Errata

Title & Document Type: **1746A Oscilloscope Operating and Service Manual**

Manual Part Number: **01746-90901**

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HP References in this Manual

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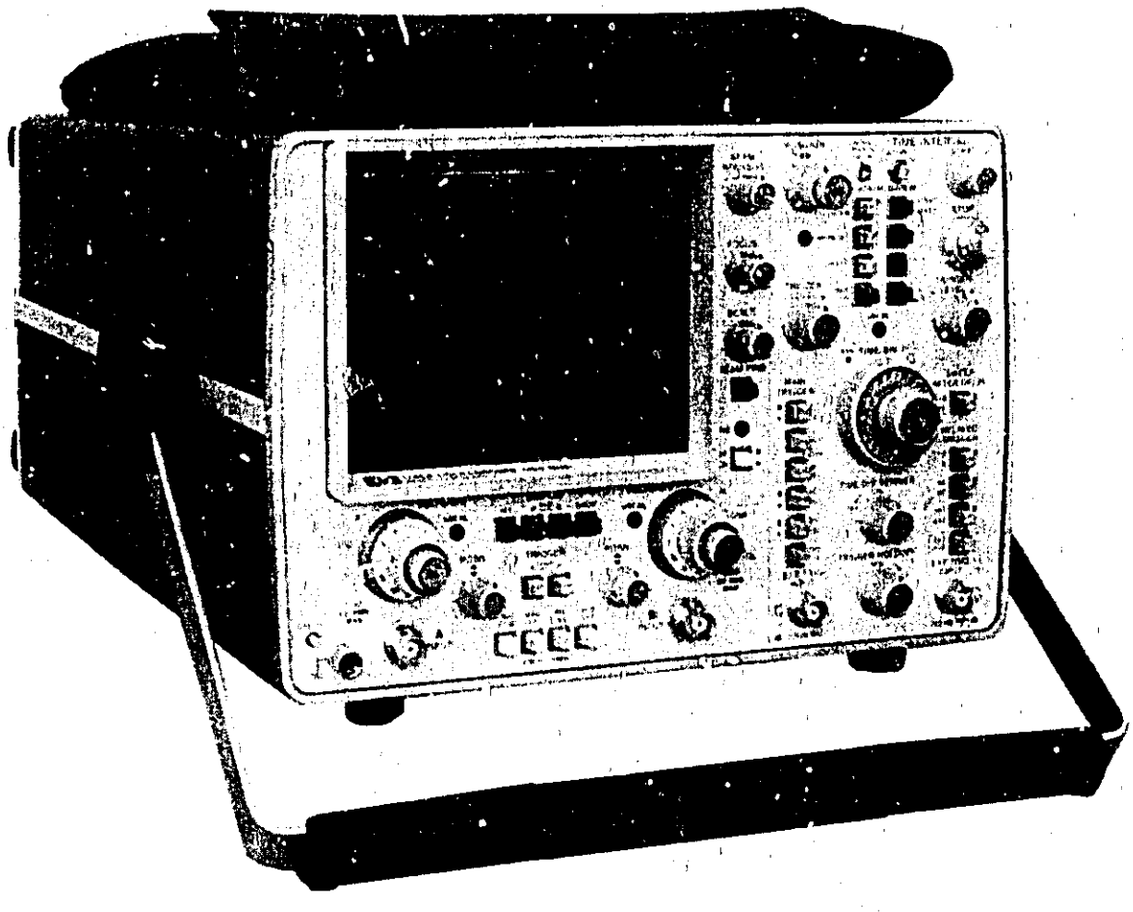
Agilent Technologies

HP 1746A

OPERATING AND SERVICE MANUAL

1746A OSCILLOSCOPE



HEWLETT PACKARD

HP 1746A

SAFETY

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

CERTIFICATION

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

WARRANTY

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

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

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

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

LIMITATION OF WARRANTY

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

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

EXCLUSIVE REMEDIES

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

ASSISTANCE

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

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

OPERATING AND SERVICE MANUAL

MODEL 1746A
OSCILLOSCOPE

SERIAL NUMBERS

This Manual applies directly to instruments with serial numbers prefixed **2228A.**

For additional information about serial numbers, refer to INSTRUMENTS COVERED BY MANUAL, in Section I.

Operating and Service Manual Part No. 01746-90901
Operating and Service Manual Microfiche Part No. 01746-90801

PRINTED SEPTEMBER 1982

SAFETY CONSIDERATIONS

GENERAL — This is a Safety Class I instrument (provided with terminal for protective earthing).

OPERATION — BEFORE APPLYING POWER verify that the power transformer primary is matched to the available line voltage, the correct fuse is installed, and Safety Precautions are taken (see the following warnings). In addition, note the instrument's external markings which are described under "Safety Symbols."

WARNING

Servicing instructions are for use by service-trained personnel. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

BEFORE SWITCHING ON THE INSTRUMENT, the protective earth terminal of the instrument must be connected to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two conductor outlet is not sufficient protection.

If this instrument is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to the earth terminal of the power source.

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short circuited fuseholders. To do so could cause a shock or fire hazard.

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.

Do not install substitute parts or perform any unauthorized modification to the instrument.

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

SAFETY SYMBOLS

Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the product.

Indicates hazardous voltages.

Earth terminal (sometimes used in manual to indicate circuit common connected to grounded chassis).

WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood or met.

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SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. The HP Model 1746A is a dual-channel, 100-MHz, delayed sweep oscilloscope designed for general-purpose bench or field use. The 1746A Operating and Service Manual has eight major sections. The manual contains the following information:

Section I. General Information: describes the instruments documented by this manual. It also provides a basic description of the oscilloscope which includes accessories and specifications.

Section II. Installation: provides information about initial inspection, preparation for use, and storage and shipment.

Section III. Operation: provides detailed operating information for the instrument, including operator's checks and maintenance.

Section IV. Performance Tests: presents the procedures required to check the performance of the instrument against the critical specifications in table 1-1.

Section V. Adjustments: provides instructions for properly adjusting the instrument.

Section VI. Replaceable Parts: provides ordering information for all replaceable parts and assemblies.

Section VII. Manual Changes: contains manual change information necessary to document all serial prefixes listed on the title page of this manual. In addition, this section also contains recommended modifications for earlier instrument configurations.

Section VIII. Service: provides the information required to repair the instrument.

1-3. One copy of the 1746A Operating and Service Manual is supplied with each instrument. Additional copies may be ordered separately through your nearest Hewlett-Packard Sales office. The part number for the complete Operating and Service Manual is listed on the title page of this manual.

1-4. Also listed on the title page is the part number for a microfiche version of the complete Operating and Service Manual. The microfiches are 100×150 mm (4×6 in.) microfilm transparencies of the manual. Each microfiche contains up to 96 photo duplicates of manual pages. The microfiche package also includes the latest Manual Change supplement.

1-5. SPECIFICATIONS.

1-6. Specifications and supplemental characteristics of the 1746A Oscilloscope are listed in table 1-1. This instrument will meet the electrical characteristics listed following complete calibration as given in the Adjustments section of the manual. These electrical characteristics apply over the ambient temperature range of 0 to 55°C except as otherwise noted.

1-7. SAFETY CONSIDERATIONS.

WARNING

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

1-8. The 1746A and related documentation must be reviewed for familiarization with safety markings and instructions before operation. Refer to the Safety Considerations page found at the beginning of this manual for a summary of general safety information. Safety precautions for installation, operation, and servicing are found in appropriate locations throughout the Operating and Service Manual. These precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in the manual violates safety standards of design, manufacture, and intended use of this instrument. Hewlett-Packard assumes no liability for failure to comply with these requirements.

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 number prefix and the last five digits are the suffix. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The letter in the prefix designates the country in which the instrument was manufactured. (A=USA; G=Germany; J=Japan; S=Singapore.) The suffix, however, is assigned sequentially and is unique to 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. Manuals accompanying these newer instruments include a Manual Changes supplement. The supplement contains change instructions for the entire Operating and Service Manual.

1-12. In addition to change information, the supplements may contain information for correcting errors in the manuals. To keep your manuals as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. These supplements are identified with the print date and part number that appears on the title page of this manual. Complimentary copies of these supplements 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 Change supplement, contact your nearest Hewlett-Packard Sales and Service office.

1-14. DESCRIPTION.

1-15. The Model 1746A is a dual-channel, 100-MHz, delayed-sweep oscilloscope. 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 40 MHz is provided on both channels by means of a 5× vertical magnification. Selectable input impedance of either 50 ohms or 1 megohm permits impedance selection that best meets measurement applications.

1-16. The 1746A provides the two marker time-interval measurement feature in addition to the traditional delayed sweep mode. When using the two marker ΔTIME mode of operation, the time interval is scaled and the output (as a voltage) is applied to rear-panel connectors for readout on an external 3-1/2-digit voltmeter. With Option 034/035, the time-interval voltage is internally connected and displayed by a DMM that is built into the top cover of the oscilloscope.

1-17. 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 10× magnifier expands all sweeps by a factor of 10 and extends the fastest sweep speed to 5 ns/div. In alternate or chop modes, a trigger-view control will display three signals: channel A, channel B, and the trigger signal. When using trigger view in the alternate mode along with the ΔTIME sweep mode, the time interval start marker appears on the trigger waveform and the stop marker appears on the channel A and channel B waveforms. This allows correlation of time between the trigger signal and the channel A and channel B signals. In trigger-view operation, center screen represents the trigger threshold point and allows the operator to see the triggering level location. With the A vs B control, an X-Y mode of operation is possible; channel A input (Y-axis) is plotted versus channel B input (X-axis). The CRT screen has 10 by 10 major divisions on an internal graticule.

1-18. OPTIONS.

1-19. Standard options are modifications installed on HP instruments at the factory and are available on request. The following options extend the usefulness of the 1746A:

OPTION 001: Supplies a fixed ac power cord in place of the normal detachable power cord.

OPTION 005: Adds the necessary controls and circuitry to enable the oscilloscope to be triggered internally from a television composite video signal applied to channel A or B. The main time base triggers on a field reference pulse, and the delayed time base triggers on a line reference pulse for displaying selected TV lines.

OPTION 034/035: Adds 3-1/2 digit, five-function, autoranging digital multimeter installed on top of the oscilloscope. The multimeter can also be used for time interval measurements. The option 034 is calibrated for 60-Hz line operation and the option 035 is calibrated for 50-Hz line operation. This option is covered by a separate Operating and Service manual. Installation information may be obtained from the nearest Hewlett-Packard Field Service Office.

OPTION 090: This option omits the two Model 10041A divider probes normally supplied as accessories.

OPTION 091: Replaces two Model 10041A (2 metre) 10:1 divider probes with two Model 10042A (3 metre) 10:1 divider probes.

OPTION 092: Replaces two Model 10041A (2 metre) 10:1 divider probes with two Model 10040A (1 metre) 10:1 divider probes.

OPTION 096: Replaces two Model 10041A (2 metre) 10:1 divider probes with two Model 10006D (1.8 metre) 10:1 divider probes.

OPTION 112: This option adds Model 1112A Inverter Power Supply, a portable power source for the oscilloscope.

OPTION 534/535: Option 534 is a combination of Options 005 and 034. Option 535 is a combination of Options 005 and 035.

OPTION 580: Provides a special bottom cover to meet Canadian Fire Safety Codes.

OPTION 9XX: These options are special cord options. The connector configurations are shown in Section II of this manual.

Table 1-1. Specifications

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.

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.

BANDWIDTH LIMIT: limits 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 the CAL position.

POLARITY: channel B may be inverted, front panel pushbutton.

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.

INPUT RC (selectable)

AC or DC: 1 MΩ ±2% shunted by approx 20 pF.

50 Ohm: 50Ω ±3%.

MAXIMUM INPUT

AC or DC: 250 V (dc + peak ac) or 500 V p-p at 1 kHz or less.

50 Ohm: 5 V rms.

A+B OPERATION

Amplifier: bandwidth and deflection factors are unchanged; channel B may be inverted for A–B operation.

Differential (A–B) Common Mode: CMR is at least 20 dB from dc to 20 MHz. Common mode signal amplitude equivalent to 8 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 40 MHz.

AC-Coupled: approx 10 Hz to 40 MHz.

RISE TIME: ≤9 ns (measured fro 10% to 90% points of 5 div input step).

DEFLECTION FACTOR: increases sensitivity of the 5 mV and 10 mV/div deflection factor settings by a factor of 5 with 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, which is triggered from channel A.

LINE FREQUENCY: 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. Ext trigger signal deflection factor is approx 100 mV/div or 1 V/div in EXT ÷10. Trigger 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.

HORIZONTAL DISPLAY MODES

Main, Main Intensified, Delayed, Mag X10, A vs. B, and Delta Time.

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:

Sweep Time/Div	*Accuracy X1	*Accuracy X10	Temp Range
50 ns to 20 ms	±3%	±4%	0°C to +15°C
	±2%	±3%	+15°C to +35°C
	±3%	±4%	+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.

Table 1-1. Specifications (Cont'd)

CALIBRATED SWEEP DELAY

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

DIFFERENTIAL TIME MEASUREMENT ACCURACY—Helidial Readout:

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% for temperatures from 0°C to +15°C and +35°C to +55°C.

DELAY JITTER: <0.002% (1 part in 50000) of maximum delay in each step from +15°C to +35°C; <0.005% (1 part in 20000) from 0°C to +15°C and +35°C to +55°C.

TIME INTERVAL (Δ TIME MODE)

FUNCTION: measures time interval between two events on channel A (channel A display); between two events on channel B (channel B display); or between two events starting from an event on either channel A or B and ending with an event on either channel A or B (alternate display).

DIFFERENTIAL TIME MEASUREMENT ACCURACY—Opt. 034/035 or External DVM (plus accuracy of external DVM):

Main Time Base Setting	*Accuracy (+15°C to +35°C)
**100 ns/div to 20 ms/div	±(0.5% of reading + 0.05% of full scale)
50 ms/div to 2 s/div	±(1% of reading + 0.1% of full scale)

*Add 1% for temperatures from 0°C to +15°C and from +35°C to +55°C.

**On 100 ns/div range, specification applies after first cm of sweep. On all other ranges, specification applies after first 8 mm of sweep.

TIME INTERVAL OUTPUT VOLTAGE: varies from 50 V to 100 mV full scale. Full-scale output voltage equals (Time/div × 10 V) (e.g., 0.05 μs or 0.05 ms give 0.5 V out).

STABILITY—0°C to 55°C: short term, 0.005%; temperature ±0.03%/°C deviation from calibration temperature range.

TRIGGERING

MAIN SWEEP

Normal: Sweep is triggered by internal or external signal.

Automatic: bright baseline displayed in absence of input signal. Triggering is same as Normal above 40 Hz.

Single: sweep occurs once with same triggering as Normal; reset pushbutton arms sweep and lights indicator.

DELAYED SWEEP (SWEEP AFTER DELAY)

Auto: delayed sweep automatically starts at end of delay.

Trig: delayed sweep is armed and triggerable at end of delay period.

INTERNAL: dc to 25 MHz on signals causing 0.3 divisions 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 ×5 vertical magnifier is used). Line frequency triggering is selectable (main sweep only).

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) 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, Main LF REJ, or Main 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.

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

MAIN INTENSIFIED

DELAYED SWEEP: intensifies that part of main time base to be expanded to full screen in delayed time base mode. Stop control adjusts position of intensified portion of sweep.

TIME MODE: intensifies two parts of main time base to be expanded to full screen in delayed time base mode. START control positions first intensified portion of the sweep; STOP control positions second intensified portion of the sweep.

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: <3°, dc to 100 kHz.

Table 1-1. Specifications (Cont'd)

CATHODE-RAY TUBE AND CONTROLS

TYPE: Hewlett-Packard, 15.6 cm (6.15 in.) rectangular CRT, post accelerator, approx 21 kV accelerating potential, aluminized P31 phosphor.

GRATICULE: 10 X 10 div internal, non-parallax graticule with 0.2 subdivision markings on major horizontal and vertical axes and markings for rise time measurements. Internal floodgun graticule illumination.

BEAM FINDER: returns trace to CRT screen regardless of setting of horizontal, vertical, or intensity 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), ≤1 kHz.

REAR PANEL CONTROLS: astigmatism and trace align.

GENERAL

REAR PANEL OUTPUTS: 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 50 Ω	±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 kg (28.6 lb); shipping, 15.7 kg (34.6 lb).

OPERATING ENVIRONMENT

Temperature: 0°C to +55°C.

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

Altitude: to 4600 m (15 000 ft).

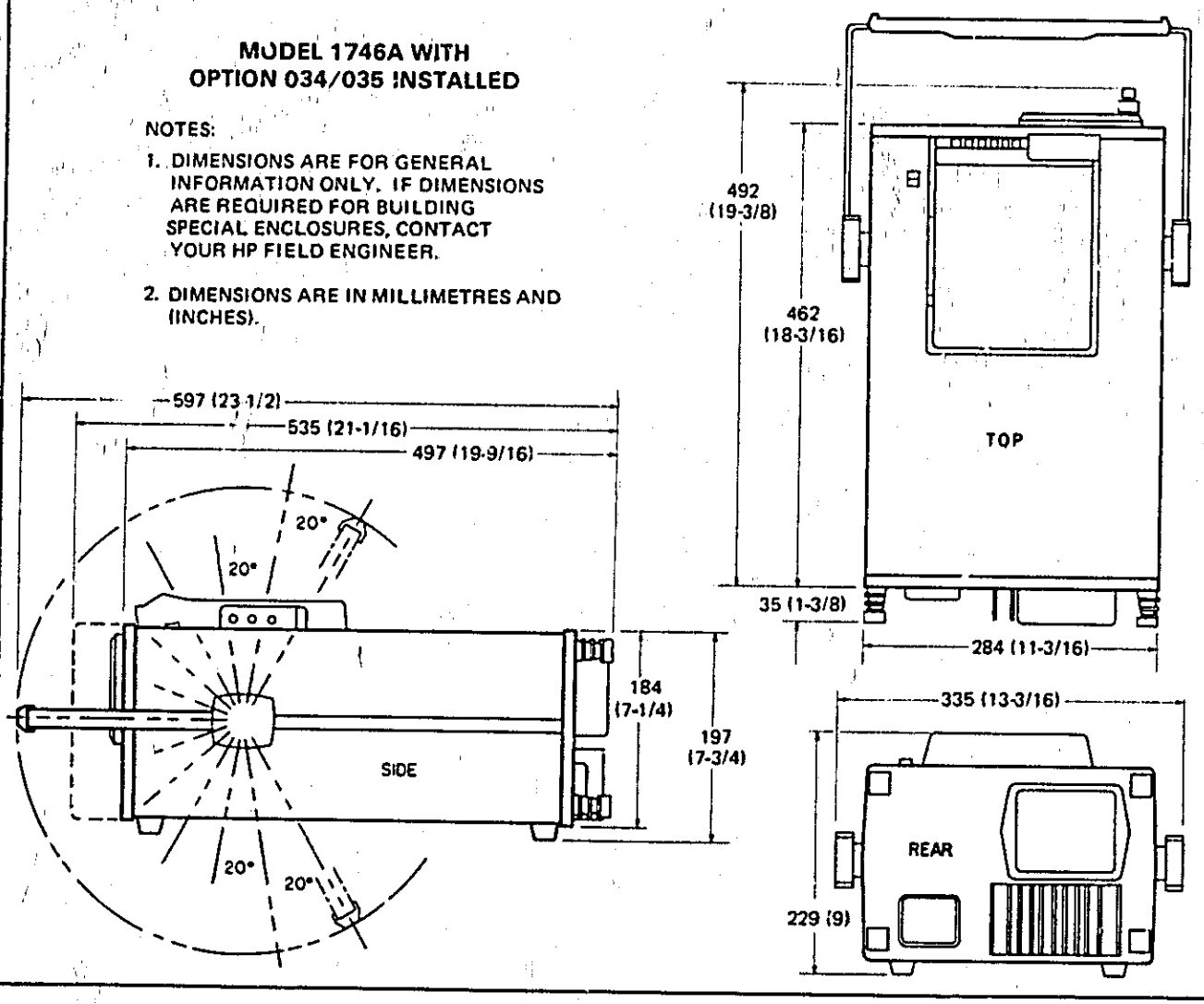
Vibration: vibrated in three planes for 15 min. each with 0.254 mm (0.010 in.) excursion, 10 to 55 Hz.

DIMENSIONS: see outline drawing.

MODEL 1746A WITH OPTION 034/035 INSTALLED

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).



1-20. ACCESSORIES SUPPLIED.

1-21. Included with the instrument are:

One 2.3 m (7.5 ft) power cord
One front-panel cover, HP Part No. 5040-0515
One Accessory Storage Pouch, HP Part No. 1540-0292
Two 10:1 Divider Probes, HP Model 10041A

1-22. The power cable and line fuse are selected at the factory according to the voltages available in the country of destination. For the part numbers of the available power cords, refer to AC Power Cable paragraph in Section II.

1-23. RECOMMENDED TEST EQUIPMENT.

1-24. Table 1-2 lists equipment required for maintaining the 1746A. The Critical Specifications column describes the essential requirements for each piece of test equipment. Other equipment can be substituted if it meets or exceeds these critical specifications.

Table 1-2. Recommended Test Equipment

Instrument		Required Characteristics	Required For
Type	Model		
Voltage Standard	Tektronix[1] PG506	Amplitude: 100 V to 25 mV p-p Accuracy: 0.01%	P
VHF Oscillator	HP Model 3200B	Frequency: to 300 MHz Accuracy: ±2%	P
Test Oscillator	HP Model 651B	Frequency: 10 MHz	A
RF Voltmeter	HP Model 3406A	Voltage: to 3V	P
50-ohm Termination	HP10100C	50 ohms ±1% VSWR ≤1.1:1; dc to 300 MHz	P
50-ohm TEE	HP Model 11063A		P,A
Time-mark Generator	Tektronix[1] TG 501	Time marks: 2 ns to 0.5 s	P,A
Fast-rise Pulse Generator	Tektronix[2] 067-0681-01	Pulse rise time: <400 ps	P
Digital Voltmeter	HP 3465A/B	Accuracy: 0.1% Voltage Range: 20 mVdc to 200 Vdc Input Impedance: ≥10 MΩ	P,A
High Voltage Probe	HP Model 34111A	Division Ratio: 1000:1	A
Probe	HP Model 10041A	Division Ratio: 10:1	A
50-ohm Power Divider	HP Model 11549	Attenuator: 20 dB	P
Test Oscilloscope	HP Model 1740A	100 MHz, Delayed Sweep Oscilloscope	A
Capacitance Meter	HP Model 4332A	Range: 20 pf	A
Pulse Generator	HP Model 8013B	Trigger Output Frequency: 10 kHz	A

P = Performance Check, A = Adjustment Procedure

[1]Requires Tektronix Model TM 503 Main Frame
[2]Used with Tektronix PG 506

INSTALLATION

OPERATION

SECTION II

INSTALLATION

2-1. INTRODUCTION.

This section provides installation instructions for the Model 1746A Oscilloscope. Also included is information pertinent to initial inspection, preparation for use, storage, and shipment.

2-2. INITIAL INSPECTION.

WARNING

To avoid electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers and panels).

Inspect the shipping container for damage. If the shipping container or cushioning is damaged, it should be kept until the contents of the shipment have been checked mechanically and electrically. Procedures for checking electrical performance are given in the Performance Tests in Section IV. If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the nearest Hewlett-Packard Sales and Service office. If the shipping container is damaged, or the cushioning materials show signs of stress, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection.

2-3. PREPARATION FOR USE.

2-4. POWER REQUIREMENTS. The Model 1746A requires a power source of 100, 120, 220, or 240 Vac +5/−10%; 48- to 440-Hz single phase. Power consumption is 100 VA maximum.

WARNING

This is a Safety Class I product (provided with a protective earth terminal). An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

WARNING

If this instrument is to be energized via an autotransformer for voltage reduction, make sure the common terminal is connected to the earthed pole of the power source.

2-5. LINE VOLTAGE AND FUSE SELECTION.

WARNING

For protection against fire hazard, the line fuse should be replaced with 250 V, slow-blow fuses with the correct current rating.

CAUTION

BEFORE CONNECTING THIS INSTRUMENT TO LINE (Mains) voltage, be sure the line voltage switches are set correctly and that the proper fuse is installed.

If the line fuse burns out, do not replace it until the cause for the failure has been determined and repaired by a qualified service person only. Replacing this fuse in a damaged instrument can cause additional damage.

The line voltage switch settings and line fuse are selected at the factory according to the line (Mains) voltage available in the country of destination. To operate the instrument from any other power source proceed as follows:

a. Disconnect power source.

b. Stand instrument on rear panel legs. Through opening in bottom cover, position LINE voltage select switches for desired Vac input. (Figure 2-1 shows switches set for 120 Vac operation.)

c. Select and install proper line fuse. Fuse current ratings are printed near the fuse on the instrument rear panel and are listed with HP part numbers in table 2-1.

d. Reconnect power cord.

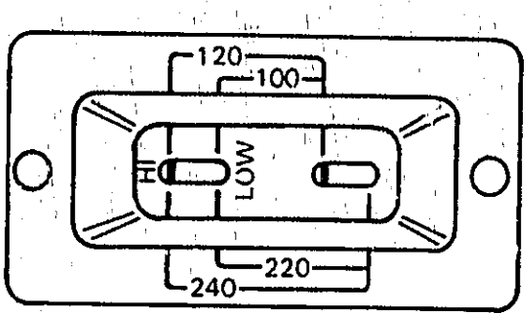


Figure 2-1. Line Voltage Selection Switches

Table 2-1. Line Fuse Part Numbers

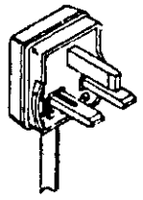
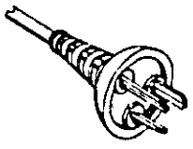
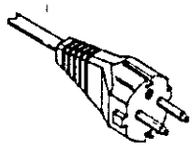
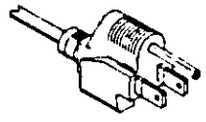
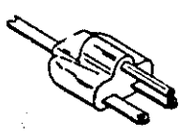
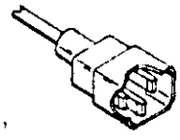
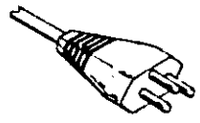
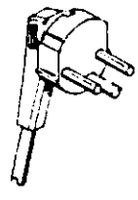
Line Voltage	Fuse Rating	HP Part Number
100/120 Vac	250 V, 1 A Slow blow	2110-0007
220/240 Vac	250 V, 500 mA Slow blow	2110-0202

2-6. AC POWER CABLE.

WARNING

BEFORE CONNECTING THIS INSTRUMENT, the protective earth terminal of the intrument must be connected to the protective Conductor of the line (Mains) power cord. The Mains plug must be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two conductor outlet does not provide an instrument ground.

This instrument is equipped with a three-wire power cable. When connected to an appropriate 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 shows the part numbers (and associated Option numbers) for the power cable and plug configurations available.

Option 900 United Kingdom 250 V  Plug: BS 1363A HP 8120-1703	Option 901 Australia/ New Zealand 250 V  Plug: NZSS 198/AS C112 HP 8120-0696	Option 902 European Continent 250 V  Plug: CEE7-VII HP 8120-1692	Option 903 USA/ Canada 125 V  Plug: NEMA 5-15P HP 8120-1521
Option 904 USA/ Canada 250 V  Plug: NEMA 6-15P HP 8120-0698	Option 905 Systems 250 V  Plug: CEE 22-VI HP 8120-2191	Option 906 Switzerland  Plug: SEV 1011.1959-24507 HP 8120-2296	Option 912 Denmark 220 V  Plug: DHCR 107 HP 8120-2956

NOTE: The number listed for the plug is the industry identifier for the plug only. The HP part number specifies a complete power cordset.

Figure 2-2. Power Cable and Mains Plug Part Numbers

2-7. MATING CONNECTORS. All connectors used with the Model 1746A are 50-ohm BNC male type connectors.

2-8. OPERATING ENVIRONMENT. The operating environment should be within the following limitations:

Temperature	0° C to +55° C
Humidity	<95% relative at 40° C
Altitude	<4570 metres (15 000 feet)

2-9. STORAGE AND ENVIRONMENT.

2-10. ENVIRONMENT. The Model 1746A may be stored or shipped in environments within the following limits:

Temperature	–55° C to +75° C
Humidity	<95% relative
Altitude	<15 300 metres (+50 000 feet)

Protect the instrument from conditions which would cause internal condensation.

2-11. PACKAGING.

2-12. ORIGINAL PACKAGING. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also mark the container FRAGILE to ensure careful handling. In correspondence, refer to the instrument by model number and full serial number.

2-13. OTHER PACKAGING. The following general instructions should be used for repacking with commercially available materials:

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

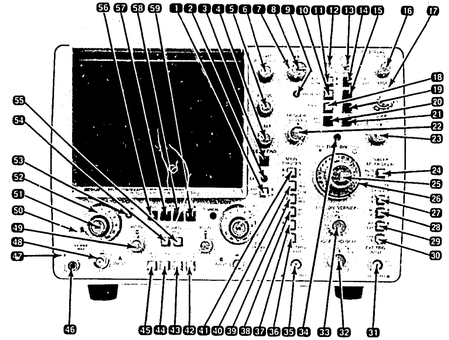
b. Use strong shipping container. A double-wall carton made of 2.4 MPa (350 psi) test material is adequate.

c. Use a layer of shock-absorbing material 75 to 100 mm (3- to 4-inch) thick around all sides of the instrument to provide firm cushioning and prevent movement inside container.

d. Seal shipping container securely.

e. Mark shipping container FRAGILE to ensure careful handling.

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



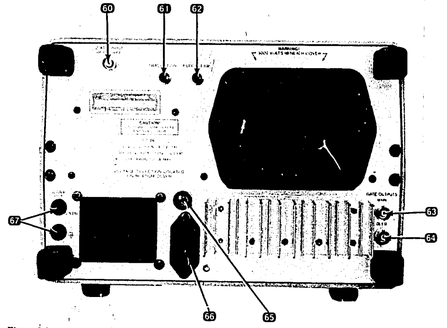


Figure 3-1. Controls and Connectors

1 LINE. Switch turns instrument power on and off.

2 LINE INDICATOR. Indicator lights when instrument power is on.

3 BEAM FIND. Returns display to viewing area relative to its off-screen position.

4 SCALE ILLUM. Adjusts CRT background illumination for good contrast between background and the graticule. Useful to illuminate graticule when viewing in dark area, photographing (if camera has no light source), or prefogging film.

5 FOCUS. Adjusts the writing beam for the sharpest trace. Always keep this display focused to prevent damaging the CRT internally.

6 BEAM INTENSITY. Controls brightness of the CRT display.

7 & 8 POSITION. Coarse **7** and FINE **8** adjustments position display horizontally.

9 Reset Lamp. When lit, indicates trigger circuit is armed. Lamp goes off at end of sweep and remains off until trigger circuit is again armed by pressing RESET **10**.

10 RESET. Momentary pushbutton that rams trigger circuit in single-sweep mode. After RESET **10**, sweep can be triggered by internal or external trigger signal or by rotating TRIGGER LEVEL control **22** through zero.

11 AUTO/NORM.

AUTO sweep mode (pushbutton out). Free-running sweep provides bright display in absence of a trigger signal. Trigger signal input (internal or external) or 40 Hz or more overrides AUTO operation and sweep triggering is same as in NORM mode.

NORM sweep mode (pushbutton in) requires internal or external signal to generate sweep and must be used if input frequency is less than 40 Hz.

12 SIGNAL OVERLAY (ΔT=0). Screwdriver adjustment to overlap traces with STOP control **17** or DMM (Option 034) at zero.

13 ΔTIME ON/OFF. In OFF position, switch turns off second delayed sweep marker, providing conventional delayed sweep operation.

14 A START/B START. A START position sets first delayed sweep marker on channel A and second delayed sweep marker on channel B. This allows time interval measurement from reference point on channel A to ending point on channel B. B START position sets first delayed sweep marker on channel B and second delayed sweep marker on channel A. This allows time interval measurement from reference point on channel B to ending point on channel A.

15 DLYD. Selects delayed sweep mode of display.

16 START. Selects delay time between start of main sweep and start of time interval measurement (positions second marker).

17 STOP. Selects end point of time interval measurement (positions first marker).

18 SINGLE. Sweep occurs once with same triggering as in NORM. After each sweep, trigger circuit must be manually RESET **10**.

19 MAIN. Selects main sweep of display.

20 MAG X10. Magnifies horizontal display 10 times, and expands the fastest sweep time to 5 ns/div.

21 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 **48**, and horizontal positioning is adjusted by POSITION **7** and FINE **8**.

22 & 23 TRIGGER LEVEL. Selects the voltage level on the input trigger signal where the sweep is triggered. With external trigger signals, the trigger level is continuously variable from +1 V to −1 V on either slope of the input trigger signal; +10 V to −10 V in EXT ÷ 10 **30** or **36** mode. With internal trigger signals, the trigger level selects any point on the vertical waveform displayed.

23 SWEEP AFTER DELAY AUTO/TRIG. In AUTO, delayed sweep starts immediately after delay interval which is product of either START **16** or STOP **17** setting and main TIME/DIV **25** setting. In TRIG'D, delay-trigger circuit is armed after delay interval and delayed sweep must be triggered internally or externally by trigger signal. (NOTE: the Δt DMM readout (option 034/035) is invalid in the TRIG'D mode of operation.)

24 Main TIME/DIV. Inner knob controls main sweep rate. Rate indicated by numbers displayed in knob skirt opening.

25 DLY'D TIME/DIV. Outer rotating section selects delayed sweep rate. Rate indicated by marker on outer knob. An interlock is incorporated so delayed sweep is always faster than main sweep. When rotated out of OFF position in MAIN mode of operation, portion of main sweep is intensified, indicating STOP **17** position of delayed sweep with respect to main sweep.

27 ∫/⌞. Two position switch that selects slope of event that triggers delayed sweep when in TRIG'D **23** mode.

28 Delayed AC/DC. Selects delayed sweep trigger coupling.

29 Delayed INT/EXT. Selects internal or external delayed sweep triggering.

30 Delayed EXT ÷ 10. Attenuates external trigger signal by factor of 10.

31 Delayed EXT TRIG INPUT. BNC connector for delayed external trigger signal.

32 TRIGGER HOLDOFF. Increases time between sweeps and aids triggering on complex displays such as digital words.

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

34 UNCAL. Lights when TIME/DIV VERNIER **25** is out of CAL detent position; indicates that sweep is not calibrated.

35 Main EXT TRIG INPUT. BNC connector for main external trigger signal.

36 Main EXT ÷ 10. Attenuates external trigger signal by factor of 10.

37 Main INT/EXT. Selects internal or external main sweep triggering.

38 Main AC/DC. Selects main sweep trigger coupling.

39 HF REJ. Attenuates internal or external trigger signals above approx 4 kHz. This is useful to condition low-frequency signals for best synchronization by eliminating unwanted high-frequency signals such as RF.

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

39 & 40 LINE. Selecting both LF REJ **40** and HF REJ **39** removes all internal and external trigger signals and applies input ac power frequency for triggering.

41 ∫/⌞. Two position switch that selects slope of internal or external trigger signal used to start main sweep.

42 CH B INVT. Inverts polarity of channel B signal. In A+B **57** & **58** mode, pressing CH B INVT **42** results in A minus B display.

43 BW LIMIT. Reduces bandwidth of channel A and channel B to approx 20 MHz.

44 MAG X5. Magnifies vertical presentation five times, and increases maximum sensitivity to 1 mV/div. Bandwidth is decreased to 40 MHz. Recommended on 5 mV/div and 10 mV/div ranges only.

45 TRIG VIEW. Displays the selected internal or external trigger signal at a fixed sensitivity of approximately 100 mV/div or 1 V/div with EXT ÷ 10 **36**. TRIGGER LEVEL **22** positions the display vertically. Center screen indicates the trigger threshold level with respect to the trigger signal. If ALT **56** or CHOP **60** is selected, three signals are displayed: channel A, the selected trigger signal (at center screen), and channel B.

46 Ground Post ⏚. Convenient chassis ground connector. Useful to ensure common ground with equipment under test.

47 CAL 1 V. Provides 1 V peak-to-peak (within 1%) square wave voltage signal recurring at approximate rate of 1.4 kHz (100 mV peak-to-peak when terminated in 50Ω).

NOTE

In the following descriptions for controls **48** through **68**, only channel A control and connectors are discussed. Channel B controls and connectors are identical in function.

48 INPUT. BNC connector to apply signals to channel A amplifier. Impedance and coupling are selectable by **50**.

49 POSN. Varies vertical position of channel A display.

50 Coupling. Selects capacitive (AC), direct (DC), or 50-ohm coupling of input signal. GND position disconnects input signal and grounds input to vertical preamplifier.

51 Vernier. Provides continuous control of deflection factor between calibrated VOLTS/DIV ranges. Vernier range is at least 2.5 to 1.

52 VOLTS/DIV. Selects vertical deflection factor in 1, 2, 5 sequence from 0.005 V/div to 20 V/div, accurate within 3% with vernier **51** in CAL position.

53 UNCAL. Lights when vernier control is out of detent position to indicate VOLTS/DIV **52** is uncalibrated.

54 TRIGGER A. Selects sample of channel A signal as trigger signal when INT/EXT **29** is in INT.

55 TRIGGER B. When in INT **37**, sample of channel B signal is selected as trigger signal.

59 & 55 COMP. Engaging both trigger A **54** and trigger B **55** selects composite trigger. When display mode is set to channel A, channel B, ALT, or A+B, sweep is triggered by displayed signal. In CHOP, sweep is triggered by channel A signal only.

56 ALT. Channel A and B signals are displayed alternately on consecutive sweeps.

57 Channel A. Displays channel A input signal.

58 Channel B. Displays channel B input signal.

57 & 58 A+B. Pressing both channel A **57** and channel B **58** displays the algebraic sum of channel A and channel B input signals. If channel B display is inverted (press CH B INVT **42**), A minus B display results.

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

60 Z-AXIS INPUT. BNC connector for intensity modulation of CRT display. +4-volt, >50-ns width pulse blanks trace of any intensity. Do not apply more than ±20 V (dc + peak ac), ≤1 kHz.

61 TRACE ALIGN. Screwdriver adjustment to align horizontal trace with graticule.

62 ASTIGMATISM. Screwdriver adjustment used in conjunction with FOCUS **5** to achieve clean, sharp spot or trace. Adjustment is easier with stationary spot.

63 MAIN GATE OUTPUT. Provides rectangular output of approx +2.5 V coincident with main sweep.

64 DLY'D GATE OUTPUT. Provides rectangular output of approx +2.5 V coincident with delayed sweep.

65 FUSE. 1A 250 V slow-blow for 100-V or 120-V operation 0.5A 250 V slow-blow for 220-V or 240-V operation.

66 LINE INPUT. Connector for ac power cord.

67 ΔTIME OUT. Banana jack connectors for time interval measurement. Voltage output and position of main TIME/DIV control **25** indicates time interval in s, ms, or μs.

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. This operating section explains the function of controls, indicators, and connectors on the 1746A. It described 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 CHECKS.

3-6. The checks that follow allow the operator to make 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 connecting power to the 1746A, make sure the low-voltage supply line select switches are set to correspond to the line voltage of the available ac power line. Refer to Section II for proper switch settings.

3-7. INITIAL TURN-ON PROCEDURE. To place the 1746A into operation and avoid CRT damage, accomplish the following steps in the sequence listed:

a. Set BEAM INTENSITY ⑥ fully counterclockwise.

b. Set vertical DISPLAY to ALT ㊻.

c. Set internal TRIGGER to A ㊹.

d. Set vertical verniers ㊶ for channel A and channel B to CAL detent.

e. Set CH B INV switch ㊷ to out position.

f. Set vertical coupling control ㊵ for channel A and channel B to GND.

g. Set vertical POSN controls ㊾ to midrange.

h. Set horizontal POSN control ⑦ to midrange.

i. Set main TIME/DIV control ㉕ to 1 mSEC.

j. Set delayed TIME/DIV control ㉖ to OFF.

k. Set TIME/DIV VERNIER ㉝ to CAL detent.

l. Set AUTO/NORM switch ⑪ to AUTO.

m. Set main INT/EXT trigger switch ㊲ to INT.

n. Set LINE switch ① to ON position and allow 15-minute warmup.

o. Adjust BEAM INTENSITY ⑥ for barely visible 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 control ㊾, set trace to center horizontal graticule line.

c. Using nonmetallic alignment tool, adjust TRACE ALIGN ㊶ (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 control ⑥ fully counterclockwise.

c. Select A vs B ㉑ horizontal mode of operation.

d. Adjust BEAM INTENSITY ⑥ to observe spot.

e. Position spot near center of CRT using vertical POSN ㊾ and horizontal POSITION ⑦ controls.

f. Adjust FOCUS ⑤ (front panel) and ASTIGMATISM control ㊷ (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 48.

c. Connect divider probe tip to CAL 1 V terminal 47.

d. Set channel A input coupling 50 to DC.

e. Set channel A VOLTS/DIV control 52 for square-wave display with two to three divisions of vertical deflection.

f. Set main TIME/DIV control 25 for horizontal display of at least two full square waves (0.2 mSEC range).

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

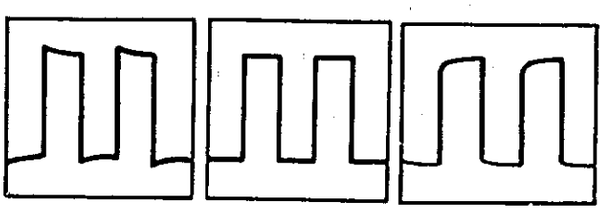


Figure 3-2. Divider Probe Adjustment Display

3-11. DISPLAY/READOUT ZERO ADJUSTMENT. Perform this adjustment before taking Δt time-interval measurements. The adjustment calibrates the 0.00 setting of the time interval STOP dial 17 or the 0.000 indication on the LED display on the digital multimeter (if used). To accomplish this adjustment, proceed as follows:

a. Apply input signal to channel A or channel B INPUT connector 48.

b. Select channel A 57 or channel B 58 vertical DISPLAY.

c. Select channel A 54 or channel B 55 internal TRIGGER.

d. Adjust appropriate VOLT/DIV control 52 and vernier 51 for full five-division vertical display of signal.

e. Select main TIME/DIV 25 range that displays at least one full cycle of signal.

f. Set delayed TIME/DIV 26 to sweep speed approximately five times faster than main TIME/DIV 25 sweep speed.

g. Set Δ TIME ON/OFF switch 13 to ON position.

h. Adjust time interval START 16 to place first intensified marker on point of interest on displayed trace.

i. Set time interval STOP 17 dial to 0.00. If using Option 034/035 digital multimeter or external multimeter, readjust time interval STOP 17 to obtain indication as close as possible to 0.000 on DMM.

j. Engage DLY'D switch 15. With an indication of 0.000 on DMM or 0.00 on time interval STOP 17 dial, the two displayed segments should be perfectly overlapped.

k. If segments are not overlapped, adjust front-panel SIGNAL OVERLAY (ΔT=0) 12 to overlay two signal segments displayed.

NOTE

If using only one signal channel, this completes the adjustment. If using two signal channels, connect probe from second channel to same signal source applied to first channel (same signal applied to both channels simultaneously), and continue on with the adjustment.

l. Select ALT 56 display and channel A 54 or channel B 55 TRIGGER.

m. Set time-interval mode 19 to A START or B START, as desired.

n. Engage MAG X10 switch 20.

o. With indication of 0.000 on multimeter or 0.00 on time-interval STOP 17 dial, two segments displayed should be overlapped. If not, adjust SIGNAL OVERLAY (ΔT=0) 12 to overlay two signal segments displayed.

3-12. VERTICAL ACCURACY CHECK. To check vertical accuracy, proceed as follows:

a. Accomplish initial turn-on procedure.

b. Connect CAL 1 V 47 output to channel A INPUT connector 48 using BNC to banana plug adapter and test lead with alligator clips.

c. Set channel A VOLTS/DIV control 52 to 0.2 V range.

d. Set main TIME/DIV control 25 to 0.2 mSEC range.

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

3-13. 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 (48).

c. Set main TIME/DIV (25) to 0.5 μSEC position.

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

e. Using horizontal POSITION controls (7) and (8), 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.

3-14. OPERATING INSTRUCTIONS.

3-15. The following procedures provide additional information concerning operation of the instrument.

3-16. AUTO VERSUS NORM (11). In AUTO operation, there will always be a recurring sweep (baseline trace), except under triggering conditions. A trigger of 40 Hz or higher overrides AUTO operation and a stable presentation is displayed. Adjustment of main TRIGGER LEVEL (22) may be necessary for a stable display. If the trigger signal is 40 Hz or less, NORM operation must be used. A trigger signal is always needed in NORM operation to generate a sweep.

3-17. SWEEP AFTER DELAY (24). In AUTO mode, delayed sweep starts immediately after the delay interval which is the product of either the START (16) or STOP (17) setting and the main TIME/DIV (25) setting. In TRIG mode, the delayed trigger circuit is armed after the delay interval and delayed sweep must be triggered internally or externally by a trigger signal.

NOTE

When the SWEEP AFTER DELAY is in TRIG'D mode of operation, the time interval feature (ΔTIME) is disabled. Output from ΔTIME OUT connectors (or DMM on Option 034/035) will indicate the position of the STOP control (17), not the time interval being displayed.

3-18. 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 procedure. In addition, set the 1746A front-panel controls as follows:

Coupling (CH A) (50)	DC
VOLTS/DIV (Ch A) (52)	0.02
Main TIME/DIV (25)	0.5 mSEC
START (16)	fully ccw
STOP (17)	fully ccw
ΔTIME ON/OFF (13)	OFF

3-19. NORMAL SWEEP DISPLAY.

a. Connect CAL 1 V terminal (47) to channel A INPUT connector (48) using 10:1 divider probe supplied.

b. Adjust channel A POSN (49) to align base of square-wave display on second horizontal graticule line from bottom. Adjust main TRIGGER LEVEL (22) for stable display.

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

3-20. MAGNIFIED SWEEP DISPLAY.

a. Obtain normal sweep display.

b. Adjust horizontal POSITION (7) to place portion of waveform to be magnified on center graticule of CRT (figure 3-3a).

c. Engage MAG X10 switch (20).

d. Adjust fine horizontal POSITION (8) for precise placement of magnified display (figure 3-3b).

3-21. DELAYED SWEEP DISPLAY.

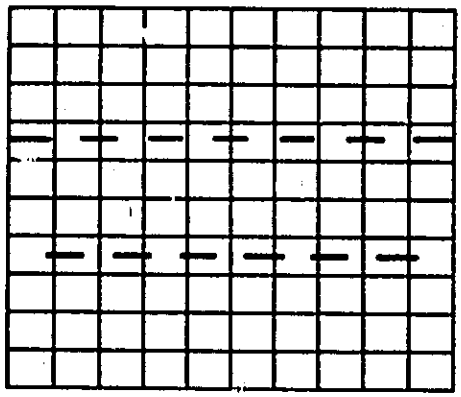
a. Obtain normal sweep display.

b. Adjust delayed TIME/DIV (26) for 50 μSEC, and observe intensified portion of square wave. Set BEAM INTENSITY (6) control to a comfortable viewing level.

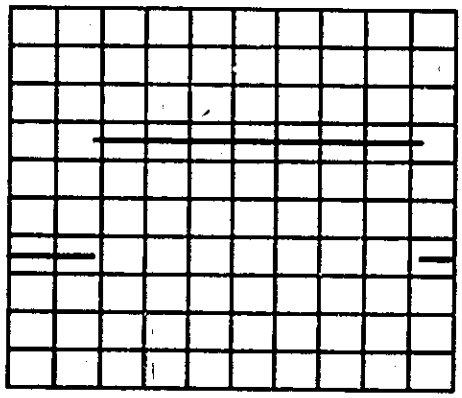
c. Adjust time interval STOP (17) until intensified portion of trace is over display segment under investigation (figure 3-4a).

d. Engage DLY'D switch (15) and note intensified portion of trace is now displayed across entire CRT (figure 3-4b).

e. Adjust time interval STOP (17) to observe other pulses in pulse train.

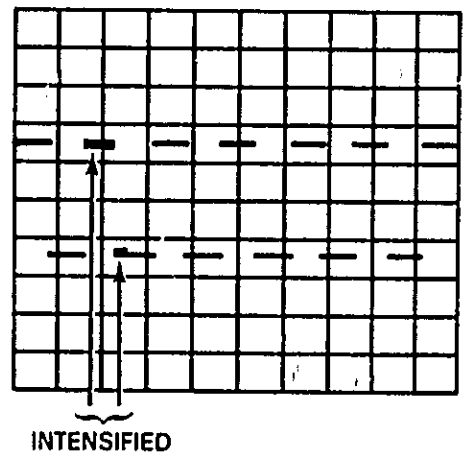


a. Normal Display

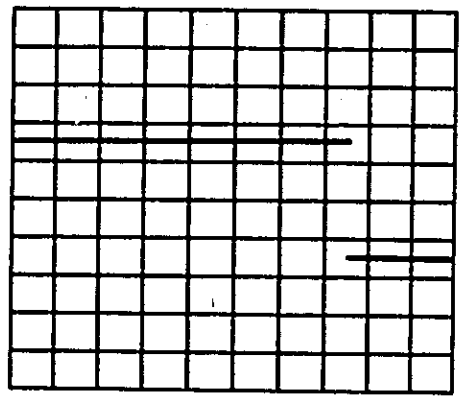


b. Magnified Display

Figure 3-3. Magnified Sweep



a. Normal Display with Intensified Area



b. Delayed Sweep Display

Figure 3-4. Delayed Sweep

3-22. A VS B DISPLAY.

a. Engage A vs B (21). BEAM INTENSITY (6) may need to be decreased. Apply vertical (Y-axis) signal to channel A INPUT (48) connector and horizontal (X-axis) signal to channel B INPUT connector. Channel A POSN, (49) adjusts vertical positioning; POSITION (7) adjust horizontal positioning. Adjust channel A and B VOLTS/DIV (52) controls as required.

b. If display is not visible, press BEAM FIND (3) and adjust channel A and B VOLT/DIV controls until display is compressed vertically. Center compressed display with POSN (49) and POSITION (7) controls. Release BEAM FIND, and adjust FOCUS (5) for a sharp display.

