELAY dial pegged at 0.2 position.
Horiz. Ampl X1 Gain Adj., A7R93	1. Set delayed TIME/DIV to .05 μSEC to obtain intensified spot on main sweep. 2. Set DELAY control to 1.00 and position intensified spot to 2nd graticule line. 3. Set DELAY control to 9.00. Adjust A7R93 to position bright spot on 10th graticule line.
.05 - 2 μSEC Adj., A8R43	4. Set for 1 marker/div.
X10 Gain, A7R117	5. Set for 1 marker/div.
Mag Center Adj., A7R105	Adjust so that display at center screen remains at center screen when MAG X10 is engaged.
HORIZONTAL LINEARITY A11R10 A11R15	Adjust on .05 μSEC range, using MAG X10, using 10 ns markers.
PRELIMINARY MAIN SWEEP CAL A8R43	1. 1 μSEC range.
A8R12	2. 10 μSEC range.
A8R13	3. 1 mSEC range.
A8R14	4. 50 mSEC range.
DELAYED SWEEP CAL A9R28	1. .5 μSEC range.
A9R10	2. 5 μSEC range.
A9R11	3. .5 mSEC range.
MAIN SWEEP FINE ADJ	Use DELAY dial at setting of 1.00 and 9.00 to adjust main sweep.

	Main Sweep and Time Mark	Delayed Sweep
A8R43	.5 μSEC	.05 μSEC
A8R12	10 μSEC	1 μSEC
A8R13	1 mSEC	.1 mSEC
A8R14	10 mSEC	5 mSEC

VERTICAL AMPLIFIER BALANCE	
A FET Bal., A3R11	1. Connect DVM to A3TP9 and adjust A3R11 for 0 V ±0.5 mV.
B FET Bal., A3R31	2. Connect DVM to A3TP10 and adjust A3R31 for 0 V ±0.5 mV.
A 5 mV Bal., A3R18	3. Switch channel A VOLTS/DIV control between .005 and .02 positions and adjust A3R18 for minimum trace shift.

Table 5-6. Condensed Adjustment Procedure (Cont'd)

Adjustment	Procedure
VERTICAL AMPLIFIER (Cont'd)	
A 50 mV Bal., A3R19	4. Switch channel A VOLTS/DIV control between .005 and .05 positions and adjust A3R19 for minimum trace shift.
B 5 mV Bal., A3R77	5. Switch channel B VOLTS/DIV control between .005 and .02 positions and adjust A3R77 for minimum trace shift.
B 50 mV Bal., A3R76	6. Switch channel B VOLTS/DIV control between .005 and .05 positions and adjust A3R76 for minimum trace shift.
Pol Bal Adj., A3R90	7. Engage/disengage CH B INVT switch and adjust A3R90 for minimum trace shift. Readjust A3R77 and A3R76, if necessary.
POSITION AND SYNC BALANCE	
B Pos Adj., A3R32	1. Select B DISPLAY; switch between normal and MAG X5, and adjust A3R32 for minimum trace shift.
Sync A Bal., A3R79	2. Apply 10-kHz sine wave to both channels. Select ALT mode and COMP trigger. Adjust A3R79 for stable triggering and minimum phase shift. Readjust A3R18 and A3R19, if necessary.
A Pos Adj., A3R58	3. Select A DISPLAY; switch between normal and MAG X5, and adjust A3R58 for minimum trace shift.
INPUT C AND ATTENUATOR COMPENSATION	
CHANNEL A:	
.5 V Comp, A3C2	1. Apply 5-kHz, 3-V peak-peak square wave to channel A. Adjust A3C2 for best response.
A Input Cap, A3C4	2. Adjust A3C4 to make .5 VOLTS/DIV range match reading on .2 range.
CHANNEL B:	
.5 V Comp, A3C17	3. Apply 5-kHz, 3-V peak-peak square wave to channel B. Adjust A3C17 for best response.
B Input Cap, A3C19	4. Adjust A3C19 to make .5 VOLTS/DIV range match reading on .2 range.
VERTICAL GAIN	
A Gain, A3R49	1. Channel A fine gain.
B Gain, A3R46	2. Channel B fine gain.
Overall Gain, A3R65	3. Composite gain.

Table 5-6. Condensed Adjustment Procedure (Cont'd)

Adjustment	Procedure
PULSE RESPONSE	
HF Adj No. 4, A17R21	1. Long time constant.
HF Adj No. 3, A17R19	2. Medium time constant.
HF Adj No. 2, A17R22	3. Short time constant.
HF Adj No. 1, A17C6	4. Short time constant.
B HF Adj, A3R22	5. Adjust to make channel B signal most resemble channel A.
X-Y Gain	
A—B Cal, A7R97	Adjust for same gain on X-axis as displayed on Y-axis.
COLLIMATOR AND FLOODGUN ADJUSTMENTS	
LV Coll Adj., A17R115	1. Adjust A17R115 until pattern just fills CRT viewing area.
HV Coll Adj., A16R41	2. Adjust A16R41 for best uniformity.
FGG1, A17R103 PATT, A12R19	3. Adjust A17R103 and A12R19 for most uniform and brightest illumination.
Acc Adj., A17R112	4. Adjust A17R112 for most uniform prefog condition.
Lens 1, A16R42	1. Set BEAM INTENSITY for normal intensity of trace.
Lens 2, A16R44	2. Adjust FOCUS for best center screen focus.
	3. Adjust A16R42 and A16R44 for best focus compromise between center and edge of CRT screen.
Window Adj., A17R53	1. Set PERSISTENCE to maximum.
	2. Adjust A17R53 to crossover point between fade positive and fade negative.
WRITING RATE AND INTENSITY LIMIT	
WRA, A18R3	1. Adjust A18R3 so that CRT is neither completely black nor bright green but somewhere between.
Intensity Limit Adj., A15R2	2. Adjust A15R2 so that spot is just extinguished with no fade positive of CRT.
Current Limit Adj., A12R3	1. Set main TIME/DIV 10 μSEC. Engage MAG X10.
	2. Apply 10 MHz, 5-vert. div display signal to instrument.
	3. Adjust A12R3 for just discernible lines over entire screen (with minimum persistence).

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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 Hewlett-Packard Model 1744A Oscilloscope. Supplied with this manual is an Operator's Guide. The Guide is basically a copy of the first three sections of the manual and should be kept with the instrument for use by the operator. The part number is listed on the title page.

1-3. Also listed on the title page of this manual is a Microfiche part number. This number can be used to order 4- x 6-inch microfilm transparencies of the manual. Each microfiche contains up to 96 photo-duplicates of the manual pages. The microfiche package includes the latest manual changes supplement as well as pertinent Service Notes.

1-4. SPECIFICATIONS.

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

1-6. SAFETY CONSIDERATIONS.

1-7. The National Electrical Manufacturer's Association (NEMA) recommends that the instrument panel and cabinet be grounded to protect operating personnel. The 1744A is equipped with a detachable, three-conductor power cord which, when plugged into an appropriate outlet, grounds the instrument through the round offset pin. When operating the 1744A from a two-contact outlet use a three-conductor to two-conductor adapter. Preserve the safety feature by grounding the adapter lead.

1-8. Prior to operating or performing maintenance on the instrument, read the Safety Summary at the front of this manual.

1-9. INSTRUMENTS COVERED BY MANUAL.

1-10. Attached to the instrument is a serial number plate. 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 identical instruments; it changes only when a change is made to the instrument. 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.

1-11. 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 the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a yellow Manual Changes supplement. This supplement contains "change information" that explains how to adapt the manual to the newer instrument.

1-12. 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.

1-13. 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.

1-14. DESCRIPTION.

1-15. The Hewlett-Packard Model 1744A is a dual-channel, 100-MHz, delayed-sweep storage and variable persistence oscilloscope designed for single-shot transients and low duty cycle waveform analyses in the bench or field environment. The dual-channel dc to 100 MHz vertical deflection system has 12 calibrated deflection factors from 5 mV/div to 20 V/div. A maximum sensitivity of 1 mV/div to 30 MHz is provided on both channels by means of a 5X vertical magnification feature. Selectable input impedance of 50 ohms or 1 megohm permits selection of that impedance that best meets measurement requirements. The horizontal deflection system has calibrated sweep rates from 2 s/div to 0.05 μs/div and delayed sweep rates from 20 ms/div to 0.05 μs/div. A 10X magnifier expands all sweeps by a factor of 10 and extends the fastest sweep to 5 ns/div. In alternate or chop modes, a trigger-view control will display three signals: the channel A signal, the channel B signal, and the trigger signal. This allows time correlation between the trigger signal and the

ADJUSTMENTS

CON'T

Table 6-2. Replaceable Parts

Reference Designation	HP Part No. & Ck Digit	Qty	Description	Mfr Code	Mfr Part Number
A1	01740-63401 0		ATTENUATOR ASSEMBLY, CHANNEL A	28480	01740-63401
A2	01740-63402 1		ATTENUATOR ASSEMBLY, CHANNEL B	28480	01740-63402
A3	01740-66530 2		VERTICAL PREAMPLIFIER ASSEMBLY-LESS A3A1	28480	01740-66530
A4	01744-61605 6		CABLE ASSEMBLY, DELAY LINE	28480	01744-61605
A5			NOT ASSIGNED		
A6	0960-0484 0		HV MULTIPLIER ASSEMBLY	28480	0960-0484
A7	01740-66524 4		HORIZONTAL SWEEP ASSEMBLY	28480	01740-66524
A8	01740-66532 4		MAIN SWEEP ASSEMBLY	28480	01740-66532
A9	01740-66522 2		DELAYED SWEEP ASSEMBLY	28480	01740-66522
A10	01740-66508 4		DELAYED TRIGGER ASSEMBLY	28480	01740-66508
A11	01740-66533 5		HORIZONTAL OUTPUT ASSEMBLY	28480	01740-66533
A12	01744-66504 4		GATE ASSEMBLY	28480	01744-66504
A13	01740-66516 4		VERT. CONTROL SWITCHING ASSEMBLY	28480	01740-66516
A14	01740-66540 4		INTERFACE ASSEMBLY	28480	01740-66540
A15	01744-66505 5		HIGH VOLTAGE POWER SUPPLY ASSEMBLY	28480	01744-66505
A16	01744-66501 1		LOW VOLTAGE POWER SUPPLY ASSEMBLY	28480	01744-66501
A17	01744-66507 7	1	STORAGE ASEMBLY CHASSIS	28480	01744-66507
A18	01744-66508 8	1	STORAGE CONTROL ASSEMBLY	28480	01744-66508
B1	3160-0303 9	1	FAN-TBAX 47-CFM 6-16VDCV 1.791-THK	28480	3160-0303
DS1	1990-0524 3	1	LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4550
DS2	1990-0586 7	4	LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4855
DS3	1990-0586 7		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4855
DS4	1990-0586 7		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4855
DS5	1990-0586 7		LED-VISIBLE LUM-INT=800UCD IF=50MA-MAX	28480	5082-4855
E1	0340-0511 0	6	INSULATOR-XSTR KAPTON	28480	0340-0511
E2	1510-0038 8	1	BINDING POST ASSY SGL THD-STUD	28480	1510-0038
E3	0360-1646 6	1	TERMINAL-STUD SPCL-FDTHRU PRESS-MTG	28480	0360-1646
E4	9170-0016 8	3	CORE-SHIELDING BEAD	28480	9170-0016
E5	9170-0016 8		CORE-SHIELDING BEAD	28480	9170-0016
E6	9170-0016 8		CORE-SHIELDING BEAD	28480	9170-0016
E7	2110-0465		CAP, FUSEHOLDER	28480	2110-0465
F1	2110-0007 4	2	FUSE 1A 250V SLO-BLO 1.25X.25 UL IEC	75915	313001
F1	2110-0202 1	1	FUSE 0.5A 250V SLO-BLO 1.25X.25 UL IEC (FOR 220/240V OPERATION)	75915	OBD
H1	0520-0127 6	3	SCREW-MACH 2-56 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H2	0624-0279 9	8	SCREW-TPG 8-32 .75-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H3	0624-0306 3	8	SCREW-TPG 2-28 .5-IN-LG PAN-HD-POZI STL	28480	0624-0306
H4	0624-0313 2	4	SCREW-TPG 4-20 1-IN-LG PAN-HD-POZI STL	28480	0624-0313
H5	2190-0005 0	9	WASHER-LK EXT T NO. 4 .116-IN-ID	28480	2190-0005
H6	2190-0016 3	11	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
H7	2190-0017 4	4	WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
H8	2190-0006 1	4	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
H9	2190-0019 6	11	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
H10	2190-0084 5	3	WASHER-LK INTL T 1/4 IN .256-IN-ID	28480	2190-0084

See introduction to this section for ordering information

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

Reference Designation	HP Part No. & Ck Digit	Qty	Description	Mfr Code	Mfr Part Number
H11	2190-0910 6	1	WASHER-LK INTL T NO. 4 .12-IN-ID	28480	2190-0910
H12	2200-0103 2	2	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H13	2200-0105 4	51	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H14	2200-0123 6	2	SCREW-MACH 4-40 1.25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H15	2200-0143 0	5	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H16	2200-0149 6	1	SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H17	2200-0762 9	8	SCREW-MACH 4-40 .25-IN-LG TR-HD-POZI	00000	ORDER BY DESCRIPTION
H18	2260-0002 6	9	NUT-HEX-DBL-CHAM 4-40-THD .062-IN-THK	00000	ORDER BY DESCRIPTION
H19	2360-0207 5	4	SCREW-MACH 6-32 .875-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H20	2360-0197 2	9	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H21	3050-0105 6	6	SCREW-MACH 8-32 .75-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H22	2510-0138 0	4	SCREW-MACH 8-32 3-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H23	2580-0004 6	4	NUT-HEX-DBL-CHAM 8-32-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
H24	2950-0035 8	2	NUT-HEX-DBL-CHAM 15/32-32-THD	00000	ORDER BY DESCRIPTION
H25	2950-0043 8	14	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
H26	2950-0072 3	5	NUT-HEX-DBL-CHAM 1/4-32-THD .062-IN-THK	00000	ORDER BY DESCRIPTION
H27	3030-0196 3	4	SCREW-SET 4-40 .188-IN-LG SMALL CUP-PT	00000	ORDER BY DESCRIPTION
H28	3050-0010 2	11	WASHER-FL MTLC NO. 6 .147-IN-ID	28480	3050-0010
H29	3050-0071 5	6	WASHER-FL MTLC NO. 8 .169-IN-ID	28480	3050-0071
H30	3050-0160 3	4	WASHER-FL MTLC 7/16 IN .47-IN-ID	28480	3050-0160
H31	3050-0481 1	1	WASHER-FL NM NO. 12 .25-IN-ID .75-IN-OD	28480	3050-0481
H32	3050-0655 1	2	WASHER-FL NM NO. 6 .156-IN-ID .375-IN-OD	28480	3050-0655
H33	0520-0136 7	8	SCREW-MACH 2-56 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H34	2190-0112 0	10	WASHER-LK HLCL NO. 2 .088-IN-ID	28480	2190-0112
H35	01741-01205 3	1	CLAMP, HV LEAD	28480	01741-01205
H36	2200-0155 4	5	SCREW-MACH 4-40 1-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H37	0400-0010 2	4	GROMMET-RND .25-IN-ID .375-IN-GRV-OD	28480	0400-0010
H38	1400-0017 0	1	CLAMP-CABLE .312-DIA .375-WD NYL	28480	1400-0017
H39	1400-0082 9	2	CLAMP-CABLE 125 DIA 375 WD NYL	28480	1400-0082
H40	2190-0037 8	1	WASHER-LK INTL T 1/2 IN .512-IN-ID	28480	2190-0037
H41	1400-0090 9	1	WASHER RUBBER 5/8" OD	00000	OBD
H42	2200-0145 2	4	SCREW-MACH 4-40 .438-IN-LG PAN-HD-POZI	28480	2200-0145
H43	3050-0105 6	4	WASHER-FLT MTLC NO. 4 .125-IN-ID	28480	3050-0105
H44	2200-0101 0	4	SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	28480	2200-0101
H45	2360-0370 3	4	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	28480	2360-0370
H46	2260-0001 5	4	NUT-HEX-DBL-CHAM 4-40-THD .094-IN-THK	28480	2260-0001
H47	1490-0968 9	2	BUSHING-PNL .14-ID .3-LG 1/4-32-THD	28480	1490-0968
H48	2110-0467 1	1	NUT-SPCLY 1/2-24-THD .125-IN-THK	28480	2110-0467
H49	3050-0050 0	2	WASHER-FLT MTLC 7/16-IN .5-IN-ID	28480	3050-0050
H50	0380-1019 9	2	STANDOFF-RND 5-LG 8-32-THD .375-OD-BRS	28480	0380-1019
H51	1400-0026 1	1	CLAMP, HOSE 1.812-2.75-DIA .5-WD SST	66295	OBD
H52	2360-0113 2	2	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	28480	2360-0113
H53	2360-0117 6	8	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	28480	2360-0117
H54	2510-0111 7	2	THREADED-INSERT-NUT-8-32 .75-LG-STL	83324	RPN-8-32SC
H55	3050-0001 1	4	WASHER-FLT MTLC NO 8 .172-IN-ID	10630	OBD
J1	1250-0118 3	5	CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0118
J2	1250-0118 3		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0118
J3	1250-0118 3		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0118
J4	1250-0118 3		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0118
J5	1250-0118 3		CONNECTOR-RF BNC FEM SGL-HOLE-FR 50-OHM	28480	1250-0118
J6	1250-0524 5	2	CONNECTOR, RF BNC SER;BHD MT JK RCPT	05276	3840-600
J7	1250-0524 5		CONNECTOR, RF BNC SER;BHD MT JK RCPT	05276	3840-600
L1	01332-66001 8	1	COIL, TRACE ALIGN	28480	01332-66001
L2	01744-66001 6	1	COIL, ORTHO ALIGN	28480	01744-66001
MP1	0370-0603 4	4	PUSHBUTTON;SQUARE, MINT GRAY	28480	0370-0603
MP2	0370-0671 6	9	KNOB	28480	0370-0671
MP3	0370-0963 9	1	KNOB-CONC 1/2 JGK .125-IN-ID	28480	0370-0963
MP4	0370-1005 2	6	KNOB-BASE-PTR 3/8 JGK .125-IN-ID	28480	0370-1005
MP5	0370-1099 4	4	KNOB-BASE-PTR 1/2 JGK .25-IN-ID	28480	0370-1099
MP6	0370-1100 8	1	KNOB-BASE-PTR 1/2 JGK .25-IN-ID	28480	0370-1100
MP7	0370-2624 5	34	KNOB	28480	0370-2626
MP8	0370-2630 5	15	KNOB	28480	0370-2630
MP9	0370-2783 5	2	KNOB	28480	0370-2783
MP10	1460-0604 7	2	SPRING-CPRSN .95-IN-OD 1.185-IN-LG MUA	28480	1460-0604
MP11	0370-0684 1	3	KNOB	28480	0370-0684
MP12	1540-0292 9	1	CASE-ACCESSPVC 13.5LG 10.5WD 2.5DP	28480	1540-0292
MP13	5020-8733 1	2	GEAR, HUB HANDLE	28480	5020-8733
MP14	5020-8734 2	2	RING, HANDLE	28480	5020-8734
MP15	5020-8744 4	1	SPACER, DIAL	28480	5020-8744
MP16	5020-8745 5	1	SPACER, DIAL	28480	5020-8745
MP17	5040-0421 0	1	INSULATOR COVER;POTENTIOMETER	28480	5040-0421
MP18	5040-0511 9	2	CAP, TRIM	28480	5040-0511
MP19	5040-0515 3	1	ASSY, HANDLE	28480	5040-0515
MP20	5040-0516 4	1	COVER, PANEL	28480	5040-0516
MP21	5040-0578 8	1	BEZEL, CRT	28480	5040-0578
MP22	5040-7829 6	4	FOOT, CORD WRAP	28480	5040-7829
MP23	01741-01206 4	1	STRAP, BOARD SUPPORT	28480	01741-01206
MP24	5040-7023 2	4	ROD, PUSH	28480	5040-7023
MP25	5040-7598 6	2	LEVER, COUPLING	28480	5040-7598
MP26	1400-0798 4	1	CLAMP;CRT, OLIVE	28480	1400-0798
MP27	5040-7705 7	4	EXTENDER, PUSHBUTTON	28480	5040-7705
MP28	5040-7706 8	4	EXTENDER, PUSHBUTTON	28480	5040-7706
MP29	5040-7755 7	1	EXTENDER, PUSHBUTTON	28480	5040-7755
MP30	5040-7756 8	1	EXTENDER, PUSHBUTTON	28480	5040-7756

See introduction to this section for ordering information

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

Reference Designation	HP Part No. & Ck Digit	Qty	Description	Mfr Code	Mfr Part Number
MP31	01741-09101 4	2	SPRING, GROUND	28480	01741-09101
MP32	7120-6274 5	1	LABEL, HANDLE	28480	7120-6274
MP33	01701-04108 3	1	COVER, CRT	28480	01701-04108
MP34	01710-04103 9	1	COVER, TRANSFORMER	28480	01710-04103
MP35	01720-22501 1	1	RING, ANTIRUN	28480	01720-22501
MP36	01720-23705 9	1	SHAFT, DELAYED SWEEP SWITCH	28480	01720-23705
MP37	01740-20601 2	1	SAFETY SHIELD, CRT	28480	01740-20601
MP38	01720-63703 1	1	SHAFT ASSEMBLY, MAIN SWEEP	28480	01720-63703
MP39	01720-67403 6	1	KNOB, DELAYED SWEEP	28480	01720-67403
MP40	01720-67405 8	2	KNOB, VERNIER	28480	01720-67405
MP41	01744-00101 9	1	DECK, REAR	28480	01744-00101
MP42	01740-00102 6	1	DECK, FRONT	28480	01740-00102
MP43	01744-00201 0	1	PANEL, FRONT	28480	01744-00201
MP44	01744-00204 2	1	PANEL, REAR	28480	01744-00204
MP45	01740-00601 0	1	SHIELD, PREAMPLIFIER	28480	01740-00601
MP46	0350-0999 9	1	DECAL-KB SKT TEXT: ".1 .2 .5 1 2 SEC OFF	28480	0350-0999
MP47	01740-01201 8	1	BRACKET, DELAYED TRIGGER	28480	01740-01201
MP48	01744-01201 2	1	BRACKET, HIGH VOLTAGE	28480	01744-01201
MP49	01740-09101 3	2	SPRING, SWEEP GROUND	28480	01740-09101
MP50	01740-01204 1	1	BRACKET, HORIZONTAL	28480	01740-01204
MP51	01740-01209 6	1	BRACKET, HORIZONTAL, TOP	28480	01740-01209
MP52	01740-01212 1	2	BRACKET, BNC	28480	01740-01212
MP53	01740-02701 5	1	FILTER, CONTRAST	28480	01740-02701
MP54	01744-04101 7	1	COVER, HIGH VOLTAGE	28480	01744-04101
MP55	01744-04102 8	1	COVER, TOP	28480	01744-04102
MP56	01744-04103 9	1	COVER, BOTTOM	28480	01744-04103
MP57	01741-20501 2	1	HEAT SINK	28480	01741-20501
MP58	01740-04109 1	1	COVER, LINE	28480	01740-04109
MP59	01740-20501 1	1	FRAME, FRONT	28480	01740-20501
MP60	01744-20501 5	1	FRAME, REAR	28480	01744-20501
MP61	01741-01204 5	1	BRACKET, HEAT SINK	28480	01741-01204
MP62	01744-23701 3	2	RAIL, SIDE	28480	01744-23701
MP63	01740-24702 2	1	SUPPORT, CRT CAMERA	28480	01740-24702
MP64	01740-43901 3	2	SHAFT, EXTENSION	28480	01740-43901
MP65	01744-60601 0	1	SHIELD ASSEMBLY, CRT	28480	01744-60601
MP66	01740-67402 9	1	KNOB ASSEMBLY, MAIN SWEEP	28480	01740-67402
MP67	01830-23201 3	2	COUPLER, SWEEP EXTENSION	28480	01830-23201
MP68	0510-0541 7	3	COLLAR .305-WD STL	28480	0510-0541
MP69	1410-0094 4	2	BUSHING-PNL .261-ID .293-LG 3/8-32-THD	28480	1410-0094
MP70	0370-2862 1	1	KNOB	28480	0370-2862
MP71	0390-0006 3	4	INSULATOR-FLG-BSHG NYLON	28480	0390-0006
MP72	7120-6277 8	1	LABEL-IDENTIFICATION .525-IN-WD 6-IN-LG	28480	7120-6277
MP73	1400-0665 4	5	CLAMP/HOLDER-CMPNT/CA (MISC)	28480	1400-0665
MP74	1140-0036 1	1	TURNS DIAL 2 SCALES	28480	1140-0036
MP75	3150-0300 5	1	FILTER, FAN	28480	3150-0300
MP76	5040-5952 2	1	KNOB CORE, STA, 1.5 IN, JGK	28480	5040-5952
MP77	01741-63701 4	1	SHAFT ASSEMBLY, PB	28480	01741-63701
MP78	3050-0791 6	5	INSULATOR-XSTR NYLON	28480	3050-0791
MP79	01703-24701 6	1	SPACER, SHAFT, PB	28480	01703-24701
MP81	01741-01201 9	1	BRACKET, CONTROL	28480	01741-01201
MP82	01744-01202 3	1	BRACKET, FAN MOUNTING	28480	01744-01202
MP83	01703-67401 3	1	KNOB ASSEMBLY, CONC	28480	01703-67401
MP84			NOT ASSIGNED		
MP85	01744-01203 4	1	BRACKET, STORAGE BOARD	28480	01744-01203
P1	1251-4070 6	1	CONNECTOR-AC PWR HP-9 MALE REC-FLG NYL	28480	1251-4070
Q1	185 33 5	1	TRANSISTOR NPN SI PD=90W FT=2MHZ	28480	1854-0433
Q2	185 573 4	1	TRANSISTOR NPN SI PD=30W FT=10MHZ	28480	1854-0573
Q3	185 0370 9	4	TRANSISTOR NPN 2N5294 SI PD=1.8W	28480	1854-0370
Q4	185 0370 9		TRANSISTOR NPN 2N5294 SI PD=1.8W	28480	1854-0370
Q5	1854-0370 9		TRANSISTOR NPN 2N5294 SI PD=1.8W	28480	1854-0370
Q6	1854-0370 9		TRANSISTOR NPN 2N5294 SI PD=1.8W	28480	1854-0370
R1	2100-3499 3	1	RESISTOR-VAR CONTROL CC 10K 20% LIN	28480	2100-3499
R2	2100-3500 7	1	RESISTOR-VAR CONTROL CC 1M 20% LIN	28480	2100-3500
R5	0683-1505 0	2	RESISTOR 15 5% .25W FC TC=-400/+500	01121	CB1505
R6	2100-1443 3	1	RESISTOR-VAR PREC WW 10-TRN 50K 3%	28480	2100-1443
R7	0684-1021 7	2	RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
R8	2100-0657 9	1	RESISTOR-VAR W/SW 100K 30% LIN	28480	2100-0657
R9	2100-3397 0	1	RESISTOR-VAR W/SW 200K 20% 10CW DPST-NC	28480	2100-3397
R10	0683-1505 0		RESISTOR 15 5% .25W FC TC=-400/+500	01121	CB1505

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

Reference Designation	HP Part No. & Ck Digit	Qty	Description	Mfr Code	Mfr Part Number
R11	2100-3731 6	1	RESISTOR-VAR DUAL 20K-20%-CCP	28480	2100-3731
R12	0684-1021 1		RESISTOR 1K 10% .25W TC=-400/+600	01121	CB1021
R13	0684-2721 6	1	RESISTOR 2.7K 10% .25W TC=-400/+600	01121	CB2721
S1	3101-0163 4	1	SWITCH SL DPDT NS STD 1.5A 125VAC	82389	11A-0163
T1	9100-3995 1	1	TRANSFORMER, INPUT POWER	28480	9100-3995
V1	5083-5152 4	1	CRT, P31 AL IG	28480	5083-5152
W1	8120-1521 6	1	CABLE ASSY 18AWG 3-CNDCT JGK-JKT	28480	8120-1521
W2	01740-61602 9	1	CABLE ASSEMBLY, SYNC	28480	01740-61602
W3	01740-61621 2	1	CABLE ASSEMBLY, FRONT PANEL	28480	01740-61621
W4	01744-61603 4	1	CABLE ASSEMBLY, HORIZONTAL OUTPUT	28480	01744-61603
W5	01744-61601 2	1	CABLE ASSEMBLY, CRT BASE	28480	01744-61601
W6	01740-61609 6	1	CABLE ASSEMBLY, TRIG VIEW	28480	01740-61609
W7	01740-61622 3	1	CABLE ASSEMBLY, HORIZONTAL POSITION	28480	01740-61622
W8	01740-61610 9	1	CABLE ASSEMBLY, VERT UNCAL	28480	01740-61610
W10	01744-61602 3	1	CABLE ASSEMBLY, CRT NECK PINS	28480	01744-61602
XF1	2110-0470 1	1	FUSEHOLDER-EXTR POST	28480	2110-0470
XV1	1200-0037 0	1	SOCKET, CRT BASE (P/O W5)	28480	1200-0037

See introduction to this section for ordering information

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

Reference Designation	HP Part No. & Ck Digit	Qty	Description	Mfr Code	Mfr Part Number
A1	01740-63401 0	1	ATTENUATOR ASSEMBLY, CHANNEL A	28480	01740-63401
A1R1	2100-3551 8	2	RESISTOR-VAR W/SW 100 10% LIN DPST-NC-NO	28480	2100-3551
A2	01740-63402 1	1	ATTENUATOR ASSEMBLY, CHANNEL B	28480	01740-63402
A2R1	2100-3551 8		RESISTOR-VAR W/SW 100 10% LIN DPST-NC-NO	28480	2100-3551
A3	01740-66530 2	1	VERTICAL PREAMPLIFIER ASSEMBLY-LESS A3A1	28480	01740-66530
A3C1	0160-4204 4	2	CAPACITOR-FXD .033UF +-10% 500VDC CER	51642	300-500-X7R-333K
A3C2	0121-0060 0	4	CAPACITOR-V TRMR-CER 2-8PF 350V PC-MTG	52763	304322 2/8PF NPO
A3C3	0150-0021 4	3	CAPACITOR-FXD .47PF +-5% 500VDC TI DIOX	28480	0150-0021
A3C4	0121-0060 0		CAPACITOR-V TRMR-CER 2-8PF 350V PC-MTG	52763	304322 2/8PF NPO
A3C5	0160-2150 5	2	CAPACITOR-FXD 33PF +-5% 300VDC MICA	28480	0160-2150
A3C6	0160-3448 6	4	CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3448
A3C7	0160-3799 0	2	CAPACITOR-FXD 18PF +-10% 100VDC CER	28480	0160-3799
A3C8	0160-3451 1	82	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C9	0160-3508 9	4	CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A3C10	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C11	0180-2752 5	2	CAPACITOR-FXD .1UF+-10% 35VDC TA	28480	0180-2752
A3C12	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C13	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C14	0160-4204 4		CAPACITOR-FXD .033UF +-10% 500VDC CER	51642	300-500-X7R-333K
A3C15	0160-3567 0	2	CAPACITOR-FXD 10PF +-5% 100VDC CER 0+-30	28480	0160-3567
A3C16	0160-3448 6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3448
A3C17	0121-0060 0		CAPACITOR-V TRMR-CER 2-8PF 350V PC-MTG	52763	304322 2/8PF NPO
A3C18	0150-0021 4		CAPACITOR-FXD .47PF +-5% 500VDC TI DIOX	28480	0150-0021
A3C19	0121-0060 0		CAPACITOR-V TRMR-CER 2-8PF 350V PC-MTG	52763	304322 2/8PF NPO
A3C20	0160-2198 1	3	CAPACITOR-FXD 20PF +-5% 300VDC MICA	28480	0160-2198
A3C21	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C22	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C23	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C24	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C25	0180-2752 5		CAPACITOR-FXD .1UF+-10% 35VDC TA	28480	0180-2752
A3C26	0160-3443 1	5	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A3C27	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C28	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C29	0180-0374 3	5	CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X902082
A3C30	0160-3443 1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A3C31	0160-3567 0		CAPACITOR-FXD 10PF +-5% 100VDC CER 0+-30	28480	0160-3567
A3C32	0160-3470 4	3	CAPACITOR-FXD .01UF +80-20% 50VDC CER	28480	0160-3470
A3C33	0180-2255 3	7	CAPACITOR-FXD 2.2UF+-20% 20VDC TA	72982	301-000-C0H0-829C
A3C34	0180-2255 3		CAPACITOR-FXD 2.2UF+-20% 20VDC TA	72982	301-000-C0H0-829C
A3C35	0180-2255 3		CAPACITOR-FXD 2.2UF+-20% 20VDC TA	72982	301-000-C0H0-829C
A3C36	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C37	0160-4324 9	2	CAPACITOR-FXD 220PF +-10% 50VDC CER	04222	3417-050-C-221-K
A3C38	0160-4324 9		CAPACITOR-FXD 220PF +-10% 50VDC CER	04222	3417-050-C-221-K
A3C39	0150-0061 2	1	CAPACITOR-FXD 20PF +-10% 100VDC CER	28480	0150-0061
A3C40	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C41	0160-3508 9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A3C42	0180-0374 3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X902082
A3C43	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C44	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C45	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C46	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C47	0160-2217 5	1	CAPACITOR-FXD 910PF +-5% 300VDC MICA	28480	0160-2217
A3C48	0180-0228 6	4	CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X901582
A3C49	0160-2207 3	1	CAPACITOR-FXD 300PF +-5% 300VDC MICA	28480	0160-2207
A3C50	0180-2255 3		CAPACITOR-FXD 2.2UF+-20% 20VDC TA	72982	301-000-C0H0-829C
A3C51	0160-0820 2	4	CAPACITOR-FXD .05UF +80-20% 25VDC CER	28480	0160-0820
A3C52	0180-2255 3		CAPACITOR-FXD 2.2UF+-20% 20VDC TA	72982	301-000-C0H0-829C
A3C53	0160-3466 8	4	CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A3C54	0160-3466 8		CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A3C55	0160-3466 8		CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A3C56	0160-0820 2		CAPACITOR-FXD .05UF +80-20% 25VDC CER	28480	0160-0820
A3C57	0180-0228 6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X901582
A3C58	0180-2255 3		CAPACITOR-FXD 2.2UF+-20% 20VDC TA	72982	301-000-C0H0-829C
A3C59	0160-0820 2		CAPACITOR-FXD .05UF +80-20% 25VDC CER	28480	0160-0820
A3C60	0180-0228 6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X901582
A3C61	0160-0820 2		CAPACITOR-FXD .05UF +80-20% 25VDC CER	28480	0160-0820
A3C63	0180-2255 3		CAPACITOR-FXD 2.2UF+-20% 20VDC TA	72982	301-000-C0H0-829C
A3C64	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C65	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451

See introduction to this section for ordering information

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

Reference Designation	HP Part No. & Ck Digit	Qty	Description	Mfr Code	Mfr Part Number
A3C66	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C67	0160-3448 6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3448
A3C68	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C69	0160-3470 4		CAPACITOR-FXD .01UF +80-20% 50VDC CER	28480	0160-3470
A3C70	0160-3470 4		CAPACITOR-FXD .01UF +80-20% 50VDC CER	28480	0160-3470
A3C71	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C72	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C73	0140-0192 9	5	CAPACITOR-FXD 68PF +-5% 300VDC MICA	72136	DM15E680J0300WV1CR
A3C74	0150-0031 6	1	CAPACITOR-FXD 2PF +-5% 500VDC TI DIOX	28480	0150-0031
A3C75	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C77	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C78	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C79	0160-3651 3	2	CAPACITOR-FXD 68PF +-10% 200VDC CER	28480	0160-3651
A3CR0	0160-3651 3		CAPACITOR-FXD 68PF +-10% 200VDC CER	28480	0160-3651
A3CR1	1901-0040 1	68	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR4	1901-0047 8	4	DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A3CR5	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR6	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR7	1901-0047 8		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A3CR8	1901-0047 8		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A3CR9	1901-0047 8		DIODE-SWITCHING 20V 75MA 10NS	28480	1901-0047
A3CR11	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR12	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR13	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR14	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR15	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR16	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR17	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR18	1910-0016 0	4	DIODE-GE 60V 60MA 1US DO-7	28480	1910-0016
A3CR19	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR20	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR21	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR23	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR25	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A3CR26	1901-0045 6	2	DIODE-PWR RECT 100V 750MA DO-29	28480	1901-0045
A3CR27	1901-0045 6		DIODE-PWR RECT 100V 750MA DO-29	28480	1901-0045
A3CR28	1906-0042 3	1	DIODE-DUAL 70V VF DIFF=10MV	28480	1906-0042
A3CR29	1901-0773 7	2	DIODE-HOT CARRIER	28480	1901-0773
A3CR30	1901-0773 7		DIODE-HOT CARRIER	28480	1901-0773
A3E1	9170-0029 3	7	CORE-SHIELDING BEAD	28480	9170-0029
A3L1	9100-0670 3	2	COIL, FXD 3-TURN,#34AWG CU ON	28480	9100-0670
A3L2	9100-0670 3		COIL, FXD 3-TURN,#34AWG CU ON	28480	9100-0670
A3L3	9100-2264 5	2	COIL-MLD 6.8UH 10% Q=50 .095DX.25LG-NOM	28480	9100-2264
A3L4	9100-2264 5		COIL-MLD 6.8UH 10% Q=50 .095DX.25LG-NOM	28480	9100-2264
A3L5	9100-1650 1	2	COIL-MLD 680UH 5% Q=60 .19DX.44LG-NOM	28480	9100-1650
A3L6	9100-1650 1		COIL-MLD 680UH 5% Q=60 .19DX.44LG-NOM	28480	9100-1650
A3MP1	01740-00603 2	2	SHIELD, RESISTOR	28480	01740-00603
A3MP2	5040-7617 0	1	FRAME, IC	28480	5040-7617
A3MP3	01801-01206 7	2	BRACKET, ANGLE	28480	01801-01206
A3MP4	1205-0095 0	4	HEAT SINK TO-5/TO-39-PKG	28480	1205-0095
A3P1			PART OF A3 ASSEMBLY		
A3P2	1251-3750 7	3	CONNECTOR 10-PIN M POST TYPE	28480	1251-3750
A3P3	1251-3904 3	2	CONNECTOR 8-PIN M POST TYPE	28480	1251-3904
A3P4	1251-3904 3		CONNECTOR 8-PIN M POST TYPE	28480	1251-3904
A3Q1	1853-0380 9	5	TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0380
A3Q2	1855-0266 4	2	TRANSISTOR-JFET DUAL N-CHAN D-MODE TO-78	28480	1855-0266
A3Q3	1853-0380 9		TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0380
A3Q4	1855-0266 4		TRANSISTOR-JFET DUAL N-CHAN D-MODE TO-78	28480	1855-0266
A3Q5	1854-0092 2	11	TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A3Q6	1854-0628 0	2	TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPS-H17
A3Q7	1854-0628 0		TRANSISTOR NPN SI TO-92 PD=625MW	04713	MPS-H17
A3Q8	1854-0215 1	26	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A3Q9	1853-0036 2	34	TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q10	1854-0092 2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A3Q11	1854-0215 1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A3Q12	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q13	1855-0367 6	1	TRANSISTOR-UJT P ON N	28480	1855-0367
A3Q14	1854-0071 7	11	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q15	1854-0071 7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q16	1853-0015 7	2	TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A3Q17	1853-0314 9	1	TRANSISTOR PNP 2N2905A SI TO-39 PD=600MW	04713	2N2905A
A3Q18	1854-0071 7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q19	1854-0213 9	1	TRANSISTOR NPN 2N2538 SI TO-5 PD=800MW	28480	1854-0213
A3Q20	1853-0086 2	3	TRANSISTOR PNP SI PD=310MW FT=40MHZ	28480	1853-0086

See introduction to this section for ordering information

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

Reference Designation	HP Part No. & Ck. Digit	Qty	Description	Mfr Code	Mfr Part Number
A3Q21	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3R1	0698-8648 7	2	RESISTOR 50 2% .5W MO TC=0+-150	28480	0698-8648
A3R2	0698-7206 1	1	RESISTOR 56.2 1% .05W F TC=0+-100	24546	C3-1/8-T00-56R2-G
A3R3	0698-8622 7	4	RESISTOR 990K .5% .125W F TC=0+-50	28480	0698-8622
A3R4	0698-3329 1	2	RESISTOR 10K .5% .125W F TC=0+-100	03888	PME55-1/8-T0-1002-D
A3R5	0698-8622 7		RESISTOR 990K .5% .125W F TC=0+-50	28480	0698-8622
A3R6	0675-1011 6	2	RESISTOR 100 10% .125W CC TC=-270/+540	01121	BB1011
A3R7	0698-7216 3	4	RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A3R8	0687-2241 1	2	RESISTOR 220K 10% .5W CC TC=0+882	01121	EB2241
A3R9	0757-0401 0	0	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R10	0698-3157 3	6	RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3R11	2100-0568 1	3	RESISTOR-TRMR 100 10% C TOP-ADJ 1-TRN	28480	2100-0568
A3R12	0684-1001 3	17	RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A3R13	0683-0475 1	3	RESISTOR 4.7 5% .25W FC TC=-400/+500	01121	CB47G5
A3R14	0757-0394 0	6	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3R15	0698-7926 2	5	RESISTOR 470 10% .125W CC TC=-330/+800	01121	BB4711
A3R16	0757-0394 0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3R17	0698-3157 3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3R18	2100-3531 4	4	RESISTOR-TRMR 250 10% C TOP-ADJ 1-TRN	28480	2100-3531
A3R19	2100-3531 4		RESISTOR-TRMR 250 10% C TOP-ADJ 1-TRN	28480	2100-3531
A3R20	0757-0410 1	4	RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A3R21	0698-8648 7		RESISTOR 50 2% .5W MO TC=0+-150	28480	0698-8648
A3R22	2100-2061 3	1	RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	73138	82PR200
A3R23	0698-8622 7		RESISTOR 990K .5% .125W F TC=0+-50	28480	0698-8622
A3R24	0698-3329 1		RESISTOR 10K .5% .125W F TC=0+-100	03888	PME55-1/8-T0-1002-D
A3R25	0698-8622 7		RESISTOR 990K .5% .125W F TC=0+-50	28480	0698-8622
A3R26	0687-2241 1		RESISTOR 220K 10% .5W CC TC=0+882	01121	EB2241
A3R27	0675-1011 6		RESISTOR 100 10% .125W CC TC=-270/+540	01121	BB1011
A3R28	0698-7216 3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A3R29	0757-0401 0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R30	0698-3157 3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3R31	2100-0568 1		RESISTOR-TRMR 100 10% C TOP-ADJ 1-TRN	28480	2100-0568
A3R32	2100-3212 8	4	RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	28480	2100-3212
A3R33	0698-0082 7	3	RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A3R34	0698-3495 2	2	RESISTOR 866 1% .125W F TC=0+-100	24546	C4-1/8-T0-866R-F
A3R35	0757-0403 2	2	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A3R36	2100-3433 5	2	RESISTOR-VAR CONTROL CCP 250 10% LIN	01121	73M1G040R251U
A3R37	0698-0082 7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A3R38	0698-4125 7	2	RESISTOR 953 1% .125W F TC=0+-100	24546	C4-1/8-T0-953R-F
A3R39	0684-1001 3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A3R40	0757-0394 0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3R41	0757-0284 7	7	RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
A3R42	0757-0398 4	3	RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A3R43	0698-7926 2		RESISTOR 470 10% .125W CC TC=-330/+800	01121	BB4711
A3R44	0684-0271 7	6	RESISTOR 2.7 10% .25W FC TC=-400/+500	01121	CB27G1
A3R45	0757-0433 8	17	RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A3R46	2100-0554 5	4	RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	28480	2100-0554
A3R47	0757-0394 0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A3R48	0698-3157 3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A3R49	2100-0554 5		RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	28480	2100-0554
A3R50	0757-0398 4		RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A3R51	0757-0284 7		RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
A3R52	0684-0271 7		RESISTOR 2.7 10% .25W FC TC=-400/+500	01121	CB27G1
A3R53	0757-0433 8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A3R54	0698-7216 3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A3R55	0698-7216 3		RESISTOR 147 1% .05W F TC=0+-100	24546	C3-1/8-T0-147R-G
A3R56	0698-4125 7		RESISTOR 953 1% .125W F TC=0+-100	24546	C4-1/8-T0-953R-F
A3R57	0698-3495 2		RESISTOR 866 1% .125W F TC=0+-100	24546	C4-1/8-T0-866R-F
A3R58	2100-3212 8		RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	28480	2100-3212
A3R59	0698-7228 7	2	RESISTOR 464 1% .05W F TC=0+-100	24546	C3-1/8-T0-464R-G
A3R60	0698-7228 7		RESISTOR 464 1% .05W F TC=0+-100	24546	C3-1/8-T0-464R-G
A3R61	2100-3433 5		RESISTOR-VAR CONTROL CCP 250 10% LIN	01121	73M1G040R251U
A3R62	0757-0403 2		RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A3R63	0757-0411 2	6	RESISTOR 332 1% .125W F TC=0+-100	24546	C4-1/8-T0-332R-F
A3R64	0757-0401 0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R65	2100-0567 0	3	RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	28480	2100-0567
A3R66	0757-0401 0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R67	0698-3455 4	3	RESISTOR 261K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2613-F
A3R68	0684-4721 0	19	RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A3R69	0684-1031 9	24	RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A3R70	0757-0462 3	2	RESISTOR 75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7502-F
A3R71	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A3R72	0698-3161 9	3	RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A3R73	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A3R74	0757-0739 7	1	RESISTOR 2K 1% .25W F TC=0+-100	27167	C5-1/4-T0-2001-F
A3R75	0698-3161 9		RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F

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

Reference Designation	HP Part No. & Ck Digit	Qty	Description	Mfr Code	Mfr Part Number
A3R76	2100-3531 4		RESISTOR-TRMR 250 10% C TOP-ADJ 1-TRN	28480	2100-3531
A3R77	2100-3531 4		RESISTOR-TRMR 250 10% C TOP-ADJ 1-TRN	28480	2100-3531
A3R78	0757-0410 1		RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A3R79	2100-3212 8		RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	28480	2100-3212
A3R80	0757-0290 5	4	RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3R81	0757-0417 8	5	RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A3R82	0757-0443 0	3	RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A3R83	0698-4037 0	3	RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A3R84	0757-0317 7	1	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A3R85	0698-4037 0		RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A3R86	2100-0567 0		RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	28480	2100-0567
A3R87	0757-0433 8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A3R88	0757-0280 3	15	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R89	0757-1094 9	3	RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A3R90	2100-3212 8		RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	28480	2100-3212
A3R91	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A3R92	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A3R93	0698-3161 9		RESISTOR 38.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3832-F
A3R94	0684-3321 4	9	RESISTOR 3.3K 10% .25W FC TC=-400/+700	01121	CB3321
A3R95	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A3R96	0757-1094 9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A3R97	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A3R98	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A3R99	0698-0082 7		RESISTOR 464 1% .125W F TC=0+-100	24546	C4-1/8-T0-4640-F
A3R100	0757-0475 8	1	RESISTOR 274K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2743-F
A3R101	0757-0401 0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A3R102	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A3R103	0757-0433 8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A3R104	0757-0442 9	9	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R105	0684-3321 4		RESISTOR 3.3K 10% .25W FC TC=-400/+700	01121	CB3321
A3R106	0757-0283 6	11	RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A3R107	0684-3321 4		RESISTOR 3.3K 10% .25W FC TC=-400/+700	01121	CB3321
A3R108	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A3R109	0757-0280 3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R110	0757-0274 5	2	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A3R111	0757-0280 3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R112	0757-0274 5		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A3R113	0684-3321 4		RESISTOR 3.3K 10% .25W FC TC=-400/+700	01121	CB3321
A3R114	0757-0290 5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A3R115	0757-0283 6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A3R116	2100-0554 5		RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	28480	2100-0554
A3R117	0757-0283 6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A3R118	0757-0417 8		RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A3R119	0757-0280 3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R120	0698-3150 6	3	RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3R121	0757-0442 9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R122	0757-0280 3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R123	0698-3150 6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A3R124	0757-0442 9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R125	0698-7096 7	2	RESISTOR 10 10% .125W CC TC=-120/+400	01121	BB1001
A3R126	0698-7229 8	2	RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A3R127	0698-7096 7		RESISTOR 10 10% .125W CC TC=-120/+400	01121	BB1001
A3R128	0698-7229 8		RESISTOR 511 1% .05W F TC=0+-100	24546	C3-1/8-T0-511R-G
A3R129	0757-0433 8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A3R130	0757-0442 9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R131	0757-0411 2		RESISTOR 332 1% .125W F TC=0+-100	24546	C4-1/8-T0-332R-F
A3R132	0698-4037 0		RESISTOR 46.4 1% .125W F TC=0+-100	24546	C4-1/8-T0-46R4-F
A3R133	0757-0433 8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A3R134	0757-1094 9		RESISTOR 1.47K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1471-F
A3R135	0757-0462 3		RESISTOR 75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7502-F
A3R136	0698-3162 0	3	RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C3-1/8-T0-4642-F
A3R137	0684-0271 7		RESISTOR 2.7 10% .25W FC TC=-400/+500	01121	CB27G1
A3R138	0698-3162 0		RESISTOR 46.4K 1% .125W F TC=0+-100	24546	C3-1/8-T0-4642-F
A3R139	0757-0416 7	9	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3R140	0757-0453 2		RESISTOR 30.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3012-F
A3R141	0757-0411 2		RESISTOR 332 1% .125W F TC=0+-100	24546	C4-1/8-T0-332R-F
A3R142	0698-7238 9	2	RESISTOR 1.21K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1211-G
A3R143	0698-7238 9		RESISTOR 1.21K 1% .05W F TC=0+-100	24546	C3-1/8-T0-1211-G
A3R144	0757-0440 7	5	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A3R145	0698-7196 8	1	RESISTOR 21.5 1% .05W F TC=0+-100	24546	C3-1/8-T00-21R5-G
A3R146	0757-0433 8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A3R147	0757-0433 8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A3RT1	0837-0035 6	2	THERMISTOR DISC 5K-OHM TC=-4.4%/C-DEG	28480	0837-0035
A3RT2	0837-0035 6		THERMISTOR DISC 5K-OHM TC=-4.4%/C-DEG	28480	0837-0035

See introduction to this section for ordering information

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

Reference Designation	HP Part No. & Ck. Digit	Qty	Description	Mfr Code	Mfr Part Number
A3S1	3101-1905 5	1	SWITCH-PB 4-STATION 10MM C-C SPACING	28480	3101-1905
A3U1	1820-1518 8	1	IC GATE TTL L NAND QUAD 2-INP	27014	DM74L00N
A3U2	1820-0596 0	2	IC FF TTL L D-TYPE POS-EDGE-TRIG	27014	DM74L74N
A3U3	1820-0585 7	1	IC GATE TTL L NAND QUAD 2-INP	01295	SN74L03N
A3U4	1820-0596 0		IC FF TTL L D-TYPE POS-EDGE-TRIG	27014	DM74L74N
A3VR1	1902-3082 9	2	DIODE-ZNR 4.64V 5% DO-7 PD=.4W TC=-.023%	28480	1902-3082
A3VR2	1902-3234 3	2	DIODE-ZNR 19.6V 5% DO-7 PD=.4W TC=+.073%	28480	1902-3234
A3VR3	1902-0072 1	1	DIODE-ZNR 7.87V 2% DO-7 PD=.4W TC=+.051%	28480	1902-0072
A3VR4	1902-3137 5	1	DIODE-ZNR 8.06V 2% DO-7 PD=.4W TC=+.052%	28480	1902-3137
A3VR5	1902-0041 4	2	DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	28480	1902-0041
A3VR6	1902-3002 3	1	DIODE-ZNR 2.37V 5% DO-7 PD=.4W TC=-.074%	28480	1902-3002
A3W1	01740-61617 6	1	CABLE ASSEMBLY	28480	01740-61617
A3XU1	1200-0474 9	13	SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0474
A3XU2	1200-0474 9		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0474
A3XU3	1200-0474 9		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0474
A3XU4	1200-0474 9		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0474
A3A1	5081-3030 9	1	SUBSTRATE ASSY(NOT SUPPLIED WITH A3 - ORDER SEPARATELY.	28480	5081-3030
A4	01744-61605 6	1	CABLE ASSEMBLY, DELAY LINE	28480	01744-61605
A6	0960-0484 0	1	HV MULTIPLIER ASSEMBLY	28480	0960-0484
A7	01740-66524 4	1	HORIZONTAL SWEEP ASSEMBLY	28480	01740-66524
A7C1	0160-3569 2	1	CAPACITOR-FXD 27PF +-5% 100VDC CER 0+-30	28480	0160-3569
A7C2	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C3	0140-0202 2	1	CAPACITOR-FXD 15PF +-5% 500VDC MICA	72136	DM15C150J0500WV1CR
A7C4	0150-0070 3	2	CAPACITOR-FXD .02UF +-20% 500VDC CER	28480	0150-0070
A7C5	0140-0196 3	1	CAPACITOR-FXD 150PF +-5% 300VDC MICA	72136	DM15F151J0300WV1CR
A7C6	0160-3318 9	1	CAPACITOR-FXD .047UF +-10% 100VDC CER	28480	0160-3318
A7C7	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C8	0150-0021 4		CAPACITOR-FXD .47PF +-5% 500VDC TI DIOX	28480	0150-0021
A7C9	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C10	0140-0193 0	2	CAPACITOR-FXD 82PF +-5% 300VDC MICA	72136	DM15E820J0300WV1CR
A7C11	0160-3443 1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A7C12	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C13	0180-0195 6	1	CAPACITOR-FXD .33UF +-20% 35VDC TA	28480	0180-0195
A7C14	0160-2204 0	6	CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A7C15	0180-0374 3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X902082
A7C16	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C17	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C18	0180-0058 0	1	CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	30D506G025CC2
A7C19	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C20	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C21	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C22	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C23	0180-1746 5	2	CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A7C24	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C25	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C26	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C27	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C28	0180-0106 9	7	CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X000682
A7C29	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C30	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C31	0180-0229 7	1	CAPACITOR-FXD 33UF+-10% 10VDC TA	56289	150D336X901082
A7C32	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C33	0180-1746 5		CAPACITOR-FXD 15UF+-10% 20VDC TA	56289	150D156X902082
A7C34	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C35	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C36	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C37	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C38	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C39	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C40	0160-2198 1		CAPACITOR-FXD 20PF +-5% 300VDC MICA	28480	0160-2198
A7C41	0160-2198 1		CAPACITOR-FXD 20PF +-5% 300VDC MICA	28480	0160-2198
A7C42	0160-2197 0	1	CAPACITOR-FXD 10PF +-5% 300VDC MICA	28480	0160-2197
A7C43					
A7C44	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C45	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451

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

Reference Designation	HP Part No. & Ck. Digit	Qty	Description	Mfr Code	Mfr Part Number
A7C46	0140-0204 4	1	CAPACITOR-FXD 47PF +-5% 500VDC MICA	72136	DM15E470J0500WV1CR
A7C47	0160-2204 0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A7C48	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A7C49	0140-0193 0		CAPACITOR-FXD 82PF +-5% 300VDC MICA	72136	DM15E820J0300WV1CR
A7CR1	1901-0376 6	1	DIODE-GEN PRP 35V 50MA DO-7	28480	1901-0376
A7CR2	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7CR3	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7CR4	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7CR5	1901-0513 3	1	DIODE-DUAL 100V	28480	1901-0513
A7CR6	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7CR7	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7CR8	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7CR9	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7CR10	1901-0050 3		DIODE-SWITCHING 80V 200MA 2NS DO-7	28480	1901-0050
A7CR11	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7CR12	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7CR13	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7CR15	1910-0016 0		DIODE-GE 60V 60MA 1US DO-7	28480	1910-0016
A7CR16	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7CR21	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7CR22	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7CR23	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7CR24	1910-0016 0		DIODE-GE 60V 60MA 1US DO-7	28480	1910-0016
A7E1	9170-0029 3		CORE-SHIELDING BEAD	28480	9170-0029
A7E2	9170-0029 3		CORE-SHIELDING BEAD	28480	9170-0029
A7E3	9170-0029 3		CORE-SHIELDING BEAD	28480	9170-0029
A7L1	9140-0105 3	5	COIL-MLD 8.2UH 10% Q=50 .155DX.375LG-NOM	28480	9140-0105
A7L2	9140-0096 1	3	COIL-MLD 1UH 10% Q=50 .155DX.375LG-NOM	28480	9140-0096
A7L3	9100-1613 6	2	COIL-MLD 470NH 20% Q=45 .155DX.375LG-NOM	28480	9100-1613
A7L4	9140-0096 1		COIL-MLD 1UH 10% Q=50 .155DX.375LG-NOM	28480	9140-0096
A7L5	9140-0105 3		COIL-MLD 8.2UH 10% Q=50 .155DX.375LG-NOM	28480	9140-0105
A7L6	9140-0096 1		COIL-MLD 1UH 10% Q=50 .155DX.375LG-NOM	28480	9140-0096
A7L7	9100-1613 6		COIL-MLD 470NH 20% Q=45 .155DX.375LG-NOM	28480	9100-1613
A7P2	1251-3901 0	2	CONNECTOR 15-PIN M POST TYPE	28480	1251-3901
A7P3	1251-3750 7		CONNECTOR 10-PIN M POST TYPE	28480	1251-3750
A7P4	1251-4238 8	1	CONNECTOR 9-PIN M POST TYPE	28480	1251-4238
A7P5	1251-3071 5	1	CONNECTOR 8-PIN M POST TYPE	28480	1251-3071
A7Q1	1854-0215 1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A7Q2	1854-0092 2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A7Q3	1854-0092 2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A7Q4	1855-0081 1	3	TRANSISTOR J-FET N-CHAN D-MODE SI	01295	2N5245
A7Q5	1854-0092 2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A7Q6	1854-0215 1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A7Q7	1853-0380 9		TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0380
A7Q8	1853-0380 9		TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0380
A7Q9	1853-0354 7	9	TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A7Q10	1853-0354 7		TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A7Q11	1853-0354 7		TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A7Q12	1853-0380 9		TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0380
A7Q13	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A7Q14	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A7Q15	1854-0071 7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q16	1854-0691 7	3	TRANSISTOR NPN SI TO-92 PD=350MW	28480	1854-0691
A7Q17	1854-0071 7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q18	1854-0071 7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q19	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A7Q20	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A7Q21	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A7Q22	1853-0015 7		TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A7Q23	1854-0215 1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A7Q24	1854-0092 2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A7Q25	1854-0092 2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A7Q26	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A7Q27	1854-0215 1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A7Q28	1854-0215 1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A7Q29	1854-0092 2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A7Q30	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A7Q31	1854-0215 1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A7Q32	1854-0215 1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A7Q33	1854-0215 1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A7Q34	1854-0092 2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A7R1	0698-3263 2	3	RESISTOR 500K 1% .125W F TC=0+-100	28480	0698-3263
A7R2	0698-3263 2		RESISTOR 500K 1% .125W F TC=0+-100	28480	0698-3263
A7R3	0757-0476 9	1	RESISTOR 301K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3013-F
A7R4	0757-0486 1	2	RESISTOR 750K 1% .125W F TC=0+-100	28480	0757-0486
A7R5	0757-0421 4	3	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F

See introduction to this section for ordering information

Table 5-6. Condensed Adjustment Procedure (Cont'd)

Adjustment	Procedure
AMPLITUDE LIMIT, KNEE, AND SLOPE	1. Using DVM and 1000:1 divider probe note difference between CRT cathode (A15TP4) and CRT grid voltage (A15TP5).
Amp Limit, A12R24	2. Disconnect HV Oscilaltor Q1. Using monitor oscilloscope connected to A12TP2, adjust A12R24 for p-p signal of one volt less than difference between CRT cathode and grid voltages.
Knee Adj., A15R32	3. Adjust A15R32 until voltage reading at A15TP6 begins to drop rapidly from most positive point.
Slope Adj., A15R39	4. Adjust A14R39 for best focused display. If necessary, repeat Collimator and Floodgun Adjustments.

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

Reference Designation	HP Part No. & Ck. Digit	Qty	Description	Mfr Code	Mfr Part Number
A7R6	0757-0283 6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A7R7	0757-0418 9	3	RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A7R8	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A7R9	0684-2711 4	7	RESISTOR 270 10% .25W FC TC=-400/+600	01121	CB2711
A7R10	0684-1061 5	1	RESISTOR 10M 10% .25W FC TC=-900/+1100	01121	CB1061
A7R11	0698-3263 2		RESISTOR 500K 1% .125W F TC=0+-100	28480	0698-3263
A7R12	0683-1505 0	1	RESISTOR 15 5% .25W FC TC=-400/+500	01121	CB1505
A7R13	0757-0486 1		RESISTOR 750K 1% .125W F TC=0+-100	28480	0757-0486
A7R14	0684-6811 3	5	RESISTOR 680 10% .25W FC TC=-400/+600	01121	CB6811
A7R15	0684-6811 3		RESISTOR 680 10% .25W FC TC=-400/+600	01121	CB6811
A7R16	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A7R17	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A7R18	0684-1011 5	20	RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A7R19	0684-2711 4		RESISTOR 270 10% .25W FC TC=-400/+600	01121	CB2711
A7R20	2100-3351 6	3	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A7R21	2100-3434 6	2	RESISTOR-VAR CONTROL CCP 50K 10% LIN	01121	73M4N048P503U
A7R22	0757-0433 8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A7R23	0698-3446 3	6	RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A7R24	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A7R25	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A7R26	0698-3433 8	5	RESISTOR 28.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-28R7-F
A7R27	0698-3433 8		RESISTOR 28.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-28R7-F
A7R28	0757-0427 0	5	RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A7R29	0757-0281 4	2	RESISTOR 2.74K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2741-F
A7R30	0757-0466 7	2	RESISTOR 110K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1103-F
A7R31	0757-0488 3	3	RESISTOR 909K 1% .125W F TC=0+-100	28480	0757-0488
A7R32	0684-4701 6	4	RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A7R33	0684-2701 2	2	RESISTOR 27 10% .25W FC TC=-400/+500	01121	CB2701
A7R34	0757-0433 8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A7R35	0757-0433 8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A7R36	0757-0410 1		RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A7R37	0757-0746 6	1	RESISTOR 4.75K 1% .25W F TC=0+-100	27167	C5-1/4-T0-4751-F
A7R38	0757-0416 7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A7R39	0757-0416 7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A7R40	0757-0440 7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A7R41	2100-3351 6		RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A7R42	0757-0280 3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A7R43	0684-1511 0	3	RESISTOR 150 10% .25W FC TC=-400/+600	01121	CB1511
A7R44	0684-1001 3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A7R45	0757-0281 4		RESISTOR 2.74K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2741-F
A7R46	0757-0401 0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A7R47	0684-4701 6		RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A7R48	0684-1521 2	4	RESISTOR 1.5K 10% .25W FC TC=-400/+700	01121	CB1521
A7R49	0757-0399 5	1	RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A7R50	0757-0284 7		RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
A7R51	0757-0284 7		RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
A7R52	0684-0271 7		RESISTOR 2.7 10% .25W FC TC=-400/+500	01121	CB27G1
A7R53	0757-0408 7	3	RESISTOR 243 1% .125W F TC=0+-100	24546	C4-1/8-T0-243R-F
A7R54	0757-0435 0	4	RESISTOR 3.92K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3921-F
A7R55	0757-0416 7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A7R56	0757-0442 9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R57	0698-3446 3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A7R58	0757-0421 4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A7R59	0684-4711 8	8	RESISTOR 470 10% .25W FC TC=-400/+600	01121	CB4711
A7R60	0757-0412 3	2	RESISTOR 365 1% .125W F TC=0+-100	24546	C4-1/8-T0-365R-F
A7R61	0757-0422 5	1	RESISTOR 909 1% .125W F TC=0+-100	24546	C4-1/8-T0-909R-F
A7R62	0757-0406 5	1	RESISTOR 182 1% .125W F TC=0+-100	24546	C4-1/8-T0-182R-F
A7R63	0757-0434 9	3	RESISTOR 3.65K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3651-F
A7R64	0757-0447 4	1	RESISTOR 16.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1622-F
A7R65	0698-7926 2		RESISTOR 470 10% .125W CC TC=-330/+800	01121	BB4711
A7R66	0698-7926 2		RESISTOR 470 10% .125W CC TC=-330/+800	01121	BB4711
A7R67	0757-0427 0		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A7R68	0698-7926 2		RESISTOR 470 10% .125W CC TC=-330/+800	01121	BB4711
A7R69	0757-0415 6	2	RESISTOR 475 1% .125W F TC=0+-100	24546	C4-1/8-T0-475R-F
A7R70	0757-0407 6	9	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A7R71	0757-0439 4	5	RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A7R72	0684-1221 9	1	RESISTOR 1.2K 10% .25W FC TC=-400/+700	01121	CB1221
A7R73	0684-2221 1	20	RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A7R74	0684-6821 5	2	RESISTOR 6.8K 10% .25W FC TC=-400/+700	01121	CB6821
A7R75	0757-0415 6		RESISTOR 475 1% .125W F TC=0+-100	24546	C4-1/8-T0-475R-F
A7R76	0757-0124 4	1	RESISTOR 39.2K 1% .125W F TC=0+-100	28480	0757-0124
A7R77	0757-0448 5	1	RESISTOR 18.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1822-F
A7R78	0757-0437 2	3	RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
A7R79	0757-0401 0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A7R80	0757-0401 0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F

See introduction to this section for ordering information

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

Reference Designation	HP Part No. & Ck. Digit	Qty	Description	Mfr Code	Mfr Part Number
A7R81	0757-0409 8	1	RESISTOR 274 1% .125W F TC=0+-100	24546	C4-1/8-T0-274R-F
A7R82	0757-0401 0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A7R83	0757-0407 6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A7R84	0757-0407 6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A7R85	0757-0435 0		RESISTOR 3.92K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3921-F
A7R86	0757-0439 4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A7R87	0757-0280 3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A7R88	0757-0290 5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A7R89	0757-0412 3		RESISTOR 365 1% .125W F TC=0+-100	24546	C4-1/8-T0-365R-F
A7R90	0698-0085 0	3	RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A7R91	0757-0407 6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A7R92	0698-3433 8		RESISTOR 28.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-28R7-F
A7R93	2100-3211 7	1	RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	28480	2100-3211
A7R94	0757-0438 3	6	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A7R95	0757-0444 1	2	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A7R96	0757-0430 5	1	RESISTOR 2.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2211-F
A7R97	2100-3350 5	1	RESISTOR-TRMR 200 10% C SIDE-ADJ 1-TRN	28480	2100-3350
A7R98	0757-0410 1		RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A7R99	0757-0283 6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A7R100	0757-0404 3	1	RESISTOR 130 1% .125W F TC=0+-100	24546	C4-1/8-T0-131-F
A7R101	0757-0418 9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A7R102	0698-3446 3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A7R103	0698-3155 1	1	RESISTOR 4.64K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4641-F
A7R104	0684-3311 2	3	RESISTOR 330 10% .25W FC TC=-400/+600	01121	CB3311
A7R105	2100-3253 7	3	RESISTOR-TRMR 50K 10% C TOP-ADJ 1-TRN	28480	2100-3253
A7R106	0757-0416 7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A7R107	0757-0457 6	1	RESISTOR 47.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4752-F
A7R108	0757-0437 2		RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
A7R109	0684-1021 7	21	RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A7R110	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A7R111	0757-0474 7	1	RESISTOR 243K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2433-F
A7R112	0757-0444 1		RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A7R113	0698-3158 4	1	RESISTOR 23.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2372-F
A7R114	0757-0280 3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A7R115	0757-0401 0		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A7R117	2100-0568 1		RESISTOR-TRMR 100 10% C TOP-ADJ 1-TRN	28480	2100-0568
A7R118	0684-1001 3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A7R119	0684-1001 3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A7R120	0684-1001 3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A7R121	0684-1001 3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A7R122	0684-1001 3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A7R123	0684-1001 3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A7R124	0684-1001 3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A7R125	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A7R126	0684-4711 8		RESISTOR 470 10% .25W FC TC=-400/+600	01121	CB4711
A7R127	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A7R128	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A7R129	0698-3446 3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A7R130	0757-0435 0		RESISTOR 3.92K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3921-F
A7R131	0698-3446 3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A7R132	0698-3446 3		RESISTOR 383 1% .125W F TC=0+-100	24546	C4-1/8-T0-383R-F
A7R133	0757-0434 9		RESISTOR 3.65K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3651-F
A7R134	0757-0289 2	1	RESISTOR 13.3K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-1332-F
A7R135	0757-0427 0		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A7R136	0757-0408 7		RESISTOR 243 1% .125W F TC=0+-100	24546	C4-1/8-T0-243R-F
A7R137	0757-0280 3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A7R138	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A7R139	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A7R140	0757-0438 3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A7R141	0757-0290 5		RESISTOR 6.19K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-6191-F
A7R142	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A7R143	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A7R144	0684-4711 8		RESISTOR 470 10% .25W FC TC=-400/+600	01121	CB4711
A7R145	0757-0416 7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A7R146	0757-0416 7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A7R147	0757-0439 4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A7R148	0757-0419 0	1	RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A7R149	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A7R150	0757-0391 7	1	RESISTOR 39.2 1% .125W F TC=0+-100	24546	C4-1/8-T0-39R2-F
A7R151	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A7R152	0757-0466 7		RESISTOR 110K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1103-F
A7R153	0684-4701 6		RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A7R154	0684-4711 8		RESISTOR 470 10% .25W FC TC=-400/+600	01121	CB4711
A7R155	0757-0283 6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A7R156	0684-2701 2		RESISTOR 27 10% .25W FC TC=-400/+500	01121	CB2701

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

Reference Designation	HP Part No. & Ck. Digit	Qty	Description	Mfr Code	Mfr Part Number
A7R157	0684-1811 3	1	RESISTOR 180 10% .25W FC TC=-400/+600	01121	CB1811
A7R158	0684-1001 3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A7R159	0757-0442 9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A7R160	0757-0428 1	3	RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A7R161	0684-1511 0		RESISTOR 150 10% .25W FC TC=-400/+600	01121	CB1511
A7R162	0757-0416 7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A7R163	0684-1511 0		RESISTOR 150 10% .25W FC TC=-400/+600	01121	CB1511
A7R164	0684-3311 2		RESISTOR 330 10% .25W FC TC=-400/+600	01121	CB3311
A7R165	0757-0465 6	4	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A7R166	0757-0433 8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A7R167	0757-0465 6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A7R168	0757-0433 8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A7R169	2100-0567 0		RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	28480	2100-0567
A7S1	3101-1906 6	1	SWITCH-PB 4-STATION 10MM C-C SPACING	28480	3101-1906
A7S2	3101-1909 9	1	SWITCH-PB 6-STATION 10MM C-C SPACING	28480	3101-1909
A7S3	3101-1907 7	2	SWITCH-PB 4-STATION 10MM C-C SPACING	28480	3101-1907
A7U1	1826-0059 2	3	IC 201A OP AMP TO-99	07263	LM201AH
A7U2	5081-3019 4	2	IC	28480	5081-3019
A7U3	1826-0059 2		IC 201A OP AMP TO-99	07263	LM201AH
A7U4	1821-0002 5	2	TRANSISTOR ARRAY	28480	1821-0002
A7W1	01740-61605 2	1	CABLE ASSEMBLY, GATE DRIVE	28480	01740-61605
A7XA9	1251-0588 3	2	CONNECTOR 12-PIN F POST TYPE	28480	1251-0588
A7XU1	1200-0763 9	2	SOCKET-IC 8-CONT DIP-SLDR	28480	1200-0763
A7XU2	1200-0473 8	4	SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0473
A7XU3	1200-0763 9		SOCKET-IC 8-CONT DIP-SLDR	28480	1200-0763
A7XU4	1200-0474 9	5	SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0474
A8	01740-66532 4	1	MAIN SWEEP ASSEMBLY	28480	01740-66532
A8C1	0160-2055 9	8	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8C2	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8C3	0180-0197 8	7	CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A8C4	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8C5	0140-0218 0	2	CAPACITOR-FXD 160PF +-2% 300VDC MICA	72136	DM15F161G0300WV1CR
A8C6	0160-2204 0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A8C8	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8C9	0160-3226 8	2	CAPACITOR-FXD .01UF +-10% 400VDC	28480	0160-3226
A8C10	0160-3726 3	2	CAPACITOR-FXD 1UF +-10% 40VDC MET-POLYC	28480	0160-3726
A8C11	0180-0481 3	1	CAPACITOR-FXD 100UF+-10% 20VDC TA	56289	109D107X9030T2
A8C12	0140-0190 7	1	CAPACITOR-FXD 39PF +-5% 300VDC MICA	72136	DM15E390J0300WV1CR
A8C13	0140-0207 7	1	CAPACITOR-FXD 330PF +-5% 500VDC MICA	72136	DM15F331J0500WV1CR
A8C14	0160-0155 6	1	CAPACITOR-FXD 3300PF +-10% 200VDC POLYE	28480	0160-0155
A8C15	0160-0194 3	1	CAPACITOR-FXD .015UF +-10% 200VDC POLYE	28480	0160-0194
A8C16	0180-2079 9	1	CAPACITOR-FXD .39UF+-10% 35VDC TA	56289	150D394X9035A2
A8C17	0180-1745 4	1	CAPACITOR-FXD 1.5UF+-10% 20VDC TA	56289	150D155X9020A2
A8C18	0180-2111 0	1	CAPACITOR-FXD 33UF+-10% 35VDC TA	56289	150D336X9035A
A8C19	0180-0197 8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A8C20	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8C21	0180-0197 8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A8C22	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A8CR1	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8CR2	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8CR3	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8CR4	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A8E1	9170-0029 3		CORE-SHIELDING BEAD	28480	9170-0029
A8E2	9170-0029 3		CORE-SHIELDING BEAD	28480	9170-0029
A8L1	9140-0105 3		COIL-MLD 8.2UH 10% Q=50 .155DX.375LG-NOM	28480	9140-0105
A8MP1	01740-61901 1	1	SWITCH ASSEMBLY, ROTARY,MALE (P/O A8S1)	28480	01740-61901
A8MP2	01740-61902 2	1	SWITCH ASSEMBLY,ROTARY,FEMALE(P/O A8S1)	28480	01740-61902
A8MP3	01840-22502 7	2	ROLLER, DETENT	28480	01840-22502
A8MP4	1460-1148 6	2	SPRING-TRSN MUW CD	28480	1460-1148
A8Q1	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A8Q2	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A8Q3	1853-0244 4	2	TRANSISTOR PNP SI PD=310MW FT=500MHZ	28480	1853-0244
A8Q4	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A8Q5	1855-0081 1		TRANSISTOR J-FET N-CHAN D-MODE SI	01295	2N5245
A8Q6	1854-0019 3	6	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A8Q7	1853-0354 7		TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A8Q8	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A8Q9	1854-0071 7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A8Q10	1854-0215 1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611

See introduction to this section for ordering information

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

Reference Designation	HP Part No. & Ck Digit	Qty	Description	Mfr Code	Mfr Part Number
A8Q11	1854-0071 7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A8Q12	1854-0071 7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A8Q13	1854-0691 7		TRANSISTOR NPN SI TO-92 PD=350MW	28480	1854-0691
A8R1	0684-3901 6	8	RESISTOR 39 10% .25W FC TC=-400/+500	01121	CB3901
A8R2	0698-3151 7	1	RESISTOR 2.87K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2871-F
A8R3	0757-0407 6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A8R4	0684-3901 6		RESISTOR 39 10% .25W FC TC=-400/+500	01121	CB3901
A8R5	0757-0411 2		RESISTOR 332 1% .125W F TC=0+-100	24546	C4-1/8-T0-332R-F
A8R6	0684-8201 9	1	RESISTOR 82 10% .25W FC TC=-400/+500	01121	CB8201
A8R7	0757-0428 1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A8R8	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A8R9	0684-2251 7	1	RESISTOR 2.2M 10% .25W FC TC=-900/+1100	01121	CB2251
A8R12	2100-3056 8	7	RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A8R13	2100-3056 8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A8R14	2100-3056 8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A8R15	0757-0434 9		RESISTOR 3.65K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3651-F
A8R16	0757-0440 7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A8R17	0698-6450 5	2	RESISTOR 2.5K .1% .125W F TC=0+-50	28480	0698-6450
A8R18	0698-5449 0	2	RESISTOR 5K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-5001-B
A8R19	0698-4157 5	2	RESISTOR 10K .1% .125W F TC=0+-50	28480	0698-4157
A8R20	0698-6942 0	2	RESISTOR 25K .1% .125W F TC=0+-50	28480	0698-6942
A8R21	0698-5450 3	2	RESISTOR 50K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-5002-B
A8R22	0698-4158 6	1	RESISTOR 100K .1% .125W F TC=0+-50	28480	0698-4158
A8R23	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A8R24	0757-0284 7		RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
A8R26	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A8R27	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A8R28	0684-3321 4		RESISTOR 3.3K 10% .25W FC TC=-400/+700	01121	CB3321
A8R29	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A8R30	0757-0284 7		RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
A8R31	0757-0416 7		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A8P32	0757-0273 4	2	RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A8R33	0698-3150 6		RESISTOR 2.37K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2371-F
A8R34	0757-0283 6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A8R35	0684-3311 2		RESISTOR 330 10% .25W FC TC=-400/+600	01121	CB3311
A8R36	0684-3901 6		RESISTOR 39 10% .25W FC TC=-400/+500	01121	CB3901
A8R37	0684-6821 5		RESISTOR 6.8K 10% .25W FC TC=-400/+700	01121	CB6821
A8R38	0757-0439 4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A8R39	0757-0420 3	4	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A8R40	0757-0454 3	2	RESISTOR 33.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3322-F
A8R41	0684-0271 7		RESISTOR 2.7 10% .25W FC TC=-400/+500	01121	CB27G1
A8R42	0684-0271 7		RESISTOR 2.7 10% .25W FC TC=-400/+500	01121	CB27G1
A8R43	2100-3056 8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A8U1	1826-0086 5	1	IC 776 OP AMP TO-99	04713	MC1776CG
A8XA7	1251-0589 4	2	CONNECTOR 10-PIN F POST TYPE	28480	1251-0589
A9	01740-66522 2	1	DELAYED SWEEP ASSEMBLY	28480	01740-66522
A9C1	0160-2250 6	1	CAPACITOR-FXD 5.1PF +-.25PF 500VDC CER	28480	0160-2250
A9C2	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9C3	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9C4	0160-2204 0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A9C5					
A9C6	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9C7	0140-0218 0		CAPACITOR-FXD 160PF +-2% 300VDC MICA	72136	DM15F161G0300WV1CR
A9C8	0160-3226 8		CAPACITOR-FXD .010UF +-10% 400VDC	28480	0160-3226
A9C9	0160-3726 3		CAPACITOR-FXD 1UF +-10% 40VDC MET-POLYC	28480	0160-3726
A9C10	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9C11	0180-2148 3	1	CAPACITOR-FXD .47UF+-20% 50VDC TA	56289	150D474X0050A2
A9C14	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9C15	0180-0197 8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A9CR1	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9CR2	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A9L1	9140-0105 3		COIL-MLD 8.2UH 10% Q=50 .155DX.375LG-NOM	28480	9140-0105
A9MP1	01740-61903 3	1	SWITCH ASSEMBLY,ROTATY,MALE (P/O A9S1)	28480	01740-61903
A9MP2	01740-61904 4	1	SWITCH ASSEMBLY,ROTARY,FEMALE(P/O A9S1)	28480	01740-61904
A9MP3	01840-22502 7		ROLLER, DETENT	28480	01840-22502
A9MP4	1460-1148 6		SPRING-TRSN MUW CD	28480	1460-1148
A9P1	1251-3072 6	1	CONNECTOR 12-PIN M POST TYPE	28480	1251-3072

See introduction to this section for ordering information

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

Reference Designation	HP Part No. & Ck. Digit	Qty	Description	Mfr Code	Mfr Part Number
A9Q1	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A9Q2	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A9Q3	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A9Q4	1853-0244 4		TRANSISTOR PNP SI PD=310MW FT=500MHZ	28480	1853-0244
A9Q5	1854-0691 7		TRANSISTOR NPN SI TO-92 PD=350MW	28480	1854-0691
A9Q6	1855-0081 1		TRANSISTOR J-FET N-CHAN D-MODE SI	01295	2N5245
A9Q7	1854-0019 3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A9R1	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A9R2	0757-0284 7		RESISTOR 150 1% .125W F TC=0+-100	24546	C4-1/8-T0-151-F
A9R3	0757-0834 3	1	RESISTOR 5.62K 1% .5W F TC=0+-100	28480	0757-0834
A9R4	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A9R5	0757-0193 7	1	RESISTOR 3.32K 1% .5W F TC=0+-100	28480	0757-0193
A9R6	0757-0442 9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A9R7	0757-0280 3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A9R10	2100-3056 8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A9R11	2100-3056 8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A9R12	0757-0433 8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A9R13	0757-0440 7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A9R14	0698-6450 5		RESISTOR 2.5K .1% .125W F TC=0+-50	28480	0698-6450
A9R15	0698-5449 0		RESISTOR 5K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-5001-B
A9R16	0698-4157 5		RESISTOR 10K .1% .125W F TC=0+-50	28480	0698-4157
A9R17	0698-6942 0		RESISTOR 25K .1% .125W F TC=0+-50	28480	0698-6942
A9R18	0698-5450 3		RESISTOR 50K .1% .125W F TC=0+-50	19701	MF4C1/8-T2-5002-B
A9R19	0698-4168 8	1	RESISTOR 2.411K .5% .25W F TC=0+-100	28480	0698-4168
A9R20					
A9R21	0683-0475 1		RESISTOR 4.7 5% .25W FC TC=-400/+500	01121	CB47G5
A9R22	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A9R23	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A9R24	0757-0400 9	3	RESISTOR 90.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-90R9-F
A9R25	0684-1001 3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A9R27	0683-0275 9	1	RESISTOR 2.7 5% .25W FC TC=-400/+500	01121	CB27G5
A9R28	2100-3056 8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A9U1	1826-0059 2		IC 201A OP AMP TO-99	07263	LM201AH
A9XA10	1251-3352 5	1	CONNECTOR-PC EDGE 12-CONT/ROW 1-ROW	28480	1251-3352
A10	01740-66508 4	1	DELAYED TRIGGER ASSEMBLY	28480	01740-66508
A10C1	0150-0070 3		CAPACITOR-FXD .02UF +-20% 500VDC CER	28480	0150-0070
A10C2	0160-2204 0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A10C3	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A10C4	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A10C6	0160-2204 0		CAPACITOR-FXD 100PF +-5% 300VDC MICA	28480	0160-2204
A10C7	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A10C8	0180-0197 8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A10C9	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A10C10	0180-0197 8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A10C11	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A10C12	0180-0197 8		CAPACITOR-FXD 2.2UF+-10% 20VDC TA	56289	150D225X9020A2
A10C13	0150-0048 5	1	CAPACITOR-FXD .22PF +-5% 500VDC TI DIOX	28480	0150-0048
A10C14	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A10CR1	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR2	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR3	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR4	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR6	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR7	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR8	1910-0016 0		DIODE-GE 60V 60MA 1US DO-7	28480	1910-0016
A10L1	9140-0105 3		COIL-MLD 8.2UH 10% Q=50 .155DX.375LG-NOM	28480	9140-0105
A10Q1	1855-0262 0	1	TRANSISTOR-JFET DUAL N-CHAN	28480	1855-0262
A10Q3	1854-0215 1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A10Q4	1854-0215 1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A10Q5	1854-0092 2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A10Q6	1854-0092 2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A10Q7	1854-0071 7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A10Q8	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A10Q9	1854-0071 7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A10Q10	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A10R1	0757-0465 6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R2	0757-0488 3		RESISTOR 909K 1% .125W F TC=0+-100	28480	0757-0488
A10R3	0684-3901 6		RESISTOR 39 10% .25W FC TC=-400/+500	01121	CB3901
A10R4	0684-3901 6		RESISTOR 39 10% .25W FC TC=-400/+500	01121	CB3901
A10R5	0757-0407 6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F

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

Reference Designation	HP Part No. & Ck. Digit	Qty	Description	Mfr Code	Mfr Part Number
A10R6	0757-0419 0		RESISTOR 681 1% .125W F TC=0+-100	28480	0757-0419
A10R7	0757-0407 6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A10R8	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A10R9	2100-3351 6		RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A10R10	2100-3434 6		RESISTOR-VAR CONTROL CCP 50K 10% LIN	01121	73M4N048P503U
A10R11	0757-0263 2	1	RESISTOR 825K 1% .5W F TC=0+-25	28480	0757-0263
A10R13	0757-0408 7		RESISTOR 243 1% .125W F TC=0+-100	24546	C4-1/8-T0-243R-F
A10R14	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A10R15	0757-0427 0		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A10R16	0698-3433 8		RESISTOR 28.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-28R7-F
A10R17	0698-3433 8		RESISTOR 28.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-28R7-F
A10R18	0698-3152 8	1	RESISTOR 3.48K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3481-F
A10R19	0757-0438 3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A10R20	0684-1531 4	3	RESISTOR 15K 10% .25W FC TC=-400/+800	01121	CB1531
A10R21	5081-7482 3	1	RESISTOR	28480	5081-7482
A10R22	0757-0443 0		RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A10R23	0757-0420 3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A10R24	0757-0438 3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A10R25	0684-6811 3		RESISTOR 680 10% .25W FC TC=-400/+600	01121	CB6811
A10R26	0684-6811 3		RESISTOR 680 10% .25W FC TC=-400/+600	01121	CB6811
A10R27	0757-0200 7	1	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A10R28	0757-0420 3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A10R29	0757-0418 9		RESISTOR 619 1% .125W F TC=0+-100	24546	C4-1/8-T0-619R-F
A10R30	0757-0433 8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A10R31	0757-0443 0		RESISTOR 11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1102-F
A10R32	0757-0420 3		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A10R33	0684-1001 3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A10R34	0684-1001 3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A10R35	0684-3901 6		RESISTOR 39 10% .25W FC TC=-400/+500	01121	CB3901
A10R36	0698-0085 0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A10R37	0757-0488 3		RESISTOR 909K 1% .125W F TC=0+-100	28480	0757-0488
A10R38	0757-0465 6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A10R39	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A10R40	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A10R41	0757-0428 1		RESISTOR 1.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1621-F
A10S1	3101-1904 4	1	SWITCH-PB 6-STATION 10MM C-C SPACING	28480	3101-1904
A10U1	5081-3019 4		IC	28480	5081-3019
A10VR1	1902-3082 9		DIODE-ZNR 4.64V 5% DO-7 PD=.4W TC=-.023%	28480	1902-3082
A10XU1	1200-0473 8		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0473
A11	01740-66533 5	1	HORIZONTAL OUTPUT ASSEMBLY	28480	01740-66533
A11C1	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C2	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A11C3	0160-3665 9	10	CAPACITOR-FXD .01UF +80-20% 500VDC CER	28480	0160-3665
A11C4	0160-3502 3	2	CAPACITOR-FXD .3PF +-5% 500VDC TI DIOX	28480	0160-3502
A11C5	0160-3665 9		CAPACITOR-FXD .01UF +80-20% 500VDC CER	28480	0160-3665
A11C6	0140-0192 9		CAPACITOR-FXD 68PF +-5% 300VDC MICA	72136	DM15E680J0300WV1CR
A11C7	0160-3665 9		CAPACITOR-FXD .01UF +80-20% 500VDC CER	28480	0160-3665
A11C8	0160-3665 9		CAPACITOR-FXD .01UF +80-20% 500VDC CER	28480	0160-3665
A11C9	0140-0192 9		CAPACITOR-FXD 68PF +-5% 300VDC MICA	72136	DM15E680J0300WV1CR
A11C10	0160-3665 9		CAPACITOR-FXD .01UF +80-20% 500VDC CER	28480	0160-3665
A11C11	0160-3665 9		CAPACITOR-FXD .01UF +80-20% 500VDC CER	28480	0160-3665
A11C12	0160-3665 9		CAPACITOR-FXD .01UF +80-20% 500VDC CER	28480	0160-3665
A11C13	0160-3502 3		CAPACITOR-FXD .3PF +-5% 500VDC TI DIOX	28480	0160-3502
A11C14	0140-0192 9		CAPACITOR-FXD 68PF +-5% 300VDC MICA	72136	DM15E680J0300WV1CR
A11E1	9170-0029 3		CORE-SHIELDING BEAD	28480	9170-0029
A11E2	9170-0029 3		CORE-SHIELDING BEAD	28480	9170-0029
A11MP1	1205-0095 0		HEAT SINK TO-5/TO-39-PKG	28480	1205-0095
A11Q1	1854-0019 3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A11Q2	1853-0354 7		TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A11Q3	1854-0019 3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A11Q4	1853-0038 4	1	TRANSISTOR PNP SI TO-39 PD=1W FT=100MHZ	28480	1853-0038
A11Q5	1853-0354 7		TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A11Q6	1854-0019 3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A11Q7	1853-0232 0	2	TRANSISTOR PNP SI TO-39 PD=1W FT=200MHZ	28480	1853-0232
A11Q8	1854-0523 4	1	TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0523
A11R1	0684-1001 3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A11R2	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A11R3	0684-1001 3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A11R4	0757-0845 6	4	RESISTOR 18.2K 1% .5W F TC=0+-100	28480	0757-0845
A11R5	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721

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

Reference Designation	HP Part No. & Ck Digit	Qty	Description	Mfr Code	Mfr Part Number
A11R6	0683-0685 5	2	RESISTOR 6.8 5% .25W FC TC=-400/+500	01121	CB68G5
A11R7	0684-3901 6		RESISTOR 39 10% .25W FC TC=-400/+500	01121	CB3901
A11R8	0683-6835 9	2	RESISTOR 68K 5% .25W FC TC=-400/+800	01121	CB6835
A11R9	0757-0407 6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A11R10	2100-3273 1	3	RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
A11R11	0757-0768 2	2	RESISTOR 47.5K 1% .25W F TC=0+-100	27167	C5-1/4-T0-4752-F
A11R12	0757-0283 6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A11R13	0757-0411 2		RESISTOR 332 1% .125W F TC=0+-100	24546	C4-1/8-T0-332R-F
A11R14	0683-6835 9		RESISTOR 68K 5% .25W FC TC=-400/+800	01121	CB6835
A11R15	2100-3273 1		RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
A11R16	0757-0407 6		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A11R17	0757-0768 2		RESISTOR 47.5K 1% .25W F TC=0+-100	27167	C5-1/4-T0-4752-F
A11R18	0757-0283 6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A11R19	0757-0411 2		RESISTOR 332 1% .125W F TC=0+-100	24546	C4-1/8-T0-332R-F
A11R20	0683-0685 5		RESISTOR 6.8 5% .25W FC TC=-400/+500	01121	CB68G5
A11R21	0684-3901 6		RESISTOR 39 10% .25W FC TC=-400/+500	01121	CB3901
A11R22	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A11R23	0757-0845 6		RESISTOR 18.2K 1% .5W F TC=0+-100	28480	0757-0845
A11R24	0683-1825 7	1	RESISTOR 1.8K 5% .25W FC TC=-400/+700	01121	CB1825
A11R25	0757-0845 6		RESISTOR 18.2K 1% .5W F TC=0+-100	28480	0757-0845
A11R26	0757-0845 6		RESISTOR 18.2K 1% .5W F TC=0+-100	28480	0757-0845
A11XA7	1251-0649 7	1	CONNECTOR 15-PIN F POST TYPE	28480	1251-0649
A12	01744-66504 4	1	GATE ASSEMBLY	28480	01744-66504
A12C1	0180-0230 0	11	CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2
A12C2	0160-0165 8	3	CAPACITOR-FXD .056UF +-10% 200VDC POLYE	28480	0160-0165
A12C3	0160-3665 9		CAPACITOR-FXD .01UF +80-20% 500VDC CER	28480	0160-3665
A12C4	0160-3665 9		CAPACITOR-FXD .01UF +80-20% 500VDC CER	28480	0160-3665
A12C5	0160-0298 8	1	CAPACITOR-FXD 1500PF +-10% 200VDC POLYE	28480	0160-0298
A12C6	0160-3452 2	2	CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3452
A12C7	0160-2150 5		CAPACITOR-FXD 33PF +-5% 300VDC MICA	28480	0160-2150
A12C8	0121-0474 0	1	CAPACITOR-V TRMR-PSTN .3-1.5PF 600V	28480	0121-0474
A12C9	0160-0162 5	1	CAPACITOR-FXD .022UF +-10% 200VDC POLYE	28480	0160-0162
A12C10	0160-0165 8		CAPACITOR-FXD .056UF +-10% 200VDC POLYE	28480	0160-0165
A12C11	0160-3452 2		CAPACITOR-FXD .02UF +-20% 100VDC CER	28480	0160-3452
A12C12	0160-0503 8	1	CAPACITOR-FXD .22UF +-2% 100VDC POLYC	28480	0160-0503
A12CR1	1910-0030 8	8	DIODE-GE 15V 50MA 1U8 DO-7	28480	1910-0030
A12CR2	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
	1				
A12CR5	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A12MP1	1205-0095 0		HEAT SINK TO-5/TO-39-PKG	28480	1205-0095
A12MP2	01801-01206 7		BRACKET, ANGLE	28480	01801-01206
A12P1	1251-3319 4	1	CONNECTOR 10-PIN M POST TYPE	28480	1251-3319
A12Q1	1853-0354 7		TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A12Q2	1853-0232 0		TRANSISTOR PNP SI TO-39 PD=1W FT=200MHZ	28480	1853-0232
A12Q3	1854-0019 3		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A12Q4	1854-0271 9	1	TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0271
A12Q5	1854-0472 2	1	TRANSISTOR NPN SI DARL PD=500MW	04713	MPS-A14
A12Q6	1854-0215 1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A12Q7	1853-0402 6	1	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0402
A12Q8	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A12Q10	1853-0080 6	3	TRANSISTOR PNP SI PD=300MW FT=30MHZ	28480	1853-0080
A12R1	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A12R2	0684-4711 8		RESISTOR 470 10% .25W FC TC=-400/+600	01121	CB4711
A12R3	2100-3359 4	1	RESISTOR-TRMR 2M 20% C SIDE-ADJ 1-TRN	28480	2100-3359
A12R4	0757-0426 9	1	RESISTOR 1.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1301-F
A12R5	0757-0460 1	1	RESISTOR 61.9K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6192-F
A12R6	0684-3921 0	6	RESISTOR 3.9K 10% .25W FC TC=-400/+700	01121	CB3921
A12R7	0757-0770 6	1	RESISTOR 56.2K 1% .25W F TC=0+-100	27167	C5-1/4-T0-5622-F
A12R8	0757-0438 3		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A12R9	0757-0730 8	1	RESISTOR 750 1% .25W F TC=0+-100	27167	C5-1/4-T0-751-F
A12R10	0698-3647 6	1	RESISTOR 15K 5% 2W MO TC=0+-200	27167	FP42-2-T00-1502-J
A12R11	0684-3921 0		RESISTOR 3.9K 10% .25W FC TC=-400/+700	01121	CB3921
A12R12	2100-3273 1		RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
A12R13	0757-0840 1	1	RESISTOR 11K 1% .5W F TC=0+-100	28480	0757-0840
A12R14	0687-5601 3	1	RESISTOR 56 10% .5W CC TC=0+412	01121	EB5601
A12R15	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021

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

Reference Designation	HP Part No. & Ck Digit	Qty	Description	Mfr Code	Mfr Part Number
A12R16	2100-3353 8	2	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	32997	3386X-Y46-203
A12R17	0757-0456 5	1	RESISTOR 43.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4322-F
A12R18	0684-3931 2	3	RESISTOR 39K 10% .25W FC TC=-400/+800	01121	CB3931
A12R19	2100-3355 0	3	RESISTOR-TRMR 100K 10% C SIDE-ADJ 1-TRN	28480	2100-3355
A12R20	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A12R21	0684-2211 9	2	RESISTOR 220 10% .25W FC TC=-400/+600	01121	CB2211
A12R22	0684-1051 3	1	RESISTOR 1M 10% .25W FC TC=-800/+900	28480	0684-1051
A12R23	0684-8211 1	12	RESISTOR 820 10% .25W FC TC=-400/+600	01121	CB8211
A12R24	2100-3274 2	1	RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A12R25	2100-3661 1	1	RESISTOR-VAR CONTROL CCP 100K 20% LIN	28480	2100-3661
A12R26	0684-4711 8		RESISTOR 470 10% .25W FC TC=-400/+600	01121	CB4711
A12R27	0684-1011 5		RESISTOR 100 10% .25% FC TC=-400/+500	01121	CB1011
A12R29	0684-1041 1	10	RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A12R30	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A12R31	0698-0085 0		RESISTOR 2.61K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2611-F
A12R32	0684-3331 6	2	RESISTOR 33K 10% .25W FC TC=-400/+800	01121	CB3331
A12R33	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A12R34	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A12R35	0684-3321 4		RESISTOR 3.3K 10% .25W FC TC=-400/+700	01121	CB3321
A12R36	0683-0335 2	1	RESISTOR 3.3 5% .25W FC TC=-400/+500	01121	CB33G5
A12R37	2100-3424 4	1	RESISTOR-VAR CONTROL CCP 5M 30% LIN	28480	2100-3424
A12R38	0684-1051 3	2	RESISTOR 1M 10% .25W FC TC=-800/+900	01121	CB1051
A12R39	0757-0427 0		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
			RESISTOR 100K 10% .25W FC TC=-400/+800	01121	
A12S1	3101-1767 7	1	SWITCH-PB DPDT MOM 1A 300VAC	28480	3101-1767
A12U1	1821-0001 4		TRANSISTOR ARRAY	28480	1821-0001
A12VR1	1902-0025 4	3	DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	28480	1902-0025
A12VR2	1902-0041 4		DIODE-ZNR 5.11V 5% DO-7 PD=.4W TC=-.009%	28480	1902-0041
A12VR3	1902-0574 8	1	DIODE-ZNR 64.9V 5% DO-15 PD=1W TC=+.083%	28480	1902-0574
A12XA16	1251-0588 3		CONNECTOR 12-PIN F POST TYPE	28480	1251-0588
A12XU1	1200-0441 0		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0441
A13	01740-66516 4	1	VERT. CONTROL SWITCHING ASSEMBLY	28480	01740-66516
A13R1	0757-0282 5	2	RESISTOR 221 1% .125W F TC=0+-100	24546	C4-1/8-T0-221R-F
A13R2	0757-0282 5		RESISTOR 221 1% .125W F TC=0+-100	24546	C4-1/8-T0-221R-F
A13S1	3101-1908 8	1	SWITCH-PB 2-STATION 10MM C-C SPACING	28480	3101-1908
A13S2	3101-1907 7		SWITCH-PB 4-STATION 10MM C-C SPACING	28480	3101-1907
A13XA3P3	1251-3900 9	2	CONNECTOR 8-PIN F POST TYPE	28480	1251-3900
A13XA3P4	1251-3900 9		CONNECTOR 8-PIN F POST TYPE	28480	1251-3900
A14	01740-66540 4	1	INTERFACE ASSEMBLY	28480	01740-66540
A14XA3	1251-0477 9	1	CONNECTOR-PC EDGE 12-CONT/ROW 1-ROW	28480	1251-0477
A14XA7	1251-0213 1	1	CONNECTOR-PC EDGE 15-CONT/ROW 1-ROW	28480	1251-0213
A14XA16	1251-5092 4	1	CONNECTOR-POST 15-CONT	28480	1251-5092
A15	01744-66505 5	1	HIGH VOLTAGE POWER SUPPLY ASSEMBLY	28480	01744-66505
A15C1	0180-1794 3	1	CAPACITOR-FXD 22UF+-10% 35VDC TA	56289	150D226X9035R2
A15C2	0160-2264 2	1	CAPACITOR-FXD 20PF +-5% 500VDC CER 0+-30	28480	0160-2264
A15C3	0180-0269 5	3	CAPACITOR-FXD 1UF+75-10% 150VDC AL	56289	30D105G150BA2
A15C4	0160-0684 6	2	CAPACITOR-FXD 1000PF +-20% 4KVDC	28480	0160-0684
A15C5	0160-0544 7	2	CAPACITOR-FXD .022UF +-20% 4KVDC	28480	0160-0544
A15C6	0160-0544 7		CAPACITOR-FXD .022UF +-20% 4KVDC	28480	0160-0544
A15C7	0160-4024 6	1	CAPACITOR-FXD .1UF +-20% 4KVDC MET-POLYE	56289	430P104040
A15C8	0160-0684 6		CAPACITOR-FXD 1000PF +-20% 4KVDC	28480	0160-0684
A15C9	0160-4079 1	1	CAPACITOR-FXD 1500PF +-20% 4KVDC	28480	0160-4079
A15C10	0180-1731 8	2	CAPACITOR-FXD 4.7UF+-10% 50VDC TA	56289	150D475X9050B2
A15C11					
A15C12	0160-0164 7	1	CAPACITOR-FXD .039UF +-10% 200VDC POLYE	28480	0160-0164
A15C13	0160-3508 9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A15C14	0160-0168 1	3	CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A15C15	0180-1731 8		CAPACITOR-FXD 4.7UF+-10% 50VDC TA	56289	150D475X9050B2
A15C16	0160-0165 8		CAPACITOR-FXD .056UF +-10% 200VDC POLYE	28480	0160-0165
A15C17	0180-0230 0		CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2
A15C18	0180-0228 6		CAPACITOR-FXD 22UF+-10% 15VDC TA	56289	150D226X9015B2
A15C19	0160-0168 1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168

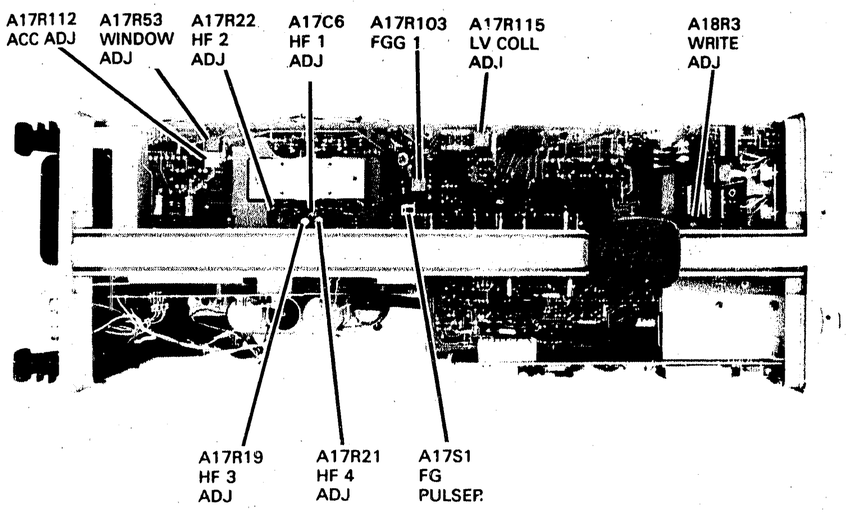
Table 6-2. Replaceable Parts (Cont'd)