3-23. SINGLE SWEEP OPERATION. Single sweep mode is often used to photograph single occurrence events. To use this mode, proceed as follows:

a. Select SINGLE (18) sweep mode.

b. Set AUTO/NORM to NORM (11).

c. Set all trigger processing controls to desired settings; for example, INT/EXT (37), slope (31), and TRIGGER LEVEL (22).

d. Depress RESET (10) pushbutton; the red RESET (9) lamp will light.

3-24. The sweep circuitry is now armed; as soon as a trigger signal is received that meets the preset requirements (slope, coupling, level, etc.), the time base will generate one sweep. As soon as the sweep ends, the RESET (9) lamp will extinguish and the time base must be reset again.

3-25. SINGLE SWEEP USING TRIGGER VIEW. To use the trigger view feature in single sweep, perform the following steps:

a. Engage TRIG VIEW (15). This turns off both vertical channels; however, trigger view circuitry will

not be activated until a certain transition occurs at the end of the sweep.

b. To activate trigger view, press RESET ⑩ and rotate TRIGGER LEVEL ㉒ from one extreme to the other or engage AUTO ⑪ and press RESET, then disengage AUTO.

3-26. After one sweep has been manually generated, the necessary transition will have occurred and trigger view mode will operate in a normal manner.

3-27. TIME-INTERVAL MEASUREMENT. The 1746A provides for the use of a DMM (digital multimeter) to simplify time-interval measurements. A built-in digital multimeter, Hewlett-Packard Option 034/035, is available for this instrument. It indicates exact time intervals between the start and stop markers directly in seconds, milliseconds, or microseconds.

3-28. The operator can connect any DMM of his choice to the ΔTIME OUT connectors ⑰ on the rear panel of the 1746A. To preserve accuracy of the 1746A, use a 3-1/2 digit multimeter for digital readout of time intervals.

3-29. To measure the time interval between two points of interest on a serial-type waveform, proceed as follows:

a. Accomplish display/readout zero adjustment (paragraph 3-11).

b. If Option 034/035 not installed, connect DMM to ΔTIME OUT ⑰ banana jack connectors on rear panel of 1746A.

c. Connect input signal to channel A INPUT connector ㊽.

d. Select channel A ㊼ DISPLAY and channel A ㊾ TRIGGER.

e. Set channel A VOLTS/DIV switch ㊷ for appropriate range.

f. Set main TIME/DIV control ㉕ and delayed TIME/DIV control ㉖ for desired display.

NOTE

Use TIME/DIV ranges that separate, as far as possible, the two points of interest being measured.

g. Set ΔTIME ON/OFF switch ⑬ to ON position.

h. Using time interval START ⑯, position first intensified spot to starting point of interval being measured.

i. Using time interval STOP ⑰, position second intensified spot to end point of interval being measured.

j. Engage DLY'D switch ⑮.

k. Using time interval STOP control ⑰, superimpose two waveforms observed.

l. Note voltage output as indicated on DMM.

m. Note whether main TIME/DIV ㉕ is in SEC, mSEC, or μSEC range. Time interval measured is then the voltage (step 1) in s, ms, or μs.

3-30. USE OF OPTION 034/035 DMM.

3-31. TIME-INTERVAL MEASUREMENTS. To use the Option 034/035 Digital Multimeter for time interval measurements, certain multimeter switches must be set properly. The meter POWER switch must be ON and the VOLTS pushbutton must be engaged (output analog voltage from 1746A is dc).

3-32. The two-position switch built into the instrument's top cover must be in the forward position to obtain time-interval measurements of displayed waveforms. With the switch in the rear position, the analog dc voltage is disconnected from the meter and the connections at the side of the multimeter are enabled for normal multimeter measurements.

3-33. AVERAGE AND RMS VOLTAGE MEASUREMENTS. The Option 034/035 DMM is an average-responding meter calibrated in rms. To measure rms voltgae using the DMM, proceed as follows:

a. Set two-position switch on 1746A top cover to rear position.

b. Set DMM controls as follows:

POWER	ON
DC/AC (⎓~)	~(IN)
VOLTS (V)	(IN)
AUTO HOLD	AUTO (OUT)
AMPS (A)	(OUT)
kΩ	(OUT)

CAUTION

Do not connect DMM leads to any voltage greater than 707 V rms.

c. Connect test leads from VΩ (HI) and COM (LOW) on DMM to signal under test. DMM will automatically select best meter range and display rms voltage.

d. To measure average voltage, set multimeter DC/AC control to DC (out position).

PERFORMANCE CHECK

SECTION IV

PERFORMANCE TESTS

4-1. INTRODUCTION.

4-2. The procedures in this section test the instrument's electrical performance using the specifications in table 1-1 as the performance standards. All tests can be performed without access to the interior of the instrument.

4-3. EQUIPMENT REQUIRED.

4-4. A complete list of required test equipment and accessories is given in table 1-3 (Section I). Any equipment that satisfies the 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 inspections can be used for comparison during periodic maintenance.

4-7. CALIBRATION CYCLE.

4-8. The 1746A requires periodic verification of performance. Depending on use and environmental conditions, the instrument should be checked using the following performance test 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, perform only those procedures indicated in table 4-1. Results may be tabulated on the Operation Verification Record at the end of this section.

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 1746A 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 (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 (Horizontal)	midrange
TRIGGER LEVEL (Main and Delayed)	3 o'clock
Sweep Mode	MAIN
START	fully ccw
STOP	fully ccw
ΔTIME	OFF
MAIN TIME/DIV	.1 mSEC
DLY'D TIME/DIV	OFF
TIME/DIV VERNIER	CAL
TRIGGER HOLDOFF	MIN

4-13. PERFORMANCE TEST PROCEDURES.

4-14. BANDWIDTH. 3 dB down from a 6-division reference signal; dc to 100 MHz, dc coupled; and 10 Hz to 100 MHz, ac coupled. In the vertical MAG X5 mode, bandwidth is reduced to 40 MHz.

4-15. 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.

Equipment Required:

VHF Oscillator	HP Model 3200B
RF Voltmeter	HP Model 3406A w/11063A

4-16. Perform bandwidth test as follows:

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

b. Set 1746A controls as follows:

Coupling (both channels)	50Ω
VOLTS/DIV (both channels)	0.01
MAIN TIME/DIV	1 μSEC

Table 4-1. Recommended Operation Verification

Paragraph No.	Performance Test	Alteration	Remarks
4-14	BANDWIDTH	No change	
4-17	COMMON MODE REJECTION RATIO (CMRR)	Omit test	CMMR is checked when bandwidth and deflection factors are checked.
4-19	TRIGGERING	Omit paragraphs 4-21 and 4-22	An out of specification condition will usually appear on internal triggering check.
4-23	SWEEP TIME ACCURACY	Check following ranges only: Main: 0.05 μSEC, 0.5 μSEC, 10 μSEC, 0.1 mSEC, 1 mSEC, 20 mSEC, 50 mSEC, 0.2 SEC Delayed: 0.05 μSEC, 0.5 μSEC, 10 μSEC, 0.1 mSEC, 2 mSEC, 20 mSEC	All sweep speed determining components checked in these ranges.
4-25	DIFFERENTIAL TIME ACCURACY	No change	
4-27	DELAY JITTER	Omit test	Usually only fails when a hard failure occurs and is repaired at the same time.
4-29	RISE TIME	Omit test	In specification when bandwidth is in specification. Can be computed by $T_r = \frac{.35}{BW}$
4-31	Z-AXIS BLANKING	Omit test	Normally in specification when no evidence of blanking failure is present.
4-33	DEFLECTION FACTOR	Check following ranges only: 0.005 V through 0.5 V/div, both channel A and B	All attenuation and gain ranges are checked on these ranges
4-35	CALIBRATOR	Omit test	Excellent long term stability, usually only fails consequentially.

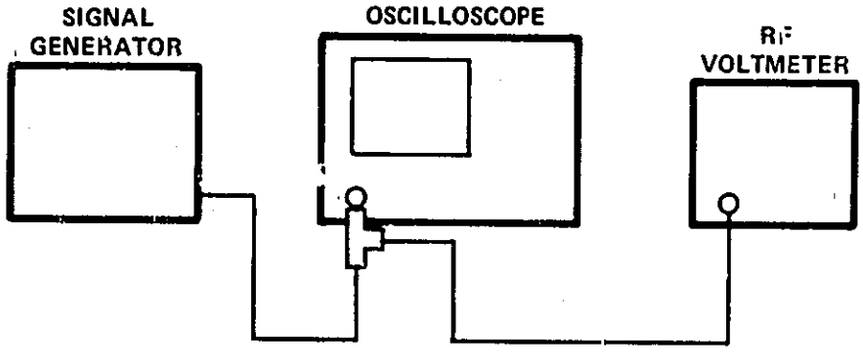


Figure 4-1. Bandwidth Test Setup

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

d. Note rf voltmeter indication.

e. Set signal generator frequency to 100 MHz.

f. Adjust signal generator amplitude to obtain same indication as in step d. Amplitude of display should be equal to or greater than 4.25 divisions.

g. Set 1746A controls as follows:

DISPLAY ..... B
TRIGGER ..... B

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

i. Disconnect test equipment.

4-17. COMMON MODE REJECTION RATIO (CMRR). CMRR is at least 20 dB from dc to 20 MHz. Common mode signal amplitude is equivalent to 8 divisions with one vernier adjusted for optimum rejection. Identical signals are applied to both channels with channel B operated in the inverted mode. The displayed signal is the common mode signal.

Equipment Required:

VHF Oscillator ..... HP Model 3200B
50-ohm Power Divider ..... HP Model 11549

4-18. Perform CMRR test as follows:

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

b. Set 1746A controls as follows:

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

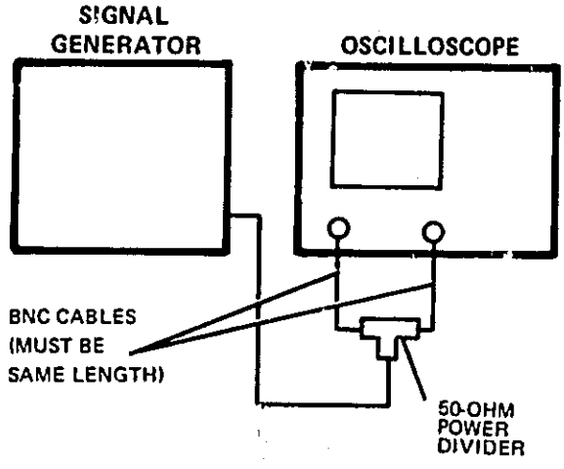


Figure 4-2. CMRR Test Setup

c. Set signal generator controls to observe 20-MHz signal, 8 divisions in amplitude.

d. Set 1746A contols 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 0.8 division (20 dB).

g. Disconnect test equipment.

4-19. TRIGGERING (INTERNAL). Main Sweep: dc to 25 MHz on signals causing 0.3 division vertical deflection, increasing to 1 division at 100 MHz. The output of a signal generator is applied to the vertical input to check internal triggering.

Equipment Required:

VHF Oscillator ..... HP Model 3200B

4-20. Perform the internal triggering check as follows:

a. Connect signal generator to channel A INPUT.

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

c. Set 1746A controls as follows:

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

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

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

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

g. Set 1746A controls as follows:

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

h. Set signal generator to obtain 1-division display.

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

j. Change signal generator output to 0.3 division amplitude at 25 MHz.

k. Adjust delayed TRIGGER LEVEL (and main TRIGGER LEVEL if necessary) to obtain stable display.

l. Disconnect test equipment.

4-21. TRIGGERING (EXTERNAL). Main Sweep: dc to 50 MHz on signals of 50 mV p-p or more, increasing to 100 mV p-p at 100 MHz. The output of a signal generator is split, using a power divider, and equal amplitude signals are applied to both channel A and the EXT TRIGGER INPUT connector to check external triggering.

Equipment Required:

VHF Oscillator ..... HP Model 3200B
RF Voltmeter..... HP Model 3406A w/11063A
50-ohm Feed-through Termination
50-ohm Power Divider ..... HP Model 11549

4-22. Perform external triggering test as follows:

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

b. Set 1746A controls as follows:

Channel A VOLTS/DIV ..... .05
Channel A Coupling 50Ω
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 display.

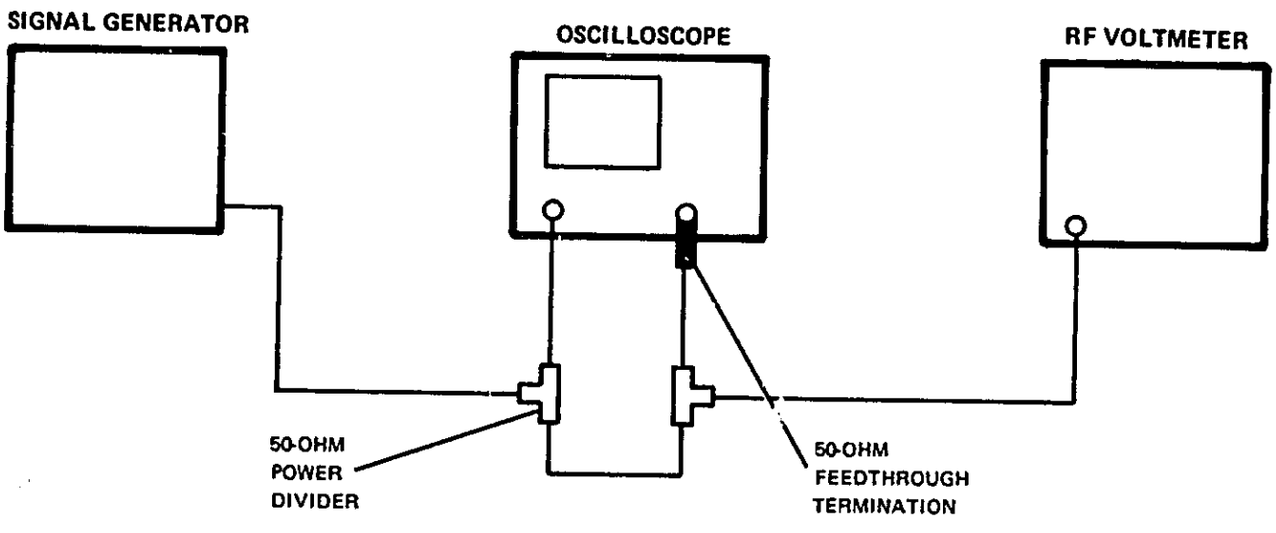


Figure 4-3. External Triggering Test Setup

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.

g. Set 1746A 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 necessary to obtain stable triggering.

n. Disconnect test equipment.

4-23. SWEEP TIME ACCURACY. (+15°C to +35°C) ±2% in unmagnified mode and ±3% in MAG X10 mode. Refer to table 1-1 for other variations in ambient temperatures. In 50 ms to 2 s ranges, add 1% error.

Equipment Required:

Time-mark Generator ..... Tektronix TG501

4-24. Perfrom sweep time accuracy test as follows:

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

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

c. Set 1746A sweep display to DLY'D.

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

4-25. DIFFERENTIAL TIME ACCURACY. Main time base accuracy: 100 ns/div to 20 ms/div, ± (0.5% of measurement +0.05% of full scale) at ambient temperature of +15°C to +35°C. Refer to table 1-1 for complete specifications. A time mark generator is used in delayed sweep mode to check accuracy.

Equipment Required:

Time-mark Generator ..... Tektronix TG501
Digital Voltmeter ..... HP Model 3465A

4-26. Perform differential time accuracy test as follows:

a. Connect time-mark generator TIME MARK OUTPUT connector to 1746A channel A INPUT connector.

b. Connect time-mark generator TRIGGER OUTPUT connector to 1746A main EXT TRIG INPUT connector.

c. Set 1746A controls as follows:

MAIN TIME/DIV ..... .1 μSEC
DELAYED TIME/DIV ..... .05 μSEC
VOLTS/DIV (channel A) ..... as required
MAIN INT/EXT ..... EXT
ΔTIME ..... ON

d. Set time-mark generator for 10 ns markers.

e. Adjust horizontal POSITION control to start display on far left vertical graticule line.

f. Connect DVM to ΔTIME OUT connectors on rear panel of 1746A.

g. Adjust START control to position start of intensified portion of sweep on fourth vertical graticule line.

h. Adjust time interval STOP control for DVM indication of 0.010.

i. Set HORIZ DISPLAY to DLY'D.

j. Set horizontal magnifier to MAG X10.

k. Adjust time interval STOP control to superimpose exactly two displayed markers.

l. Note DVM indication.

m. Slowly rotate time interval START control clockwise. Verify that every cycle is superimposed. If cycle is not superimposed, vary time interval STOP control until display is superimposed and note DVM indications for each change of time interval STOP control.

Table 4-2. Main TIME/DIV Accuracy

Main TIME/DIV Setting	Time-mark Generator Settings	Accuracy	
		X1	X10
.05 µSEC	50 nSEC	1 mark/div ±2%	±3%
.1 µSEC	.1 µSEC	1 mark/div ±2%	±3%
.2 µSEC	.2 µSEC	1 mark/div ±2%	±3%
.5 µSEC	.5 µSEC	1 mark/div ±2%	±3%
1 µSEC	1 µSEC	1 mark/div ±2%	±3%
2 µSEC	2 µSEC	1 mark/div ±2%	±3%
5 µSEC	5 µSEC	1 mark/div ±2%	±3%
10 µSEC	10 µSEC	1 mark/div ±2%	±3%
20 µSEC	20 µSEC	1 mark/div ±2%	±3%
50 µSEC	50 µSEC	1 mark/div ±2%	±3%
.1 mSEC	.1 mSEC	1 mark/div ±2%	±3%
.2 mSEC	.2 mSEC	1 mark/div ±2%	±3%
.5 mSEC	.5 mSEC	1 mark/div ±2%	±3%
1 mSEC	1 mSEC	1 mark/div ±2%	±3%
2 mSEC	2 mSEC	1 mark/div ±2%	±3%
5 mSEC	5 mSEC	1 mark/div ±2%	±3%
10 mSEC	10 mSEC	1 mark/div ±2%	±3%
20 mSEC	20 mSEC	1 mark/div ±2%	±3%
50 mSEC	50 mSEC	1 mark/div ±3%	±4%
.1 SEC	.1 SEC	1 mark/div ±3%	±4%
.2 SEC	.2 SEC	1 mark/div ±3%	±4%
.5 SEC	.5 SEC	1 mark/div ±3%	±4%
1 SEC	1 SEC	1 mark/div ±3%	±4%
2 SEC	2 SEC	1 mark/div ±3%	±4%

Table 4-3. Delayed TIME/DIV Accuracy

Main TIME/DIV Settings	Delayed TIME/DIV Settings	Time-mark Generator Settings	Accuracy	
			X1	X10
.1 µSEC	.05 µSEC	50 nSEC	1 mark/div ±2%	1 mark/div ±3%
.2 µSEC	.1 µSEC	.1 µSEC	1 mard/div ±2%	1 mark/div ±3%
.5 µSEC	.2 µsEC	.2 µSEC	1 mark/div ±2%	1 mark/div ±3%
1 µSEC	.5 µSEC	.5 µSEC	1 mark/div ±2%	1 mark/div ±3%
2 µSEC	1 µSEC	1 µSEC	1 mark/div ±2%	1 mark/div ±3%
5 µSEC	2 µSEC	2 µSEC	1 mark/div ±2%	1 mark/div ±3%
10 µSEC	5 µSEC	5 µSEC	1 mark/div ±2%	1 mark/div ±3%
20 µSEC	10 µSEC	10 µSEC	1 mark/div ±2%	1 mark/div ±3%
50 µSEC	20 µSEC	20 µSEC	1 mark/div ±2%	1 mark/div ±3%
.1 mSEC	50 µSEC	50 µSEC	1 mark/div ±2%	1 mark/div ±3%
.2 mSEC	.1 mSEC	.1 mSEC	1 mark/div ±2%	1 mark/div ±3%
.5 mSEC	.2 mSEC	.2 mSEC	1 mark/div ±2%	1 mark/div ±3%
1 mSEC	.5 mSEC	.5 mSEC	1 mark/div ±2%	1 mark/div ±3%
2 mSEC	1 mSEC	1 mSEC	1 mark/div ±2%	1 mark/div ±3%
5 mSEC	2 mSEC	2 mSEC	1 mark/duv ±2%	1 mark/div ±3%
10 mSEC	5 mSEC	5 mSEC	1 mark/div ±2%	1 mark/div ±3%
20 mSEC	10 mSEC	10 mSEC	1 mark/div ±2%	1 mark/div ±3%
50 mSEC	20 mSEC	20 mSEC	1 mark/div ±2%	1 mark/div ±3%

n. Continue step m until time interval START control is fully clockwise. All voltage deviations from indication noted in step l should be equal to or less than 0.0008 (0.8 mV) This corresponds to an 80 picosecond time interval.

o. Disconnect test equipment.

4-27. DELAY JITTER. <0.002% (1 part in 50 000) of maximum delay in each step from +15°C to +35°C. Delay jitter is checked by expanding the sweep by 50 000 and visually monitoring the jitter.

Equipment Required:

Time-mark Generator ..... Tektronix TG501

4-28. Perform delay jitter test as follows:

a. Connect time-mark generator to channel A INPUT (1 mSEC markers).

b. Set 1746A controls as follows:

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

c. Adjust STOP dial to position intensified portion of sweep on 11th time marker.

d. Set sweep mode to delayed sweep (DLY'D).

e. Increase INTENSITY control, as required, and adjust STOP control to observe horizontal axis jitter on time marker. Jitter should be less than 1 division (corresponds to 1:50 000).

f. Disconnect test equipment.

4-29. RISE TIME. ≤3.5 ns, measured from 10% to 90% points of a 6-division input step, and ≥9 ns in X5 vertical magnification mode. A fast-rise pulse generator is applied to the vertical input; display is then checked to verify the ≤3.5 ns rise time.

Equipment Required:

Fast-rise pulse generator .. Tektronix 067-0681-01

4-30. Perform rise time test as follows:

a. Connect pulse generator to channel A INPUT.

b. Set channel A VOLTS/DIV and pulse generator controls to obtain 6 divisions of vertical deflection.

c. Using channel A POSN control, center 6-division display on CRT.

d. Set 1746A controls as follows:

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

e. Adjust horizontal POSITION as necessary to measure rise time between 10% and 90% points (inner set of dots across CRT face). Rise time should be equal to or less than 3.5 ns.

NOTE

If 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

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

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. Depress vertical MAG X5 switch.

g. Reset channel A VOLTS/DIV and pulse generator controls to obtain 8-division display.

h. Center display on CRT. Rise time should be equal to or less than 9 ns.

i. Connect pulse generator to channel B input and repeat step b through h for channel B.

j. Disconnect test equipment.

4-31. Z-AXIS BLANKING. +4 V, ≥50-ns wide pulse blanks trace of any intensity, usable to 10 MHz for normal intensity. +4 V signal is applied to the Z-axis input and the CRT is monitored to verify blanking.

Equipment Required:

Voltage..... Tektronix PG506

4-32. Perform blanking test as follows:

a. Connect dc standard to Z-AXIS INPUT on rear panel.

b. Set dc standard for +4 Vdc.

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

d. Disconnect test equipment.

4-33. DEFLECTION FACTOR. Accuracy ±3% on all ranges. A dc standard is connected to the vertical inputs and deflection is checked on all ranges.

Equipment Required:

Voltage Standard..... Tektronix PG506

4-34. Perform deflection factor test as follows:

a. Connect dc standard to channel A INPUT.

b. Set channel A VOLTS/DIV control and dc standard as indicated in table 4-4. Deflection should be 8 divisions ±3% for each checkpoint.

Table 4-4. Deflection Factor Accuracy

VOLTS/DIV Settings	Dc Standard Settings
20	160 V
10	80 V
5	40 V
2	16 V
1	8 V
.5	4 V
.2	1.6 V
.1	.8 V
.05	.4 V
.02	.16 V
.01	.08 V
.005	.04 V

c. Change DISPLAY to B and repeat step b for channel B.

d. Disconnect test equipment.

4-35. CALIBRATOR. Amplitude: 1 V p-p into 1 megohm, ±1.0% 0.1 V into 50 ohms with <0.1 μs rise time. Calibrator amplitude is checked against a known dc standard. Rise time is measured directly on CRT.

Equipment Required:

Voltage Standard..... Tektronix PG506

4-36. Perform calibrator test as follows:

a. Set channel A VOLTS/DIV to .2.

b. Connect dc standard to channel A INPUT.

c. Set dc standard for +1 V output and carefully note vertical deflection.

d. Disconnect dc standard and connect CAL 1 V output to channel A INPUT using test lead and adapter. Deflection should be within ±1.0% of that noted in step c.

e. Set channel A VOLTS/DIV to .02 and coupling to 50 ohms. Set MAIN TIME/DIV control to .05 μSEC and measure rise time. Rise time should be less than 0.1 μs.

f. Disconnect test equipment.

4-37. This completes the performance checks.

PERFORMANCE TEST RECORD

HP MODEL 1746A OSCILLOSCOPE

Tested By _____

Date _____

Paragraph No.	Test	Specification	Measured
4-14	**BANDWIDTH**		
	A 100 MHz	≥4.25 div	_____
	B 100 MHz	≥4.25 div	_____
4-17	**CMRR**		
	20 dB 20 MHz	<.8 div	_____
4-19	**TRIGGERING**		
	Internal MAIN		
	.3 div 25 MHz	stable display	_____
	1 div 100 MHz	stable display	_____
	DLY'D		
	.3 div 25 MHz	stable display	_____
	1 div 100 MHz	stable display	_____
	External MAIN		
	50 mV p-p 50 MHz	stable display	_____
	100 mV p-p 100 MHz	stable display	_____
	DLY'D		
	50 mV p-p 50 MHz	stable display	_____
	100 mV p-p 100 MHz	stable display	_____
4-23	**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	_____ / _____

PERFORMANCE TEST RECORD (Cont'd)
HP MODEL 1746A OSCILLOSCOPE

Paragraph No.	Test	Specification	Measured
4-23	**SWEEP TIME ACCURACY (at room Temperature)** DLY'D (Cont'd)		X1 X10
	.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	_____ _____
4-25	**DIFFERENTIAL TIME ACCURACY** Accuracy: ±0.5% of measurement +0.05% of full scale and accuracy of DMM	≤0.8 mV	_____
4-27	**DELAY JITTER** <1:50 000	<1 div	_____
4-29	**RISE TIME**		
	Ch A	≤3.5 nSEC	_____
	Ch A MAG X5	≤9 nSEC	_____
	Ch B	≤3.5 nSEC	_____
	Ch B MAG X5	≤9 nSEC	_____
4-31	**Z-AXIS BLANKING** +4 V blanking	√	_____
4-33	**DEFLECTION FACTOR**	±3% all ranges	CH A CH B
		20 V/div	_____ _____
		10 V/div	_____ _____
		5 V/div	_____ _____
		2 V/div	_____ _____
		1 V/div	_____ _____
		.5 V/div	_____ _____
		.2 V/div	_____ _____
		.1 V/div	_____ _____
		.05 V/div	_____ _____
		.02 V/div	_____ _____
		.01 V/div	_____ _____
		.005 V/div	_____ _____
4-35	**CALIBRATOR**		
	Amplitude (1 V)	±1.0%	_____
	Rise Time (T_r)	≤.1 µs	_____

OPERATION VERIFICATION RECORD
HP MODEL 1746A OSCILLOSCOPE

Paragraph No.	Test	Specification	Meets Specification
4-14	**BANDWIDTH**		Yes / No
	A 100 MHz	≥4.25 div	_____ _____
	B 100 MHz	≥4.25 div	_____ _____
4-19	**TRIGGERING**		Yes / No
	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	_____ _____
4-23	**SWEEP TIME ACCURACY (at room temperature)**		
	MAIN		Yes / No
	.05 µSEC	±2%, ±3% in X10	_____ _____
	.5 µSEC	±2%, ±3% in X10	_____ _____
	10 µSEC	±2%, ±3% in X10	_____ _____
	.1 mSEC	±2%, ±3% in X10	_____ _____
	1 mSEC	±2%, ±3% in X10	_____ _____
	20 mSEC	±2%, ±3% in X10	_____ _____
	50 mSEC	±3%, ±4% in X10	_____ _____
	.2 SEC	±3%, ±4% in X10	_____ _____
	DLY'D		
	.05 µSEC	±2%, ±3% in X10	_____ _____
	.5 µSEC	±2%, ±3% in X10	_____ _____
	10 µSEC	±2%, ±3% in X10	_____ _____
	.1 mSEC	±2%, ±3% in X10	_____ _____
	2 mSEC	±2%, ±3% in X10	_____ _____
	20 mSEC	±2%, ±3% in X10	_____ _____
4-25	**DIFFERENTIAL TIME ACCURACY**		Yes / No
	Accuracy: ±0.5% of measurement +0.05% of full scale and accuracy of DMM	≤0.8 mV	_____ _____
4-33	**DEFLECTION FACTOR**	±3% all ranges	CH A Yes No / CH B Yes No
	.5 V/div		___ ___ ___ ___
	.2 V/div		___ ___ ___ ___
	.1 V/div		___ ___ ___ ___
	.05 V/div		___ ___ ___ ___
	.02 V/div		___ ___ ___ ___
	.01 V/div		___ ___ ___ ___
	.005 V/div		___ ___ ___ ___

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 special accessories is given in table 1-3 (Section I). 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 recommended that they be made sequentially as a number of adjustments are directly related to preceding or following adjustments. Refer to table 5-1 for a list of adjustable components and their functions.

Table 5-1. Adjustable Components

Reference Designator	Adjustment Name	Adjustment Paragraph	Schematic Number	Description
A16R26	+15 V ADJ	5-13	1	Adjusts +15 Vdc supply to within ±10 mV.
A15R113	CATHODE ADJ	5-14	2	Adjusts cathode voltage to −2870 ±100 V.
A15R2	Intensity Limit Adj	5-15	2	Minimum setting or BEAM INTENSITY control extinguishes trace.
A12R12/ A12C11	Gate Comp Adj	5-17	3	Adjusts for best gate pulse response.
A16R20	F G Adj	5-18	1	Adjusts scale illumination uniformity.
A12R16	Y-ALIGN	5-19	3	Aligns trace with vertical axis of CRT.
A3R116	CALIB Ampl	5-20	6	Adjusts calibrator output for 1 V p-p.
A7R20	TRIG SENS (Main)	5-21	7	Sets maximum trigger sensitivity (Main).
A10R9	TRIG SENS (Delayed)	5-21	9	Sets maximum trigger sensitivity (Delayed).
A7R41	SYNC ZERO	5-22	7	Compensate for sync signal AC/DC Coupling.
A3R86	TRIG VIEW BAL	5-23	4	Center trigger view display on CRT.
A7R93	X1 Cal	5-24	11	Adjust X1 gain of horizontal amplifier.
A8R43 A8R12 A8R13 A8R14	1 µSEC Range 0.1 mSEC Range 10 mSEC Range 50 mSEC Range	5-25 and 5-30	8	Main sweep calibration adjustments.
A7R117	X10 Cal	5-26	11	Adjust X10 gain of horizontal amplifier.

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

Reference Designator	Adjustment Name	Adjustment Paragraph	Schematic Number	Description
A7R105	Mag Center	5-26	11	Balance display around center screen when magnifier is engaged.
A11R10 A11R15	LIN 1 LIN 2	5-27	11	Adjust for best horizontal linearity.
A17R30 A17R35	Δ=0 CNTR Gain Equal	5-28	14	Balances inputs from START, STOP, Δ=0 controls.
A17R39	VM CAL DVM ZERO	5-28	14	Balances STOP control with system DVM.
A9R28 A9R10 A9R11	0.5 μSEC Range 5 μSEC Range 0.5 mSEC Range	5-29	10	Calibrates delayed sweep.
A3R11 A3R31	FET BAL (Channel A) FET BAL (Channel B)	5-31	4	Input channel balance adjustment to vertical preamplifier. 0 V ±0.5 V at A3TP9 and A3TP10.
A3R18 A3R77	5 mV BAL (Chennel A) 5 mV BAL (Channel B)	5-31	4	Set for minimum trace shift on 0.005, 0.01, 0.02 ranges.
A3R19 A3R76	50 mV BAL (Channel A) 50 mV BAL (Channel B)	5-31	4	Set for minimum trace shift between 0.05 ranges.
A3R90	POL BAL	5-31	4	Balance Channel B polarity selection.
A3R79	A SYNC BAL	5-32	4	Balances channel A sync signal with channel B sync signal.
A3R58 A3R32	A POSN B POSN	5-32	4	Compensates for position variations between normal and MAG X5 operation.
A3C2 A3C17	0.5 V COMP (Ch A) 0.5 V COMP (Ch B)	5-33	4	Adjusts for best input response on 0.5 V range.
A3C4 A3C19	0.5 V INPUT CAP (Ch A) 0.5 V INPUT CAP (Ch B)	5-33	4	Adjust input capacitance for 0.5 V range.
A3R49 A3R46	A GAIN B GAIN	5-34	4	Equalizes vertical gain of each channel.
A3R65	GAIN	5-34	4	Adjusts overall gain of vertical preamplifier.
A5R24 A5R20 A5R19 A5R22 A5R25 A5C3	HF1 HF2 HF3 HF4 HF5 HF6	5-35	4	Vertical output pulse response adjustments.
A3R22	B HF ADJ	5-35	4	Matches Ch B response with Ch A.
A7R97	A vs B CAL	5-37	7	Calibrates Channel A vs Channel B.

5-9. In addition to complete adjustment procedures, a condensed adjustment procedure is included (table 5-8) for the convenience of technicians who have sufficient experience with the 1746A. For best results, adjustments should be performed at normal room temperature. An adjustment location photograph (figure 5-2) is provided at the rear of this section.

5-10. ADJUSTMENT PROCEDURES.

WARNING

Read the Safety Summary at the front of this manual before performing adjustment procedures.

5-11. Remove top and bottom covers from the instrument. Apply input power and allow thirty minutes for the instrument to warm up.

5-12. The following front-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 and disconnect test equipment.

CONTROL	SETTING
All Pushbuttons (except as noted below)	out position
VOLTS/DIV (Channels A and B)	.1
CAL (Channels A and B)	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 (Horizontal)	midrange
TRIGGER LEVEL (Main and Delayed)	3 o'clock
Sweep Mode	MAIN
START	fully ccw
STOP	fully ccw
ΔTIME	OFF
MAIN TIME/DIV	.1 mSEC
DLY'D TIME/DIV	OFF
TIME/DIV VERNIER	CAL
TRIGGER HOLDOFF	MIN

5-13. LOW-VOLTAGE POWER SUPPLY ADJUSTMENT.

Equipment Required:

Digital Multimeter ..... HP Model 3465A

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

b. Adjust the +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. Low-voltage Supply Limits

Voltage	Test Point	Limits	Ripple
-15 V	A16TP1	±300 mV	<10 mV
+ 5 V	A16TP2	±100 mV	< 5 mV
+15 V	A16TP4	previously set to <±10 mV	<10 mV
+43 V	A16TP5	±.8 V	< 5 mV
+120 V	A16TP6	±6 V	<20 mV

5-14. HIGH VOLTAGE POWER SUPPLY ADJUSTMENT.

NOTE

During routine calibration do not adjust cathode voltage if it reads -2870 ±100 V. Adjustment is usually only necessary after major repair to HVPS assembly or replacement of CRT or HVPS assembly.

Equipment Required:

DVM ..... HP Model 3465A
1000:1 HV Divider Probe ..... HP Model 34111A

NOTE

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

a. Set front-panel BEAM INTENSITY control fully ccw.

WARNING

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

b. Connect DVM to +120 V test point A16TP6 and note indication.

c. Connect DVM to +120 V test point A16TP6 through 1000:1 divider probe and note voltage indication.

d. Compute error introduced by 1000:1 divider probe (difference between indications noted in steps b and c divided by step b).

e. Connect DVM through 1000:1 divider probe to cathode (HV) test point A15TP1 through insulated access hole in top of high voltage power supply cover.

f. Adjust CATHODE ADJ (A15R113) for cathode voltage of -2870 V ± error computed in step d.

5-15. INTENSITY LIMIT ADJUSTMENT.

a. Set controls as follows:

DELAYED TIME/DIV..... 10 μSEC
BEAM INTENSITY..... fully ccw

b. Adjust intensity limit control A15R2 until intensified portion of sweep is just extinguished.

5-16. ASTIGMATISM AND FOCUS ADJUSTMENT.

a. Set Model 1746A controls as follows:

MAIN TIME/DIV ..... 1 SEC
TIME/DIV VERNIER ..... fully ccw
BEAM INTENSITY..... barely visible spot

b. While spot moves slowly across screen, adjust FOCUS on front panel and ASTIGMATISM on rear panel for smallest, best-defined spot.

5-17. GATE RESPONSE ADJUSTMENT.

Equipment Required:

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

a. Connect monitor oscilloscope through 10:1 divider probe to test point A12TP1.

b. Adjust front-panel BEAM INTENSITY control A12R3 so that peak amplitude of gate signal at A12TP1 is 25 volts.

c. Adjust gate comp adj A12R12 and A12C11 for best square-wave response (overshoot, undershoot, etc., should be less than 3%).

5-18. FLOODGUN ADJUSTMENT.

a. Set SCALE ILLUM fully clockwise.

b. Adjust F G adj A16R20 for maximum brightness with uniform illumination.

c. Verify that CRT remains evenly illuminated as SCALE ILLUM control is turned slowly counterclockwise.

5-19. TRACE ALIGN AND Y-AXIS ALIGN ADJUSTMENT.

Equipment Required:

Test Oscillator ..... HP Model 651B

a. Obtain horizontal baseline.

b. Adjust TRACE ALIGN on rear panel to make horizontal trace exactly parallel with CRT graticule lines.

c. Set display mode to A vs B.

d. Connect test oscillator to channel A INPUT.

e. Adjust test oscillator for approximately 1-kHz sine wave with 8 divisions of vertical deflection.

f. Adjust Y-align A12R16 so that vertical trace is parallel with vertical graticule line.

5-20. CALIBRATOR AMPLITUDE ADJUSTMENT.

Equipment Required:

Digital Voltmeter ..... HP Model 3465A

a. Connect DVM between CAL 1 V OUTPUT and ground.

b. Adjust A3R116, CALIB AMPL, for an indication of 0.500 V ±5 mV. Since the calibrator signal is a square wave, by adjusting amplitude for 0.5 V average value, peak value of calibrator pulse will be 1 V ±10 mV.

5-21. TRIGGER SENSITIVITY ADJUSTMENT.

Equipment Required:

Test Oscillator..... HP Model 651B

a. Set 1746A controls as follows:

VOLTS/DIV (Channel A) ..... .005
Coupling (Channel A)..... 50Ω
MAIN TIME/DIV ..... 10 μSEC
DELAYED TIME/DIV..... 2 μSEC
Main INT/EXT ..... EXT

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

c. Set test oscillator output for 50-kHz, 15-mV p-p sine wave (3 div).

d. Set main AUTO/NORM to NORM.

e. Set main trig sens A7R20 fully cw.

f. Slowly turn main TRIGGER LEVEL from one extreme to the other. Note that one sweep occurs for each direction of rotation (increase INTENSITY slightly).

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

h. Set main AUTO/NORM to AUTO.

i. Increase output amplitude from test oscillator to 20 mV p-p (4 div).

j. Set main AUTO/NORM to NORM.

k. Rotate main TRIGGER LEVEL. Sweep should occur for each direction of rotation and there should be one small area of TRIGGER LEVEL control where stable triggering can be obtained.

l. Change 1746A controls as follows:

Main AUTO/NORM	AUTO
Main INT/EXT	INT
Delayed INT/EXT	EXT

m. Connect test oscillator to delayed EXT TRIGGER input.

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

o. Set SWEEP AFTER DELAY to TRIG'D.

p. Set horizontal sweep mode to DLY'D.

q. Set delay trig sens A10R9 fully cw.

r. While turning delayed TRIGGER LEVEL from one extreme to the other, adjust A10R9 ccw until sweep occurs for only one direction of rotation or not at all (keep INTENSITY set higher than normal).

s. Set SWEEP AFTER DELAY to AUTO.

t. Increase test oscillator output to 20-mV p-p.

u. Set SWEEP AFTER DELAY to TRIG'D.

v. Turn delayed TRIGGER LEVEL. Sweep should occur for each direction of rotation.

NOTE

If sweep does not occur for each direction of rotation, readjust A10R9 slightly cw until sweeps do occur.

w. Disconnect test equipment.

5-22. SYNC ZERO ADJUSTMENT.

Equipment Required:

Test Oscillator ..... HP Model 651B

a. Connect test oscillator to channel A INPUT.

b. Set test oscillator output for 1-kHz sine wave and approximately six divisions of amplitude.

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.

f. Disconnect test equipment.

5-23. TRIGGER VIEW BALANCE ADJUSTMENT.

Equipment Required:

Test Oscillator ..... HP Model 651B

a. Set 1746A controls as follows:

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

b. Connect test oscillator to main EXT TRIGGER input.

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

d. Adjust main TRIGGER LEVEL for stable display.

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

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

5-24. HORIZONTAL AMPLIFIER GAIN.

a. Set 1746A controls as follows:

Coupling (Channel A)	50Ω
VOLTS/DIV (Channel A)	.5
MAIN TIME/DIV	1 μSEC
DELAYED TIME/DIV	.05 μSEC
ΔTIME	ON

b. Adjust X1 gain A7R93 for sweep baseline of 10 div in length. (Use horizontal POSITION control to position baseline while making this adjustment.)

c. Using START control, position beginning of first intensified trace at 0.5 horizontal division graticule mark.

d. Using STOP control, position end of second intensified trace at 9.5 horizontal division graticule mark.

e. Readjust A7R93 until start of first delayed trace and stop of second delayed trace are at 0- and 10-division points respectively.

5-25. PRELIMINARY MAIN SWEEP CALIBRATION.

Equipment Required:

Time-mark Generator ..... Tektronix TG501

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

b. Set main AUTO/NORM to NORM.

c. Set main TIME/DIV and time-mark generator as indicated in table 5-3. Make adjustments to obtain one marker/division. (Set Adjustments as closely as possible.)

Table 5-3. Preliminary Main Sweep Calibration

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

5-26. X10 GAIN AND BALANCE ADJUSTMENTS.

Equipment Required:

Time-mark Generator ..... Tektronix TG501

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

b. Set main TIME/DIV to 1 μSEC position.

c. Set time-mark generator for 1 μs markers.

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

e. Engage horizontal sweep MAG X10 pushbutton.

f. Using horizontal POSITION control, align one time marker with first vertical graticule line.

g. Adjust X10 Cal A7R117 until one marker coincides with first vertical graticule line and one marker coincides with last vertical graticule line.

h. Disengage horizontal sweep MAG X10 pushbutton.

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

j. Using horizontal POSITION control, center middle time-marker.

k. Engage horizontal sweep MAG X10 pushbutton.

l. Adjust Mag Center A7R105 to re-center time marker.

5-27. HORIZONTAL LINEARITY ADJUSTMENT.

Equipment Required:

Time-mark Generator ..... Tektronix TG501

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

b. Set 1746A controls as follows:

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

c. Set time-mark generator for 10 ns markers.

d. Starting with linearity adj A11R10 and A11R15 fully cw, adjust for best overall linearity in center 8 divisions of unmagnified sweep (center 80 divisions of magnified sweep).

5-28. TIME INTERVAL DECODER ANALOG ADJUSTMENTS.

Equipment Required:

Time-mark Generator ..... Tektronix TG501
Digital Voltmeter ..... HP Model 3465A

a. Connect DVM to 1746A ΔTIME OUT connectors (rear panel).

b. Set 1746A controls as follows:

MAIN TIME/DIV ..... .5 μSEC
DELAYED TIME/DIV ..... .1 μSEC
ΔTIME ..... ON
SIGNAL OVERLAY (ΔT=0) ..... midrange

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

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

e. Adjust START control to position intensified spot on second time mark from left.

f. Set horizontal sweep mode to DLY'D.

g. Set START control as required to observe second time mark (superimposed).

h. Adjust A17R30 to exactly superimpose time mark observed in step g.

i. Set START control to observe tenth time marker.

NOTE

Do not adjust time interval STOP control.

j. Adjust A17R35 to superimpose exactly two time markers observed.

k. Repeat steps e through j until no interaction occurs.

l. With STOP control set to 0.00 (±1 dial line width), adjust A17R42 for DVM indication of 0.000 ±0.005.

m. Set STOP control to 10.00 (±1 dial line width).

n. Adjust A17R39 for DVM indication of 5.000 V ±0.005.

5-29. DELAYED SWEEP ADJUSTMENT.

Equipment Required:

Time mark Generator ..... Tektronix TG501

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

b. Set 1746A controls as follows:

VOLTS/DIV (Channel A) 5
Coupling (Channel A) 50Ω
Horizontal Sweep ..... DLY'D
SWEEP AFTER DELAY ..... TRIG'D

c. Set time-mark generator, main TIME/DIV and delayed TIME/DIV as indicated in table 5-4. Make necessary adjustments for one time marker/div, compromising (if necessary) so that all ranges controlled by particular adjustment are in specified tolerance.

5-30. MAIN SWEEP CALIBRATION ADJUSTMENTS.

Equipment Required:

Time mark Generator ..... Tektronix TG501

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

b. Set 1746A controls as follows:

MAIN TIME/DIV ..... 1 μSEC
DELAYED TIME/DIV ..... .1 μSEC
SWEEP AFTER DELAY ..... AUTO
ΔTIME ..... ON

c. Set time-mark generator for 1 μs markers.

Table 5-4. Delayed Sweep Calibration Adjustments

MAIN TIME/DIV Settings	DLY'D 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		

d. Adjust START control to position first intensified trace at second time marker.

e. Adjust STOP control for dial setting of 8.00.

f. Engage horizontal sweep DLY'D pushbutton.

g. Adjust A8R43 so that two time markers overlap.

h. Set 1746A controls as follows:

MAIN TIME/DIV ..... 10 μSEC
DELAYED TIME/DIV..... 1 μSEC
Main AUTO/NORM ..... NORM
HORIZONTAL SWEEP..... MAIN
ΔTIME ..... ON

i. Set time-mark generator for 10 μs markers.

j. Adjust START control to position first intensified trace to second time marker.

k. Adjust STOP control for dial setting of 8.00.

l. Engage horizontal sweep DLY'D pushbutton.

m. Adjust A8R12 so that two time markers overlap.

n. Repeat steps h through for two remaining adjustments using control settings indicated in table 5-5.

o. Disconnect test equipment.

Table 5-5. Main Sweep Fine Adjustments

MAIN TIME/DIV	DELAYED TIME/DIV	Time Markers	STOP CONTROL DIAL SETTING	Adjustment
1 mSEC	.1 mSEC	.1 ms	8.00	A8R13
50 mSEC	5 mSEC	50 ms	8.00	A8R14

5-31. VERTICAL AMPLIFIER BALANCE ADJUSTMENT.

Equipment Required:

Digital Voltmeter ..... HP Model 3465A

a. Set channel A and B coupling to GND.

b. Connect DVM to A3TP9.

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

d. Connect DVM to A3TP10.

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

f. Disconnect DVM.

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

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

i. Change DISPLAY to B.

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

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

l. 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 j and k for correct balance. If additional adjustments are made for j and k, recheck adjustment of A3R90 as described above.

5-32. POSITION AND SYNC BALANCE ADJUSTMENT.

Equipment required:

Test Oscillator ..... HP Model 651B

a. Set 1746A 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. Set 1746A controls as follows:

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

d. Using test oscillator, apply 10-kHz sine wave to both channel INPUTS using BNC tee and two cables of equal electrical length.

e. Adjust test oscillator for 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 g and h in paragraph 5-31 for correct balance. If additional adjustments are made for g and h, recheck adjustment of A3R79 as described above.

g. Disconnect test oscillator.

h. Set 1746A controls to initial settings.

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

j. Disengage MAG X5.

5-33. INPUT CAPACITANCE AND ATTENUATOR COMPENSATION ADJUSTMENTS.

Equipment Required:

Pulse Generator ..... HP Model 8013B
Capacitance Meter..... HP Model 4332A

a. Connect pulse generator to channel A INPUT.

b. Set 1746A controls as follows:

Coupling (channel A) 50Ω
VOLTS/DIV (channel A) 5
MAIN TIME/DIV ..... 20 μSEC

c. Set pulse generator controls to obtain 3-V peak, 10-kHz square wave.

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

e. Disconnect pulse generator.

f. Set 1746A controls as follows:

VOLTS/DIV (both channels)..... .2
Coupling (channel A) ..... DC

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

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

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

j. Disconnect capacitance meter.

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

5-34. VERTICAL GAIN ADJUSTMENT.

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

b. Set 1746A 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 connect CAL 1 V signal to channel B INPUT.

e. If channel B amplitude is larger than channel A, turn channel B gain A3R46 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.

5-35. 0.01 VOLT/DIV PULSE RESPONSE ADJUSTMENT.

Equipment Required:

Fast-rise pulse generator... Tektronix 067-0681-01

a. Set Model 1746A controls as follows:

Coupling (both channels)..... 50 ohms
VOLTS/DIV (both channels)..... .01
TIME/DIV (main) as necessary (see table 5-6)

NOTE

Perform the following preset adjustments only if major repair or parts replacement was done to delay line, A5 Vertical Output assembly or CRT.

b. Preset high frequency adjustments A5R19, A5R20, A5R22, A5R24, and A5R25 to midrange.

c. Connect fast-rise pulse generator to channel A INPUT and adjust pulse generator amplitude for 5 division display. It may be necessary to use oscilloscope VOLTS/DIV CAL vernier to obtain exactly 5 divisions of display.

d. Adjust A5C3 for dip in leading edge (slowest response).

e. While referring to table 5-6, perform high frequency adjustments for best pulse shape and fast risetime. Due to interaction it may be necessary to repeat procedure making small incremental changes.

NOTE

Optimum adjustment occurs when A5R24 and A5R25 are nearly equal and midrange with minimum ringing ~150 to 200 ns from leading edge. Optimum setting of A5C3 is minimum speed (capacitance) required to make risetime specification on 0.01 VOLT/DIV range. Adding more capacitance than necessary will cause excessive overshoot on 0.2 VOLT/DIV range.

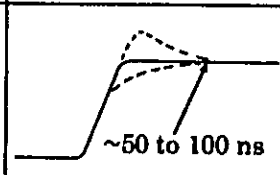
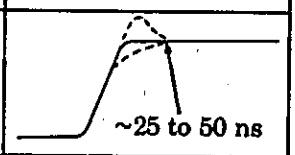
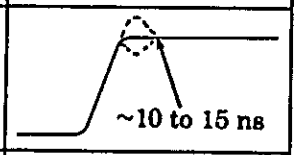
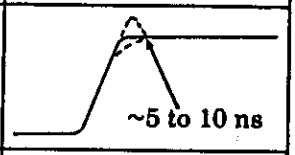
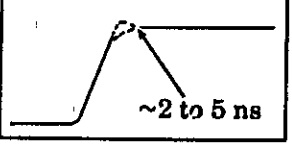
f. Connect fast-rise pulse generator to channel B INPUT and adjust pulse generator and/or oscilloscope VOLTS/DIV CAL vernier for 5 division display on 0.01 VOLT/DIV range.

g. Adjust A3R22, channel B HF adj, to make channel B pulse shape match channel A pulse shape as closely as possible.

NOTE

Perform bandwidth test (paragraph 4-14) after making pulse response adjustments. If bandwidth is low, increase capacitance of A5C3 slightly until bandwidth is adequate. A5R24 and A5R25 will need to be readjusted for optimum pulse shape without degrading bandwidth.

Table 5-6. Pulse Response Adjustments

Step	Adjustment	Sweep Speed	Effect on Pulse
1	A5R22 (HF4)	.5 μSEC	 ~50 to 100 ns
2	A5R19 (HF3)	.1 μSEC	 ~25 to 50 ns
3	A5R20 (HF2)	.05 μSEC	 ~10 to 15 ns
4	A5R24 (HF1) A5R25 (HF5)	.05 μSEC	 ~5 to 10 ns
5	A5C3 (HF6)	.05 μSEC MAG X10 (5 ns)	 ~2 to 5 ns

5-36. 0.5 VOLT/DIV PULSE RESPONSE ADJUSTMENT.

NOTE

Do not perform this procedure unless major repair of the ÷100 attenuator (A3 Vertical Preamp) has taken place. If this procedure is necessary due to repair of a channel, it is not necessary perform on both channels.

a. Ensure pulse response has been adjusted in accordance with paragraph 5-35 for the 0.01 VOLT/DIV range on the repaired channel.

b. Set Model 1746A controls as follows:

Coupling (repaired channel) 50Ω
VOLTS/DIV (repaired channel) ..... .01
TIME/DIV (main) ..... .05 μSEC

c. Connect fast-rise pulse generator to repaired channel input and adjust pulse generator amplitude for 5 division display. It may be necessary to use oscilloscope VOLTS/DIV CAL vernier to obtain exactly 5 divisions of display.

d. Observe and note pulse shape and risetime on 0.01 VOLT/DIV range.

e. Change attenuator of repaired channel to 0.5 VOLT/DIV and adjust pulse generator amplitude for exactly 5 divisions of display.

f. Compare 0.5 VOLT/DIV pulse response and risetime with 0.01 VOLT/DIV pulse response and risetime. If pulse response and risetime closely match, no further adjustment is necessary. If the parameters do not match, continue with step g.

g. Note difference of overshoot or undershoot on 0.5 VOLT/DIV range and note the present value of A3R7 (channel A) or A3R28 (channel B). To decrease excessive overshoot, reduce resistance of either A3R7 (channel A) or A3R28 (channel B). To reduce undershoot, increase resistance of either A3R7 or A3R28. Refer to table 5-7 for HP part numbers and resistance values.

Table 5-7. A3R7 and A3R28 Resistance Values

Resistance (Ohms)	HP Part Number
100	0698-7710
121	0698-7214
133	0698-7215
147	0698-7216
162	0698-7217
178	0698-7218
196	0698-7219
215	0698-7220
261	0698-7222

5-37. X-Y GAIN ADJUSTMENT.

Equipment Required:

Test Oscillator ..... HP Model 651B

a. Connect test oscillator to both channels using BNC tee.

b. Adjust test oscillator and channel A VOLTS/DIV for exactly 6 divisions of vertical deflection. Test oscillator should be set for low frequency (<1 kHz).

c. Change sweep mode to A vs B.

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

Table 5-8. Condensed Adjustment Procedure

Adjustment	Procedure
+15 V Adj A16R26	+15 Vdc ±10 mV.
CATHODE ADJ A15R113	-2870 ±100 V at A15TP1
Intensity Limit Adj A15R2	1. Set main sweep to .1 mSEC. 2. Set delayed sweep to 10 μSEC. 3. Adjust so that intensified sweep is just extinguished with BEAM INTENSITY at minimum.
Gate Comp Adj A12R12 and A12C11	1. Set BEAM INTENSITY to midrange. 2. Adjust for fastest rise time with <3% overshoot. Observe trace and adjust for even intensity, particularly at left edge. Check for less than 1 division of baseline loss at fastest sweep speed.
F.G. Adj A16R20	Adjust for uniform illumination at all settings of SCALE ILLUM.
TRACE ALIGN (rear panel) and Y-align (A12R16)	1. Perform TRACE ALIGN first. 2. Apply 10-kHz sine wave to channel A while A VS B mode. 3. Adjust for perpendicular line.
Calibrator Amp 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 circuit recognize a 50-kHz, 20 mV sine wave.
Sync Zero A7R41	1. Apply 1-kHz sine wave. 2 Adjust for no shift in trigger point while switching time base between AC/DC coupling.
Trig View Bal A3R86	1. Apply small sine wave to main EXT TRIGGER. 2. Select TRIG VIEW mode. 3. Adjust to position the triggered display to center screen.
Horizontal Ampl Gain A7R93	1. Adjust for full 10-div baseline. 2. Trigger externally. 3. Position 1st intensified trace at 0.5 and 2nd intensified trace at 9.5 horiz div marks using START and STOP controls respectively. 4. Adjust A7R93 so 1st delayed trace starts at 0 division and 2nd delayed trace ends at 10th division points.

Table 5-8. Condensed Adjustment Procedure (Cont'd)

Adjustment	Procedure
PRELIMINARY MAIN SWEEP CAL A8R43 A8R12 A8R13 A8R14	 1. 1 μSEC range 2. 0.1 mSEC range 3. 10 mSEC range 4. 50 mSEC range
X10 Cal A7R117	1. Apply 1 μs time marks. 2. Set main TIME/DIV for 1 marker/div. 3. Engage MAG X10. 4. Adjust for 1 marker/10 div.
Mag Center A7R105	1. Set main TIME/DIV for 1 μSEC and time-mark generator for 5 μs markers. 2. Center middle time marker. 3. Engage MAG X10. 4. Adjust to re-center marker.
HORIZONTAL LINEARITY A11R10 A11R15	1. Adjust on .05 μSEC range, using MAG X10, observing 10-ns markers.
TIME INTERVAL ADJUSTMENTS ΔT=0 CNTR, A17R30 Gain Equal, A17R35 DVM Zero, A17R42 VM CAL, A17R39	1. Connect DVM to ΔTIME OUT connectors. 2. Set SIGNAL OVERLAY (ΔT=0) to midrange. 3. Apply 0.5 μs time markers. 4. Adjust START control to position intensified spot to second time mark. 5. Set horizontal sweep to DLY'D. 6. Adjust A17R30 to superimpose time marks exactly. 7. Set START control to tenth time marker. 8. Adjust A17R35 to superimpose time marks exactly. 9. Set STOP control exactly on 0.00. 10. Adjust A17R42 for DVM indication of 0.000 ± 0.005. 11. Set STOP control to exactly 10.00. 12. Adjust A17R39 for DVM indication of +5.0[illegible] ± 0.005.

Table 5-8. Condensed Adjustment Procedure (Cont'd)

<table>
<tr><th>Adjustment</th><th>Procedure</th></tr>
<tr><td>Delayed Sweep Calibration
A9R28
A9R10
A9R11</td><td>
<table>
<tr><th>Time Marks and Delayed TIME/DIV</th><th>Adjust</th><th>Tolerance</th></tr>
<tr><td>.05 - 2 µs</td><td>A9R28</td><td>±2%</td></tr>
<tr><td>5 µs - .2 ms</td><td>A9R10</td><td>±2%</td></tr>
<tr><td>.5 ms - 20 ms</td><td>A9R11</td><td>±2%</td></tr>
</table>
</td></tr>
<tr><td>Fine Adjustments

Main Sweep

A8R43
A8R12
A8R13
A8R14</td><td>
1. Use time markers and TIME/DIV settings as indicated below.

2. Set START control so 1st intensified trace coincides with 2nd marker.

3. Set STOP control as indicated.

4. Adjust for marker overlap.

<table>
<tr><th>Time Marks and Main TIME/DIV</th><th>DLY'D TIME/DIV</th><th>STOP DIAL SETTING</th><th>ADJUST</th></tr>
<tr><td>1 µSEC</td><td>.1 µSEC</td><td>8.00</td><td>A8R43</td></tr>
<tr><td>10 µSEC</td><td>1 µSEC</td><td>8.00</td><td>A8R12</td></tr>
<tr><td>1 mSEC</td><td>.1 mSEC</td><td>8.00</td><td>A8R13</td></tr>
<tr><td>50 mSEC</td><td>5 mSEC</td><td>8.00</td><td>A8R14</td></tr>
</table>
</td></tr>
<tr><td>Vertical Amplifier Balance

A3R11

A3R31

A3R18

A3R19

A3R77

A3R76

A3R90</td><td>
1. Connect DVM to A3TP9 and adjust A FET balance for 0 V ±5 mV.

2. Connect DVM to A3TP10 and adjust B FET balance for 0 V ±5 mV.

3. Switch channel A VOLTS/DIV between 0.005 and 0.02 and adjust 5-mV balance for minimum trace shift.

4. Switch channel A VOLTS/DIV between 0.005 and 0.05 and adjust 50-mV balance for minimum trace shift.

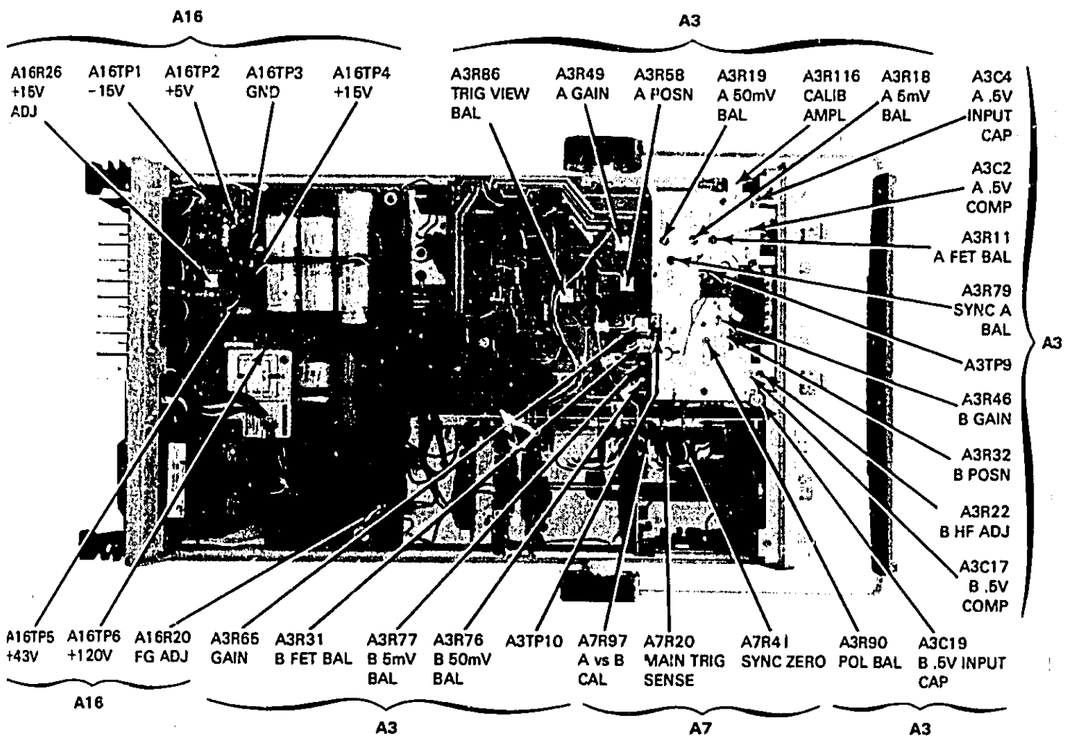
5. Switch channel B VOLTS/DIV between 0.005 and 0.02 and adjust 5-mV balance for minimum trace shift.

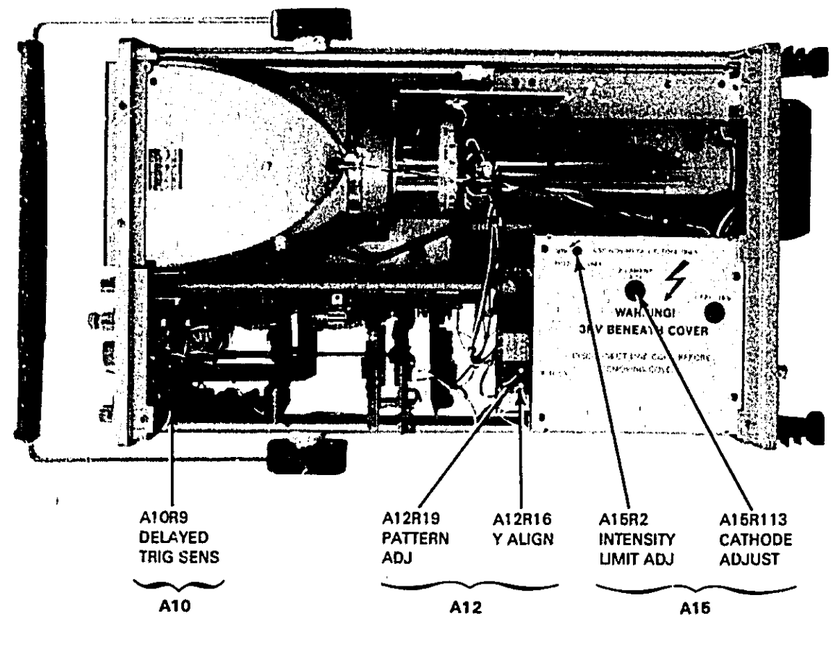
6. Switch channel B VOLTS/DIV between 0.005 and 0.05 and adjust 50-mV balance for minimum trace shift.

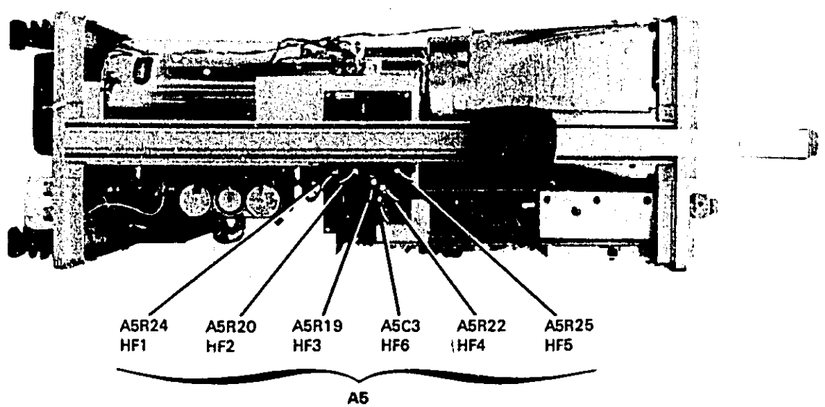
7. Engage/disengage CH B INVT and adjust for minimum trace shift. Readjust A3R77 and A3R76 if necessary.
</td></tr>
</table>

Table 5-8. Condensed Adjustment Procedure (Cont'd)

Adjustment	Procedure
Position and Sync Balance A3R32 A3R79 A3R58	1. Select B DISPLAY; switch between normal and MAG X5, and adjust channel B POSN for minimum trace shift. 2. Apply 10-kHz sine wave to both channels. Select ALT mode and COMP TRIGGER, and adjust sync A balance for stable triggering and minimum phase shift. Readjust A3R18 and A3R19 if necessary. 3. Select A DISPLAY; switch between normal and MAG X5, and adjust channel A position for minimum trace shift.
Input C and Attenuator Compensation (Channel A) A3C2 A3C4	1. Apply 10-kHz square wave, and adjust 0.5V comp for best response. 2. Adjust 0.5 V input cap to make 0.5 VOLTS/DIV range match reading on 0.2 range (19.5 to 21.5 pF).
Input C and Attenuator Compensation (Channel B) A3C17 A3C19	1. Apply 10-kHz square wave, and adjust 0.5V comp for best response. 2. Adjust 0.5 V input cap to make 0.5 VOLTS/DIV range match reading on 0.2 range (19.5 to 21.5 pF).
Gain A3R49 A3R49 A3R65	1. Channel A fine gain. 2. Channel B fine gain. 3. Composite gain.
Pulse Response A5R22 A5R19 A5R20 A5R24 and A5R25 A5C3 A3R22	1. Long time constant. 2. Medium time constant. 3. Short time constant. 4. Short time constant. 5. Very short time constant. 6. Adjust to make channel B most resemble channel A.
X-Y Gain A7R97	Adjust for same gain on X-axis as on Y-axis.







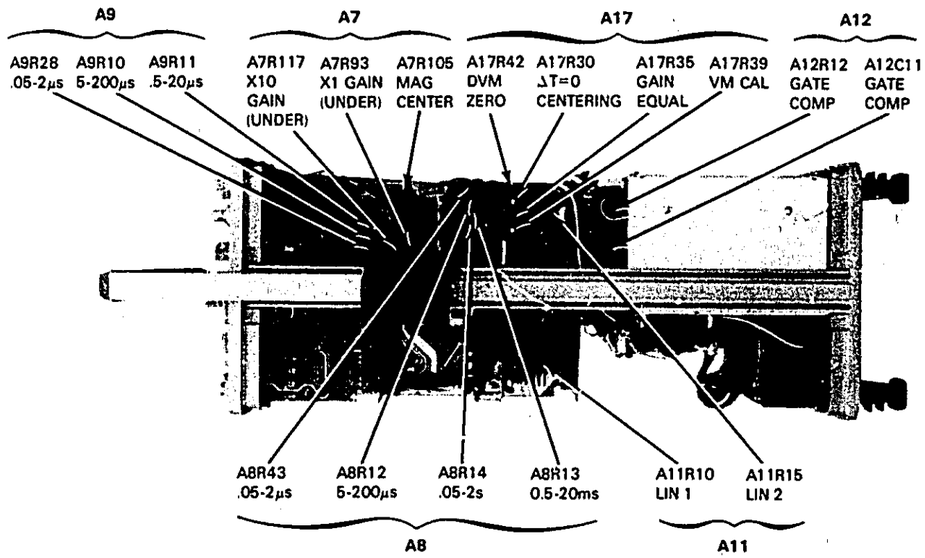


Figure 5-1.
Adjustment Locations

PARTS LIST

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 lists. Table 6-2 lists all replaceable parts in reference designator order. Table 6-3 contains the names and addresses that correspond to the manufacture's code numbers. Figure 6-1 shows the illustrated parts breakdown.

6-3. ABBREVIATIONS.

6-4. Table 6-1 lists abbreviations used in the parts lists, the schematics, and throughout this manual. The abbreviations in the parts list are always capital letters. However, in other parts of the manual abbreviations may be 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. Electrical assemblies in alphanumerical order by reference designation.

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

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

The information given for each part consists of the following:

a. Reference designation.

b. Hewlett-Packard part number.

c. Part number Check Digit (CD).

d. Total quantity (QTY) in instrument (or on assembly).

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

e. Description of part.

f. Typical manufacturer of part in an identifying five-digit code.

6-4. ORDERING INFORMATION.

To order a part listed in the material lists, quote the Hewlett-Packard part number, indicate the quantity desired, and address the order to the nearest Hewlett-Packard Sales/Service Office.

To order a part that is not listed in the material lists, include the instrument model number, instrument serial number, a description of the part (including its function), and the number of parts required. Address the order to the nearest Hewlett-Packard Sales/Service Office.

6-5. DIRECT MAIL ORDER SYSTEM.

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

a. Direct ordering and shipment from the Hewlett-Packard Parts Center in Mountain View, California.

b. No maximum or minimum on any mail order (there is a minimum order amount for parts ordered through a local Hewlett-Packard office when the orders require billing and invoicing).

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

d. No invoices.

To provide these advantages, a check or money order must accompany each order.

Mail order forms and specific ordering information is available through your local Hewlett-Packard office. Addresses and phone numbers are located at the back of this manual.

Table 6-1. Reference Designators and Abbreviations

REFERENCE DESIGNATORS

A	= assembly	F	= fuse	Q	= transistor, SCR, triode thyristor	U	= integrated circuit, microcircuit
B	= fan, motor	FL	= filter	R	= resistor	V	= electron tube, glow lamp
BT	= battery	H	= hardware	RT	= thermistor	VR	= voltage regulator, breakdown diode
C	= capacitor	J	= electrical connector (stationary portion), jack	S	= switch, jumper	W	= cable
CR	= diode, diode thyristor, varactor	L	= coil, inductor	T	= transformer	X	= socket
DL	= delay line	MP	= misc mechanical part	TB	= terminal board	Y	= crystal unit (piezoelectric or quartz)
DS	= annunciator, lamp, LED	P	= electrical connector (movable portion), plug	TP	= test point		
E	= misc. electrical part						

ABBREVIATIONS

A	= amperes	DWL	= dowel	MFR	= manufacturer	RND	= round
A/D	= analog-to-digital	ECL	= emitter coupled logic	MICPROC	= microprocessor	ROM	= read-only memory
AC	= alternating current	ELAS	= elastomeric	MINTR	= miniature	RPG	= rotary pulse generator
ADJ	= adjustment	EXT	= external	MISC	= miscellaneous	RX	= receiver
AL	= aluminum	F	= farads, metal film (resistor)	MLD	= molded	S	= Schottky-clamped, seconds (time)
AMPL	= amplifier			MM	= millimeter		
ANLG	= analog	FC	= carbon film/ composition	MO	= metal oxide	SCR	= screw, silicon controlled rectifier
ANSI	= American National Standards Institute			MTG	= mounting		
		FD	= feed	MTLC	= metallic	SEC	= second (time), secondary
ASSY	= assembly	FEM	= female	MUX	= multiplexer	SEG	= segment
ASTIG	= astigmat.	FF	= flip-flop	MW	= milliwatt	SEL	= selector
ASYNCHRO	= asynchron.	FL	= flat	N	= nano (10-9)	SGL	= single
ATTEN	= attenuator	FM	= foam,from	NC	= no connection	SHF	= shift
AWG	= American wire gauge	FR	= front	NMOS	= n-channel metal-oxide-semiconductor	SI	= silicon
BAL	= balance	FT	= gain bandwidth product			SIP	= single in-line package
BCD	= binary-coded decimal			NPN	= negative-positive-negative	SKT	= skirt
BD	= board	FW	= full wave			SL	= slide
BFR	= buffer	FXD	= fixed	NPRN	= neoprene	SLDR	= solder
BIN	= binary	GEN	= generator	NRFR	= not recommended for field replacement	SLT	= slotted
BRDG	= bridge	GND	= grounded			SOLD	= solenoid
BSHG	= bushing	GP	= general purpose	NSR	= not separately replaceable	SPCL	= special
BW	= bandwidth	GRAT	graticule			SQ	= square
C	= ceramic; cermet (resistor)	GRV	= groove	NUM	= numeric	SRCG	= shift register
CAL	= calibrate; calibration	H	= henries, high	OBD	= order by description	SRQ	= service request
CC	= carbon composition	HD	= hardware	OCTL	= octal	STAT	= static
CCW	= counterclockwise	HDND	= hardened	OD	= outside diameter	STD	= standard
CER	= ceramic	HG	= mercury	OPAMP	= operational amplifier	SYNCHRO	= synchronous
CFM	= cubic feet/minute	HGT	= height	OSC	= oscillator	TA	= tantalum
CH	= choke	HLCL	= helical	P	= plastic	TBAX	= tubeaxial
CHAM	= chamfered	HORIZ	= horizontal	P/O	= part of	TC	= temperature coefficient
CHAN	= channel	HP	= Hewlett-Packard	PC	= printed circuit	TD	= time delay
CHAR	= character	HP-IB	= Hewlett-Packard Interface Bus	PCB	= printed circuit board	THD	= threaded
CM	= centimeter			PD	= power dissipation	THK	= thick
CMOS	= complementary metal-oxide-semiconductor	HR	= hours	PF	= picofarads	THRU	= through
		HV	= high voltage	PI	= plug in	TP	= test point
CMR	= common mode rejection	HZ	= Hertz	PL	= plated	TPG	= tapping
CNDCT	= conductor	I/O	= input/output	PLA	= programmable logic array	TPL	= triple
CNTR	= counter	IC	= integrated circuit			TRANS	= transformer
CON	= connector	ID	= inside diameter	PLST	= plastic	TRIG	= triggered
CONT	= contact	IN	= inch	PNP	= positive-negative-positive	TRMR	= trimmer
CRT	= cathode-ray tube	INCL	= includes			TRN	= turns
CW	= clockwise	INCAND	= incandescent	POLYE	= polyester	TTL	= transistor-transistor
D	= diameter	INP	= input	POS	= positive, position	TX	= transmitter
D/A	= digital-to-analog	INTEN	= intensity	POT	= potentiometer	U	= micro (10-6)
DAC	= digital-to-analog converter	INTL	= internal	POZI	= pozidrive	UL	= Underwriters Laboratory
		INV	= inverter	PP	= peak-to-peak	UNREG	= unregulated
DARL	= darlington	JFET	= junction field-effect transistor	PPM	= parts per million	VA	= voltampere
DAT	= data			PRCN	= precision	VAC	= volt, ac
DBL	= double	JKT	= jacket	PREAMP	= preamplifier	VAR	= variable
DBM	= decibel referenced to 1 mW	K	= kilo (103)	PRGMBL	= programmable	VCO	= voltage-controlled oscillator
		L	= low	PRL	= parallel		
DC	= direct current	LB	= pound	PROG	= programmable	VDC	= volt, dc
DCDR	= decoder	LCH	= latch	PSTN	= position	VERT	= vertical
DEG	= degree	LCL	= local	PT	= point	VF	= voltage, filtered
DEMUX	= demultiplexer	LED	= light-emitting diode	PW	= potted wirewound	VS	= versus
DET	= detector	LG	= long	PWR	= power	W	= watts
DIA	= diameter	LI	= lithium	R-S	= reset-set	W/	= with
DIP	= dual in-line package	LK	= lock	RAM	= random-access memory	W/O	= without
DIV	= division	LKWR	= lockwasher	RECT	= rectifier	WW	= wirewound
DMA	= direct memory access	LS	= low power Schottky	RET	= retainer	XSTR	= transistor
DPDT	= double-pole, double-throw	LV	= low voltage	RF	= radio frequency	ZNR	= zener
		M	= mega (106, megohms, meter (distance)	RGLYR	= regulator	°C	= degree Celsius (Centigrade)
DRC	= DAC refresh controller			RGTR	= register		
DRVR	= driver	MACH	= machine	RK	= rack	°F	= degree Fahren
		MAX	= maximum	RMS	= root-mean-square	°K	= degree Kelvin

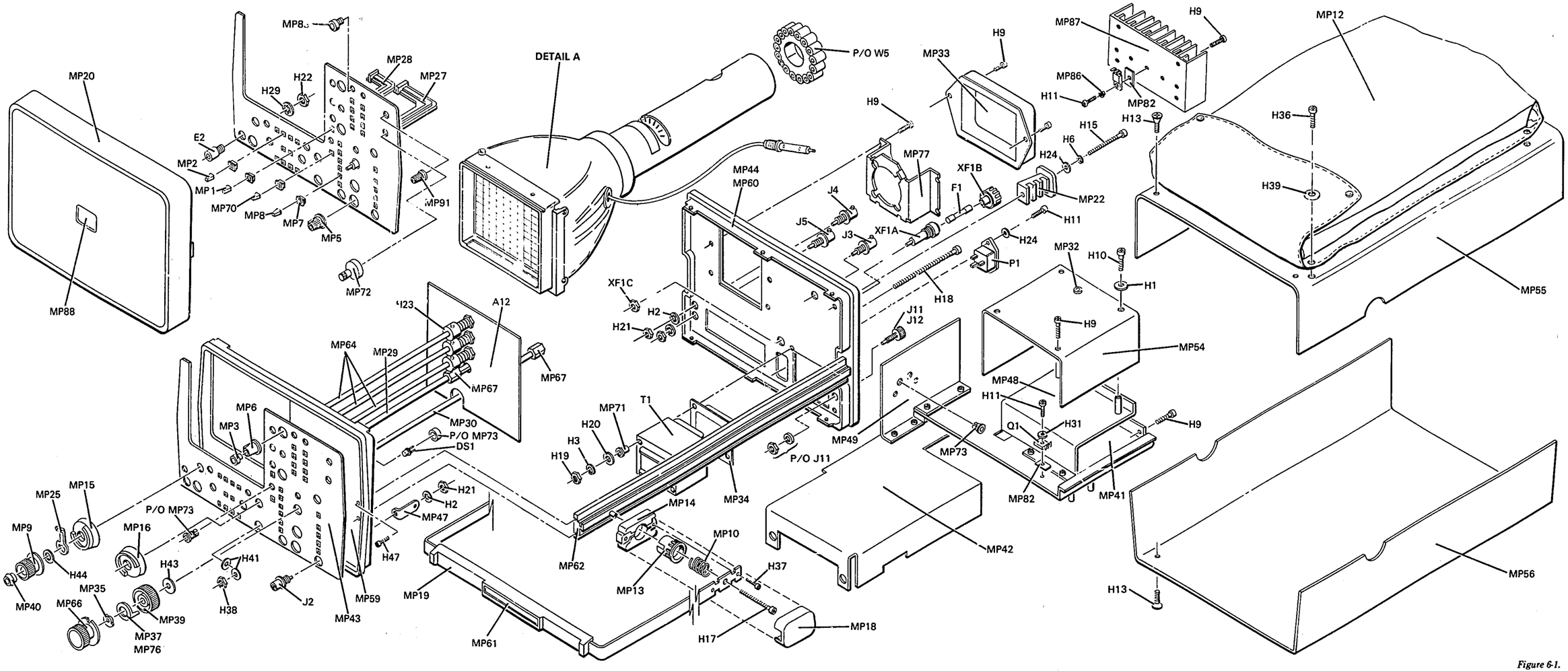
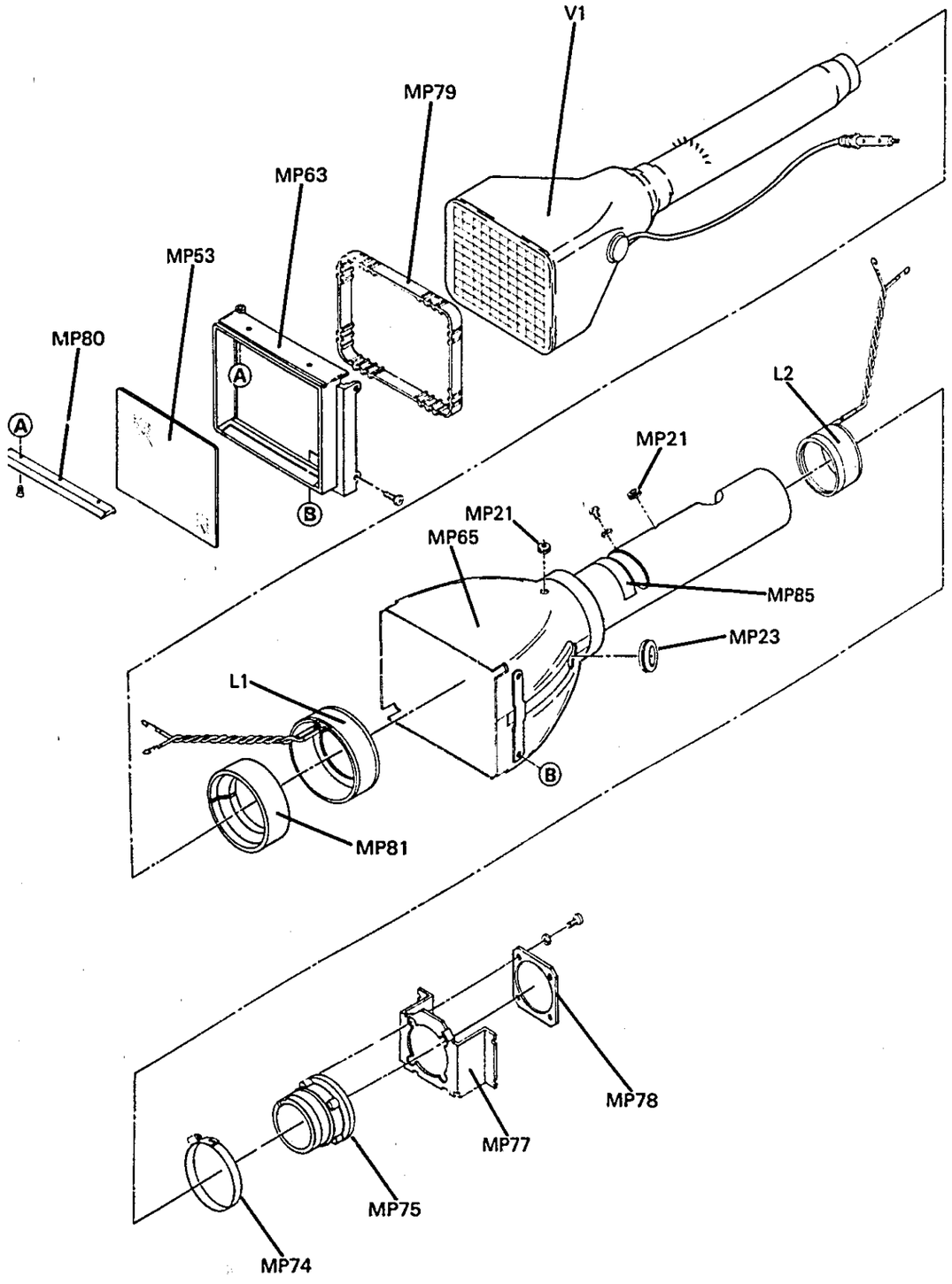


Figure 6-1.
Chassis Parts and Board Assembly Identification (Sheet 1 of 2)



DETAIL A

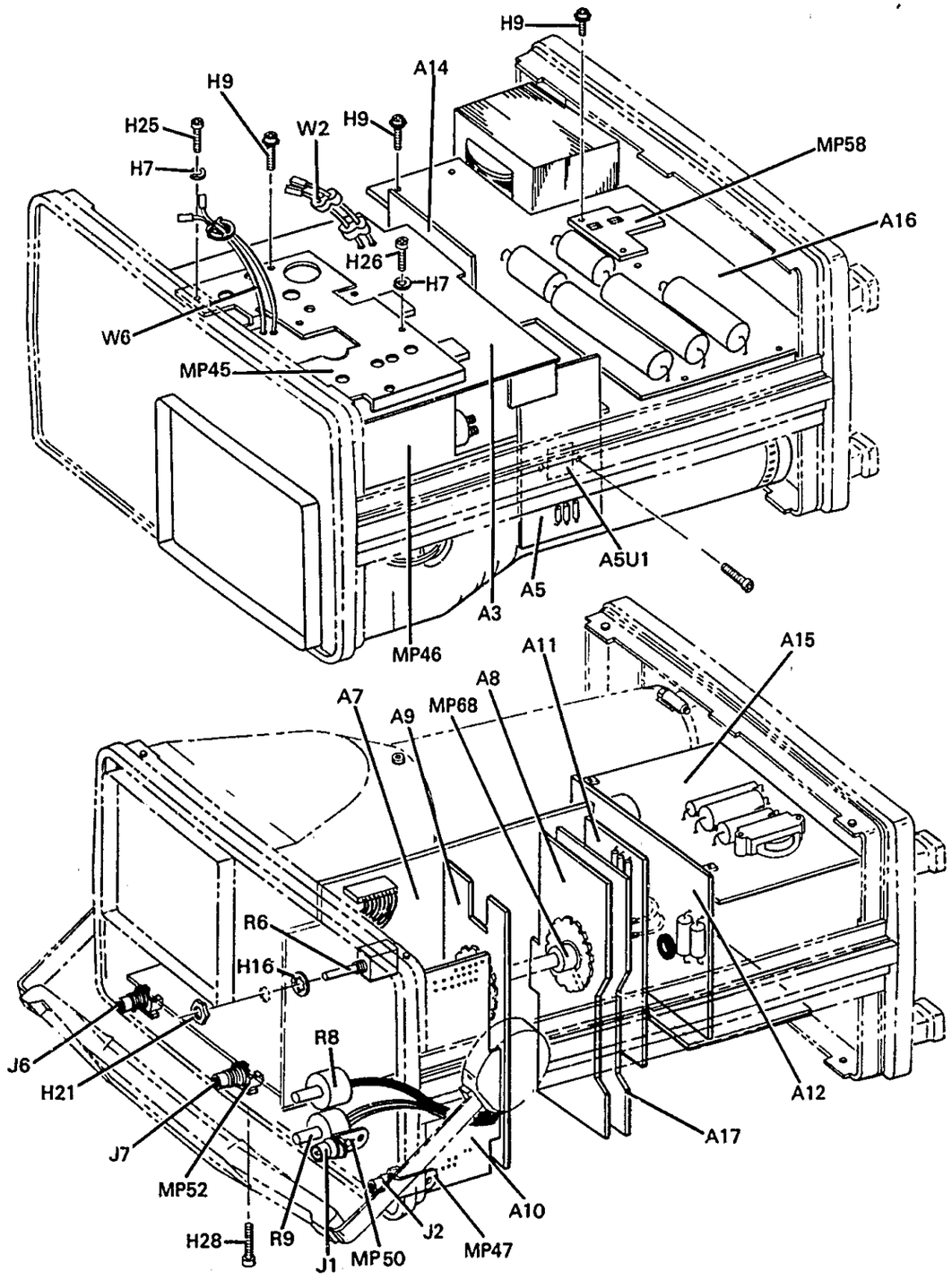


Figure 6-1. Chassis Parts and Board Assembly Identification (Sheet 2 of 2)

Table 6-2. Replaceable Parts

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	01740-63401	0	1	ATTEN ASSY "A" (LEFT)	28480	01740-63401
A2	01740-63402	1	1	ATTEN ASSY "B" (RIGHT)	28480	01740-63402
A3	01740-66596	0	1	BOARD ASSY-V PREAMP	28480	01740-66596
A4	01740-61611	0	1	CABLE ASSEMBLY-DELAY LINE	28480	01740-61611
A5	01745-66503	4	1	BOARD ASSY-VERT OUTPUT	28480	01745-66503
A6	0960-0117	6	1	H.V. MULTIPLIER ASSEMBLY	28480	0960-0117
A7	01743-66518	9	1	HORIZONTAL MOTHERBOARD ASSY	28480	01743-66518
A8	01740-66568	6	1	BOARD ASSY-MAIN SWEEP	28480	01740-66568
A9	01740-66565	3	1	BOARD ASSY-DELAY SWEEP	28480	01740-66565
A10	01745-66504	5	1	BOARD ASSY-DELAY TRIGGER	28480	01745-66504
A11	01740-66569	7	1	BOARD ASSY-HORIZONTAL OUTPUT	28480	01740-66569
A12	01745-66501	2	1	BOARD ASSY-GATE	28480	01745-66501
A13	01740-66564	2	1	BOARD ASSY-VERT LOGIC	28480	01740-66564
A14	01740-66540	4	1	BOARD ASSY-INTERFACE	28480	01740-66540
A15	01745-66502	3	1	BOARD ASSY-H.V. POWER	28480	01745-66502
A16	01740-66594	8	1	BOARD ASSY-L.V. POWER	28480	01740-66594
A17	01742-66502	0	1	BOARD ASSEMBLY-DECODING	28480	01742-66502
C2	0160-3592	1	1	CAPACITOR-FXD 2.4PF ±.5PF 200VDC CER	28480	0160-3592
DS1	1990-0485	5	1	LED-VISIBLE (GREEN)	28480	5082-4984
DS2	1990-0487	7	4	LED-VISIBLE (YELLOW)	28480	5082-4584
DS3	1990-0487	7		LED-VISIBLE (YELLOW)	28480	5082-4584
DS4	1990-0487	7		LED-VISIBLE (YELLOW)	28480	5082-4584
DS5	1990-0487	7		LED-VISIBLE (YELLOW)	28480	5082-4584
E1	01740-61203	6	1	GROUND STRAP	28480	01740-61203
E2	1510-0038	8	1	BINDING POST ASSY SGL THD-STUD	28480	1510-0038
E3	9170-0016	8	3	CORE-SHIELDING BEAD	28480	9170-0016
E4	9170-0016	8		CORE-SHIELDING BEAD	28480	9170-0016
E5	9170-0016	8		CORE-SHIELDING BEAD	28480	9170-0016
F1	2110-0007	4	2	FUSE 1A 250V TD 1.25X.25 UL	75915	313001
F1	2110-0202	1	2	FUSE .5A 250V TD 1.25X.25 UL	75915	313.500
H1	2190-0005	0	9	WASHER-LK EXT T NO. 4 .115-IN-ID	28480	2190-0005
H2	2190-0016	3	10	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
H3	2190-0017	4	4	WASHER-LK HLCL NO. 8 .168-IN-ID	28480	2190-0017
H4	2190-0018	5	2	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0018
H5	2190-0019	6	7	WASHER-LK HLCL NO. 4 .115-IN-ID	28480	2190-0019
H6	2190-0006	1	4	WASHER-LK HLCL NO. 6 .141-IN-ID	28480	2190-0006
H7	2190-0112	0	6	WASHER-LK HLCL NO. 2 .068-IN-ID	28480	2190-0112
H8	2190-0033	4	1	WASHER-LK INTL T 5/16 IN .314-IN-ID	28480	2190-0033
H9	2200-0106	4	39	SCREW-MACH 4-40 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H10	2200-0123	6	2	SCREW-MACH 4-40 1.25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H11	2200-0113	0	9	SCREW-MACH 4-40 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H12	2200-0149	6	3	SCREW-MACH 4-40 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H13	2200-0762	9	8	SCREW-MACH 4-40 .25-IN-LG TR-HD-POZI	00000	ORDER BY DESCRIPTION
H14	2260-0002	6	10	NUT-HEX-DBL-CHAM 4-40-THD .062-IN-THK	00000	ORDER BY DESCRIPTION
H16	2190-0056	1	1	WASHER-LK INTL T 3/8 IN .42-IN-ID	28480	2190-0056
H17	2510-0111	9	2	SCREW-MACH 8-32 .75-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H18	2510-0138	0	4	SCREW-MACH 8-32 3-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H19	2580-0004	A	4	NUT-HEX-DBL-CHAM 8-32-THD .125-IN-THK	00000	ORDER BY DESCRIPTION
H20	3050-0071	B	7	WASHER-FL MTLC NO. 8 .16[illegible]-IN-ID	28480	3050-0071
H21	2950-0043	8	15	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
H22	2950-0072	3	2	NUT-HEX-DBL-CHAM 1/4-32-THD .062-IN-THK	00000	ORDER BY DESCRIPTION
H23	3030-0196	3	6	SCREW-SET 4-40 .188-IN-LG SMALL CUP-PT	00000	ORDER BY DESCRIPTION
H24	3050-0010	2	15	WASHER-FL MTLC NO. 6 .147-IN-ID	28480	3050-0010
H25	0620-0127	6	2	SCREW-MACH 2-56 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H26	0620-0136		4	SCREW-MACH 2-56 .625-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H27	0624-0306	3	2	SCREW-TPG 2-28 .5-IN-LG PAN-HD-POZI STL	28480	0624-0306
H28	0624-0313	2	4	SCREW-TPG 4-20 1-IN-LG PAN-HD-POZI STL	28480	0624-0313
H29	2190-0084	5	1	WASHER-LK INTL T 1/4 IN .256-IN-ID	28480	2190-0084
H30	2190-0655	5	1	WASHER-LK INTL T 3/8 IN .384-IN-ID	28480	2190-0655
H31	2190-0910	6	2	WASHER-LK INTL T NO. 4 .12-IN-ID	28480	2190-0910
H32	2200-0092	8	4	SCREW-MACH 4-40 .125-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
H33	2200-0101	0	1	SCREW-MACH 4-40 .188-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H34	2200-0117	8	1	SCREW-MACH 4-40 .875-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H35	2200-0165	6	2	SCREW-MACH 4-40 .25-IN-LG 82 DEG	00000	ORDER BY DESCRIPTION
H36	2950-0035	8	2	NUT-HEX-DBL-CHAM 15/32-32-THD	00000	ORDER BY DESCRIPTION
H40	3050-0105	6	3	WASHER-FL MTLC NO. 4 .125-IN-ID	28480	3050-0105
H41	3050-0160	3	4	WASHER-FL MTLC 7/16 IN .47-IN-ID	28480	3050-0160
H42	3050-0437	7	6	WASHER-SPR CRVD NO. 4 .128-IN-ID	28480	3050-0437
H43	3050-0481	1	1	WASHER-FL NM NO. 12 .25-IN-ID .75-IN-OD	28480	3050-0481
H44	3050-0655	1	2	WASHER-FL NM NO. 6 .156-IN-ID .375-IN-OD	28480	3050-0655
H45	0624-0206	2	2	SCREW-TPG 6-32 .25-IN-LG PAN-HD-POZI STL	28480	0624-0206
H46	0624-0208	4	4	SCREW-TPG 6-32 .5-IN-LG PAN-HD-POZI STL	28480	0624-0208
H47	0624-0279	9	8	SCREW-TPG 8-32 .75-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H48	2360-0113	2	4	SCREW-MACH 6-32 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H49	2360-0135	8	4	SCREW-MACH 6-32 1.5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
H50	2360-0197	2	8	SCREW-MACH 6-32 .375-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H51	3050-0099	7	3	WASHER-FL MTLC NO. 12 .25-IN-ID .5-IN-OD	28480	3050-0099
H52	3050-0386	5	2	WASHER-SHLDR 1/4 IN .25-IN-ID .5-IN-OD	28480	3050-0386
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 FEM SGL-HOLE-RR 50-OHM	28480	1250-0524
J7	1250-0524	5		CONNECTOR-RF BNC FEM SGL-HOLE-RR 50-OHM	28480	1250-0524
J11	1251-0468	8	2	CONNECTOR-BNA SINGLE	28480	1251-0468
J12	1251-0468	8		CONNECTOR-BNA SINGLE	28480	1251-0468
L1	01980-65601	6	1	COIL ASSY	28480	01980-65601
L2	01701-66001	5	1	COIL ASSEMBLY-ALIGN	28480	01701-66001
MP1	0370-0603	4	1	PUSHBUTTON-MEDIUM GRAY	28480	0370-0603
MP2	0370-0683	0	10	PUSHBUTTON-OLIVE BLACK	28480	0370-0683
MP3	0370-3042	1	1	KNOB-CONC (ROUND)	28480	0370-3042
MP4	0370-1005	2	5	KNOB-JADE GRAY	28480	0370-1005
MP5	0370-1099	4	4	KNOB-JADE GRAY	28480	0370-1099
MP6	0370-1100	8	1	KNOB-JADE GRAY	28480	0370-1100
MP7	0170-2626	5	31	BEZEL-PUSHBUTTON (GRAY)	28480	0370-2626
MP8	0370-0604	5	16	PUSHBUTTON-JADE GRAY	28480	0370-0604
MP9	0370-2783	5	2	KNOB-SKIRT 0.750	28480	0370-2783
MP10	1460-0604	7	2	SPRING-COMPRESSION	28480	1460-0604
MP11	01727-01205	5	1	CLAMP-H.V.	28480	01727-01205
MP12	1540-0292	9	1	CASE-ACCESSORY	28480	1540-0292
MP13	5020-8733	1	2	GEAR-HUB HANDLE	28480	5020-8733
MP14	5020-8788	6	2	GEAR-RING HANDLE	28480	5020-8788
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-FOCUS POT	28480	5040-0421
MP18	5040-0611	9	2	CAP-TRIM HANDLE	28480	5040-0611
MP19	5041-2625	2	1	GRIP-HANDLE	28480	5041-2625
MP20	5040-0516	4	1	COVER-PANEL	28480	5040-0516
MP21	0400-0002	2	2	GROMMET-RND .188-IN-ID .312-IN-GRV-OD	28480	0400-0002
MP22	5040-7829	6	4	FOOT-CORD WRAP	28480	5040-7829
MP23	0400-0001	1	1	GROMMET-RND .562-IN-ID .75-IN-GRV-OD	28480	0400-0001
MP24	5041-3124	8	4	PUSH ROD	28480	5041-3124
MP25	5041-3196	4	2	COUPLER-LEVER	28480	5041-3196
MP27	5040-7706	7	4	EXTENDER-PUSHBUTTON	28480	5040-7706
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
MP31	01745-01206	7	1	BRACKET-HORIZ BOARD	28480	01745-01206
MP32	0400-0010	2	2	GROMMET-RND .25-IN-ID .375-IN-GRV-OD	28480	0400-0010
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 (ROUND)	28480	01720-22501
MP36	01720-23705	9	1	SHAFT-DELAYED SWEEP	28480	01720-23705
MP37	0350-0999	9	1	KNOB-DECAL	28480	0350-0999
MP38	01743-63701	6	1	SHAFT ASSEMBLY-MAIN SWITCH	28480	01743-63701
MP39	01745-67401	3	1	KNOB-SWEEP	28480	01745-67401
MP40	0370-3043	2	2	KNOB-CONC (ROUND)	28480	0370-3043
MP41	01745-00102	1	1	DECK-REAR	28480	01745-00102
MP42	01745-00101	0	1	DECK-FRONT	28480	01745-00101
MP43	01745-00201	1	1	PANEL-FRONT	28480	01745-00201
MP44	01745-00202	2	1	PANEL-REAR	28480	01745-00202
MP45	01740-00601	0	1	SHIELD-PREAMPL	28480	01740-00601
MP46	01745-00601	5	1	SHIELD-CAL	28480	01745-00601
MP47	01740-01201	6	1	BRACKET-DELAY TRIGGER	28480	01740-01201
MP48	01740-01202	9	1	BRACKET-H.V.	28480	01740-01202
MP49	01745-01201	3	1	BRACKET-VERT OUTPUT	28480	01745-01201
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	1000-0649	6	1	CONTRAST FILTER	28480	1000-0649
MP54	01745-04101	8	1	COVER-H.V.	28480	01745-04101
MP55	01740-04102	4	1	COVER-TOP	28480	01740-04102
MP56	01740-04108	0	1	COVER-BOTTOM	28480	01740-04108
MP58	01740-04109	1	1	COVER-LINE	28480	01740-04109
MP59	01745-20501	6	1	FRAME-FRONT	28480	01745-20501
MP60	01745-20502	7	1	FRAME-REAR	28480	01745-20502
MP61	7121-3753	1	1	LABEL-HANDLE	28480	7121-3753
MP62	01740-23701	9	2	RAIL-SIDE	28480	01740-23701
MP63	5041-3198	6	1	BEZEL-CRT	28480	5041-3198
MP64	01740-43901	3	3	SHAFT-EXTENSION	28480	01740-43901
MP65	01745-60601	1	1	SHIELD ASSY-CRT	28480	01745-60601

See introduction to this section for ordering informatic.