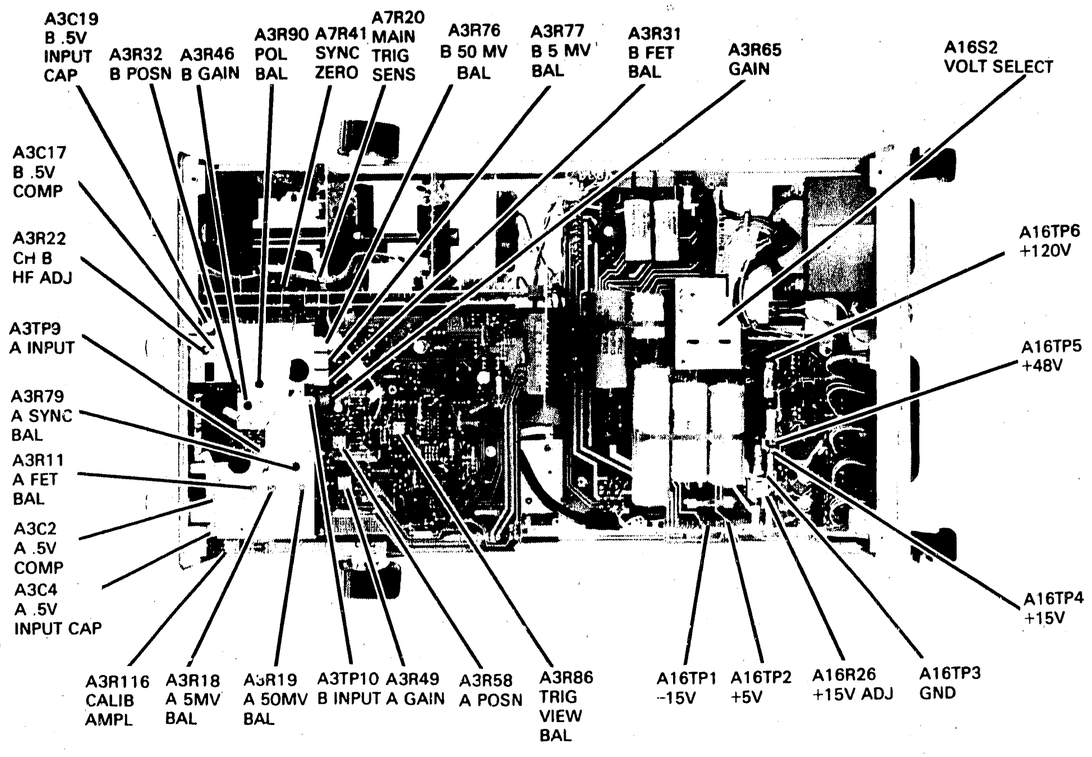
Reference Designation	HP Part No. & Ck Digit	Qty	Description	Mfr Code	Mfr Part Number
A15CR1	1901-0028 5	2	DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A15CR2	1901-0028 5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A15CR3	1901-0683 8	1	DIODE-HV RECT 10KV 5MA 250NS	28480	1901-0683
A15CR4	1901-0036 5	10	DIODE-HV RECT 1KV 600MA DO-29	28480	1901-0036
A15CR5	1901-0036 5		DIODE-HV RECT 1KV 600MA DO-29	28480	1901-0036
A15CR6	1901-0036 5		DIODE-HV RECT 1KV 600MA DO-29	28480	1901-0036
A15CR7	1901-0036 5		DIODE-HV RECT 1KV 600MA DO-29	28480	1901-0036
A15CR8	1901-0036 5		DIODE-HV RECT 1KV 600MA DO-29	28480	1901-0036
A15CR9	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A15CR10	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A15CR11	1901-0646 3	1	DIODE-PWR RECT 200V 1A 150NS	14099	92F
A15CR12	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A15D81	2140-0014 6	3	LAMP-GLOW 4AB 135/70VDC 500UA T-2-BULB	28480	2140-0014
A15D82	2140-0014 6		LAMP-GLOW 4AB 135/70VDC 500UA T-2-BULB	28480	2140-0014
A15D83	2140-0014 6		LAMP-GLOW 4AB 135/70VDC 500UA T-2-BULB	28480	2140-0014
A15D84	2140-0013 5	2	LAMP-GLOW 5AB-A 70/57VDC 300UA T-2-BULB	08806	5AB (NE-23A)
A15D85	2140-0013 5		LAMP-GLOW 5AB-A 70/57VDC 300UA T-2-BULB	08806	5AB (NE-23A)
A15E1	2110-0269 0	2	FUSEHOLDER-CLIP TYPE .25D-FUSE	28480	2110-0269
A15F1	2110-0007 4	1	FUSE 1A 250V SLO-BLO 1.25X.25 UL IEC	75915	313001
A15H1	3200-0125 8	1	SCREW-MACH 4-40 1.5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A15H2	2260-0001 5	1	NUT-HEX-DBL-CHAM 4-40-THD .094-IN-THK	28480	2260-0001
A15L1	9140-0171 3	1	COIL-MLD 40UH 10% Q=20 .296DX.9=BLG-NOM	28480	9140-0171
A15L2	9140-0210 1	1	COIL-MLD 100UH 5% Q=50 .155DX.375LG-NOM	28480	9140-0210
A15L3	9140-0129 1	1	COIL-MLD 220UH 5% Q=65 .155DX.375LG-NOM	28480	9140-0129
A15MP1	5040-0402 7	1	MOUNT, TRANSFORMER	28480	5040-0402
A15MP2	5040-0403 8	1	MOUNT, TRANSFORMER	28480	5040-0403
A15Q1	1854-0215 1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A15Q2	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A15Q3	1853-0437 7	1	TRANSISTOR PNP 2N6520 SI TO-92 PD=625MW	04713	2N6520
A15Q4	1853-0086 2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	28480	1853-0086
A15Q5	1854-0575 6	5	TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A15R1	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A15R2	2100-3253 7		RESISTOR-TRMR 50K 10% C TOP-ADJ 1-TRN	28480	2100-3253
A15R3	0684-4741 4	1	RESISTOR 470K 10% .25W FC TC=-800/+900	01121	CB4741
A15R4	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A15R5	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A15R6	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A15R7	0684-5601 7	2	RESISTOR 56 10% .25W FC TC=-400/+500	01121	CB5601
A15R8	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A15R9	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A15R10	0683-2265 1	2	RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A15R11	0687-5621 7	1	RESISTOR 5.6K 10% .5W CC TC=0+647	01121	EB5621
A15R12	0687-3301 6	1	RESISTOR 33 10% .5W CC TC=0+412	01121	EB3301
A15R13	0698-8018 5	1	RESISTOR 30M 1% 3W C TC=0+-100	03888	PVC175-3-T0-3004-F
A15R14	0684-6831 7	3	RESISTOR 68K 10% .25W FC TC=-400/+800	01121	CB6831
A15R15	0698-5353 5	1	RESISTOR 8.25M 5% 1W CF TC=-2000/+250	28480	0698-5353
A15R16	0698-6580 2	1	RESISTOR 16.25M 5% 1W CF TC=-3500/+250	28480	0698-6580
A15R17	0684-1531 4		RESISTOR 15K 10% .25W FC TC=-400/+800	01121	CB1531
A15R18	0687-5611 5	1	RESISTOR 560 10% .5W CC TC=0+529	01121	EB5611
A15R19	0684-5611 9	1	RESISTOR 560 10% .25W FC TC=-400/+600	01121	CB5611
A15R20	0698-5102 2	1	RESISTOR 1.2M 10% .25W FC TC=-900/+1100	01121	CB1251
A15R21	0684-1051 3		RESISTOR 1M 10% .25W FC TC=-800/+900	01121	CB1051
A15R22	0684-1021 7	2	RESISTOR 1K 10% .25W FC TC=-400/+600	28480	0684-1021
A15R23	0684-1041 1		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A15R24	0684-1041 1		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A15R25	0757-0446 3	1	RESISTOR 15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1502-F
A15R26	2100-3355 0		RESISTOR-TRMR 100K 10% C SIDE-ADJ 1-TRN	28480	2100-3355
A15R27	2100-3207 1	1	RESISTOR-TRMR 5K 10% C SIDE-ADJ 1-TRN	28480	2100-3207
A15R28	0687-1011 1	1	RESISTOR 100 10% .5W CC TC=0+529	01121	EB1011
A15R29	0684-2211 9		RESISTOR 220 10% .25W FC TC=-400/+600	01121	CB2211
A15R30	0757-0436 1	1	RESISTOR 4.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4321-F
A15R31	0698-3449 6	1	RESISTOR 28.7K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2872-F
A15R32	2100-3210 6	2	RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	28480	2100-3210
A15R33	0757-0471 4	2	RESISTOR 182K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1823-F
A15R34	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A15R35	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A15R36	0757-0442 9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A15R37	0757-0468 9	1	RESISTOR 130K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1303-F
A15R38	2100-0558 9	4	RESISTOR-TRMR 20K 10% C TOP-ADJ 1-TRN	28480	2100-0558
A15R39	2100-0569 2	1	RESISTOR-TRMR 1M 20% C TOP-ADJ 1-TRN 1-TRN	28480	2100-0569
A15R40	0687-2751 8	1	RESISTOR 2.7M 10% .5W CC TC=0+1000	01121	EB2751

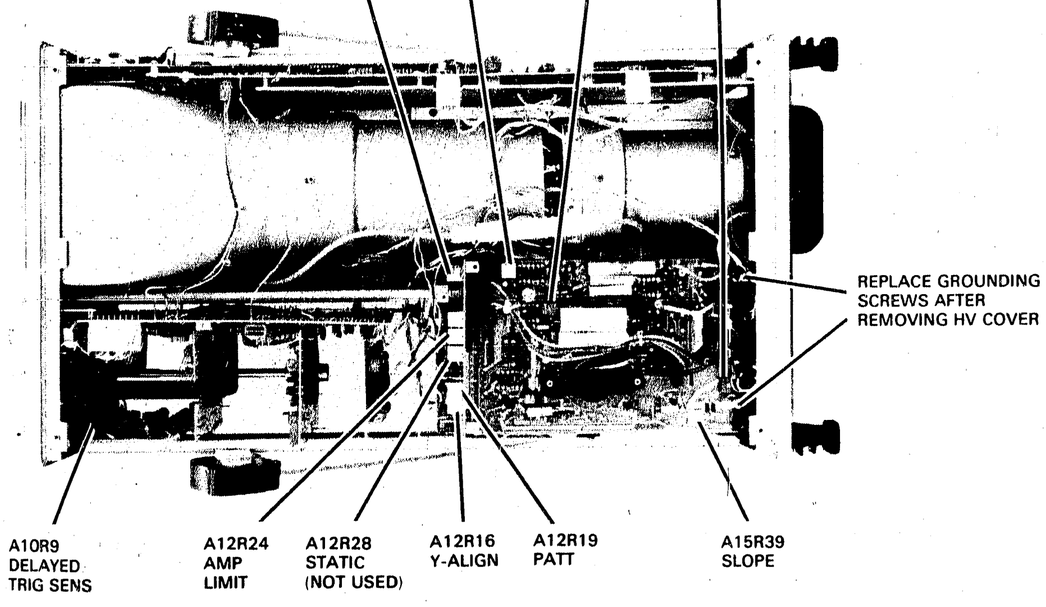
See introduction to this section for ordering information

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

Reference Designation	HP Part No. & Ck Digit	Qty	Description	Mfr Code	Mfr Part Number
A15R41	0757-0471 4		RESISTOR 182K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1823-F
A15R42	0757-0437 2		RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
A15R44	0684-6831 7		RESISTOR 68K 10% .25W FC TC=-400/+800	01121	CB6831
A15R45	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A15R46	0684-1011 5		RESISTOR 100 10% 25W FC TC=-400/+500	01121	CB1011
A15R47	0684-5601 7		RESISTOR 56 10% .25W FC TC=-400/+500	01121	CB5601
A15R48	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A15R49	0684-4741 4	1	RESISTOR 470K 10% .25W CC TC=-800/+900	01121	CB4741
A15T1	01744-61101 7	1	TRANSFORMER, HIGH VOLTAGE	28480	01744-61101
A15U1	1826-0167 3	1	IC OP AMP TO-99	28480	1826-0167
A15U2	1990-0607 3	1	OPTO-ISOLATOR LED-PXSTR IF=80MA-MAX	28480	1990-0607
A15VR1	1902-0040 3	2	DIODE-ZNR 14V 5% DO-7 PD=.4W TC=+.056%	28480	1902-0040
A15VR2	1902-0040 3		DIODE-ZNR 14V 5% DO-7 PD=.4W TC=+.056%	28480	1902-0040
A15VR3	1902-3428 7	1	DIODE-ZNR 100V 5% DO-7 PD=.4W TC=+.083%	28480	1902-3428
A15VR4	1902-3171 7	1	DIODE-ZNR 11V 5% DO-7 PD=.4W TC=+.062%	28480	1902-3171
A15VR5	1902-0766 0	1	DIODE-ZNR 18.2V 5% DO-7 PD=.4W TC=+.068%	28480	1902-0766
A15XA12	1251-0589 4		CONNECTOR 10-PIN F POST TYPE	28480	1251-0589
A16	01744-66501 1	1	LOW VOLTAGE POWER SUPPLY ASSEMBLY	28480	01744-66501
A16C1	0140-0208 8	1	CAPACITOR-FXD 680PF +-5% 300VDC MICA	72136	DM15F681J0300WV1CR
A16C2	0160-0168 1		CAPACITOR-FXD .1UF +-10% 200VDC POLYE	28480	0160-0168
A16C3	0180-1827 3	1	CAPACITOR-FXD 50UF+50-10% 25SVDC AL	56289	39D506F250JE4
A16C4	0180-0089 7	1	CAPACITOR-FXD 10UF+50-10% 150VDC AL	56289	30D106F150DD2
A16C5	0180-0489 1	1	CAPACITOR-FXD 520UF+75-10% 100VDC AL	56289	39D527F100JP4
A16C6	0180-0091 1	1	CAPACITOR-FXD 10UF+50-10% 100VDC AL	56289	30D106F100DC2
A16C7	0180-2801 5	2	CAPACITOR-FXD 10UF+50-10% 475VDC AL	56289	43D100F475GJ1
A16C8	0180-0583 6	1	CAPACITOR-FXD 6000UF+75-10% 30VDC AL	28480	0180-0583
A16C9	0160-2211 9	3	CAPACITOR-FXD 510PF +-5% 300VDC MICA	28480	0160-2211
A16C10	0180-0059 1	2	CAPACITOR-FXD 10UF+75-10% 25VDC AL	56289	30D106G025BB2
A16C11	0180-0443 7	1	CAPACITOR-FXD 5300UF+75-10% 15VDC AL	28480	0180-0443
A16C12	0160-2211 9		CAPACITOR-FXD 510PF +-5% 300VDC MICA	28480	0160-2211
A16C13	0180-0341 4	1	CAPACITOR-FXD 25UF+75-10% 12VDC AL	56289	30D256G012BB2
A16C14	0180-0576 7	1	CAPACITOR-FXD 3500UF+75-10% 30VDC AL	56289	39D596
A16C15	0160-2211 9		CAPACITOR-FXD 510PF +-5% 300VDC MICA	28480	0160-2211
A16C16	0180-0059 1		CAPACITOR-FXD 10UF+75-10% 25VDC AL	56289	30D106G025BB2
A16C17	0180-0039 7	1	CAPACITOR-FXD 100UF+75-10% 12VDC AL	56289	30D107G012CC2
A16C18	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A16C19	0180-2801 5		CAPACITOR-FXD 10UF+50-10% 475VDC AL	56289	43D100F475GJ1
A16C20	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A16C21	0160-3451 1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A16C22	0160-0543 6	1	CAPACITOR-FXD 4700PF +-20% 4KVDC	28480	0160-0543
A16CR1	1906-0006 9	5	DIODE-FW BRDG 400V 1A	28480	1906-0006
A16CR2	1906-0006 9		DIODE-FW BRDG 400V 1A	28480	1906-0006
A16CR3	1906-0006 9		DIODE-FW BRDG 400V 1A	28480	1906-0006
A16CR4	1906-0006 9		DIODE-FW BRDG 400V 1A	28480	1906-0006
A16CR5	1901-0638 3	2	DIODE-FW BRDG 100V 4A	04713	MDA-970-2
A16CR6	1906-0006 9		DIODE-FW BRDG 400V 1A	28480	1905-0006
A16CR7	1901-0638 3		DIODE-FW BRDG 100V 4A	04713	MDA-970-2
A16CR8	1901-0040 1		DIODE-SWITCHING 30V 50MA 2N8 DO-35	28480	1901-0040
A16E1	2110-0269 0		FUSEHOLDER-CLIP TYPE .250-FUSE	28480	2110-0269
A16F1	2110-0044 9	1	FUSE 300mAT 250V SLO-BLO 1.25x.25 UL IEC	28480	2100-0044
A16MP1	1205-0095 0		HEAT SINK TO-5/TO-39-PKG	28480	1205-0095
A16P1	1251-3901 0		CONNECTOR 15-PIN M POST TYPE	28480	1251-3901
A16P2	1251-5093 5	1	CONNECTOR 15-PIN M POST TYPE	28480	1251-5093
A16P3	1251-3902 1	1	CONNECTOR 12-PIN M POST TYPE	28480	1251-3902
A16P4	1251-3750 7		CONNECTOR 10-PIN M POST TYPE	28480	1251-3750
A16P5	1251-3638 0	1	CONNECTOR 6-PIN M POST TYPE	28480	1251-3638
A16Q1	1853-0336 5	5	TRANSISTOR PNP SI PD=625MW FT=50MHZ	04713	MPSA92
A16Q2	1853-0336 5		TRANSISTOR PNP SI PD=625MW FT=50MHZ	04713	MPSA92
A16Q3	1854-0215 1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A16Q4	1854-0575 6		TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A16Q5	1853-0080 6		TRANSISTOR PNP SI PD=300MW FT=30MHZ	28480	1853-0080
A16Q6	1853-0080 6		TRANSISTOR PNP SI PD=300MW FT=30MHZ	28480	1853-0080
A16Q7	1854-0215 1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A16Q8	1854-0358 3	1	TRANSISTOR NPN SI PD=310MW FT=60MHZ	28480	1854-0358
A16Q9	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A16Q10	1853-0036 2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A16Q11	1853-0336 5	1	TRANSISTOR PNP SI PD=625 MW FT=50MHZ	04713	MPSA92
A16Q12	1853-0221 7		TRANSISTOR PNP 2N5416 SI TO-5 PD=1W	28480	1853-0221
A16Q13	1854-0575 6		TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42







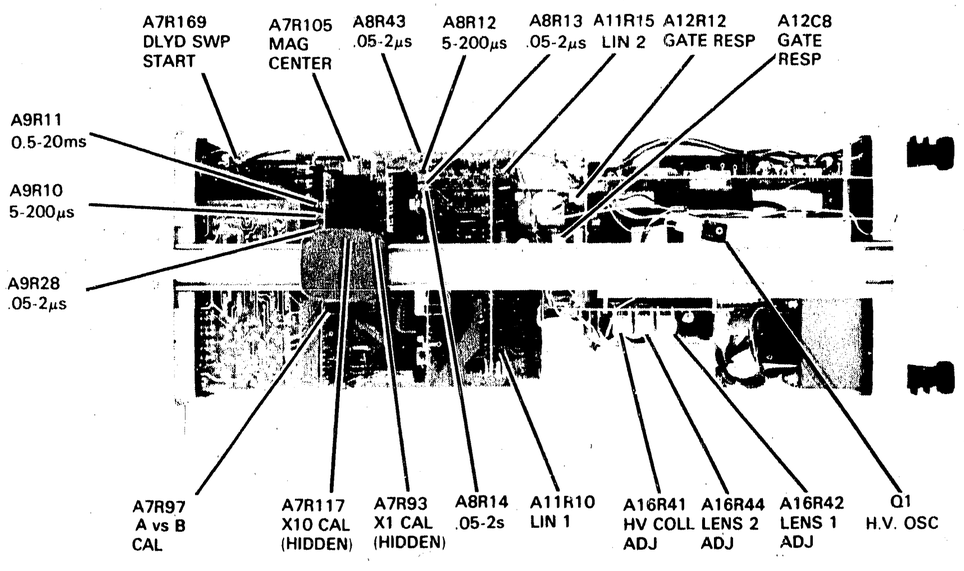


Figure 5-1.
Adjustment Locations

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

Reference Designation	HP Part No. & Ck. Digit	Qty	Description	Mfr Code	Mfr Part Number
A16R1	0757-0454 3		RESISTOR 33.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3322-F
A16R2	0699-0002 3	1	RESISTOR 6.8 10% .5W CC TC=0+412	01121	EB68G1
A16R3	0684-1241 3	2	RESISTOR 120K 10% .25W FC TC=-800/+900	01121	CB1241
A16R4	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A16R5	0698-3455 4		RESISTOR 261K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2613-F
A16R6	0698-4495 4	1	RESISTOR 37.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3742-F
A16R7	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A16R8	0684-1041 1		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A16R9	0757-0431 6	1	RESISTOR 2.43K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2431-F
A16R10	0811-1668 9	2	RESISTOR 1.5 5% 2W PW TC=0+-400	75042	BWH2-1R5-J
A16R11	0684-1231 1	3	RESISTOR 12K 10% .25W FC TC=-400/+800	01121	CB1231
A16R12	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A16R13	0757-0449 6	2	RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A16R14	0757-0288 1	1	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A16R15	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A16R16	0684-4731 2		RESISTOR 47K 10% .25W FC TC=-400/+800	01121	CB4731
A16R17	0698-3655 6	1	RESISTOR 56K 5% 2W MO TC=0+-200	27167	FP42-2-T00-5602-J
A16R18	0684-1241 3		RESISTOR 120K 10% .25W FC TC=-800/+900	01121	CB1241
A16R19	0684-4701 6		RESISTOR 47 10% .25W FC TC=-400/+500	01121	CB4701
A16R20	0698-3455 4		RESISTOR 261K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2613-F
A16R21	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A16R22	0687-4721 6	1	RESISTOR 4.7K 10% .5W CC TC=0+647	01121	EB4721
A16R23	0757-0278 9	1	RESISTOR 1.78K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1781-F
A16R24	0811-1668 9		RESISTOR 1.5 5% 2W PW TC=0+-400	75042	BWH2-1R5-J
A16R25	0757-0433 8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A16R26	2100-0554 5		RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	28480	2100-0554
A16R27	0757-0273 4		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A16R28	0757-0442 9		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A16R29	0698-5579 7	3	RESISTOR 5K .5% .125W F TC=0+-100	24546	C4-1/8-T0-5001-D
A16R30	0811-1665 6	1	RESISTOR .82 5% 2W PW TC=0+-800	75042	BWH2-82/100-J
A16R31	0684-3321 4		RESISTOR 3.3K 10% .25W FC TC=-400/+700	01121	CB3321
A16R32	0698-5579 7		RESISTOR 5K .5% .125W F TC=0+-100	24546	C4-1/8-T0-5001-D
A16R33	0698-5579 7		RESISTOR 5K .5% .125W F TC=0+-100	24546	C4-1/8-T0-5001-D
A16R34	0757-0913 3	1	RESISTOR 2.4K 2% .125W F TC=0+-100	24546	C4-1/8-T0-2401-G
A16R35	0811-1555 1	1	RESISTOR .68 5% 2W PW TC=0+-800	75042	BWH2-11/16-J
A16R36	0684-4711 8		RESISTOR 470 10% .25W FC TC=-400/+600	01121	CB4711
A16R37	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A16R38	0684-4711 8		RESISTOR 470 10% .25W FC TC=-400/+600	01121	CB4711
A16R39	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A16R40	0684-1041 1		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A16R41	2100-3665 5	3	RESISTOR-VAR CONTROL CP 1M 10% LIN	28480	2100-3665
A16R42	2100-3665 5		RESISTOR-VAR CONTROL CP 1M 10% LIN	28480	2100-3665
A16R43	0684-2241 5	2	RESISTOR 220K 10% .25W FC TC=-800/+900	01121	CB2241
A16R44	2100-3665 5		RESISTOR-VAR CONTROL CP 1M 10% LIN	28480	2100-3665
A16R45	0684-2241 5		RESISTOR 220K 10% .25W FC TC=-800/+900	01121	CB2241
A16R46	0683-4715 0	2	RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A16R47	0683-4715 0		RESISTOR 470 5% .25W FC TC=-400/+600	01121	CB4715
A16S1	3101-0555 9	1	SWITCH-PB DPDT ALTNG 4A 250VAC	28480	3101-0555
A16S2	3101-1914 6	1	SWITCH-SL 2-DPDT-NS STD 1.5A 250VAC PC	28480	3101-1914
A16U1	1820-0196 6	3	IC 723 V RGLTR TO-100	04713	MC1723CG
A16U2	1820-0196 6		IC 723 V RGLTR TO-100	04713	MC1723CG
A16U3	1820-0196 6		IC 723 V RGLTR TO-100	04713	MC1723CG
A16VR1	1902-3048 7	1	DIODE-ZNR 3.48V 5% DO-7 PD=.4W TC=-.058%	28480	1902-3048
A16VR2	1902-0025 4		DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	28480	1902-0025
A16VR3	1902-0175 5	1	DIODE-ZNR 100V 5% DO-15 PD=1W TC=+.083%	28480	1902-0175
A17	01744-66507 7	1	STORAGE ASSEMBLY	28480	01744-66507
A17C1	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C2	0160-3652 4	1	CAPACITOR-FXD 4.7PF +.5-4.7PF 200VDC CER	28480	0160-3652
A17C3	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C4	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C5	0160-3650 2	1	CAPACITOR-FXD .018UF +-10% 50VDC CER	28480	0160-3650
A17C6	0121-0491 1	1	CAPACITOR-V TRMR-CER 5-30PF 50V PC-MTG	72982	518-000-5-30A
A17C7	0160-3647 7	1	CAPACITOR-FXD 22PF +-5% 100VDC CER 0+-30	28480	0160-3647
A17C8	0160-3770 7	1	CAPACITOR-FXD 47PF +-5% 100VDC CER	28480	0160-3770
A17C9	0160-3694 4	1	CAPACITOR-FXD 330PF +-10% 100VDC CER	28480	0160-3694
A17C10	0160-3654 6	2	CAPACITOR-FXD 4700PF +-20% 50VDC CER	28480	0160-3654
A17C11	0160-3665 9		CAPACITOR-FXD .01UF +80-20% 500VDC CER	28480	0160-3665
A17C12	0180-0230 0		CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2
A17C13	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C14	0160-3799 0		CAPACITOR-FXD 18PF +-10% 100VDC CER	28480	0160-3799
A17C15	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055

See introduction to this section for ordering information

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

Reference Designation	HP Part No. & Ck Digit	Qty	Description	Mfr Code	Mfr Part Number
A17C16	0160-3654 6		CAPACITOR-FXD 4700PF +-20% 50VDC CER	28480	0160-3654
A17C17	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C18	0160-3443 1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A17C19	0160-3443 1		CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A17C20	0180-0106 9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X0006B2
A17C21	0160-3447 5	4	CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3447
A17C22	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C23	0180-0106 9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X0006B2
A17C24	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C25	0140-0178 1	2	CAPACITOR-FXD 560PF +-2% 300VDC MICA	72136	DM15F561G0300WV1CR
A17C26	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C27	0180-0230 0		CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2
A17C28	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C29	0140-0178 1		CAPACITOR-FXD 560PF +-2% 300VDC MICA	72136	DM15F561G0300WV1CR
A17C30	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C32	0160-3448 6		CAPACITOR-FXD 1000PF +-10% 1KVDC CER	28480	0160-3448
A17C33	0160-3466 8		CAPACITOR-FXD 100PF +-10% 1KVDC CER	28480	0160-3466
A17C34	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C35	0160-3447 5		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3447
A17C37	0180-0374 3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A17C38	0160-3447 5		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3447
A17C39	0140-0192 9		CAPACITOR-FXD 68PF +-5% 300VDC MICA	72136	DM15E680J0300WV1CR
A17C40	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C41	0180-0230 0		CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2
A17C42	0180-0230 0		CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2
A17C43	0160-0159 0	1	CAPACITOR-FXD 6800PF +-10% 200VDC POLYE	28480	0160-0159
A17C44	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C45	0180-0106 9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X0006B2
A17C46	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C47	0180-0374 3		CAPACITOR-FXD 10UF+-10% 20VDC TA	56289	150D106X9020B2
A17C48	0180-0159 2		CAPACITOR-FXD 220UF +-20% 10VDC TA	25088	D220D10MI
A17C49	0180-0059 1		CAPACITOR-FXD 10UF +75-10% 25VDC AL	56289	30D106G025BB2
A17C50	0180-0230 0		CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2
A17C51	0180-1701 2		CAPACITOR-FXD 6.8UF +-20% 6VDC TA	28480	0180-1701
A17C52	0180-1743 2		CAPACITOR-FXD 0.1UF +-10% 35VDC TA	28480	0180-1743
A17C53	0160-3447 5		CAPACITOR-FXD 470PF +-10% 1KVDC CER	28480	0160-3447
A17C54	0160-3448 6		CAPACITOR-FXD 1000PF +-10% 1 KVDC CER	56289	C016B102F102KS25-CDH
A17C55	0180-0230 0		CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2
A17C56	0160-2141 4		CAPACITOR-FXD 680PF +-20% 1KVDC CER	56289	40C826
A17C57	0180-0230 0		CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2
A17C58	0180-0106 9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X0006B2
A17C59	0180-0230 0		CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2
A17C60	0180-0309 4	3	CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
A17C61	0180-0106 9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X0006B2
A17C62	0180-0309 4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
A17C63	0180-0309 4		CAPACITOR-FXD 4.7UF+-20% 10VDC TA	56289	150D475X0010A2
A17C64	0180-0269 5		CAPACITOR-FXD 1UF+75-10% 150VDC AL	56289	30D105G150BA2
A17C65	0180-0230 0		CAPACITOR-FXD 1UF+-20% 50VDC TA	56289	150D105X0050A2
A17C66	0180-0269 5		CAPACITOR-FXD 1UF+75-10% 150VDC AL	56289	30D105G150BA2
A17C67	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C68	0160-2055 9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C69	0180-0106 9		CAPACITOR-FXD 60UF+-20% 6VDC TA	56289	150D606X0006B2
A17C70	0160-3508 9		CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A17CR1	1910-0030 1		DIODE GE 15V 50MA 1NS DO-7	14433	G694
A17CR2	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR3	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR4	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR5	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR6	1910-0030 8		DIODE-GE 15V 50MA 1US DO-7	28480	1910-0030
A17CR7	1910-0030 8		DIODE-GE 15V 50MA 1US DO-7	28480	1910-0030
A17CR8	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR9	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR10	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR11	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR12	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR13	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR14	1901-0036 5		DIODE-HV RECT 1KV 600MA DO-29	28480	1901-0036
A17CR15	1901-0036 5		DIODE-HV RECT 1KV 600MA DO-29	28480	1901-0036
A17CR16	1910-0030 8		DIODE-GE 15V 50MA 1US DO-7	28480	1910-0030
A17CR17	1901-0036 5		DIODE-HV RECT 1KV 600MA DO-29	28480	1901-0036
A17CR18	1901-0036 5		DIODE-HV RECT 1KV 600MA DO-29	28480	1901-0036
A17CR19	1901-0036 5		DIODE-HV RECT 1KV 600MA DO-29	28480	1901-0036
A17CR20	1901-0040 1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040

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

Reference Designation	HP Part No. & Ck Digit		Qty	Description	Mfr Code	Mfr Part Number
A17CR21	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR22	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR23	1901-0040	1		DIODE-GE 15V 50MA 1US DO-7	28480	1901-0040
A17CR24	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR25	1901-0028	5		DIODE-PWR RECT 400V 750MA DO-29	28480	1901-0028
A17CR26	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR27	1901-0040	8		DIODE-GE 15V 50MA 1US DO-7	28480	1910-0030
A17CR28	1901-0040	1		DIODE-GE 15V 50MA 1US DO-7	28480	1910-0030
A17CR29	1910-0030	8		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17CR30	1901-0036	5		DIODE-HV RECT 1 KV 600MA DO-29	28480	1901-0036
A17CR31	1901-0036	5		DIODE-HV RECT 1 KV 600MA DO-29	28480	1901-0036
A17CR32	1901-0040			DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17J1	1200-0438	5		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0438
A17L1	9100-2598	8	2	COIL 80NH 10% Q=35 .26LG-NOM SRF=700MHZ	28480	9100-2598
A17L2	9100-2261	2	2	COIL-MLD 2.7UH 10% Q=40 .095DX.25LG-NOM	28480	9100-2261
A17L3	9100-2261	2		COIL-MLD 2.7UH 10% Q=40 .095DX.25LG-NOM	28480	9100-2261
A17L4	9100-2598	8		COIL 80NH 10% Q=35 .26LG-NOM SRF=700MHZ	28480	9100-2598
A17L5	9100-2250	9	2	COIL-MLD 180NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2250
A17L6	9100-2250	9		COIL-MLD 180NH 10% Q=34 .095DX.25LG-NOM	28480	9100-2250
A17L7	9100-2251	0	2	COIL-MLD 220NH 10% Q=32 .095DX.25LG-NOM	28480	9100-2251
A17L8	9100-2251	0		COIL-MLD 220NH 10% Q=32 .095DX.25LG-NOM	28480	9100-2251
A17Q1	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q2	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q3	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A17Q4	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q5	1853-0336	5		TRANSISTOR PNP SI PD=625MW FT=50MHZ	04713	MPSA92
A17Q6	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A17Q7	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A17Q8	1854-0575	6		TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A17Q9	1854-0234	4	1	TRANSISTOR NPN 2N3440 SI TO-5 PD=1W	28480	1854-0234
A17Q10	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A17Q11	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q12	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q13	1853-0086	2		TRANSISTOR PNP SI PD=310MW FT=40MHZ	28480	1853-0086
A17Q14	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q15	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q16	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q17	1853-0354	7		TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A17Q18	1853-0354	7		TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A17Q19	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A17Q20	1853-0336	5		TRANSISTOR PNP SI PD=625MW FT=50MHZ	04713	MPSA92
A17Q21	1854-0575	6		TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A17Q22	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A17Q23	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q24	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A17Q25	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q26	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A17Q28	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	SPS 3611
A17Q29	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHz	01295	SKA1124
A17Q30	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHz	01295	SKA1124
A17Q31	1854-0575	6		TRANSISTOR NPN SI PD=625MW FT=50 MHz	04713	MPS-A42
A17Q32	1854-0575	6		TRANSISTOR NPN SI PD=625MW FT=50 MHz	04713	MPS-A42
A17Q33	1853-0336	5		TRANSISTOR PNP SI PD=625MW FT=50 MHz	04713	MPS-A92
A17R1	0698-4399	7	2	RESISTOR 88.7 1% .125W F TC=0+-100	24546	C4-1/8-T0-88R7-F
A17R2	0757-0734	2	2	RESISTOR 1.21K 1% .25W F TC=0+-100	27167	C5-1/4-T0-1211-F
A17R3	0698-3404	3	1	RESISTOR 383 1% .5W F TC=0+-100	28480	0698-3404
A17R4	0757-0734	2		RESISTOR 1.21K 1% .25W F TC=0+-100	27167	C5-1/4-T0-1211-F
A17R5	0698-4399	7		RESISTOR 88.7 1% .125W F TC=0+-100	24546	C4-1/8-T0-88R7-F
A17R6	0698-7028	5	1	RESISTOR 27 10% .125W CC TC=-270/+540	01121	BB2701
A17R7	0684-1011	5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A17R8	0698-5674	3	2	RESISTOR 5.62K 1% .125W F TC=0+-25	28480	0698-5674
A17R9	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A17R10	0757-0283	6		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A17R11	0698-5674	3		RESISTOR 5.62K 1% .125W F TC=0+-25	28480	0698-5674
A17R12	0757-0400	9		RESISTOR 90.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-90R9-F
A17R13	0757-0417	8		RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A17R14	0757-0417	8		RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A17R15	0757-0400	9		RESISTOR 90.9 1% .125W F TC=0+-100	24546	C4-1/8-T0-90R9-F
A17R16	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A17R17	0698-3157	3		RESISTOR 19.6K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1962-F
A17R18	0757-0440	7		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A17R19	2100-1986	9	2	RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	73138	82PR1K
A17R20	0757-0398	4		RESISTOR 75 1% .125W F TC=0+-100	24546	C4-1/8-T0-75R0-F
A17R21	2100-2497	9	1	RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	73138	82PR2K
A17R22	2100-1986	9		RESISTOR-TRMR 1K 10% C TOP-ADJ 1-TRN	73138	82PR1K
A17R23	0698-7248	1	1	RESISTOR 3.16K 1% .05W F TC=0+-100	24546	C3-1/8-T0-3161-G
A17R24	0698-3440	7	1	RESISTOR 196 1% .125W F TC=0+-100	24546	C4-1/8-T0-196R-F
A17R25	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A17R26	0684-1041	1		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A17R27	0684-1021	7		RESISTOR 1K 10% .25W FC TC=-400/+800	01121	CB1021
A17R28	0684-1041	1		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A17R29	0757-0806	9	1	RESISTOR 243 1% .5W F TC=0+-100	28480	0757-0806
A17R30	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F

See introduction to this section for ordering information

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

Reference Designation	HP Part No. & Ck. Digit	Qty	Description	Mfr Code	Mfr Part Number
A17R31	0683-0475 1		RESISTOR 4.7 5% .25W FC TC=-400/+500	01121	CB47G5
A17R32	0684-2231 3	3	RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A17R33	0684-8211 1		RESISTOR 820 10% .25W FC TC=-400/+600	01121	CB8211
A17R34	0684-8211 1		RESISTOR 820 10% .25W FC TC=-400/+600	01121	CB8211
A17R35	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A17R36	0684-8211 1		RESISTOR 820 10% .25W FC TC=-400/+600	01121	CB8211
A17R37	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A17R38	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A17R39	0684-2231 3		RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A17R40	0684-8211 1		RESISTOR 820 10% .25W FC TC=-400/+600	01121	CB8211
A17R41	0757-0280 3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A17R42	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A17R43	0757-0280 3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A17R44	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A17R45	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A17R46	0684-8211 1		RESISTOR 820 10% .25W FC TC=-400/+600	01121	CB8211
A17R47	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A17R48	0684-8211 1		RESISTOR 820 10% .25W FC TC=-400/+600	01121	CB8211
A17R49	0757-0280 3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A17R50	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A17R51	0757-0280 3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A17R52	0684-8211 1		RESISTOR 820 10% .25W FC TC=-400/+600	01121	CB8211
A17R53	2100-3253 7		RESISTOR-TRMR 50K 10% C TOP-ADJ 1-TRN	28480	2100-3253
A17R54	0684-1531 4		RESISTOR 15K 10% .25W FC TC=-400/+800	01121	CB1531
A17R55	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A17R56	0160-2141 4		CAPACITOR-FXD 680PF +-20% 1 KVDC CER	56289	40C826
A17R57	0684-3321 4		RESISTOR 3.3K 10% .25W FC TC=-400/+700	01121	CB3321
A17R58	0684-8211 1		RESISTOR 820 10% .25W FC TC=-400/+600	01121	CB8211
A17R59	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A17R60	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A17R61	0684-8211 1		RESISTOR 820 10% .25W FC TC=-400/+600	01121	CB8211
A17R62	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A17R63	0684-3921 0		RESISTOR 3.9K 10% .25W FC TC=-400/+700	01121	CB3921
A17R64	0684-3921 0		RESISTOR 3.9K 10% .25W FC TC=-400/+700	01121	CB3921
A17R65	0757-0482 7	1	RESISTOR 511K 1% .125W F TC=0+-100	28480	0757-0482
A17R67	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A17R68	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A17R69	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A17R70	0684-3321 4		RESISTOR 3.3K 10% .25W FC TC=-400/+700	01121	CB3321
A17R71	0757-0439 4		RESISTOR 6.81K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6811-F
A17R72	0684-3911 8	2	RESISTOR 390 10% .25W FC TC=-400/+600	01121	CB3911
A17R73	0684-1041 1		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A17R74	0684-3921 0		RESISTOR 3.9K 10% .25W FC TC=-400/+700	01121	CB3921
A17R75	0757-0484 9	1	RESISTOR 619K 1% .125W F TC=0+-100	19701	MF5C1/8-T0-6193-F
A17R76	0757-0459 8	1	RESISTOR 56.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5622-F
A17R77	0687-2741 6	1	RESISTOR 270K 10% .5W CC TC=0+882	01121	EB2741
A17R78	0683-2265 1		RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A17R79	0757-0417 8		RESISTOR 562 1% .125W F TC=0+-100	24546	C4-1/8-T0-562R-F
A17R80	0684-8221 3	1	RESISTOR 8.2K 10% .25W FC TC=-400/+700	01121	CB8221
A17R81	0684-8211 1		RESISTOR 820 10% .25W FC TC=-400/+600	01121	CB8211
A17R82	0757-0199 3	1	RESISTOR 21.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2152-F
A17R83	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A17R84	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A17R85	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A17R86	0757-0450 9	1	RESISTOR 22.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2212-F
A17R87	0684-1521 2		RESISTOR 1.5K 10% .25W FC TC=-400/+700	01121	CB1521
A17R88	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A17R89	0684-5621 1	2	RESISTOR 5.6K 10% .25W FC TC=-400/+700	01121	CB5621
A17R90	0684-6831 7		RESISTOR 68K 10% .25W FC TC=-400/+800	01121	CB6831
A17R91	0684-3931 2		RESISTOR 39K 10% .25W FC TC=-400/+800	01121	CB3931
A17R92	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A17R93	0684-2231 3		RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A17R94	0684-1231 1		RESISTOR 12K 10% .25W FC TC=-400/+800	01121	CB1231
A17R95	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A17R96	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A17R97	0684-1051 3		RESISTOR 1M 10% .25W FC TC=-800/+900	01121	CB1051
A17R98	0684-1231 1		RESISTOR 12K 10% .25W FC TC=-400/+800	01121	CB1231
A17R99	0684-1041 1		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A17R100	0684-2221 1		RESISTOR 2.2K 10% .25W F TC=-400/+700	01121	CB2221
A17R101	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A17R102	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A17R103	2100-0558 9		RESISTOR-TRMR 20K 10% C TOP-ADJ 1-TRN	28480	2100-0558
A17R104	0757-0342 8	1	RESISTOR 100K 1% .25W F TC=0+-100	27167	C5-1/4-T0-1003-F
A17R105	0684-1541 6		RESISTOR 150K 10% .25W FC TC=-800/+900	01121	CB1541

See introduction to this section for ordering information

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

Reference Designation	HP Part No. & Ck. Digit	Qty	Description	Mfr Code	Mfr Part Number
A17R106	0684-1821 5		RESISTOR 1.8K 10% .25W FC TC=-400/+700	01121	CB1821
A17R107	0811-1788 4	1	RESISTOR 15 5% 2W PW TC=0+=400	75042	BWH2-15R-J
A17R108	0684-3931 2		RESISTOR 39K 10% .25W FC TC=-400/+800	01121	CB3931
A17R109	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A17R110	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A17R111	0757-0442 9		RESISTOR 10K 1% .125W FC TC=0+-100	24546	CR-1/8-TO-1002-F
A17R112	2100-3210 6		RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	02111	63P103T623
A17R113	0757-0461 2		RESISTOR 68.1K 1% .125W F TC=0 +-100	24546	CR-1/8-TO-6812-F
A17R114	0698-3154 0		RESISTOR 4.22K 1% .125W F TC=0+-100	24546	CR-1.8-TO-4221-F
A17R115	2100-0567 0		RESISTOR-TRMR 2K 10% C TOP-ADK 1-TRN	02111	63P202T623
A17R116	0757-0465 6		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1003-F
A17R117	0684-1541 6		RESISTOR 150K 10% .25W FC TC=-800/+900	01121	DB1541
A17R118	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A17R119	0698-3243 8	1	RESISTOR 17AK 1% .125W F TC=0+-100	24546	C4-1/8-T0-1783-F
A17R120	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A17R121	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A17R122	0757-0280 3		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A17R123	0684-8231 5	1	RESISTOR 82K 10% .25W FC TC=-400/+800	01121	CB8231
A17R124	0684-5621 1		RESISTOR 5.6K 10% .25W FC TC=-400/+700	01121	CB5621
A17R125	0687-1041 7	1	RESISTOR 100K 10% .5W CC TC=0+882	01121	EB1041
A17R126	0684-4721 0		RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A17R127	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A17R128	0684-1521 2		RESISTOR 1.5K 10% .25W FC TC=-400/+700	01121	CB1521
A17R129	0684-8211 1		RESISTOR 820 10% .25W FC TC=-400/+600	01121	CB8211
A17R130	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A17R131	0757-0421 4		RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-T0-825R-F
A17R132	0757-0433 8		RESISTOR 3.32K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3321-F
A17R133	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A17R134	0684-1001 3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A17R135	0684-2221 1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A17R136	0684-1041 1		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A17R137	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A17R138	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A17R139	0684-2231 3		RESISTOR 22K 10% .25W FC TC=-400/+800	01121	CB2231
A17R140	0684-1031 9		RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A17S1	3101-1341 3	1	SWITCH-SL SPDT-N8 SUBMIN .5A 125VAC/DC	28480	3101-1341
A17U1	1826-0205 0	1	IC 14-DIP-P	18324	NE556A
A17U2	1820-1116 2	1	IC FF TTL J-K BAR POS-EDGE-TRIG	01295	SN74109N
A17U3	1820-0269 4	6	IC GATE TTL NAND QUAD 2-INP	01295	SN7403N
A17U4	1820-0511 9	2	IC GATE TTL AND QUAD 2-INP	01295	SN7408N
A17U5	1820-0077 2	1	IC FF TTL D-TYPE POS-EDGE-TRIG CLEAR	01295	SN7474N
A17U6	1826-0205 0		IC 14-PIP-P	18324	NE556A
A17U7	1820-0269 4		IC GATE TTL NAND QUAD 2-INP	01295	SN7403N
A17U8	1820-0269 4		IC GATE TTL NAND QUAD 2-INP	01295	SN7403N
A17U9	1820-0511 9		IC GATE TTL AND QUAD 2-INP	01295	SN7408N
A17U10	1820-0054 5	2	IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A17U11	1820-0579 9	1	IC MV TTL MONOSTBL RETRIG DUAL	01295	SN74123N
A17U12	1820-0269 4		IC GATE TTL NAND QUAD 2-INP	01295	SN7403N
A17VR1	1902-3096 5	2	DIODE-ZNR 5.23V 5% DO-7 PD=.4W TC=-.003%	28480	1902-3096
A17VR2	1902-0234 7	2	DIODE-ZNR 59V 5% PD=1.5W TC=+.092%	28480	1902-0234
A17VR3	1902-0234 7		DIODE-ZNR 59V 5% PD=1.5W TC=+.092%	28480	1902-0234
A17VR4	1902-3070 5	1	DIODE-ZNR 4.22V 5% DO-7 PD=.4W TC=-.038%	28480	1902-3070
A17VR5	1902-3193 3	1	DIODE-ZNR 13.3V 5% DO-7 PD=.4W TC=+.059%	28480	1902-3193
A17VR6	1902-3234 3		DIODE-ZNR 19.6V 5% DO-7 PD=.4W TC=+.073%	28480	1902-3234
A17VR7	1902-3096 5		DIODE-ZNR 5.23V 5% DO-7 PD=.4W TC=-.003%	28480	1902-3096
A17XA16	1251-3903 2	1	CONNECTOR 6-PIN F POST TYPE	28480	1251-3903
A17XU2	1200-0438 5		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0438
A17XU3	1200-0474 9		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0474
A17XU4	1200-0474 9		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0474
A17XU5	1200-0474 9		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0474
A17XU6	1200-0474 9		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0474
A17XU7	1200-0474 9		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0474
A17XU8	1200-0474 9		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0474
A17XU9	1200-0474 9		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0474
A17XU10	1200-0474 9		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0474
A17XU11	1200-0438 5		SOCKET-IC 16-CONT DIP-SLDR	28480	1200-0438
A17XU12	1200-0474 9		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0474
A17A1	1NA9-8005 1	1	IC, OUTPUT AMPLIFIER(NOT P/O A17, ORDER SEPARATELY)	28480	1NA9-8005
A18	01744-66508 8		STORAGE CONTROL ASSEMBLY	28480	01744-66508
A18DS1	1990-0487 7	4	LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
A18DS2	1990-0485 5	1	LED-VISIBLE LUM-INT=600UCD IF=30MA-MAX	28480	5082-4984
A18DS3	1990-0487 7		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
A18DS4	1990-0487 7		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584
A18DS5	1990-0487 7		LED-VISIBLE LUM-INT=1MCD IF=20MA-MAX	28480	5082-4584

See introduction to this section for ordering information

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

Reference Designation	HP Part No. & Ck. Digit	Qty	Description	Mfr Code	Mfr Part Number
A18R1	0684-1041 1		RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A18R2	0757-0441 8	1	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A18R3	2100-3210 6		RESISTOR-TRMR 10K 10% C TOP-ADJ 1-TRN	28480	2100-3210
A18R4	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A18R5	1810-0076 0	1	NETWORK-RES 9-PIN-BIP .15-PIN-SPCG	28480	1810-0076
A18R6	0684-2711 4		RESISTOR 270 10% .25W FC TC=-400/+600	01121	CB2711
A18R7	0684-2711 4		RESISTOR 270 10% .25W FC TC=-400/+600	01121	CB2711
A18R8	0684-2711 4		RESISTOR 270 10% .25W FC TC=-400/+600	01121	CB2711
A18R9	0684-2711 4		RESISTOR 270 10% .25W FC TC=-400/+600	01121	CB2711
A18R10	0684-2711 4		RESISTOR 270 10% .25W FC TC=-400/+600	01121	CB2711
A18R11	0684-3911 8		RESISTOR 390 10% .25W FC TC=-400/+600	01121	CB3911
A18R12	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A18R13	0684-1021 7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A18R14	0684-1011 5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A18S1	3101-1374 2	2	SWITCH-PB DPDT MOM .4A 115VAC	28480	3101-1374
A1882	3101-1374 2		SWITCH-PB DPDT MOM .4A 115VAC	28480	3101-1374
A1883	3101-1400 5	1	SWITCH-PB DPDT ALTNG .4A 115VAC	28480	3101-1400
A1884	3101-1628 9	1	SWITCH-PB SPDT MOM 1A 115VAC YEL-BTN	28480	3101-1628
A18U1	1820-0054 5		IC GATE TTL NAND QUAD 2-INP	01295	SN7400N
A18U2	1820-0269 4		IC GATE TTL NAND QUAD 2-INP	01295	SN7403N
A18U3	1820-0269 4		IC GATE TTL NAND QUAD 2-INP	01295	SN7403N
A18VR1	1902-0025 4		DIODE-ZNR 10V 5% DO-7 PD=.4W TC=+.06%	28480	1902-0025
A18XU1	1200-0441 0		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0441
A18XU2	1200-0441 0		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0441
A18XU3	1200-0441 0		SOCKET-IC 14-CONT DIP-SLDR	28480	1200-0441

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
02111	SPECTROL ELECTRONICS CORP	CITY OF IND CA	91745
03888	KDI PYROFILM CORP	WHIPPANY NJ	07981
04222	AVX CERAMICS CORP	MYRTLE BEACH SC	29577
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85062
05276	ITT POMONA ELECTRONICS	POMONA CA	91776
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	94042
08806	GE CO MINIATURE LAMP PRODUCT CO	CLEVELAND OH	44112
14099	SEMTECH CORP	NEWBURY PARK CA	91320
17856	SILICONIX INC	SANTA CLARA CA	95054
18324	SIGNETICS CORP	SUNNYVALE CA	94086
19701	MEPCO/ELECTRA CORP	MINERAL WELLS TX	76067
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	16701
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA CA	95051
27167	CORNING GLASS WORKS (WILMINGTON)	WILMINGTON NC	28401
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
32997	BOURNS INC TRIMPOT PROD DIV	RIVERSIDE CA	92507
51642	CENTRE ENGINEERING INC	STATE COLLEGE PA	16801
52763	STETTNER-TRUSH INC	CAZENOVIA NY	13035
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
72136	ELECTRO MOTIVE CORP SUB IEC	WILLIMANTIC CT	06226
72982	ERIE TECHNOLOGICAL PRODUCTS INC	ERIE PA	16512
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON CA	92634
75042	TRW INC PHILADELPHIA DIV	PHILADELPHIA PA	19108
75915	LITTELFUSE INC	DES PLAINES IL	60016

See introduction to this section for ordering information

BACK DATING

MANUAL

CHANGES

SECTION VII

MANUAL CHANGES

7-1. INTRODUCTION.

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

SERVICE INFORMATION

Table 8-1. Schematic Notes

REFER TO ANSI Y 32.2 AND Y32.14 FOR SCHEMATIC SYMBOLS NOT LISTED IN THIS TABLE.

ETCHED CIRCUIT BOARD

ASSEMBLY

ETCHED CIRCUIT BOARD ON ASSEMBLY

VERNIER — FRONT-PANEL MARKING

VERNIER — REAR-PANEL MARKING

MAIN SIGNAL PATH

PRIMARY FEEDBACK PATH

SECONDARY FEEDBACK PATH

SINGLE-PIN CONNECTOR ON BOARD

A — PIN OF A PLUG-IN BOARD (WITH LETTER OR NUMBER)

COAXIAL CABLE CONNECTED DIRECTLY TO BOARD

COAXIAL CABLE CONNECTED TO SNAP-ON JACK

FRONT-PANEL CONTROL

TP4 — TEST POINT (TP WITH NUMBER)

SCREWDRIVER ADJUSTMENT

7 — WAVEFORM TEST POINT (WITH NUMBER)

A — COMMON ELECTRICAL POINT (WITH LETTER); NOT NECESSARILY GROUND

70 — SIGNAL REFERENCE

9 — SCHEMATIC REFERENCE

BREAKDOWN DIODE (VOLTAGE REGULATOR)

LIGHT EMITTING DIODE (LED)

TUNNEL DIODE

G D S — FIELD-EFFECT TRANSISTOR (N-TYPE BASE)

CIRCUITS OR COMPONENTS DRAWN WITH DASHED LINES (PHANTOM) SHOW FUNCTION ONLY AND ARE NOT INTENDED TO BE COMPLETE. THE CIRCUIT OR COMPONENT IS SHOWN IN DETAIL ON ANOTHER SCHEMATIC.

(925) **WIRE COLORS ARE GIVEN BY NUMBERS IN PARENTHESES 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

* OPTIMUM VALUE SELECTED AT FACTORY, TYPICAL VALUE SHOWN; PART MAY HAVE BEEN OMITTED.