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
MP66	01740-67402	9	1	KNOB-MAIN SWEEP	28480	01740-67402
MP67	01830-23201	3	2	COUPLER-SWITCH EXTENSION	28480	01830-23201
MP68	0510-0641	7	1	SHAFT-COLLAR (STL)	28480	0510-0641
MP69	1410-0094	4	2	PANEL BUSHING- 3/8-32	28480	1410-0094
MP70	0370-2862	1	1	PUSHBUTTON- CORP WHITE	28480	0370-2862
MP71	0390-0006	3	4	BUSHING-INSULATOR	28480	0390-0006
MP72	1140-0068	9	1	DIAL-TURNS COUNT	28480	1140-0068
MP73	1400-1213	0	7	COMPONENT-CLIP	28480	1400-1213
MP74	1400-1163	9	1	HOSE CLAMP	28480	1400-1163
MP75	5041-3145	3	1	COLLAR-SUP CRT	28480	5041-3145
MP76	5040-5952	2	1	CORE-FLOATING	28480	5040-5952
MP77	01745-01204	6	1	BRACKET-CRT MOUNT	28480	01745-01204
MP78	01980-01227	6	1	CLAMP RING-CRT MOUNT	28480	01980-01227
MP79	5041-3042	9	1	SHOCK MOUNT BELT-CRT	28480	5041-3042
MP80	5041-3197	5	3	RETAINER/FILTER	28480	5041-3197
MP81	1520-0231	4	1	SHOCK MOUNT	28480	1520-0231
MP82	0340-0949	8	7	INSULATOR	28480	0340-0949
MP83	1400-0017	0	1	CLAMP-CABLE .312-DIA .375-WD NYL	28480	1400-0017
MP84	0510-0027	4	2	RETAINER-PUSHON	28480	0510-0027
MP85	7121-0333	7	1	LABEL-CRT	28480	7121-0333
MP86	3050-0791	6	5	INSULATOR-TRANSISTOR (NYLON)	28480	3050-0791
MP87	01743-21101	2	1	HEAT SINK	28480	01743-21101
MP88	7120-4184	2	1	LABEL-COVER	28480	7120-4184
MP89	1490-0968	9	1	BUSHING-POTENTIOMETER	28480	1490-0968
MP90	1400-0333	8	1	CLAMP-CABLE	28480	1400-0333
MP91	0370-1001	8	1	KNOB-JADE GRAY	28480	0370-1001
P1	1251-2357	8	1	CONNECTOR-AC PWR HP-9 MALE FLG-MTG	28480	1251-2357
Q1	1854-0433	5	1	TRANSISTOR NPN SI PD=90W FT=2MHZ	28480	1854-0433
Q2	1854-0803	3	1	TRANSISTOR NPN SI TO-220AB PD=2W FT=4MHZ	01295	TIP75B
Q3	1854-0370	9	4	TRANSISTOR NPN 2N5294 SI PD=1 8W	3L585	2N5294
Q4	1854-0370	9		TRANSISTOR NPN 2N5294 SI PD=1 8W	3L585	2N5294
Q5	1854-0370	9		TRANSISTOR NPN 2N5294 SI PD=1 8W	3L585	2N5294
Q6	1854-0370	9		TRANSISTOR NPN 2N5294 SI PD=1 8W	3L585	2N5294
R3	0683-4705	8	2	RESISTOR 47 5% 25W FC TC=-400/+500	01121	CB4705
R3	0684-6801	1	2	RESISTOR 68 10% 25W FC TC=-400/+500	01121	CB6801
R4	0683-4705	8		RESISTOR 47 5% 25W FC TC=-400/+500	01121	CB4705
R4	0684-6801	1		RESISTOR 68 10% 25W FC TC=-400/+500	01121	CB6801
R5	0684-4701	6	1	RESISTOR 15 5% 25W FC TC=-400/+500	01121	CB4701
R6	2100-1443	3	1	RESISTOR-VAR PREC WW 10-TRN 50K 3%	28480	2100-1443
R7	0684-1021	7	1	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 SPST-NC	28480	2100-3397
R10	0683-1505	0		RESISTOR 15 5% 25W FC TC=-400/+500	01121	CB1505
R11	2100-3731	6	1	RESISTOR-VAR DUAL 20K-20%-CP 20K-20%-CP	28480	2100-3731
S1	3101-2312	0	1	SWITCH-TGL SUBMIN DPDT 2A 250VAC	28480	3101-2312
T1	9100-2619	4	1	TRANSFORMER	28480	9100-2619
V1	5083-5652	0	1	CRT-P31 ALIGN	28480	5083-5652
W1	8120-1521	6	1	POWER CORD 7 5 FT	28480	8120-1521
W2	01740-61602	9	1	CABLE ASSEMBLY-SYNC (TWIN LEAD)	28480	01740-61602
W3	01742-61602	1	1	CABLE ASSEMBLY FRONT PANEL	28480	01742-61602
W4	01745-61605	7	1	CABLE ASSEMBLY-HORIZONTAL	28480	01745-61605
W5	01745-61601	3	1	CABLE ASSEMBLY-GTE/CRT	28480	01745-61601
W6	01740-61609	6	1	CABLE ASSEMBLY-TRIGGER VIEW	28480	01740-61609
W7	01743-61611	3	1	CABLE ASSEMBLY-HOR/POS/D	28480	01743-61611
W8	01745-61603	5	1	CABLE ASSEMBLY-SCALE ILL	28480	01745-61603
W9	01745-61602	4	1	CABLE ASSEMBLY-CRT BASE	28480	01745-61602
W10	01745-61604	6	1	CABLE ASSEMBLY-FOCUS POT	28480	01745-61604
W11	01740-61631	4	5	CABLE ASSEMBLY-3 CONTACT	28480	01740-61631
XF1A	2110-0664	8	1	FUSEHOLDER BODY 12A MAX FOR UL	H9027	031 1657
XF1B	2110-0565	9	1	FUSEHOLDER CAP 12A MAX FOR UL	28480	2110-0565
XF1C	2110-0669	3	1	FUSEHOLDER COMPONENT NUT, THREAD M12 7	28480	2110-0669

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A1	01740-63401	0	1	ATTENUATOR ASSEMBLY "A" (LEFT)	28480	01740-63401
A1H1	2950-0072	3	1	NUT-HEX-DBL-CHAM 1/4-32-THD .062-IN-THK	00000	ORDER BY DESCRIPTION
A1MP1	01740-01205	2	1	BRACKET-VERNIER	28480	01740-01205
A1MP2	5040-0218	3	1	COUPLER	28480	5040-0218
A1R1	2100-3551	8	1	RESISTOR-VAR W/SW 100 10% LIN DPST-NC-NO	28480	2100-3551
A2	01740-63402	1	1	ATTENUATOR ASSEMBLY "B" (RIGHT)	28480	01740-63402
A2H1	2950-0072	3	1	NUT-HEX-DBL-CHAM 1/4-32-THD .062-IN-THK	00000	ORDER BY DESCRIPTION
A2MP1	01740-01205	2	1	BRACKET-VERNIER	28480	01740-01205
A2MP2	5040-0218	3	1	COUPLER	28480	5040-0218
A2R1	2100-3551	8	1	RESISTOR-VAR W/SW 100 10% LIN DPST-NC-NO	28480	2100-3551
A3	01740-66596	0	1	V-PREAMP BOARD ASSEMBLY	28480	01740-66596
A3A1	5081-3030	9	1	IC-VERTICAL PREAMPLIFIER	28480	5081-3030
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	2	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	1	CAPACITOR-FXD 33PF ±5% 300VDC MICA	28480	0160-2150
A3C6	0160-4751	6	3	CAPACITOR-FXD 1000PF ±10% 1KVDC CER	28480	0160-4751
A3C7	0160-3799	0	1	CAPACITOR-FXD 18PF ±10% 100VDC CER	28480	0160-3799
A3C8	0160-2055	9	21	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C9	0160-3508	9	2	CAPACITOR-FXD 1UF +80-20% 50VDC CER	28480	0160-3508
A3C10	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C11	0180-0648	4	2	CAPACITOR-FXD .1UF±10% 35VDC TA	90201	TDC104K035NSE
A3C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C13	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
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	0160-4751	6		CAPACITOR-FXD 1000PF ±10% 1KVDC CER	28480	0160-4751
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	1	CAPACITOR-FXD 20PF ±5% 300VDC MICA	28480	0160-2198
A3C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C22	0160-3451	1	4	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C23	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C24	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C25	0180-0648	4		CAPACITOR-FXD .1UF±10% 35VDC TA	90201	TDC104K035NSE
A3C26	0160-3443	1	2	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A3C27	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C28	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C29	0180-0374	3	2	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	28480	0180-2255
A3C34	0180-2255	3		CAPACITOR-FXD 2.2UF±20% 20VDC TA	28480	0180-2255
A3C35	0180-2255	3		CAPACITOR-FXD 2.2UF±20% 20VDC TA	28480	0180-2255
A3C36	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C37	0160-0670	9	2	CAPACITOR-FXD 220PF ±20% 100VDC CER	20932	5024EM100RD221M
A3C38	0160-0670	9		CAPACITOR-FXD 220PF ±20% 100VDC CER	20932	5024EM100RD221M
A3C39	0140-0202	2	1	CAPACITOR-FXD 15PF ±5% 500VDC MICA	72136	DM15C150J0500WV1CR
A3C40	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
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	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C44	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C45	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C46	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C47	0160-2217	5	1	CAPACITOR-FXD 910PF ±5% 300VDC MICA	28480	0160-2217
A3C48	0180-0228	6	3	CAPACITOR-FXD 22UF±10% 15VDC TA	56289	150D226X9015B2
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	28480	0180-2255
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	28480	0180-2255
A3C53	0160-3466	8	2	CAPACITOR-FXD 100PF ±10% 1KVDC CER	28480	0160-3466
A3C54	0160-3877	5	1	CAPACITOR-FXD 100PF ±20% 200VDC CER	28480	0160-3877
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	150D226X9015B2
A3C58	0180-2255	3		CAPACITOR-FXD 2.2UF±20% 20VDC TA	28480	0180-2255
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	150D226X9015B2

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
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	28480	0180-2255
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
A3C66	0160-3451	1		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-3451
A3C67	0160-4751			CAPACITOR-FXD 1000PF ±10% 1KVDC CER	28480	0160-4751
A3C68	0160-2055	6		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
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	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C72	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C73	0140-0192	9	1	CAPACITOR-FXD 68PF ±5% 300VDC MICA	72136	DM15E680J0300WV1CR
A3C74	0150-0031	6	1	CAPACITOR-FXD 2PF ±5% 500VDC TI DIOX	28480	0150-0031
A3C75	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C77	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C78	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A3C79	0160-3651	3	2	CAPACITOR-FXD 68PF ±10% 200VDC CER	28480	0160-3651
A3C80	0160-3651	3		CAPACITOR-FXD 68PF ±10% 200VDC CER	28480	0160-3651
A3CR1	1901-0040	1	15	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	1	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	28480	1901-0773
A3CR30	1901-0773	7		DIODE	28480	1901-0773
A3E1	9170-0029	3	1	CORE-SHIELDING BEAD	28480	9170-0029
A3L1	9100-0670	3	2	INDUCTOR-FIXED CORE: 47 OHM 1/4 W CARBON	28480	9100-0670
A3L2	9100-0670	3		INDUCTOR-FIXED CORE: 47 OHM 1/4 W CARBON	28480	9100-0670
A3L3	9100-2264	5	2	INDUCTOR RF-CH-MLD 6 8UH 10% .105DX.26LG	28480	9100-2264
A3L4	9100-2264	5		INDUCTOR RF-CH-MLD 6 8UH 10% .105DX.26LG	28480	9100-2264
A3L5	9100-1650	1	2	INDUCTOR RF-CH-MLD 680UH 5% .2DX.45LG	28480	9100-1650
A3L6	9100-1650	1		INDUCTOR RF-CH-MLD 680UH 5% .2DX.45LG	28480	9100-1650
A3MP1	01740-00603	2	2	SHIELD-RESISTOR	28480	01740-00603
A3MP2	1205-0037	0	1	HEAT SINK TO-18-CS	28480	1205-0037
A3MP3	1205-0361	3	2	HEAT SINK SGL TO-5/TO-39-CS	13103	2226C
A3P2	1251-5346	1	1	CONNECTOR 10-PIN M POST TYPE	28480	1251-5346
A3P3	1251-6149	4	2	CONNECTOR	28480	1251-6149
A3P4	1251-6149	4		CONNECTOR	28480	1251-6149
A3Q1	1853-0380	9	2	TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0380
A3Q2	1855-0266	4	2	TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	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 SI	28480	1855-0266
A3Q5	1854-0092	2	2	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	2	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A3Q9	1853-0036	2	3	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	2N3904
A3Q12	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q13	1855-0367	6	1	TRANSISTOR-UJT P CH N	28480	1855-0367
A3Q14	1854-0071	7	3	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	1	TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A3Q17	1853-0314	9	1	TRANSISTOR PNP 2N2906A SI TO-39 PD=600MW	04713	2N2906A
A3Q18	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A3Q19	1854-0786	1	1	TRANSISTOR NPN 2N2540 SI TO-18 PD=500MW	04713	2N2540
A3Q20	1853-0086	2	1	TRANSISTOR PNP SI PD=310MW FT=40MHZ	27014	2N5087

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
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-TO-56R2-F
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	0698-7214	1	1	RESISTOR 121 1% .05W F TC=0±100	24546	C3-1/8-TO-121R-F
A3R7	0698-7215	2	2	RESISTOR 133 1% .05W F TC=0±100	24546	C3-1/8-TO-133R-F
A3R7	0698-7216	3	5	RESISTOR 147 1% .05W F TC=0±100	24546	C3-1/8-TO-147R-F
A3R7	0698-7217	4	2	RESISTOR 162 1% .05W F TC=0±100	24546	C3-1/8-TO-162R-F
A3R7	0698-7218	5	2	RESISTOR 178 1% .05W F TC=0±100	24546	C3-1/8-TO-178R-F
A3R7	0698-7219	6	1	RESISTOR 196 1% .05W F TC=0±100	24546	C3-1/8-TO-196R-F
A3R7	0698-7220	9	1	RESISTOR 215 1% .05W F TC=0±100	24546	C3-1/8-TO-215R-F
A3R7	0698-7222	1	1	RESISTOR 261 1% .05W F TC=0±100	24546	C3-1/8-TO-261R-F
A3R7	0698-7710	2	1	RESISTOR 100 5% .05W F TC=0±100	24546	C3-1/8-T00-100R-J
A3R8	0687-2241	1	2	RESISTOR 220K 10% .5W CC TC=0+882	01121	EB2241
A3R9	0757-0401	0	7	RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A3R10	0698-3157	3	4	RESISTOR 19 6K 1% .125W F TC=0±100	24546	C4-1/8-T0-1962-F
A3R11	2100-0568	1	2	RESISTOR-TRMR 100 10% C TOP-ADJ 1-TRN	28480	2100-0568
A3R12	0684-1001	3	2	RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A3R13	0683-0475	1	1	RESISTOR 4.7 5% .25W FC TC=-400/+500	01121	CB47G5
A3R14	0757-0394	0	4	RESISTOR 51.1 1% .125W F TC=0±100	24546	C4-1/8-T0-51R1-F
A3R15	0698-7926	2	2	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	0698-0082	7	5	RESISTOR 464 1% .125W F TC=0±100	24546	C4-1/8-T0-4640-F
A3R20	0757-0346	2	2	RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A3R20	0757-0401	0		RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A3R20	0757-0410	1	2	RESISTOR 301 1% .125W F TC=0±100	24546	C4-1/8-T0-301R-F
A3R20	0757-0413	4	2	RESISTOR 392 1% .125W F TC=0±100	24546	C4-1/8-T0-392R-F
A3R20	0757-1102	0	2	RESISTOR 180 1% .125W F TC=0±100	24546	C4-1/8-T0-181-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	0698-7215	2		RESISTOR 133 1% .05W F TC=0±100	24546	C3-1/8-TO-133R-F
A3R28	0698-7216	3		RESISTOR 147 1% .05W F TC=0±100	24546	C3-1/8-TO-147R-F
A3R28	0698-7217	4		RESISTOR 162 1% .05W F TC=0±100	24546	C3-1/8-TO-162R-F
A3R28	0698-7218	5		RESISTOR 178 1% .05W F TC=0±100	24546	C3-1/8-TO-178R-F
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		RESISTOR 464 1% .125W F TC=0±100	24546	C4-1/8-T0-4640-F
A3R34	0698-3496	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 CP 250 10% LIN	01121	73U1G040R251U
A3R37	0698-0082	7		RESISTOR 464 1% .125W F TC=0±100	24546	C4-1/8-T0-4640-F
A3R38	0698-4126	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	2	RESISTOR 150 1% .125W F TC=0±100	24546	C4-1/8-T0-151-F
A3R42	0757-0398	4	2	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	3	RESISTOR 2.7 10% .25W FC TC=-400/+500	01121	CB27G1
A3R45	0757-0433	8	7	RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-F
A3R46	2100-0654	5	3	RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	28480	2100-0654
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	2100-0654	5		RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	28480	2100-0654
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	0698-7218	3		RESISTOR 147 1% .05W F TC=0±100	24546	C3-1/8-TO-147R-F
A3R55	0698-7218	3		RESISTOR 147 1% .05W F TC=0±100	24546	C3-1/8-TO-147R-F
A3R56	0698-4125	7		RESISTOR 953 1% .125W F TC=0±100	24546	C4-1/8-T0-953R-F
A3R57	0698-3485	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-TO-464R-F

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A3R60	0698-7228	7		RESISTOR 464 1% .05W F TC=0±100	24546	C3-1/8-TO-464R-F
A3R61	2100-3433	5		RESISTOR-VAR CONTROL CP 250 10% LIN	01121	73U1G040R251U
A3R62	0757-0403	2		RESISTOR 121 1% .125W F TC=0±100	24546	C4-1/8-T0 121R-F
A3R63	0757-0411	2	3	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	2100-0667	0	2	RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	28480	2100-0667
A3R66	0757-0401	0		RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A3R67	0698-3455	4	1	RESISTOR 261K 1% .125W F TC=0±100	24546	C4-1/8-T0-2613-F
A3R68	0684-4721	0	2	RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A3R69	0684-1031	9	9	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	0757-1022	3	1	RESISTOR 1.78K 1% .25W F TC=0±100	24546	C5-1/4-T0-1781-F
A3R75	0698-3161	9		RESISTOR 38.3K 1% .125W F TC=0±100	24546	C4-1/8-T0-3832-F
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	0698-0082	7		RESISTOR 464 1% .125W F TC=0±100	24546	C4-1/8-T0-4640-F
A3R78	0757-0346	2		RESISTOR 10 1% .125W F TC=0±100	24546	C4-1/8-T0-10R0-F
A3R78	0757-0410	1		RESISTOR 301 1% .125W F TC=0±100	24546	C4-1/8-T0-301R-F
A3R78	0757-0413	4		RESISTOR 392 1% .125W F TC=0±100	24546	C4-1/8-T0-392R-F
A3R78	0757-1102	0		RESISTOR 150 1% .125W F TC=0±100	24546	C4-1/8-T0-151-F
A3R79	2100-3212	8		RESISTOR-TRMR 200 10% C TOP-ADJ 1-TRN	28480	2100-3212
A3R80	0757-0291	5	2	RESISTOR 6.19K 1% .125W F TC=0±100	19701	MF4C1/8-T0-6191-F
A3R81	0757-0417	8	2	RESISTOR 562 1% .125W F TC=0±100	24546	C4-1/8-T0-562R-F
A3R82	0757-0443	0	1	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	2100-0667	0		RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	28480	2100-0667
A3R87	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-F
A3R88	0757-0280	3	5	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	4	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	0757-0476	9	1	RESISTOR 301K 1% .125W F TC=0±100	24546	C4-1/8-T0-301J-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	4	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	3	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-T0-1211-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-T0-1211-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	2100-0654	5		RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	28480	2100-0654
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	2	RESISTOR 2.37K 1% .125W F TC=0±100	24546	C4-1/8-T0-2371-F
A3R120	0757-0430	5	1	RESISTOR 2.21K 1% .125W F TC=0±100	24546	C4-1/8-T0-2211-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-F
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-F
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

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
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	2	RESISTOR 46.4K 1% .125W F TC=0±100	24546	C4-1/8-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	C4-1/8-T0-4642-F
A3R139	0757-0416	7	1	RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A3R140	0757-0453	2	1	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
A3R144	0757-0440	7	1	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-T0-21R5-F
A3R146	0698-7152	4	1	RESISTOR 14.7 1% .05W F TC=0±100	24546	C3-1/8-T0-14R7-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
A3S1	3101-1905	5	1	SWITCH-PUSHBUTTON 4 STATIONS	28480	3101-1905
A3U1	1820-1518	8	1	IC GATE TTL L NAND QUAD 2-INP	27014	DM74L00N
A3U2	1820-0696	0	2	IC FF TTL L D-TYPE POS-EDGE-TRIG	27014	DM74L74N
A3U3	1820-1198	0	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS03N
A3U4	1820-0696	0		IC FF TTL L D-TYPE POS-EDGE-TRIG	27014	DM74L74N
A3VR1	1902-3082	9	1	DIODE-ZNR 4.64V 5% DO-35 PD=.4W	28480	1902-3082
A3VR2	1902-3234	3	1	DIODE-ZNR 19.6V 5% DO-35 PD=.4W	28480	1902-3234
A3VR3	1902-0072	1	1	DIODE-ZNR 7.87V 2% DO-35 PD=.4W	28480	1902-0072
A3VR4	1902-3137	5	1	DIODE-ZNR 8.06V 2% DO-35 PD=.4W	28480	1902-3137
A3VR5	1902-0041	4	1	DIODE-ZNR 5.11V 5% DO-35 PD=.4W	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-COAX	28480	01740-61617
A3XU1	1200-0638	7	4	SOCKET-IC 4-CONT DIP DIP-SLDR	28480	1200-0638
A3XU2	1200-0638	7		SOCKET-IC 4-CONT DIP DIP-SLDR	28480	1200-0638
A3XU3	1200-0638	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0638
A3XU4	1200-0638	7		SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0638
A5	01745-66503	4	1	VERTICAL OUTPUT BOARD ASSEMBLY	28480	01745-66503
A5C1	0150-0029	2	1	CAPACITOR-FXD 1PF ±10% 500VDC TI DIOX	28480	0150-0029
A5C2	0160-2055	9	4	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C3	0121-0489	7	1	CAPACITOR-V TRMR-CER 2.5PF 100V PC-MTG	28480	0121-0489
A5C3	0160-3567	0	1	CAPACITOR-FXD 10PF ±5% 100VDC CER 0±30	28480	0160-3567
A5C4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C6	0180-2255	3	2	CAPACITOR-FXD 2.2UF±20% 20VDC TA	28480	0180-2255
A5C7	0180-2255	3		CAPACITOR-FXD 2.2UF±20% 20VDC TA	28480	0180-2255
A5C8	0160-3650	2	1	CAPACITOR-FXD .018UF ±10% 50VDC CER	28480	0160-3650
A5C9	0160-3799	0	2	CAPACITOR-FXD 18PF ±10% 100VDC CER	28480	0160-3799
A5C10	0160-3569	2	1	CAPACITOR-FXD 27PF ±5% 100VDC CER 0±30	28480	0160-3569
A5C10	0160-3647	7	1	CAPACITOR-FXD 22PF ±5% 100VDC CER 0±30	28480	0160-3647
A5C11	0160-3651	3	1	CAPACITOR-FXD 68PF ±10% 200VDC CER	28480	0160-3651
A5C12	0160-3694	4	1	CAPACITOR-FXD 330PF ±10% 100VDC CER	28480	0160-3694
A5C13	0180-0269	5	1	CAPACITOR-FXD [illegible]UF+50-10% 150VDC AL	56289	30D106G150BA2
A5C14	0160-3799	0		CAPACITOR-FXD 18PF ±10% 100VDC CER	28480	0160-3799
A5C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A5C17	0160-3848	0	1	CAPACITOR-FXD 3.3PF ± 5PF 100VDC CER	28480	0160-3848
A5C18	0160-4831	3	2	CAPACITOR-FXD 4700PF ±10% 100VDC CER	28480	0160-4831
A5C19	0160-4831	3		CAPACITOR-FXD 4700PF ±10% 100VDC CER	28480	0160-4831
A5C20	0160-5211	5	1	CAPACITOR-FXD .1UF 250VDC P.C.	28480	0160-5211
A5L1	9100-2598	9	2	INDUCTOR 80NH 6.25% X.26LG Q=35	28480	9100-2598
A5L2	9100-2257	8	2	INDUCTOR RF-CH-MLD 820NH 10% .105DX.26LG	28480	9100-2257
A5L3	9100-2257	6		INDUCTOR RF-CH-MLD 820NH 10% .105DX.26LG	28480	9100-2257
A5L4	9100-2598	8		INDUCTOR 80NH 6.25% X.26LG Q=35	28480	9100-2598
A5L5	9100-2249	6	2	INDUCTOR RF-CH-MLD 150NH 10% .105DX.26LG	28480	9100-2249
A5L6	9100-2249	6		INDUCTOR RF-CH-MLD 150NH 10% .105DX.26LG	28480	9100-2249
A5L7	9100-2250	9	2	INDUCTOR RF-CH-MLD 180NH 10% .105DX.26LG	28480	9100-2250
A5L8	9100-2250	9		INDUCTOR RF-CH-MLD 180NH 10% .105DX.26LG	28480	9100-2250
A5L9	9100-2258	7	1	INDUCTOR RF-CH-MLD 1.2UH 10% .105DX.26LG	28480	9100-2258
A5MP1	01740-20506	8	1	HEAT SINK-V OUTPUT	28480	01740-20506
A5Q1	1853-0354	7	2	TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A5Q2	1853-0473	1	2	TRANSISTOR- HP SPEC PL5 P.S.	28480	1853-0473
A5Q3	1853-0354	7		TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A5Q4	1853-0473	1		TRANSISTOR- HP SPEC PL5 P.S.	28480	1853-0473
A5R1	0698-4399	7	2	RESISTOR 88.7 1% .125W F TC=0±100	24546	C4-1/8-T0-88R7-F
A5R2	0757-0734	2	2	RESISTOR 1.21K 1% .25W F TC=0±100	28480	0757-0734
A5R3	0757-0719	3	1	RESISTOR 221 1% .25W F TC=0±100	24546	C6-1/4-T0-221R-F
A5R4	0757-0734	2		RESISTOR 1.21K 1% .25W F TC=0±100	28480	0757-0734
A5R5	0698-4399	7		RESISTOR 88.7 1% .125W F TC=0±100	24546	C4-1/8-T0-88R7-F

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A5R6	0698-7096	7	1	RESISTOR 10 10% .125W CC TC=-120/+400	01121	BB1001
A5R7	0684-1011	5	1	RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A5R8	0757-0435	0	2	RESISTOR 3 92K 1% .125W F TC=0±100	24546	C4-1/8-T0-3921-F
A5R9	0698-0083	8	2	RESISTOR 1 96K 1% .125W F TC=0±100	24546	C4-1/8-T0-1961-F
A5R10	0684-1001	3	2	RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A5R11	0757-0435	0		RESISTOR 3 92K 1% .125W F TC=0±100	24546	C4-1/8-T0-3921-F
A5R12	0684-1001	3		RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A5R13	0698-0083	8		RESISTOR 1 96K 1% .125W F TC=0±100	24546	C4-1/8-T0-1961-F
A5R14	0757-0397	3	2	RESISTOR 68 1 1% .125W F TC=0±100	24546	C4-1/8-T0-68R1-F
A5R15	0698-4425	0	2	RESISTOR 1 54K 1% .125W F TC=0±100	24546	C4-1/8-T0-1541-F
A5R16	0698-4425	0		RESISTOR 1 54K 1% .125W F TC=0±100	24546	C4-1/8-T0-1541-F
A5R17	0757-0397	3		RESISTOR 68 1 1% .125W F TC=0±100	24546	C4-1/8-T0-68R1-F
A5R18	0757-0238	1	1	RESISTOR 9 09K 1% .125W F TC=0±100	19701	MF4C1/8-T0-9091-F
A5R19	2100-2216	0	2	RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	73138	82PR5K
A5R20	2100-1788	9	3	RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	73138	82PR500
A5R21	0757-0400	9	1	RESISTOR 90 9 1% .125W F TC=0±100	24546	C4-1/8-T0-90R9-F
A5R21	0757-0401	0	2	RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A5R21	0757-0401	0		RESISTOR 100 1% .125W F TC=0±100	24546	C4-1/8-T0-101-F
A5R22	2100-2216	0		RESISTOR-TRMR 5K 10% C TOP-ADJ 1-TRN	73138	82PR5K
A5R23	0698-6435	6	1	RESISTOR 2 61K 5% .06W F TC=0±100	28480	0698-6435
A5R23	0698-7245	8	1	RESISTOR 2 37K 1% .05W F TC=0±100	24546	C3-1/8-T0-2371-F
A5R23	0698-7250	5	2	RESISTOR 3 83K 1% .05W F TC=0±100	24546	C3-1/8-T0-3831-F
A5R23	0698-7250	5		RESISTOR 3 83K 1% .05W F TC=0±100	24546	C3-1/8-T0-3831-F
A5R23	0698-7252	7	3	RESISTOR 4 64K 1% .05W F TC=0±100	24546	C3-1/8-T0-4641-F
A5R23	0698-7252	7		RESISTOR 4 64K 1% .05W F TC=0±100	24546	C3-1/8-T0-4641-F
A5R23	0698-7252	7		RESISTOR 4 64K 1% .05W F TC=0±100	24546	C3-1/8-T0-4641-F
A5R24	2100-1788	9		RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	73138	82PR500
A5R25	2100-1788	9		RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	73138	82PR500
A5R26	0757-0720	6	1	RESISTOR 243 1% .25W F TC=0±100	24546	C5-1/4-T0-243R-F
A5R27	0757-0316	6	2	RESISTOR 42 2 1% .125W F TC=0±100	24546	C4-1/8-T0-42R2-F
A5R28	0757-0316	6		RESISTOR 42 2 1% .125W F TC=0±100	24546	C4-1/8-T0-42R2-F
A5R29	0757-0461	2	2	RESISTOR 68 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-6812-F
A5R30	0757-0461	2		RESISTOR 68 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-6812-F
A5R31	0757-0280	3	1	RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A5U1	1NA9 8005	1	1	IC-OUTPUT AMPLIFIER	28480	1NA9 8005
A5VR1	1902-3069	0	1	DIODE-ZNR 3 83V 5% DO-35 PD=.4W	28480	1902-3069
A5VR2	1902-1392	0	2	DIODE-ZNR 30 0V 2% DO-35 PD=.4W	28480	1902-1392
A5VR3	1902-1392	0		DIODE-ZNR 30 0V 2% DO-35 PD=.4W	28480	1902-1392
A5XA3	1251-6137	0	1	CONNECTOR	28480	1251-6137
A7	01743-66518	9	1	HORIZONTAL MOTHERBOARD ASSEMBLY	28480	01743-66518
A7C1	0160-3569	2	1	CAPACITOR-FXD 27PF ±5% 100VDC CER 0±30	28480	0160-3569
A7C2	0160-2055	9	26	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C3	0140-0202	2	1	CAPACITOR-FXD 15PF ±5% 500VDC MICA	72136	DM15C150J0500WV1CR
A7C4	0160-0070	3	1	CAPACITOR-FXD .02UF ±20% 500VDC CER	28480	0160-0070
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	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C8	0150-0021	4	1	CAPACITOR-FXD .47PF ±5% 500VDC TI DIOX	28480	0150-0021
A7C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C10	0140-0193	0	2	CAPACITOR-FXD 82PF ±5% 300VDC MICA	72136	DM15E820J0300WV1CR
A7C11	0160-3443	1	1	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A7C12	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C13	0180-0196	6	1	CAPACITOR-FXD .33UF±20% 35VDC TA	56289	150D334X0035A2
A7C14	0160-2204	0	2	CAPACITOR-FXD 100PF ±5% 300VDC MICA	28480	0160-2204
A7C15	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C16	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C17	0140-0204	4	1	CAPACITOR-FXD 47PF ±5% 500VDC MICA	72136	DM15E470J0500WV1CR
A7C18	0140-0193	0		CAPACITOR-FXD 82PF ±5% 300VDC MICA	72136	DM15E820J0300WV1CR
A7C19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C20	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C21	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C22	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C23	0180-1746	5	2	CAPACITOR-FXD 15UF±10% 20VDC TA	56289	150D156X902082
A7C24	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C25	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C26	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C27	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C28	0180-0106	0	1	CAPACITOR-FXD 60UF±20% 6VDC TA	56289	150D606X0006B2
A7C29	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C30	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C31	0180-0229	7	1	CAPACITOR-FXD 33UF±10% 10VDC TA	56289	150D336X9010B2
A7C32	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C33	0180-1746	5		CAPACITOR-FXD 15UF±10% 20VDC TA	56289	150D156X902082
A7C34	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C35	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A7C36	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C37	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C38	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C39	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C40	0160-2198	1	2	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	0160-2204	0		CAPACITOR-FXD 100PF ±5% 300VDC MICA	28480	0160-2204
A7C44	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C45	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7C46	0140-0198	5	1	CAPACITOR-FXD 200PF ±5% 300VDC MICA	72136	DM15F201J0300WV1CR
A7C47	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A7CR1	1901-0376	6	1	DIODE-GEN PRP 35V 50MA DO-35	28480	1901-0376
A7CR2	1901-0040	1	16	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	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
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	1	DIODE-SWITCHING 80V 200MA 2NS DO-35	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
A7CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A7CR15	1910-0016	0	1	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
A7L1	9140-0105	3	2	INDUCTOR RF-CH-MLD 8.2UH 10%	28480	9140-0105
A7L2	9140-0096	1	3	INDUCTOR RF-CH-MLD 1UH 10% .166DX.385LG	28480	9140-0096
A7L3	9100-1613	6	2	INDUCTOR RF-CH-MLD 470NH 20%	28480	9100-1613
A7L4	9140-0096	1		INDUCTOR RF-CH-MLD 1UH 10% .166DX.385LG	28480	9140-0096
A7L5	9140-0105	3		INDUCTOR RF-CH-MLD 8.2UH 10%	28480	9140-0105
A7L6	9140-0096	1		INDUCTOR RF-CH-MLD 1UH 10% .166DX.385LG	28480	9140-0096
A7L7	9100-1613	6		INDUCTOR RF-CH-MLD 470NH 20%	28480	9100-1613
A7E1	9170-0029	3	9	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
A7E4	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
A7E5	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
A7E6	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
A7E7	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
A7E8	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
A7E9	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
A7MP1	01801-01206	7	1	BRACKET-ANGLE	28480	01801-01206
A7MP2	0380-0744	5	31	SPACER .090 .093	28480	0380-0744
A7P2	1251-6009	5	2	CONNECTOR 15-PIN M POST TYPE	28480	1251-6009
A7P3	1251-5346	1	1	CONNECTOR 10-PIN M POST TYPE	28480	1251-5346
A7P4	1251-6144	9	1	CONNECTOR	28480	1251-6144
A7P5	1251-6012	0	1	CONNECTOR 8-PIN M POST TYPE	28480	1251-6012
A7P6	1251-6009	5		CONNECTOR 15-PIN M POST TYPE	28480	1251-6009
A7P7	1251-6146	1	1	CONNECTOR	28480	1251-6146
A7Q1	1854-0215	1	8	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A7Q2	1854-0092	2	9	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	1	TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0081
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	2N3904
A7Q7	1853-0380	9	3	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	3	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	6	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	3	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q16	1854-0683	6	2	TRANSISTOR NPN SI TO-92 PD=310MW	04713	MPS-A18
A7Q17	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q18	1854-0683	6		TRANSISTOR NPN SI TO-92 PD=310MW	04713	MPS-A18
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

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A7Q21	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A7Q22	1853-0015	7	1	TRANSISTOR PNP SI PD=200MW FT=600MHZ	28480	1853-0015
A7Q23	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
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	2N3904
A7Q28	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A7Q29	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A7Q30	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A7Q31	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A7Q32	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A7Q33	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A7Q34	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A7Q36	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A7Q37	1854-0092	2		TRANSISTOR NPN SI PD=200MW FT=600MHZ	28480	1854-0092
A7R1	0698-3215	4	3	RESISTOR 499K 1% .125W F TC=0±100	28480	0698-3215
A7R2	0698-3215	4		RESISTOR 499K 1% .125W F TC=0±100	28480	0698-3215
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	2	RESISTOR 825 1% .125W F TC=0±100	24546	C4-1/8-T0-825R-F
A7R6	0757-0283	6	2	RESISTOR 2K 1% .125W F TC=0±100	24546	C4-1/8-T0-2001-F
A7R7	0757-0418	9	2	RESISTOR 619 1% .125W F TC=0±100	24546	C4-1/8-T0-619R-F
A7R8	0684-4721	0	7	RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A7R9	0684-2711	4	2	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	0698-3215	4		RESISTOR 499K 1% .125W F TC=0±100	28480	0698-3215
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	2	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	3	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	2	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A7R21	2100-3434	6	1	RESISTOR-VAR CONTROL CP 50K 10% LIN	01121	73U4N048P503U
A7R22	0757-0433	8	5	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	3	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	3	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	1	RESISTOR 909K 1% .125W F TC=0±100	28480	0757-0488
A7R32	0684-4701	6	3	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	2	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	24546	C5-1/4-T0-4751-F
A7R38	0757-0416	7	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	1	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	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	8	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	2	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	1	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	2	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	1	RESISTOR 2.7 10% .25W FC TC=-400/+500	01121	CB27G1
A7R53	0757-0408	7	2	RESISTOR 243 1% .125W F TC=0±100	24546	C4-1/8-T0-243R-F
A7R54	0757-0434	9	3	RESISTOR 3.65K 1% .125W F TC=0±100	24546	C4-1/8-T0-3651-F
A7R55	0757-0416	7		RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A7R56	0757-0442	9	1	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	5	RESISTOR 470 10% .25W FC TC=-400/+600	01121	CB4711
A7R60	0757-0412	3	1	RESISTOR 365 1% .125W F TC=0±100	24546	C4-1/8-T0-365R-F

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
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		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	3	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	0698-3442	9	1	RESISTOR 237 1% .125W F TC=0±100	24546	C4-1/8-T0-237R-F
A7R71	0757-0439	4	2	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	2	RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A7R74	0684-6821	5	1	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	0757-0458	7	1	RESISTOR 51.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-5112-F
A7R77	0698-3321	5	2	RESISTOR 3.3K 10% .125W CC TC=-350/+857	01121	BB3321
A7R78	0698-3321	5		RESISTOR 3.3K 10% .125W CC TC=-350/+857	01121	BB3321
A7R79	0757-0444	1	3	RESISTOR 12.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1212-F
A7R80	0757-0465	6	3	RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A7R81	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-F
A7R82	0757-1094	9	1	RESISTOR 1.47K 1% .125W F TC=0±100	24546	C4-1/8-T0-1471-F
A7R83	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A7R84	0757-0465	6		RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A7R85	0757-0433	8		RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-F
A7R86	0684-4711	8		RESISTOR 470 10% .25W FC TC=-400/+600	01121	CB4711
A7R87	0684-3311	2	2	RESISTOR 330 10% .25W FC TC=-400/+600	01121	CB3311
A7R88	0684-1511	0		RESISTOR 150 10% .25W FC TC=-400/+600	01121	CB1511
A7R89	0757-0199	3	2	RESISTOR 21.5K 1% .125W F TC=0±100	24546	C4-1/8-T0-2152-F
A7R90	0698-0085	0	1	RESISTOR 2.61K 1% .125W F TC=0±100	24546	C4-1/8-T0-2611-F
A7R91	0757-0407	6	1	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	3	RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A7R95	0757-0444	1		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		RESISTOR 330 10% .25W FC TC=-400/+600	01121	CB3311
A7R105	2100-3253	7	1	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	1	RESISTOR 4.75K 1% .125W F TC=0±100	24546	C4-1/8-T0-4751-F
A7R109	0684-1021	7	5	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
A7R116	0684-1511	0		RESISTOR 150 10% .25W FC TC=-400/+600	01121	CB1511
A7R117	2100-0668	1	1	RESISTOR-TRMR 100 10% C TOP-ADJ 1-TRN	28480	2100-0668
A7R118	0757-0416	7		RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
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	1	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	0757-0283	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	0757-0406	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

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A7R138	0757-0428	1	1	RESISTOR 1 62K 1% .125W F TC=0±100	24546	C4-1/8-T0-1621-F
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	1	RESISTOR 6 19K 1% .125W F TC=0±100	19701	MF4C1/8-T0-6191-F
A7R142	0684-4721	9		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	6		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/+500	01121	CB4711
A7R155	0757-0446	3	1	RESISTOR 15K 1% .125W F TC=0±100	24546	C4-1/8-T0-1502-F
A7R156	0684-2701	2		RESISTOR 27 10% .25W FC TC=-400/+500	01121	CB2701
A7R157	0684-1811	3	2	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	0757-0438	3		RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A7R160	0757-0130	3		RESISTOR 21 5K 1% .125W F TC=0±100	24546	C4-1/8-T0-2152-F
A7R161	2100-0567	0	1	RESISTOR-TRMR 2K 10% C TOP-ADJ 1-TRN	28480	2100-0567
A7R162	0684-1811	3		RESISTOR 180 10% .25W FC TC=-400/+600	01121	CB1811
A7S1	3101-1906	6	1	SWITCH-PUSHBUTTON 4 STATIONS	28480	3101-1906
A7S2	3101-1909	9	1	SWITCH-PUSHBUTTON 6 STATIONS	28480	3101-1909
A7S3	3101-2301	7	1	SWITCH-PUSHBUTTON	28480	3101-2301
A7U1	1826-0069	2	1	IC OP AMP GP TO-99 PKG	01295	LM201AL
A7U2	5081-3019	4	1	IC-SEALED PACKAGE	28480	5081-3019
A7U3	1820-1211	8	1	IC GATE TTL LS EXCL-OR QUAD 2-INP	01295	SN74LS86N
A7W1	01740-61605	2	1	CABLE ASSEMBLY-GATE DRIVE	28480	01740-61605
A7XA9	1251-6006	2	1	CONNECTOR 12-PIN F POST TYPE	28480	1251-6006
A7XU1	1200-0475	0	1	CONNECTOR-SGL CONT SKT .017-IN-BSC-SZ	28480	1200-0475
A7XU2	1200-0607	0	1	SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A8	01740-66568	6	1	MAIN SWEEP BOARD ASSEMBLY	28480	01740-66568
A8C1	0160-2055	9	6	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	3	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	1	CAPACITOR-FXD 160PF ±2% 300VDC MICA	72136	DM15F161G0300WV1CR
A8C6	0160-2204	0	1	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	1	CAPACITOR-FXD .01UF ±10% 400VDC	28480	0160-3226
A8C10	0160-3726	3	1	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	0180-1746	4	1	CAPACITOR-FXD 1.5UF±10% 20VDC TA	56289	150D155X9020A2
A8C18	0180-2111	0	1	CAPACITOR-FXD 33UF±10% 35VDC TA	56289	150D336X9035SA
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	4	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	2	CORE-SHIELDING BEAD	28480	9170-0029
A8E2	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
A8L1	9140-0105	3	1	INDUCTOR RF-CH-MLD 8.2UH 10%	28480	9140-0105
A8MP1	01840-22502	7	1	ROLLER-DETENT	28480	01840-22502
A8MP2	1460-1148	6	1	SPRING-TORSION	28480	1460-1148
A8Q1	1853-0036	2	4	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	1	TRANSISTOR PNP SI PD=310MW FT=500MHZ	04713	MPS3640
A8Q4	1853-0036	2		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A8Q5	1855-0081	1	1	TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0081

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A8Q6	1854-0019	3	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A8Q7	1853-0354	7	1	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	3	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A8Q10	1854-0215	1	1	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
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	1854-0683	6	1	TRANSISTOR NPN SI TO-92 PD=310MW	04713	MPS-A18
A8R1	0684-3901	6	3	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	1	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	1	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	1	RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-T0-1621-F
A8R8	0684-1011	5	3	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	2100-3066	8	4	RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A8R13	2100-3066	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A8R14	2100-3066	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A8R15	0757-0434	9	1	RESISTOR 3.65K 1% .125W F TC=0±100	24546	C4-1/8-T0-3651-F
A8R16	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0±100	24546	C4-1/8-T0-7501-F
A8R17	0698-6450	5	1	RESISTOR 2.5K .1% .125W F TC=0±50	28480	0698-6450
A8R18	0698-5449	0	1	RESISTOR 5K .1% .125W F TC=0±50	19701	MF4C1/8-T2-5001-B
A8R19	0698-4157	5	1	RESISTOR 10K .1% .125W F TC=0±50	28480	0698-4157
A8R20	0698-6942	0	1	RESISTOR 25K .1% .125W F TC=0±50	28480	0698-6942
A8R21	0698-5450	3	1	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	1	RESISTOR 1K 10% .25W FC TC=-400/+500	01121	CB1021
A8R24	0757-0284	7	2	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	1	RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A8R28	0684-3321	4	1	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	1	RESISTOR 511 1% .125W F TC=0±100	24546	C4-1/8-T0-511R-F
A8R32	0757-0273	4	1	RESISTOR 3.01K 1% .125W F TC=0±100	24546	C4-1/8-T0-3011-F
A8R33	0698-3150	6	1	RESISTOR 2.37K 1% .125W F TC=0±100	24546	C4-1/8-T0-2371-F
A8R34	0757-0283	6	1	RESISTOR 2K 1% .125W F TC=0±100	24546	C4-1/8-T0-2001-F
A8R35	0684-3311	2	1	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	1	RESISTOR 6.8K 10% .25W FC TC=-400/+700	01121	CB6821
A8R38	0757-0439	4	1	RESISTOR 6.81K 1% .125W F TC=0±100	24546	C4-1/8-T0-6811-F
A8R39	0757-0420	3	1	RESISTOR 750 1% .125W F TC=0±100	24546	C4-1/8-T0-751-F
A8R40	0757-0454	3	1	RESISTOR 33.2K 1% .125W F TC=0±100	24546	C4-1/8-T0-3322-F
A8R41	0684-0271	7	2	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	2100-3066	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A8S1MP1	01740-61901	1	1	SWITCH ASSEMBLY-ROTARY (MALE)	28480	01740-61901
A8S1MP2	01740-61902	2	1	SWITCH ASSEMBLY-ROTARY (FEMALE)	28480	01740-61902
A8S1MP3	0510-1101	7	1	RING-RETAINING	28480	0510-1101
A8U1	1826-0066	5	1	IC OP AMP PRGMBL TO-99 PKG	04713	MC1776CG
A8XA7	1251-6136	9	1	CONNECTOR 10-PIN F POST TYPE	28480	1251-6136
A8XU1	1200-0475	0	8	CONNECTOR-SGL CONT SKT .017-IN-BSC-SZ	28480	1200-0475
A9	01740-66565	3	1	DELAY SWEEP BOARD ASSEMBLY	28480	01740-66565
A9C1	0160-2250	6	1	CAPACITOR-FXD 5.1PF ± 25PF 500VDC CER	28480	0160-2250
A9C2	0160-2055	9	5	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	1	CAPACITOR-FXD 100PF ±5% 300VDC MICA	28480	0160-2204
A9C5	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9C7	0140-0218	0	1	CAPACITOR-FXD 160PF ±2% 300VDC MICA	72136	DM15F161G0300WV1CR
A9C8	0160-3226	8	1	CAPACITOR-FXD .01UF ±10% 400VDC	28480	0160-3226
A9C9	0160-3726	3	1	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	0180-0269	5	1	CAPACITOR-FXD 1UF+50-10% 150VDC AL	56289	30D105G150BA2
A9C14	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A9C15	0180-0197	8	1	CAPACITOR-FXD 2.2UF±10% 20VDC TA	56289	150D225X9020A2
A9CR1	1901-0040	1	2	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	1	INDUCTOR RF-CH-MLD 8.2UH 10%	28480	9140-0105
A9MP1	01840-22502	7	1	ROLLER-DETENT	28480	01840-22502
A9MP2	1460-1148	6	1	SPRING-TORSION	28480	1460-1148