UNLESS OTHERWISE INDICATED ALL LOGIC ELEMENTS ARE OF THE TTL LOGIC FAMILY

UNLESS OTHERWISE INDICATED: RESISTANCE IN OHMS, CAPACITANCE IN PICOFARADS AND INDUCTANCE IN MICROHENRIES

CW	CLOCKWISE END OF VARIABLE RESISTOR
NC	NO CONNECTION
P/O	PART OF

VF (A)

V	- VOLTAGE
F	- FILTERED
(A)	- FILTER SOURCE

PARTS LIST

SECTION VIII

SERVICE

8-1. INTRODUCTION.

8-2. This section provides instructions for troubleshooting and repairing the Model 1744A Oscilloscope.

8-3. Detailed theory of operation and troubleshooting information are located opposite the schematics on foldout Service Sheets. Adjustment and assembly locations are shown in Section V of this manual. The remainder of this section has general service information that should help to quickly service and repair the oscilloscope.

8-4. THEORY OF OPERATION.

8-5. Overall theory of operation appears on the foldout pages opposite the overall block diagrams starting with Service Sheet 1. The block diagrams briefly describe overall instrument operation. Each block diagram refers to service sheets where the detailed theory, schematics, and troubleshooting information are presented. Table 8-1, Schematic Notes, explains any unusual symbols that appear on the schematics.

8-6. TROUBLESHOOTING.

WARNING

Maintenance and troubleshooting procedures described herein are performed with power applied to the instrument, and protective covers removed. Such maintenance and troubleshooting should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock). Where maintenance can be performed without power applied, the power should be removed.

8-7. INITIAL TROUBLESHOOTING PROCEDURE. Before troubleshooting the 1744A 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.

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

8-9. TROUBLE DIAGNOSIS. By the use of front-panel controls, note as many symptoms of the malfunction as possible. From these symptoms it can usually be determined which section (vertical, horizontal, low-voltage, or high-voltage power supplies) is malfunctioning. But even if the problem is in the vertical or horizontal section, it is still good practice to check the low-voltage power supplies, since an out-of-tolerance supply can affect the operation of other circuits. Table 8-2 lists the sequence of checks that should be used when troubleshooting.

8-10. CIRCUIT-LEVEL TROUBLESHOOTING. Once a problem has been isolated to a particular assembly or circuit, the text and waveforms on the service sheet that documents that circuit should be used to locate the faulty component(s).

8-11. RECOMMENDED TEST EQUIPMENT.

8-12. Test equipment and test equipment accessories required to maintain the 1744A are listed in Section I, table 1-3 of this manual. Equipment other than that listed may be used if it meets the listed critical 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 8-3 for the list of assemblies indexed to Service Sheets.

8-15. PREVENTIVE MAINTENANCE.

8-16. Cleaning. Painted surfaces can be cleaned with a commercial, spray-type window cleaner or with a mild soap and water solution.

CAUTION

Avoid the use of 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.

8-17. Corroded spots are best removed with soap and water. Stubborn residues can be removed with a fine abrasive. Protect such areas from further corrosion with an application of silicone resin such as GE DRIFILM 88.

Table 8-2. Troubleshooting Sequence

CHECK	COMMENT
1. LVPS	All other functions rely on LVPS for proper operation.
2. CRT & HVPS	All high voltages and CRT must function to obtain a display.
3. GATE AMPLIFIER	CRT must be unblanked to display signal.
4. CRT DEFLECTION PLATES	Check plate average volts (listed on schematics) for both horizontal and vertical plates with position controls centered. If these voltages are approximately correct continue. If not, troubleshoot the appropriate amplifier.
5. VERTICAL SECTION	After obtaining a visible beam, begin checking deflection circuitry.
6. HORIZONTAL OUTPUT AMPLIFIER	To distinguish between time base and horizontal output amplifier problems, apply signal to channel B (in A VS B mode); if deflection occurs, horizontal output amplifier is operating properly.
7. SWEEP	After checking horizontal output amplifier, check ramp generating circuitry (in AUTO mode). When auto sweep is operating properly, check trigger circuit.

8-18. Switch Maintenance. The pushbutton switches in this instrument were designed for long, trouble-free service. If one of these switches should become defective, replacement rather than repair is recommended.

8-19. Rotary switches can easily be serviced after removal from the instrument. For example, to remove the TIME/DIV switch, the TIME/DIV switch shaft must also be removed. Refer to Service Sheet 9 for TIME/DIV switch shaft removal and appropriate Service Sheet for switch maintenance.

8-20. Conventional rotary switches are serviced by cleaning the contacts with a degreaser such as M-180 FREON TF DEGREASER. Contact surfaces should be lubricated with a lubricant comparable to LUBRIPLATE FML produced by Fiske Brothers Refining Company. LUBRIPLATE FML is available from Hewlett-Packard (HP Part No. 6040-0305).

8-21. Fan Air Filter. The air filter covering the fan air intake should be cleaned every six months (or sooner in dusty environments). To clean the air filter proceed as follows:

a. Remove fan from instrument by removing four screws holding fan mounting bracket to rear panel of instrument.

b. Remove two screws and nuts used to mount air filter to fan.

c. Using low-pressure air (not to exceed 50 psi) blow dust from air filter.

d. Reinstall air filter by reversing removal procedure.

8-22. CIRCUIT BOARDS.

8-23. Board Connections. Square-pin connectors are identified on circuit boards by color code of connecting wire or by the signal name. Connector pins on plugs and jacks are identified by either a numeral or a letter. The letters G, I, O, and Q have been omitted.

8-24. Servicing Etched Circuit Boards. All the etched circuit boards have plated-through component holes. This allows components to be removed or replaced by unsoldering or soldering from either side of the board. When removing large components such as potentiometers, rotate the soldering iron tip from lead to lead while applying pressure to the part to lift it from the board. HP Service Note M-20E contains additional information for repair of etched circuit boards.

Table 8-3. Assembly Index

ASSY NO.	ASSY NAME	THEORY OF OPERATION	COMPONENT ID	REMOVAL PROCEDURE	TROUBLE-SHOOTING	SCHEMATICS
A1	Channel A Attenuator	NA	NA	NA	NA	Service Sheet 5
A2	Channel B Attenuator	NA	NA	NA	NA	Service Sheet 5
A3	Vertical Preamplifier	Service Sheets 5, 7	Service Sheet 5	Service Sheet 5	Service Sheets 5, 7	Service Sheets 5, 7
A4	Delay Line	NA	NA	Service Sheet 5	NA	Service Sheet 5
A5	Not Assigned					
A6	HV Multiplier	NA	NA	Service Sheet 3	NA	Service Sheet 3
A7	Horizontal Sweep	Service Sheets 8, 12, 13	Service Sheets 8, 12, 13	Service Sheet 8	Service Sheets 8, 12, 13	Service Sheets 8, 12, 13
A8	Main Sweep	Service Sheet 9	Service Sheet 9	Service Sheet 9	Service Sheet 9	Service Sheet 9
A9	Delayed Sweep	Service Sheet 11	Service Sheet 11	Service Sheet 11	Service Sheet 11	Service Sheet 11
A10	Delayed Trigger	Service Sheet 10	Service Sheet 10	Service Sheet 10	Service Sheet 10	Service Sheet 10
A11	Horizontal Output	Service Sheet 12	Service Sheet 12	Service Sheet 12	Service Sheet 12	Service Sheet 12
A12	Gate Amplifier	Service Sheet 4	Service Sheet 4	Service Sheet 4	Service Sheet 4	Service Sheet 4
A13	Vertical Control Switching	Service Sheet 7	Service Sheet 7	Service Sheet 7	Service Sheet 7	Service Sheet 7
A14	Interface	NA	NA	NA	NA	Service Sheet 14
A15	HV Power Supply	Service Sheet 3	Service Sheet 3	Service Sheet 3	Service Sheet 3	Service Sheet 3
A16	Low Voltage Power Supply	Service Sheet 2	Service Sheet 2	Service Sheet 2	Service Sheet 2	Service Sheet 2
P/O A17	Storage Assembly	Service Sheet 16	Service Sheet 16	Service Sheet 16	Service Sheet 16	Service Sheets 16, 17
P/O A17	Vertical Output Amplifier	Service Sheet 6	Service Sheet 6	Service Sheet 6	Service Sheet 6	Service Sheet 6
A18	Storage Control	Service Sheet 15	Service Sheet 15	Service Sheet 15	Service Sheet 15	Service Sheets 15, 17

SERVICE SHEET 1

BASIC PRINCIPLES OF OPERATION

General. The following paragraphs contain functional descriptions keyed to a block diagram located on the opposite page. The block diagram is drawn for function and does not show circuit details. Schematics, along with a detailed theory description of each circuit, are located on following service sheets. Refer to table 8-3 for Service Sheet identification.

Vertical Section. The input attenuators select the type of input coupling (50Ω, DC, GND, or AC), and determine the vertical deflection factor (5 mV/div to 20 V/div) as selected by the front-panel VOLTS/DIV switches. Only contact strips and their actuating cams are contained in the attenuator assemblies. The major part of each attenuator is on the preamplifier substrate. The only passive attenuation is a X100 section preceding the discrete, dual-FET impedance converter in each channel. The preamplifier substrate (A3A1) performs the necessary control functions for both channel A and B, including six dc-actuated ranges of attenuation per channel. Along with the X100 section, this configuration provides 12 calibrated levels of vertical sensitivity, ranging from 5 mV/div to 20 V/div. Peripheral circuitry includes control logic for the preamplifier substrate and a trigger-view amplifier that routes trigger signals through the delay line to the output amplifier.

Delay Line. The delay line provides the required delay of approximately 100 nanoseconds to the vertical input signal. This allows the horizontal sweep to trigger before the vertical signal reaches the CRT plates.

Vertical Output Amplifier. The vertical output amplifier contains the necessary pulse-shaping networks and an X5 amplification stage. Its output stage provides drive to the CRT vertical deflection plates.

Horizontal Section. The internal sync amplifier provides a synchronization signal for the main and delayed trigger generators. The generators develop the trigger signals that start the main and delayed sweeps. The trigger is also applied to an auto circuit that is used in AUTO mode only. The outputs of the generators are controlled by the level of the sync signal applied and the reset signal from the holdoff control circuit. When the reset signal is high, the generator is operational and a trigger signal will be developed if there is an internal or external sync input.

The main and delayed sweep circuits initiate horizontal sweeps from the trigger signal applied to their inputs. Miller integrators produce the horizontal sweep ramps; their slopes are controlled by the front-panel TIME/DIV switches. The outputs from the Miller integrators are applied through the horizontal display mode switches to the horizontal preamplifier.

The horizontal sweep is also compared to a reference voltage by a ramp comparator that drives the reset circuit. The reset and holdoff circuits control the timing sequence of the sweep ramp.

The holdoff circuit establishes a time interval at the end of the sweep that disables the trigger generator. The trigger generator is armed at the end of holdoff and is ready for the next trigger signal. The duration of holdoff is controlled by the TIME/DIV setting and the TRIGGER HOLDOFF control. The horizontal preamplifier provides amplification for the sweep ramp. The horizontal POSITION control establishes a reference level for the horizontal sweeps. Trace magnification (X10) is also accomplished in this stage. When the BEAM FIND switch is pressed, current in the output stage of the preamplifier is reduced, preventing the horizontal output stage from driving the beam beyond the viewing area of the CRT. The horizontal output stage provides drive to the CRT horizontal deflection plates.

Gate and HV Power Supply. The gate amplifier assembly contains circuitry necessary to control the brightness of the CRT display. An intensity control circuit is used for brightening or blanking the CRT when necessary. BEAM FIND and BEAM INTENSITY controls are part of the gate amplifier assembly.

The high-voltage power supply consists of a high-voltage oscillator, a high-voltage transformer, and a rectifying circuit. The high-voltage oscillator produces cathode, grid, and focus voltages for the CRT. A secondary winding on the high-voltage transformer provides voltage for the CRT cathode heater.

An operational amplifier compares the rectified cathode voltage to a fixed reference voltage. Changes in cathode voltage are sensed and fed back to the high-voltage oscillator, causing its output to change. The change in output from the oscillator is always in the direction that will return the cathode voltage to its normal operating level.

The unrectified cathode voltage in the secondary of the high-voltage transformer is applied to an X3 multiplier assembly. The multiplier output is connected to the CRT post accelerator.

Low-voltage Power Supply. The low-voltage power supply operates from an ac power source. The ac line is applied to the input power circuit (100-, 120-, 220-, 240-Vac operation is selectable) that contains the ac line protection fuse and applies the input ac to a step-down power transformer.

Secondary outputs from the power transformer are applied to rectifiers and voltage regulator circuits that convert input ac power to usable dc outputs of different voltage levels.

CATHODE-RAY TUBE - GENERAL STORAGE THEORY

Previous CRTs used in HP variable persistence and storage oscilloscopes contain a conventional electron gun with deflection plates (write gun), an aluminized phosphor viewing screen, a pair of floodguns operated in parallel, flood beam shaping and accelerating grids, a flood beam collimator, a collector mesh, and a storage mesh as shown in figure 8-1.

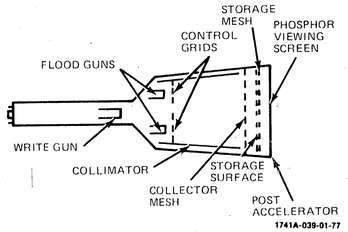


Figure 8-1. Simplified CRT Construction

Unlike other HP storage oscilloscopes, the 1744A uses an expansion storage CRT. In previous CRTs, the storage mesh is located just behind the viewing screen at the front of the CRT. In the 1744A CRT, the storage mesh is located about mid-way between the write gun and the viewing screen (see figure 8-2).

The write gun in the 1744A functions as a conventional electrostatic deflection gun and is used to write images onto the storage mesh. After an image is written on the dielectric side of the storage mesh, flood-gun electrons pass through the image and are expanded by a static crossover lens system and focused onto the phosphor viewing screen at the front of the CRT.

In principle, the operation of the expansion mesh storage tube is similar to the operation of a slide projector. The projector light is analogous to the CRT floodgun while the projector slide corresponds to the storage mesh with an image stored on it. The images on the storage mesh are magnified by the lens system of the CRT, and projected to the screen for viewing.

In all other aspects, the 1744A CRT functions in the conventional storage manner. When the ERASE push-button is pressed, the storage mesh is charged to the same potential as the collector mesh (+120 V). The storage surface is also charged to nearly this same potential by capacitive coupling. Since the surface is then being bombarded by electrons with energies much higher than first crossover energy, the entire storage potential becomes equal to +120 volts. The surface potential cannot increase beyond +120 volts because the collector mesh would then repel the emitted electrons back to the storage surface, tending to decrease the surface potential.

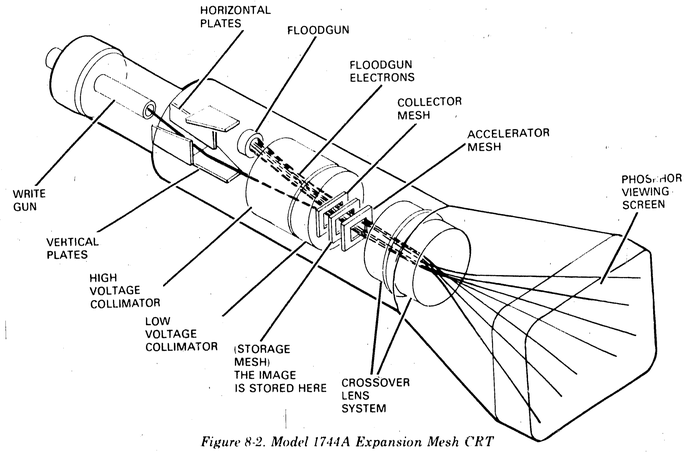


Figure 8-2. Model 1744A Expansion Mesh CRT

After approximately 60 milliseconds, the storage mesh potential steps down negatively and immediately begins to ramp in a positive direction (see figure 8-3). Approximately 225 milliseconds later (at the end of the erase cycle), the storage mesh potential steps down again but this time to V1.

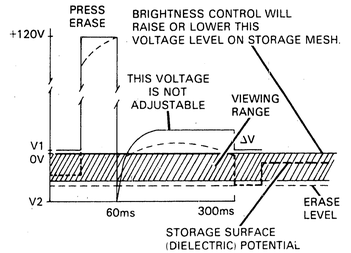


Figure 8-3. Storage Mesh and Surface Potentials During Erase

The BRIGHTNESS control sets the level of the base line voltage (V1) of the storage mesh voltage waveform. It also (indirectly by capacitive coupling) raises or lowers the storage surface voltage (V2). The voltage level on the dielectric storage surface determines the number of floodgun electrons that strike the viewing screen of the CRT, thus determining the brightness of the stored display.

Because the dielectric surface of the storage mesh is only indirectly (capacitively) connected to the storage mesh grid, adjusting the BRIGHTNESS control too high tends to erase written information. This is because the same floodgun electron source used for viewing is also used for erasing. Once the dielectric surface potential is high enough to view the stored displays it becomes high enough to collect floodgun electrons in the written area, charging it negatively and reducing contrast with respect to the background. Therefore, exercise discretion when using the BRIGHTNESS control. It is advisable to always adjust the BRIGHTNESS control from its minimum position.

In a variable persistence storage oscilloscope, the write gun deposits a charge on the dielectric surface of the storage mesh. The amount of charge is dependent on the write gun current. Therefore, the faster the write gun beam traverses the storage area, the less the resulting change in surface potential. It is therefore necessary to adjust the dielectric surface potential to get the written parts of the trace to cross into the turn-on range of the floodguns (see figure 8-4). It will be noted that raising the potential of the storage target makes faster waveforms viewable or enhances the viewable writing speed. In the same way, raising the potential on the storage target dielectric surface will enhance the writing speed of the oscilloscope for continuous waveforms by allowing floodgun electrons to add with the write gun electrons. This enables the oscilloscope to perform like a lamp amplifier for dim displays.

Function of Storage Control Assembly. In the write mode of operation, the persistence enable signal enables the storage mesh driver circuit. The driver circuit is then pulsed by a timer with the pulse duration being a function of the PERSISTENCE control setting. The timer is inhibited during the store mode and auto erase modes of operation.

The erase function is controlled by flip-flops that enable a blanking gate that blanks the CRT during the erase cycle.

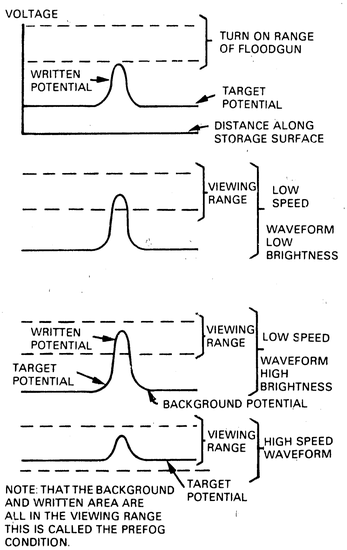


Figure 8-4. Variable Persistence Storage

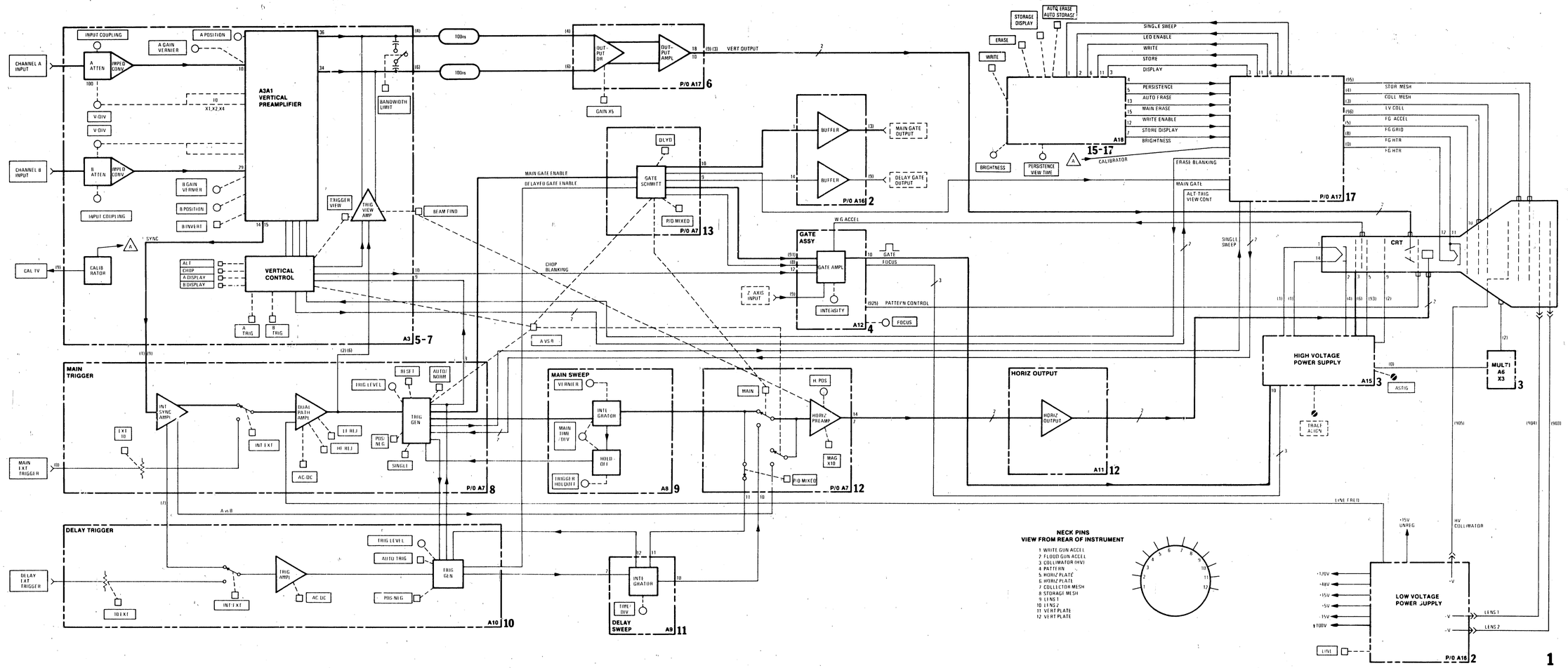


Figure 8-5.
Service Sheet 1, Overall Block Diagram

SERVICE SHEET 2

THEORY OF OPERATION

General. The low-voltage power supply (LVPS) can be operated from 100-, 120-, 220-, or 240-Vac, 48 Hz to 440 Hz power source. The line voltage is converted to five regulated voltages, +5 V, +15 V, +48 V, +120 V, and -15 V. Approximately +21 V is tapped off the +15 V supply (before regulation) for use in the high-voltage oscillator circuit. This voltage is referred to on the schematics as +15 V UNREG. Since the +5 V, +15 V, and -15 V supplies function in the same manner, only the +15 V supply will be discussed.

+15-volt Supply. The ac input is applied through transformer T1 to a full-wave, diode-bridge rectifier A16CR5. The unregulated rectified voltage (nominally +21 Vdc) is applied to voltage regulator A16U2 that employs a built-in current-limiting circuit. Operation of the +15 V supply is explained in the following paragraphs.

The output of series regulator Q4 is controlled by the base bias applied from regulator A16U2 which contains a temperature compensated reference circuit and a differential amplifier with a Darlington output. The voltage developed internally by the reference circuit (pin 4 output) is connected to the noninverting input (pin 3) of the differential amplifier through A16R23. The V_{REF} voltage is approximately +7 volts with respect to pin 5 (ground). The +15 V output (from Q4) is divided by resistor network A16R25-A16R27. The wiper of A16R26 is connected to the inverting input (pin 2) of the differential amplifier and is adjusted to compensate for V_{REF} variations developed within different ICs. When adjusted, the noninverting and inverting input voltages will always be equal (within a few millivolts) when the regulator is functioning properly. If the output of the +15 V supply raises or lowers for some reason, the inverting input voltage will follow. On the other hand, the reference voltage applied to the noninverting input will remain fixed. With different voltages applied to the noninverting and inverting inputs to the amplifier, the output (pin 6) at A16U2 will vary, causing Q4 to increase or decrease its output as necessary to restore the output to +15 volts.

The -15-volt supply, consisting of A16U3 and Q6, operates identically as the +15-volt supply except that the noninverting input to A16U3 (pin 3) is the sum of the +15 V and -15 V outputs (nominally 0 V). The +5-volt supply, consisting of A16U1 and Q5, operates identically to the +15-volt supply except that the reference voltage is the +15-volt supply divided by A16R28 and A16R29.

+120-volt and +48-volt Power Supplies. The ac input voltage from power transformer T1 is applied to diode-bridge rectifier A16CR1. The dc output from the rectifier is filtered by A16C3. +15-volt reference is applied through A16R1 to the base of A16Q1 which is part of differential amplifier A16Q1/Q2. The base of A16Q2 is connected to a voltage divider network across the output circuit. If the output falls below +120 V, the base of A16Q2 becomes less positive and A16Q2 conducts harder. A16Q2 is direct-coupled to Darlington pair A16Q4 and Q2. When A16Q2 current increases, conduction through A16Q4 and Q2 increase. This results in an increase in output voltage. When the output voltage reaches +120 volts, A16Q2 current reduces and equilibrium is reached. Transistor A16Q3 and resistor A16R2 form a current-limiting circuit. As the current requirements increase towards the limit of the supply capability, the voltage drop across A16R2 is applied to the base of A16Q3 which conducts, limiting the current drain from the Darlington pair.

The +48-volt power supply functions identically as the +120-volt supply. The Darlington pair consists of A16Q8 and Q3, and the current-limiting circuit consists of A16Q7 and A16R10.

Line Frequency. The line frequency sync signal is developed in the same secondary winding of ac input power transformer T1 that is used for the +120-volt supply. The signal is applied through A16R40 to HF REJ switch A7S2C on assembly A7 (see Service Sheet 8).

Floodgun Collimator Voltage. Floodgun collimator voltage is developed in a secondary winding of transformer T1. The input voltage is rectified by A16CR4 and filtered by A16C7. The rectified voltage is applied to a regulator circuit consisting of A16Q11-A16Q13. A16R41 controls the hv collimator voltage.

-100-volt Supply. The -100 volts used in the CRT erase circuitry is developed in a secondary winding of transformer T1. The input voltage is rectified by A16CR3 and filtered by A16C19. The rectified voltage is applied to storage assembly A17 (Service Sheet 17). -200 volts is also applied to potentiometers A16R42 and A16R44 which set the voltage levels applied to lens 1 and lens 2 in the CRT.

REMOVAL PROCEDURE

To remove Low-voltage Power Supply Assembly A16, see figure 8-6 and proceed as follows:

NOTE

Removal of A16 is not necessary unless it must be replaced; all work can be performed with A16 in place except for repair or replacement of line selection and on-off switches.

a. Disconnect ac input power cord from instrument.

b. Remove Interface Assembly A14.

c. Disconnect gate output wires (9) and (3).

d. Disconnect two plugs to power transformer.

e. Remove line cover (MP57) by removing two screws.

f. Disconnect ac input leads (98) and (918).

g. Disconnect five plugs to series regulators (Q2-6).

h. Disconnect cable to CRT consisting of wires (903), (904), and (905).

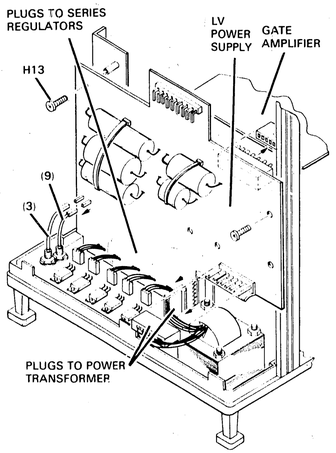


Figure 8-6. LV Power Supply Removal

i. Remove five screws holding A16 to chassis.

j. Disconnect plug to Gate Amplifier Assembly A12.

k. Carefully lift A16 and move toward front of instrument. LINE switch shaft will protrude through front panel.

l. Unscrew LINE switch shaft and extract it.

m. Remove button from shaft; A16 can now be removed.

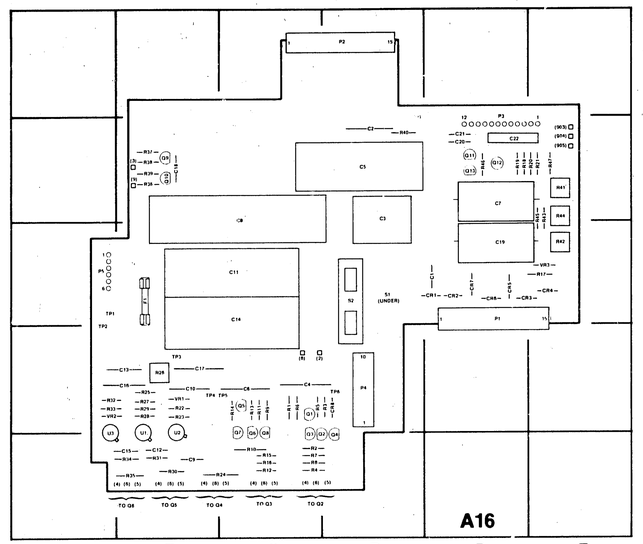
n. To reinstall A16, reverse removal procedure, except after A16 is secured in place, screw LINE switch shaft into switch (switch must be in "out" position) until slot is halfway through bezel, then press button onto shaft (see Service Sheet 4).

TROUBLESHOOTING

All voltages: +5 V, +48 V, +120 V, -15 V, and the high voltage are referenced to the +15 V supply, so it must be made operational first. The supplies are current-limiting type, so any excessive loading from the vertical, horizontal, etc., will cause the supply to read low.

To quickly check if an external load is causing A16 to current-limit and read low, remove Interface Assembly A14 that connects the power supply to Vertical Preamplifier A3 and Horizontal Sweep Assembly A7. If the supplies return to normal, then an external short is probably loading the supply. Assembly A3 can be flexed upward, so A14 can be connected between assemblies A16 and A7. This will help determine if the problem is on A3 or A7. It is also possible to disconnect the Gate Amplifier A12 and HV Power Supply A15, from assembly A16 by disconnecting A15 from the bottom of A16.

Finally, check for proper dc voltages indicated on the schematic for certain active components. Unless otherwise indicated, all voltages are referenced to chassis ground. All indications are nominal and 15% variations from those indicated should be considered normal.



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	E-3	CR1	E-3	Q10	B-4	R19	E-4	R41	F-4
C2	D-4	CR2	E-3	Q11	E-4	R20	F-4	R42	F-3
C3	D-4	CR3	F-3	Q12	E-4	R21	F-4	R43	F-4
C4	C-2	CR4	F-3	Q13	E-4	R22	B-2	R44	F-4
C5	D-4	CR5	E-3	R1	C-2	R23	B-2	R45	F-4
C6	C-2	CR6	E-3	R2	C-1	R24	C-1	R46	E-4
C7	E-4	CR7	E-3	R3	D-2	R25	B-2	R47	F-4
C8	C-4	CR8	D-2	R4	C-1	R26	B-2	S1	D-3
C9	B-1	F1	B-3	R5	C-2	R27	B-2	S2	D-3
C10	B-2	P1	E-3	R6	C-2	R28	B-2	TP1	A-3
C11	C-3	P2	D-5	R7	C-1	R29	B-2	TP2	A-3
C12	B-1	P3	E-4	R8	C-1	R30	B-1	TP3	B-2
C13	B-2	P5	A-3	R9	C-2	R31	B-1	TP4	B-2
C14	C-3	Q1	C-2	R10	C-1	R32	A-2	TP5	C-2
C15	B-1	Q2	C-1	R11	C-2	R33	A-2	TP6	D-2
C16	B-2	Q3	C-1	R12	C-1	R34	B-1	U1	B-2
C17	B-2	Q4	D-1	R13	C-2	R35	B-1	U2	B-2
C18	B-4	Q5	C-2	R14	C-2	R36	B-4	U3	A-2
C19	E-3	Q6	C-1	R15	C-1	R37	B-4	VR1	B-2
C20	E-4	Q7	C-1	R16	C-1	R38	B-4	VR2	A-2
C21	E-4	Q8	C-1	R17	F-3	R39	B-4	VR3	F-3
C22	E-4	Q9	B-4	R18	E-4	R40	D-4		

Figure 8-7. LV Power Supply, A16, Component Identification

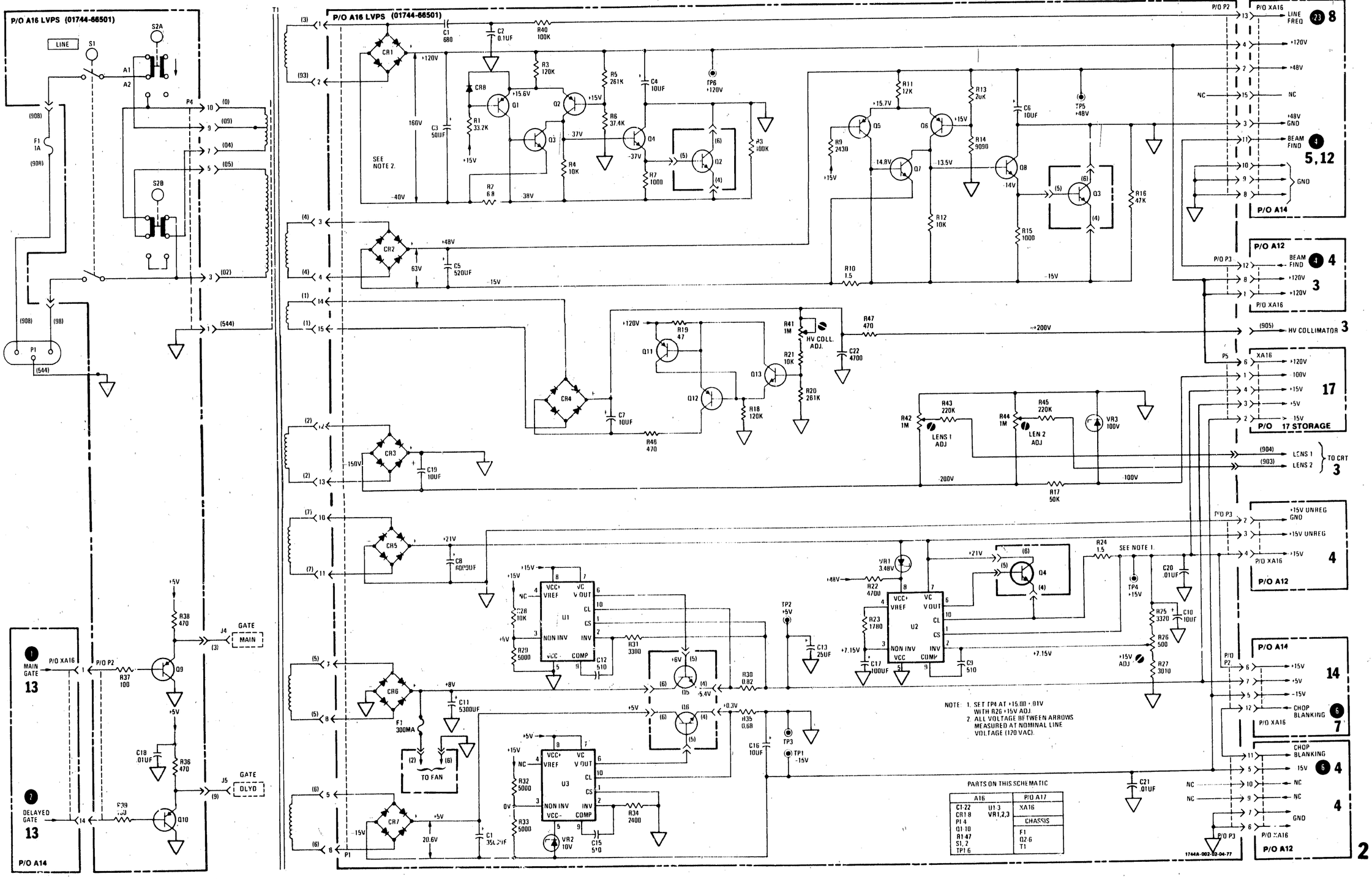


Figure 8-8.
Service Sheet 2, LV Power Supply

SERVICE SHEET 3

THEORY OF OPERATION

High-voltage Oscillator. The high-voltage power supply consists of an oscillator (Q1) and a rectifying circuit. When the instrument is turned on +15 volts unregulated is applied to Q1, turning it on. As Q1 conducts through the primary winding of A15T1 (pins 3 and 4), positive feed back to the base of Q1 occurs through another winding of the transformer (pins 1 and 2). When conduction through Q1 reaches saturation, the magnetic field develo, ed in primary winding (pins 3 and 4) starts to collapse. This induces reverse feed back in the other winding, causing reduced conduction through Q1. With varying conduction through Q1, the circuit oscillates at a rate determined by the inherent distributed inductance and capacitance of the oscillator circuit. The magnitude of the oscillations, and consequently the output of the power supply, is controlled by the voltage at the output of differential amplifier A15U1.

High-voltage Regulator. Operational Amplifier A15U1 compares the voltage at the junction of A15R13 and A15R37 with ground and then drives HV oscillator Q1 to compensate for any differences noted. The voltage level is determined by the divider action of A15R13, A15R36, A15R37, and A15R38. For example, an increase in the cathode current of the CRT (V1) will tend to change the cathode voltage, resulting in the (+) input of A15U1 going positive. The output of A15U1 follows the input, forcing Q1 to conduct harder. When the oscillator conducts harder, the HV from A15CR3 goes more negative returning the input of A15U1 to 0 V (equal to the reference level applied to the (–) input (pin 2).

Auto Focus. The output from A12Q8 (Service Sheet 4) is a function of beam intensity and is applied to A15Q3 for correction to the CRT focus voltage. When the beam is off, approximately –250 V is present at A15TP6. As the beam intensity increases, a level is reached (determined by the setting of KNEE control A15R32) where A15Q3 begins to conduct. The more A15Q3 conducts, the lower (goes more positive) the focus voltage on the CRT. This action tends to maintain the CRT beam focus over the full intensity range. The level of correction can be adjusted by SLOPE control A15R39.

HV Disable. Transistor A15Q2 monitors the +120 V supply through resistor network A15R41 and A15R31. If the output of the +120 V supply drops below approximately +100 volts, A15Q2 conducts, turning on A15Q1 and effectively grounding the base of Q1, turning it off. In addition, if the +120 V supply surges above approximately +138 volts, zener diode A15VR5 conducts, turning on A15Q1. Again high-voltage oscillator Q1 turns off, protecting the CRT from high-intensity burns. In the event that the –15 V supply is shorted to ground, A15Q2 conducts, turning on A15Q1 and cutting off Q1. Shorting the +15 V supply to ground causes the output of A15U1 to go low, turning off Q1. In both instances, the CRT is protected against deep burns.

A protection circuit consisting of A15Q4, A15U2, and A15Q5 is incorporated in the cathode circuit to prevent accidental burning of the CRT while turning the instrument on and off, and during quick power drop outs. When the instrument is turned off, A15C18 discharges, turning off A15Q4. When the instrument is turned on, A15C18 starts to charge towards the –15 V supply through A15R44. Until the capacitor becomes fully charged, A15Q4 is cut off and there is no current flow through A15R45. A15U2 is an opto-electrical device consisting of an LED (light-emitting diode) and a light-sensitive transistor. With no current flowing through A15R45, the LED is nonconducting and the light-sensitive transistor is cut off. This turns off A15Q5 and the CRT cathode is held 100 volts positive with respect to the grid through A15VR3. This action disables the write gun in the CRT. The time that it takes A15C18 to charge to –15 volts allows the high-voltage regulator circuit to stabilize the output from the high-voltage oscillator. When A15C18 charges to approximately +12 volts, A15Q4 conducts, causing the LED in A15U2 to light. This turns on the light-sensitive transistor and A15Q5 conducts, by-passing A15VR3. This enables the write gun in the CRT.

High-voltage Rectifier. The CRT cathode and grid voltages are developed in the secondary of high-voltage transformer A15T1. The cathode voltage is rectified and filtered before application to the cathode of the CRT. It is also used as a feedback control to the high-voltage oscillator, as a reference for the CRT filament winding, as a reference for the grid bias supply, and for the focus voltage divider network. The cathode voltage is –3000 volts and is adjustable by A15R38.

The CRT grid voltage is picked off the secondary winding of transformer A15T1 at pin 5. The voltage is applied through an RC network (A15C2/A15R3) to diodes that clamp the voltage swing between that established by intensity limit control (A15R2) and the gate dc levels. The peak-to-peak voltage swing is rectified and applied to the CRT grid which is voltage-referenced to the cathode. This controls the brightness of the CRT trace. The HV Multiplier voltage is picked off the secondary winding of transformer A15T1 at pin 7. The voltage is applied to Assembly A6 where it is multiplied (X3), rectified, filtered, and then applied to the post accelerator of the CRT. The post accelerator voltage is approximately 9.5 kV.

REMOVAL PROCEDURE

High-voltage Assembly A15 Removal. To remove High-voltage Power Supply Assembly A15, proceed as follows:

a. Disconnect ac input power cord from instrument.

b. Remove HV cover (MP54).

WARNING

Failure to discharge high voltage can result in severe electrical shock to personnel and damage to the instrument.

c. Discharge high voltage by shorting test point A15TP1 to chassis.

d. Disconnect two (6) wires and one (2) wire to FOCUS potentiometer A12R22 at A15.

e. Disconnect (956) and (957) wires from rear of A15.

f. Remove CRT socket cover (MP33).

g. Disconnect CRT socket (XV1).

h. Remove connector to HV oscillator, Q1. Note connector orientation (wires remain parallel from board to device).

i. Disconnect Gate Amplifier Assembly A12 from Low-voltage Power Supply Assembly A16.

j. Disconnect A15 from A12.

WARNING

When performing next step (k) discharge high voltage by holding insulated part of wires and touching the two leads together.

k. Lift A15 and disconnect small (0) wire and large (0) wire from HV Multiplier Assembly A6.

l. Remove A15.

m. To reinstall A15, reverse removal procedure; remembering to again short small (0) wire and large (0) wire from HV multiplier as in step k.

Cathode-ray Tube Removal. To remove the CRT, see figure 8-9 of this Service Sheet, and proceed as follows:

WARNING

To prevent personal injury, wear a face mask or goggles, protective gloves, and handle the CRT carefully. Do not lift the CRT or support its weight by the neck.

a. Disconnect ac input power cord from instrument.

WARNING

Failure to discharge high voltage can result in severe electrical shock to personnel and damage to the instrument.

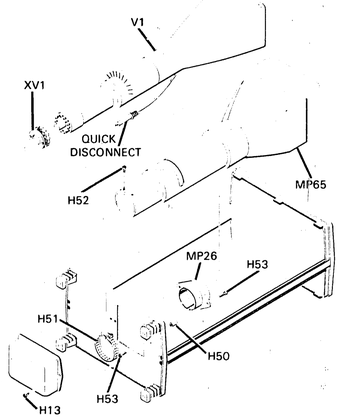


Figure 8-9. CRT Removal

b. Disconnect post-accelerator lead from CRT at ceramic quick-disconnect connector and immediately discharge lead from high-voltage multiplier to chassis ground.

c. Remove rear-panel CRT socket cover (MP33); then disconnect CRT base socket (XV1).

d. Remove HV Power Supply cover (MP54).

e. Discharge high voltage by shorting test point A15TP1 to chassis ground.

f. Disconnect (956) and (957) wires (X ALIGN COIL leads) from rear of HV Power Supply Assembly A15.

g. Disconnect (95) and (0) wires (Y ALIGN COIL leads) from Gate Assembly A12.

h. Disconnect all CRT neck-pin leads.

i. Remove adjustable clamp (H51) from CRT clamp (MP26).

j. Remove two screws (H52) securing CRT shield to CRT clamp.

k. Remove two screws (H53) from rear panel securing CRT clamp to rear panel.

l. Rotate CRT clamp (MP26) 45°; then remove through rear-panel CRT opening.

m. Gently move CRT and shield about two inches towards rear of instrument.

n. Tilt shield up and gently lift CRT and shield out of instrument.

CAUTION

When removing or installing CRT, be careful not to bend CRT neck pins.

o. Remove CRT from CRT shield (MP65).

p. To reinstall CRT, reverse removal procedure.

High-voltage Multiplier Assembly A6 Removal. To remove High-voltage Multiplier Assembly A6, proceed as follows:

WARNING

Failure to discharge high voltage can result in severe electrical shock to personnel and damage to the instrument.

a. Disconnect post-accelerator lead from CRT at ceramic quick-disconnect connector and immediately discharge lead from hv multiplier assembly to chassis ground.

b. Remove hv power supply assembly A15 (refer to removal procedure in this service sheet).

c. Remove bracket MP48 over A6 assembly (two screws to chassis and two screws to rear panel).

d. Lift bracket off large (0) wire to A6 from A15.

e. Remove post-accelerator lead cable clamp H35.

f. Remove two screws securing A6 to chassis and remove A6.

g. To reinstall A6, reverse removal procedure.

TROUBLESHOOTING

WARNING

When power is applied to the 1744A, –3000 Vdc is present at all times in the High Voltage Power Supply Assembly (A15). Be extremely careful when working in proximity to this area. The high voltage could cause serious personal injury if contacted.

To troubleshoot HV Power Supply Assembly A15, remove the HV cover and reinstall the two screws closest to the rear of the instrument. This provides the necessary ground connections for assembly A15. The high-voltage oscillator collector and base waveform measurements are accessible directly on assembly A15, as well as the control grid and cathode voltages. A high voltage disable circuit turns off the H.V. oscillator should a L.V. supply fail. This protects the CRT from high beam current and burns. If grid and cathode voltages are present on A15, verify that voltages are present at the CRT socket; a faulty socket or wire can cause an open circuit.

CAUTION

When measuring high voltages, always use a 1000:1 probe with an impedance of 100 MΩ or greater.

Common CRT problems consist of open filaments, grid-cathode shorts (uncontrollable beam), and "hollow cathodes," sometimes referred to as "double-peaking."

If the high voltage is low, and low voltages are correct, check for a faulty high-voltage transformer, leaky capacitors, or resistors that may have changed in value (typical problem with extremely large resistors - 30 MΩ, etc.).

Faulty high-voltage multipliers usually cause the display to be of low intensity and out of focus. Multipliers can sometimes be checked by measuring the output with a high-voltage probe.

DC VOLTAGE MEASUREMENT CONDITIONS SERVICE SHEET 3

1. Set front-panel controls in accordance with initial control settings in Section V.
2. All voltages are referenced to chassis ground. All indications are nominal and 15% variations from those indicated should be considered normal.

WARNING

Voltages in the HIGH VOLTAGE Area are dangerous to life. Use extreme care in making measurements and observe precautions listed in the SAFETY SUMMARY at the front of this manual.

WAVEFORM MEASUREMENT CONDITIONS
SERVICE SHEET 3

1. Set front-panel controls in accordance with initial control settings in Section V.
2. Set monitor oscilloscope TIME/DIV and VOLTS/DIV controls as indicated under waveform(s).

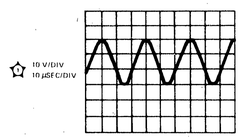
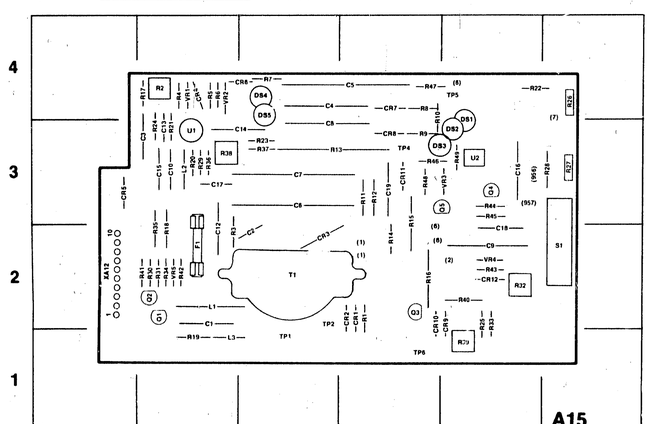


Figure 8-10. Waveforms for Service Sheet 3



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-2	C16	E-4	CR11	D-3	Q4	E-3	R13	C-3	R27	F-3	R41	B-2	TP5	E-4
C2	C-2	C17	B-3	CR12	E-2	Q5	E-3	R14	D-2	R28	F-3	R42	B-2	TP6	D-1
C3	B-3	C18	E-2	DS1	E-4	R1	D-2	R15	D-3	R29	B-3	R43	E-2	U1	B-3
C4	C-4	C19	D-3	DS2	E-4	R2	B-4	R16	D-2	R30	B-2	R44	E-3	U2	E-3
C5	D-4	CR1	D-2	DS3	E-4	R3	B-2	R17	B-4	R31	B-2	R45	E-3	VR1	B-4
C6	C-3	CR2	D-3	DS4	C-4	R4	B-4	R18	B-2	R32	E-2	R46	D-3	VR2	B-4
C7	C-3	CR3	C-2	DS5	C-4	R5	B-4	R19	B-1	R33	E-2	R47	D-4	VR3	E-3
C8	C-3	CR4	B-4	F1	B-2	R6	B-4	R20	B-3	R34	B-2	R48	D-3	VR4	E-2
C9	E-2	CR5	A-3	L1	B-2	R7	C-4	R21	B-3	R35	B-2	R49	E-4	VR5	B-2
C10	B-3	CR6	C-4	L2	B-3	R8	D-4	R22	E-4	R36	B-3	S1	F-2	XA12	A-2
C12	B-2	CR7	D-4	L3	B-1	R9	D-3	R23	C-3	R37	C-3	T1	C-2		
C13	B-3	CR8	D-3	Q1	B-2	R10	D-4	R24	B-3	R38	B-3	TP1	C-1		
C14	C-3	CR9	E-2	Q2	B-2	R11	D-3	R25	E-2	R39	E-1	TP2	C-2		
C15	B-3	CR10	D-2	Q3	D-2	R12	D-3	R26	F-4	R40	E-2	TP4	D-3		

Figure 8-11. HV Power Supply, A15, Component Identification.

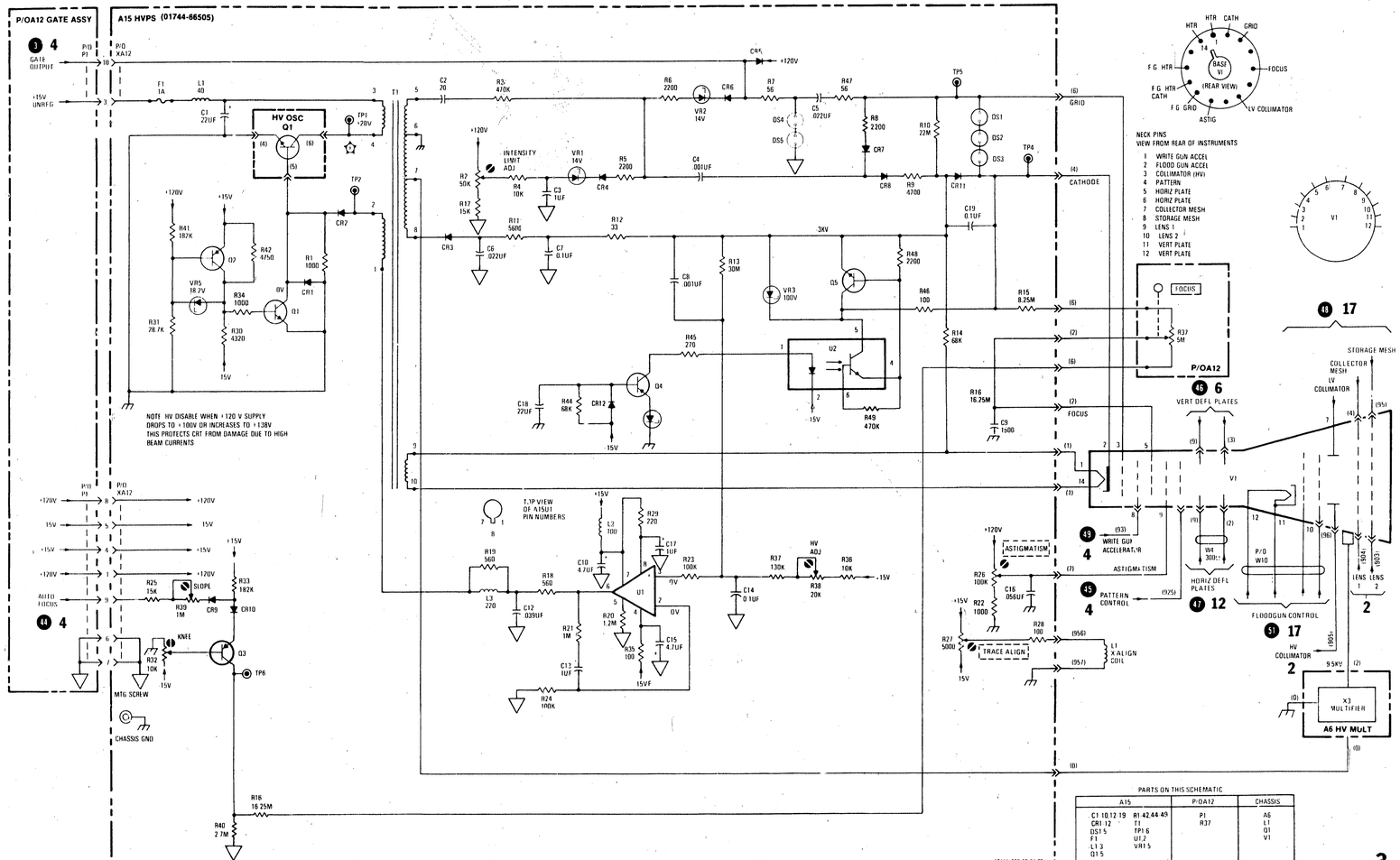


Figure 8-12. Service Sheet 3, HV Power Supply

SERVICE SHEET 4

GATE ASSEMBLY - CIRCUIT THEORY

General. Gate assembly A12 controls trace intensity on the CRT. A12U1 sums all functions necessary for control of trace intensity. Inputs to A12U1 are external Z AXIS inputs, main gate, delayed gate, chop blanking, and erase blanking.

Beam Intensity. Front-panel BEAM INTENSITY control A12R25 establishes the voltage level supplied by A12Q8 (through A12R4) to current switches in A12U1. Outputs from the current switches are applied to gate amplifier circuit A12Q1 through A12Q4. The greater the current, the brighter the trace.

Intensity Limit. Transistors A12Q5/A12Q7/A12Q10 make up the intensity limit circuit. As intensity becomes excessive in the CRT, the accelerator element begins to draw current. This increases the current flow through A12R20, causing a reduction in the base voltage applied to A12Q7. The collector output of A12Q7 (through A17Q10) is applied to Darlington amplifier A12Q5 which controls the base voltage applied to A12Q8, thereby modifying the current available from BEAM INTENSITY control A12R25.

Gate Drive. The gate drive signal is applied to the base of A12U1Q1 to control its operation. When the signal is low, A12U1Q1 turns off and A12U1Q2 turns on, unblanking the CRT. When the main gate signal is high, A12U1Q1 turns on and A12U1Q2 turns off, blanking the CRT.

Delayed Gate. The delayed gate signal is applied to the base of A12U1Q5. With the delay gate signal high, A12U1Q5 conducts, unblanking the CRT. When the delayed gate signal is low, A12U1Q5 turns off and A12U1Q4 turns on.

Chop Blanking. Chop blanking is accomplished by A12U1Q3. When CHOP mode of operation is selected the chop blanking signal causes A12U1Q3 to alternately turn on and off at the chop blanking repetition rate (≈250 kHz). When conducting, A12U1Q3 turns off A12U1Q2, blanking the CRT. When A12U1Q3 is not conducting, A12U1Q2 turns on, unblanking the CRT.

Z-Axis Blanking. A signal of +4 volts (greater than 50 nanoseconds in pulse width) applied to the Z-AXIS input connector will cause A12Q6 to conduct heavily turning off A12U1Q2, blanking the CRT.

Gate Amplifier. The gate amplifier is a shunt feedback stage consisting of A12Q1 through A12Q4. Transistor A12Q1 furnishing the ac signal path. Network A12R13/A12C8 provides the feedback path.

REMOVAL PROCEDURE

To remove Gate Amplifier Assembly A12, proceed as follows:

a. Remove post-accelerator lead cable clamp H35.

b. Remove HVPS cover MP54.

c. Disconnect eight wires from component side of A12.

d. Disconnect two (6) wires and one (2) wire from FOCUS potentiometer to HVPS (A15).

e. Remove FOCUS and INTENSITY shafts from potentiometers using small hex wrench (Allen 050) to loosen set screws. Unscrew extender shafts from potentiometer shafts.

f. Disconnect A12 from LVPS (A16).

g. Disconnect A12 from HVPS (A15).

h. Remove BEAM FIND shaft by pushing A12 forward so that BEAM FIND button clears front panel and then unscrew shaft.

i. Remove button from shaft.

j. Remove A12.

k. To reinstall A12, reverse removal procedure, except install BEAM FIND shaft and adjust so slot is halfway through front-panel bezel after HVPS cover MP54 is secured; then install button.

TROUBLESHOOTING

Malfunctions in Gate Amplifier A12 will usually be transistor failure in the output stages. At high intensity levels, these transistors are sometimes operating at fairly high voltages and therefore are subject to failure. If intensity is low check the current limit circuit.

DC VOLTAGE MEASUREMENT CONDITIONS
SERVICE SHEET 4

1. Set front-panel controls in accordance with initial control settings in Section V.
2. All voltages are referenced to chassis ground. All indications are nominal and 15% variation from those indicated should be considered normal.

WAVEFORMS MEASUREMENT CONDITIONS
SERVICE SHEET 4

1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

Coupling (channel A)	50Ω
TIME/DIV (delayed)	1 μSEC
DELAY	5.00
Horiz display	MAIN
TRIGGER LEVEL (main)	stable display

2. Set monitor oscilloscope TIME/DIV and VOLTS/DIV controls as indicated under waveform(s).
3. Connect pulse generator 50-ohm output to Model 1744A channel A INPUT connector.
4. Adjust pulse generator output for 6 divisions of signal amplitude (.6 V [illegible] kHz.

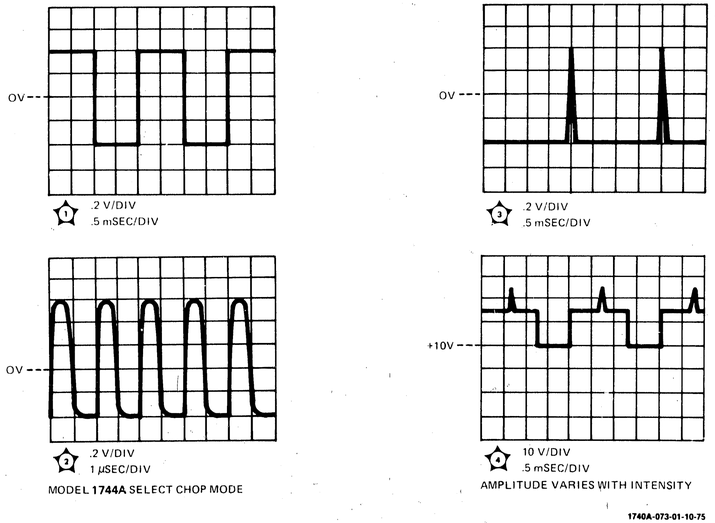
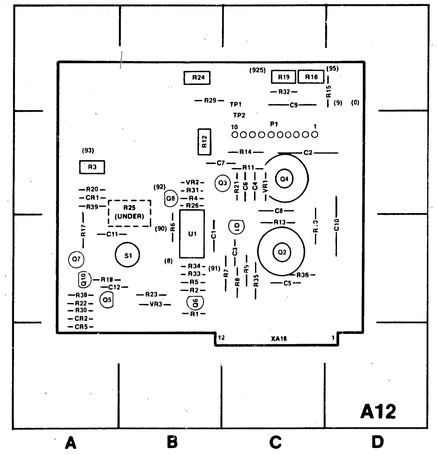


Figure 8-13. Waveforms for Service Sheet 4



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-2	CR2	A-2	R2	B-2	R15	C-4	R31	B-3
C2	C-3	CR5	A-1	R3	A-3	R16	C-4	R32	C-4
C3	C-2	P1	C-3	R4	B-3	R17	A-2	R33	B-2
C4	C-3	Q1	C-2	R5	B-2	R18	A-2	R34	B-2
C5	C-2	Q2	C-2	R6	B-2	R19	C-4	R35	C-2
C6	C-3	Q3	C-3	R7	C-2	R20	A-3	R36	C-2
C7	B-3	Q4	C-3	R8	C-2	R21	C-3	R38	A-2
C8	C-3	Q5	A-2	R9	C-2	R22	A-2	R39	A-3
C9	C-4	Q6	B-2	R10	C-2	R23	B-3	S1	B-2
C10	C-2	Q7	A-2	R11	C-3	R24	B-4	U1	B-2
C11	A-2	Q8	B-3	R12	B-3	R25	B-3	VR1	C-3
C12	A-2	Q10	A-2	R13	C-2	R26	B-3	VR2	B-3
CR1	A-3	R1	B-2	R14	C-3	R29	B-4	VR3	B-2
						R30	A-2	XA16	C-1

Figure 8-14. Gate Assembly, A12, Component Identification

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, and table 6-3 contains the names and addresses that correspond to the manufacturers' code numbers.

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 abbreviation 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 lowercase 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. Illustrated parts breakdown.

b. Electrical assemblies in alphanumerical order by reference designation.

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

d. Electrical assemblies and their components by alphanumerical order by reference designation.

The information given for each part consists of the following:

a. The Hewlett-Packard part number and the check digit (for HP internal use).

b. Hewlett-Packard part number.

c. Total quantity (Qty) in instrument.

d. Description of part.

e. Typical manufacturer of part in identifying five-digit code.

f. Manufacturer's number for part.

The total quantity for each part is given only 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 and 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 the 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:

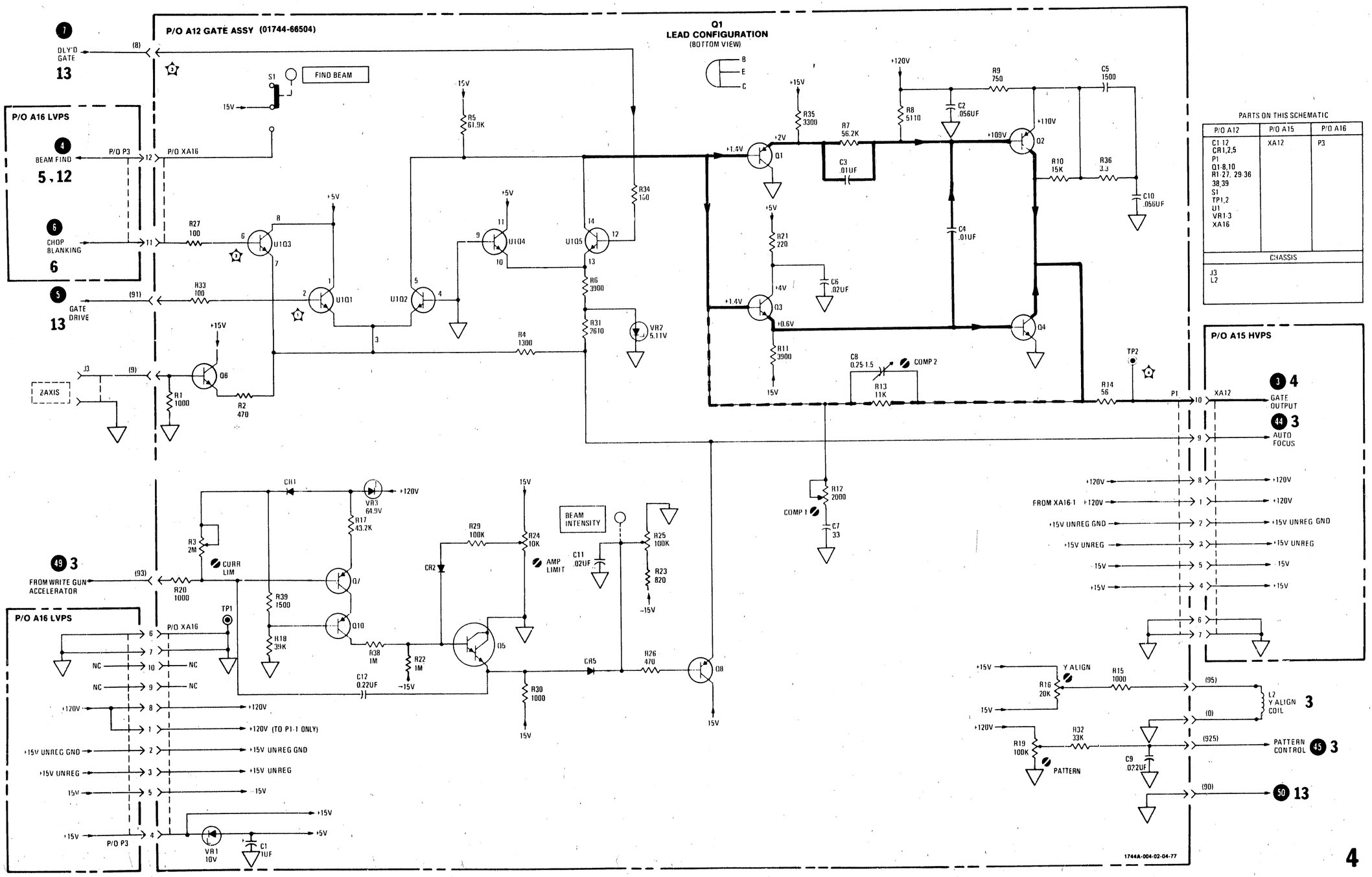
a. Direct ordering and shipment from HP Parts Center in Mountain View, California.

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

c. Prepaid transportation (there is 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 is available through your local HP office. Addresses and phone number are located at the back of this manual.



PARTS ON THIS SCHEMATIC

P/O A12	P/O A15	P/O A16
C1 12 CR1,2,5 P1 Q1-8,10 R1-27, 29-36 38,39 S1 TP1,2 U1 VR1-3 XA16	XA12	P3
CHASSIS		
J3 L2		

4

Figure 8-15.
Service Sheet 4, Gate Assembly

Table 6-1. Reference Designators and Abbreviations

REFERENCE DESIGNATORS

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

ABBREVIATIONS

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

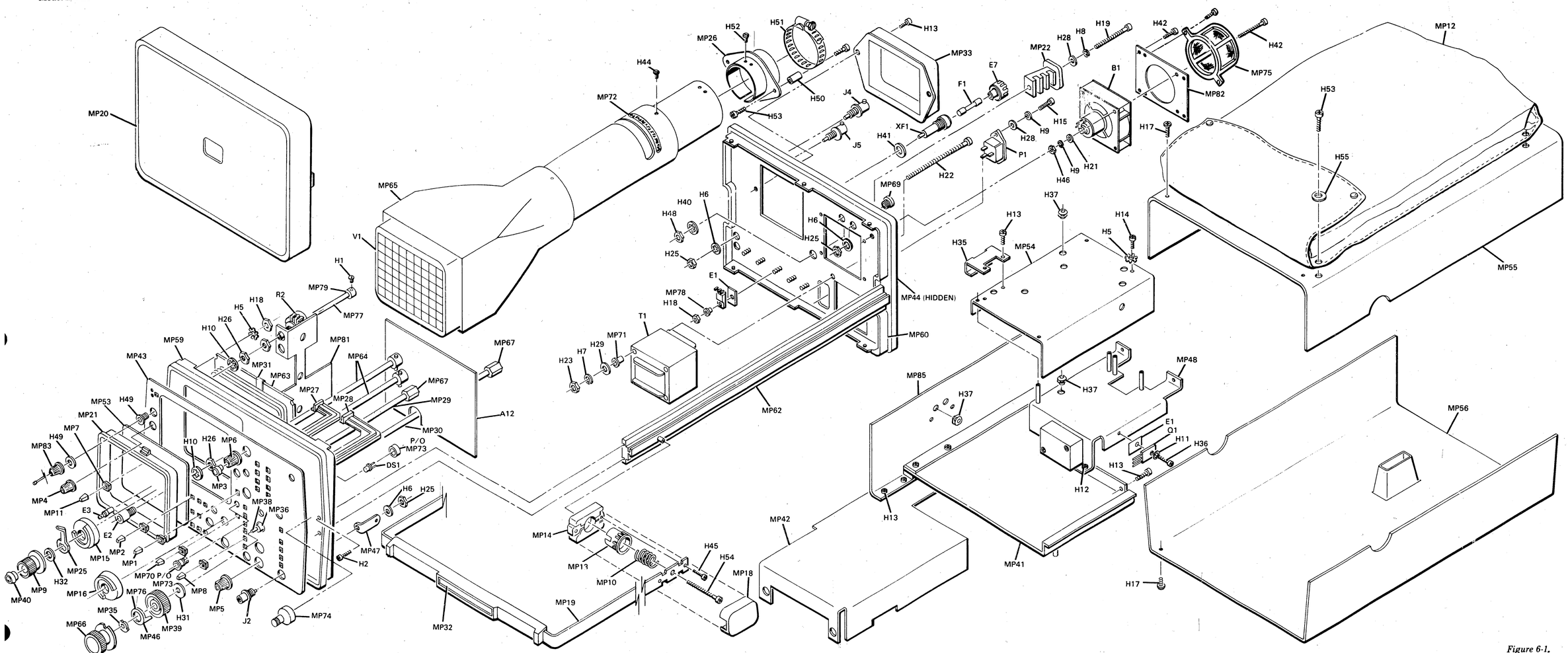


Figure 6-1.
Chassis Parts and Board Assy Identification
(Sheet 1 of 3)

REF DESIGNATOR	NOMENCLATURE	HP PART NO.	TQ	WHERE USED (QUANTITY)
H1	SCREW, MACH 2-56 .188 LG	0520-0127	3	VERT PREAMPL SHIELD MTG (2) ERASE PUSHBUTTON SHAFT COLLAR (1)
H2	SCREW, TAPER 8-32 0.75 LG	0624-0279	8	SIDE RAIL MTG (8)
H3	SCREW, TAPER 2-28 0.50 LG	0624-0306	8	ATTENUATOR MTG TO VERT PREAMPL ASSY (8)
H4	SCREW, TAPER 4-20 1.000 LG	0624-0313	4	ATTENUATOR BRACKET MTG (4)
H5	WASHER, EXL LK .116, .285	2190-0005	9	CRT CAMERA SUPPORT MTG (4) HV COVER (2) HORIZ MOTHER BD MTG (1) OUTPUT HEATSINK BRACKET (2)
H6	WASHER, LK INTL .377, .507	2190-0016	11	FOCUS POT MTG (1) BNC CONNECTION MTG (5) BNC BRACKET MTG (2) HORIZONTAL POSITION POTENTIOMETER MTG (1) SPACER FOR MAIN TRIG LEVEL POT (1) DELAYED TRIG LEVEL POT MTG (1)
H7	WASHER, LK HLCL .168, .310	2190-0017	4	AC POWER TRANSFORMER MTG (4)
H8	WASHER, LK HLCL .141, .314	2190-0006	4	FEET MTG (4)
H9	WASHER, LK HLCL .115, .226	2190-0019	11	FAN MTG BRACKET (4) FAN MOTOR CONTROL MTG (2) DELAY LINE CABLE CLAMPS (2) AC INPUT POWER CONNECTOR MTG (2) CRT BASE CABLE CLAMP MTG (1)
H10	WASHER, LK INTL .256, .408	2190-0084	3	BINDING POST MTG (1) ERASE PUSHBUTTON BUSHING (1) BRIGHTNESS POT BUSHING (1)
H55	WASHER-FL, MTLC NO. 6	3050-0001	4	ACCESSORY POUCH MTG (4)
H11	WASHER, LK, DOME .120, .275	2190-0910	1	Q1 TSTR MTG (1)
H12	SCREW, MACH 4-40, 0.250 LG	2200-0103	2	HV BRACKET ASSY MTG (2)
H13	SCREW, MACH 4-40 0.312 LG	2200-0105	51	LVPS ASSY MTG (5) FAN MOTOR CONTROL CABLE CLAMP (1) MULTIPLIER ASSY MTG (2) DELAY LINE ASSY MTG (2) VERT PREAMPL SHIELD MTG (2) STORAGE CONTROL ASSY MTG (2) FAN ASSY MTG (4) ATTACH DECK ASSY TO REAR PANEL (3) HV BRACKET ASSY MTG (2) HV BOARD MTG (1) LINE SELECT SWITCH COVER (2) FRONT DECK MTG (1) CRT BASE COVER MTG (2) CRT NECK-PIN CABLE CLAMP (1) HV CABLE CLAMP (2) HV COVER (2) HORIZ MOTHER BD MTG (3) DLYD TRIG BD MTG (1) STORAGE BOARD BRACKET MTG (6) STORAGE BOARD ASSY MTG (3) STORAGE CONTROL BD MTG (4)

REF DESIGNATOR	NOMENCALTURE	HP PART NO.	TQ	WHERE USED (QUANTITY)
H14	SCREW, MACH 4-40 1.250 LG	2200-0123	2	HV COVER (2)
H15	SCREW, MACH 4-40, 0.375 LG	2200-0143	5	DELAY LINE CABLE CLAMPS (2) AC INPUT POWER CONNECTOR MTG (2) CRT BASE CABLE CLAMP MTG (1)
H16	SCREW, MACH 4-40 0.625 LG	2200-0149	1	HORIZ MOTHER BD MTG (1)
H17	SCREW, MACH 4-40 0.250 LG	2200-0762	8	BOTTOM COVER MTG (4) TOP COVER MTG (4)
H18	NUT HEX, DBL, 4-40 THD .06	2260-0002	9	Q2-Q6 TSTR MTG (5) CRT CAMERA SUPPORT MTG (4) CRT NECKPIN CABLE CLAMP (1)
H19	SCREW, MACH 6-32, 0.875 LG	2360-0207	4	FEET MTG (4)
H20	SCREW, MACH 6-32, 0.375 LG	2360-0197	1	VERT CONTROL SW ASSY MTG (1)
H21	WASHER-FL, MTLC NO. 4	3050-0105	6	FAN MOTOR CONTROL MTG (2) FAN TO FAN MTG BRACKET (4)
H22	SCREW, MACH 8-32, 3.000 LG	2510-0138	4	AC POWER TRANSFORMER MTG (4)
H23	NUT, HEX 8-32 THD, .125	2580-0004	4	AC POWER TRANSFORMER MTG (4)
H24	NUT, HEX 8-32 THD, .078	2950-0035	2	ATTENUATORS TO FRONT PANEL MTG (2)
H25	NUT, HEX 3/8-32 THD, .093	2950-0043	14	FOCUS POT MTG (1) BNC CONNECTOR MTG (7) HORIZONTAL POSITION POTENTIOMETER MTG (1) DELAY, SWP VERNIER, AND TRIG HOLDOFF POTENTIOMETER MTG (3) MAIN TRIG LEVLE POT MTG (1) DELAY TRIG LEVEL POT MTG (1)
H26	NUT, HEX 1/4-32, .062	2950-0072	5	PERSISTENCE/VIEW TIME AND BRIGHTNESS POTENTIOMETERS MTG (2) BINDING POST MTG (1) ERASE PUSHBUTTON BUSHING (1) BRIGHTNESS POT BUSHING (1)
H27	SCREW, SET, 0.188 LG	3030-0196	4	CONTROL SHAFT COLLARS (4)
H28	WASHER, FLT, .147, 312, .03	3050-0010	11	FAN MOTOR CONTROL CABLE CLAMP (1) MULTIPLIER ASSY MTG (2) FEET MTG (4) AC INPUT POWER CONNECTOR MTG (2) CRT BASE CABLE CLAMP MTG (1) CRT NECKPIN CABLE CLAMP (1)
H29	WASHER, FLT, .169, .438, .03	3050-0071	6	DELAY LINE CABLE CLAMPS (2) AC POWER TRANSFORMER MTG (4)
H30	WASHER, FLT, .470, .570, .01	3050-0160	4	ATTENUATORS TO FRONT PANEL MTG (4)
H31	WASHER, FLT, .25, .75, .125	3050-0481	1	TIME/DIV DIAL ASSY (1)
H32	WASHER, TFL, .160, .375, .062	3050-0655	2	VOLT/DIV KNOB ASSY (2)

REF DESIGNATOR	NOMENCLATURE	HP PART NO.	TQ	WHERE USED (QUANTITY)
H33	SCREW, MACH 2-56 0.625 LG	0520-0136	8	VERT PREAMPL A3A1 MTG (2) VERT PREAMPL SHIELD MTG (2) VERT OUTPUT HEATSINK MTG (4)
H34	WASHER, LK HLCL .088, .175	2190-0112	10	VERT PREAMPL A3A1 MTG (2) VERT PREAMPL SHIELD MTG (4) VERT OUTPUT HEATSINK MTG (4)
H35	CLAMP, HV LEAD	01741-01205	1	HV CABLE CLAMP (1)
H36	SCREW, MACH 4-40 1.000 LG	2200-0155	5	FAN MOTOR CONTROL MTG (2) Q1 TSTR MTG (1) OUTPUT HEATSINK BRACKET MTG (2)
H37	GROMMET, VINYL .375 ID	0400-0010	7	MULTIPLIER CABLE FEEDTHRU (1) CRT SHIELD (1) HV COVER (3) STORAGE BOARD BRACKET (2)
H38	CLAMP, CABLE .312 ID	1400-0017	1	CRT BASE CABLE CLAMP (1)
H39	CLAMP, CABLE .125	1400-0082	2	FAN MOTOR CONTROL CABLE CLAMP (1)
H40	WASHER, LK, INTL .512, .789	2190-0037	1	FUSE HOLDER MTG (1)
H41	WASHER, NEOPRENE	1400-0090	1	FUSE HOLDER MTG (1)
H42	SCREW, MACH 4-40 .438, P-H-P	2200-0145	4	FAN/FAN GUARD TO FAN MTG BRACKET (4)
H44	SCREW, MACH 4-40 .188, P-H-P	2200-0101	4	TRACE ALIGN COIL ASSY MTG (2) ORTHO ALIGN COIL ASSY MTG (2)
H45	SCREW, MACH 6-32 .375 P-H-P	2360-0370	4	HANDLE (4)
H46	NUT-HEX-DBL-CHAM 4-40 THD	2260-0001	4	FAN TO FAN MTG BRACKET (4)
H47	BUSHING, POTENTIOMETER	1490-0968	2	ERASE PUSHBUTTON BUSHING (1) BRIGHTNESS POT BUSHING (1)
H48	NUT-SPCLY 1/2-24 THD	2110-0467	1	FUSE HOLDER MTG (1)
H49	WASHER-FL, MTLC 7/16 IN. .5 ID	3050-0050	2	DELAY CONTROL MTG (2)
H50	SPACER-RND .5LG 8-32 THD	0380-1019	2	CRT CLAMP MTG (2)
H51	CLAMP-HOSE 1.812-2.75 DIA	1400-0026	1	CRT MTG (1)
H52	SCREW, MACH 6-32 .25 LG P-H-P	2360-0113	2	CRT CLAMP TO CRT SHIELD (2)
H53	SCREW, MACH 6-32 .375 LG P-H-P	2360-0117	8	CRT CLAMP TO RER PANEL (4) ACCESSORY POUCH MTG (4)
H54	THD INSERT-NUT 8-32, .19 LG STL	2510-0111	2	HANDLE MTG (2)

Figure 6-1. Chassis Parts and Board Assy Identification (Sheet 2 of 3)

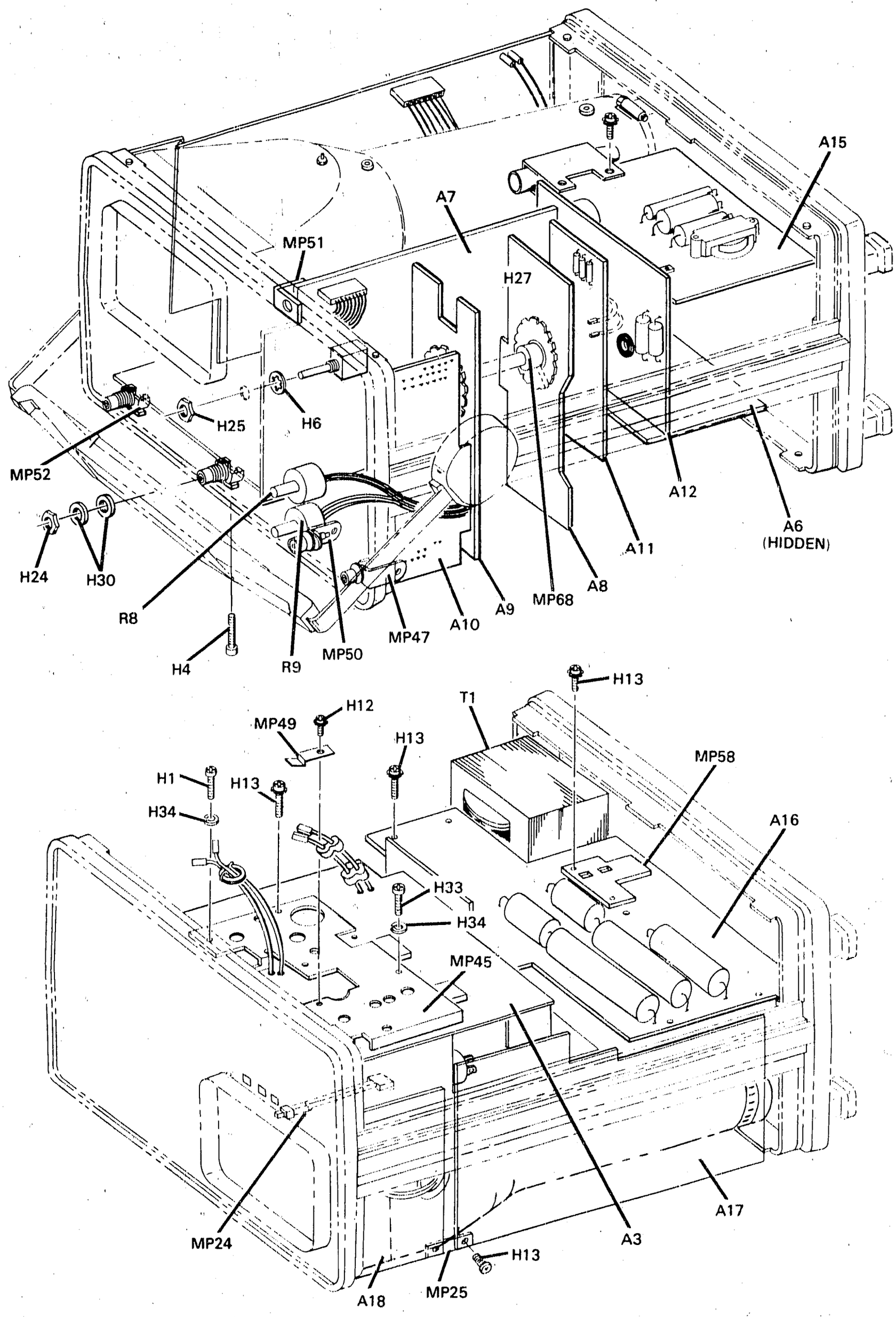


Figure 6-1. Chassis Parts and Board Assy Identification (Sheet 3 of 3)

SERVICE INFORMATION

CON'T

SERVICE SHEET 9

MAIN SWEEP

General. The main sweep circuit can be separated into four definable areas:

1. Transistors A8Q1 - A8Q4 make up the main sweep switch. This circuit enables the Miller integrator circuit (ramp generator).

2. Integrated circuit A8U1 and transistor A8Q13 provide a constant current source for the Miller integrator. The current output from A8Q13 depends on the setting of the main TIME/DIV switch (repeating every sixth range). Range adjustments and the SWEEP VERNIER also controls the current source.

3. Transistors A8Q5 and A8Q6 function as a Miller integrator, generating a sweep ramp from +1 V to +11 V. Transistor A8Q7 provides constant current for the integrator load.

4. Transistors A8Q8 - A8Q12 generate the holdoff period between sweeps and provide the reset/arming pulses to the main sweep trigger circuit (Service Sheet 8).

Detailed Theory. The primary function of the main sweep circuitry is to generate a linear, positive-going ramp waveform. The waveform starts at a voltage level of +1 volt and ramps to a maximum voltage of approximately +11.5 volts. The circuit that generates the waveform is Miller integrator A8Q5 and A8Q6. Negative feedback is provided by A8C6, A8C9, A8C10, A8C11, depending on the setting of the main TIME/DIV switch.

A preset (TIME/DIV switch setting) amount of current is delivered to the gate node of A8Q5 from current source A8U1/A8Q13. An equal amount of current leaves the node to charge the selected feedback capacitor. Initially, the voltage at the gate of A8Q5 goes negative due to the charging action of the selected feedback capacitor. This action is applied through source-follower A8Q5 to A8Q6, reducing its conduction. The collector of A8Q6 is connected to the selected feedback capacitor. The net effect is that the collector voltage of A8Q6 increases positively in a very linear manner that parallels the charging action of the feedback capacitor.

The sweep generated in the collector circuit of A8Q6 is applied through cascaded emitter-followers A8Q8/A8Q9 to the sweep holdoff circuit. During ramp-up time A8CR3 is forward biased and the sweep charges the selected holdoff capacitor (A8C13-A8C18). The sweep is also applied to A8Q10 through divider network A8R33/A8R34. Since the emitter of A8Q10 is biased at +4.7 volts by divider network A7R53/A7R54 (see Service Sheet 8), the transistor will conduct when the sweep ramp reaches approximately +11.5 volts. When A8Q10 conducts, a positive spike is generated on the reset line, resetting the main trigger IC, A7U2. When A7U2 resets, the main sweep enable signal causes A8Q1-A8Q3 to conduct, resetting the Miller integrator.

When the ramp resets, A8CR3 is reversed biased and the selected holdoff capacitor must discharge through A8R40 and the TRIGGER HOLDOFF control, R9. During the ramp-up period and the following holdoff time, A8Q11 is conducting and A8Q12 is turned off. When the holdoff capacitor discharges to the value of the base bias of A8Q12 (+1.5 volts), less the diode voltage drop of A8CR4, A8Q11 turns off and A8Q12 conducts. This pulls the sweep reset line low, arming A7U2. With A7U2 armed, the circuit waits for another trigger signal to repeat the process. Transistors A8Q2 and A8Q4 form a comparator circuit. When the sweep ramp reaches +11.5 V and A8Q10 generates the sweep reset pulse, A8Q1 turns off. When A8Q1 turns off, A8Q2 and A8Q3 turns on. As long as the sweep ramp voltage is above +1 V, A8Q4 is turned off. As the ramp falls, a level is reached that is equal to the base voltage of A8Q2 (+1 V). At this time A8Q4 begins to conduct and A8Q2 begins to turn off. An equilibrium state is reached, and the ramp output remains at +1 V until another trigger is sensed and A8Q1 turns on again.

REMOVAL PROCEDURE

To remove main sweep assembly A8, proceed as follows:

a. Loosen hex screws of TIME/DIV shaft collar located directly behind A9.

b. Loosen hex screws of TIME/DIV shaft collars located in front and behind A8.

c. Set MAIN TIME/DIV to 1 μSEC and DLY'D TIME/DIV to OFF.

d. Sweep time shaft can now be removed.

e. Remove A8 by pulling from socket.

f. To reinstall assembly A8, reverse removal procedure.

TIME/DIV SWITCH MAINTENANCE

To service the TIME/DIV rotor switch on assembly A8 proceed as follows:

a. Remove assembly A8 as described in this service sheet.

b. After removing A8, note orientation of slot in rotor section of TIME/DIV switch.

c. Remove metal retainer ring from rotor switch and separate two sections.

d. Check contact area on etched circuit board. If contact area shows excessive wear, replace circuit board.

e. Check contacts on both rotor sections. If contacts show excessive wear, replace rotor section.

f. Clean and lubricate contacts on etched circuit board and rotors as described in Section VIII, paragraph 8-20.

g. Place rotor sections on etched circuit board and reinstall retainer ring.

h. Position slotted portion of open rotor section as noted in step b.

i. Reinstall assembly in instrument.

j. Reinstall TIME/DIV shaft and knob assembly.

TROUBLESHOOTING

If trouble is isolated to the main sweep assembly A8, use the waveforms and dc voltages indicated on the schematic to isolate the problem to a particular stage or component.

DC VOLTAGE MEASUREMENT CONDITIONS SERVICE SHEET 9

1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

   Main TRIGGER LEVEL ..... fully cw
   AUTO/NORM ..... NORM
   SINGLE ..... engaged
   RESET light should be off

2. All voltages are referenced to chassis ground. All indications are nominal and 15% variation from those indicated should be considered normal.

WAVEFORM MEASUREMENT CONDITIONS SERVICE SHEET 9

1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

   Coupling (channel A) 50Ω
   TRIGGER LEVEL (main) ..... stable display

2. Set monitor oscilloscope TIME/DIV and VOLTS/DIV controls as indicated under waveform(s).
3. Connect pulse generator 50-ohm output to Model 1744A channel A INPUT connector.
4. Adjust pulse generator output for 6 divisions of signal amplitude (.6 V) at 5 kHz.

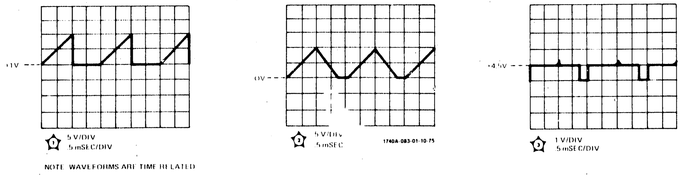
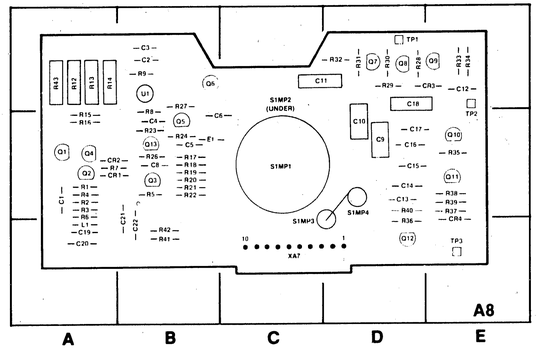


Figure 8-32. Waveforms for Service Sheet 9



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	A-2	C20	A-1	Q10	E-2	R17	B-2	R36	D-1
C2	B-3	C21	B-1	Q11	E-2	R18	B-2	R37	E-2
C3	B-3	C22	B-1	Q12	D-1	R19	B-2	R38	E-1
C4	B-3	CR1	A-2	Q13	B-2	R20	B-2	R39	E-2
C5	B-2	CR2	A-2	R1	A-2	R21	B-2	R40	D-2
C6	C-2	CR3	E-2	R2	A-2	R22	B-2	R41	B-1
C8	B-2	CR4	E-1	R3	A-2	R23	B-2	R42	B-1
C9	D-2	E1	B-2	R4	A-2	R24	B-2	R43	A-3
C10	D-2	L1	A-1	R5	B-2	R26	B-2	S1MP1	C-2
C11	D-3	Q1	A-2	R6	A-2	R27	B-3	S1MP2	C-3
C12	E-3	Q2	A-2	R7	A-2	R28	D-3	S1MP3	C-1
C13	D-2	Q3	B-2	R8	B-2	R29	D-3	S1MP4	D-2
C14	D-2	Q4	A-2	R9	B-3	R30	D-3	TP1	D-3
C15	D-2	Q5	B-2	R12	A-3	R31	D-3	TP2	E-2
C16	D-2	Q6	B-3	R13	A-3	R32	D-3	TP3	E-1
C17	D-2	Q7	D-3	R14	A-3	R33	E-3	U1	B-3
C18	D-3	Q8	D-3	R15	A-2	R34	E-3	XA7	C-1
C19	A-1	Q9	E-3	R16	A-2	R35	E-2		

Figure 8-33. Main Sweep, A8, Component Identification

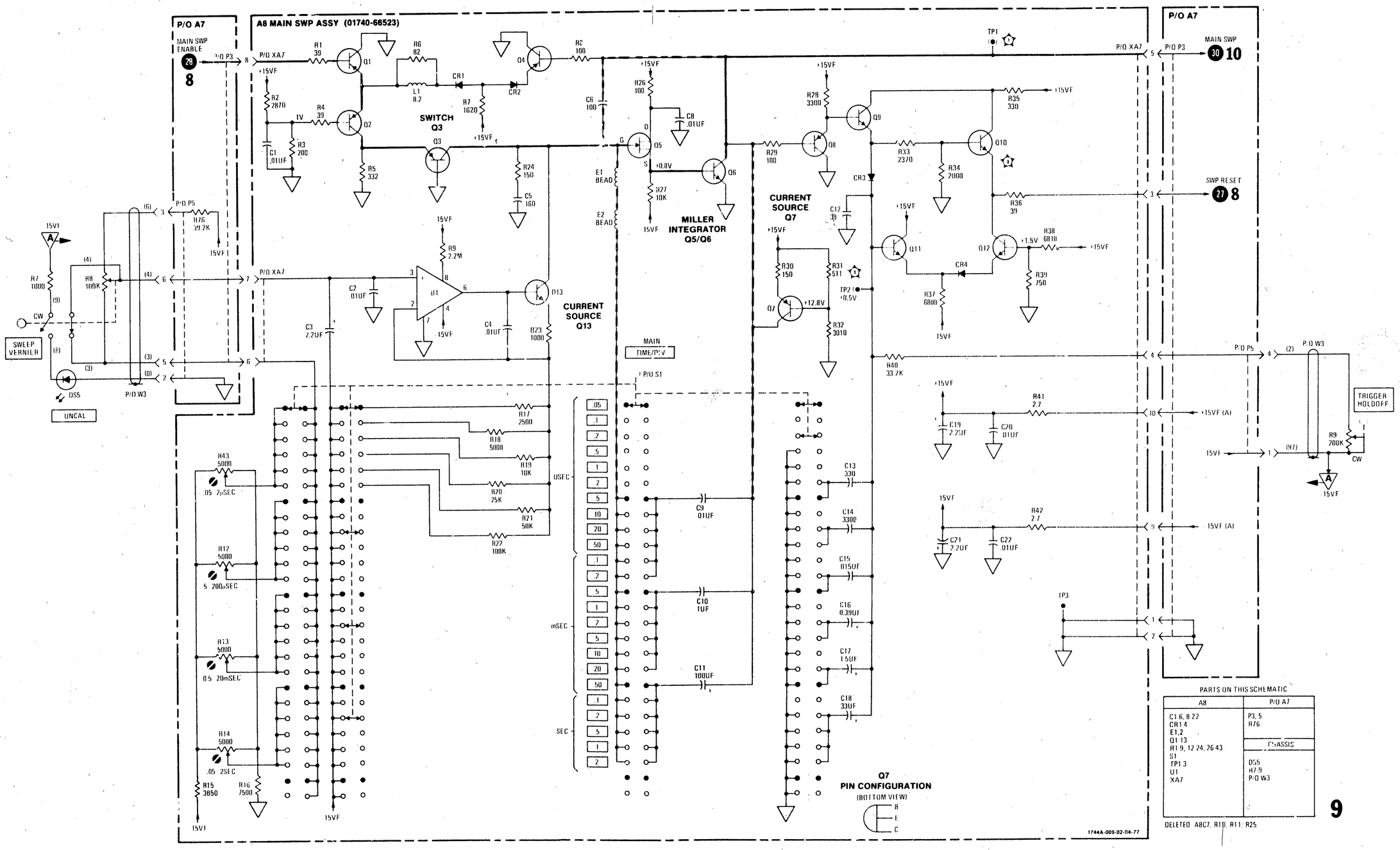


Figure 8-34.
Service Sheet 9, Main Sweep Circuitry

SERVICE SHEET 10

DELAYED TRIGGER - CIRCUIT THEORY

Arming Circuitry. The positive-going ramp of the main sweep is applied to the horizontal amplifier (Service Sheet 12) and to delay comparator A7U4 (pin 9). A7U4 is a transistor array which controls arming of the delayed sweep. DELAY potentiometer R6 establishes a reference voltage that is applied through isolation amplifier A7U3 to A7U4 (pin 6). When the main sweep-ramp voltage applied to the base of A7U4Q4 (pin 9) slightly exceeds the level established by R6 at the base of A7U4Q3 (pin 6), A7U4Q4 conduction increases and A7U4Q3 conduction decreases, setting Schmitt trigger A7U4Q1 and A7U4Q2. This causes the delayed enable signal, generated at A7U4 pin 1, to arm the delayed trigger circuit. When delayed TIME/DIV switch A9S1 (Service Sheet 11) is in its OFF position, current source A7U4Q5 is inhibited, preventing the delayed enable signal from being generated.

Delayed Trigger. Delayed trigger operation is similar to main trigger operation. The sync input to delayed trigger IC A10U1 is supplied through an impedance converter consisting of an FET matched pair (A10Q1A and A10Q1B) and emitter follower A10Q3. The delayed sweep is started by a negative-going pulse at the collector of A10Q10. With SWEEP AFTER DELAY switch A10S1D in AUTO, the delayed sweep starts as soon as A10U1 is armed (at pin 5) by the negative-going delayed enable signal from A7U4. With A10S1D in TRIG, the negative-going transition from A7U4 does not immediately cause the delayed sweep to start. It arms A10U1 and a delayed trigger will be formed if a sync pulse occurs during the main sweep time.

REMOVAL PROCEDURE

To remove delayed trigger assembly A10, proceed as follows:

a. Remove assembly A9 (refer to Service Sheet 11).

b. Unsolder resistor from delayed EXT TRIGGER BNC connector.

c. Disconnect wire (7) from component side of A10.

d. Remove delayed TRIGGER LEVEL knob and nut underneath.

e. Remove screw from A10 (corner next to delayed EXT TRIGGER BNC connector).

f. Gently pull A10 to rear and remove from instrument. Save lockwasher on TRIGGER LEVEL potentiometer for reinstallation.

g. To reinstall A10, reverse removal procedure; lockwasher must be in place on TRIGGER LEVEL potentiometer before inserting it in front panel.

TROUBLESHOOTING

The delayed trigger assembly should cause little trouble in the operation of the instrument. If trouble is suspected, determine if the delayed sweep can be triggered externally. If so it is the internal sync circuit that is faulty. If unable to trigger internally or externally, suspect trigger enable generator A10U1. Use waveforms provided to isolate the problem.

DC VOLTAGE MEASUREMENT CONDITIONS
SERVICE SHEET 10

1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

DLY'D TIME/DIV	50 μSEC

2. All voltages are referenced to chassis ground. All indications are nominal and 15% variation from those indicated should be considered normal.

WAVEFORM MEASUREMENT CONDITIONS
SERVICE SHEET 10

1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

Coupling (channel A)	50Ω
DLY'D TIME/DIV	10 μSEC
DELAY	5.00
Horiz display	MAIN
TRIGGER LEVEL (main)	stable display

2. Set monitor oscilloscope TIME/DIV and VOLTS/DIV controls as indicated under waveform(s).
3. Connect pulse generator 50-ohm output to Model 1744A channel A INPUT connector.
4. Adjust pulse generator output for 6 divisions of signal amplitude (.6 V) at 5 kHz.

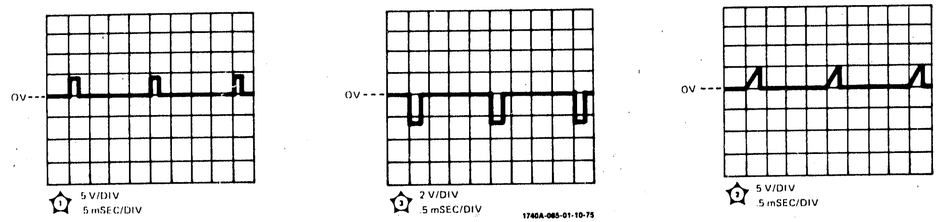
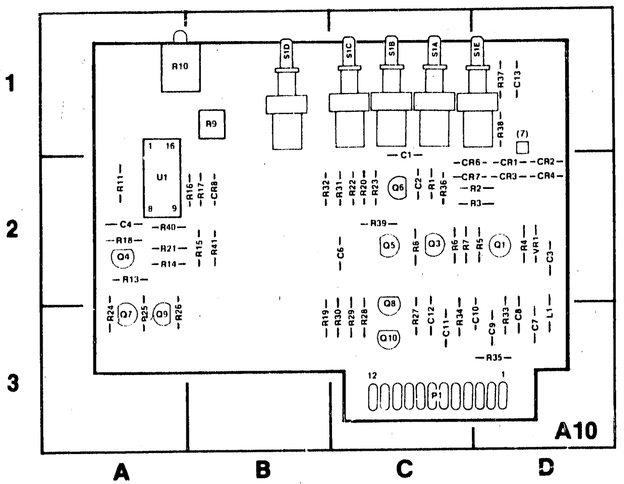


Figure 8-35. Waveforms for Service Sheet 10



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	C-1	C14	C-2	Q3	C-2	R4	D-2	R16	A-2	R27	C-3	R38	D-1
C2	C-2	CR1	D-2	Q4	A-2	R5	D-2	R17	B-2	R28	C-3	R39	C-2
C3	D-2	CR2	D-2	Q5	C-2	R6	C-2	R18	A-2	R29	C-3	R40	A-2
C4	A-2	CR3	D-2	Q6	C-2	R7	C-2	R19	B-3	R30	C-3	R41	B-2
C6	B-2	CR4	D-2	Q7	A-3	R8	C-2	R20	C-2	R31	C-2	S1A	C-1
C7	D-3	CR6	C-2	Q8	C-2	R9	B-1	R21	A-2	R32	B-2	S1B	C-1
C8	D-3	CR7	C-2	Q9	A-3	R10	A-1	R22	C-2	R33	D-3	S1C	C-1
C9	D-3	CR8	B-2	Q10	C-3	R11	A-2	R23	C-2	R34	C-3	S1D	B-1
C10	D-3	L1	D-3	R1	C-2	R13	A-2	R24	A-3	R35	D-3	S1E	C-1
C11	C-3	P1	C-3	R2	C-2	R14	A-2	R25	A-3	R36	C-2	U1	A-2
C12	C-3	Q1	D-2	R3	C-2	R15	B-2	R26	A-3	R37	D-1	VR1	D-2
C13	D-1												

Figure 8-36. Delayed Trigger, A10, Component Identification

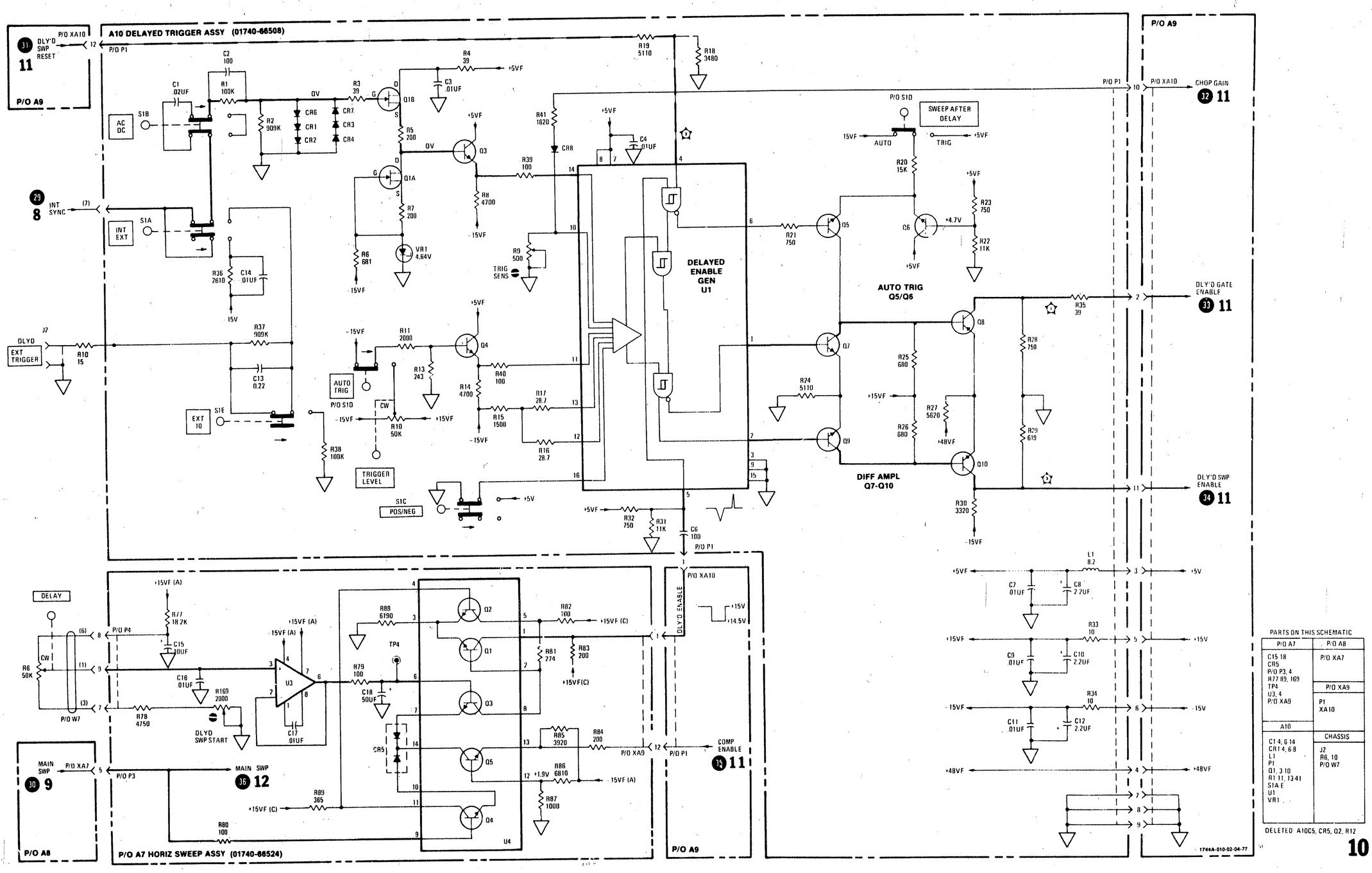


Figure 8-37.
Service Sheet 10, Delayed Trigger Circuitry

SERVICE SHEET 11

DELAYED SWEEP - CIRCUIT THEORY

The operation of delayed sweep is similar to that of main sweep (Service Sheet 9). One major difference is the delayed sweep reset level applied to the base of A9Q1. In delayed mode, this level is set at 1 volt; but in mixed mode of operation, the reference level is established by the main sweep ramp. Output of the delayed integrator (A9TP1) follows the main sweep ramp until the delayed sweep enable signal applied to the base of A9Q3 goes low. At this point, the delayed integrator no longer follows the reference level of the main sweep but ramps up at a slope determined by the selected integrating capacitor and selected current source resistor.