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A9Q1	1853-0036	2	3	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	1	TRANSISTOR PNP SI PD=310MW FT=500MHZ	04713	MPS3640
A9Q5	1854-0683	6	1	TRANSISTOR NPN SI TO-92 PD=310MW	04713	MPS-A18
A9Q6	1855-0081	1	1	TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0081
A9Q7	1854-0019	3	1	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A9R1	0684-1021	7	1	RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A9R2	0757-0284	7	2	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	2	RESISTOR 100 10% .25W FC TC=-400/+600	01121	CB1011
A9R5	0757-0193	7	1	RESISTOR 3.32K 1% .5W F TC=0±100	28480	0757-0193
A9R6	0757-0442	9	1	RESISTOR 10K 1% .125W F TC=0±100	24546	C4-1/8-T0-1002-F
A9R7	0757-0280	3	1	RESISTOR 1K 1% .125W F TC=0±100	24546	C4-1/8-T0-1001-F
A9R10	2100-3066	8	3	RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A9R11	2100-3066	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A9R12	0757-0433	8	1	RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-F
A9R13	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0±100	24546	C4-1/8-T0-7501-F
A9R14	0698-6450	5	1	RESISTOR 2.5K .1% .125W F TC=0±50	28480	0698-6450
A9R15	0698-5449	0	1	RESISTOR 5K .1% .125W F TC=0±50	19701	MF4C1/8-T2-5001-B
A9R16	0698-4157	5	1	RESISTOR 10K .1% .125W F TC=0±50	28480	0698-4157
A9R17	0698-6942	0	1	RESISTOR 25K .1% .125W F TC=0±50	28480	0698-6942
A9R18	0698-5450	3	1	RESISTOR 50K .1% .125W F TC=0±50	19701	MF4C1/8-T2-5002-B
A9R19	0698-4158	6	1	RESISTOR 100K .1% .125W F TC=0±50	28480	0698-4158
A9R20	0757-0284	7		RESISTOR 150 1% .125W F TC=0±100	24546	C4-1/8-T0-151-F
A9R21	0683-0475	1	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	1	RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A9R24	0757-0400	9	1	RESISTOR 80.9 1% .125W F TC=0±100	24546	C4-1/8-T0-80R9-F
A9R25	0684-1001	3	1	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	2100-3066	8		RESISTOR-TRMR 5K 10% C SIDE-ADJ 17-TRN	02111	43P502
A9S1MP1	01740-61903	3	1	SWITCH ASSEMBLY-ROTARY (MALE)	28480	01740-61903
A9S1MP2	01740-61904	4	1	SWITCH ASSEMBLY-ROTARY (FEMALE)	28480	01740-61904
A9S1MP3	0510-1101	7	1	RING-RETAINING	28480	0510-1101
A9U1	1826-0059	2	1	IC OP AMP GP TO 99 PKG	01295	LM201AL
A9XA1	1251-6105	2	1	CONNECTOR	28480	1251-6105
A9XA10	1251-3352	5	1	CONNECTOR-PC EDGE 12-CONT/ROW 1-ROW	28480	1251-3352
A9XU1	1200-0475	0	1	CONNECTOR-SGL CONT SKT .017-IN-BSC-SZ	28480	1200-0475
A10	01745-66504	5	1	DELAY TRIGGER BOARD ASSEMBLY	28480	01745-66504
A10C1	0150-0070	3	1	CAPACITOR-FXD .02UF ±20% 500VDC CER	28480	0150-0070
A10C2	0160-2204	0	1	CAPACITOR-FXD 100PF ±5% 300VDC MICA	28480	0160-2204
A10C3	0160-2055	9	5	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C4	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C5	0140-0197	4	1	CAPACITOR-FXD 180PF ±5% 300VDC MICA	72136	DM15F181J0300WV1CR
A10C7	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C8	0180-0197	8	3	CAPACITOR-FXD 2.2UF±10% 20VDC TA	56289	150D225X9020A2
A10C9	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C10	0180-0197	8		CAPACITOR-FXD 2.2UF±10% 20VDC TA	56289	150D225X9020A2
A10C11	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A10C12	0180-0197	8		CAPACITOR-FXD 2.2UF±10% 20VDC TA	56289	150D225X9020A2
A10C13	0150-0048	6	1	CAPACITOR-FXD 22PF ±5% 500VDC TI DIOX	28480	0150-0048
A10CR1	1901-0040	1	12	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	1	DIODE-GE 60V 60MA 1US DO-7	28480	1910-0016
A10CR9	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR10	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR12	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR13	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10CR14	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A10L1	9140-0105	3	1	INDUCTOR RF-CH-MLD 8.2UH 10%	28480	9140-0105
A10MP1	0380-0744	5	10	SPACER- .080 .093	28480	0380-0744

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A10Q1	1855-0262	0	1	TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0262
A10Q3	1854-0215	1	2	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N39C4
A10Q4	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A10Q5	1854-0092	2	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	2	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A10Q8	1853-0036	2	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	2	RESISTOR 100K 1% .125W F TC=0±100	24546	C4-1/8-T0-1003-F
A10R2	0757-0488	3	2	RESISTOR 909K 1% .125W F TC=0±100	28480	0757-0488
A10R3	0684-3901	6	3	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	2	RESISTOR 200 1% .125W F TC=0±100	24546	C4-1/8-T0-201-F
A10R6	0757-0419	0	1	RESISTOR 681 1% .125W F TC=0±100	24546	C4-1/8-T0-681R-F
A10R7	0757-0407	6		RESISTOR 200 1% .125W F TC=0±100	24546	C4-1/8-T0-201-F
A10R8	0684-4721	0	2	RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A10R9	2100-3351	6	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 1-TRN	28480	2100-3351
A10R10	2100-3434	6	1	RESISTOR-VAR CONTROL CP 50K 10% LIN	01121	73U4N048P503U
A10R11	0757-0283	6	1	RESISTOR 2K 1% .125W F TC=0±100	24546	C4-1/8-T0-2001-F
A10R13	0757-0408	7	1	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	2	RESISTOR 1.5K 1% .125W F TC=0±100	24546	C4-1/8-T0-1501-F
A10R16	0698-3433	8	2	RESISTOR 28.7 1% .125W F TC=0±100	03888	PME55-1/8-T0-2B87-F
A10R17	0698-3433	8		RESISTOR 28.7 1% .125W F TC=0±100	03888	PME55-1/8-T0-2B87-F
A10R18	0698-3152	6	1	RESISTOR 3.48K 1% .125W F TC=0±100	24546	C4-1/8-T0-3481-F
A10R19	0757-0438	3	2	RESISTOR 5.11K 1% .125W F TC=0±100	24546	C4-1/8-T0-5111-F
A10R20	0684-1531	4	1	RESISTOR 15K 10% .25W FC TC=-400/+800	01121	CB1531
A10R21	0757-0420	3	4	RESISTOR 750 1% .125W F TC=0±100	24546	C4-1/8-T0-751-F
A10R22	0757-0443	0	2	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	2	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	8	1	RESISTOR 619 1% .125W F TC=0±100	24546	C4-1/8-T0-619R-F
A10R30	0757-0433	8	1	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	2	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	0757-0427	0		RESISTOR 1.5K 1% .125W F TC=0±100	24546	C4-1/8-T0-1501-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	2	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	1	RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-T0-1621-F
A10S1	3101-1904	4	1	SWITCH-PUSHBUTTON 6 STATIONS	28480	3101-1904
A10U1	5081-3019	4	1	IC-SEALED PACKAGE	28480	5081-3019
A10VR1	1902-3082	9	1	DIODE-ZNR 4.64V 5% DO-35 PD=.4W	28480	1902-3082
A10XU1	1200-0607	0	1	SOCKET-IC 16-CONT DIP DIP-SLDR	28480	1200-0607
A11	01740-66569	7	1	HORIZONTAL OUTPUT BOARD ASSEMBLY	28480	01740-66569
A11C1	0160-2055	9	2	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	7	CAPACITOR-FXD .01UF +80-20% 500VDC CER	28480	0160-3665
A11C4	0160-3502	1	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	3	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	2	CORE-SHIELDING BEAD	28480	9170-0029
A11E2	9170-0029	3		CORE-SHIELDING BEAD	28480	9170-0029
A11MP1	1206-0085	0	1	HEAT SINK SGL TO-5/TO-39-CS	30161	3225B
A11MP2	[illegible]	9	1	INSULATOR-XSTR NYLON	28480	1200-0185

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A11Q1	1854-0019	3	2	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A11Q2	1853-0354	7	2	TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A11Q3	1854-0419	7	1	TRANSISTOR NPN SI TO-39 PD=1W FT=200MHZ	28480	1854-0419
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	1	TRANSISTOR PNP SI TO-39 PD=1W FT=200MHZ	28480	1853-0232
A11Q8	1854-0623	4	1	TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0623
A11R1	0684-1001	3	2	RESISTOR 10 10% .25W FC TC=-400/+500	01121	CB1001
A11R2	0684-1011	5	1	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	8	4	RESISTOR 18.2K 1% .5W F TC=0±100	28480	0757-0845
A11R5	0684-4721	0	2	RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A11R6	0683-0685	5	2	RESISTOR 6.8 5% .25W FC TC=-400/+500	01121	CB68G5
A11R7	0684-3901	6	2	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	0757-0394	0	2	RESISTOR 51.1 1% .125W F TC=0±100	24546	C4-1/8-T0-51R1-F
A11R10	2100-3273	1	2	RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
A11R11	0757-0788	2	2	RESISTOR 47.5K 1% .25W F TC=0±100	24546	C5-1/4-TO-4752-F
A11R12	0757-0283	6	2	RESISTOR 2K 1% .125W F TC=0±100	24546	C4-1/8-T0-2001-F
A11R13	0757-0411	2	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	0757-0394	0		RESISTOR 51.1 1% .125W F TC=0±100	24546	C4-1/8-T0-51R1-F
A11R17	0757-0788	2		RESISTOR 47.5K 1% .25W F TC=0±100	24546	C5-1/4-TO-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	8		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	8		RESISTOR 18.2K 1% .5W F TC=0±100	28480	0757-0845
A11R26	0757-0845	8		RESISTOR 18.2K 1% .5W F TC=0±100	28480	0757-0845
A11XA7	1251-6007	3	1	CONNECTOR 15-PIN F POST TYPE	28480	1251-6007
A12	01745-66501	2	1	GATE BOARD ASSEMBLY	28480	01745-66501
A12C1	0180-0230	0	1	CAPACITOR-FXD 1UF±20% 50VDC TA	56289	150D105X0050A2
A12C2	0160-0165	8	2	CAPACITOR-FXD .056UF ±10% 200VDC POLYE	28480	0160-0165
A12C3	0160-3665	9	2	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	0160-0165	8		CAPACITOR-FXD .056UF ±10% 200VDC POLYE	28480	0160-0165
A12C6	0160-3459	9	3	CAPACITOR-FXD .02UF ±20% 100VDC CER	28480	0160-3459
A12C7	0140-0196	3	1	CAPACITOR-FXD 150PF ±5% 300VDC MICA	72136	DM15F151J0300WV1CR
A12C9	0160-3459	9		CAPACITOR-FXD .02UF ±20% 100VDC CER	28480	0160-3459
A12C10	0160-3459	9		CAPACITOR-FXD .02UF ±20% 100VDC CER	28480	0160-3459
A12C11	0121-0474	0	1	CAPACITOR-V TRMR-PSTN 3-13PF 600V	28480	0121-0474
A12CR1	1901-0040	1	3	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A12CR2	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A12CR3	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A12H1	2200-0103	2	2	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A12H2	2260-0002	6	2	NUT-HEX-DBL-CHAM 4-40-THD .062-IN-THK	00000	ORDER BY DESCRIPTION
A12H3	2190-0016	3	3	WASHER-LK INTL T 3/8 IN .377-IN-ID	28480	2190-0016
A12H4	2950-0043	8	3	NUT-HEX-DBL-CHAM 3/8-32-THD .094-IN-THK	00000	ORDER BY DESCRIPTION
A12MP1	1205-0095	0	2	HEAT SINK SGL TO-5/TO-39 CS	30161	3228B
A12MP2	01801-01206	7	2	BRACKET-ANGLE	28480	01801-01206
A12MP3	1200-0185	9	2	INSULATOR-XSTR NYLON	28480	1200-0185
A12P1	1251-3898	4	1	CONNECTOR 10-PIN M POST TYPE	28480	1251-3898
A12P2	1251-6015	3	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-6015
A12P3	1251-6011	9	1	CONNECTOR 5-PIN M POST TYPE	28480	1251-6011
A12Q1	1853-0015	7	1	TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A12Q2	1853-0232	0	1	TRANSISTOR PNP SI TO-39 PD=1W FT=200MHZ	28480	1853-0232
A12Q3	1854-0215	1	1	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A12Q4	1854-0271	9	1	TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0271
A12R1	0684-1231	1	1	RESISTOR 12K 10% .25W FC TC=-400/+800	01121	CB1231
A12R2	0757-0422	5	1	RESISTOR 909 1% .125W F TC=0±100	24546	C4-1/8-T0-909R-F
A12R3	2100-3423	3	1	RESISTOR-VAR CONTROL CCP 10K 20% LIN	28480	2100-3423
A12R4	0757-0279	0	1	RESISTOR 3.16K 1% .125W F TC=0±100	24546	C4-1/8-T0-3161-F
A12R5	0698-3159	5	1	RESISTOR 26.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-2612-F
A12R6	0757-0462	3	1	RESISTOR 75K 1% .125W F TC=0±100	24546	C4-1/8-T0-7502-F
A12R7	0757-0124	4	1	RESISTOR 39.2K 1% .125W F TC=0±100	28480	0757-0124
A12R8	0757-0440	7	1	RESISTOR 7.5K 1% .125W F TC=0±100	24546	C4-1/8-T0-7501-F
A12R9	0757-0737	5	1	RESISTOR 1.62K 1% .25W F TC=0±100	24546	C5-1/4-TO-1621-F
A12R10	0698-3646	5	1	RESISTOR 12K 5% 2W MO TC=0±200	27187	FP42-2-T00-1202-J

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A12R11	0757-0435	0	1	RESISTOR 3.92K 1% .125W F TC=0±100	24546	C4-1/8-T0-3921-F
A12R12	2100-3273	1	1	RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
A12R13	0757-0843	4	1	RESISTOR 15K 1% .5W F TC=0±100	28480	0757-0843
A12R14	0687-1211	3	1	RESISTOR 120 10% .5W CC TC=0+529	01121	EB1211
A12R15	0684-1021	7	2	RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A12R16	2100-3353	8	1	RESISTOR-TRMR 20K 10% C SIDE-ADJ 1-TRN	28480	2100-3353
A12R17	0684-1021	7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A12R19	2100-3355	0	1	RESISTOR-TRMR 100K 10% C SIDE-ADJ 1-TRN	28480	2100-3355
A12R20	0684-3331	6	1	RESISTOR 33K 10% .25W FC TC=-400/+800	01121	CB3331
A12R21	0684-2211	8	1	RESISTOR 220 10% .25W FC TC=-400/+600	01121	CB2211
A12R22	2100-3424	4	1	RESISTOR-VAR CONTROL CCP 5M 30% LIN	28480	2100-3424
A12R23	0684-1011	5	1	RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A12R24	0683-0335	2	1	RESISTOR 3.3 5% .25W FC TC=-400/+500	01121	CB33G5
A12R25	2100-4024	2	1	RESISTOR-VAR 1000 CP 10% LIN	28480	2100-4024
A12S1	3101-1767	7	1	SWITCH-PUSHBUTTON DPDT	28480	3101-1767
A12U1	1821-0002	5	1	TRANSISTOR ARRAY CA3045	3L585	CA3045
A12VR1	1902-0025	4	1	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
A12VR2	1902-3345	7	1	DIODE-ZNR 51.1V 5% DO-35 PD=.4W	28480	1902-3345
A12XA15	1251-6007	3	1	CONNECTOR 15-PIN F POST TYPE	28480	1251-6007
A12XU1	1200-0638	7	1	SOCKET-IC 14-CONT DIP DIP-SLDR	28480	1200-0638
A13	01740-66564	2	1	VERTICAL LOGIC BOARD ASSEMBLY	28480	01740-66564
A13MP1	0380-0744	5	8	SPACER .090 .093	28480	0380-0744
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-PUSHBUTTON 2 STATIONS	28480	3101-1908
A13S2	3101-1907	7	1	SWITCH-PUSHBUTTON 4 STATIONS	28480	3101-1907
A13XA3	1251-6014	2	2	CONNECTOR- 8 FEMALE RECEPTACLE	28480	1251-6014
A13XA3	1251-6014	2		CONNECTOR- 8 FEMALE RECEPTACLE	28480	1251-6014
A14	01740-66540	4	1	INTERFACE BOARD ASSEMBLY	28480	01740-66540
A14XA3	1251-1632	0	1	CONNECTOR-PC EDGE 12-CONT/ROW 1-ROW	28480	1251-1632
A14XA7	1251-1633	1	1	CONNECTOR-PC EDGE 15-CONT/ROW 1-ROW	28480	1251-1633
A14XA16	1251-5092	4	1	CONNECTOR-POST 16 CONTACT	28480	1251-5092
A15	01745-66502	3	1	HIGH VOLTAGE POWER BOARD ASSEMBLY	28480	01745-66502
A15A1	01740-61101	3	1	TRANSFORMER ASSEMBLY- HIGH VOLTAGE	28480	01740-61101
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	2	CAPACITOR-FXD 1UF+50-10% 150VDC AL	56289	30D105G1508A2
A15C4	0160-0684	6	2	CAPACITOR-FXD 1000PF ±20% 4KVDC	28480	0160-0684
A15C5	0160-4051	9	1	CAPACITOR-FXD .01UF ±20% 4KVDC	28480	0160-4051
A15C6	0160-0644	7	1	CAPACITOR-FXD .022UF ±20% 4KVDC	28480	0160-0644
A15C7	0160-0684	5	1	CAPACITOR-FXD .068UF ±20% 4KVDC	56289	430P683040
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	0180-0197	8	2	CAPACITOR-FXD 2.2UF±10% 20VDC TA	56289	150D225X9020A2
A15C11	0180-0197	8		CAPACITOR-FXD 2.2UF±10% 20VDC TA	56289	150D225X9020A2
A15C12	0170-0040	9	1	CAPACITOR-FXD .047UF ±10% 200VDC POLYE	56289	292P47392
A15C13	0160-3443	1	1	CAPACITOR-FXD .1UF +80-20% 50VDC CER	28480	0160-3443
A15C14	0160-0165	8	1	CAPACITOR-FXD .056UF ±10% 200VDC POLYE	28480	0160-0165
A15C15	0180-0269	5		CAPACITOR-FXD 1UF+50-10% 150VDC AL	56289	30D105G1508A2
A15C16	0160-0168	1	1	CAPACITOR-FXD .1UF ±10% 200VDC POLYE	28480	0160-0168
A15C17	0180-0230	0	1	CAPACITOR-FXD 1UF±20% 50VDC TA	56289	150D106X0050A2
A15C102	0160-2055	9	1	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A15CR1	1901-0873	8	7	DIODE-HV RECT 600V 1A	28480	1901-0873
A15CR2	1901-0873	8		DIODE-HV RECT 600V 1A	28480	1901-0873
A15CR3	1901-0873	8		DIODE-HV RECT 600V 1A	28480	1901-0873
A15CR4	1901-0873	8		DIODE-HV RECT 600V 1A	28480	1901-0873
A15CR5	1901-0873	8		DIODE-HV RECT 600V 1A	28480	1901-0873
A15CR6	1901-0873	8		DIODE-HV RECT 600V 1A	28480	1901-0873
A15CR7	1901-0683	8	1	DIODE-HV RECT 10KV 5MA 250NS	28480	1901-0683
A15CR9	1901-0873	8		DIODE-HV RECT 600V 1A	28480	1901-0873
A15CR10	1901-0040	1	3	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A15CR11	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A15CR102	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A15E1	2110-0269	0	2	FUSEHOLDER-CLIP TYPE 250-FUSE	28480	2110-0269
A15E2	2110-0269	0		FUSEHOLDER-CLIP TYPE 250-FUSE	28480	2110-0269
A15F1	2110-0007	4	1	FUSE 1A 250V TD 1.25X.25 UL	75915	313001

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A15H1	2190-0019	6	2	WASHER-LK HLCL NO 4 .115-IN-ID	28480	2190-0019
A15H2	2200-0125	8	2	SCREW-MACH 4-40 1.5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A15H3	2260-0001	5	2	NUT-HEX-DBL-CHAM 4-40-THD .094-IN-THK	28480	2260-0001
A15L1	9140-0171	3	1	INDUCTOR RF-CH-MLD 40UH 10% .296DX.968LG	28480	9140-0171
A15L2	9140-0210	1	1	INDUCTOR RF-CH-MLD 100UH 5% .166DX.385LG	28480	9140-0210
A15L3	9140-0129	1	1	INDUCTOR RF-CH-MLD 220UH 5% .166DX.385LG	28480	9140-0129
A15MP1	5040-0402	7	1	MOUNT-TRANSFORMER	28480	5040-0402
A15MP2	5040-0430	1	1	MOUNT-TRANSFORMER	28480	5040-0430
A15Q1	1854-0071	7	1	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A15R1	0684-1021	7	1	RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A15R2	2100-3253	7	1	RESISTOR-TRMR 50K 10% C TOP-ADJ 1-TRN	28480	2100-3253
A15R3	0687-6841	5	1	RESISTOR 680K 10% .5W CC TC=0+882	01121	EB6841
A15R4	0684-1031	9	1	RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A15R5	0684-2221	1	3	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	0698-4112	2	1	RESISTOR 54.9 1% .25W F TC=0±100	24546	C8-1/4-TO-54R9-F
A15R8	0684-2221	1		RESISTOR 2.2K 10% .25W FC TC=-400/+700	01121	CB2221
A15R9	0684-4721	0	1	RESISTOR 4.7K 10% .25W FC TC=-400/+700	01121	CB4721
A15R10	0683-1065	7	1	RESISTOR 10M 5% .25W CC TC=-900/+1100	01121	CB1065
A15R11	0687-1531	0	1	RESISTOR 15K 10% .5W CC TC=0+765	01121	EB1531
A15R12	0687-3301	6	1	RESISTOR 33 10% .5W CC TC=0+412	01121	EB3301
A15R13	0699-1010	5	1	RESISTOR-.30 MEGOHM	28480	0699-1010
A15R14	0684-1011	5	2	RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A15R15	0698-8995	7	1	RESISTOR 10M 5% 1W C TC=0±250	28480	0698-8995
A15R16	0699-0169	3	1	RESISTOR 16.26M 5% 1W C TC=0±250	28480	0699-0169
A15R17	0687-1011	1	1	RESISTOR 100 10% .5W CC TC=0+529	01121	EB1011
A15R18	0687-5611	5	1	RESISTOR 560 10% .5W CC TC=0+529	01121	EB5611
A15R20	0683-2265	1	1	RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A15R21	0757-0488	3	3	RESISTOR 909K 1% .125W F TC=0±100	28480	0757-0488
A15R23	0684-1041	1	2	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	0683-3935	4	1	RESISTOR 39K 5% .25W FC TC=-400/+800	01121	CB3935
A15R26	2100-3355	0	1	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	0684-1011	5		RESISTOR 100 10% .25W FC TC=-400/+500	01121	CB1011
A15R29	0757-0814	0	1	RESISTOR 390 2% .125W F TC=0±100	24546	C4-1/8-TO-391-G
A15R101	0757-0978	6	1	RESISTOR 95.3K 1% .125W F TC=0±100	24546	C4-1/8-TO-9532-F
A15R102	0757-0488	3		RESISTOR 909K 1% .125W F TC=0±100	28480	0757-0488
A15R103	0757-0488	3		RESISTOR 909K 1% .125W F TC=0±100	28480	0757-0488
A15R104	0684-6821	5	2	RESISTOR 6.8K 10% .25W FC TC=-400/+700	01121	CB6821
A15R105	0684-6821	5		RESISTOR 6.8K 10% .25W FC TC=-400/+700	01121	CB6821
A15R106	0757-0465	4	2	RESISTOR 36.5K 1% .125W F TC=0±100	24546	C4-1/8-TO-3652-F
A15R107	0757-0465	4		RESISTOR 36.5K 1% .125W F TC=0±100	24546	C4-1/8-TO-3652-F
A15R110	0757-0450	9	1	RESISTOR 22.1K 1% .125W F TC=0±100	24546	C4-1/8-TO-2212-F
A15R111	0698-5470	7	1	RESISTOR 111K 1% .125W F TC=0±100	24546	C4-1/8-TO-1113-F
A15R112	0757-0448	5	1	RESISTOR 18.2K 1% .125W F TC=0±100	24546	C4-1/8-TO-1822-F
A15R113	2100-0658	9	1	RESISTOR-TRMR 20K 10% C TOP-ADJ 1-TRN	28480	2100-0658
A15TP1	1251-0206	2	1	CONNECTOR-SGL CONT SKT .04-IN-BSC-SZ RND	28480	1251-0206
A15U1	1826-0946	6	1	IC-CA3094	28480	1826-0946
A15U2	1826-0346	0	1	IC OP AMP GP DUAL 8-DIP-P PKG	27014	LM358N
A15U3	1826-0708	8	1	IC-10V	28480	1826-0708
A15V1	2140-0013	5	2	LAMP-GLOW 5AB-A 70/57VDC 300UA T-2-BULB	06806	5AB-A(NE-23A)
A15V2	2140-0013	5		LAMP-GLOW 5AB-A 70/57VDC 300UA T-2-BULB	06806	5AB-A(NE-23A)
A15VR1	1902-3345	7	1	DIODE-ZNR 51.1V 5% DO-35 PD=.4W	28480	1902-3345
A15XA12	1251-6136	9	1	CONNECTOR	28480	1251-6133
A16	01740-66594	8	1	LOW VOLTAGE POWER BOARD ASSEMBLY	28480	01740-66594
A16C1	0140-0208	8	1	CAPACITOR-FXD 680PF ±5% 300VDC MICA	72136	DM15F681J0300WV1CR
A16C2	0160-0168	1	1	CAPACITOR-FXD .1UF ±10% 200VDC POLYE	28480	0160-0168
A16C3	0180-1827	3	1	CAPACITOR-FXD 50UF+50-10% 25VDC AL	28480	0180-1827
A16C4	0180-0089	7	1	CAPACITOR-FXD 10UF+50-10% 150VDC AL	56289	30D106F150DD2
A16C5	0180-1866	0	1	CAPACITOR-FXD AL 500UF 75VDC	28480	0180-1866
A16C6	0180-0091	1	1	CAPACITOR-FXD 10UF+50-10% 100VDC AL	56289	30D106F100DC2
A16C7	0180-2500	1	1	CAPACITOR-FXD AL 1500UF 16VDC	37942	TT152U016G1C3P
A16C8	0180-0683	6	1	CAPACITOR-FXD 6000UF+75-10% 30VDC AL	28480	0180-0683
A16C9	0160-7211	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	28480	0180-0576
A16C15	0160-2211	9		CAPACITOR-FXD 510PF ±5% 300VDC MICA	28480	0160-2211

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
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	0160-2055	9	2	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A16C19	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A16C20	0180-0100	3	1	CAPACITOR-FXD 4.7UF±10% 35VDC TA	56289	1500476X9035B2
A16C21	0160-5445	7	1	CAPACITOR-FLM 0.1UF ±10% 400VDC	28480	0160-5445
A16C22	0160-3670	8	5	CAPACITOR-FXD .1UF ±20% 200VDC CER	28480	0160-3670
A16C23	0160-3670	6		CAPACITOR-FXD .1UF ±20% 200VDC CER	28480	0160-3670
A16C24	0160-3670	6		CAPACITOR-FXD .1UF ±20% 200VDC CER	28480	0160-3670
A16C25	0160-3670	6		CAPACITOR-FXD .1UF ±20% 200VDC CER	28480	0160-3670
A16C26	0160-3670	6		CAPACITOR-FXD .1UF ±20% 200VDC CER	28480	0160-3670
A16CR1	1906-0006	9	5	DIODE-FW BRDG 400V 1A	18546	VE48
A16CR2	1906-0006	9		DIODE-FW BRDG 400V 1A	18546	VE48
A16CR3	1906-0006	9		DIODE-FW BRDG 400V 1A	18546	VE48
A16CR4	1906-0048	9	1	DIODE-FW BRDG 100V 5A	28480	1906-0048
A16CR5	1906-0006	9		DIODE-FW BRDG 400V 1A	18546	VE48
A16CR6	1906-0006	9		DIODE-FW BRDG 400V 1A	18546	VE48
A16CR7	1901-0040	1	2	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A16CR8	1901-0040	1		DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A16E1	0340-0949	8	1	INSULATOR	28480	0340-0949
A16H1	0624-0006	9	2	SCREW-TPG 4-24 .25-IN-LG PAN-HD-PHL	00000	ORDER BY DESCRIPTION
A16H2	2200-0146	2	1	SCREW-MACH 4-40 .438-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
A16H3	2190-0199	3	1	WASHER-FL NM NO. 4 .125-IN-ID .312-IN-OD	28480	2190-0199
A16H4	2190-0910	5	1	WASHER-LK INTL T NO. 4 .12-IN-ID	28480	2190-0910
A16H5	2250-0003	7	1	NUT-HEX-PLSTC LKG 4-40-THD .141-IN-THK	00000	ORDER BY DESCRIPTION
A16MP1	1400-0747	3	1	CABLE TIE .062-4-DIA .19-WD NYL	28480	1400-0747
A16MP2	1400-0249	0	1	CABLE TIE .062-.625-DIA .091-WD NYL	06383	PLT1M-8
A16P1	1251-6008	4	1	CONNECTOR 12-PIN M POST TYPE	28480	1251-6008
A16P2	1251-5093	5	1	CONNECTOR-POST 15 CONTACT	28480	1251-5093
A16P3	1251-6009	5	1	CONNECTOR 16-PIN M POST TYPE	28480	1251-6009
A16P4	1251-5346	1	1	CONNECTOR 10-PIN M POST TYPE	28480	1251-5346
A16P5	1251-6010	8	1	CONNECTOR 3-PIN M POST TYPE	28480	1251-6010
A16Q1	1853-0336	5	2	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	2	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A16Q4	1854-0575	6	1	TRANSISTOR NPN SI PD=625MW FT=50MHZ	04713	MPS-A42
A16Q5	1853-0080	6	2	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	2N3904
A16Q8	1854-0358	3	1	TRANSISTOR NPN SI PD=310MW FT=60MHZ	28480	1854-0358
A16Q9	1853-0036	2	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
A16Q13	1854-0472	2	1	TRANSISTOR NPN SI DARL PD=600MW	04713	MPS-A14
A16Q14	1854-0658	5	1	TRANSISTOR NPN SI DARL PD=70W FT=1MHZ	28480	1854-0658
A16R1	0757-0454	3	1	RESISTOR 33.2K 1% .125W F TC=0±100	24546	C4-1/8-T0-3322-F
A16R2	0699-0003	4	1	RESISTOR 8.2 10% .5W CC TC=0+412	01121	EB82G1
A16R3	0684-1241	3	1	RESISTOR 120K 10% .25W FC TC=-800/+900	01121	CB1241
A16R4	0684-1031	9	2	RESISTOR 10K 10% .25W FC TC=-400/+700	01121	CB1031
A16R5	0698-3455	4	1	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	2	RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A16R8	0684-1041	1	2	RESISTOR 100K 10% .25W FC TC=-400/+800	01121	CB1041
A16R9	0757-0431	8	2	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	1	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	0757-0450	9	1	RESISTOR 22.1K 1% .125W F TC=0±100	24546	C4-1/8-T0-2212-F
A16R14	0698-5437	6	1	RESISTOR 12K .1% .125W F TC=0±50	28480	0698-5437
A16R15	0684-1021	7		RESISTOR 1K 10% .25W FC TC=-400/+600	01121	CB1021
A16R16	0684-4731	2	1	RESISTOR 47K 10% .25W FC TC=-400/+800	01121	CB4731
A16R20	2100-3253	7	1	RESISTOR-TRMR 50K 10% C TOP-ADJ 1-TRN	28480	2100-3253
A16R21	0684-8231	5	1	RESISTOR 82K 10% .25W FC TC=-400/+800	01121	CB8231
A16R22	0687-4721	6	1	RESISTOR 4.7K 10% .5W CC TC=0+647	01121	EB4721
A16R23	0757-0428	1	1	RESISTOR 1.62K 1% .125W F TC=0±100	24546	C4-1/8-T0-1621-F
A16R24	0811-1668	9		RESISTOR 1.5 5% 2W PW TC=0±400	75042	BWH2-1R5-J
A16R25	0757-0433	8	1	RESISTOR 3.32K 1% .125W F TC=0±100	24546	C4-1/8-T0-3321-F
A16R26	2100-0654	5	1	RESISTOR-TRMR 500 10% C TOP-ADJ 1-TRN	28480	2100-0654
A16R27	0757-1093	8	1	RESISTOR 3K 1% .125W F TC=0±100	24546	C4-1/8-T0-3001-F
A16R28	0698-3329	1	1	RESISTOR 10K .5% .125W F TC=0±100	03888	PME55-1/8-T0-1002-D
A16R29	0698-5579	7	3	RESISTOR 6K .5% .125W F TC=0±100	24546	C4-1/8-T0-6001-D
A16R30	0811-1666	7	1	RESISTOR 1.5% 2W PW TC=0±800	75042	BWH2-1R0-J
A16R31	0684-3321	4	1	RESISTOR 3.3K 10% .25W FC TC=-400/+700	01121	CB3321
A16R32	0698-5579	7		RESISTOR 6K .5% .125W F TC=0±100	24546	C4-1/8-T0-6001-D
A16R33	0698-5579	7		RESISTOR 6K .5% .125W F TC=0±100	24546	C4-1/8-T0-6001-D

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A16R34	0757-0431	6		RESISTOR 2 43K 1% 125W F TC=0±100	24546	C4-1/8-T0-2431-F
A16R35	0811-1667	8	1	RESISTOR 1 2 5% 2W PW TC=0±400	75042	BWH2-1R2-J
A16R36	0683-4715	0	2	RESISTOR 470 5% 25W FC TC=-400/+600	01121	CB4715
A16R37	0684-1011	5	2	RESISTOR 100 10% 25W FC TC=-400/+600	01121	CB1011
A16R38	0683-4715	0		RESISTOR 470 5% 25W FC TC=-400/+600	01121	CB4715
A16R39	0684-1011	5		RESISTOR 100 10% 25W FC TC=-400/+600	01121	CB1011
A16R40	0684-1041	1		RESISTOR 100K 10% 25W FC TC=-400/+800	01121	CB1041
A16R44	0757-0477	0	2	RESISTOR 332K 1% 125W F TC=0±100	19701	MF4C1/8-T0-3323-F
A16R45	0757-0477	0		RESISTOR 332K 1% 125W F TC=0±100	19701	MF4C1/8-T0-3323-F
A16R46	0757-0429	2	1	RESISTOR 1 82A 1% 125W F TC=0±100	24546	C4-1/8-T0-1821-F
A16R47	0757-0406	5	1	RESISTOR 182 1% 125W F TC=0±100	24546	C4-1/8-T0-182R-F
A16S1	3101-0555	9	1	SWITCH PB DPDT ALTNG 4A 250VAC	28480	3101-0555
A16S2	3101-1914	6	1	SWITCH-SL 2-DPDT 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-35 PD=.4W	28480	1902-3048
A16VR2	1902-0025	4	1	DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%	28480	1902-0025
A16VR3	1902-0049	2	1	DIODE-ZNR 6 19V 5% DO-35 PD=.4W	28480	1902-0049
A17	01742-66502	0	1	DECODING BOARD ASSEMBLY	28480	01742-66502
A17C1	0160-2055	9	2	CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C2	0160-2055	9		CAPACITOR-FXD .01UF +80-20% 100VDC CER	28480	0160-2055
A17C3	0180-1745	4	1	CAPACITOR-FXD 1 5UF±10% 20VDC TA	56289	150D155X9020A2
A17C4	0160-3456	6	1	CAPACITOR-FXD 1000PF ±10% 1KVDC CER	28480	0160-3456
A17C5	0180-0068	0	2	CAPACITOR-FXD 50UF+75-10% 25VDC UL	56289	300606G025CC2
A17C6	0180-0068	0		CAPACITOR-FXD 50UF+75-10% 25VDC AL	56289	300606G025CC2
A17CR3	1901-0613	3	2	DIODE-DUAL 100V	28480	1901-0613
A17CR4	1901-0613	3		DIODE-DUAL 100V	28480	1901-0613
A17CR5	1901-0535	9	1	DIODE-SM SIG SCHOTTKY	28480	1901-0535
A17CR6	1901-0040	1	1	DIODE-SWITCHING 30V 50MA 2NS DO-35	28480	1901-0040
A17Q2	1853-0036	2	1	TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A17Q3	1854-0071	7	3	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A17Q4	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A17Q5	1854-0071	7		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A17Q6	1854-0215	1	2	TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A17Q7	1854-0215	1		TRANSISTOR NPN SI PD=350MW FT=300MHZ	04713	2N3904
A17Q8	1854-0523	4	1	TRANSISTOR NPN SI TO-39 PD=1W FT=150MHZ	28480	1854-0523
A17Q9	1853-0354	7	2	TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A17Q10	1853-0354	7		TRANSISTOR PNP SI TO-92 PD=350MW	28480	1853-0354
A17R1	0757-0442	9	5	RESISTOR 10K 1% 125W F TC=0±100	24546	C4-1/8-T0-1002-F
A17R2	0757-0282	6	1	RESISTOR 221 1% 125W F TC=0±100	24546	C4-1/8-T0-221R-F
A17R3	0757-0200	7	1	RESISTOR 5 62K 1% 125W F TC=0±100	24546	C4-1/8-T0-5621-F
A17R4	0757-0280	3	4	RESISTOR 1K 1% 125W F TC=0±100	24546	C4-1/8-T0-1001-F
A17R5	0757-0435	0	3	RESISTOR 3 92K 1% 125W F TC=0±100	24546	C4-1/8-T0-3921-F
A17R6	0757-0435	0		RESISTOR 3 92K 1% 125W F TC=0±100	24546	C4-1/8-T0-3921-F
A17R7	0757-0442	9		RESISTOR 10K 1% 125W F TC=0±100	24546	C4-1/8-T0-1002-F
A17R8	0757-0442	9		RESISTOR 10K 1% 125W F TC=0±100	24546	C4-1/8-T0-1002-F
A17R9	0757-0280	3		RESISTOR 1K 1% 125W F TC=0±100	24546	C4-1/8-T0-1001-F
A17R10	0757-0280	3		RESISTOR 1K 1% 125W F TC=0±100	24546	C4-1/8-T0-1001-F
A17R11	0757-0438	3	4	RESISTOR 5 11K 1% 125W F TC=0±100	24546	C4-1/8-T0-5111-F
A17R12	0757-0438	3		RESISTOR 5 11K 1% 125W F TC=0±100	24546	C4-1/8-T0-5111-F
A17R13	0757-0435	0		RESISTOR 3 92K 1% 125W F TC=0±100	24546	C4-1/8-T0-3921-F
A17R14	0757-0401	0	6	RESISTOR 100 1% 125W F TC=0±100	24546	C4-1/8-T0-101-F
A17R15	0757-0401	0		RESISTOR 100 1% 125W F TC=0±100	24546	C4-1/8-T0-101-F
A17R16	0757-0282	6	2	RESISTOR 2K 1% 125W F TC=0±100	24546	C4-1/8-T0-2001-F
A17R17	0684-4721	0	3	RESISTOR 4 7K 10% 25W FC TC=-400/+700	01121	CB4721
A17R18	0684-4721	0		RESISTOR 4 7K 10% 25W FC TC=-400/+700	01121	CB4721
A17R19	0684-4721	0		RESISTOR 4 7K 10% 25W FC TC=-400/+700	01121	CB4721
A17R20	0757-0283	6		RESISTOR 2K 1% 125W F TC=0±100	24546	C4-1/8-T0-2001-F
A17R21	0684-2231	3	1	RESISTOR 22K 10% 25W FC TC=-400/+800	01121	CB2231
A17R24	0698-6688	1	2	RESISTOR 99 8K 1% 125W F TC=0±25	28480	0698-6688
A17R25	0757-0458	7	2	RESISTOR 51 1K 1% 125W F TC=0±100	24546	C4-1/8-T0-5112-F
A17R26	0684-2251	7	1	RESISTOR 2 2M 10% 25W FC TC=-900/+1100	01121	CB2251
A17R27	0698-6688	1		RESISTOR 99 8K 1% 125W F TC=0±25	28480	0698-6688
A17R28	0757-0438	3		RESISTOR 5 11K 1% 125W F TC=0±100	24546	C4-1/8-T0-5111-F
A17R29	0757-0438	3		RESISTOR 5 11K 1% 125W F TC=0±100	24546	C4-1/8-T0-5111-F
A17R30	2100-3274	2	1	RESISTOR-TRMR 10K 10% C SIDE-ADJ 1-TRN	28480	2100-3274
A17R31	0698-6600	7	1	RESISTOR 4 87K 1% 125W F TC=0±25	28480	0698-6600
A17R32	0757-0401	0		RESISTOR 100 1% 125W F TC=0±100	24546	C4-1/8-T0-101-F
A17R33	0757-0401	0		RESISTOR 100 1% 125W F TC=0±100	24546	C4-1/8-T0-101-F
A17R34	0684-1063	6	1	RESISTOR 10M 10% 25W FC TC=-900/+1100	01121	CB1061
A17R35	2100-3123	0	1	RESISTOR-TRMR 500 10% C SIDE-ADJ 17-TRN	02111	43P501
A17R36	0698-3155	1	1	RESISTOR 4 64K 1% 125W F TC=0±100	24546	C4-1/8-T0-4641-F
A17R37	0698-3156	2	1	RESISTOR 14 7K 1% 125W F TC=0±100	24546	C4-1/8-T0-1472-F

See introduction to this section for ordering information

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

Reference Designator	HP Part Number	C D	Qty	Description	Mfr Code	Mfr Part Number
A17R38	0757-0445	2	1	RESISTOR 13K 1% 125W F TC=0±100	24546	C4-1/8-T0-1302-F
A17R39	2100-3273	1	1	RESISTOR-TRMR 2K 10% C SIDE-ADJ 1-TRN	28480	2100-3273
A17R40	0757-0442	9		RESISTOR 10K 1% 125W F TC=0±100	24546	C4-1/8-T0-1002-F
A17R41	0757-0487	2	1	RESISTOR 825K 1% 125W F TC=0±100	28480	0757-0487
A17R42	2100-3094	4	1	RESISTOR-TRMR 100K 10% C SIDE-ADJ 17-TRN	02111	43P104
A17R43	0757-0458	7		RESISTOR 51.1K 1% 125W F TC=0±100	24546	C4-1/8-T0-5112-F
A17R44	0757-0441	8	1	RESISTOR 8.25K 1% 125W F TC=0±100	24546	C4-1/8-T0-8251-F
A17R45	0757-0280	3		RESISTOR 1K 1% 125W F TC=0±100	24546	C4-1/8-T0-1001-F
A17R46	0757-0412	3	1	RESISTOR 365 1% 125W F TC=0±100	24546	C4-1/8-T0-365R-F
A17R47	0757-0290	5	1	RESISTOR 6.19K 1% 125W F TC=0±100	19701	MF4C1/8-T0-6191-F
A17R48	0757-0409	8	1	RESISTOR 274 1% 125W F TC=0±100	24546	C4-1/8-T0-274R-F
A17R49	0757-0407	6	1	RESISTOR 200 1% 125W F TC=0±100	24546	C4-1/8-T0-201-F
A17R50	0757-0401	0		RESISTOR 100 1% 125W F TC=0±100	24546	C4-1/8-T0-101-F
A17R51	0761-0030	0	1	RESISTOR 2.7K 5% 1W MO TC=0±200	28480	0761-0030
A17R52	0698-6977	1	1	RESISTOR 30.1 1% 125W F TC=0±25	28480	0698-6977
A17R53	0698-6360	4	1	RESISTOR 10K 1% 125W F TC=0±25	28480	0698-6360
A17R54	0698-5449	0	1	RESISTOR 5K 1% 125W F TC=0±50	19701	MF4C1/8-T2-5001-B
A17R55	0698-6348	0	1	RESISTOR 3K 1% 125W F TC=0±25	28480	0698-6348
A17R56	0698-3491	8	1	RESISTOR 1K 1% 125W F TC=0±50	28480	0698-3491
A17R57	0698-6317	3	1	RESISTOR 500 1% 125W F TC=0±25	03888	PME55-1/8-T9-500R-B
A17R58	0698-6296	6	1	RESISTOR 300 1% 125W F TC=0±50	28480	0698-6295
A17R59	0698-4343	1	2	RESISTOR 100 1% 125W F TC=0±50	28480	0698-4343
A17R60	0698-4343	1		RESISTOR 100 1% 125W F TC=0±50	28480	0698-4343
A17R61	0757-0442	9		RESISTOR 10K 1% 125W F TC=0±100	24546	C4-1/8-T0-1002-F
A17R62	0757-0401	0		RESISTOR 100 1% 125W F TC=0±100	24546	C4-1/8-T0-101-F
A17R63	0684-1011	5	2	RESISTOR 100 10% 25W FC TC=-400/+500	01121	CB1011
A17R64	0684-1011	5		RESISTOR 100 10% 25W FC TC=-400/+500	01121	CB1011
A17R65	0757-0439	4	1	RESISTOR 6.81K 1% 125W F TC=0±100	24546	C4-1/8-T0-6811-F
A17R66	0698-3438	3	1	RESISTOR 147 1% 125W F TC=0±100	24546	C4-1/8-T0-147R-F
A17R67	0684-1021	7	1	RESISTOR 1K 10% 25W FC TC=-400/+800	01121	CB1021
A17R68	0757-0465	6	1	RESISTOR 100K 1% 125W F TC=0±100	24546	C4-1/8-T0-1003-F
A17S1MP1	0510-1101	7	1	RING-RETAINING	28480	0510-1101
A17S1MP2	01722-61901	9	1	SWITCH ASSEMBLY-ROTOR (MALE)	28480	01722-61901
A17S1MP3	01722-61902	0	1	SWITCH ASSEMBLY-ROTOR (FEMALE)	28480	01722-61902
A17U1	1826-0059	2	3	IC OP AMP GP TO-99 PKG	01295	LM201AL
A17U2	1826-0059	2		IC OP AMP GP TO-99 PKG	01295	LM201AL
A17U3	1820-0203	6	1	IC OP AMP GP TO-99 PKG	3L585	CA741CT
A17U4	1826-0059	2		IC OP AMP GP TO-99 PKG	01295	LM201AL
A17U7	1821-0001	4	1	TRANSISTOR ARRAY CA3046	3L585	CA3046
A17U8	1820-1197	9	1	IC GATE TTL LS NAND QUAD 2-INP	01295	SN74LS00N
A17U9	1820-1112	8	1	IC FF TTL LS D-TYPE POS-EDGE-TRIG	01295	SN74LS74AN
A17VR1	1902-3002	3	1	DIODE-ZNR 2.37V 5% DO-7 PD=4W TC=-.074%	28480	1902-3002
A17XA7	1251-6007	3	1	CONNUT 15 FEMALE RECEPTACLE	28480	1251-6007
				PARTS LIST FOR OPTION 001		
MP100	01720-03201	8	1	ADAPTER-POWER CORD	28480	01720-03201
MP101	0400-0013	5	1	GROMMET-STR RLF STR-THRU .1-IN-THK-PNL	28480	0400-0013
W100	8120-1202	0	1	CABLE-POWER 7.5 FT	28480	8120-1202
				PARTS LIST FOR OPTION 034/036		
A200	3476AH	5	1	DVM-SCOPE	28480	3476AH
E200	8120-2996	0	1	TEST LEADS	28480	8120-2995
H201	2200-0091	7	2	SCREW-MACH 4-40 .562-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H202	2200-0133	2	2	SCREW-MACH 4-40 .25-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H203	2200-0111	2	2	SCREW-MACH 4-40 .5-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
H204	2360-0115	4	4	SCREW-MACH 8-32 .312-IN-LG PAN-HD-POZI	00000	ORDER BY DESCRIPTION
MP12	1540-0446	6	1	POUCH-PLASTIC	28480	1540-0446
MP55	01742-04102	6	1	COVER-TOP	28480	01742-04102
MP200	01710-24705	9	2	SPACER	28480	01710-24705
MP201	01742-01202	1	1	BRACKET	28480	01742-01202
MP202	5040-8302	2	1	ADAPTER-3476A	28480	5040-8302
T200	9100-3956	4	1	TRANSFORMER-POWER	28480	9100-3956
W200	01740-61627	8	1	CABLE ASSEMBLY POWER	28480	01740-61627

See introduction to this section for ordering information

Table 6-3. List of Manufacturers' Codes

Mfr No.	Manufacturer Name	Address		Zip Code
H9027	SCHURTER A G H	LUZERN	SW	
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	K D I PYROFILM CORP	WHIPPANY	NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX	AZ	85008
06383	PANDUIT CORP	TINLEY PARK	IL	60477
06806	GE CO MINIATURE LAMP PROD DEPT	CLEVELAND	OH	44112
18546	VARO SEMICONDUCTOR INC	GARLAND	TX	75040
13103	THERMALLOY CO	DALLAS	TX	75234
19701	MEPCO/ELECTRA CORP	MINERAL WELLS	TX	76067
20932	EMCON DIV ITW	SAN DIEGO	CA	92129
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD	PA	16701
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA	CA	95051
27137	CORNING GLASS WORKS (WILMINGTON	WILMINGTON	NC	28401
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO	CA	94304
3L585	RCS CORP SOLID STATE DIV	SOMERVILLE	NJ	
30161	AAVID ENGINEERING INC	LACONIA	NH	03246
37942	MALLORY P R AND CO INC	INDIANAPOLIS	IN	46206
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	FLORENCE	SC	06226
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON	CA	92634
75042	TRW INC PHILADELPHIA DIV	PHILADELPHIA	PA	19108
75915	LITTELFUSE INC	DES PLAINES	IL	60016
90201	MALLORY CAPACITOR CO	INDIANAPOLIS	IN	46206

See introduction to this section for ordering information

BACK DATING MANUAL CHANGES

SECTION VII

MANUAL CHANGES

7-1. INTRODUCTION.