REMOVAL PROCEDURE

To remove delayed sweep assembly A9, proceed as follows:

a. Loosen hex screw of TIME/DIV shaft collar located directly behind A9.

b. Loosen hex screws of TIME/DIV shaft collars located in front and behind A8.

c. Set MAIN TIME/DIV to 1 μSEC and DLY'D TIME/DIV to OFF.

d. Sweep time shaft can now be removed.

e. Remove A9 by gently rocking board toward rear of instrument to disconnect it from two connectors.

f. To reinstall A9, reverse removal procedure.

Time/Div Switch Maintenance. To service the TIME/DIV rotor switch on assembly A9, follow service directions stated in Service Sheet 8.

TROUBLESHOOTING

If trouble is isolated to the delayed sweep assembly A9, use the waveform and dc voltages indicated on the schematic to isolate the problem to a particular stage or component.

DC VOLTAGE MEASUREMENT CONDITIONS
SERVICE SHEET 11

1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

DLY'D TIME/DIV	50 μSEC
AUTO/NORM	NORM
SINGLE	engaged
Both TRIGGER LEVELS	fully cw
RESET light should be off	

2. All voltages are referenced to chassis ground. All indications are nominal and 15% variation from those indicated should be considered normal.

WAVEFORM MEASUREMENT CONDITIONS
SERVICE SHEET 11

1 Set front-panel controls in accordance with initial control settings in Section V, except as follows:

Coupling (channel A)	50Ω
DLY'D TIME/DIV	10 μSEC
DELAY	5.00
Horiz display	MAIN
TRIGGER LEVEL (main)	stable display

2. Set monitor oscilloscope TIME/DIV and VOLTS/DIV controls as indicated under waveform(s).
3. Connect pulse generator 50-ohm output to Model 1744A channel A INPUT connector.
4. Adjust pulse generator output for 6 divisions of signal amplitude (.6 V) at 5 kHz.

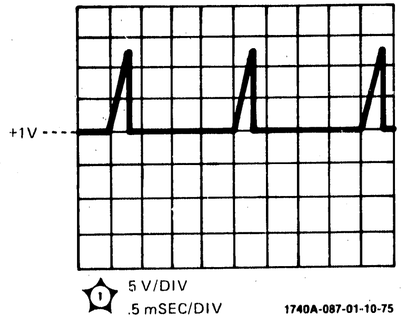
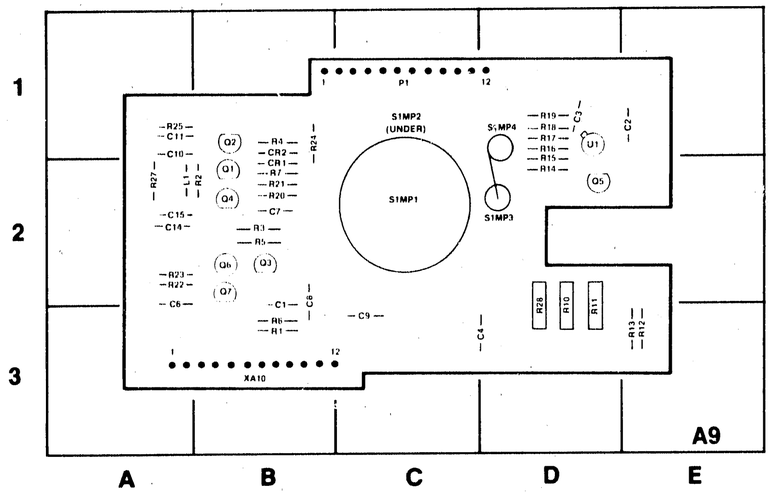


Figure 8-38. Waveforms for Service Sheet 11



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-2	C15	A-2	Q7	B-2	R13	E-3	R24	B-1
C2	E-1	CR1	B-2	R1	B-3	R14	D-2	R25	A-1
C3	D-1	CR2	B-1	R2	B-2	R15	D-1	R27	A-2
C4	C-3	L1	A-2	R3	B-2	R16	D-1	R28	D-2
C6	A-2	P1	C-1	R4	B-1	R17	D-1	S1MP1	C-2
C7	B-2	Q1	B-2	R5	B-2	R18	D-1	S1MP2	C-1
C8	B-2	Q2	B-1	R6	B-3	R19	D-1	S1MP3	D-2
C9	C-3	Q3	B-2	R7	B-2	R20	B-2	S1MP4	D-1
C10	A-1	Q4	B-2	R10	D-2	R21	B-2	U1	D-1
C11	A-1	Q5	D-2	R11	D-2	R22	A-2	XA10	B-3
C14	A-2	Q6	B-2	R12	E-3	R23	A-1		

Figure 8-39. Delayed Sweep, A9, Component Identification

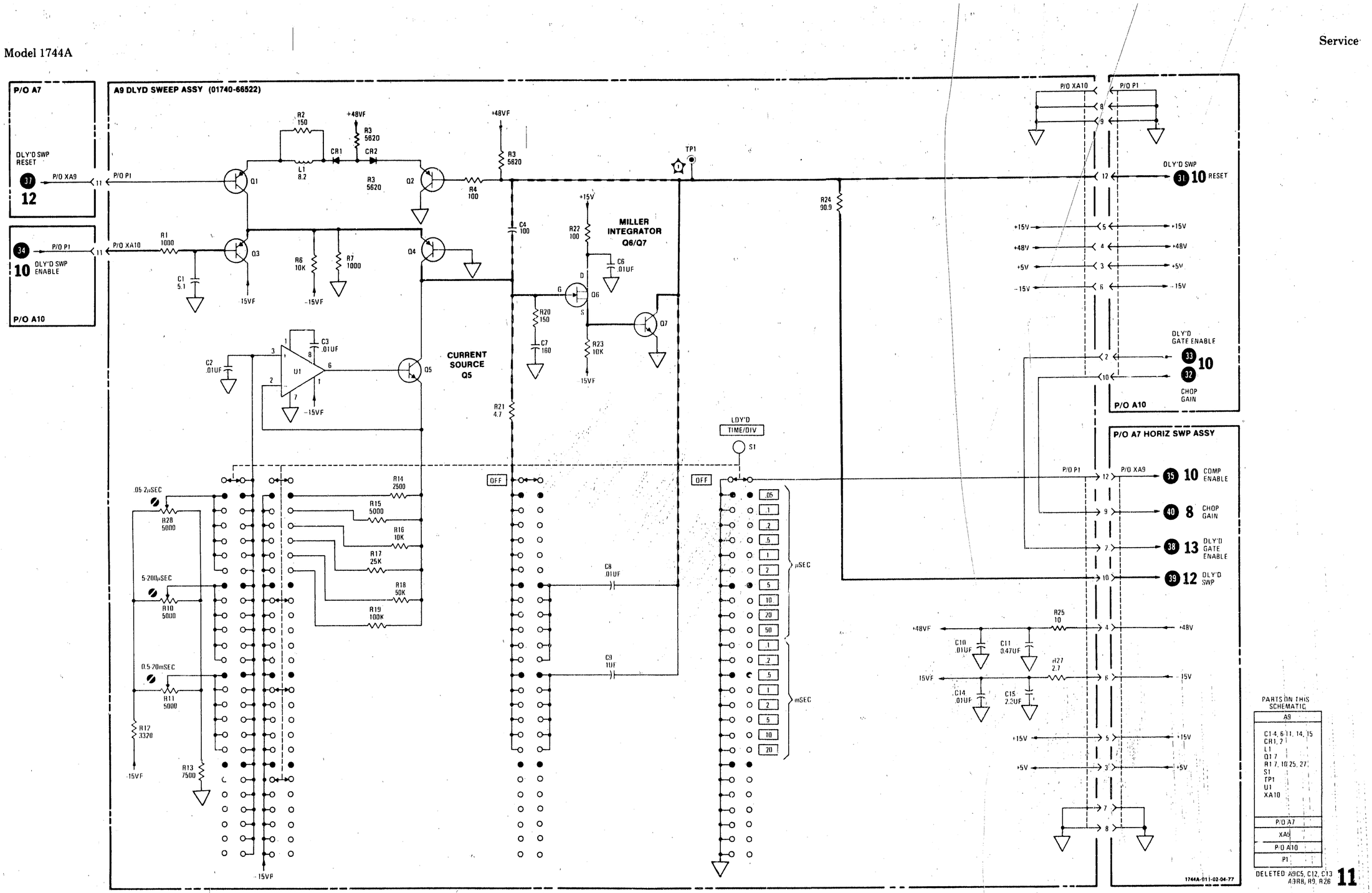


Figure 8-40.
Service Sheet 11, Delayed Sweep Circuitry

SERVICE SHEET 12

HORIZONTAL PREAMPLIFIER - CIRCUIT THEORY

Horizontal Preamplifier. The horizontal preamplifier converts the single-ended sweep (main or delayed) or A VS B signal to a differential signal suitable for driving the horizontal output amplifier. The preamplifier provides sweep gain adjustment (X1), sweep magnification adjustment (X10), horizontal position, horizontal beam finding control, and X10 magnification centering.

Transistor A7Q22 is a shunt feedback stage that level shifts the sweep ramp and drives paraphase amplifier A7Q23/A7Q27. Transistor A7Q26 balances the amplifier for temperature stability. Horizontal POSITION control R11 drives A7Q26. MAG CENTER control A7R105 also drives A7Q26 when MAG X10 switch A7S1D is engaged. Current source A7Q24 provides bias for A7Q22. Current sources A7Q25 and A7Q34 provide bias for the paraphase amplifier. The X1 sweep speed is calibrated by A7R93. MAG X10 control is calibrated by A7R117.

When BEAM FIND switch A12S1 is pressed, voltage at the bases of A7Q25 and A7Q34 is lowered. This decreases the amount of current available to the output amplifier and prevents it from driving the trace off screen.

Horizontal Output. The output amplifier is a differential shunt feedback amplifier. Current required by A7Q23 is supplied through A11R4. This determines the voltage driving one horizontal plate through A11R7. Current required for A7Q27 is supplied through A11R23 establishing the voltage required to drive the other horizontal plate through A11R21. Transistors A11Q1, Q2, Q5, and Q6 are emitter followers that provide a high impedance for each side of the amplifier. High speed linearity is controlled by a lag network at the input to each side of the amplifier. Resistor A11R10 controls one side, while A11R15 controls the other. Each side of the output amplifier can swing from approximately +8 volts to +100 volts.

REMOVAL PROCEDURE

To remove horizontal sweep assembly A7, refer to Service Sheet 8.

To remove horizontal output assembly A11, proceed as follows:

a. Disconnect (2) and (9) wires from assembly A11.

b. Remove assembly A11 from assembly A7.

TROUBLESHOOTING

If no horizontal deflection can be obtained under normal sweep conditions, the problem may be either in the time base or horizontal output assembly A11. To quickly determine which is at fault, place the oscilloscope in the A VS B mode of operation and connect a 1 kHz sinewave to channel B INPUT connector. If horizontal deflection is present, the horizontal amplifier (and sync amplifier) are operating properly and the problem is in the time base. If no horizontal deflection occurs, then assembly A11 is probably defective.

DC VOLTAGE MEASUREMENT CONDITIONS SERVICE SHEET 12

1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

   Sweep mode ..... A vs B
   Spot centered on CRT

   BEAM INTENSITY ..... barely visible spot

2. All voltages are referenced to chassis ground. All indications are nominal and 15% variation from those indicated should be considered normal.

WAVEFORM MEASUREMENT CONDITIONS SERVICE SHEET 12

1. Set front-panel controls in accordance with initial control settings Section V, except as follows:

   Coupling (channel A) 50Ω
   TRIGGER LEVEL (main) ..... stable display

2. Set monitor oscilloscope TIME/DIV and VOLTS/DIV controls as indicated under waveform(s).

3. Connect pulse generator 50-ohm output to Model 1744A channel A INPUT connector.

4. Adjust pulse generator output for 6 divisions of signal amplitude (.6 V) at 5 kHz.

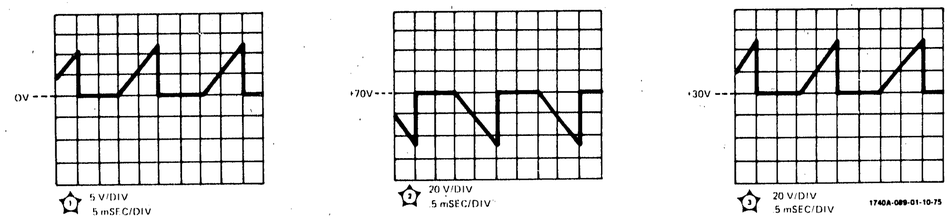
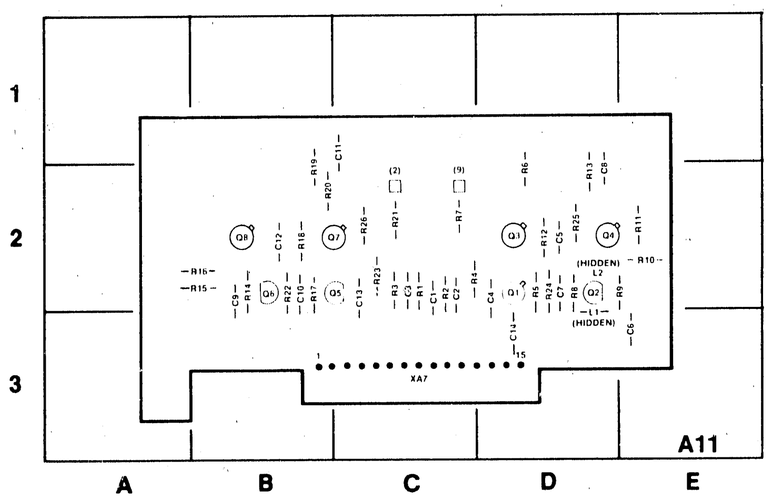


Figure 8-41. Waveforms for Service Sheet 12



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	C-2	C12	B-2	Q6	B-2	R8	D-2	R18	B-2
C2	C-2	C13	C-2	Q7	C-2	R9	E-2	R19	B-2
C3	C-2	C14	D-3	Q8	B-2	R10	E-2	R20	B-2
C4	D-2	L1	D-3	R1	C-2	R11	E-2	R21	C-2
C5	D-2	L2	D-2	R2	C-2	R12	D-2	R22	B-2
C6	D-2	Q1	D-2	R3	C-2	R13	D-2	R23	C-2
C7	D-2	Q2	D-2	R4	C-2	R14	B-2	R24	D-2
C8	D-2	Q3	D-2	R5	D-2	R15	B-2	R25	D-2
C9	B-2	Q4	D-2	R6	D-2	R16	B-2	R26	C-2
C10	B-2	Q5	C-2	R7	C-2	R17	B-2	XA7	C-3
C11	C-1								

Figure 8-42. Horizontal Output, A11, Component Identification

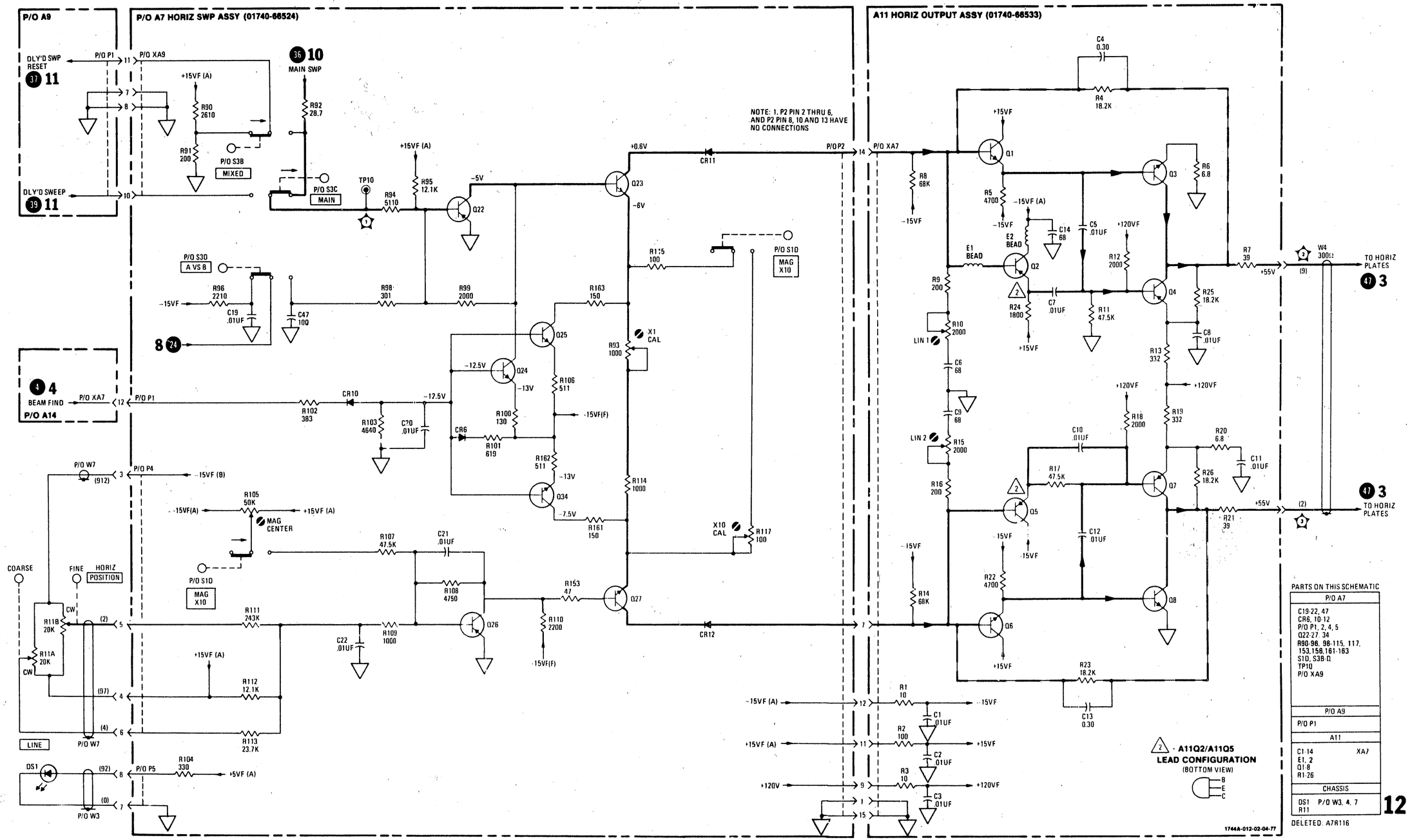


Figure 8-43.
Service Sheet 12. Horizontal Output

SERVICE SHEET 13

GATE SCHMITT - CIRCUIT THEORY

Gate Schmitt circuit A7Q28 - A7Q32 provides gate amplifier A12 with main and delayed gate signals. The Schmitt circuit is controlled by horizontal mode switch A7S3. It is set by the first positive control pulse and resets on the first negative control pulse. In main sweep operation, the gate follows the main sweep. In delayed sweep, the gate follows the delayed sweep. In mixed operation, the gate is started by the main sweep and terminated by the end of delayed sweep. The following waveforms (see figure 8-44) show the timing relationship of the gate and sweep waveforms.

The gate Schmitt also furnishes main and delayed gate outputs to rear-panel BNC connectors for external use (Service Sheet 2).

REMOVAL PROCEDURE

To remove horizontal sweep assembly A7. refer to Service Sheet 8.

TROUBLESHOOTING

Troubleshooting the gate Schmitt circuit should present no problem to the technician. If input signals are present, follow signals through the individual circuits.

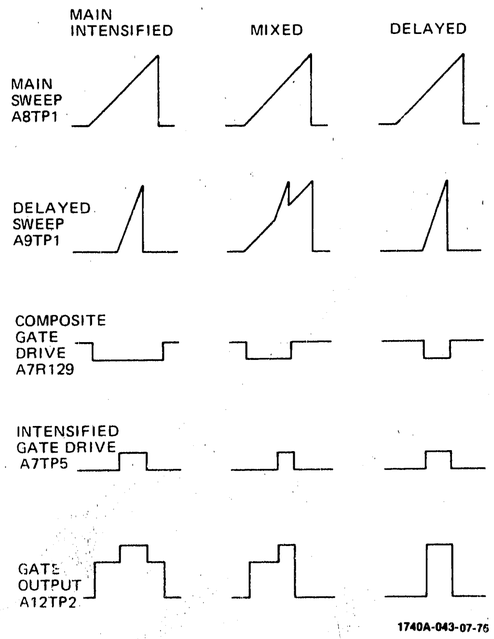


Figure 8-44. Sweep Waveforms

DC VOLTAGE MEASUREMENT CONDITIONS SERVICE SHEET 13

1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

   Sweep mode ..... A VS B
   BEAM INTENSITY ..... barely visible spot
   Spot centered on CRT

2. All voltages are referenced to chassis ground. All indications are nominal and 15% variation from those indicated should be considered normal.

WAVEFORM MEASUREMENT CONDITIONS SERVICE SHEET 13

1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

   Coupling (channel A) 50Ω
   TRIGGER LEVEL (main) ..... stable display

2. Set monitor oscilloscope TIME/DIV and VOLTS/DIV controls as indicated under waveform(s).
3. Connect pulse generator 50-ohm output to Model 1744A channel A INPUT connector.
4. Adjust pulse generator output for 6 divisions of signal amplitude (.6 V) at 5 kHz.

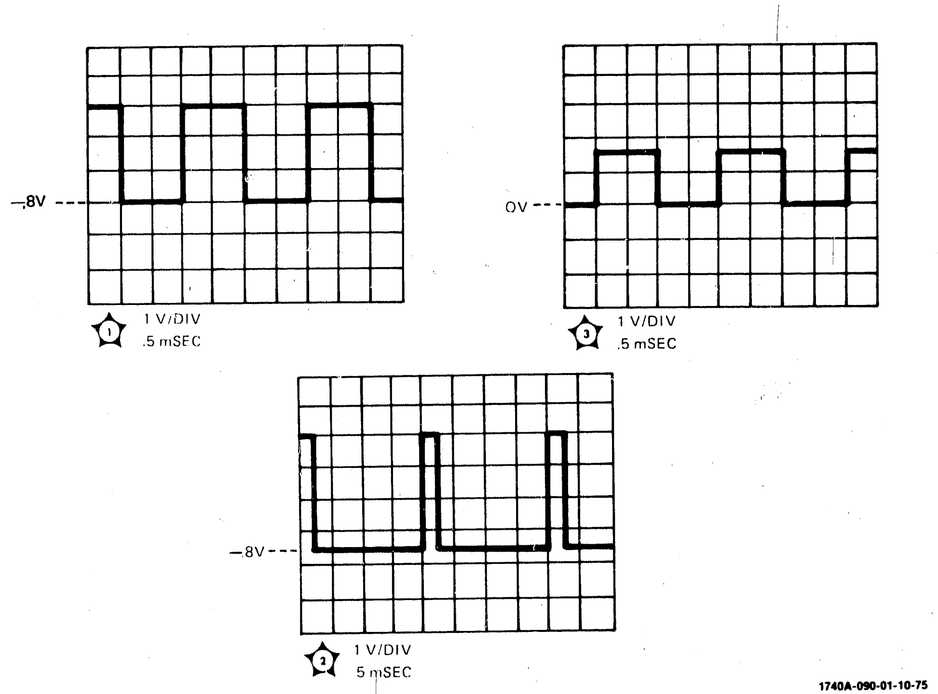


Figure 8-45. Waveforms for Service Sheet 13

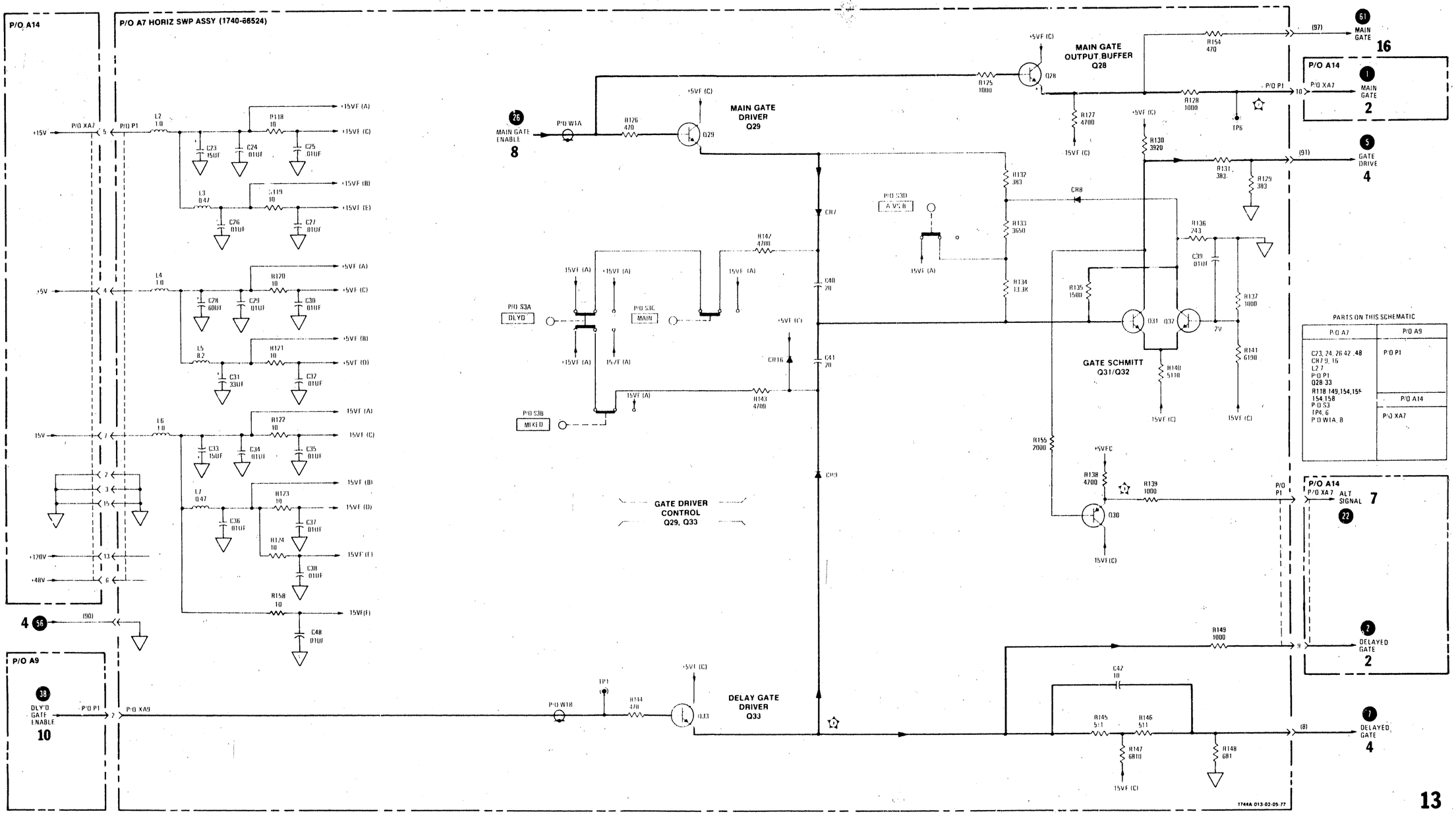


Figure 8-46.
Service Sheet 13, Main Gate Output
8-29/(8-30 blank)

SERVICE SHEET 5

CHANNEL A, CHANNEL B PREAMPLIFIER - CIRCUIT THEORY

General. In the following explanation, circuits that are identical are explained for channel A only.

Attenuator Assembly. Channel A attenuator is a cam-actuated switch assembly. Only contact strips and their actuating cams are contained in the switch. The contacts connect appropriate pads on the preamplifier assembly to complete coupling and attenuation requirements for the input circuit. Refer to charts on the schematic which indicate appropriate switch closures for VOLTS/DIV and coupling settings. The VOLTS/DIV switch selects X1 and X100 attenuation circuits in the input circuit, X1 or X10 attenuation circuits in preamplifier substrate A3A1, and X1, X2, or X4 attenuation circuits, also in substrate A3A1.

Preamplifier Stage. The channel A input signal is applied to a high-to-low impedance converter stage consisting of dual field-effect transistor (FET) A3Q2 connected in a source follower configuration. Half of the FET, A3Q2B, provides a current bias for the source of A3Q2A. FET BAL adjustment A3R11 balances the two sections of the FET and ensures that a zero-volt input is applied to channel A input on substrate A3A1 (pin 10). The preamplifier substrate contains 31 thick-film resistors and three monolithic chips: channel A and channel B preamplifiers and a delay-line driver amplifier. These chips perform the conventional control functions of signal polarity, gain vernier, channel switching, and sync extraction; they also control six ranges of vertical sensitivity. The gain chip is a four-transistor differential shunt-feedback amplifier that provides a current gain of eight and directly drives the balanced delay line. The bandwidth limit circuit shunts the delay line input, and, by switching the appropriate capacitance across the line, limits frequency response to approximately 20 MHz. Diodes CR29 and CR30 are hot-carrier type diodes that limit the output swing of the vertical preamplifier.

Trigger view amplifier A3Q6/A3Q7 routes output signals from trigger conditioning circuit A7Q1 (schematic 7) to delay line A4. In channel A or B DISPLAY, trigger view switch A3S1A replaces the main channel display with the triggering waveform. In ALT or CHOP, channel A, channel B, and the trigger signal are displayed.

When BEAM FIND switch A12S1 (schematic 3) is pressed, sufficient current is applied through A3CR4/A3CR5 and A3CR6/A3CR7 to lower sensitivity of the input to the delay line, causing the trace to return to the viewing area of the CRT.

Channel A and channel B verniers are used to vary the gain of each channel over a range of at least 2.5:1. Channel B has a vernier interface circuit A3Q21 (schematic 6) that allows A2R1 to control channel B gain in both normal and A VS B operations.

Delay Line. Output of the vertical preamplifier is applied to delay line assembly A4. The delay line has a differential impedance of approximately 180 ohms and provides a time delay of 100 nanoseconds which allows the internal sync signal sufficient time to trigger the horizontal sweep before the input vertical signal is applied to the CRT vertical deflection plates.

REMOVAL PROCEDURE

Vertical Preamplifier Assembly A3, Delay Line Assembly A4, and Vertical Control Switching Assembly A13 can be removed from the instrument as follows:

a. Remove channel A and B POSN, vernier, coupling, and VOLTS/DIV knobs.

b. Remove nuts and washers from both INPUT connectors.

c. Disconnect (9) wire from calibrator output.

d. Disconnect delay line wires (4), (6), and (0) from back side of assembly A17.

e. Remove delay line clamp from A17.

f. Remove twin leads (3,4) and (9,1) from assembly A7.

g. Remove screw that connects assembly A7, shield, and assembly A3 together. This screw is near point where twin lead (9,1) attaches to assembly A7.

h. Disconnect Interface Assembly A14.

i. Disconnect plug to assembly A17.

j. Carefully tilt assembly A3 outward and extract toward rear of instrument.

k. Disconnect vernier UNCAL light cable (95), (96), and two (0) wires from assembly A13.

l. To reinstall assemblies A3, A4, and A13, reverse removal procedure.

NOTE

To remove assembly A13 from assembly A3, continue with step m.

m. Disconnect wires (4) and (9) from channel A and B verniers (total of four wires).

n. Disconnect wires (3), (93), (913) and (7), (8) from component side of assembly A13.

o. Remove screw on component side of assembly A3 that screws into standoff of A13 (near delay line).

p. Disconnect two plugs to assembly A3.

q. To reinstall assembly A13, reverse removal procedure.

VERTICAL PREAMPLIFIER IC A3A1 REMOVAL

To remove A3A1, see figure 8-16 and proceed as follows:

a. Disconnect twin lead (3,4) from assembly A7.

b. Remove six screws holding vertical preamplifier shield MP45 to assembly A3. Remove shield.

c. Remove two screws holding IC to assembly A3.

d. Lift IC from assembly A3.

e. To reinstall IC, reverse removal procedure; be certain that orientation of location pins is as shown in figure 8-16.

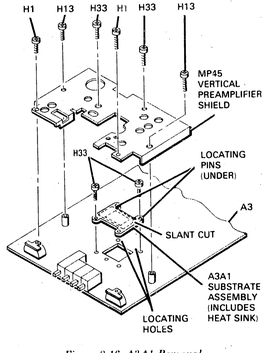


Figure 8-16. A3A1 Removal

TROUBLESHOOTING

Problems in the vertical amplifier may show up as a variety of symptoms. Low gain problems may be located by applying an input signal and monitoring it through the various stages (refer to waveforms adjacent to schematics). Attenuator problems may be on the attenuator itself or within Vertical Preamplifier Substrate A3A1.

Problems can be isolated to A3A1 or to the vertical output circuit on assembly A17 by pressing TRIG VIEW on the front panel while applying a known signal to the main EXT TRIGGER input connector. If it is displayed properly (approximately 100 mV/div), this indicates that the vertical output circuit on A17 is operating properly and the problem is in A3A1.

Bandwidth, rise time, or pulse response problems can be caused by dirty CRT neck pins or by a faulty delay line. However, they are most likely caused by defective amplifiers or improper adjustments.

DC VOLTAGE MEASUREMENT CONDITIONS SERVICE SHEET 5

1. **Set front-panel controls in accordance with initial control settings in Section V.**
2. **All voltages are referenced to chassis ground. All indications are nominal and 15% variation from those indicated should be considered normal.**

WAVEFORM MEASUREMENT CONDITIONS SERVICE SHEET 5

1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

   Coupling (channel A) 50Ω
   TRIGGER LEVEL (main) ..... stable display

2. Set monitor oscilloscope TIME/DIV and VOLTS/DIV controls as indicated under waveform(s).
3. Connect pulse generator 50-ohm output to Model 1744A channel A INPUT connector.
4. Adjust pulse generator output for 6 divisions of signal amplitude (.6 V) at 5 kHz.

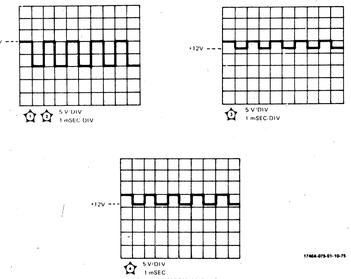
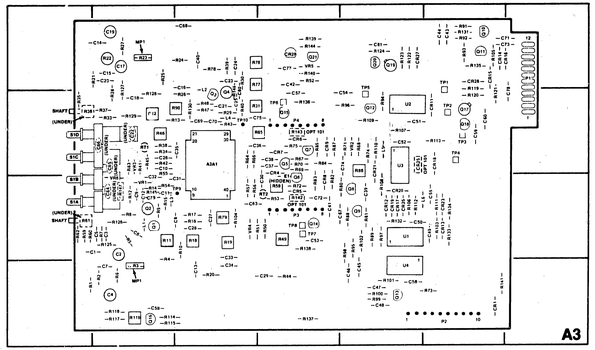


Figure 8-17. Waveforms for Service Sheet 5



A		B		C		D		E		F		G	
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A3A1	C-3	C39	E-2	C79	B-2	Q2	B-2	R19	C-2	R57	C-2	R95	E-2	R133	F-2
C1	B-2	C40	C-4	C80	C-3	Q3	C-3	R20	C-1	R58	D-2	R96	E-3	R134	F-2
C2	B-2	C41	D-2	CR1	F-1	Q4	C-3	R21	B-4	R59	A-2	R97	E-2	R135	F-4
C3	B-2	C42	D-4	CR4	D-2	Q5	D-3	R22	B-4	R60	A-2	R98	E-2	R136	D-3
C4	B-1	C43	F-4	CR5	D-2	Q6	D-2	R23	B-4	R61	A-2	R99	E-1	R137	D-1
C5	B-2	C44	F-4	CR6	D-3	Q7	D-2	R24	C-4	R62	A-2	R100	E-1	R138	D-2
C6	B-2	C45	E-1	CR7	D-3	Q8	E-2	R25	B-4	R63	B-3	R101	E-1	R139	D-4
C7	B-1	C46	E-1	CR9	D-2	Q9	E-2	R26	C-3	R64	C-3	R102	E-2	R140	D-4
C8	C-2	C47	E-1	CR9	D-3	Q10	F-4	R27	B-4	R65	C-3	R103	F-2	R141	F-1
C9	B-2	C48	E-1	CR11	F-3	Q11	F-4	R28	B-3	R66	C-3	R104	C-2	R142	D-2
C10	B-3	C49	F-2	CR12	E-2	Q12	E-3	R29	C-3	R67	D-3	R105	E-4	R143	D-3
C11	B-2	C50	E-2	CR13	F-2	Q13	E-1	R30	C-4	R68	D-3	R106	E-2	R144	D-4
C12	B-2	C51	E-3	CR14	F-4	Q14	D-2	R31	C-3	R69	D-3	R107	E-3	R145	B-2
C13	C-1	C52	E-3	CR15	F-4	Q15	D-3	R32	B-3	R70	D-3	R108	E-2	R146	C-3
C14	B-4	C54	E-3	CR16	F-4	Q16	E-1	R33	A-3	R71	E-3	R109	E-3	R147	B-2
C15	B-4	C54	E-3	CR17	E-2	Q17	F-3	R34	B-3	R72	D-2	R110	E-3	RT1	B-3
C16	C-4	C55	F-2	CR18	F-3	Q18	F-3	R35	A-3	R73	F-1	R111	E-2	RT2	D-2
C17	B-4	C56	E-1	CR19	E-2	Q19	E-4	R36	A-3	R74	E-3	R112	E-2	S1A	A-3
C18	B-3	C57	D-3	CR20	E-2	Q20	E-4	R37	B-3	R75	D-3	R113	F-3	S1B	A-2
C19	B-4	C58	B-1	CR21	E-3	Q21	D-4	R38	B-3	R76	C-4	R114	B-1	S1C	A-3
C20	B-4	C59	C-3	CR23	F-2	R1	A-1	R39	C-4	R77	C-4	R115	B-1	S1D	A-3
C21	C-3	C60	F-3	CR25	E-2	R2	B-1	R40	C-3	R78	C-4	R116	B-1	TP1	F-4
C22	B-3	C61	E-4	CR26	F-4	R3	B-1	R41	B-3	R79	C-2	R117	B-1	TP2	F-3
C23	C-4	C62	D-2	CR27	E-4	R4	B-1	R42	B-3	R80	D-2	R118	B-1	TP3	F-3
C24	C-4	C64	B-2	CR28	D-4	R5	B-2	R43	C-3	R81	E-2	R119	F-3	TP4	F-3
C25	C-3	C65	B-3	E1	D-2	R6	B-1	R44	D-1	R82	D-2	R120	F-3	TP5	E-4
C26	B-3	C66	B-3	L1	B-2	R7	B-2	R45	B-3	R83	D-2	R121	F-3	TP6	D-3
C27	C-2	C67	D-2	L2	C-3	R8	B-2	R46	B-3	R84	D-3	R122	E-4	TP7	D-2
C28	C-2	C68	C-4	L3	B-2	R9	B-2	R47	C-3	R85	D-3	R123	E-4	TP8	D-2
C29	D-1	C69	C-3	L4	C-3	R10	C-2	R48	C-3	R86	E-3	R124	E-4	TP9	C-2
C30	D-2	C70	C-3	L5	E-3	R11	B-2	R49	D-2	R87	D-3	R125	B-2	TP10	C-3
C31	C-2	C71	F-4	L6	E-2	R12	B-2	R50	D-2	R88	E-2	R126	B-2	U1	E-2
C32	B-2	C72	D-2	P1	G-4	R13	C-3	R51	C-2	R89	E-2	R127	B-4	U2	E-3
C33	C-2	C73	F-4	P2	F-1	R14	B-2	R52	D-4	R90	C-3	R128	B-3	U3	E-3
C34	C-1	C74	E-3	P3	D-2	R15	B-2	R53	D-2	R91	F-4	R129	B-3	U4	E-1
C35	C-3	C75	C-3	P4	D-3	R16	B-2	R54	B-2	R92	F-4	R130	C-3	VR1	B-2
C36	C-3	C77	D-4	Q1	B-2	R17	C-2	R55	B-3	R93	F-4	R131	F-4	VR2	E-3
C37	D-3	C78	G-3			R18	C-2	R56	C-2	R94	E-3	R132	E-2	VR3	B-3
C38	D-3													VR4	C-2
														VR5	D-4
														VR6	B-2

Figure 8-18. Vertical Preamplifier, A3, Component Identification

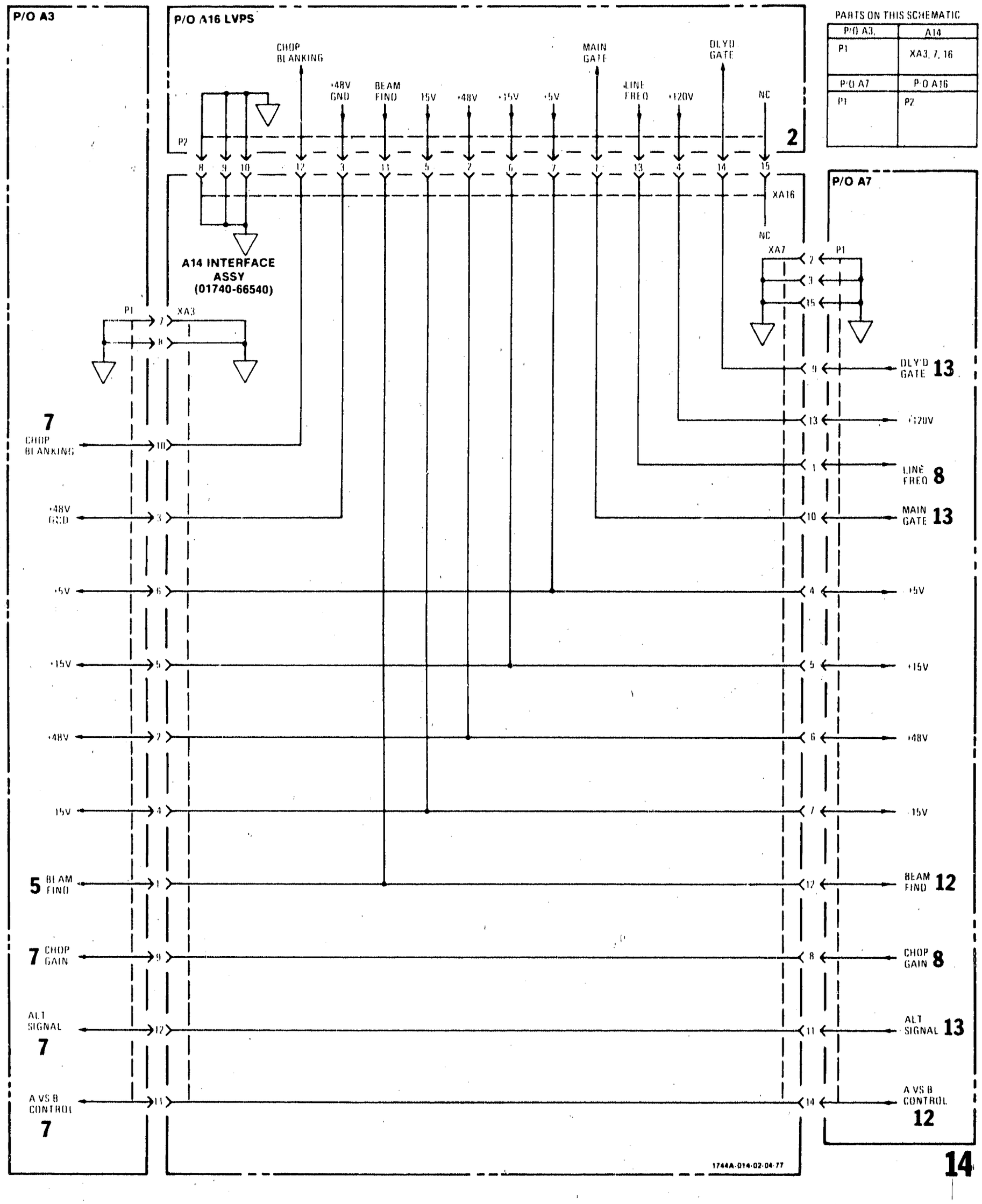


Figure 8-47.
Service Sheet 14, Interface Assembly, A14

SERVICE SHEET 15

General. The Storage Control Assembly A18 performs the switching functions required to write, store, or erase information on the CRT screen. The function performed by the individual switches are not discussed in this service sheet, but are discussed functionally in Service Sheets 16 and 17.

REMOVAL PROCEDURE

To remove assembly A18, proceed as follows:

a. Remove ERASE pushbutton shaft by removing collar behind PERSISTENCE control.

b. Remove PERSISTENCE and BRIGHTNESS control knobs.

c. Disconnect 16-pin connector from assembly A17.

d. Remove one screw that holds A18 to board support strap MP23.

e. Remove two screws that hold A18 mounting bracket (MP81) to front deck.

f. Remove A18 by sliding to rear of instrument.

g. To reinstall A18, reverse removal procedure.

TROUBLESHOOTING

The storage control assembly should present no problems when troubleshooting the assembly. NAND gate output levels are indicated on the schematic when certain switches are engaged. These output levels will either be present or not, indicating a faulty NAND gate.

The pushbutton switches used on this assembly are designed for long, trouble-free service. If one of these switches should become defective, replacement rather than repair is recommended.

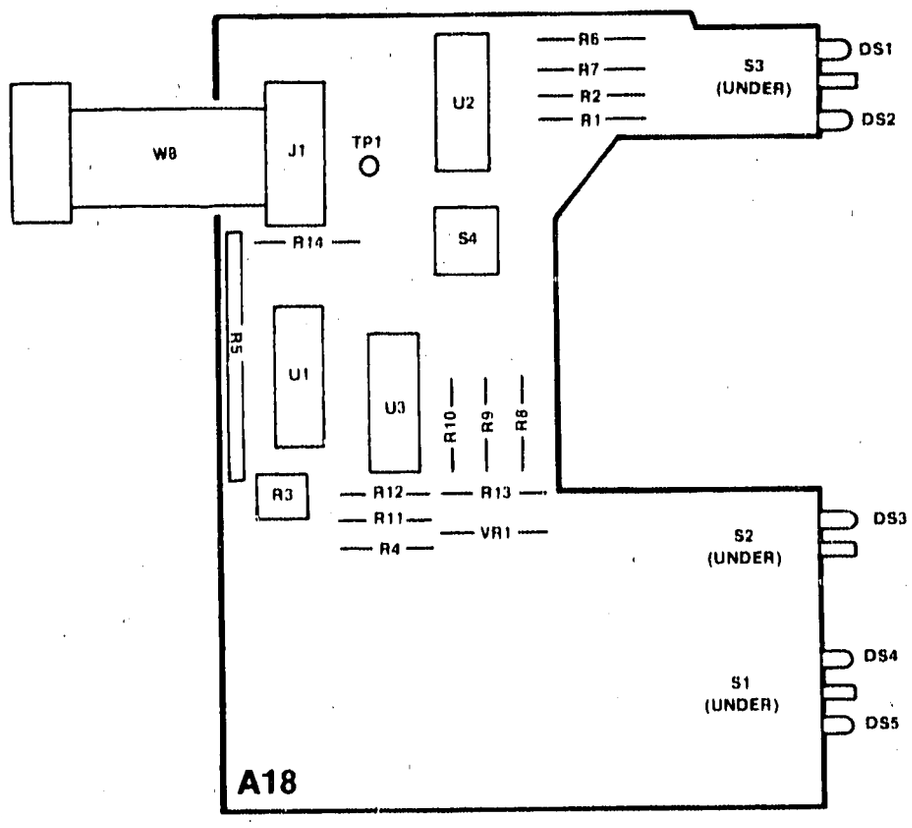


Figure 8-48. Storage Control, A18, Component Identification

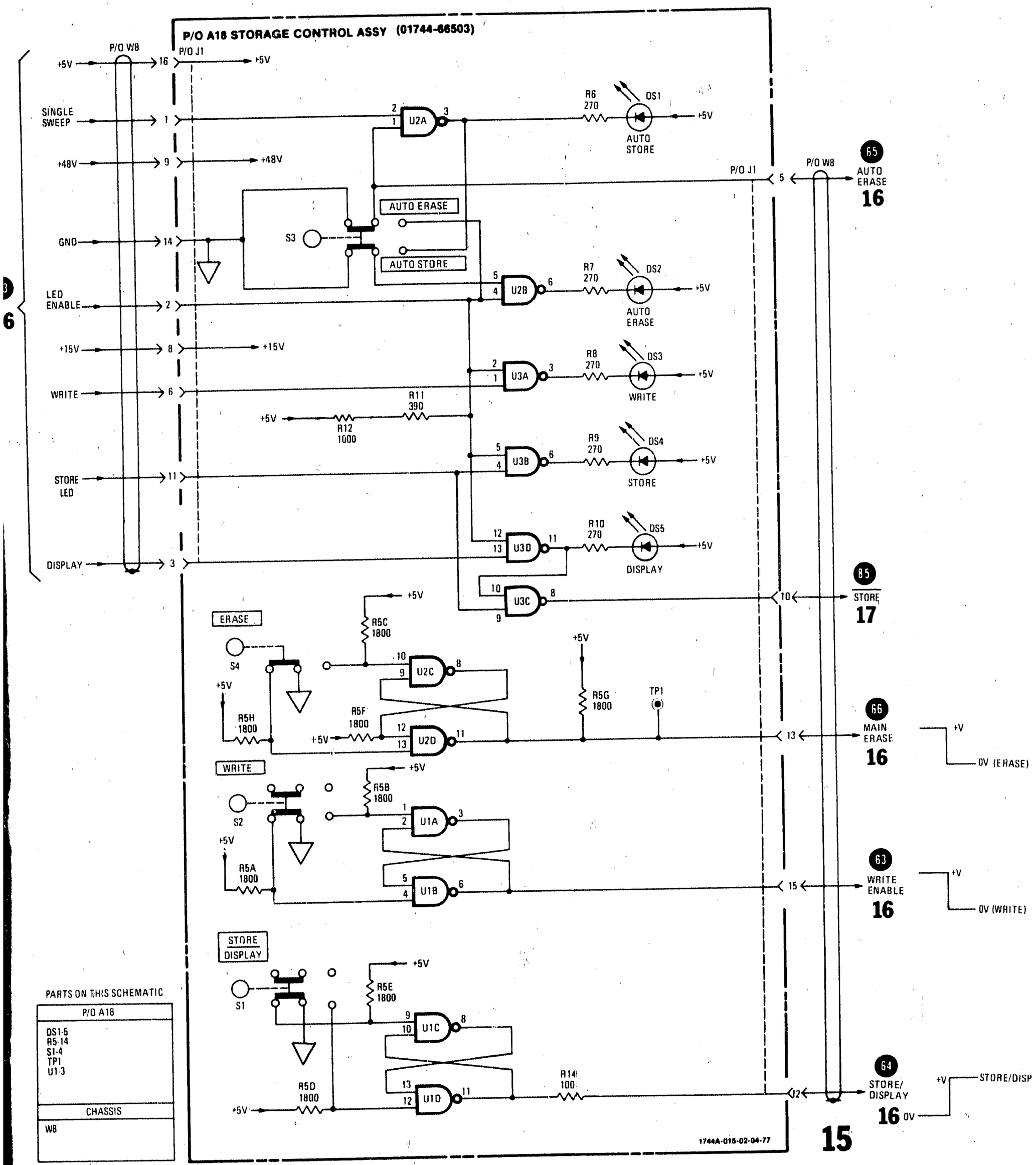
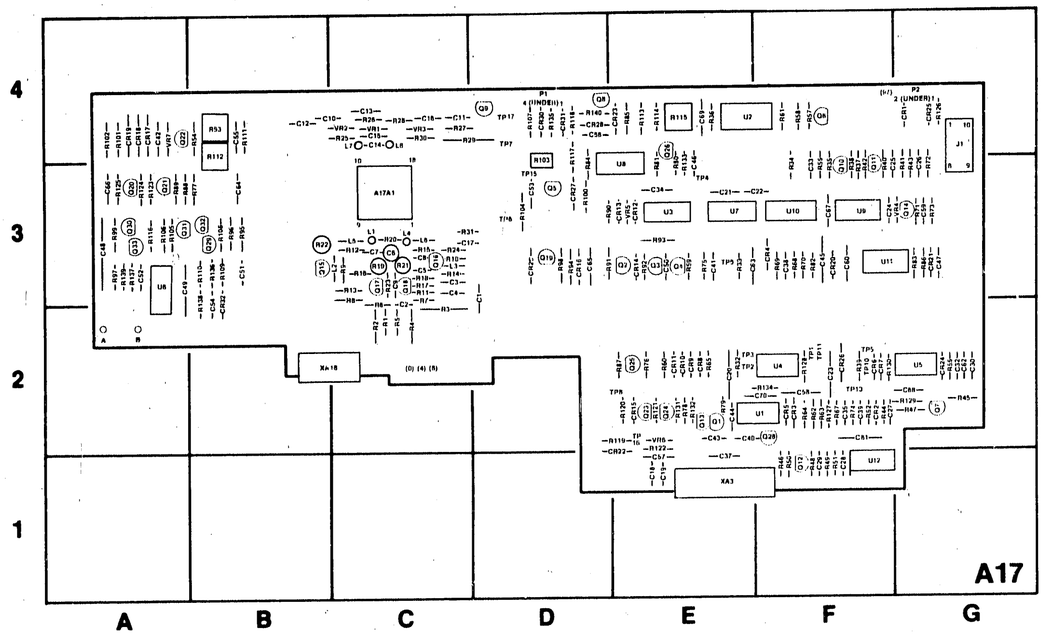


Figure 8-49.
Service Sheet 15, Storage Control Circuitry



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
A17A1	C-3	C42	A-4	CR12	E-3	Q9	D-4	R18	C-3	R59	E-3	R99	A-3	R138	B-3
C1	D-3	C43	E-2	CR13	E-3	Q10	G-3	R19	C-3	R60	E-2	R100	D-3	R139	A-3
C2	C-2	C44	E-2	CR14	E-3	Q11	G-3	R20	C-3	R61	F-4	R101	A-4	R140	D-4
C3	C-3	C45	F-3	CR15	E-2	Q12	F-1	R21	C-3	R62	F-2	R102	A-4	TP1	F-2
C4	C-3	C46	E-3	CR16	D-3	Q13	E-3	R22	B-3	R63	F-2	R103	D-3	TP2	E-2
C5	C-3	C47	G-3	CR17	A-4	Q14	G-3	R23	C-3	R64	F-2	R104	D-3	TP3	E-2
C6	C-3	C48	A-3	CR18	A-4	Q15	B-3	R24	C-3	R65	E-2	R105	A-3	TP4	E-3
C7	C-3	C49	A-3	CR19	A-4	Q16	C-3	R25	F-3	R67	F-2	R106	A-3	TP5	F-2
C8	C-3	C50	E-3	CR20	F-3	Q17	C-3	R26	C-4	R68	F-3	R107	D-4	TP6	D-3
C9	C-3	C51	B-3	CR21	G-3	Q18	C-3	R27	C-4	R69	F-3	R108	B-3	TP7	D-4
C10	C-4	C52	A-3	CR22	E-1	Q19	D-3	R28	C-4	R70	F-3	R109	B-3	TP8	E-2
C11	C-4	C53	D-3	CR23	E-4	Q20	A-3	R29	C-4	R71	G-3	R110	B-3	TP9	F-2
C12	B-4	C54	B-2	CR24	G-2	Q21	A-3	R30	C-4	R72	G-3	R111	B-4	TP10	F-2
C13	C-4	C55	B-4	CR25	G-4	Q23	A-4	R31	C-3	R73	G-3	R112	B-3	TP11	F-2
C14	C-4	C56	D-4	CR26	F-2	Q24	E-2	R32	E-2	R74	F-2	R113	E-4	TP13	F-2
C15	C-4	C57	E-1	CR27	D-3	Q25	E-2	R33	E-3	R75	E-3	R114	E-4	TP15	E-4
C16	C-4	C58	F-2	CR28	D-4	Q26	E-4	R34	F-3	R76	E-2	R115	E-4	TP16	D-3
C17	C-3	C59	G-3	CR29	D-3	Q28	F-2	R35	F-3	R77	B-3	R116	A-3	TP17	D-4
C18	E-1	C60	F-3	CR30	D-4	Q29	B-3	R36	E-4	R78	E-2	R117	D-4	U1	F-2
C19	E-1	C61	F-2	CR31	D-4	Q30	A-3	R37	F-3	R79	E-2	R118	D-4	U2	E-4
C20	E-2	C62	G-2	CR32	B-3	Q31	A-3	R38	F-3	R80	E-3	R119	E-2	U3	E-3
C21	E-3	C63	E-3	J1	G-4	Q32	B-3	R40	F-3	R81	E-3	R120	E-2	U4	F-2
C22	F-3	C64	B-3	L1	C-3	Q33	A-3	R41	G-3	R82	F-3	R121	E-2	U5	G-2
C23	F-2	C65	D-3	L2	C-3	R1	C-2	R42	F-3	R83	G-3	R122	E-2	U6	A-3
C24	F-3	C66	A-3	L3	C-3	R2	C-2	R43	G-3	R84	D-3	R123	A-3	U7	E-3
C25	F-3	C67	F-3	L4	C-3	R3	C-2	R44	F-2	R85	E-4	R124	A-3	U8	E-3
C26	G-3	C68	G-3	L5	C-3	R4	C-2	R45	G-2	R86	G-3	R125	A-3	U9	F-3
C27	F-2	C69	E-4	L6	C-3	R5	C-2	R46	F-1	R87	E-2	R126	G-4	U10	F-3
C28	F-1	C70	F-2	L7	C-4	R6	C-2	R47	G-2	R88	A-3	R127	F-2	U11	F-3
C29	F-1	CR1	G-4	L8	C-4	R7	C-2	R48	F-1	R89	A-3	R128	F-2	U12	F-1
C30	G-2	CR2	F-2	P1	D-4	R8	C-3	R49	F-1	R90	E-3	R129	G-2	VR1	C-4
C32	G-2	CR3	F-2	P2	G-4	R9	C-3	R50	F-1	R91	E-3	R130	F-2	VR2	C-4
C33	F-3	CR4	F-3	Q1	E-2	R10	C-3	R51	F-1	R92	E-3	R131	E-2	VR3	C-4
C34	E-3	CR5	F-2	Q2	E-3	R11	C-3	R52	F-2	R93	E-3	R132	E-2	VR4	G-3
C35	F-2	CR6	F-2	Q3	E-3	R12	C-3	R53	B-3	R94	D-3	R133	E-3	VR5	E-3
C37	E-2	CR7	F-2	Q4	E-3	R13	C-3	R54	B-3	R95	B-3	R134	F-2	VR6	E-2
C38	F-3	CR8	E-2	Q5	D-3	R14	C-3	R55	G-2	R96	B-3	R135	D-4	VR7	A-4
C39	F-2	CR9	E-2	Q6	F-4	R15	C-3	R56	F-3	R97	A-3	R136	B-3	XA3	E-1
C40	E-2	CR10	E-2	Q7	G-2	R16	C-3	R57	F-4	R98	D-3	R137	A-3	XA16	C-2
C41	E-3	CR11	E-2	Q8	D-4	R17	C-3	R58	F-4						

Figure 8-50. Storage Assembly, A17, Component Identification

SERVICE SHEET 16-17

STORAGE ASSEMBLY - CIRCUIT THEORY

Normal Write Mode. WRITE/STORE ENABLE flip-flop A17U2B establishes the operating mode of the instrument. In the write mode, the flip-flop is set. In the store or store display mode, the flip-flop is clocked to its reset condition.

When engaged, WRITE switch A18S2 (Service Sheet 15) applies the WRITE ENABLE signal (logic low) to the preset input on flip-flop U2B through AND gate U4A (schematic 16), setting the flip-flop. The Q output (high) lights the WRITE LED and applies the PERSISTENCE ENABLE signal to persistence timer NAND gate U8B, enabling it (schematic 17). The other input to U8B is from persistence control timer U1A through buffer transistor Q26. The timer functions as a free-running multivibrator whose repetition rate is determined by the voltage level applied by PERSISTENCE/VIEW TIME potentiometer R2 through current source transistor Q1. The timer output is applied through Q26 and U8B to level-shifting circuit Q2-Q4. Amplitude of the pulses developed at the collector of Q3 can be varied by BRIGHTNESS potentiometer R1; however, the overall amplitude is controlled by Q22 and its associated circuitry. This circuit ensures that the voltage levels between the collector mesh and the storage mesh remains constant during the erase cycle. WINDOW ADJ R53 is used to compensate for slight operating variations between CRTs.

The output from Q3 is applied through an OR-diode summing network, through Q22 circuitry, to the CRT storage mesh. The amplitude and pulse rate of the signal applied to the storage mesh determine the amount of floodgun electrons that reach the phosphor viewing screen.

Write Mode - Main Erase. In the write mode, the Q (high) output of U2B (schematic 16) is applied through AND gate U4B to the clear (CLR) input on flip-flop U5A. This conditions the flip-flop so that a negative-going signal applied to the preset (PR) input will set the flip-flop.

When ERASE pushbutton switch A18S4 is pressed, the MAIN ERASE signal goes low, developing a differentiated, negative-going pulse at the junction of R55 and C32. This sets U5A, causing its $\overline{Q}$ output to go low. The $\overline{Q}$ output of U5A triggers the one-shot multivibrator U11A (Service Sheet 17) through U10B. The one-shot completes its cycle after 300 ms and clocks U5A back to its reset condition, causing $\overline{Q}$ to go high. This action generates an auto reset pulse by way of Q6 for the trigger circuit. The $\overline{Q}$ output of U5A is also applied to AND gate U9A causing its output to go low, forcing the output of NAND gate U10A high, developing the ERASE BLANKING signal that cuts off the CRT write gun during the erase cycle (schematics 7 and 4). The output of U10A, when high, also turns on Q14, producing the TRIG INHIBIT signal to the horizontal sweep circuit, preventing a new sweep from being generated (schematic 8).

In addition, the $\overline{Q}$ output of U5A is applied to NAND gate U10B producing the ERASE ENABLE signal that is applied simultaneously to monostable multivibrators U11A and U11B (schematic 17). Since the STORE ENABLE signal is low in the write mode, the monostable multivibrators are triggered by the high ERASE ENABLE signal. The Q output of U11B is a 60-millisecond pulse that is applied to two circuits. One signal path is through level-shifting circuit Q21 and Q20. This circuit conducts during the erase cycle and applies +120 volts to the CRT storage mesh, bringing its potential to the same level as the collector mesh.

The other circuit driven by the 60-millisecond erase pulse is a ramp-generator circuit consisting of Q23-Q25. During the 60-millisecond erase cycle, Q25 and Q24 are turned on. When conducting, Q24 partially discharges capacitor C57. At the end of the erase cycle, Q25 and Q24 turn off. Q23 continues to conduct through CR15 and R94 for a time period determined by the discharge time constant of C57 and R119 producing a voltage ramp at the OR-diode summing point. When the ramp reaches approximately +15 volts, it is clamped by CR16.

During an erase cycle, the Q output of U11A is a 300 millisecond pulse that is applied to NAND gates U8A and U8D. Since the PERSISTENCE ENABLE signal is high during the write mode, the output of U8A goes low, holding the reset input to timer U1A low. This inhibits the timer during the erase cycle.

The Q output of U11A enables U8D during the erase cycle and allows a pulse train, generated by the instrument calibrator to be applied to a level-shifting circuit consisting of Q8 and Q9. The pulsating output from Q8/Q9 is applied to the CRT LV collimator, enhancing the erasure of the CRT. In addition, a protection circuit is provided to prevent damage to the CRT during instrument turn-on. When the instrument is first turned on, Q30 is held in its off condition and Q31/Q33 conduct, applying a steady +120 V to the low-voltage collimator. This prevents excessive flood-gun electrons from reaching the CRT meshes prior to all voltages stabilizing. The time that Q30 is held off is a function of RC network R97/C48. When C48 charges to approximately +5 volts, Q30 conducts turning off Q31/Q33. The LV collimator circuit now functions at its normal operating level.

The $\overline{Q}$ output from U11A is applied as a clock to erase flip-flops U5A and U5B (schematic 16). At the end of the erase cycle, the Q output goes high, clocking both U5A and U5B to their reset condition (D inputs grounded).

During the erase cycle, the $\overline{Q}$ output from U11A (low) is applied through CR29 to the base of Q19, turning it off. This prevents the instrument calibrator signal from

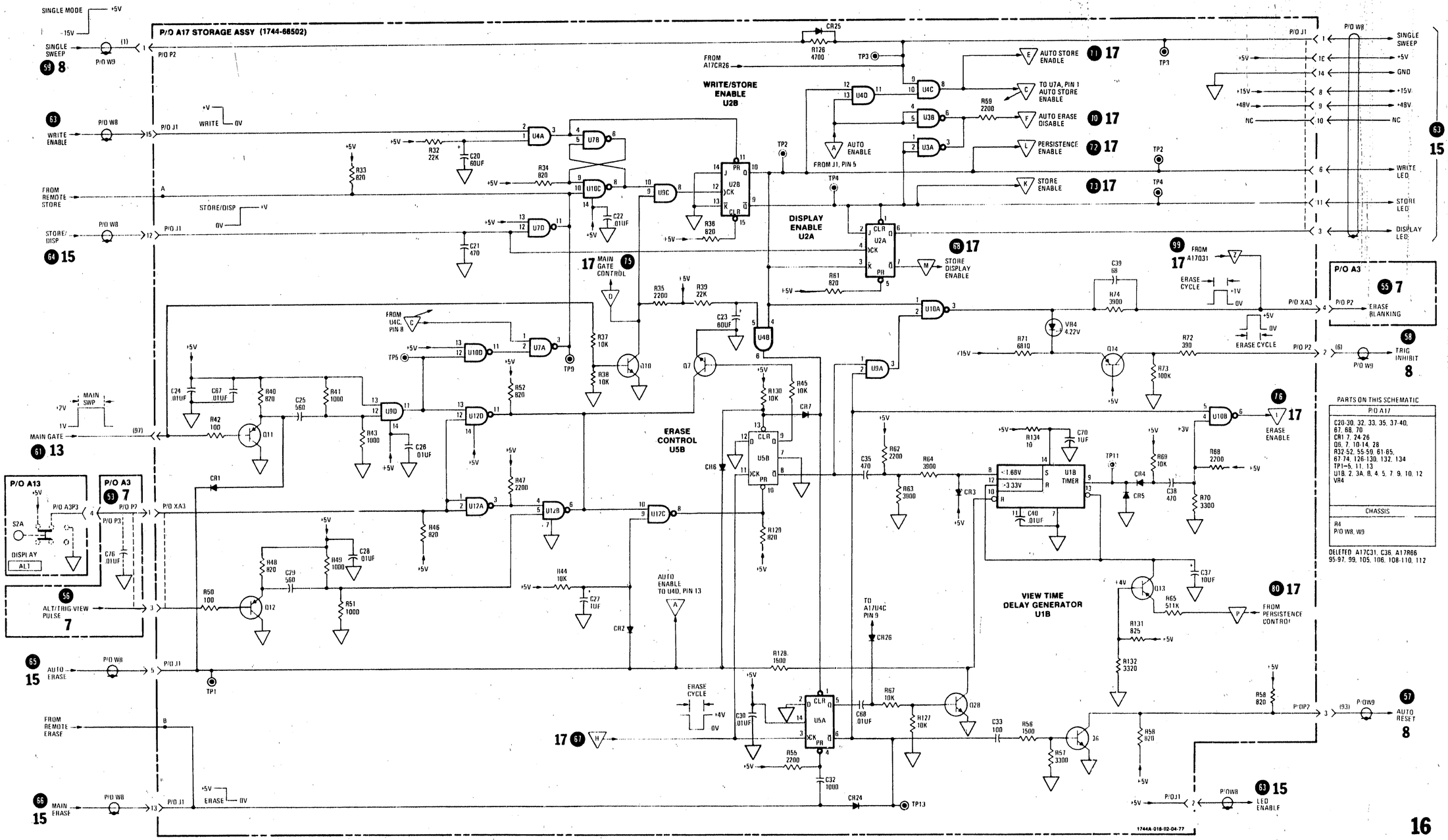


Figure 8-51.
Service Sheet 16, Write/Store Enable Circuitry

pulsing the CRT floodgun (provided DISPLAY BRIGHTNESS switch S1 is in its NORMAL position). During the erase cycle the CRT floodgun is on continuously.

Write Mode - Auto Erase. Engaging AUTO ERASE/AUTO STORE switch A18S3 produces an AUTO ERASE signal (high) that lights the AUTO ERASE LED (schematic 15). When disengaged, the AUTO ERASE/AUTO STORE switch applies a low through CR1 to the emitter of Q11 (schematic 16), inhibiting the main gate function. In addition, a low is applied through CR2 to NAND gate U12C, holding its output high. The output of U12C supplies the preset input signal to erase flip-flop U5B. A low is applied also through CR6 to the clear input of U5B. With these conditions established on the clear and preset inputs to U5B, the flip-flop is held in its reset state. With AUTO ERASE/AUTO STORE switch engaged, CR1, CR2, and CR6 are reverse biased.

The main gate signal (high during a main sweep) is buffered by transistor Q11. When the main gate signal goes low at the end of the main sweep, Q11 conducts, producing a negative-going, differentiated pulse at an input to AND gate U9D. The output of U9D goes low momentarily, forcing the output of U12D high. Since both inputs to NAND gate U12C are high, its output goes low, setting flip-flop U5B. The $\overline{Q}$ output (low) from U5B is differentiated by C35/R62 and applied as a trigger signal to view time delay generator U1B, causing its output to go high. Duration of the output pulse from U1B is a function of PERSISTENCE/VIEW TIME potentiometer R2 that regulates the discharge rate of the generator through current source Q13. During AUTO ERASE mode, persistence timer U1A is disabled (refer to later explanation). At the end of the output pulse, a negative-going differentiated pulse is applied to U10B causing its output to go high momentarily. The high is applied to erase-cycle monostable multivibrators U11A and U11B (schematic 17), initiating the erase cycle. At the end of the erase cycle, U5B is clocked to its reset condition by multivibrator U11A.

The $\overline{Q}$ output from U5B is also applied to AND gate U9A. When the $\overline{Q}$ output goes low, it initiates the ERASE BLANKING and TRIG INHIBIT signals discussed previously.

During AUTO ERASE mode, the AUTO ERASE signal is applied to NAND gate U3B (schematic 16), causing the AUTO ERASE DISABLE signal to go low. This low is applied to the anode of CR10 (schematic 17) inhibiting the enabling voltage from PERSISTENANCE/VIEW TIME potentiometer R2, causing Q1 to shut off. Since Q1 is the current source for timer U1A, the timer is inhibited. The PERSISTENCE/VIEW TIME potentiometer is now used to establish the auto erase cycle rate.

Write Mode - Auto Store. The AUTO ERASE signal is applied to AND gate U4D (schematic 16). In write mode of operation, the PERSISTENCE ENABLE signal, applied to the other input on U4D, is also high, forcing the output of U4D high. The high from U4D is applied to AND gate U4C. The other input to U4C is the SINGLE SWEEP from A7S1C (schematic 8). When SINGLE switch A7S1C is engaged, the SINGLE SWEEP signal (high) switches the instrument from auto erase to auto store operation. The AUTO STORE LED turns on (schematic 15). In addition, the high is applied through CR26/R67 to the base of Q28, turning it on (schematic 16). With Q28 conducting, a low is applied to the reset input on view time delay generator U1B, inhibiting the AUTO ERASE function.

NOTE

The instrument is now in the WRITE, AUTO STORE, SINGLE mode of operation. Normally, in this mode, the operator wishes to capture a single event and store it for observation.

The output of U4C (high) accomplishes two things. First, it is applied to an input on NAND gate U7A enabling it. At the end of the main sweep (event of interest written on screen), the main gate signal causes the output of U9D to go low, forcing the output of U10D high. With both inputs high, the output of U7A goes low, triggering WRITE/STORE ENABLE flip-flop U2B through R/S latch U7B/U10C and AND gate U9C. This automatically switches the instrument from WRITE to STORE mode of operation, and stores the event of interest.

Secondly, the output of U4C is applied to a circuit which maintains the instrument in a state of readiness, regardless of time interval between placing the instrument in WRITE, AUTO STORE, and SINGLE mode of operation, and the arrival of the event of interest. The high from U4C is applied to an input on NAND gate U3C (schematic 17). The other input to U3C is the MAIN GATE CONTROL signal from the collector circuit of Q10 (schematic 16). Since the main gate signal is low (no main sweep-awaiting arrival of the event of interest), the collector circuit of Q10 is high. With both inputs to U3C high, its output is low, holding the output of U7C high. The high output from U7C is applied to the current source circuit for persistence control timer U1A, enabling it. The timer generates a train of pulses (equivalent to maximum persistence setting of R2) that is applied to the CRT storage mesh. Without this conditioning, the CRT could fade positive (from electrons emitted by the floodgun) before arrival of the event of interest. Upon receiving a signal, the main sweep is triggered and the MAIN GATE signal goes high, turning on transistor Q10, and causing the MAIN GATE CONTROL signal to go low. The output of U3C goes high, forcing the output of U7C low. A low applied to the junction of R76/CR9 disables the current source circuit of U1A and turns it off. The CRT storage mesh is no longer pulsed. As explained previously, at the end of the main sweep when the event of interest is written, the instrument switches from the WRITE to the STORE mode of operation. This causes the AUTO STORE ENABLE signal to go low, holding the output of U3C high. This prevents persistence control timer U1A from turning on again at the end of the main sweep (MAIN GATE CONTROL signal goes high).

Alt Mode. In ALT mode of display, two or three sweeps across the CRT are required before an erase cycle is desired; therefore, the main gate signal must be ignored during this mode of display because it is generated during each sweep. When ALT display switch A13S2A is engaged, a ground is applied to an input on NAND gate U12D (schematic 16), holding its output high. This prevents the main gate signal from presetting erase control flip-flop U5B. The ground is also applied to both inputs on U12A holding its output high. The high is applied to an input on U12B. In ALT mode or ALT/TRIG-VIEW mode of display, channel B is always the last channel to be displayed. At the end of the channel B sweep, the ALT/TRIG-VIEW pulse is developed. The pulse is applied to buffer Q12 turning it off. At the end of the ALT/TRIG-VIEW pulse, A17Q12 turns on, developing a negative-going, differentiated pulse input to NAND gate U12B, forcing its output high. Both inputs to NAND gate U12C are now high, causing its output to go low, setting erase control flip-flop U5B and the erase cycle is initiated.

Store Mode. Engaging STORE/DISPLAY switch A18S1 causes the STORE/DISP signal from R/S latch A18U1C/A18U1D (schematic 15) to go high. The signal is applied as a clock signal to display enable flip-flop U2A (schematic 16); however, the CLR, J, and $\overline{K}$ inputs are such that the Q and $\overline{Q}$ outputs remain unchanged. The STORE/DISP signal is also applied through NAND gate U7D to R/S latch U7B/U10C. The output of the latch goes high, clocking flip-flop U2B through AND gate U9C, provided the MAIN GATE signal is low. As explained previously, the MAIN GATE signal, which is high during the main sweep, is applied to Q10, causing it to conduct. This holds the output of U9C low, preventing U2B from toggling during a trace sweep. At the end of the main sweep, Q10 turns off and U2B resets. The Q output of U2B (low) extinguishes the WRITE LED and hold the output of NAND gate U8B high, inhibiting the function of persistence control timer U1A (schematic 17). The Q output also is applied through U4D and U4C to an input on NAND gate U7A, holding its output high. This prevents U7A from clocking U2B after each sweep.

In addition, the $\overline{Q}$ output of U2B is applied through AND gate U4B to the CLR inputs on erase flip-flops in their reset state.

The Q output of U2B (high) lights the STORE LED. The signal is inverted by NAND gate U3A and applied to the junction of R75/CR10 (schematic 17), disabling the PERSISTENCE/VIEW TIME potentiometer R2 input to timer U1A. Also, the $\overline{Q}$ output of U2B is applied to the inverted inputs on both erase-cycle monostable multivibrators U11A and U11B, inhibiting them. This prevents generation of the erase cycle functions during the store mode of operation.

In the STORE mode of operation, $\overline{\text{STORE}}$ signal from A18U3C (schematic 15) goes low, turning off Q29. Transistor Q32 now conducts, performing the same function as Q31 during turn on. Q32 turns on Q33, holding the LV collimator to +120 V during the STORE mode of operation. In addition, with Q29 cut off, CR32 is reverse biased, allowing C51 to charge toward +5 volts. When C51 charges above the input hysteresis level of dual timer U6, it triggers the timer section of U6 that is connected in an astable multivibrator configuration. The output from the astable multivibrator is a train of one-second pulses. This pulse train is applied to the input of the second section of timer U6. Triggering of the second section occurs on the negative transition of the one-second pulses. The second section of U6 is connected in a monostable multivibrator configuration. Its output is a train of pulses each having a width of approximately one millisecond. The one millisecond pulse train is used to pulse the CRT floodgun during the STORE mode of operation.

Store Display Mode. The store mode of operation preconditions display enable flip-flop U2A (schematic 16) by applying a high to the CLR and J inputs, and by applying a low to the $\overline{K}$ input. Engaging STORE/DISPLAY switch A18S1 while in the store mode of operation toggles U2A (Q output high) and the DISPLAY LED lights. With the CLR and J inputs high and the $\overline{K}$ input low, U2A will toggle from one state to the other (set-reset) each time the STORE/DISPLAY switch is engaged.

The $\overline{Q}$ output of U2A (low) is applied to an input on U3D (schematic 17) as the STORE DISPLAY ENABLE signal. The signal holds the output of U3D high allowing Q5 to conduct, turning on the CRT floodguns. This allows the operator to view the stored display.

REMOVAL PROCEDURE

To remove assembly A17, refer to Service Sheet 6.

TROUBLESHOOTING

When troubleshooting storage assembly A17, use the voltages and waveforms provided on the schematics.

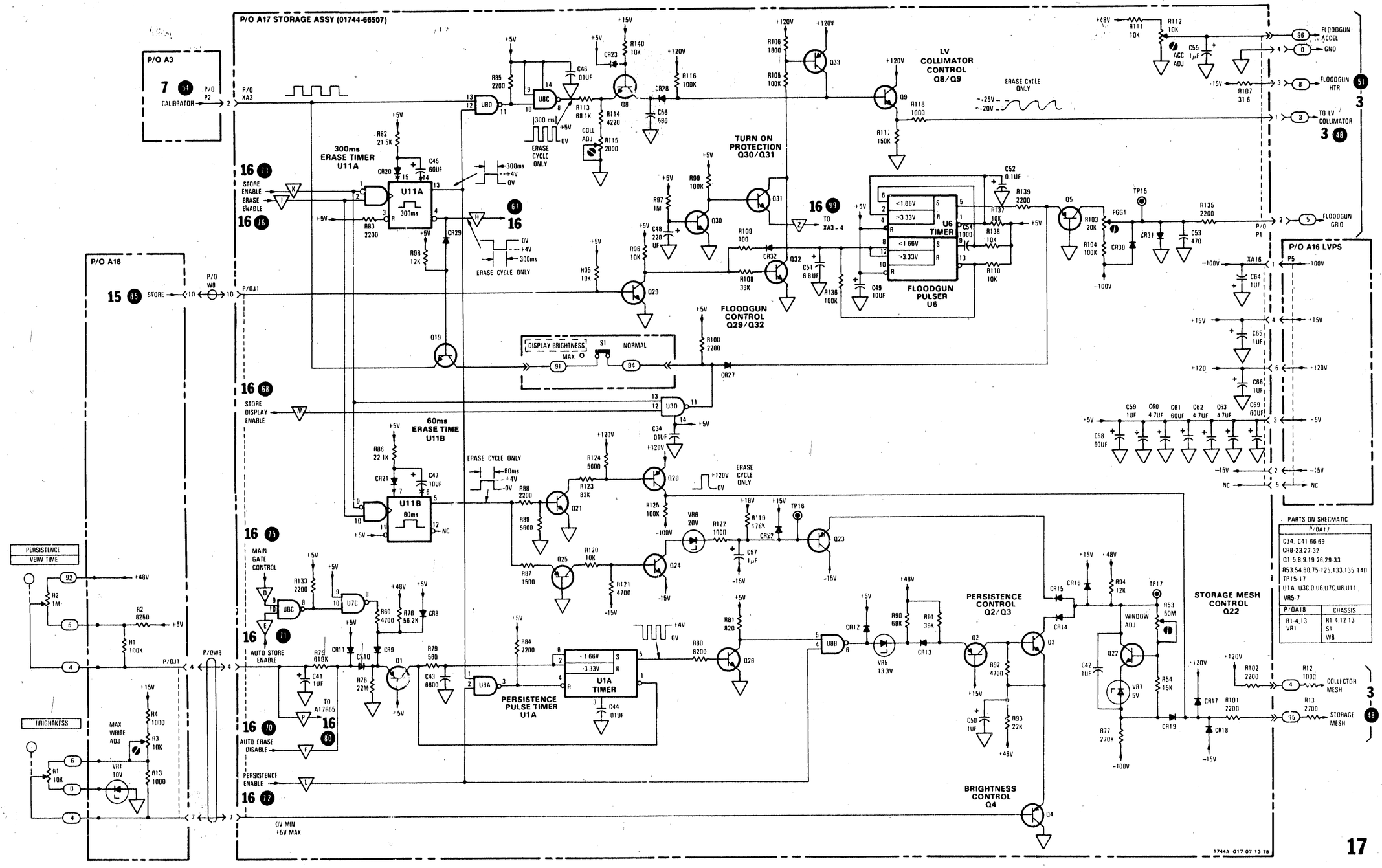


Figure 8-52.
Service Sheet 17, CRT Control Circuitry

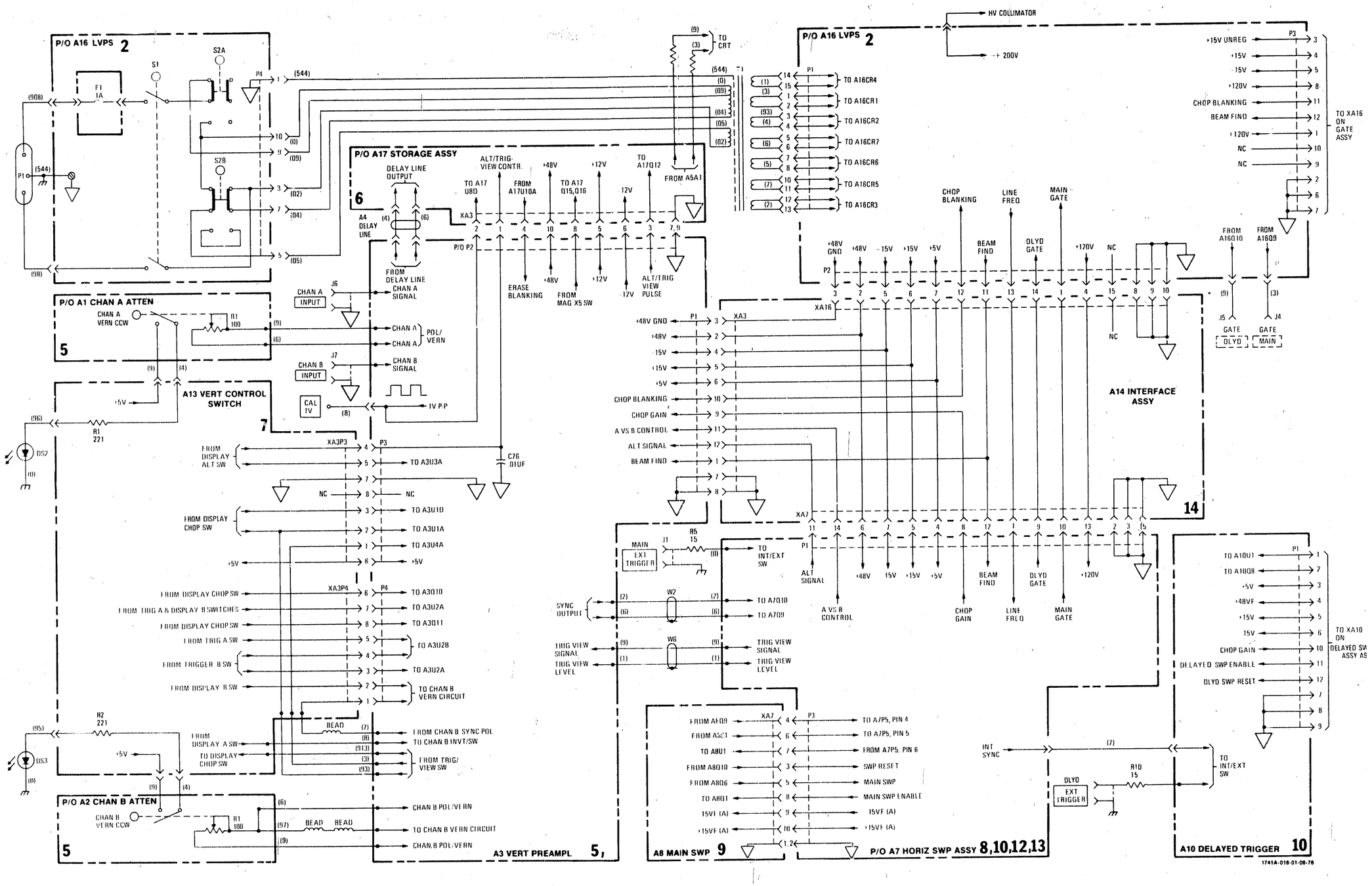


Figure 8-53. Interconnect Wiring Diagram (Sheet 1 of 3)

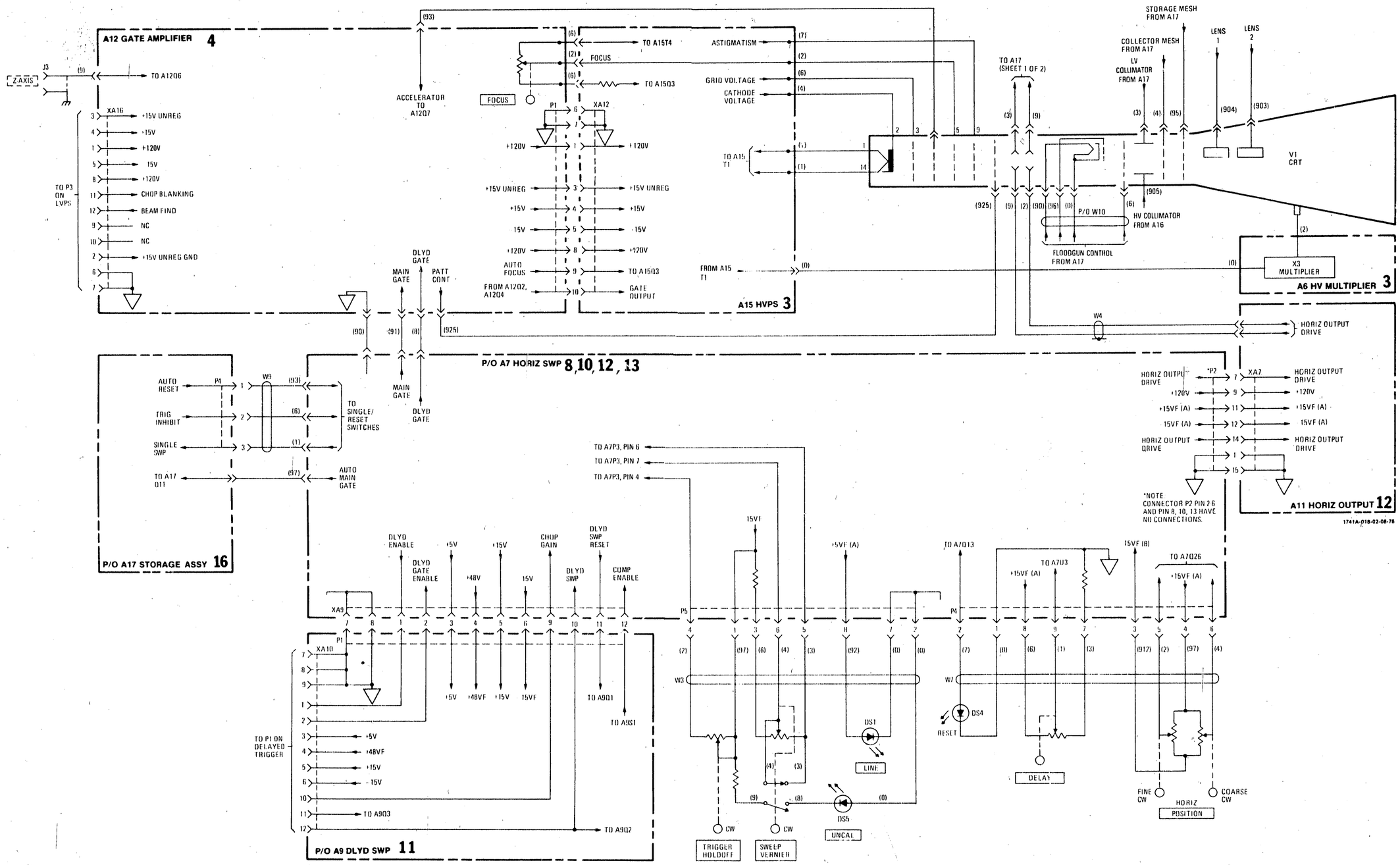


Figure 8-53.
Interconnect Wiring Diagram (Sheet 2 of 3)

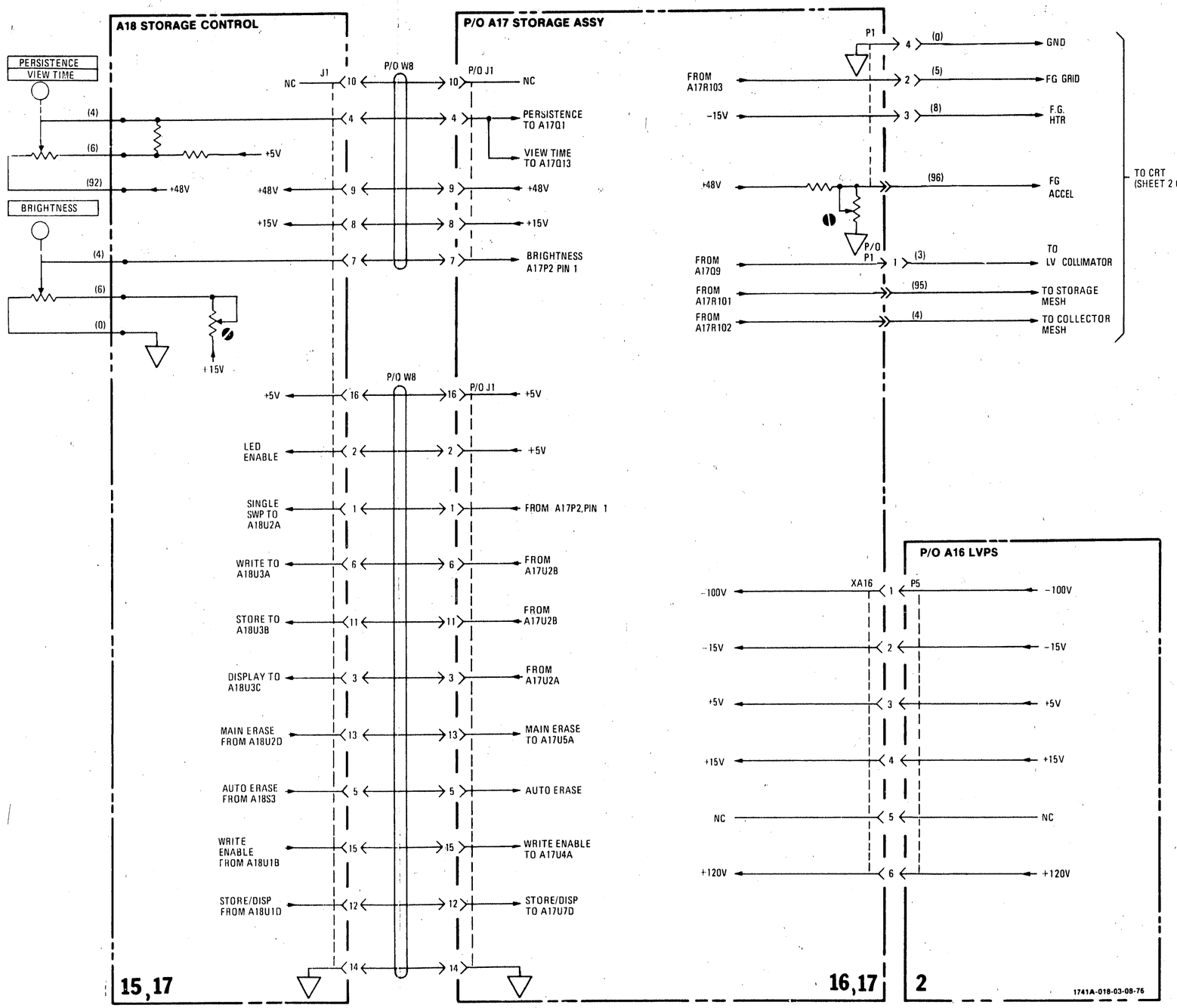


Figure 8-53. Interconnect Wiring Diagram (Sheet 3 of 3)

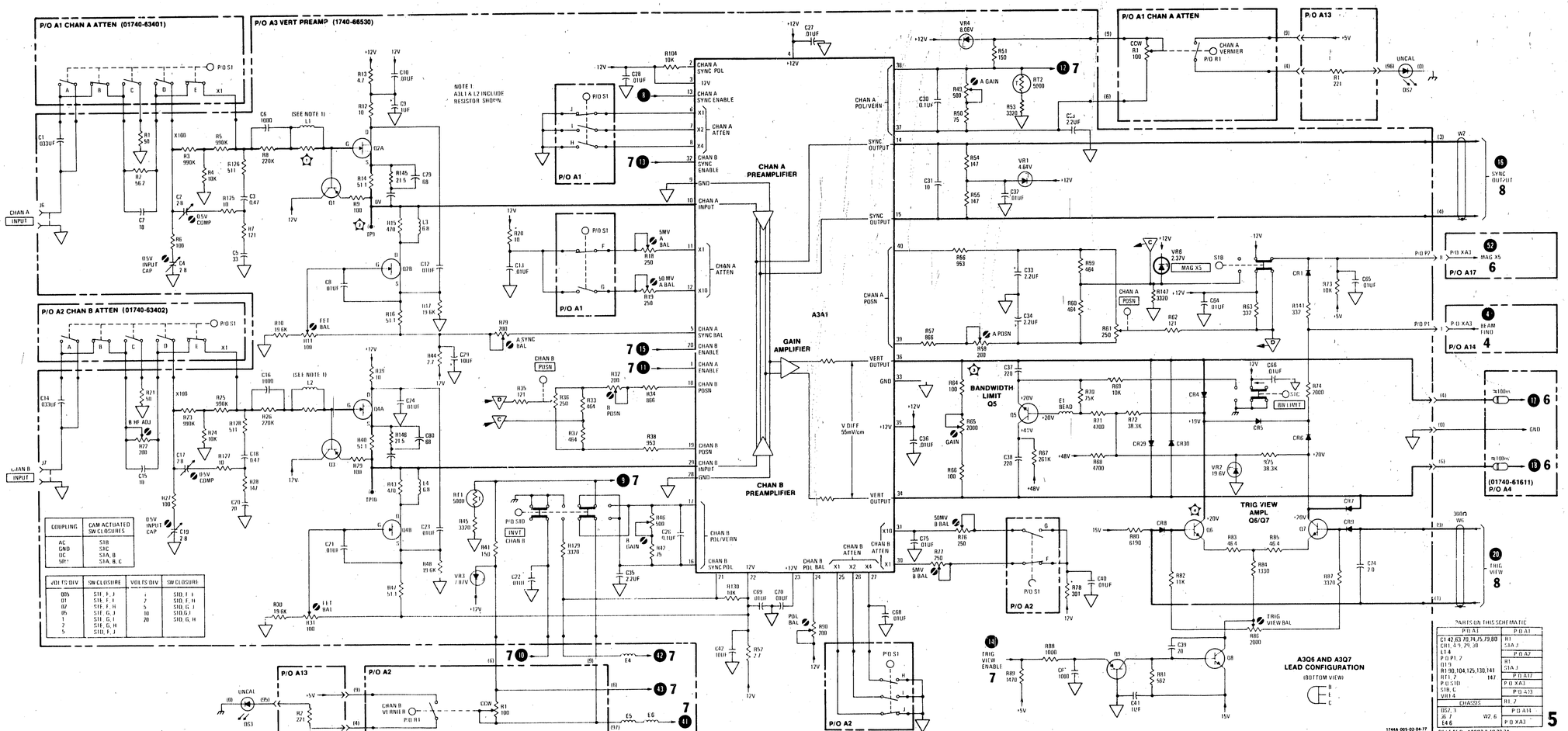


Figure 8-19.
Service Sheet 5, Vertical Preamplifier

MANUAL CHANGES

MANUAL CHANGES

MANUAL IDENTIFICATION

Model Number: 1744A
Date Printed: August 1978
Part Number: 01744-90901

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
1915A	1
1926A	1,2

Serial Prefix or Number	Make Manual Changes

▲ NEW ITEM

CHANGE 1 (S/P 1915A)

Table 6-2,
Change: A16 (LOW VOLTAGE POWER SUPPLY ASSY) HP and Mfr Part No. 01744-66509.
Change : A16 CR5 - CR7, HP Part No. 1906-0048, DIODE-MULT FULL WAVE BRIDGE RECTIFIER, Mfr Code 28480, Mfr Part No. 1906-0048.

▲ CHANGE 2 (S/P 1926A)

Section V,
Change Section V as follows:
Paragraph 5-40. Change heading to AMPLITUDE LIMIT and delete steps s. through ab. Also change **DESCRIPTION** to: The amplitude limit circuits are adjusted for optimum response.
Add new paragraphs 5-41 and 5-42 as follows:

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.

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CHANGE 2 (Cont'd)

5-41. KNEE AND SLOPE ADJUSTMENT.

REFERENCE:
Service Sheets 3 and 4.

DESCRIPTION:
The dynamic focus circuits are adjusted for optimum response.

EQUIPMENT:
Digital Multimeter ..... HP 3465A/B

PROCEDURE:

a. Set PERSISTENCE to maximum.

b. Set BRIGHTNESS as necessary to see the written trace.

c. Set sweep select to SINGLE.

d. Set horizontal sweep speed 1 μsec/div x 10.

c. Apply a 10 MHz, 6 division sine wave to channel A.

f. While depressing ERASE pushbutton, increase BEAM INTENSITY until trace is just viewable.

g. Optimize focus while depressing ERASE pushbutton.

h. Increase BEAM INTENSITY until trace just starts to defocus.

i. Measure voltage of emitter of Q8 on A12 board.

j. Turn AC power off.

k. Remove H.V. cover.

WARNING

Contact with the high-voltage power supply voltage can result in injury or death.

l. Turn AC power on.

m. Measure voltage at base of Q3 on HV board. Adjust knee control A15R32 until voltage matches that of step i.

n. Increase BEAM INTENSITY to maximum.

o. Adjust slope control A15R39 until best focus is obtained.

NOTE

Steps f through o may be repeated until focus remains optimized over the entire range of BEAM INTENSITY control.

p. After optimum focus has been achieved, be certain to turn the AC power off and replace the HV cover.

CHANGE 2 (Cont'd)

NOTE

Upon completion of this procedure, check maximum brightness writing rate as outlined in Section IV, performance checks. View the waveform using a CRT viewing hood and adjust BRIGHTNESS until waveform is just visible over entire quality viewing area of CRT (6 div. x 8 div.).

5-42. INTENSITY RATIO

REFERENCE:
Service Sheet 4.

DESCRIPTION:
To adjust the ratio between main and delayed sweep.

EQUIPMENT: None.

PROCEDURE:

a. Set main TIME/DIV on 1 μs.

b. Adjust front panel intensity until trace is viewable, but not far enough to cause current limiting.

NOTE

Current limiting can be observed on screen by noting the point past which further clockwise rotation of the front panel intensity control yields to no further increase in intensity.

c. Set DELAY dial at approx. 5.0 to place intensified portion of the trace at mid-screen.

d. Set DELAYED SWEEP to .2μs.

NOTE

Intensified portion may not be visible.

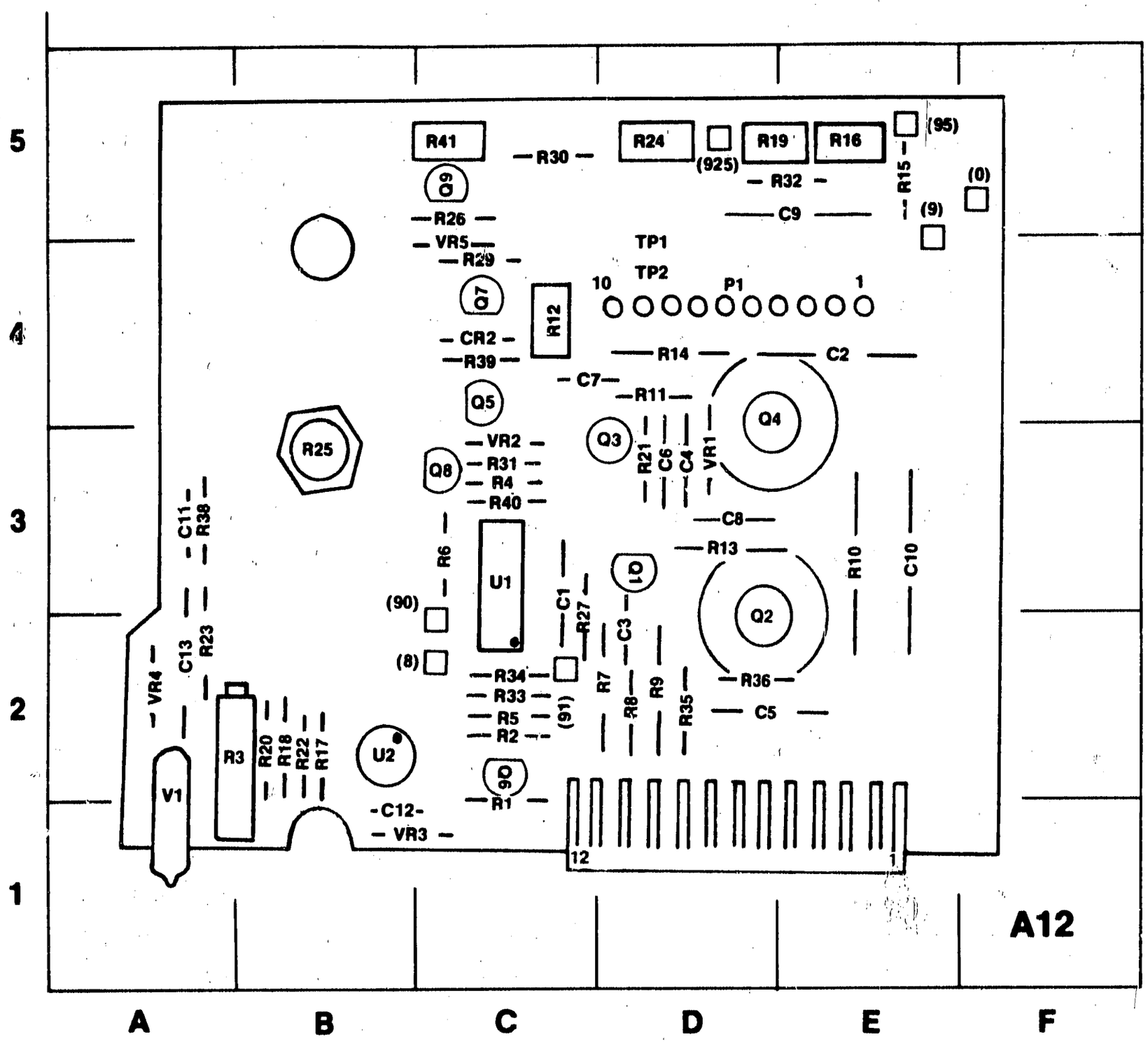
e. Adjust A12R41 (INTENSITY RATIO) until there is a noticeable difference in intensity ratio between main and delayed sweep, while not allowing the intensified portion to "bloom".