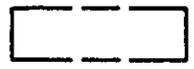
7-2. This section normally contains information for adapting this manual to instruments for which the content does not apply directly. Since this manual does apply directly to instruments having serial numbers listed on the title page, no change information is given here. Refer to INSTRUMENTS COVERED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

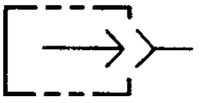
FRONT-PANEL MARKING

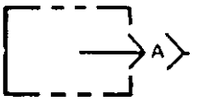
REAR-PANEL MARKING

MAIN SIGNAL PATH

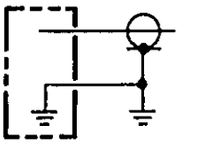
PRIMARY FEEDBACK PATH

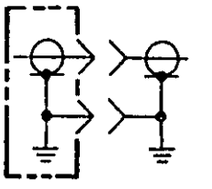
SECONDARY FEEDBACK PATH


SINGLE-PIN CONNECTOR ON BOARD



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

TEST POINT (TP WITH NUMBER)


SCREWDRIVER ADJUSTMENT

WAVEFORM TEST POINT (WITH NUMBER)

COMMON ELECTRICAL POINT (WITH LETTER); NOT NECESSARILY GROUND

SIGNAL REFERENCE

SCHEMATIC REFERENCE


BREAKDOWN DIODE (VOLTAGE REGULATOR)


LIGHT EMITTING DIODE (LED)


TUNNEL DIODE

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 PARENTHESIS USING THE RESISTOR COLOR CODE (1925) 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: 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

SECTION VIII

SERVICE

8-1. INTRODUCTION.

8-2. This section contains schematics, repair and replacement information, component locators, waveform and test conditions.

8-3. SAFETY CONSIDERATIONS.

8-4. The following warnings and cautions must be followed for your protection and to avoid damage to the equipment.

WARNING

Maintenance described in this section is performed with power supplied to the instrument and with the protective covers removed. Maintenance should be performed only by trained service 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. Read the Safety Summary at the front of this manual before attempting repair on this instrument.

8-5. SERVICE SHEETS.

8-6. The service sheet is a unit of information for a circuit which includes a schematic diagram, component locators, theory of operation, and testing information for the schematic. The service sheet number is a large bold number printed on the lower right-hand corner of each schematic.

8-7. SCHEMATICS. Schematics are printed on foldout pages for easy reference to the text and figures in other sections. The schematics are drawn to show the electronic function of the circuits. Any one schematic may include all or part of several different physical assemblies. Graphic symbols (table 8-1) used in this manual are based on ANSI Y-32.2-1975, Graphic Symbols for Electrical and Electronics Diagrams.

8-8. The schematics are numbered in sequence with a bold number at the lower right-hand corner of each page. These numbers are used to cross reference signal conections between the schematics. At circuit breaking points, a number in a circle is shown, followed by another number in bold type. The circled number indicates the signal and the bold number indicates the associated schematic that contains the source or destination of the signal. To find the source or destination of the signal, turn to the indicated schematic and find the circled number.

8-9. A table on each schematic lists all components shown on the schematic by reference designation. Component reference designators that have been deleted from the schematic are listed below the table.

8-10. All components within the bordered areas of the schematic are physically located on circuit board assemblies. Components not physically located on a circuit board assembly are shown in the unbordered areas of the schematic.

8-11. COMPONENT LOCATIONS. Locations of components on assemblies and subassemblies are illustrated on line drawings adjacent to the schematics. Since the schematics are drawn to show function, portions of a particular assembly may appear on several different schematics.

8-12. THEORY OF OPERATION. Overall theory of operation appears opposite the overall block diagram (figure 8-1). The block diagram briefly describes instrument operation. Each block in the diagram contains the service sheet number(s) where the detailed theory, schematics, and troubleshooting information are presented.

8-13. REFERENCE DESIGNATIONS.

8-14. Reference designations used in this manual are based on ANSI Y32.16-1975, Reference Designations for Electrical and Electronics Parts and Equipments. Minor variations from the standard, due to design and manufacturing practices, may be noted.

8-15. TROUBLESHOOTING.

8-16. INITIAL TROUBLESHOOTING PROCEDURE. Before troubleshooting the 1746A in detail, try to perform the adjustment procedures listed in Section V of this manual. Some apparent malfunctions may be corrected by these adjustments; failure to obtain a correct adjustment will often reveal the source of trouble.

8-17. 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.

8-18. TROUBLE DIAGNOSIS. Use the front-panel controls and note as many symptoms of the malfunction as possible. From these symptoms you can usually determine which section (vertical, horizontal, low- or high-voltage power supply) is malfunctioning. Even if the problem happens to be 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 these circuits. Table 8-2 lists the sequence of checks that should be used when troubleshooting.

8-19. CIRCUIT-LEVEL TROUBLESHOOTING. Once a problem has been isolated to a particular assembly or circuit, the text and waveforms on the service sheet that document that circuit should be used to locate the faulty component(s).

8-20. RECOMMENDED TEST EQUIPMENT.

8-21. Test equipment and accessories required to maintain the 1746A are listed in Section I of this manual. Equipment other than that listed may be used if it meets the listed critical specifications.

8-22. REPAIR.

8-23. ASSEMBLY REMOVAL. Instructions for removing major assemblies are contained in the Service Sheet instructions for that particular assembly. Refer to table 8-3 for a list of assemblies indexed to Service Sheets.

8-24. PREVENTIVE MAINTENANCE.

8-25. Cleaning. Painted surfaces can be cleaned with a commercial spray-type window cleaner or with a mild soap and water solution.

CAUTION

Avoid 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.

8-26 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.

8-27. 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.

8-28. 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 8 for TIME/DIV switch shaft removal and appropriate Service Sheet for switch maintenance.

8-29. 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 FLM produced by Fiske Brothers Refining Company. LUBRIPLATE FLM is available from Hewlett-Packard (HP Part No. 6040-0305).

8-30. CIRCUIT BOARDS.

8-31. 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

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. VERTICAL SECTION	After obtaining a visible beam, begin checking deflection circuitry.
5. 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.
6. SWEEP	After checking horizontal output amplifier, check ramp generating circuitry in AUTO mode). When auto sweep is operating properly, check trigger circuit.

jacks are identified by either a numeral or a letter. The letters G, I, O, and Q have been omitted.

8-32. Servicing Etched Circuit Boards. All 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 to Service Sheet Index

ASSY NO.	ASSY NAME	THEORY OF OPERATION	COMPONENT ID	REMOVAL PROCEDURE	TROUBLE-SHOOTING	SCHEMATIC
A1	CHAN A ATTENUATOR	Service Sheet 4	NA	Service Sheet 4	NA	Service Sheet 4
A2	CHAN B ATTENUATOR	Service Sheet 4	NA	Service Sheet 4	NA	Service Sheet 4
A3	Vertical Preamplifier	Service Sheets 4 and 6	Service Sheet 4	Service Sheet 4	Service Sheets 4 and 6	Service Sheets 4 and 6
A4	Delay Line	Service Sheet 4	NA	Service Sheet 4	NA	Service Sheet 4
A5	Vertical Output	Service Sheet 5	Service Sheet 5	Service Sheet 5	Service Sheet 5	Service Sheet 5
A6	High-Voltage Multiplier	Service Sheet 2	NA	Service Sheet 2	NA	Service Sheet 2
A7	Horizontal Sweep	Service Sheet 7	Service Sheet 7	Service Sheet 7	Service Sheets 7, 11, and 12	Service Sheets 10-12 and 14
A8	Main Sweep	Service Sheet 8	Service Sheet 8	Service Sheet 8	Service Sheet 8	Service Sheet 8
A9	Delayed Sweep	Service Sheet 10	Service Sheet 10	Service Sheet 10	Service Sheet 10	Service Sheet 10
A10	Delayed Trigger	Service Sheet 9	Service Sheet 9	Service Sheet 9	Service Sheet 9	Service Sheet 9
A11	Horizontal Output	Service Sheet 11	Service Sheet 11	Service Sheet 11	Service Sheet 11	Service Sheet 11
A12	Gate	Service Sheet 3	Service Sheet 3	Service Sheet 3	Service Sheet 3	Service Sheets 2, 3
A13	Vertical Control Switch	NA	Service Sheet 6	Service Sheet 4	NA	Service Sheets 4, 6
A14	Interface	NA	NA	NA	NA	Service Sheet 13
A15	High-Voltage Power Supply	Service Sheet 2	Service Sheet 2	Service Sheet 2	Service Sheet 2	Service Sheet 2
A16	Low-Voltage Power Supply	Service Sheet 1	Service Sheet 1	Service Sheet 1	Service Sheet 1	Service Sheet 1
A17	Time-Interval Decoder	Service Sheet 14	Service Sheet 14	Service Sheet 14	Service Sheet 14	Service Sheet 14

OVERALL BLOCK DIAGRAM

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 an Assembly to Service Sheet Index.

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 an X100 section preceding the discrete, dual-FET impedance converter in each channel. The preamplifier substrate (A3A1) performs the necessary control functions for both channels 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 approximately 100 nanoseconds delay 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 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 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. 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 inoperative; when low, 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 TIME/DIV switches. Outputs from the Miller integrators are applied through horizontal display mode switches to the horizontal preamplifier. In addition, the trigger generator also supplies signals to control the dual delay comparators on the time interval decoder board assembly. 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 sweep. 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 defleciton plates.

Gate and HV Power Supply. The gate amplifier provides the circuitry to control brightness of the CRT display. An intensity control circuit is used for brightening or blanking the CRT when necessary. BEAM FIND, BEAM INTENSITY, and SCALE 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.

The rectified CRT cathode voltage is sampled and fed back to the high-voltage oscillator. Changes in cathode voltage cause the oscillator to change the amplitude of its oscillation. This change corrects the rectified cathode voltage and returns it to the normal operating value. The unrectified cathode voltage in the secondary of the high-voltage transformer is applied to a multiplier assembly where it is increased six times. 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-, or 240-Vac operation is selectable). The input power circuit contains the ac line protection fuse and applies input ac to a step-down power transformer.

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

Time Interval - General. The two-marker sweep measurement technique is used for developing time interval measurements. Two separate markers enable the operator to select both the starting and stopping points of a time interval simultaneously. The markers are developed on alternate sweeps with the START control positioning the first marker and the STOP control positioning the second marker.

TROUBLESHOOTING

Use this overall block diagram and the troubleshooting sequence outlined in table 8-2 to isolate the trouble to a specific section of the instrument. Next, refer to the service sheets which cover that section, and isolate the trouble to a specific circuit or component.

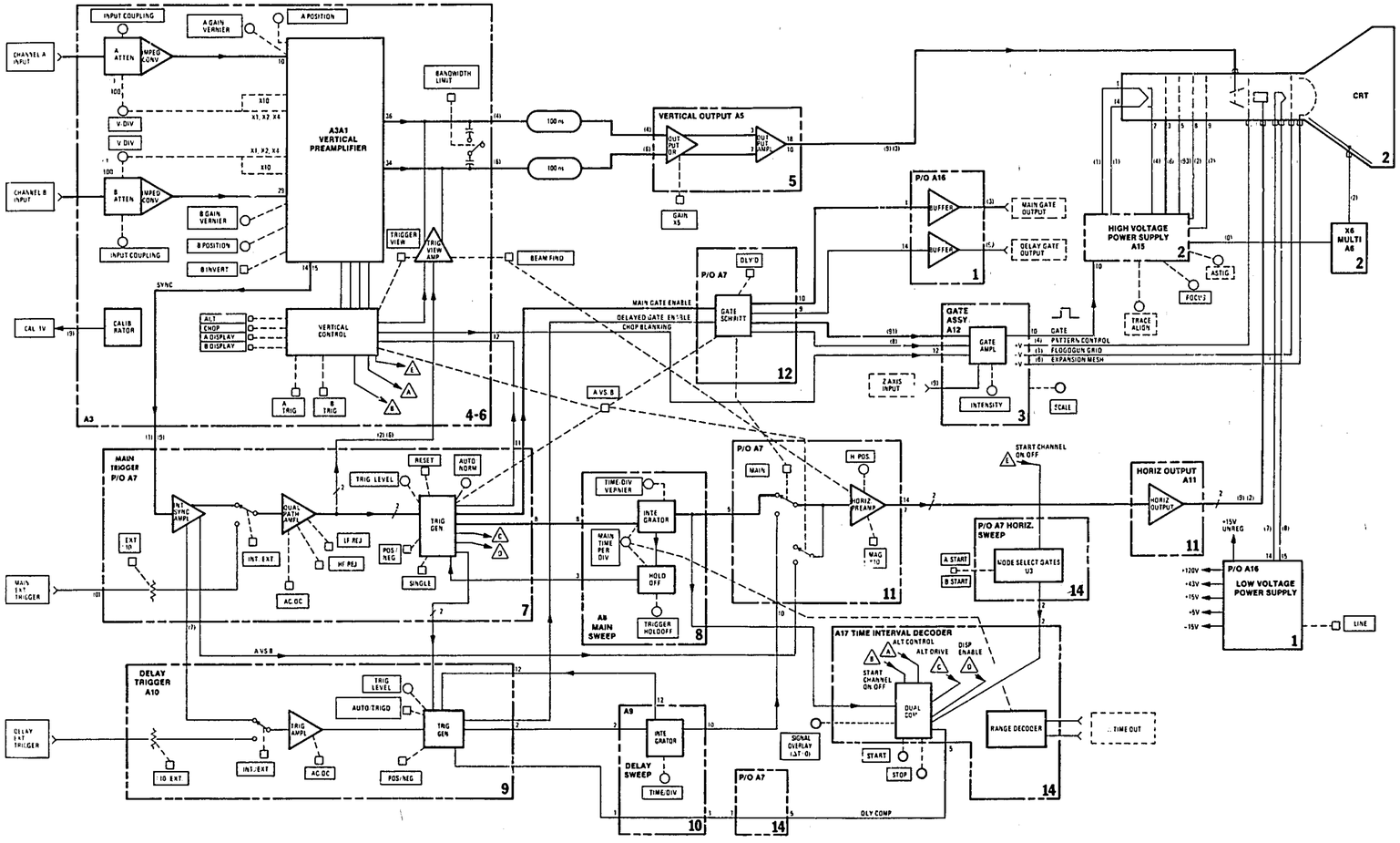


Figure 8-1.
Overall Block Diagram

SERVICE SHEET 1

THEORY OF OPERATION

General. The low-voltage power supply (LVPS) can be operated from a 100-, 120-, 220-, or 240-Vac, 48-Hz to 440 Hz power source. The line voltage is connected to five regulated voltage circuits +5 V, +15 V, +43 V, +120 V, and —15 V. Approximately +22 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 and +120 V supplies will be discussed.

+15-volt Supply. The ac input is applied through transformer T1 to full-wave, diode-bridge rectifier A16CR4. The unregulated rectified voltage (nominally +22 Vdc is applied to voltage regulator A16U1 that employs a built-in thermal shutdown and current-limiting circuits. Operation of the +15 V suply is explained in the following paragraphs.

The output of series regulator Q4 is controlled by the base bias applied from regulator A16U1. IC A16U1 contains a temperature compensation 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 V- pin 5 (ground). The +15 V output (from Q4) is divided by resistor network A16R25-A16R27. The wiper of potentiometer 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 remains fixed. With different voltages applied to the noninverting and inverting inputs to the amplifier, the output (pin 6) at A16U1 will vary, causing Q4 to increase or decrease its output as necessary to restore the output to +15 volts. The —15 V supply, consisting of A16U3 and Q6, operates identically to the +15 V 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 V supply, consisting of A16U2 and Q5, operates identically to the +15 V supply except that the reference voltage is the +15 V supply and attenuated by A16R28 and A16R29.

+120-volt and +43-volt Power Supplies. The +120 V and +43 V power supplies function in the same manner; therefore, only the +120 V supply will be discussed.

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. A +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 the current through A16Q2 increases, conduction through A16Q4 and Q2 will also increase and cause an increase in output voltage. When the output voltage reaches +120 volts, A16Q2 current decreases and equilibrium is attained. Transistor A16Q3 and resistor A16R2 form a current-limiting circuit. As current requirements increase toward 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 +43 V power supply functions in the same way as the +120 V supply. The Darlington pair consists of A16Q8 and Q3; the current-limiting circuit consists of A16Q7 and A16R10.

Line Frequency. The line frequency sync signal is developed in the same secondary winding of power transformer T1 that is used for the +120 V supply. The ac signal is applied through A16R40 to HF REJ switch A7S2B,C on assembly A7 (see Service Sheet 7).

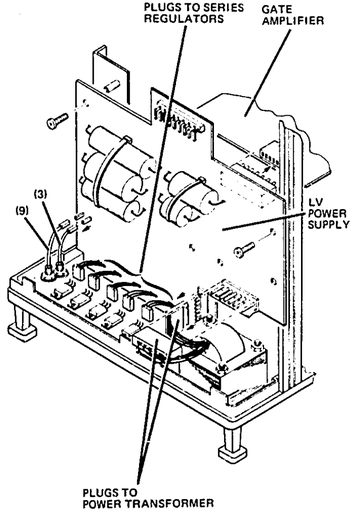
Floodgun Filament Voltage. Floodgun filament voltage is developed in a secondary winding of transformer T1, rectified by A16CR3, and filtered by A16C7. The rectified voltage is applied to a time-delay, current-source circuit consisting of two Darlington amplifiers, A16Q11/A16Q12. When the instrument is first turned on, A16Q11 conducts, holding the output of A16Q12 to a minimum value. When A16C20 becomes fully charged (through A16R41), A16Q11 cuts off. The current through A16Q12 is now controlled by front-panel SCALE ILLUM control A12R25 (Service Sheet 4). Zener diode A16VR3 provides a constant voltage across the SCALE ILLUM potentiometer and A16R20 adjusts the floodgun pattern.

REMOVAL PROCEDURE

To remove Low-Voltage Power Supply Assembly A16, 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.



LV Power Supply Removal

a. Remove Interface Assembly A14.

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

c. Disconnect two plugs to power transformer.

d. Remove line cover MP58 by removing two screws.

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

f. Disconnect five plugs to series regulators Q2 thru Q6.

g. Remove five screws holding A16 to chassis.

h. Disconnect plug to Gate Amplifier Assembly A12.

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

j. Unscrew LINE switch shaft and extract it.

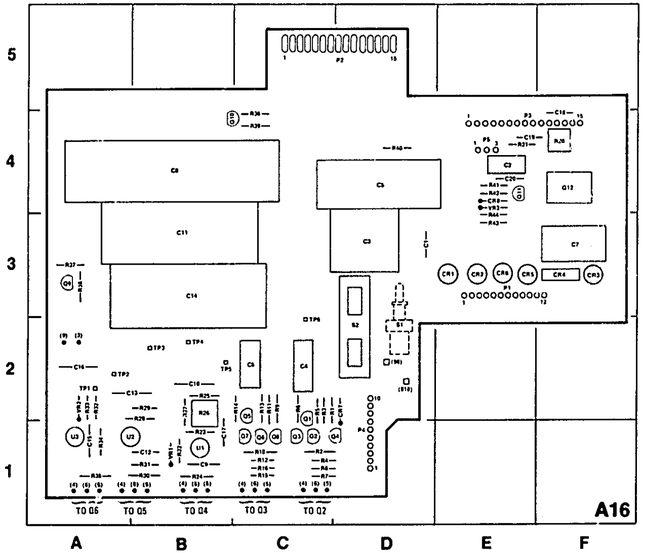
k. Remove button from shaft; A16 can now be removed.

l. To reinstall A16, reverse 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 3).

TROUBLESHOOTING

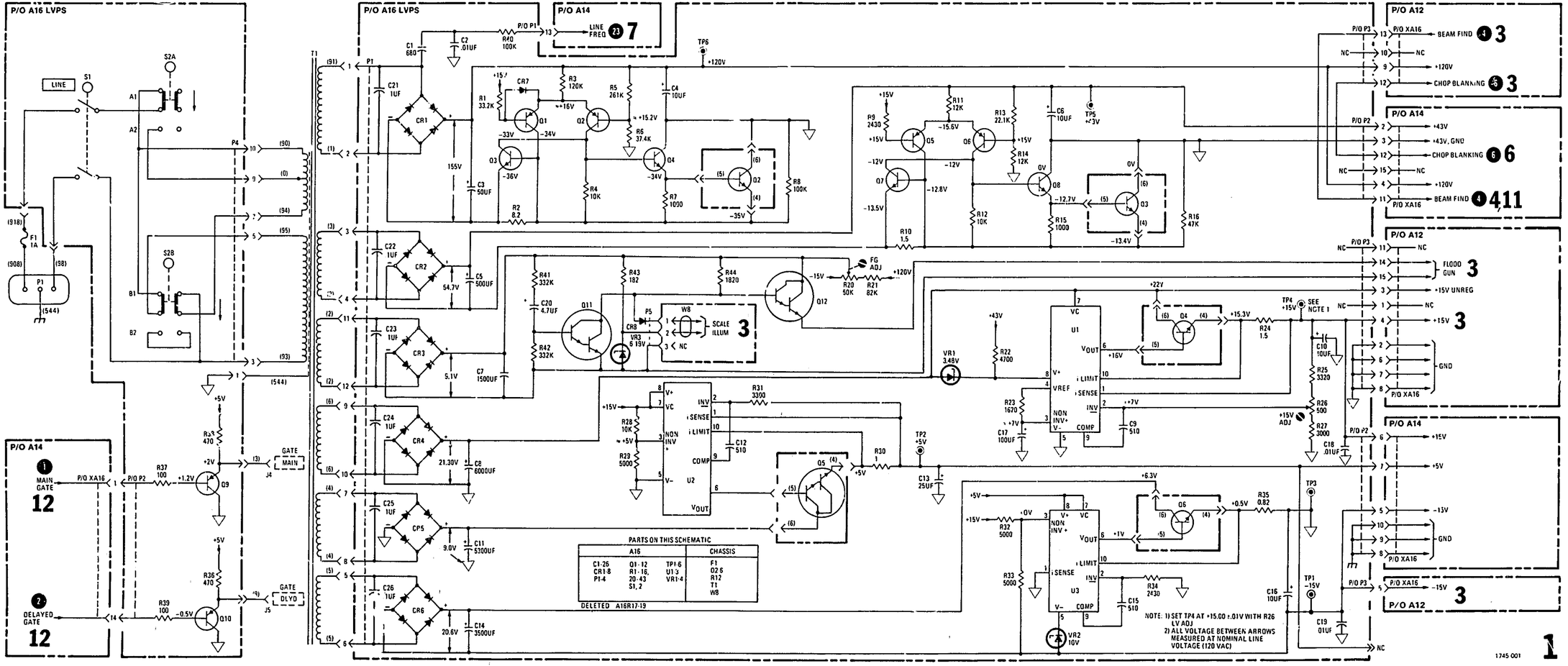
All voltages: +5 V, +43 V, +120 V, —15 V, and the high voltage are referenced to the +15 V supply, so it must be made operational first. Each supply is the current-limiting type, so any excessive loading from the vertical, horizontal, etc., will cause the supply to read low. To quickly check if an external load is causing A16 to current-limit and read low, remove Interface Assembly A14 that connects the power supply to Vertical Preamplifiier A3 and Horizontal Sweep Assembly A7. If supplies return to normal, then an external heavy load is most likely causing the problem. Assembly A3 can be flexed upward, so A14 (Interface Assembly) can be connected between Assembly A16 and Assembly A7. This will help determine if the problem is on A3 or A7. It is also possible to disconnect Gate Amplifier A12 and HV Power Supply A15, from Power Supply 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	D-3	CR1	E-3	Q8	C-1	R16	C-1	R39	C-4
C2	E-4	CR2	E-3	Q9	A-3	R20	F-4	R40	D-4
C3	D-3	CR3	F-3	Q10	B-4	R21	E-4	R41	E-4
C4	C-2	CR4	F-3	Q11	E-4	R22	B-1	R42	E-4
C5	D-4	CR5	E-3	Q12	F-4	R23	B-1	R43	E-3
C6	C-2	CR6	E-3	R1	C-2	R24	B-1	R44	E-4
C7	F-3	CR7	D-2	R2	C-1	R25	B-2	S1	D-2
C8	B-4	CR8	E-4	R3	C-2	R26	B-2	S2	D-2
C9	B-1	P1	E-3	R4	C-1	R27	B-2	TP1	A-2
C10	B-2	P2	D-5	R5	C-2	R28	B-2	TP2	A-2
C11	B-3	P3	E-4	R6	C-2	R29	B-2	TP3	B-2
C12	B-1	P4	D-1	R7	C-1	R30	B-1	TP4	B-2
C13	B-2	P5	E-4	R8	C-1	R31	B-1	TP5	B-2
C14	B-3	Q1	C-2	R9	C-2	R32	A-2	TP6	C-3
C15	A-1	Q2	C-1	R10	C-1	R33	A-2	U1	B-1
C16	A-2	Q3	C-1	R11	C-2	R34	A-1	U2	A-1
C17	B-1	Q4	C-1	R12	C-1	R35	A-1	U3	A-1
C18	F-4	Q5	C-2	R13	C-2	R36	C-4	VR1	B-1
C19	E-4	Q6	C-1	R14	C-2	R37	A-3	VR2	A-2
C20	E-4	Q7	C-1	R15	C-1	R38	A-3	VR3	E-4

LVPS, A16, Component Identification



Service Sheet 1.
LV Power Supply
8-7

SERVICE SHEET 2

THEORY OF OPERATION

High-Voltage Oscillator. The high-voltage power supply consists of 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 feedback 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 developed in primary winding (pins 3 and 4) starts to collapse. This induces reverse feedback in the other winding, causing reduced conduction through Ql. The circuit oscillates at a rate determined by the inherent distributed inductance and capacitance of the oscillator circuit. The magnitude of oscillations, and consequently the power supply output, are controlled by the output of differential amplifier A15U1.

High-Voltage Regulator. A voltage divider, consisting of A15R13 and A15R101 (between the +15 V and -2870 V cathode supply) provides a voltage (≈0 V) relative to the two supplies to differential amplifier A15U1, pin 3. This voltage is compared to ground at pin 2 of J.15U1 through A15R24.

Any change in CRT cathode voltage is detected by A15U1 and applied through the primary winding on A15T1 to the base of high-voltage oscillator Q1, changing the amplitude of its oscillation. This change is in such a direction as to correct the original change in the rectified cathode voltage. Diode A15CR1 and A15CR9 protects the oscillator transistor from excess reverse voltage.

HV Disable. IC comparators A15U2A and A15U2B monitor the +120 V and -15 V power supply voltages to prevent excessive beam current caused by a malfunction of either supply. This in turn prevents CRT from generating excessive X-radiation and protects CRT from phosphor burns.

Voltage divider A15R106, A15R112 and A15R107 sets the reference voltages for comparators A15U2A and A15U2B. The +120 V and -15 V supply voltages are monitored by comparators through voltage division of A15R111 and A15R110.

When a fault occurs in either +120 V or -15 V supply voltage, output of either A15U2A or A15U2B goes high turning on A15Q1. When A15Q1 conducts, the base of HV Oscillator Q1 is effectively grounded disabling the HV power supply.

Comparator A15U2A disables HV when either the +120 V goes above +130 V or the -15 V supply goes to -13.3 V. Coparator A15U2B disables HV when either the +120 V supply drops to +110 V or the -15 V supply goes to -17.2 V.

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, the grid bias supply, and for the focus voltage-divider network.

The CRT grid voltage is picked off the secondary winding of transformer A15T1 at pin 5 and applied through RC network A15C2/A15R3 to diodes that clamp the voltage swing to that established by intensity limit control A15R2 and the gate dc levels. The clipped sine wave is rectified and applied to the CRT grid, which is voltage-referenced to the cathode. This controls brightness of the CRT trace. The HV Multiplier voltage is picked off the secondary winding of transformer A15T1 at pin 7, applied to Assembly A6 where it is multiplied (X6), rectified, filtered, and then applied to the post accelerator of the CRT. The post-accelerator voltage is approximately 19 kV.

REMOVAL PROCEDURE

To remove High-Voltage Power Supply Assembly A15, proceed as follows:

a. Disconnect input ac power cord W1 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.

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, 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 reconnect small (0) wire and large (0) wire to HV Multiplier (removed in step k).

Cathode-Ray Tube Removal.

a. Disconnect line cord.

b. Remove top and bottom covers.

c. Remove HVPS cover and reinstall 2 longer cover screws in their original location at the rear of HV PC board for proper grounding.

WARNING

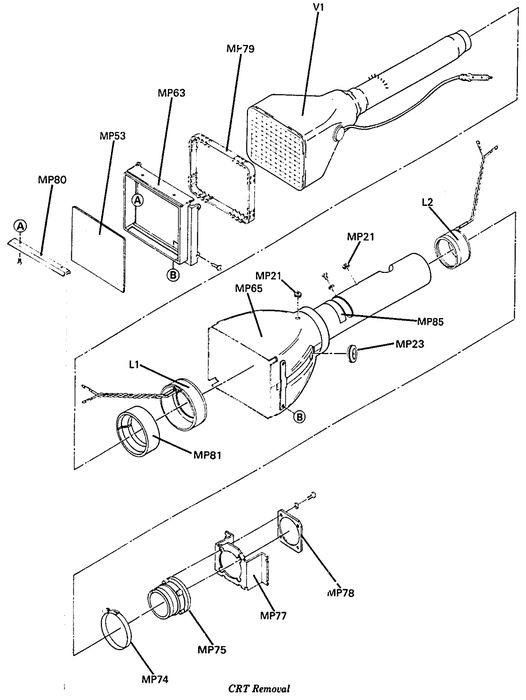
Voltages capable of causing injury or death are present on the HV board. Exercise extreme caution while performing the following steps.

CAUTION

Circuit failure can result from static discharge from the CRT Post Accelerator lead. To prevent static damage do not deviate from the following PA discharge procedure.

d. Discharge CRT post accelerator as follows:

1) Set BEAM INTENSITY to minimum.
2) Set SCALE to maximum.
3) Connect line cord.
4) Turn power on.
5) Verify scale illumination is present on CRT.
6) With instrument on, pull HV oscillator transistor connector to disable oscillator.
7) Wait 10 seconds, then turn off power and disconnect line cord.
8) Disconnect post accelerator output lead at in-line connector and short CRT end to CRT shield to ensure complete PA discharge.



CRT Removal

e. Disconnect 9 neck pin leads and base socket from CRT.

f. Disconnect front CRT shield leads (956 and 967) from HVPS board.

g. Disconnect rear CRT shield leads (0 and 3) from gate board.

h. Remove shield to deck ground strap screw.

i. Loosen hose clamp (MP74) (clamp accessible through cut-out in shield).

j. Remove 4 pan-head and 2 flat-head screws from CRT mounting bracket (MP77).

k. Slide CRT mount assembly (MP75, MP77 and MP78) rearward until it is completely removed from instrument.

NOTE

It may be necessary to loosen 4 screws holding CRT mount clamp ring (MP78) to CRT mounting bracket (MP77) in order for the hose clamp screw to clear the inside of CRT shield.

l. While supporting rear of CRT and shield, remove 2 flat-head screws holding CRT bezel (MP63) to front casting just above the CRT.

m. Slide CRT and shield rearward until the CRT bezel clears the front casting.

n. Lift front of CRT and shield as an assembly up and forward until clear of instrument.

o. With CRT laying on bench, remove 4 flat-head screws holding CRT bezel to front of CRT shield and remove mount.

p. While holding CRT faceplate and shield so that CRT does not slip out of shield, position CRT face down on a protected bench surface (soft mat, carpeted, etc.).

q. Carefully pull the shield upward while providing a slight downward pressure on CRT until shield clears the front CRT positioning strap.

r. Continue the shield removal being careful not to damage CRT neck pins.

s. Note the position of the CRT shock mount belt (MP79) before removing so that it can be positioned the same way for installation.

t. To install CRT reverse steps o through s and check for proper graticule to mount alignment. If the alignment is correct continue installation by reversing steps a through n. If graticule alignment is not correct note which direction of rotation of the CRT will align graticule.

u. Repeat steps o, p, and q.

v. Rotate front CRT shock mount belt (MP79) in the opposite direction the CRT needs to be rotated a couple of notches and repeat step t.

TROUBLESHOOTING

To troubleshoot HV Power Supply Assembly A15, remove the HV cover. Be sure to reinstall the two screws nearest the rear of the instrument. This provides the necessary ground connections for assembly A15.

WARNING

Dangerous voltages capable of causing death are present in this instrument. Use extreme care when working on an active high-voltage power supply.

High-voltage oscillator collector and base waveform measurement locations are accessible directly on assembly A15, as well as control-grid and cathode-voltage test points. A high-voltage disable circuit turns off the oscillator if the low-voltage power supplies malfunction. This protects the CRT phosphor from burns.

CAUTION

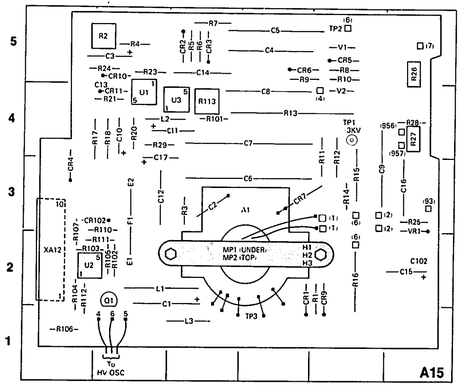
When measuring high voltages, always use a 1000:1 probe with an impedance of 100 MΩ or greater.

If grid and cathode voltages are present on A15, verify that they are also present at the CRT socket; a faulty socket or wire can cause an open circuit.

Common CRT problems consist of open filaments, grid-cathode shorts (uncontrollable beam), and "hollow cathodes," sometimes referred to as "double-peaking." Hollow cathodes can be detected by increasing intensity. As the intensity knob is rotated clockwise, the beam will get brighter, up to a point; beyond this point it will decrease in brilliance and may defocus.

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.



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
A1	D-3	C12	B-3	CR6	D-5	H3	D-2	R5	B-5	R16	E-2	R29	F-4	R113	C-4
C1	B-1	C13	B-4	CR7	D-3	L1	B-2	R6	B-5	R17	A-4	R101	C-4	TP1	E-4
C2	C-3	C14	C-5	CR9	E-2	L2	B-4	R7	C-5	R18	B-4	R102	B-2	RP2	E-5
C3	B-5	C15	F-2	CR10	B-5	L3	C-1	R3	C-5	R20	B-4	R103	A-2	TP3	D-1
C4	D-5	C16	F-3	CR11	B-4	MP1	C-2	R21	D-5	R21	B-4	R104	A-2	U1	B-4
C5	D-5	C17	B-3	CR102	B-3	MP2	C-2	R10	E-5	R23	B-5	R105	B-2	U2	A-2
C6	D-5	C102	F-2	E1	B-2	Q1	B-2	R11	E-3	R24	B-5	R106	A-1	U3	C-4
C7	D-4	CR1	D-2	E2	B-3	R1	E-2	R12	E-3	R25	F-3	R107	A-2	V1	E-5
C8	D-4	CR2	C-5	F1	B-3	R2	B-5	R13	D-4	R26	F-5	R110	B-2	V2	E-4
C9	E-3	CR3	C-5	H1	D-2	R3	C-3	R14	E-3	R27	F-4	R111	B-2	VR1	F-3
C10	B-4	CR4	A-3	H2	D-2	R4	B-5	R15	E-3	R28	F-4	R112	A-2	XA12	A-2
C11	C-4	CR5	E-5												

HVPS, A15, Component Identification

DC VOLTAGE MEASUREMENT CONDITIONS
SERVICE SHEET 2

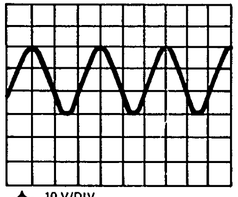
1. Set front-panel controls in accordance with initial control settings in Section V.
2. All voltages are referenced to chassis ground. All indications are nominal and 15% variations from those indicated should be considered normal.

WARNING

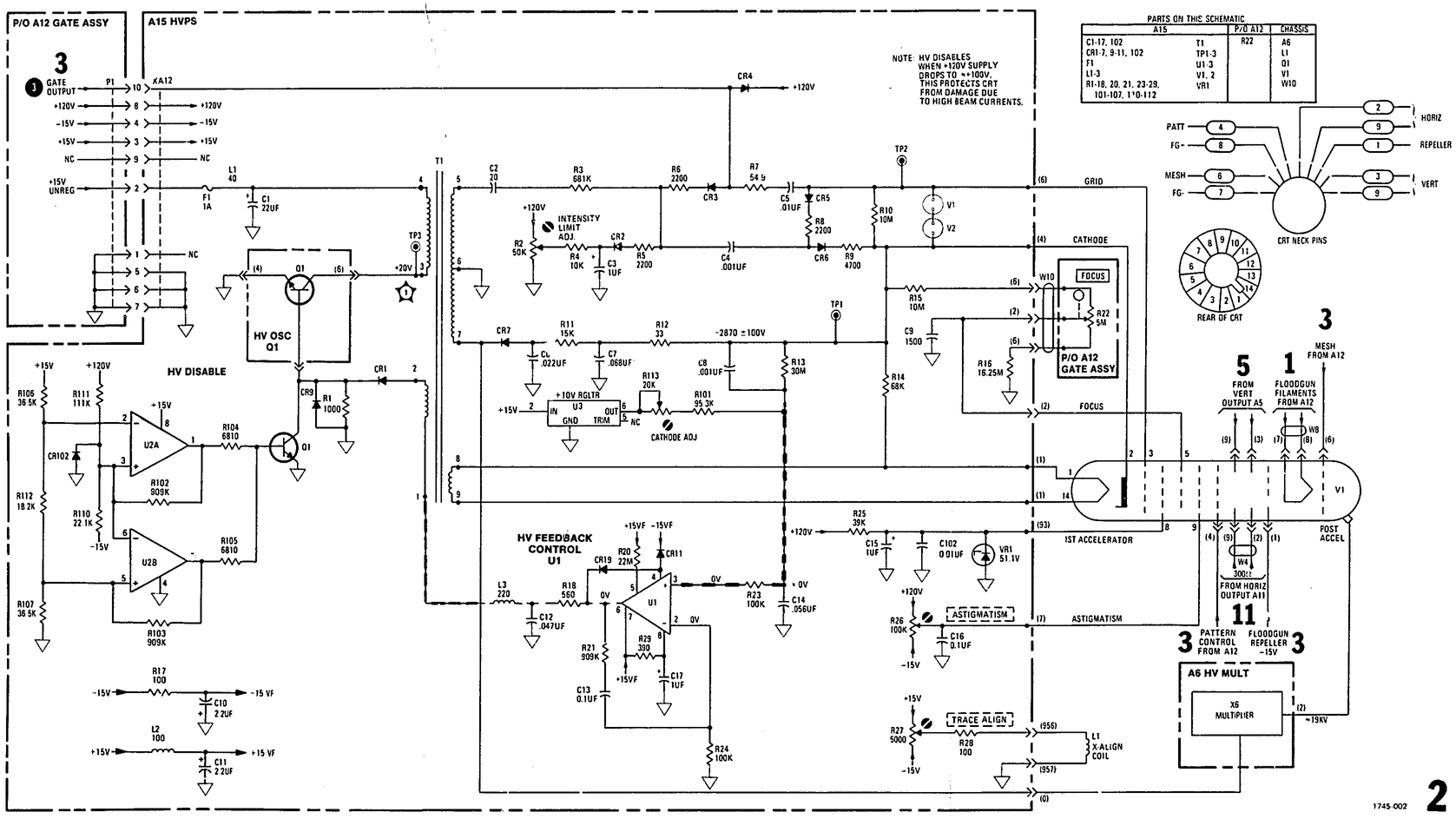
Voltages in the HIGH VOLTAGE area are dangerous to life. Use extreme care in making measurements and observe precautions listed in the SAFETY SUMMARY at the front of this manual.

WAVEFORM MEASUREMENT CONDITIONS
SERVICE SHEET 2

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).



Waveforms for Service Sheet 2



Service Sheet 2.
HV Power Supply

SERVICE SHEET 3

THEORY OF OPERATION

General. Gate Assembly A12 controls trace intensity on the CRT; A12U1 sums all functions necessary for intensity control. Inputs to A12U1 are external Z-axis input, main gate, delayed gate, and chop blanking.

Beam Intensity. Front-panel BEAM INTENSITY control A12R3 establishes the level of current supplied to current switch A12U1Q1/A12U1Q2. Output of the current switch is applied to a gate amplifier circuit consisting of A12Q1 through A12Q4. Intensity adjustment A15R2 on the high-voltage power supply establishes the minimum cut-off level for the CRT.

Main Gate. The main gate signal is applied to the base of A12U1Q1, controlling its operation. When the main gate signal is low, A12U1Q1 turns off and A12U1Q2 conducts, unblanking the CRT. The same sequence occurs for the delayed gate signal which is applied to the base of A12U1Q5. When the delayed gate signal is high, A12U1Q5 conducts, unblanking the CRT.

Chop Blanking. Chop blanking is accomplished through A12U1Q3. When CHOP mode of operation is selected, the chop blanking signal, applied to the base of A12U1Q3, turns it on and off. This causes blanking and unblanking of the CRT at the chop blanking repetition rate (≈250 kHz).

Z-axis Input. A Z-axis signal of +4 V, pulse width >50 nanoseconds, dc to <10 MHz will blank the CRT trace of normal intensity.

Beam Find. When BEAM FIND switch A12S1 is engaged, the setting of INTENSITY control A12R3 is added to a fixed voltage and supplied through the gate amplifier to the CRT. This causes intensification of the CRT trace.

Output. The gate amplifier output is a shunt feedback stage consisting of A12Q1 through A12Q4. Transistors A12Q1 and A12Q3 are emitter followers with A12Q1 providing the ac signal path. Network A12R13/A12C11 provides the feedback path.

REMOVAL PROCEDURE

To remove Gate Amplifier Assembly A12, proceed as follows:

a. Remove HVPS cover MP54.

b. Disconnect wires on component side of A12.

c. Disconnect two (6) wires and one (2) wire from FOCUS potentiometer on A15 (HVPS).

d. Disconnect Z-axis wire (9) on rear of A12.

e. Remove SCALE, FOCUS and BEAM INTENSITY shafts from potentiometer using small hex wrench (Allen 050).

f. Disconnect A12 from A16 (LVPS).

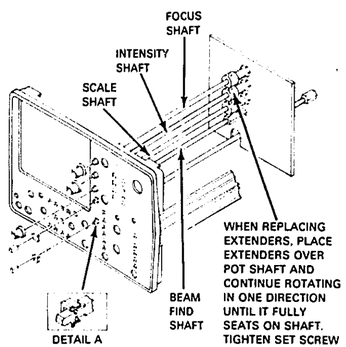
g. Disconnect A12 from A15 (HVPS).

h. Remove BEAM FIND shaft by pushing A12 forward so that 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 bezel after HVPS cover MP54 is secured; then install button.



Gate Amplifier Assembly A12 Removal

TROUBLESHOOTING

Malfunctions in Gate Amplifier Assembly A12 will usually be transistor failures in the output driver stages.

DC VOLTAGE MEASUREMENT CONDITIONS
SERVICE SHEET 3

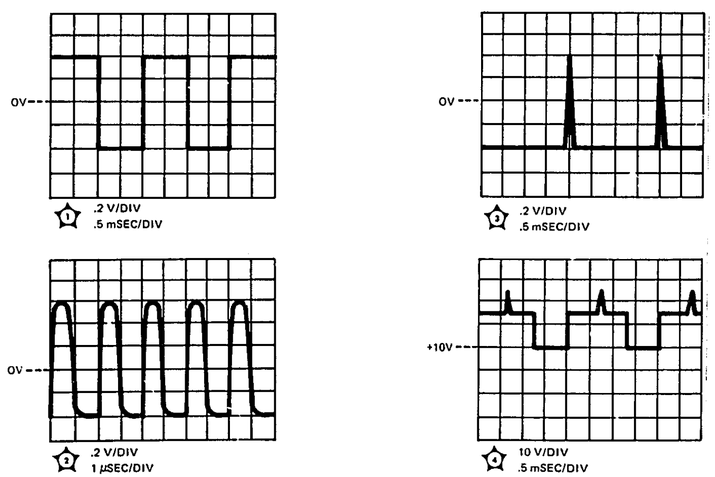
1. Set front-panel controls in accordance with initial control settings in Section V.
2. All voltages are referenced to chassis ground. All indications are nominal and 15% variations from those indicated should be considered normal.

WAVEFORM MEASUREMENT CONDITIONS
SERVICE SHEET 3

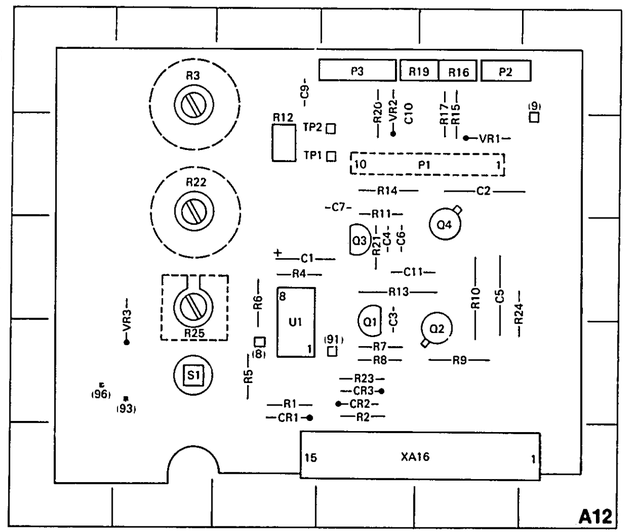
1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

Coupling (channel A)	50Ω
TIME/DIV (delayed)	1 μSEC
STOP	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 square-wave generator 50-ohm output to Model 1746A channel A INPUT connector.
4. Adjust square-wave generator output for 6 divisions of signal amplitude (.6 V pk) at 5 kHz.