Table 6-2,
Change: A12 (BOARD: GATE ASSY) to HP and Mfr Part No. 01744-66510.
Change: A12C11, HP Part No. 0160-2903, CAPACITOR-FXD .05UF +-20% 500VDC CER, Mfr Code 56289, Mfr Part No. 1233C24A2-CDH.
Change: A12C12, HP Part No. 0160-3451, CAPACITOR-FXD .01UF +80-20% 100VDC CER, Mfr Code 51406, Mfr Part No. 00610 B305 Y5V 1032 100V.
Add: A12C13, HP Part No. 0160-0161, CAPACITOR-FXD .01UF +-10% 200VDC POLYE, Mfr Code 28480, Mfr Part No. 0160-0161.
Delete: A12CR1.
Delete: A12CR5.
Change: A12Q5, HP Part No. 1854-0215, TRANSISTOR NPN S1 PD=350 MW FT=300MHZ, Mfr Code 04713, Mfr Part No. SPS 3611.
Change: A12Q7, HP Part No. 1854-0215, TRANSISTOR NPN S1 PD=350 MW FT=300MHZ, Mfr Code 04713, Mfr Part No. SPS 3611.
Change: A12Q8, HP Part No. 1853-0086, TRANSISTOR PNP S1 PD=310 MW FT=40MHZ, Mfr Code 04713, Mfr Part No. SPS 3322.

CHANGE 2 (Cont'd)

Add: A12Q9, HP Part No. 1853-0086, TRANSISTOR PNP S1 PD=310MW FT=40MHZ, Mfr Code 04713, Mfr Part No. SPS 3322.
Delete: Q10.
Change: A12R3, HP Part No. 2100-3056, RESISTOR-TRMR 5K 10% C SIDE-ADJ 17 TRN, Mfr Code 02111, Mfr Part No. 43P502T050.
Change: A12R17, HP Part No. 0698-3449, RESISTOR 28.7K 1% .125W F TC=0+-100, Mfr Code 28480, Mfr Part No. 0698-3449.
Change: A12R18, HP Part No. 0698-6439, RESISTOR 10M 5% .125W F TC=0+-200, Mfr Code 28480, Mfr Part No. 0698-6439.
Change: A12R22, HP Part No. 0698-3450, RESISTOR 42.2K 1% .125W F TC=0+-100, Mfr Code 28480, Mfr Part No. 0698-3450.
Change: A12R23, HP Part No. 0698-6286, RESISTOR 100M 10% .25W FC TC=900+1200, Mfr Code 28480, Mfr Part No. 0698-6286.
Change: A12R25, HP Part No. 2100-3423, RESISTOR-VAR CONTROL CCP 10K 20% LIN, Mfr Code 28480, Mfr Part No. 2100-3423.
Change: A12R26, HP Part No. 0684-2231, RESISTOR 22K 2% .125W F TC=0+-100, Mfr Code 24546, Mfr Part No. C4-1/8-TO-2202-6.
Change: A12R29, HP Part No. 0684-5631, RESISTOR 56K 10% .25W FC TC=-400/+800, Mfr Code 01121, Mfr Part No. CB5631.
Change: A12R30, HP Part No. 0757-0405, RESISTOR 162 1% .125W F TC=0+-100, Mfr Code 24546, Mfr Part No. C4-1/8-TO-162R-F.
Change: A12R39, HP Part No. 0757-0931, RESISTOR 2K 2% .125W F TC=0+-100, Mfr Code 24546, Mfr Part No. C4-1/8-TO-2001-G.
Add: A12R40, HP Part No. 0757-0442, RESISTOR 10K 1% .125W F TC=0-+100, Mfr Code 24546, Mfr Part No. C4-1/8-TO-1002-F.
Add: A12R41, HP Part No. 2100-3274, RESISTOR-TRMR 10K 10% C SIDE ADJ 1-TRN, Mfr Code 02111, Mfr Part No. 63X103T623.
Add: A12U2, HP Part No. 1826-0465, IC OP AMP B1MOS TO-99, Mfr Code 3L585, Mfr Part No. CA3140T.
Add: A12V1, HP Part No. 2140-0013, LAMP-GLOW 5AB-A 70/57VDC 300UA T-2-BULB, Mfr Code 08806, Mfr Part No. 5AB-A (NE-23A).
Change: A12VR3, HP Part No. 1902-0519, DIODE-ZNR 5.1V 5% DO-7 PD=.4W TC=+.005%, Mfr Code 04713, Mfr Part No. SZ 12691.
Add: A12VR4, HP Part No. 1902-3268, DIODE-ZNR 26.1V 5% DO-7 PD=.4W TC=+.079%, Mfr Code 04713, Mfr Part No. SZ 10939-302.
Add: A12VR5, HP Part No. 1902-0243, DIODE-ZNR 30.1V 5% DO-7 PD=.4W TC=+.075%, Mfr Code 04713, Mfr Part No. SZ 10939-320.

Figure 8-14. Gate Assembly, A12, Component Identification. Replace with Figure 1 of this manual change Supplement.
Figure 8-15. Service Sheet 4, Gate Assembly
Make changes shown on Figure 2 of this manual change Supplement.



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	C-3	Q7	C-4	R18	B-2	R41	C-5
C2	E-4	Q8	C-3	R19	E-5	TP1	D-4
C3	D-2	Q9	C-5	R20	B-2	TP2	D-4
C4	D-3	R1	C-2	R21	D-3	U1	C-3
C5	D-2	R2	C-2	R22	B-2	U2	B-2
C6	D-3	R3	B-2	R24	D-5	V1	A-1
C7	C-4	R4	C-3	R25	B-3	VR1	D-3
C8	D-3	R5	C-2	R26	C-5	VR2	C-3
C9	E-5	R6	C-3	R27	C-3	VR3	B, C-1
C10	E-3	R7	D-2	R29	C-4	VR4	A-2
C11	A-3	R8	D-2	R30	C-5	VR5	C-4
C12	B-1	R9	D-2	R31	C-3		
C13	A-2	R10	E-3	R32	E-5		
CR2	C-4	R11	D-4	R33	C-2		
Q1	D-3	R12	C-4	R34	C-2		
Q2	D-2	R13	D-3	R35	D-2		
Q3	D-3	R14	D-4	R36	D-2		
Q4	D-3, 4	R15	E-5	R38	B-3		
Q5	C-4	R16	E-5	R39	C-4		
Q6	C-2	R17	B-2	R40	C-3		

Figure 1. Replacement for Gate Amplifier A12 Component Locator (S/P 1926A)

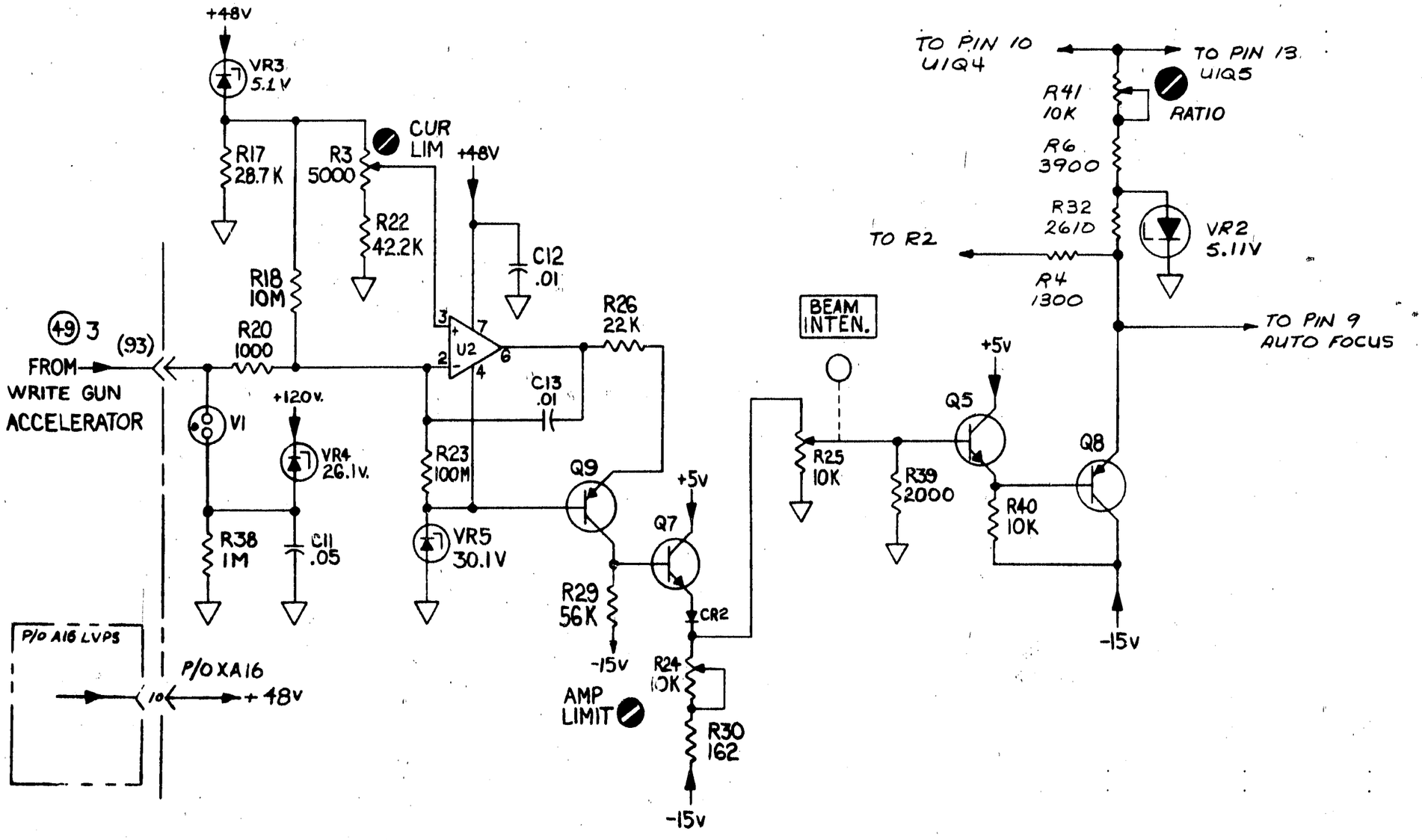


Figure 2. Changes to Schematic, Figure 8-15 (S/P 1926A)

SERVICE SHEET 6

VERTICAL OUTPUT AMPLIFIER - CIRCUIT THEORY

Vertical Output Preamplifier. The vertical output amplifier consists of a vertical output preamplifier and output amplifier substrate A17A1. Vertical output preamplifier A 7Q17/A17Q18 terminates differential delay line A4 and translates the common-mode bias level to ground for the output amplifier substrate. An X5 magnifier circuit (A17Q15/A17Q16) is incorporated in the output preamplifier stage. Normally, with MAG X5 switch A3S1B not engaged, A17Q15/A17Q16 conducts and functions as a current sink for the input signal to the output preamplifier. When MAG X5 is engaged, A3S1B turns off A17Q15/A17Q16, increasing the system gain by a factor of five. Complementary circuitry on the vertical preamplifier assembly (schematic 4) simultaneously diminishes position range by the same factor to maintain a consistent position control range.

Vertical Output Amplifier. Substrate A17A1 contains resistors, a high-frequency monolithic chip, and two discrete transistor chips. It provides drive for the CRT vertical deflection plates and has a differential voltage gain in excess of 100. High frequency adjustments A17C6, A17R19, A17R21, and A17R22 control the shape of the pulse response.

STORAGE AND VERTICAL OUTPUT AMPLIFIER ASSEMBLY A17 REMOVAL PROCEDURE

To remove assembly A17 proceed as follows:

a. Disconnect delay line wires (4), (6), and (0) from front of assembly A17 (square-pin connections).

b. Remove screw holding delay line cable clamp to A17.

c. Unsolder vertical output wires (3) and (9) from A17.

d. Disconnect three plastic connectors (two white and one brown) from back side of assembly A17.

e. Disconnect wire (97) from back side of assembly A17 (square-pin connection).

f. Disconnect 16-pin ribbon cable connector from assembly A17 to assembly A18.

g. Remove two screws securing A17A1 heat sink MP57 to storage assembly bracket MP85.

h. Remove four mounting screws from top of assembly A17.

i. Remove assembly A17.

j. To reinstall assembly A17, reverse removal procedure.

VERTICAL OUTPUT AMPLIFIER IC A17A1 REMOVAL PROCEDURE

To remove integrated circuit A17A1 from assembly A17 proceed as follows (see figure 8-20):

a. Remove two screws (H36) securing heat sink MP57 to storage assembly bracket MP61.

b. Remove four screws (H33) securing heat sink MP57 to assembly A17.

c. Remove A17A1 from heat sink MP57.

d. To reinstall A17A1, reverse removal procedure, being certain to orient A17A1 properly with assembly A17 (see figure 8-20).

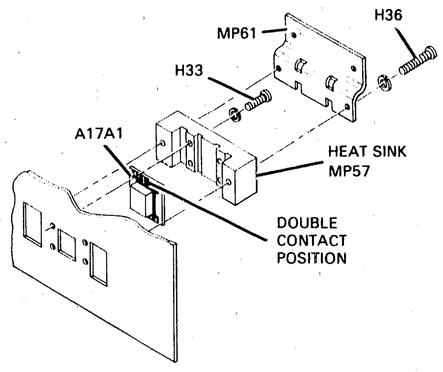


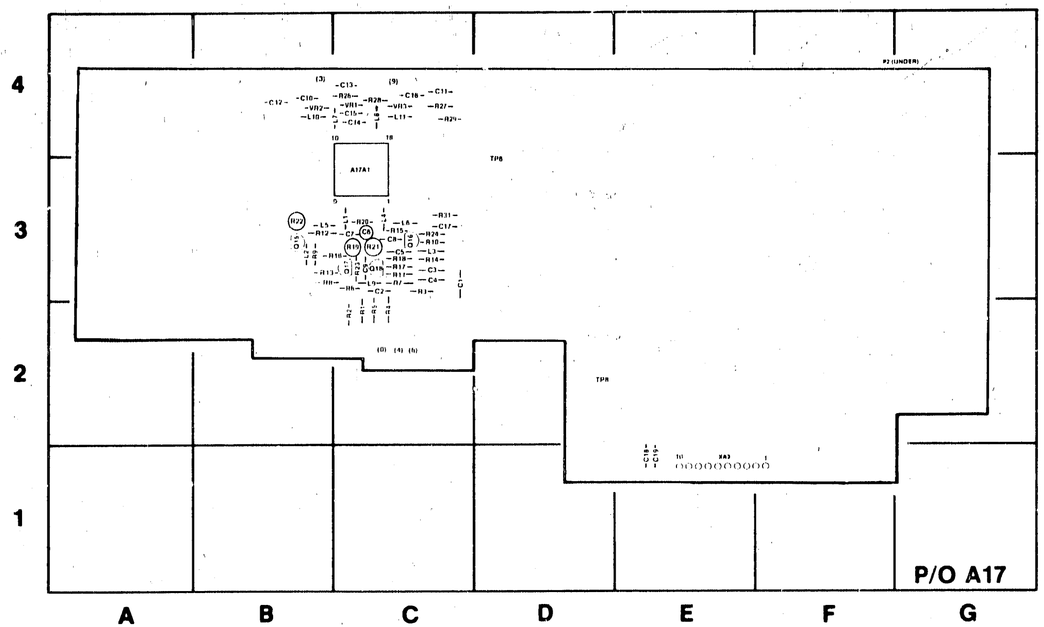
Figure 8-20. A17A1 Assembly Removal

TROUBLESHOOTING

Refer to the troubleshooting section of Service Sheet 5 when troubleshooting the vertical section of the instrument.

DC VOLTAGE MEASUREMENT CONDITIONS SERVICE SHEET 6

1. Set front-panel controls in accordance with initial control settings in Section V.
2. All voltages are referenced to chassis ground. All indications are nominal and 15% variation from those indicated should be considered normal.



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
A17A1	C-3	C18	E-1	R4	C-2	R21	C-3
C1	C-2	C19	E-1	R5	C-2	R22	C-3
C2	C-2	L1	C-3	R6	C-2	R23	C-3
C3	C-2	L2	B-3	R7	C-2	R24	C-3
C4	C-2	L3	C-3	R8	C-2	R25	B-4
C5	C-3	L4	C-3	R9	B-3	R26	C-4
C6	C-2	L5	B-3	R10	C-3	R27	C-4
C7	C-2	L6	C-3	R11	C-2	R28	C-4
C8	C-2	L7	C-4	R12	B-3	R29	C-4
C9	C-3	L8	C-4	R13	C-2	R30	C-4
C10	B-4	Q15	B-3	R14	C-3	R31	C-3
C11	C-4	Q16	C-3	R15	C-3	TP6	D-3
C12	B-4	Q17	C-3	R16	C-3	TP8	D-2
C13	C-4	Q18	C-3	R17	C-3	VR1	C-4
C14	C-4	R1	C-2	R18	C-3	VR2	B-4
C15	C-4	R2	C-2	R19	C-3	VR3	C-4
C16	C-4	R3	C-2	R20	C-3	XA3	E-1
C17	C-3						

Figure 8-21. Vertical Output Amplifier, P/O A17, Component Identification

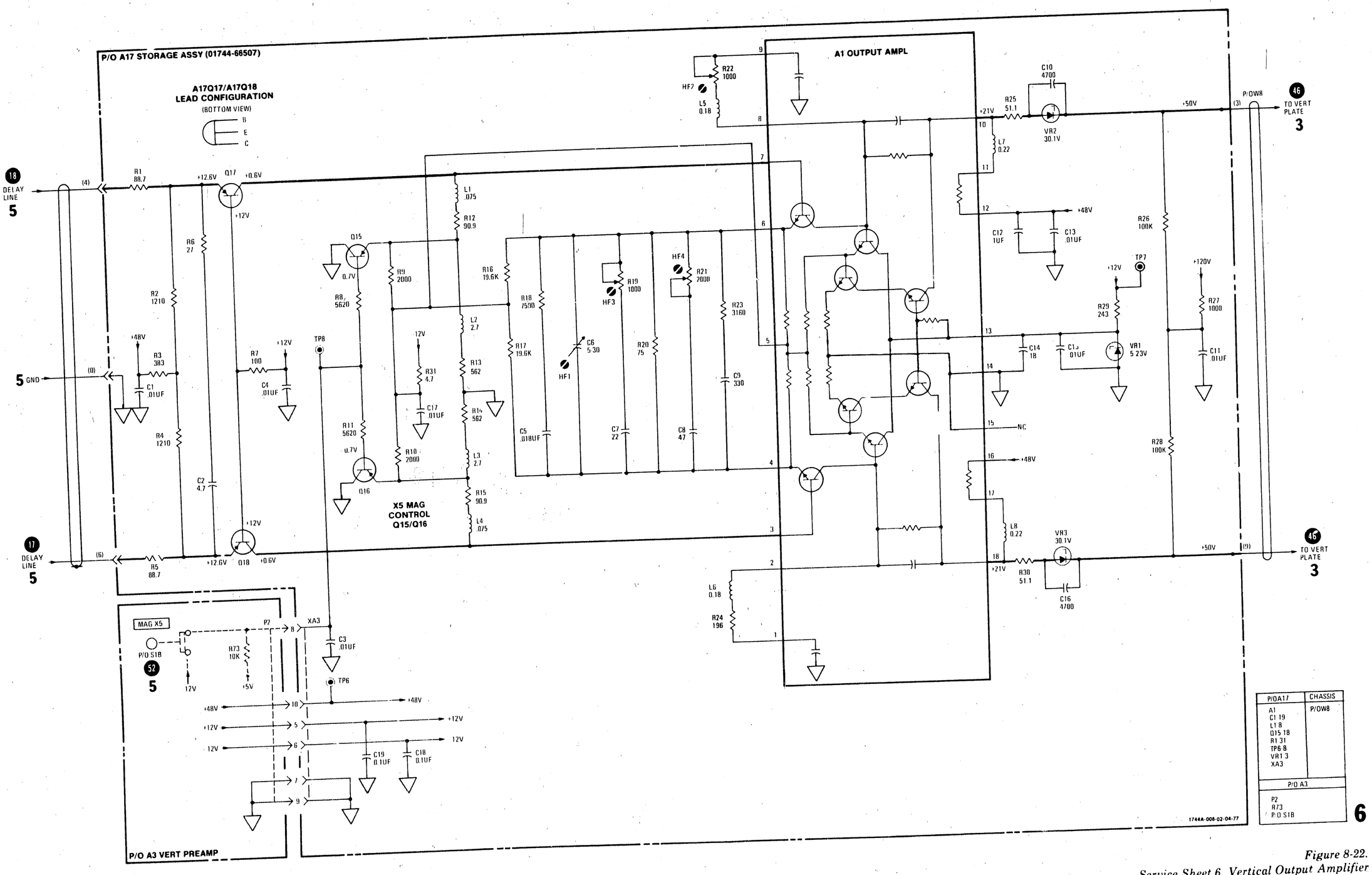


Figure 8-22.
Service Sheet 6, Vertical Output Amplifier

SERVICE SHEET 7

PREAMPLIFIER CONTROLS - CIRCUIT THEORY

General. Vertical control Switching Assembly A13 selects the trigger and display modes by controlling operation of vertical preamplifier substrate A3A1.

Channel A Display. Engaging DISPLAY A switch A13S2B grounds the preset input (pin 4) on A3U2A, forcing Q output high (pin 5). This state, along with a high Q output (pin 5) from A3U4A, forces NAND gate A3U3C (pin 8) low. A low (≤+2.7 V) at test point A3TP7 indicates channel A in on; a high (~ +4.7 V) indicates channel A is off.

Channel B Display. Engaging DISPLAY B switch A13S2C grounds the clear input (pin 1) on A3U2A, forcing $\overline{Q}$ (pin 6) high. This state, along with a high applied to its other input, forces NAND A3U3A (pin 3) low. A low at test point A13TP5 indicates channel B is on; a high indicates channel B is off.

Channel A+B Display. To algebraically display channel A and channel B, DISPLAY switches A13S2B and A13S2C are engaged simultaneously; both clear and preset inputs to A3U2A are grounded, forcing both Q and $\overline{Q}$ outputs high. These states are inverted by A3U3A and A3U3C, enabling both channel A and channel B.

Alt Mode Display. With ALT mode display selected, the ALT SIGNAL developed at the end of each horizontal sweep is applied through transistor switch A3Q10 and emitter follower A3Q12 to clock flip-flop A3U2A. As A3U2A is switched by successive sweeps, channel A and B are alternately turned on and off.

Chop Mode Display. In CHOP mode display, channe A and channel B are alternately switched on/off as in ALT mode of operation, except in CHOP mode, the clock signal applied to A3U2A comes from chop oscillator A3U1B-D through transistor switch A3Q11 and emitter follower A3Q12. The chop oscillator runs continuously at 500 kHz, causing each channel to be displayed at a 250-kHz rate.

Trig View Mode Display. If channel A or channel B display is selected, engaging TRIG VIEW switch A3S1A forces a low state on one input to NAND gates A3U3A and A3U3C, holding their outputs high, disabling both channel A and channel B. The $\overline{Q}$ output of A3U4A (pin 6) is forced high by a low input (pin 2). This state switches on transistors A3Q8 and A3Q9, enabling trigger view amplifier A3Q6/A3Q7. (See Service Sheet 5.)

If ALT or CHOP mode is selected, low states are removed from the inputs of A3U3A and A3U3C. A divide-by-three counter, formed by A3U2A, A3U4A, and A3U3C, is clocked by either the chop oscillator signal or the ALT SIGNAL. In this manner, the trigger signal, channel A, and channel B are switched on alternately.

Channel A Trigger Circuit. Engaging TRIGGER A sync switch A13S1A grounds the preset input on A3U2B (pin 10), forcing Q high (pin 9). This state is inverted by A3U3D, turning off A3Q14, and causing a low on channel A sync enable line. A low at test point A3TP8 indicates sync A is on; a high indicates sync A is off.

Channel B Trigger Circuit. Engaging TRIGGER B sync switch A13S1B applies a ground to the clear input (pin 13) on A3U2B, causing $\overline{Q}$ (pin 8) to go high. The high is inverted by A3U3B, turning off A3Q15, and causing a low on channel B sync enable line. A low at test point A3TP6 indicates sync B is on; a high indicates sync B is off.

Composite Trigger Circuit. When composite triggering is selected, channel A and channel B TRIGGER switches are engaged simultaneously. In A+B mode of display, low states are applied to both the preset and clear inputs on A3U2B causing both Q and $\overline{Q}$ outputs to go high. This forces the sync enable lines low through A3U3D/ A3Q14 and A3U3B/A3Q15. With both channel sync lines enabled, the sweep is triggered by the A+B display. If channel B is inverted, sync B is also inverted. In ALT mode of display, engaging channel A and channel B TRIGGER switches simultaneously removes the preset and clear overrides from A3U2B and allows the flip-flop to be clocked by the ALT SIGNAL generated in the horizontal section. This triggers channel A from the channel B signal. If trigger view is also selected, triggering will change to channel A only. This is accomplished by grounding one input on A3U1A (pin 1). In CHOP mode of display, engaging channel A and channel B TRIGGER switches selects sync A only as the internal trigger source. Again, pin 1 on A3U1A is grounded.

REMOVAL PROCEDURE

Refer to Service Sheet 5 for removal procedures for assemblies A3 and A13.

TROUBLESHOOTING

This service sheet contains waveforms and conditions for measuring these waveforms. Use the dc voltages listed on the schematic for active components as a guide in isolating problem area.

DC VOLTAGE MEASUREMENT CONDITIONS
SERVICE SHEET 7

1. Set front-panel controls in accordance with initial control settings in Section V.
2. All voltages are referenced to chassis ground. All indications are nominal and 15% variation from those indicated should be considered normal.

WAVEFORM MEASUREMENT CONDITIONS
SERVICE SHEET 7

1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

Coupling (channel A)	50Ω
TRIGGER LEVEL (main)	stable display
DISPLAY	ALT
TRIG VIEW	engaged

2. Set monitor oscilloscope TIME/DIV and VOLTS/DIV controls as indicated under waveform(s).
3. Connect pulse generator 50-ohm output to Model 1744A channel A INPUT connector.
4. Adjust pulse generator output for 6 divisions of signal amplitude (.6 V) at 5 kHz.

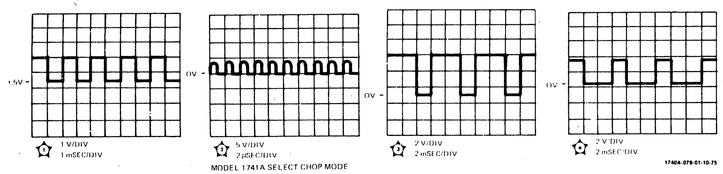


Figure 8-23. Waveforms for Service Sheet 7

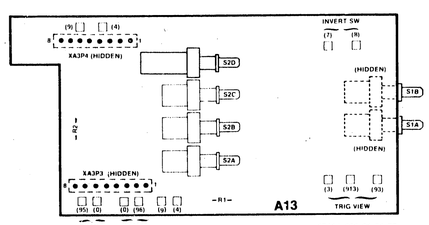
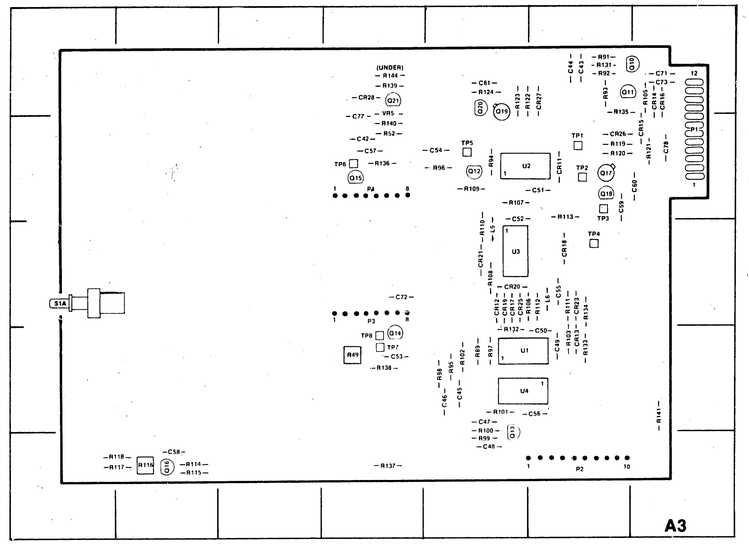


Figure 8-24. Vertical Control, A13, Component Identification



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C43	F-5	C77	D-4	P2	F-1	R108	E-3	R136	D-4
C44	F-5	C78	G-4	P3	D-2	R109	E-4	R137	D-1
C45	E-2	CR11	F-4	P4	D-4	R110	E-3	R138	D-2
C46	E-2	CR12	E-3	R91	F-5	R111	F-3	R139	D-5
C47	E-1	CR13	F-2	R92	F-5	R113	F-3	R140	D-4
C48	E-1	CR14	G-5	R93	F-5	R114	B-1	R141	G-2
C49	F-2	CR15	G-4	R94	E-4	R115	B-1	R144	D-5
C50	F-2	CR16	G-5	R95	E-2	R116	B-1	S1A	A-3
C51	F-4	CR17	E-3	R96	E-4	R117	A-1	TP1	F-4
C52	E-3	CR18	F-3	R97	E-2	R118	A-1	TP2	F-4
C53	D-2	CR19	E-3	R98	E-2	R119	F-4	TP3	F-4
C54	E-4	CR20	E-3	R99	E-1	R120	F-4	TP4	F-3
C55	F-3	CR21	E-3	R100	E-1	R122	F-5	TP5	E-4
C56	F-2	CR22	F-3	R101	E-2	R123	E-5	TP6	D-4
C57	B-1	CR25	E-3	R102	E-2	R124	E-5	TP7	D-2
C58	F-4	CR26	F-4	R103	F-2	R131	F-5	TP8	D-2
C59	F-4	CR27	F-5	R104	C-2	R132	E-2	U1	E-2
C60	G-4	CR28	D-5	R105	G-5	R133	F-2	U2	F-4
C61	E-5	L5	E-3	R106	F-3	R134	F-3	U3	E-3
C71	G-5	L6	F-3	R107	E-4	R135	F-5	U4	E-2
C72	D-3	P1	G-4						
C73	G-5								

Figure 8-25. A3 Assembly, Component Identification

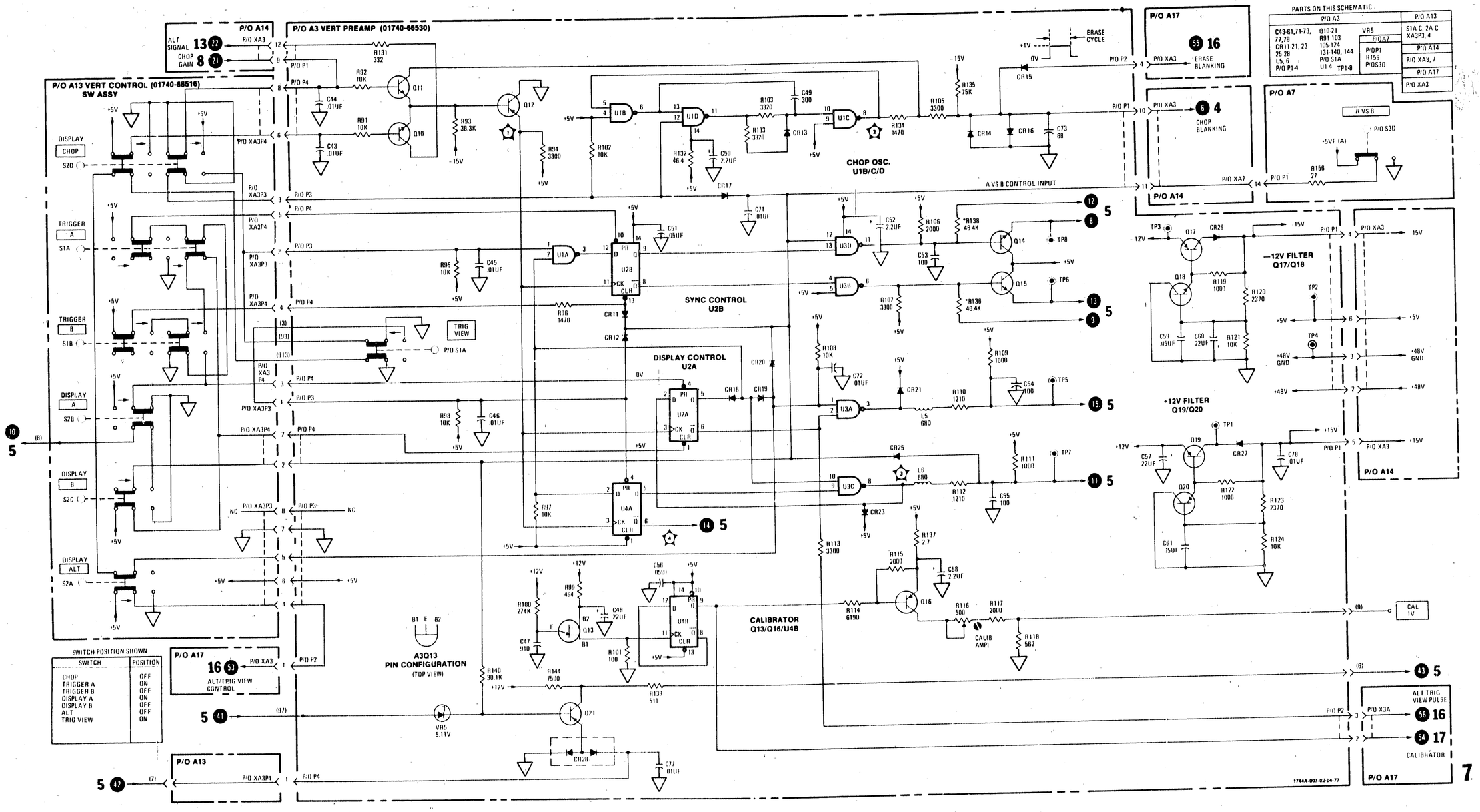


Figure 8-26.
Service Sheet 7, Vertical Control Circuitry

SERVICE SHEET 8

MAIN TRIGGER - CIRCUIT THEORY

Sync Amplifier. The internal sync signal from assembly A3 is applied to the bases of A7Q9 and A7Q10 through cable W2. Shunt-feedback stage A7Q11 drives emitter followers A7Q7, A7Q8, and A7Q12. The output of A7Q12 is used in A VS B display mode (see Service Sheet 12). A7Q7 provides sync drive for the main sweep and A7Q8 provides sync drive for the delayed sweep (Service Sheet 10). The instrument can be triggered externally by a sync signal applied to main EXT TRIGGER connector J1 and engaging INT/EXT switch A7S2E. The external sync signal can be attenuated by a factor of 10 by engaging ÷1/÷10 switch A7S2F.

The sync signal (external or internal) is applied to a high-frequency circuit and to a low-frequency circuit. The high-frequency path, through A7Q4 and Q7Q5, passes frequencies below 4 kHz. The high- and low-frequency cutoffs are established by A7R5 and A7C6. Engaging LF REJ switch A7S2B removes the sync signal from the input to A7U1 and only the high-frequency path is enabled. Engaging HF REJ switch A7S2C applies reverse bias to A7Q4 disabling the high-frequency path. When both switches are engaged, a line frequency signal from the low-voltage power supply is applied to A7U1. Outputs from the high- and low-frequency amplifiers are summed at the base of emitter follower A7Q1. The signal developed through A7Q1 is applied to A7U2 (pin 14).

Triggering. Integrated circuit A7U2 contains a differential amplifier and three dual-input Schmitt triggers. The first Schmitt trigger senses the end of sweep and disables the other two Schmitt triggers until the end of the holdoff period. At the end of holdoff, the holdoff comparator generates a reset signal that is applied to the first Schmitt trigger, which then arms the second Schmitt trigger. The second Schmitt trigger conducts when the input sync signal crosses the trigger level threshold established by TRIGGER LEVEL control A7R21. This arms the third Schmitt trigger which conducts when the sync signal recrosses the trigger level threshold.

Auto/Norm. The output of A7U2 (pin 1) is applied to a transistor current switch consisting of A7Q19/A7Q20/A7Q21. With AUTO/NORM switch A7S1A in NORM position, the base of A7Q21 is held to +5 volts, disabling it. The bases of A7Q19 and A7jQ20 are differentially driven from A7U2. When the collector of A7Q19 goes low, the main sweep starts. The complementary signal at the collector of A7Q20 enables the gate Schmitt (Service Sheet 13) and turns the gate on. Current switch A7Q13/A7Q14 drives the RESET light and the bright-line auto circuit.

The bright-line auto circuit consists of A17Q15-A17Q18. With the AUTO/NORM switch in NORM position, emitter bias is removed from A17Q15-A17Q17, disabling the bright-line auto circuit. In AUTO position, a trigger signal of greater than 45 Hz will override the bright-line auto circuit function. With a trigger signal greater than 45 Hz, capacitor A7C13 will remain discharged, allowing A7Q16 to conduct. With A7Q16 conducting, A7Q17 is cut off. If no trigger signal (or a trigger signal of less than 45 Hz) is present, A7C13 has sufficient time to charge, turning off A7Q16 and enabling A7Q17. When A7Q17 conducts, A7Q21 turns on and the main sweep starts. When the sweep reaches +11 volts, the reset Schmitt trigger on A7U2 conducts, causing the output at pin 6 of A7U2 to go low, turning on A7Q14, and in turn, A7Q15. With A7Q15 conducting, A7Q17 is cut off, and the sweep resets. At the end of the holdoff period, the output at A7U2 pin 6 goes high, turning off A7Q14 and A7Q15. A7Q17 conducts and a new sweep is initiated. (See timing charts in this Service Sheet.)

Single Mode. For single sweep operation, SINGLE switch A7S1C is engaged. The SINGLE mode of operation overrides the AUTO mode by applying reverse bias to the emitter circuit of A7Q15-A7Q17. It also applies a bias signal (+4.7 V) to pin 5 of A7U2, preventing the input Schmitt of A7U2 from resetting at the end of the holdoff period. This prevents development of a new trigger signal. The input Schmitt does not reset until RESET switch A7S1B is pressed. Engaging A7S1B causes the input at pin 5 of A7U2 to go low momentarily (due to the charging time constant established by A7R72/A7C14), allowing the input Schmitt to reset.

Trigger View Signal. The internal or external sync signal developed in emitter follower A7Q1 is applied to the base of A7Q2 where the trigger view signal is developed. Transistor A7Q3 is used to translate the position of the TRIGGER LEVEL control for the trigger view signal.

REMOVAL PROCEDURE

To remove horizontal sweep assembly A7, proceed as follows:

a. Remove assemblies A8, A9, and A10 as outlined in Service Sheets 9, 10, and 11.

b. Remove assembly A11 as outlined in Service Sheet 12.

c. Unsolder resistor from main EXT TRIGGER BNC connector J1.

d. Disconnect two white-plastic cable connectors from assembly A7.

e. Disconnect twin leads (3,4) and (1,9) from assembly A7 (square-pin connections).

f. Disconnect wires (1), (6), (93) and (97) from back of assembly A7 (square-pin connections).

g. Disconnect wires (7), (8), (90), and (91) from component side of assembly A7.

h. Remove main TRIGGER LEVEL knob and nut from potentiometer.

i. Remove assembly A14.

j. Remove four screws holding assembly A7 to sheet metal (see figure 8-27).

k. Remove assembly A7 by pulling it toward rear and tilting away from sheet metal deck. Save lockwasher on trigger level potentiometer for reinstallation.

l. To reinstall assembly A7, reverse removal procedure except install four screws (step j) without tightening them until nut on TRIGGER LEVEL potentiometer (step h) is tightened. Lockwasher must be in place on TRIGGER LEVEL potentiometer before inserting in panel.

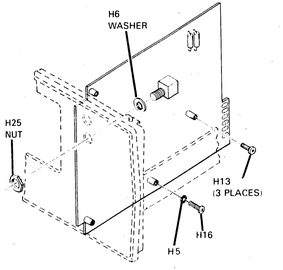


Figure 8-27. Location of A7 Attaching Screws

TROUBLESHOOTING

Troubleshooting the time base can be difficult since it is a closed loop circuit and waveforms may be nonexistent in any part of the loop. Where waveforms have been noted, they have been placed adjacent to the particular service sheet schematic to which they are associated. In addition, accomplish adjustment procedures outlined in Section V of this manual for the horizontal section of the instrument. Failure to accomplish certain adjustments may indicate the faulty circuit.

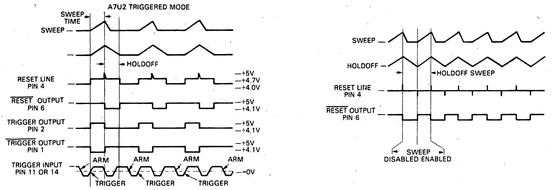


Figure 8-28. A7U2 Timing Chart

DC VOLTAGE MEASUREMENT CONDITIONS SERVICE SHEET 8

1. Set front-panel controls in accordance with initial control settings in Section V.
2. All voltages are referenced to chassis ground. All indications are nominal and 15% variation from those indicated should be considered normal.

WAVEFORM MEASUREMENT CONDITIONS SERVICE SHEET 8

1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

   Coupling (channel A) 50Ω
   TRIGGER LEVEL (main) ..... stable display
2. Set monitor oscilloscope TIME/DIV and VOLTS/DIV controls as indicated under waveform(s).
3. Connect pulse generator 50-ohm output to Model 1744A channel A INPUT connector.
4. Adjust pulse generator output for 6 divisions of signal amplitude (.6 V) at 5 kHz.

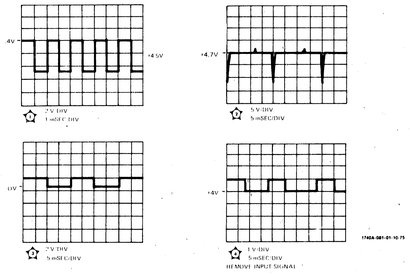
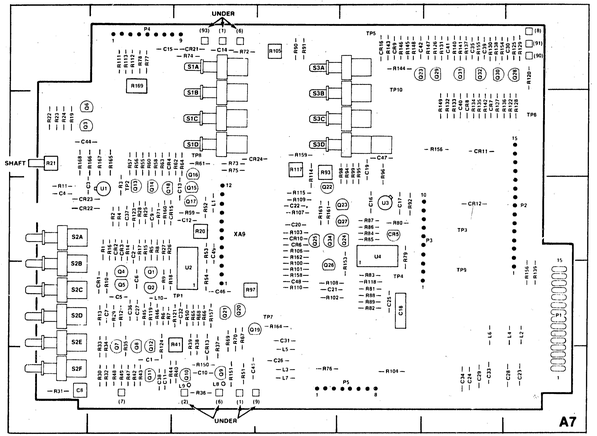


Figure 8-29. Waveforms for Service Sheet 8



REF DES/G	GRID LOC	REF DES/G	GRID LOC	REF DES/G	GRID LOC	REF DES/G	GRID LOC	REF DES/G	GRID LOC	REF DES/G	GRID LOC	REF DES/G	GRID LOC	REF DES/G	GRID LOC
C1	B-5	C29	F-5	CR9	F-1	Q4	B-4	Q32	F-1	R26	B-3	R54	C-4	R82	E-4	R111	B-1	R141	F-1	S1A	C-1
C2	B-3	C30	F-1	CR10	D-3	Q5	B-4	Q33	E-1	R27	B-3	R55	B-2	R83	E-4	R112	B-1	R142	F-2	S1B	C-2
C3	A-3	C31	D-4	CR11	F-2	Q6	A-2	Q34	D-3	R28	B-3	R56	B-2	R84	E-3	R113	D-2	R143	E-1	S1C	C-2
C4	A-3	C32	C-4	CR12	F-3	Q7	B-5	R1	B-3	R29	B-4	R57	B-2	R85	E-3	R114	D-2	R144	E-1	S1D	C-2
C5	B-4	C33	F-5	CR13	C-4	Q8	B-5	R2	B-3	R30	B-5	R58	B-2	R86	E-3	R115	D-3	R145	E-1	S2A	A-3
C6	B-4	C34	F-5	CR15	B-3	Q9	C-5	R3	B-3	R31	A-5	R59	C-3	R87	E-3	R117	D-2	R146	E-1	S2B	A-4
C7	B-4	C35	F-1	CR16	E-1	Q10	C-5	R4	B-3	R32	B-5	R60	B-2	R88	E-4	R118	D-4	R147	E-1	S2C	A-4
C8	A-5	C36	B-4	CR21	C-1	Q11	B-5	R5	B-3	R33	B-5	R61	C-2	R89	E-4	R119	B-4	R148	E-1	S2D	A-4
C9	B-3	C37	B-3	CR22	A-3	Q12	B-5	R6	B-4	R34	B-5	R62	B-2	R90	D-1	R120	G-1	R149	F-2	S2E	A-4
C10	C-5	C38	B-5	CR23	A-3	Q13	B-3	R7	B-4	R35	B-5	R63	B-2	R91	D-1	R121	C-4	R150	C-5	S2F	A-5
C11	B-5	C39	F-1	CR24	C-2	Q14	B-3	R8	B-3	R36	C-5	R64	C-2	R92	F-3	R122	F-2	R151	C-5	S3A	D-1
C12	C-3	C40	F-2	L1	C-3	Q15	B-3	R9	B-4	R37	C-4	R65	C-4	R93	D-2	R123	B-3	R152	F-2	S3B	D-2
C13	C-3	C41	F-1	L2	G-4	Q16	C-2	R10	B-4	R38	C-4	R66	C-4	R94	E-2	R124	B-4	R153	E-4	S3C	D-2
C14	C-1	C42	E-1	L3	D-5	Q17	C-3	R11	A-3	R39	C-4	R67	C-4	R95	E-2	R125	G-1	R154	F-1	S3D	D-2
C15	B-1	C44	A-2	L4	G-4	Q18	B-3	R12	B-4	R40	C-5	R68	C-4	R96	E-2	R126	F-1	R155	F-1	TP1	C-4
C16	E-3	C45	C-5	L5	D-5	Q19	C-4	R13	B-4	R41	C-4	R69	C-4	R97	C-4	R127	F-2	R156	G-4	TP2	B-3
C17	E-3	C46	C-4	L6	F-4	Q20	C-4	R14	B-3	R42	B-5	R70	C-4	R98	D-2	R128	F-2	R157	C-4	TP3	F-3
C18	E-4	C47	E-2	L7	D-5	Q21	C-4	R15	B-3	R43	B-5	R71	B-3	R99	E-2	R129	G-1	R158	D-4	TP4	E-4
C19	E-4	C48	D-4	L8	C-5	Q22	D-3	R16	B-3	R44	B-5	R72	C-1	R100	D-4	R130	F-1	R159	D-2	TP5	E-1
C20	D-3	C49	C-3	L9	C-5	Q23	E-3	R17	B-3	R45	B-4	R73	C-2	R01	D-4	R131	F-1	R160	B-3	TP6	G-2
C21	D-4	C51	B-4	L10	B-4	Q24	E-3	R18	B-3	R46	B-4	R74	C-1	R102	D-4	R132	F-2	R161	D-3	TP7	D-4
C22	D-3	C52	B-3	P2	G-3	Q25	D-3	R19	A-2	R47	B-5	R75	C-2	R103	D-3	R133	F-2	R162	D-3	TP8	C-2
C23	G-3	C53	B-3	P3	F-3	Q26	D-4	R20	C-2	R48	B-5	R76	D-5	R104	E-5	R134	F-2	R163	D-3	TP9	F-4
C24	F-5	C54	B-2	P4	B-1	Q27	E-3	R21	A-2	R49	B-5	R77	B-1	R105	D-1	R135	F-2	R164	D-4	TP10	E-1
C25	E-4	C55	E-3	P5	E-5	Q28	G-1	R22	A-2	R50	C-4	R78	B-1	R106	D-3	R136	F-2	R165	B-2	U1	B-3
C26	D-5	C56	D-3	Q1	B-4	Q29	F-1	R23	A-2	R51	C-5	R79	E-3	R107	D-3	R137	F-1	R166	A-2	U2	C-4
C27	B-4	C57	F-2	Q2	B-4	Q30	F-1	R24	A-2	R52	C-3	R80	E-3	R108	D-5	R138	F-1	R167	B-2	U3	E-3
C28	G-5	CR8	F-2	Q3	A-2	Q31	F-1	R25	B-3	R53	C-3	R81	E-4	R109	D-3	R139	G-4	R168	A-2	U4	E-3
														R110	D-4			R140	F-1	R169	B-1	XA9	C-3

Figure 8-30. Main Trigger, A7, Component Identification

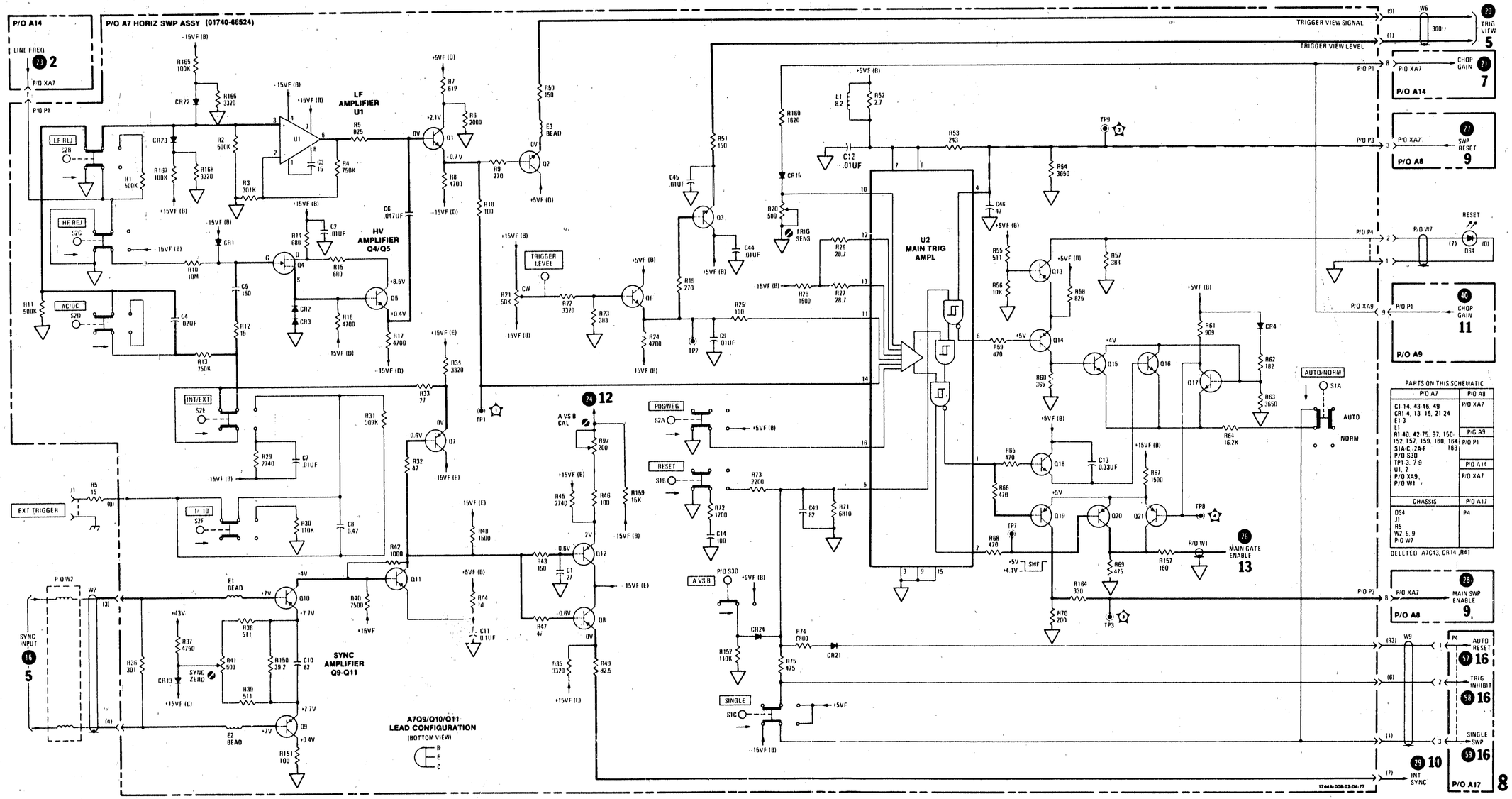


Figure 8-31.
Service Sheet 8, Main Trigger Circuitry