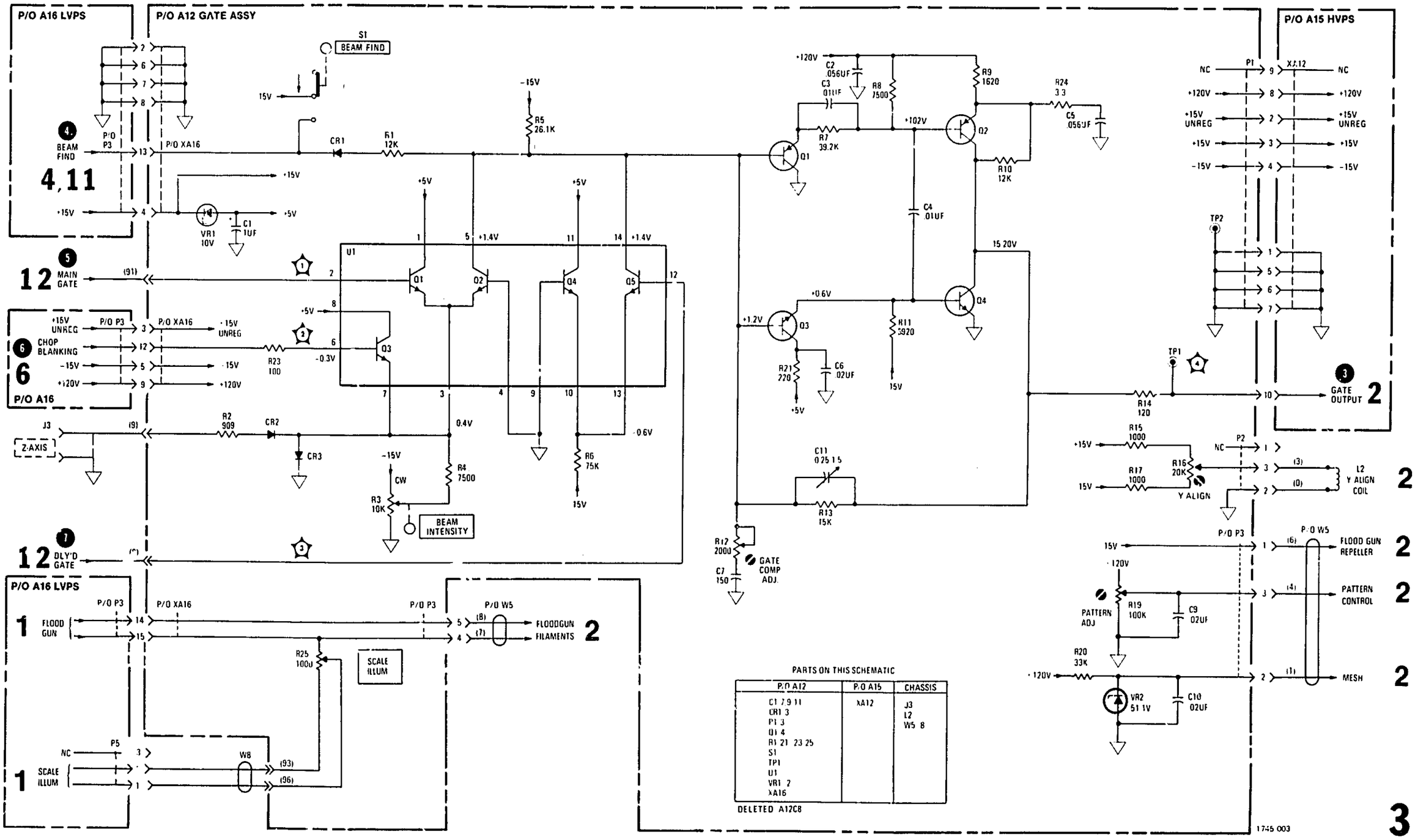


Waveforms for Service Sheet 3



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	C-3	P1	E-4	R7	D-2	R21	D-3
C2	E-4	P2	E-5	R8	D-2	R22	B-4
C3	D-3	P3	D-5	R9	E-2	R23	D-2
C4	D-3	Q1	D-2	R10	E-3	R24	E-3
C5	E-3	Q2	E-2	R11	D-4	R25	B-2
C6	D-3	Q3	D-3	R12	C-4	S1	B-2
C7	D-4	Q4	E-3	R13	D-3	TP1	C-4
C9	C-5	R1	C-2	R14	D-4	TP2	C-4
C10	D-5	R2	D-2	R15	E-5	U1	C-2
C11	D-3	R3	B-5	R16	E-5	VR1	E-4
CR1	C-2	R4	C-3	R17	E-5	VR2	D-5
CR2	D-2	R5	C-2	R19	D-5	VR3	B-2
CR3	D-2	R6	C-3	R20	D-5	XA16	D-1

Gate Assembly, A12, Component Identification



PARTS ON THIS SCHEMATIC

P/O A12	P/O A15	CHASSIS
C1 2 9 11 CR1 3 P1 3 Q1 4 R1 21 23 25 S1 TP1 U1 VR1 2 XA16	XA12	J3 L2 W5 8

DELETED A12C8

Service Sheet 3.
Gate Circuitry
8-11

SERVICE SHEET 4

THEORY OF OPERATION

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 assembly. The contacts connect appropriate pads on the pre-amplifier assembly to complete the coupling and attenuation requirements for the input circuit. Refer to the 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 and X10 attenuation circuits in preamplifier substrate A3A1, and X1, X2, or X4 attenuation circuits, also in the substrate assembly.

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. The second 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 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; in addition, they 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 the frequency response to approximately 20 MHz. Trigger view amplifier A3Q6/A3Q7 routes output signals from trigger conditioning circuit A7Q1 (Service Sheet 7), to delay line assembly 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 (Service Sheet 3) is pressed, sufficient current is removed through A3CR4/A3CR5 and A3CR6/A3CR7 to lower sensitivity of the input to the delay line, causing the trace to return to the CRT viewing area.

Channel A and channel B verniers vary the gain of each channel over a range of at least 2.5:1. Channel B vernier interface circuit A3Q21 (Service Sheet 6) allows A2R1 to control channel B gain in both normal and A VS B operations.

Delay Line. Output of the Vertical Preamplifier Assembly is applied to Delay Line A4. The delay line has a differential impedance of approximately 180 ohms and provides a time delay of 100 nanoseconds. This delay gives sufficient time for the internal sync signal to trigger the horizontal sweep before the input vertical signal is applied to the CRT vertical deflection plates.

REMOVAL PROCEDURE FOR ASSEMBLIES A3 AND A13.

Assembly A3 Removal:

a. Disconnect Interface Assembly A14.

b. Remove channel A and B POSN vernier, coupling, and VOLTS/DIV knobs.

c. Remove nuts and washers from both input BNC connectors.

d. Disconnect (9) wire from calibrator output.

e. Disconnect delay line wires (4), (6), and (0) from rear of Vertical Output Amplifier A5.

f. Remove delay line clamp screw from chassis.

g. Disconnect twin leads (2, 6) and (1, 9) at Horizontal Sweep Assembly A7.

h. Remove channel A attenuator shield by removing three screws.

i. Remove screw that connects Horizontal Sweep Assembly A7, shield, and A3 together. This screw is close to point wh... (1, 9) twin lead attaches to A7.

j. Disconnect plug to A5.

k. Carefully tilt A3 outward and extract toward rear.

l. Disconnect vernier UNCAL light cable (95), (96), and two (0- wires.

m. To reinstall A3, reverse removal procedure.

Assembly A13 Removal:

a. Remove assembly A3 as described above.

b. Disconnect wires (4) and (9) from channel A and B vernier potentiometers (total of four wires).

c. Disconnect wires (3), (93), (913), (7), and (8) from front of A13.

d. Remove screw on component side of A3 that screws into standoff on A13 (near delay line).

e. Disconnect two plugs to Vertical Preamplifier Assembly A3.

f. To reinstall A13, reverse removal procedure.

IC A3A1 Removal:

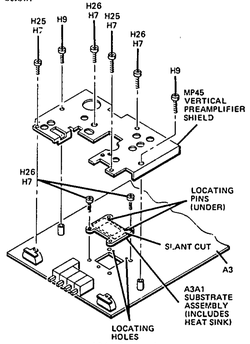
a. Disconnect two leads (2, 6).

b. Remove six screws that hold vertical preamplifier shield MP45 to assembly A3, and remove shield.

c. Remove two remaining screws that hold IC to A3.

d. Lift IC frame and IC off A3.

e. To reinstall A3A1, reverse removal procedure, be certain that orientation of location pins is as shown below.



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 either substrate A3A1 or ... Vertical Output Assembly A5 by pressing TRIG V ... W on the front panel while applying a known signal to the main EXT TRIGGER input. If it is displayed properly (approximately 100 mV/div), this indicates that assembly A5 is operating properly and the problem is in substrate 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 adjustment.

DC VOLTAGE MEASUREMENT CONDITIONS
SERVICE SHEET 4

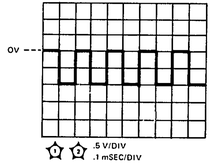
1. Set front-panel controls in accordance with initital control settings in Section V.
2. All voltages are referenced to chassis ground. All indications are nominal and 15% variation from those indicated should be considered normal.

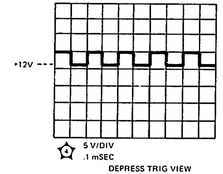
WAVEFORM MEASUREMENT CONDITIONS
SERVICE SHEET 4

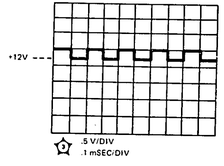
1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

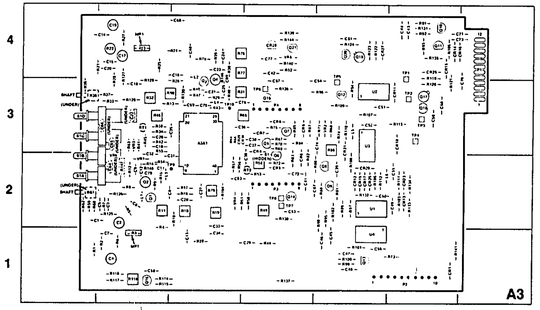
   Coupling (channel A) 50Ω
   TRIGGER LEVEL (main) ..... stable display

2. Set monitor oscilloscope TIME/DIV and VOLTS/DIV controls as indicated under waveform(s).
3. Connect Square-wave Generator 50-ohm output to Model 1746A channel A INPUT connector.
4. Adjust square-wave generator output for 6 divisions of signal amplitude (.6 V) at 5 kHz.









A		B		C		D		E		F		G	
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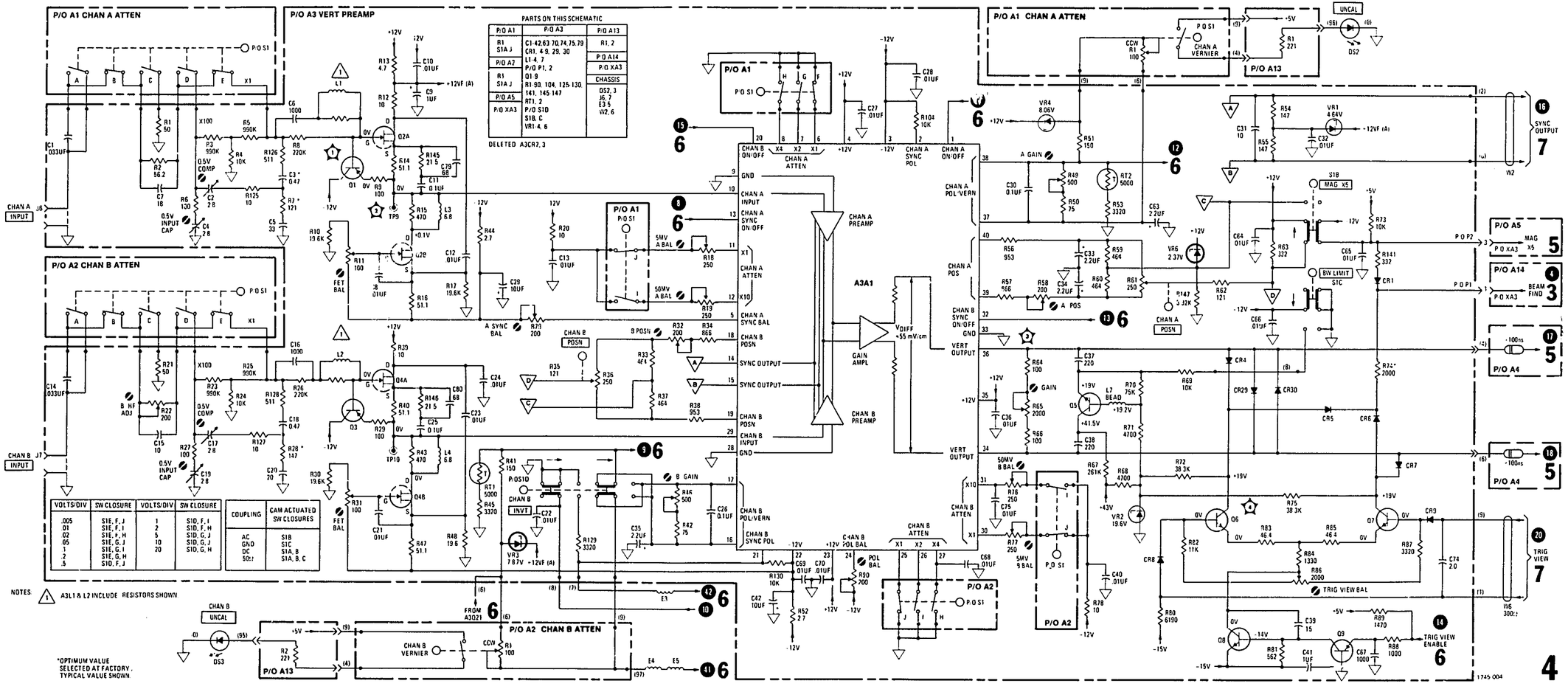
A3A1	C-3	C39	E-2	C79	B-2	Q2	B-2	R19	C-2	R57	C-2	R95	E-2	R133	F-2
C1	B-2	C40	C-4	C80	C-3	Q3	C-3	R20	C-1	R58	D-2	R96	E-3	R134	F-2
C2	B-2	C41	D-2	CR1	F-1	Q4	C-3	R21	B-4	R59	A-2	R97	E-2	R135	F-4
C3	B-2	C42	D-4	CR4	D-2	U5	D-3	R22	B-4	R60	A-2	R98	E-2	R136	D-3
C4	B-1	C43	F-4	CR5	D-2	Q6	D-2	R23	B-4	R61	A-2	R99	E-1	R137	D-1
C5	B-2	C44	F-4	CR6	D-3	Q7	D-3	R24	B-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	CR8	D-3	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-4	R104	C-2	R144	D-4
C10	B-3	C49	F-2	CR12	E-2	Q12	E-3	R29	C-3	R67	D-3	R105	F-4	R145	B-2
C11	B-2	C50	E-2	CR13	F-2	Q13	E-1	R30	C-4	R68	E-2	R106	E-2	R146	C-3
C12	C-1	C51	E-3	CR14	F-2	Q14	D-2	R31	C-3	R69	D-3	R107	E-3	R147	E-2
C13	C-1	C52	E-3	CR15	F-4	Q15	D-3	R32	B-3	R70	D-3	R108	E-2	RT1	B-3
C14	B-4	C53	D-2	CR16	F-4	Q16	D-1	R33	A-3	R71	E-3	R109	E-3	RT2	D-2
C15	B-4	C54	E-3	CR17	E-2	Q17	F-3	R34	B-3	R72	D-2	R110	E-3	S1A	A-2
C16	C-4	C55	E-2	CR18	F-3	Q18	F-3	R35	A-3	R73	F-1	R111	F-2	S1B	A-2
C17	B-1	C56	E-1	CR19	E-2	Q19	E-4	R36	A-3	R74	E-3	R112	E-2	S1C	A-3
C18	B-3	C57	D-3	CR20	E-2	Q20	E-4	R37	B-3	R75	D-3	R113	F-3	S1D	A-3
C19	B-4	C58	D-1	CR21	E-3	Q21	D-4	R38	B-3	R76	C-4	R114	B-1	TP1	F-4
C20	B-4	C59	F-3	CR23	F-2	R1	A-1	R39	C-4	R77	C-4	R115	B-1	TP2	F-3
C21	C-3	C60	F-3	CR26	F-4	R2	B-1	R40	C-3	R78	C-4	R116	B-1	TP3	F-3
C22	B-3	C61	E-4	CR27	E-4	R3	B-1	R41	B-3	R79	C-2	R117	B-1	TP4	F-3
C23	C-4	C62	C-2	CR28	D-4	R4	B-1	R42	B-3	R80	D-2	R118	B-1	TP5	E-4
C24	C-4	C64	B-2	CR2	C-3	R5	B-2	R43	B-1	R81	D-2	R119	F-3	TP6	D-3
C25	C-3	C65	B-3	CR30	C-3	R6	B-1	R44	D-1	R82	D-2	R120	F-3	TP7	D-2
C26	B-3	C66	B-3	E1	D-2	R7	B-2	R45	B-3	R83	D-2	R121	F-3	TP8	D-2
C27	D-1	C67	D-2	L1	B-2	R8	B-2	R46	B-3	R84	D-3	R122	E-4	TP9	B-2
C28	C-2	C68	C-4	L2	C-3	R9	B-2	R47	C-3	R85	D-3	R123	E-4	TP10	C-3
C29	D-1	C69	C-3	L3	B-2	R10	C-2	R48	C-3	R86	E-3	R124	E-4	U1	E-2
C30	D-2	C70	C-3	L4	C-3	R11	B-2	R49	D-2	R87	D-3	R125	B-2	U2	E-3
C31	C-2	C71	F-4	L5	E-3	R12	B-2	R50	D-2	R88	E-2	R126	B-2	U3	E-3
C32	B-2	C72	D-2	L6	E-2	R13	C-3	R51	C-2	R89	E-2	R127	B-4	U4	E-1
C33	C-2	C73	F-4	P1	G-4	R14	B-2	R52	D-4	R90	C-3	R128	B-3	VR1	B-2
C34	C-1	C74	E-3	P2	F-1	R15	B-2	R53	D-2	R91	F-4	R129	B-3	VR2	E-3
C35	C-3	C75	C-3	P3	D-2	R16	C-2	R54	B-2	R92	F-4	R130	C-3	VR3	B-3
C36	C-3	C77	D-4	P4	D-2	R17	C-2	R55	B-3	R93	F-4	R131	F-4	VR4	C-2
C37	D-3	C78	C-3	Q1	B-2	R18	C-2	R56	C-2	R94	E-3	R132	E-2	VR5	D-4
C38	D-3													VR6	B-2

Vertical Preamplifier, A3, Component Identification



Service Sheet 4.
Vertical Preamplifier Circuitry
8-13

SERVICE SHEET 5

THEORY OF OPERATION

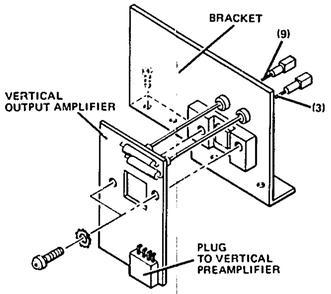
Vertical Output Assembly A5 consists of a vertical amplifier and Output Amplifier Substrate A5A1. Vertical amplifier A5Q1/A5Q3, terminates differential Delay Line Assembly A4 and translates the common-mode bias level to ground for the output amplifier substrate. X5 magnifier A5Q2/A5Q4 increases the vertical gain by a factor of five but limits the bandwidth to approximately 40 MHz. Engaging MAG X5 switch A3S1B turns off A5Q2 and A5Q4 (normally saturated). This increases system gain by a factor of five, and complementary circuitry on the preamplifier simultaneously diminishes position range by the same factor to maintain a consistent position control range.

Substrate A5A1 contains a number of thick-film resistors, one high-frequency monolithic chip, and two discrete transistor chips. It provides drive capability for the CRT vertical deflection plates and has a differential voltage gain in excess of 100. High-frequency adjustments A5R19, A5R20, A5R22, A5R24 control the shape of the pulse response.

REMOVAL PROCEDURE

Assembly A5 Removal:

a. Disconnect delay line wires (4), (9), and (0) from back of A5.



Vertical Output Amplifier Removal

b. Disconnect CRT leads (3) and (9).

c. Disconnect plug to Vertical Preamplifier Assembly A3 (push down gently on A3).

d. Remove four screws holding A5 and bracket to chassis, and remove assembly.

e. Remove two screws holding A5 to bracket and heat sink, and remove board.

f. To reinstall A5, reverse removal procedure.

IC A5U1 Removal:

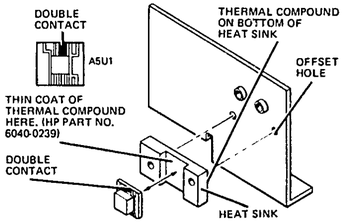
a. Remove Vertical Output Amplifier A5 as described above.

b. A5U1 can be removed from heat sink. (Heat sink can remain on bracket or be removed.)

c. To reinstall A5U1, reverse removal procedure, being certain to note orientation of parts as shown below.

NOTE

Apply a thin coat of silicone grease (HP P/N 6040-0239) to points indicated.



A5U1 Removal

TROUBLESHOOTING

Refer to Service Sheet 4 for vertical section troubleshooting.

DC VOLTAGE MEASUREMENT CONDITIONS
SERVICE SHEET 5

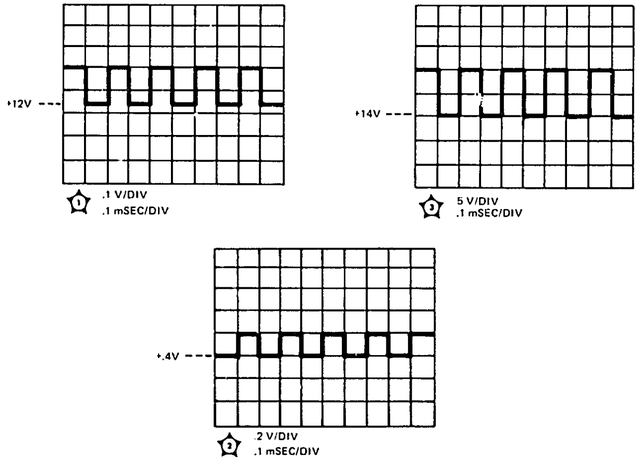
1. Set front-panel controls in accordance with initial control settings in Section V.
2. All voltages are referenced to chassis ground. All indications are nominal and 15% variation from those indicated should be considered normal.

WAVEFORM MEASUREMENT CONDITIONS
SERVICE SHEET 5

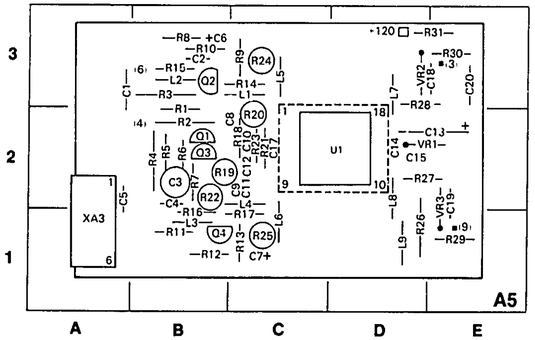
1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

   Coupling (channel A) 50Ω

2. Set monitor oscilloscope TIME/DIV and VOLTS/DIV controls as indicted under waveform(s).
3. Connect square-wave generator 50-ohm output to Model 1746A channel A INPUT connector.
4. Adjust square-wave generator output for 6 divisions of signal amplitude (.6 V) at 5 kHz.

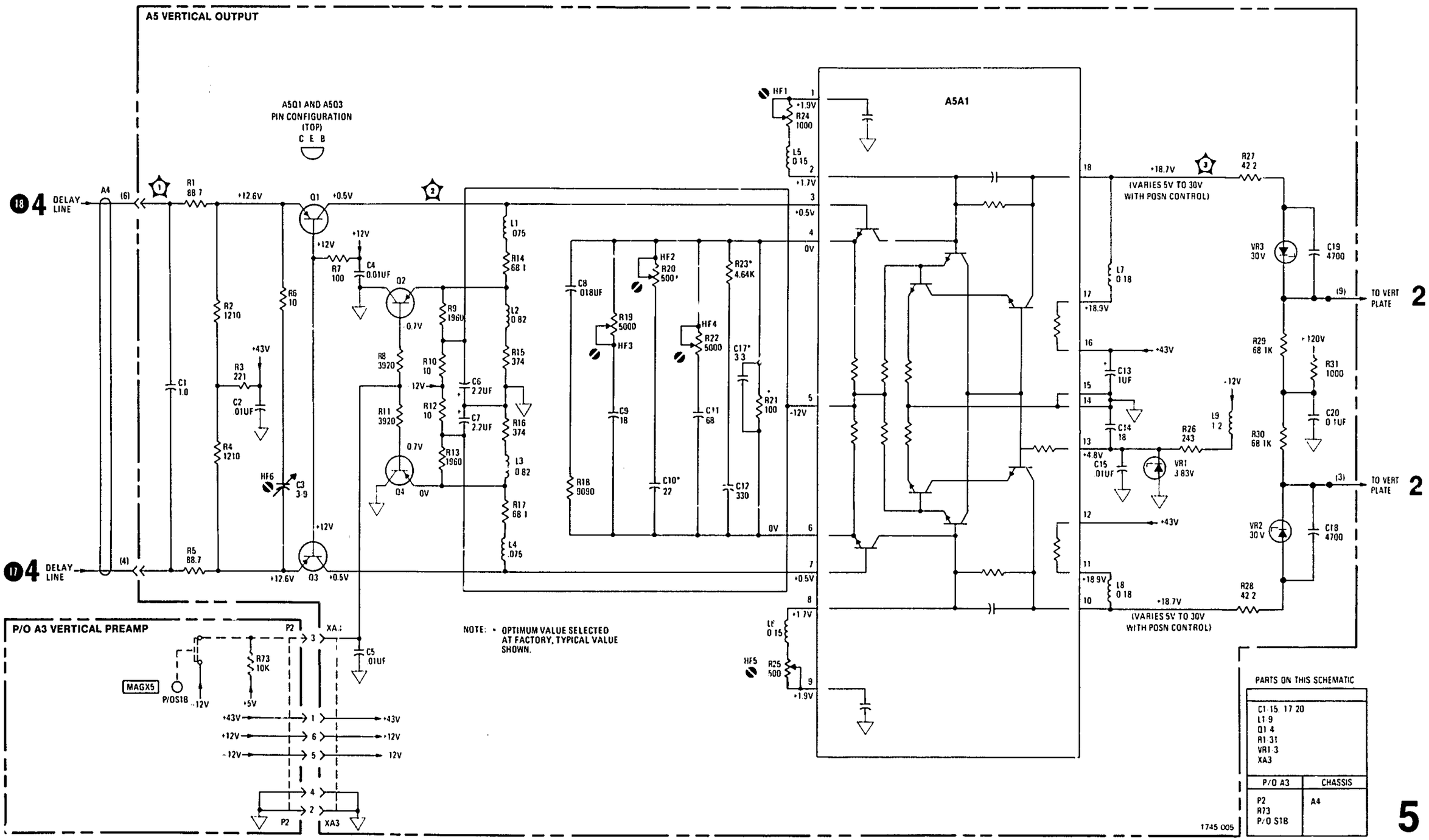


Waveforms for Service Sheet 5



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	A-3	C19	E-1	R3	B-3	R20	C-2
C2	B-3	C20	E-3	R4	B-2	R21	C-2
C3	B-2	L1	C-3	R5	B-2	R22	B-2
C4	B-2	L2	B-3	R6	B-2	R23	C-2
C5	A-2	L3	B-1	R7	B-2	R24	C-3
C6	B-3	L4	C-2	R8	B-3	R25	C-1
C7	C-1	L5	C-3	R9	B-3	R26	D-1
C8	B-2	L6	C-1	R10	C-3	R27	D-2
C9	C-2	L7	D-3	R11	B-1	R28	D-3
C10	C-2	L8	D-2	R12	B-1	R29	E-1
C11	C-2	L9	D-1	R13	C-1	R30	E-3
C12	C-2	Q1	B-2	R14	C-3	R31	E-3
C13	E-2	Q2	B-3	R15	B-3	U1	D-2
C14	D-2	Q3	B-2	R16	B-1	VR1	D-2
C15	D-2	Q4	B-1	R17	C-1	VR2	D-3
C17	C-2	R1	B-2	R18	C-2	VR3	E-1
C18	E-3	R2	B-2	R19	B-2	XA3	A-1

Vertical Output, A5, Component Identification



Service Sheet 5.
Vertical Output
8-15

SERVICE SHEET 6

THEORY OF OPERATION

General. Vertical Control Switching Assembly A13 selects the trigger and display modes by controlling the 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 is 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 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. The channel B display signal is also used as the START CHANNEL ON-OFF signal that is applied to TIME/DIVISION DECODER Assembly A17.

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. ALT display switch A13S2A applies an ALT CONTROL signal to TIME/DIVISION DECODER assembly A17.

CHOP Mode Display. In CHOP mode display, channel A and channel B are switched on and off alternately as in ALT mode of operation, except that 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, resulting in each channel being displayed at a 250-kHz rate.

Trig View Display. If channel A or channel B display is selected, engaging TRIG VIEW switch A3S1A forces a low state on the input to NAND gates A3U3A and A3U3C, holding their outputs high, disabling both channel A and channel B. The 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.

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, A3U3A, 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, causing a low on channel A sync enable line. A low at test point A3TP8 indicates sync A is on; a high at A3TP8 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 Q (pin 8) to go high. The high is inverted by A3U3B, turning off A3Q15, causing a low on channel B sync enable line. A low at test point A3TP6 indicates sync B is on; a high at A3TP6 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, engaging channel A and B TRIGGER switches together will remove the preset and clear overrides from A3U2B and allow the flip-flop to be clocked by the ALT SIGNAL generated in the horizontal section. This triggers channel A from the channel A signal and channel B from the channel B signal. If trig ·r 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, engaging channel A and B TRIGGER switches selects sync A only as the internal trigger source. Again, pin 1 on A3U1A is grounded.

REMOVAL PROCEDURE

To remove either assembly A3 or A13, use the removal procedures given in Service Sheet 4.

TROUBLESHOOTING

This service sheet contains waveforms and conditions for measuring these waveforms. Use the dc voltage listed on the schematic for active components as a guide in isolating problem areas.

DC VOLTAGE MEASUREMENT CONDITIONS
SERVICE SHEET 6

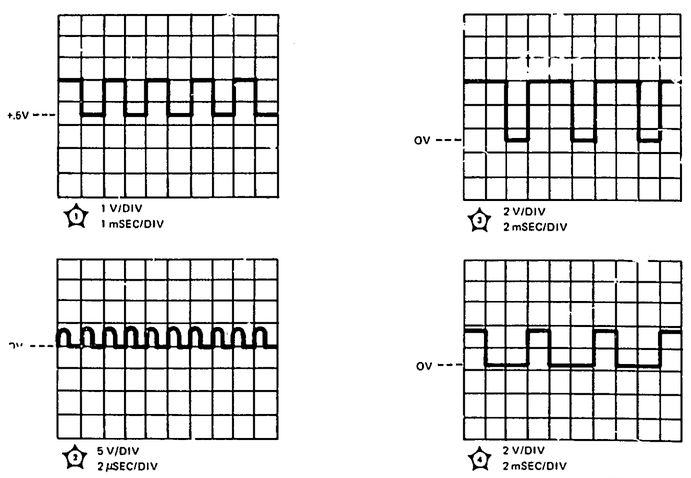
1. Set front-panel controls in accordance with initial control settings in Section V.
2. All voltages are referenced to chassis ground. All indications are nominal and 15% variation from those indicated should be considered normal.

WAVEFORM MEASUREMENT CONDITIONS
SERVICE SHEET 6

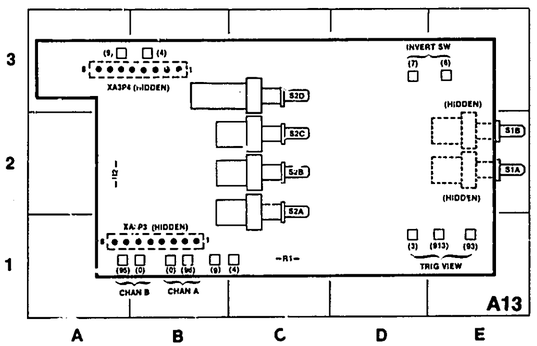
1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

   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 square-wave generator 50-ohm output to Model 1746A channel A INPUT connector.
4. Adjust square-wave generator output for 6 divisions of signal amplitude (.6 V) at 5 kHz.

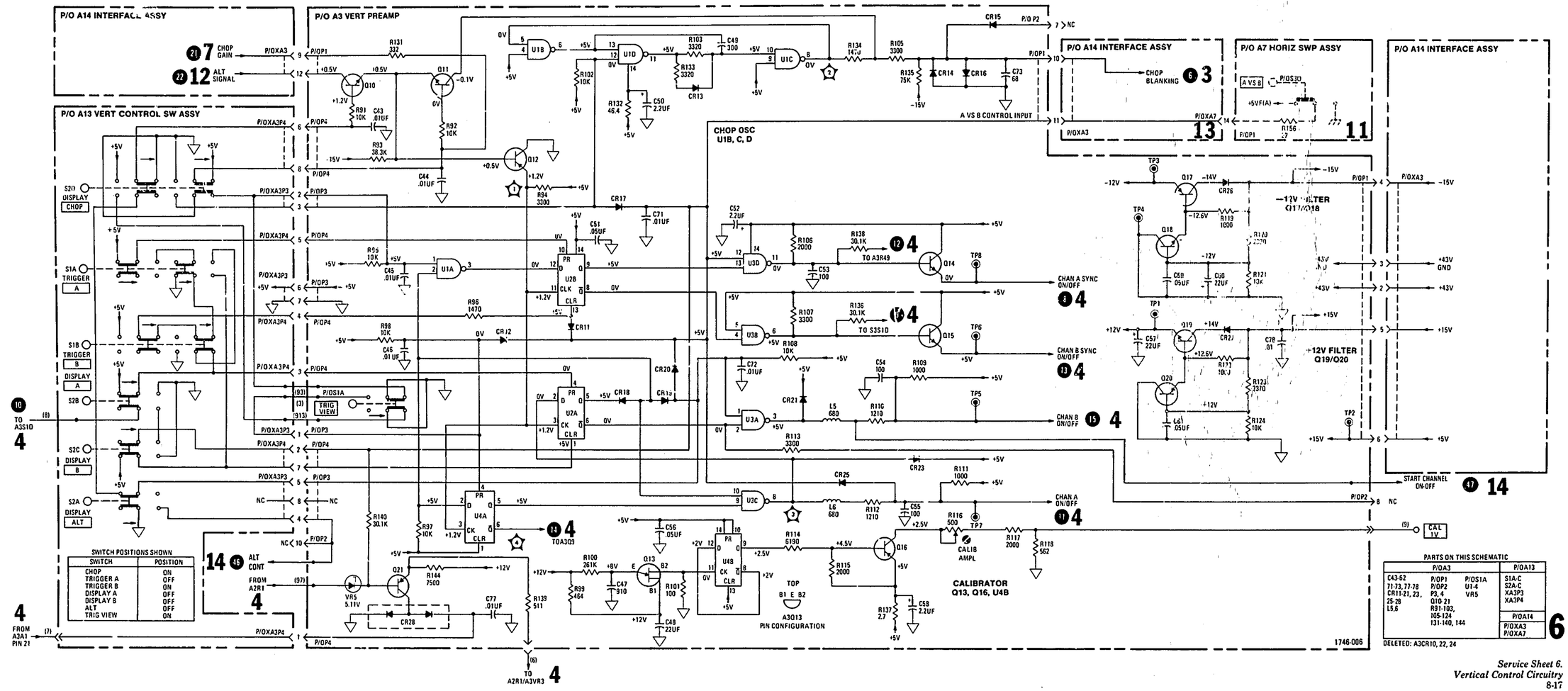


Waveforms for Service Sheet 6



NOTE
See Service Sheet 4
for Assembly A3
Component Identification

Switch Control, A13, Component Identification



Service Sheet 6.
Vertical Control Circuitry
8-17

SERVICE SHEET 7

THEORY OF OPERATION

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, 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 applying a sync signal 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 A7U1 passes all frequencies above 4 kHz. The low-frequency path through A7U1 passes all 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 gate 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. The 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 determines the end of sweep and disables the other two Schmitt triggers until the end of holdoff period. At the end of holdoff, the holdoff comparator develops 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 switches 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 A7Q20 are differentially driven from A7U2. When the collector of A7Q19 goes low (A7Q19 cut off), the main sweep starts. The complementary signal at the collector of A7Q20 (A7Q20 turned on) enables the gate Schmitt (Service Sheet 12) and turns the gate on.

Main Trig Signal. The output of A7U2 (pin 1) is also applied to the base of emitter follower A7Q30 (NPN-type transistor) turning it on. The complementary output of A7U2 (pin 2) is applied to emitter follower A7Q37 turning it off. The two transistors develop the MAIN TRIG signal that is applied to line receiver A10U2A on assembly A10 (Service Sheet 9).

Bright-Line Auto Circuit. Current switch A7Q13/A7Q14 drives the RESET light and the bright-line auto circuit. The bright-line auto circuit consists of A7Q15 - A7Q18. With the AUTO/NORM switch in NORM position, bias is removed from the emitters of A7Q15 - A7Q17, disabling the bright-line auto circuit. In AUTO mode of operation, A7C13 is discharged by A7Q18 and remains discharged as long as the trigger circuit switches at a rate greater than 45 Hz. With A7C13 discharged, A7Q17 is disabled. When A7C13 becomes charged (no trigger signal), base current to A7Q16 ceases, turning A7Q16 off. When A7Q16 turns off, A7Q17 turns on, turning on A7Q21 which enables the main gate circuit and the main sweep starts. When the sweep reaches +11 volts, the reset Schmitt trigger on A7U2 conducts, forcing pin 6 low. This turns on A7Q14 and A7Q15; A7Q17 and A7Q21 turn off and the sweep resets. At the end of holdoff, A7U2 pin 6 goes high, A7Q15 turns off, A7Q17 turns on and a new sweep is generated.

Single Mode. For single sweep operation, SINGLE switch A7S1C is engaged. The SINGLE mode overrides the AUTO mode and also applies a bias signal (+4.7 volts) to pin 5 of A7U2, preventing the input Schmitt of A7U2 from resetting at the end of holdoff. This prevents development of a trigger signal. The input Schmitt does not reset until RESET switch A7S1B is pressed. Pressing A7S1B causes the input at pin 5 of A7U2 to go low momentarily (due to the charging action of A7C14). This allows 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 assembly A7, proceed as follows:

a. Remove assemblies A8, A9, and A17 as outlined in Service Sheets 8, 10, and 14.

b. Remove assembly A11 as outlined in Service Sheet 11.

c. Unsolder resistor from main EXT TRIGGER BNC connector J1.

d. Remove two cable connector plugs.

e. Remove twin leads (3, 6) and (1, 9).

f. Remove main TRIGGER LEVEL knob and nut from potentiometer.

g. Remove Interface Assembly A14.

h. Remove four screws holding A7 to sheet metal.

i. Remove A7 by pulling it toward rear and tilting away from sheet metal deck. Save lockwasher on trigger level potentiometer for reinstallation.

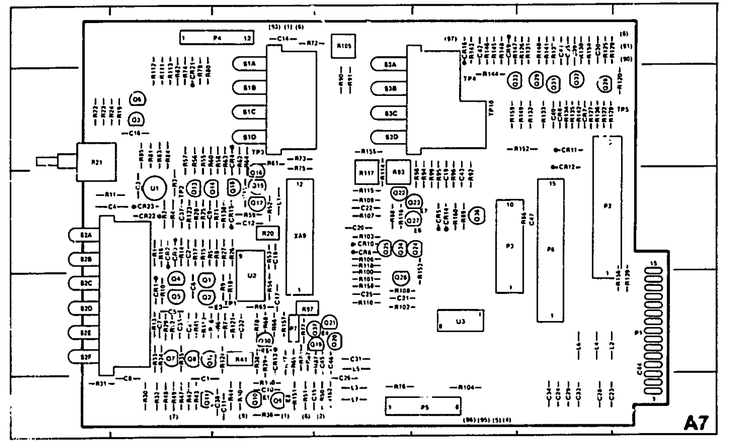
j. To reinstall A7, reverse removal procedure, except install four screws (step h) without tightening them until nut on TRIGGER LEVEL potentiometer (step f) is tightened. Lockwasher must be in place on TRIGGER LEVEL potentiometer before inserting in panel.

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. The following table will help analyze problems under a no-sweep condition. Select main sweep of operation, set main TIME/DIV control to 0.1 ms range, and put all other time base pushbuttons in their out position. This places the time base in the auto-sweep mode. Set INTENSITY control to midrange and set the FOCUS control fully ccw.

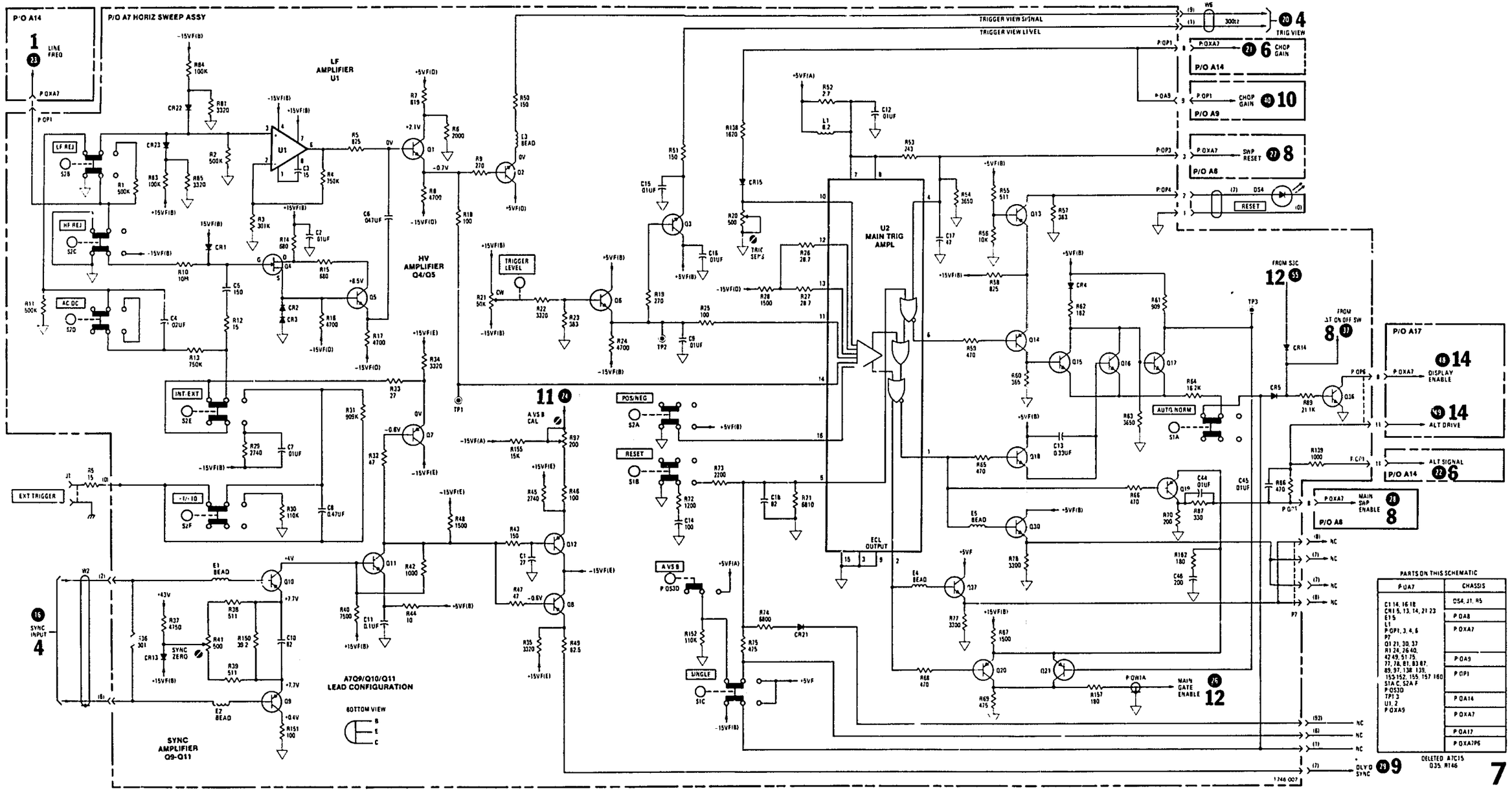
Table 8-4. Time Base Troubleshooting

INDICATION	PROBLEM CAUSE
Is baseline present?	YES - Check input circuitry (HF/LF amplifiers or sync amplifier). NO - Proceed to next step.
RESET Lamp OFF Beam OFF Beam position left (Using BEAM FIND)	Check reset/holdoff circuitry.
RESET Lamp OFF Beam OFF Beam position right (Using BEAM FIND)	Check Miller integrator and associated circuitry.
RESET Lamp OFF Beam ON	With RESET lamp OFF, beam should NEVER be ON. Check gate amplifier circuitry and CRT for grid-cathode short; then return to time base troubleshooting.
RESET Lamp ON BEAM OFF	With RESET LAMP ON, beam should also be ON. Check gate amplifier and HVPS; then return to time base to repair second problem.
RESET Lamp ON Beam ON (Left side)	Check Miller integrator and associated circuitry.
RESET Lamp ON Beam ON (Right side)	Check sweep reset circuitry.



A		B		C		D		E		F		G	
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	C39	F-5	P1	G-2	Q30	C-2	R32	B-1	R70	C-2	R108	D-2	R147	E-5
C2	B-3	C40	F-4	P2	F-3	Q31	F-4	R33	B-2	R71	C-3	R109	D-3	R148	E-5
C3	B-3	C41	F-5	P3	E-3	Q32	F-4	R34	B-2	R72	C-5	R110	D-2	R149	F-4
C4	B-3	C42	E-5	P4	C-5	Q33	E-4	R35	B-2	R73	C-4	R111	B-4	R150	C-1
C5	B-2	C43	E-3	P5	E-1	Q34	D-3	R36	C-1	R74	B-4	R112	B-4	R151	C-1
C6	B-2	CR1	B-2	P6	F-3	Q36	E-3	R37	C-2	R75	C-4	R113	B-4	R152	F-4
C7	B-2	CR2	B-3	P7	C-4	Q37	D-2	R38	C-2	R76	D-1	R114	D-3	R153	E-3
C8	B-2	CR3	B-3	Q1	B-2	Q1	B-3	R39	C-2	R77	C-2	R115	D-3	R154	F-5
C9	B-3	CR4	C-4	Q2	F-2	Q2	B-3	R40	B-1	R78	C-2	R116	D-3	R155	D-4
C10	C-1	CR5	F-3	Q3	B-4	R3	B-3	R41	C-2	R79	B-4	R117	D-3	R156	G-3
C11	B-1	CR6	D-3	Q4	B-2	R4	B-3	R42	B-1	R80	B-4	R118	D-3	R157	C-2
C12	C-3	CR7	F-4	Q5	B-2	R5	C-3	R43	B-1	R81	B-4	R119	B-2	R158	D-2
C13	C-3	CR8	B-2	Q6	B-4	R6	C-2	R44	B-1	R82	B-4	R120	G-4	R159	E-4
C14	C-5	CR9	E-5	Q7	B-2	R7	C-2	R45	B-2	R83	B-4	R121	C-2	R160	E-3
C15	D-1	CR10	D-3	Q8	B-2	R8	C-3	R46	C-2	R84	B-4	R122	F-4	R161	B-4
C16	B-4	CR11	F-4	Q9	C-1	R9	C-2	R47	B-1	R85	B-4	R123	B-3	S1A	C-5
C17	C-2	CR12	F-4	Q10	E-1	R10	B-2	R48	B-1	R86	F-3	R124	C-2	S1B	C-4
C18	C-3	CR13	C-2	Q11	B-1	R11	B-3	R49	B-1	R87	D-2	R125	F-5	S1C	C-4
C19	E-3	CR14	E-3	Q12	C-2	R12	B-2	R50	D-1	R88	D-3	R126	F-5	S1D	C-4
C20	D-3	CR15	C-3	Q13	B-3	R13	B-2	R51	C-1	R89	E-3	R127	F-4	S2A	A-3
C21	D-2	CR16	E-5	Q14	C-3	R14	B-3	R52	C-3	R90	D-4	R128	F-4	S2B	A-3
C22	D-3	CR21	B-4	Q15	C-3	R15	B-3	R53	C-3	R91	D-4	R129	F-5	S2C	A-2
C23	F-1	CR22	B-3	Q16	C-3	R16	B-3	R54	C-2	R92	E-3	R130	F-5	S2D	A-2
C24	F-1	CR23	B-3	Q17	C-3	R17	B-3	R55	B-4	R93	D-3	R131	F-5	S2E	A-2
C25	D-2	E1	C-1	Q18	C-3	R18	C-2	R56	B-4	R94	E-3	R132	F-4	S2F	A-2
C26	D-2	E2	C-1	Q19	D-2	R19	B-4	R57	B-4	R95	E-3	R133	F-4	S3A	D-5
C27	E-2	E3	C-2	Q20	D-2	R20	C-3	R58	C-4	R96	E-3	R134	F-4	S3B	D-4
C28	F-1	E4	D-2	Q21	D-2	R21	A-4	R59	C-3	R97	C-2	R135	F-4	S3C	D-4
C29	F-1	E5	C-2	Q22	D-3	R22	A-4	R60	C-4	R98	E-3	R136	F-4	S3D	D-4
C30	F-5	L1	C-3	Q23	E-3	R23	A-4	R61	C-4	R99	E-3	R137	F-5	TP1	C-2
C31	D-2	L2	F-2	Q24	E-3	R24	B-4	R62	C-4	R100	D-3	R138	C-3	TP2	B-3
C32	C-2	L3	D-1	Q25	D-3	R25	B-3	R63	C-4	R101	D-2	R139	G-3	TP3	C-4
C33	F-1	L4	F-2	Q26	D-2	R26	C-3	R64	C-4	R102	D-2	R140	F-5	TP4	E-4
C34	F-1	L5	D-2	Q27	E-3	R27	C-3	R65	C-2	R103	D-3	R141	F-5	TP5	G-4
C35	F-5	L6	F-2	Q28	F-4	R28	B-3	R66	C-2	R104	E-1	R142	F-4	TP10	E-4
C36	B-2	L7	D-1	Q29	F-4	R29	B-2	R67	C-2	R105	D-5	R143	E-5	U1	B-3
C37	B-3					R30	B-1	R68	C-2	R106	D-3	R144	E-4	U2	C-2
C38	B-1					R31	A-1	R69	C-2	R107	D-3	R145	E-5	U3	E-2
												R146	E-5	XA9	C-3

Horizontal Sweep, A7, Component Identification



Service Sheet 7.
Main Trigger Circuitry
8-19

SERVICE SHEET 8

THEORY OF OPERATION

The main sweep integrator consists of current source A8Q13, source follower A8Q5, common-emitter stage A8Q6, and an integrating capacitor between the gate of A8Q5 and the collector of A8Q6. In the reset condition, current from A8Q13 is drained through A8Q3, and the main sweep output remains at approximately +1 V.

When the main sweep enable signal goes low, A8Q1 conducts, turning off A8Q2 and A8Q3. Current from A8Q13 is now applied through the selected integrating capacitor, A8C9 - A8C14, producing a linear ramp (main sweep) at the collector of A8Q6. (For the fastest sweep speeds, .05 - 2 μSEC, A8C6 is the integrating capacitor.) The main sweep is also applied to an emitter follower circuit consisting of A8Q8 - A8Q10. When the main sweep reaches an amplitude of +11 volts, the emitter of A8Q10 is approximately +5 volts, arming A7U2 and shutting off A8Q1. With A8Q1 off, current flows through A8Q3, discharging the selected integrating capacitor. When the voltage level at the base of A8Q4 falls to the voltage level applied to the base of A8Q2, both A8Q2 and A8Q4 are conducting and the sum of the currents at the gate of A8Q5 is zero. This is the reset condition of the ramp.

The output of constant-current source A8Q13 is controlled by operational amplifier A8U1. Different reference voltages are developed for different ranges on TIME/DIV switch A8S1. When different ranges are selected, values of the ramp capacitor, integrating resistor, and reference voltage are changed. This changes the slope of the ramp for different sweep speeds. The slope can be varied for any sweep speed by TIME/DIV VERNIER R8.

The emitter of A8Q9 drives one of the six holdoff capacitors (A8C13 through A8C18) depending on the position of the TIME/DIV switch. At the end of the sweep, the holdoff capacitor is discharged through A8R40 and TRIGGER HOLDOFF potentiometer R9. When voltage at the base of A8Q11 decays to +0.7 volt, A8Q12 turns on and the reset line to A7U2 (pin 4) goes low, resetting A7U2 and arming it for another sync signal.

REMOVAL PROCEDURE

Remove assembly A8 as follows:

a. Loosen hex screws on three TIME/DIV shaft collars.

b. Set main TIME/DIV control to 1 μSEC position.

c. Set delayed TIME/DIV control to OFF position.

d. Remove TIME/DIV shaft by pulling through front panel of instrument.

e. Remove mounting screw and standoff that hold assemblies A8 and A17 together.

f. Unsolder bare wire between A8 and A17 at assembly A8.

g. Remove A8 by pulling from connector on A7.

h. To replace 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 contact on both rotor sections. If contacts show excessive wear, replace rotor section.

f. Clean and lubricate contacts on circuit board and rotors as described in Preventive Maintenance at the front of this section.

g. Place rotor sections on 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 Main Sweep Assembly A8, use waveforms and dc voltages indicated on the schematic to isolate the problem to a particular stage or component.

DC VOLTAGE MEASUREMENT CONDITIONS
SERVICE SHEET 8

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 8

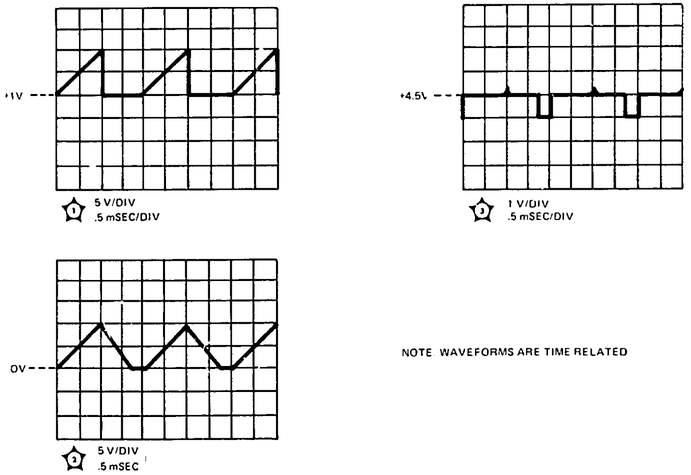
1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

   Coupling (channel A) 50Ω
   TRIGGER LEVEL (main) ..... stable display

2. Set monitor oscilloscope TIME/DIV and VOLTS/DIV controls as indicated under waveform(s).

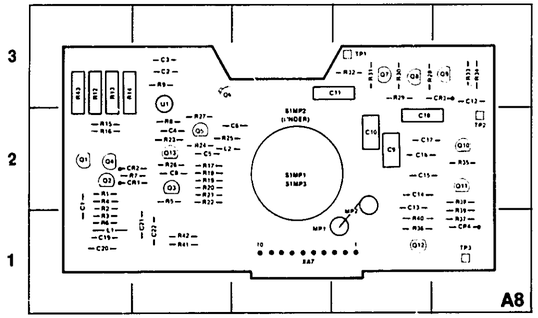
3. Connect square-wave generator 50-ohm output to Model 1746A channel A INPUT connector.

4. Adjust square-wave generator output for divisions of signal amplitude (.6 V) at 5 kHz.



NOTE WAVEFORMS ARE TIME RELATED

Waveforms for Service Sheet 8



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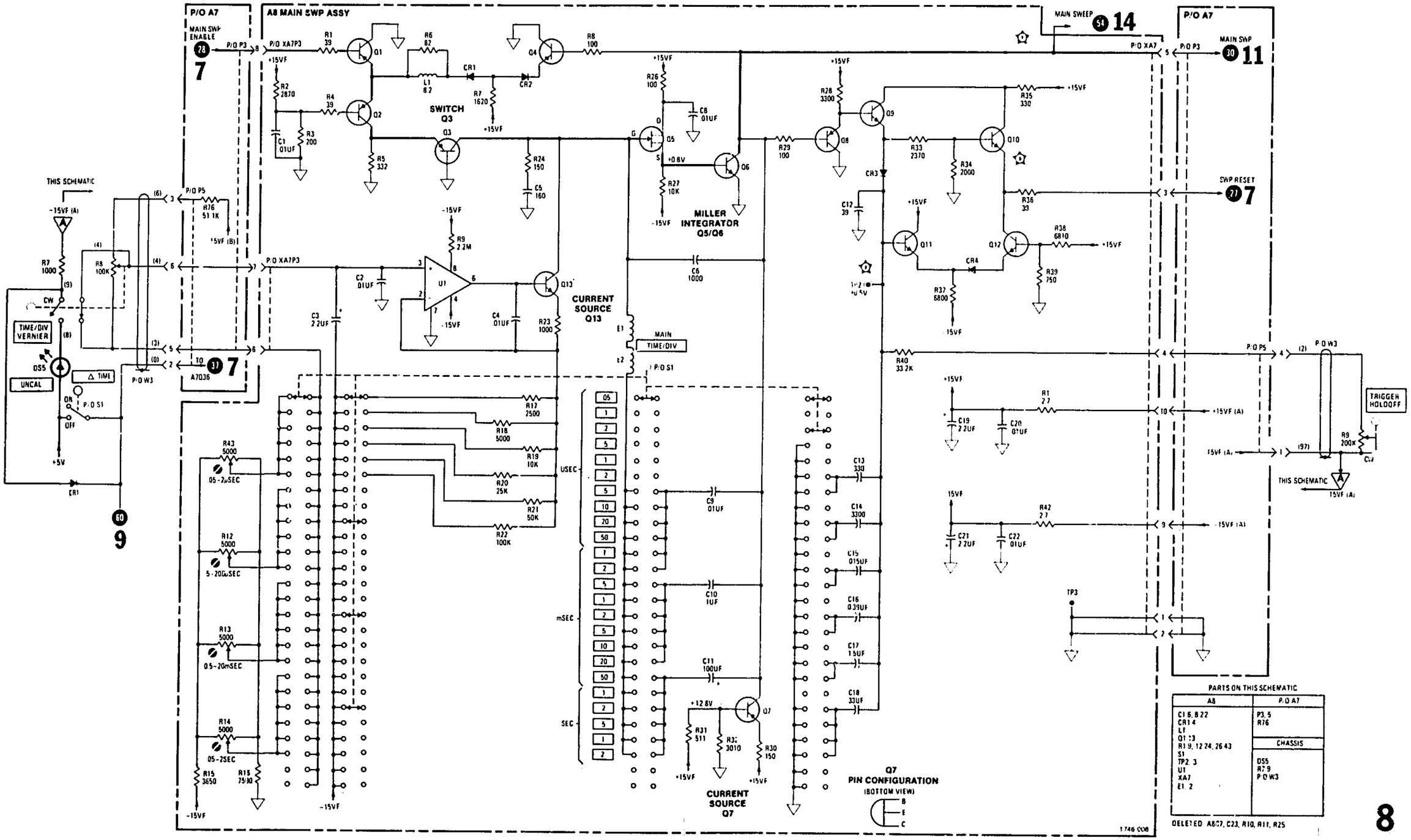
C2	B-3	C21	B-1	Q11	E-2	R18	B-2	R37	E-1
C3	B-3	C22	B-1	Q12	D-1	R19	B-2	R38	E-2
C4	B-2	CR1	B-2	Q13	B-2	R20	B-2	R39	E-1
C5	B-2	CR2	B-2	R1	A-2	R21	B-2	R40	D-1
C6	C-2	CR3	E-3	R2	A-2	R22	B-2	R41	B-1
C8	B-2	CR4	E-1	R3	A-1	R23	B-2	R42	B-1
C9	D-2	E1	B-2	R4	A-2	R24	B-2	R43	A-3
C10	D-2	L1	A-1	R5	B-2	R26	B-2	S1MP1	C-2
C11	C-3	Q1	A-2	R6	A-1	R27	B-2	S1MP2	C-2
C12	E-3	Q2	A-2	R7	B-2	R28	D-3	S1MP3	C-1
C13	D-2	Q3	B-2	R8	B-2	R29	D-3	S1MP4	D-1
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-2	Q8	D-3	R15	A-2	R34	E-3	XA7	C-1
C19	A-1	Q9	E-3	R16	A-2	R35	E-2		

Main Sweep, A8, Component Identification



7 9 8

Service Sheet 8.
Main Sweep Generator
8-21

SERVICE SHEET 9

THEORY OF OPERATION

Arming Circuit. The positive going ramp of the main sweep is applied to the horizontal amplifier (Service Sheet 11) and to delay comparator A17U7 (Service Sheet 14). The delay comparator circuit compares the main sweep ramp, and the level established by either the START or STOP controls and develops the DLY COMP signal.

The DLY COMP signal, when high, arms delayed trigger circuit A10U1.

Delayed Trigger. Delayed trigger operation is similar to main trigger operation. The DLYD SYNC input to integrated circuit A10U1 is applied through an impedance converter consisting of FET matched pair A10Q1A/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 transition developed from the DLY COMP signal. With A10S1D in TRIGD position, the transition applied to A10U1, and a delayed trigger will be formed if a DLYD sync pulse occurs during the main sweep time. TRIGGER LEVEL control A10R10 establishes the trigger level threshold in TRIGD mode of operation.

REMOVAL PROCEDURE

To remove assembly A10, proceed as follows:

a. Remove assembly A9 (see Service Sheet 10).

b. Unsolder resistor from delayed EXT TRIGGER BNC connector.

c. Remove delayed TRIGGER LEVEL knob and nut underneath.

d. Remove screw from corner of A10 (next to delayed EXT TRIGGER BNC connector).

e. Gently pull A10 to rear and remove from instrument. Save lockwasher on TRIGGER LEVEL potentiometer before inserting in front panel.

TROUBLESHOOTING

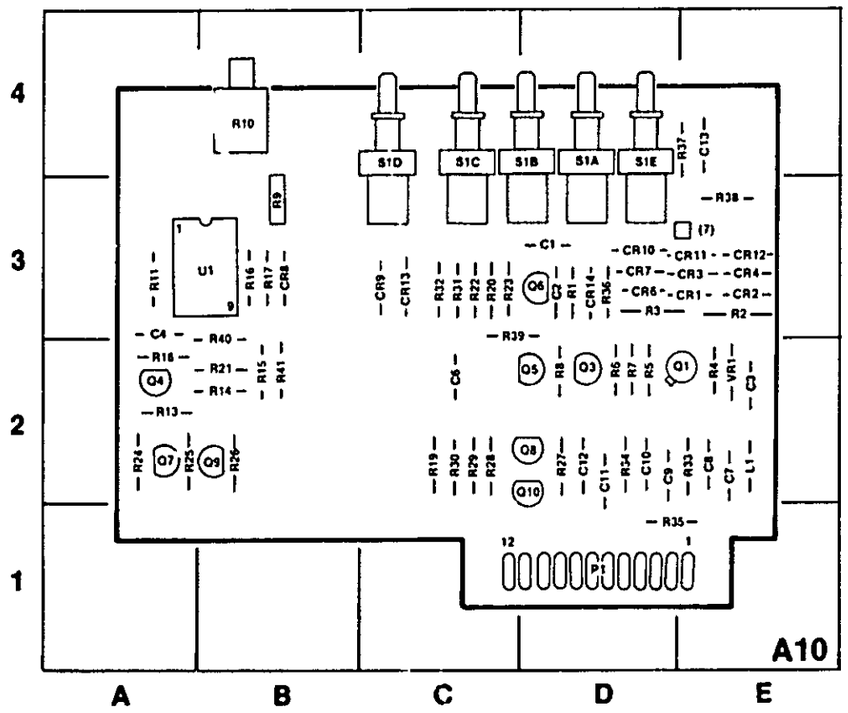
The delayed trigger assembly should cause little trouble in the operation of the instrument. If trouble is suspected, check the following inputs:

a. MAIN TRIG signal.

b. DLY COMP signal.

c. DLYD SYNC signal.

d. DLY'D SWP.



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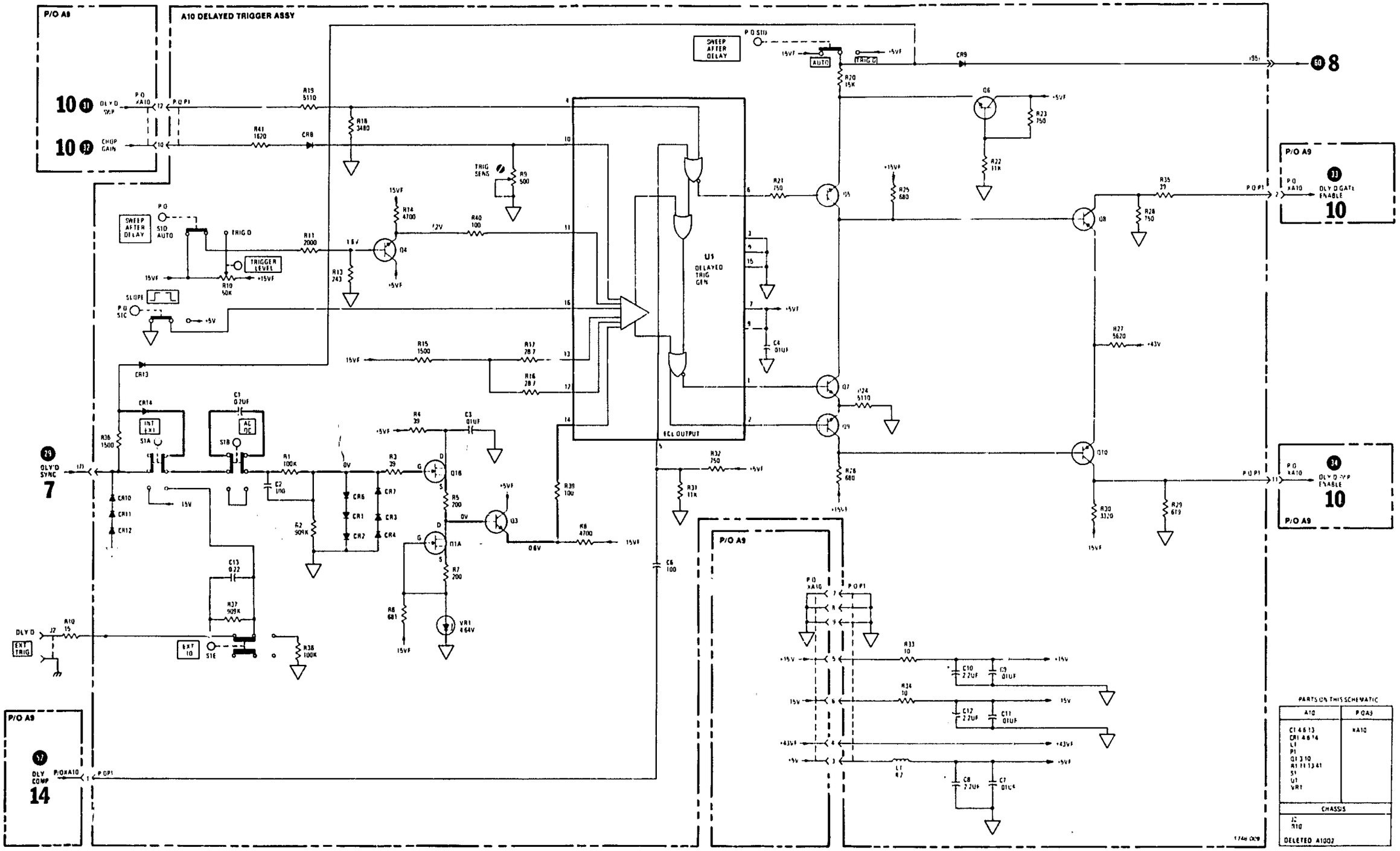
C1	D-3	CR1	E-3	CR14	D-3	R1	D-3	R14	B-2	R26	B-2	R38	E-3
C2	D-3	CR2	E-3	L1	E-2	R2	E-3	R15	B-2	R27	D-2	R39	C-3
C3	E-2	CR3	E-3	P1	D-1	R3	D-3	R16	B-3	R28	C-2	R40	B-3
C4	A-3	CR4	E-3	Q1	E-2	R4	E-2	R17	B-3	R29	C-2	R41	B-2
C6	C-2	CR6	D-3	Q3	D-2	R5	D-2	R18	A-2	R30	C-2	S1A	D-4
C7	E-2	CR7	D-3	Q4	A-2	R6	D-2	R19	C-2	R31	C-3	S1B	D-4
C8	E-2	CR8	B-3	Q5	D-2	R7	D-2	R20	C-3	R32	C-3	S1C	C-4
C9	D-2	CR9	C-3	Q6	D-3	R8	D-2	R21	B-2	R33	E-2	S1D	C-4
C10	D-2	CR10	D-3	Q7	A-2	R9	B-3	R22	C-3	R34	D-2	S1E	D-4
C11	D-2	CR11	E-3	Q8	D-2	R10	B-4	R23	C-3	R35	D-1	U1	B-3
C12	D-2	CR12	E-3	Q9	B-2	R11	A-3	R24	A-2	R36	D-3	VR1	E-2
C13	E-4	C..13	C-3	Q10	D-2	R13	A-2	R25	A-2	R37	E-4		

Delayed Trigger, A10, Component Identification



Service Sheet 9.
Delayed Trigger Circuitry
8-23

SERVICE SHEET 10

THEORY OF OPERATION

The operation of delayed sweep is similar to that of the main sweep (Service Sheet 8). Output of the delayed integrator (A9TP1) parallels the main sweep ramp until the delayed sweep enable signal applied to the base of A9Q3 goes low. At this point, the delayed integrator ramps up at a slope determined by the selected integrating capacitor and selected current source resistor.

REMOVAL PROCEDURE

Remove assembly A9 as follows:

a. Loosen hex screws on three TIME/DIV shaft collars.

b. Set main TIME/DIV control to 1 μSEC position.

c. Set delayed TIME/DIV control to OFF position.

d. Remove TIME/DIV shaft by pulling through front panel of instrument.

e. Remove A9 by gently rocking assembly toward rear of instrument to disconnect it from two connectors.

f. To replace, reverse removal procedure.

TIME/DIV SWITCH MAINTENANCE

To service the TIME/DIV rotor switch on A9 proceed as follows:

a. Remove assembly A9 as described above.

b. After removing A9, 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 circuit board. If contact area shows excessive wear, replace circuit board.

e. Check contact on both rotor sections. If contacts show excessive wear, replace rotor section.

f. Clean and lubricate contacts on circuit board and rotors as described in Preventive Maintenance at the front of this section.

g. Place rotor sections on circuit board and reinstall retainer ring.

h. Position slotted portion of open rotor sections as noted in step b.

i. Reinstall assembly A9 in instrument.

j. Reinstall TIME/DIV shaft and knob assembly.

TROUBLESHOOTING

If trouble is isolated to 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 10

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 10

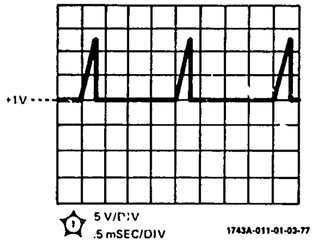
1. Set front-panel controls in accordance with initial control settings in Section V, except as follows:

Coupling (channel A)	50Ω
DLY'D TIME DIV	10μSEC
START	midrange
Horiz display	MAIN
TRIGGER LEVEL (main)	stable display

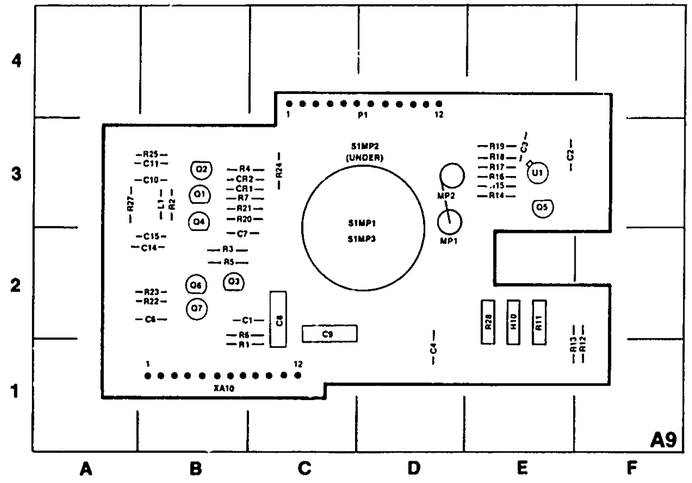
2. Set monitor oscilloscope TIME/DIV and VOLTS/DIV controls as indicated under waveform(s).

3. Connect square-wave generator 50-ohm output to Model 1746A channel A INPUT connector.

4. Adjust square-wave generator output for 6 divisions of signal amplitude (.6 V) at 5 kHz.

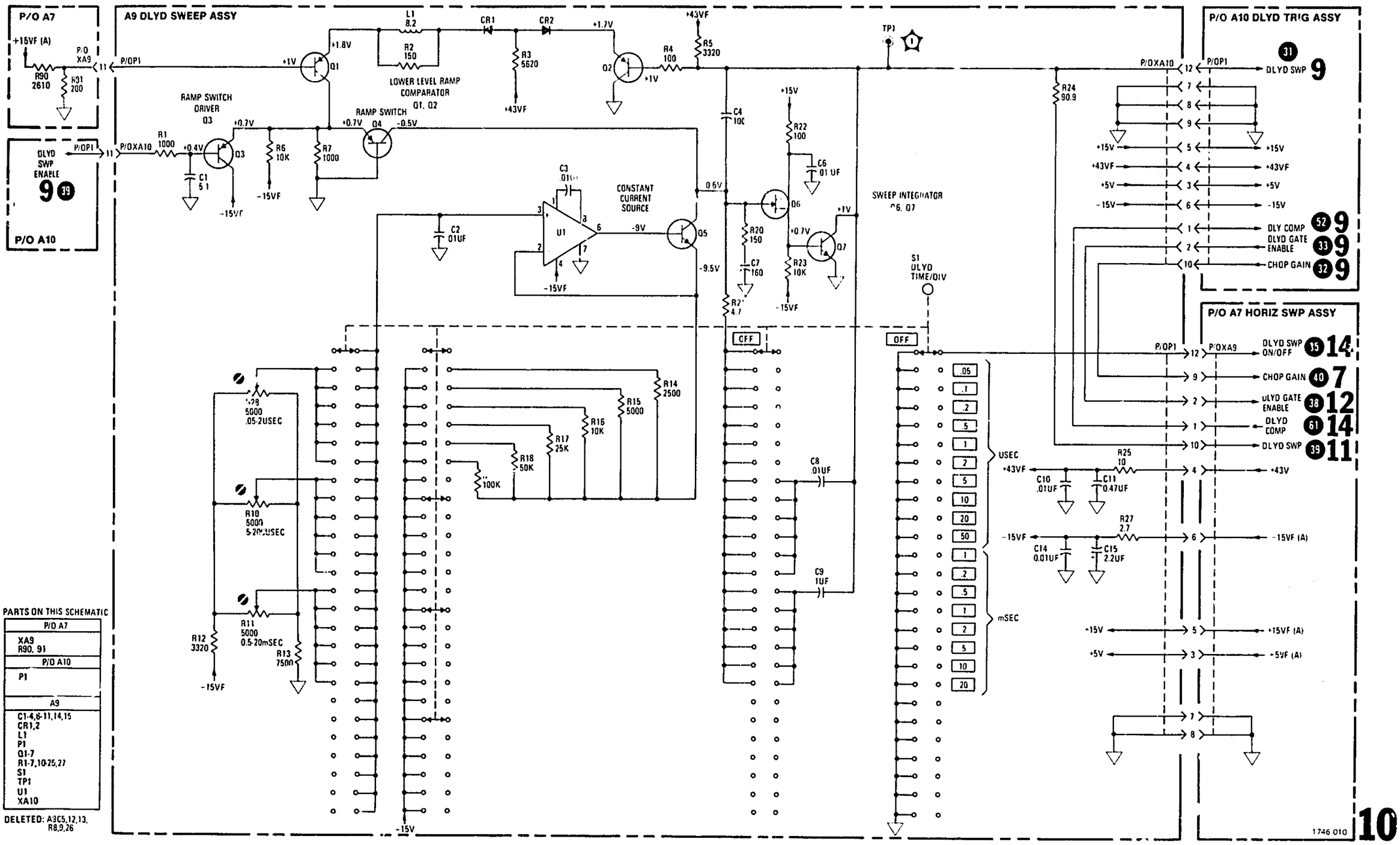


Waveforms for Service Sheet 10



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-2	C15	A-2	Q7	B-2	R13	F-1	R24	C-3
C2	F-3	CR1	B-3	R1	B-1	R14	E-3	R25	A-3
C3	E-3	CR2	B-3	R2	B-3	R15	E-3	R27	A-3
C4	D-1	L1	B-3	R3	B-2	R16	E-3	R28	E-2
C6	A-2	P1	C-4	R4	B-3	R17	E-3	S1MP1	D-2
C7	B-2	Q1	B-3	R5	B-2	R18	E-3	S1MP2	D-3
C8	C-2	Q2	B-3	R6	B-2	R19	E-3	S1MP3	D-2
C9	C-2	Q3	B-2	R7	B-3	R20	B-3	U1	E-3
C10	A-3	Q4	B-3	R10	E-2	R21	B-3	XA10	B-1
C11	A-3	Q5	E-3	R11	E-2	R22	A-2	MP1	D-3
C14	A-2	Q6	B-2	R12	F-1	R23	A-2	MP2	D-3

Delayed Sweep, A9, Component Identification



PARTS ON THIS SCHEMATIC

P/O A7
XA9 R90, 91
P/O A10
P1
A9
C1-4,6-11,14,15 CR1,2 L1 P1 Q1-7 R1-7,10-25,27 S1 TP1 U1 XA10

DELETED: A3C5,12,13, R8,9,26

Service Sheet 10.
Delayed Sweep Generator

SERVICE SHEET 12

THEORY OF OPERATION

Main Sweep. MAIN sweep switch A7S3C routes the main sweep ramp to the horizontal preamplifier.

A VS B Control. The A VS B switch A7S3D performs several functions. It sends a control signal to the vertical preamplifier which is used to select channel A vertical display and channel B sync. It biases the gate Schmitt to turn the gate on and forces the main trigger circuit to the single-shot mode. It also connects the sync amplifier output to the horizontal preamplifier.

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 differential amplifier A7Q23/A7Q27. Transistor A7Q26 provides temperature compensation for A7Q22. Horizontal POSITION control R11 drives A7Q26. MAG CENTER control A7R105 also drives A7Q26 when MAG X10 switch A7S10 is engaged. Transistors A7Q24, A7Q25 and A7Q34 are current sources, A7Q24 acts as a collector load for A7Q22. A7Q25 and A7Q34 are emitter loads for A7Q23 and A7Q27. The X1 gain 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 Ouput. Amplifier A11 is a differential shunt feedback amplifier. Current required by A7Q23 is supplied through A11R4. This determines the voltage that drives one horizontal deflection plate through A11R7. Current required by A7Q27 is supplied through A11R23. Transistors A11Q1, A11Q2, A11Q5, and A11Q6 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 +110 volts.

REMOVAL PROCEDURE

Assembly A7 Removal: (see Service Sheet 7).

Assembly A11 Removal:

To remove assembly A11, proceed as follows:

a. Disconnect (2) and (9) wires from A11.

b. Remove A11 from connector by first pulling top of A11 away from assembly A7 and then pulling bottom of A11.

c. To reinstall, reverse removal procedure.

TROUBLESHOOTING

If no horizontal deflection can be obtained under normal sweep conditions, the problem may be either in the time base or in Horizontal Output Assembly A11. To quickly determine which is at fault, put the oscilloscope in the A VS B mode and connect a 1-kHz sine wave to the channel B input. 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, assembly A11 is probably defective.

DC VOLTAGE MEASUREMENT CONDITIONS
SERVICE SHEET 11

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 11

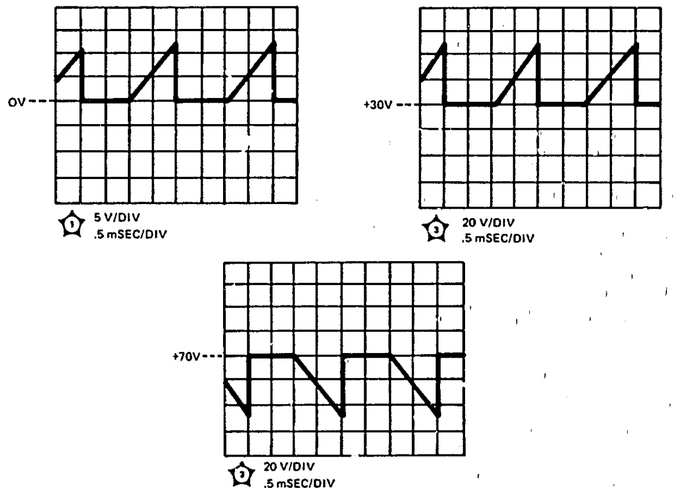
1. Set front-panel controls in accordance with initial control settings Section V, except as follows:

   Coupling (channel A) 50Ω
   TRIGGER LEVEL (main) ..... stable display

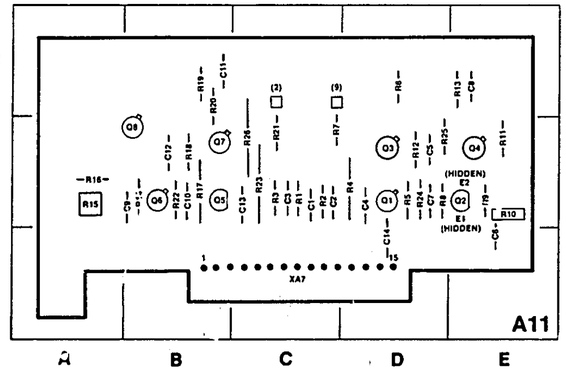
2. Set monitor oscilloscope TIME/DIV and VOLTS/DIV controls as indicated under waveform(s).

3. Connect square-wave generator 50-ohm output to Model 1746A channel A INPUT connector.

4. Adjust square-wave generator output for 6 divisions of signal amplitude (.6 V) at 5 kHz.



Waveforms for Service Sheet 11



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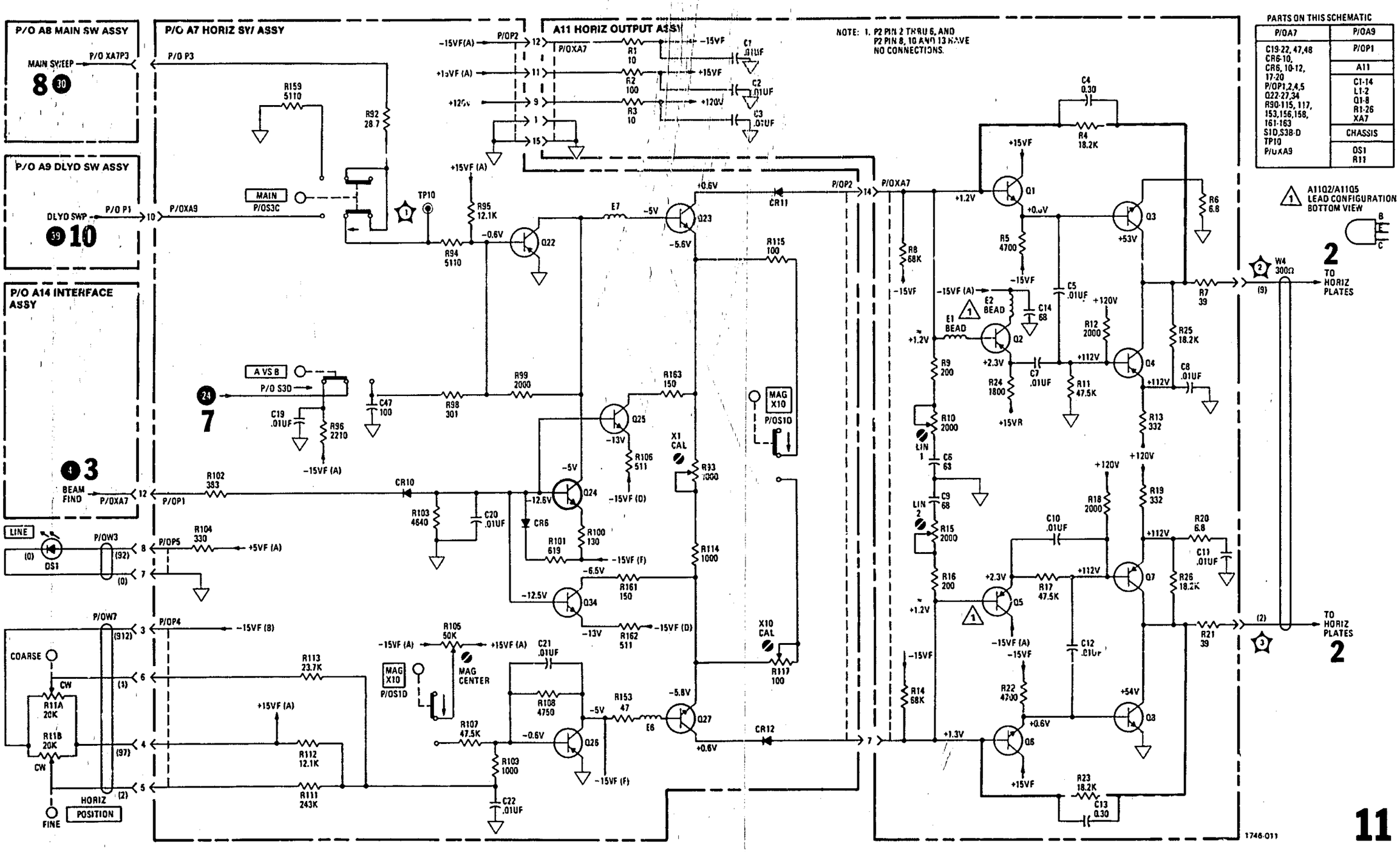
C3	C-2	E2	E-2	R5	D-2	R*8	B-2
C4	D-2	Q1	D-2	R6	D-3	R19	B-3
C5	D-2	Q2	E-2	R7	C-2	R20	B-3
C6	E-1	Q3	D-2	R8	D-2	R21	C-2
C7	D-2	Q4	E-2	R9	E-2	R22	B-2
C8	E-3	Q5	B-2	R10	E-2	R23	C-2
C9	B-2	Q6	B-2	R11	E-2	R24	D-2
C10	B-2	Q7	B-2	R12	D-2	R25	D-2
C11	B-3	Q8	B-2	R13	E-3	R26	C-2
C12	B-2	R1	C-2	R14	B-2	XA7	C-1
C13	C-2	R2	C-2	R15	A-2		

Horizontal Output, A11, Component Identification



11

Service Sheet 11.
Horizontal Output
8-27

SERVICE SHEET 12

THEORY OF OPERATION

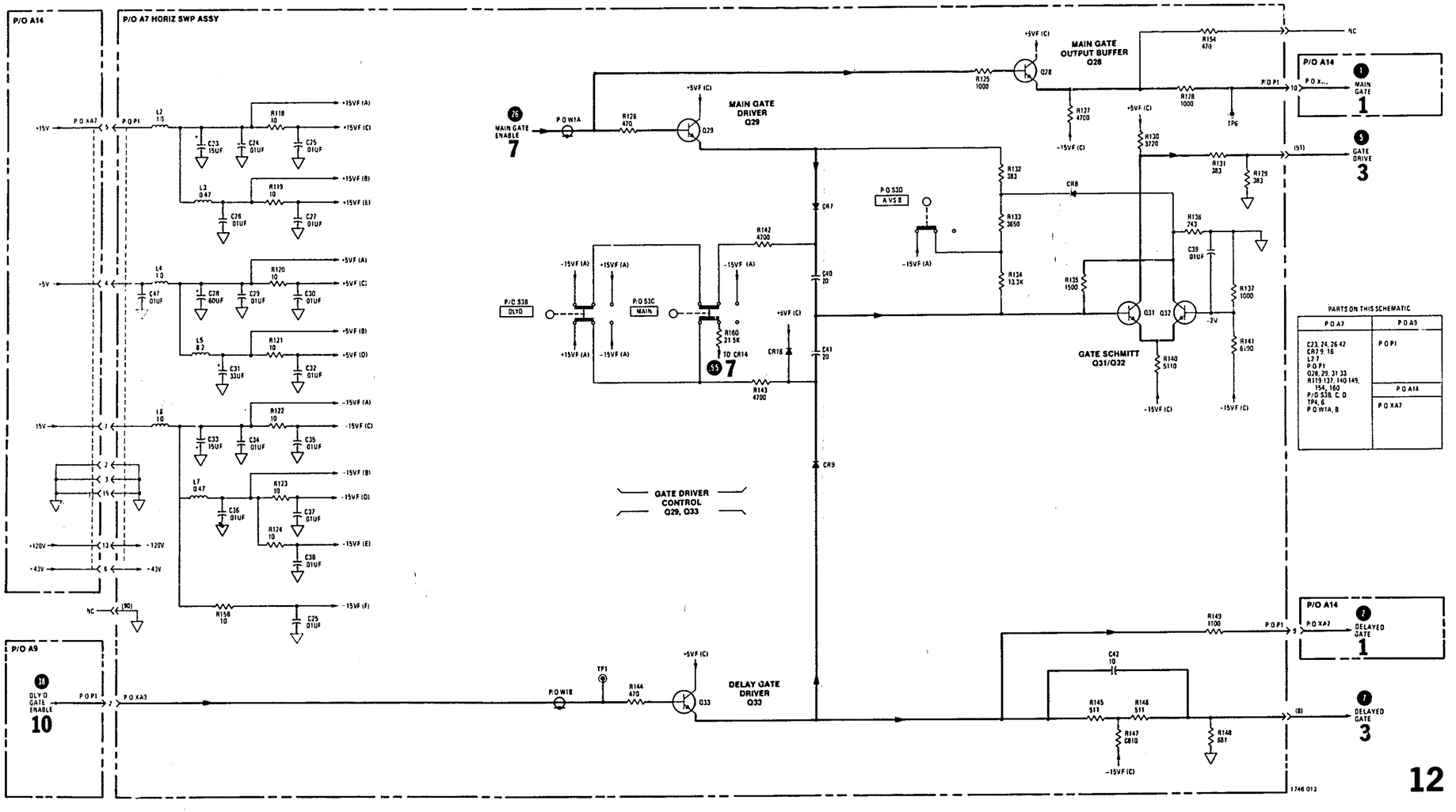
The gate Schmitt circuit, A7Q28 - A7Q32, provides Gate Amplifier Assembly A12 with main and delayed gate signals. The Schmitt circuit is controlled by horizontal mode switch A7S3. It is set by the first positive control pulse and resets on the first negative control pulse. In main sweep operation, the gate follows the main sweep. In ΔTIME operation, the gate follows the delayed sweep. The gate Schmitt also furnishes the main and delayed gate outputs to rear panel BNC connectors for external use (Service Sheet 1).

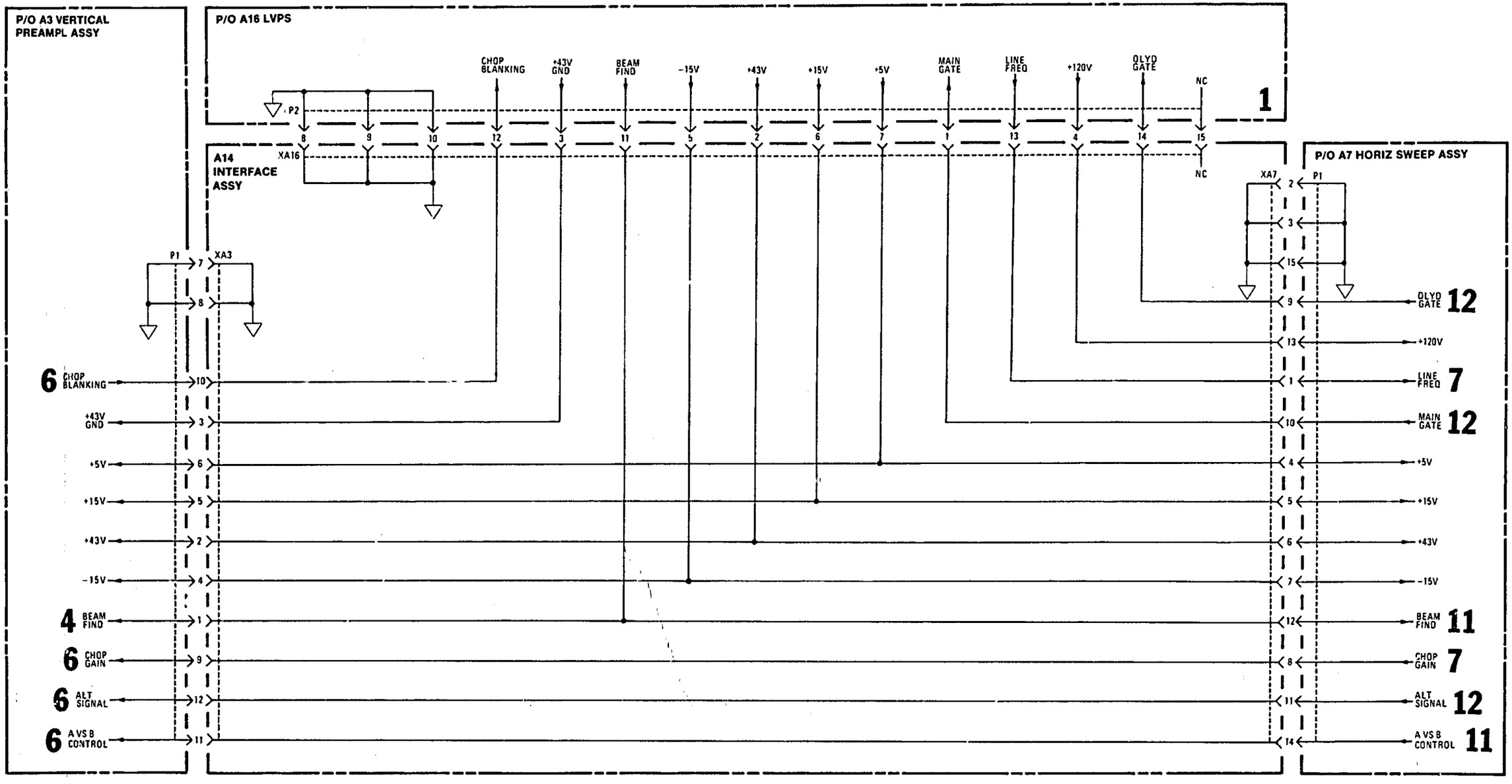
REMOVAL PROCEDURE

To remove assembly A7 see Service Sheet 7.

TROUBLESHOOTING

Troubleshooting the gate Schmitt circuit should present few problems to the technician. If input signals are present, follow signals through the individual circuits.


P/O A14
P/O A7 HORIZ SWP ASSY
P/O A9
MAIN GATE DRIVER Q29
MAIN GATE OUTPUT BUFFER Q28
GATE SCHMITT Q31/Q32
GATE DRIVER CONTROL Q29, Q33
DELAY GATE DRIVER Q33
PARTS ON THIS SCHEMATIC
P O A7
P O A9
P O A14
P O XA7
1746 012



1745-013

PARTS ON THIS SCHEMATIC

P/O A3	P/O A7	A14	P/O A16
P1	P1	XA3 XA7 XA16	P2

SERVICE SHEET 14

THEORY OF OPERATION

The time-interval decoder assembly produces the delay comparator signal used in conjunction with the main trigger signal to arm the delay trigger generator (Service Sheet 9) and the analog voltage that is applied to the rear-panel ΔTIME OUT connectors.

The NAND gate circuitry of A17U8 controls the D input to flip-flop A17U9A. When the instrument is operated in any vertical mode other than ALT, the ALT CONT signal is high, holding the output of A17U8B high (through A17U8A). The high from A17U8B is applied to an input on A17U8C. The other input to A17U8C is from the Q output of flip-flop A17U9A (through A17U8D). This arrangement causes the output of A17U8C to alternately go high and low after each main sweep (provided the DISPLAY ENABLE signal is not low). Flip-flop A17U9A is clocked at the start of each main sweep by the ALT DRIVE signal which turns A17Q13 on and off.

In the ALT mode of operation, the ALT CONT signal goes low, holding the outputs of A17U8A and A17U8D high. The output of A17U8C is now controlled by the START CHAN ON/OFF signal. The START CHAN ON/OFF signal is high when channel A is selected and low when channel B is selected. The Q and $\overline{Q}$ outputs of A17U9A are applied to transistors A17Q7 and A17Q9 alternately turning them on and off. When conducting, each transistor enables either diode gate A17CR3 or A17CR4. For example, when A17Q9 conducts, it forward biases A17CR3, allowing A17U7Q4 to conduct. This turns off A17U7Q1, which turns on A17Q9. The voltage applied to the base of A17U7Q4 is established by the position of START control R6.

The main sweep signal is applied to the base of A17U7Q5. When main sweep voltage slightly exceeds the voltage applied to the base of A17U7Q4, A17U7Q5 conducts, turning off A17U7Q4 and turning on A17U7Q1. A17Q9 turns off, A17Q10 turns on, causing the DLY COMP signal to go high. This arms the delay trigger generator (See Service Sheet 9).

On the next sweep, A17Q6 will bias A17CR4 on, turning on A17U7Q3 and, again turning off A17U7Q1. The voltage applied to the base of A17U7Q3 is established by STOP control R13 through START/STOP summing amplifier A17U3. The start signal developed by START control R6 (through A17U1) is applied as a reference level to the non-inverting input on A17U3. When the main sweep voltage slightly exceeds that voltage applied to the base of A17U7Q3, A17U7Q5 again conducts, turning off A17U7Q3/A17U7Q2. Again the DLY COMP signal goes high arming the delayed trigger generator.

The output of STOP control buffer A17U2 is also applied to inverting amplifier A17U4. The output of A17U4 is applied through A17Q8 to a voltage-divider network consisting of A17R51-A17R60. This voltage-divider network is connected to different position of the TIME/DIV switch A17S1. Output from the TIME/DIV switch is applied to ΔTIME OUT connectors on the rear panel. SIGNAL OVERLAY (ΔT=0) potentiometer R2 is used to balance outputs from the START and STOP potentiometers.

REMOVAL PROCEDURE

Remove assembly A17 as follows:

a. Loosen hex screws on three TIME/DIV shaft collars.

b. Set main TIME/DIV control to 1 μSEC.

c. Set delayed TIME/DIV control to OFF.

d. Remove TIME/DIV shaft by pulling through front panel of instrument.

e. Disconnect two square-pin wires to rear-panel ΔTIME OUT connectors at A17.

f. Disconnect square-pin wires (3), (4), and (96).

g. Remove assemblies A8 and A17 by pulling from connectors on assembly A7.

h. Unsolder bare wire from A8.

i. Disconnect A8 and A17 by removing standoff and mounting screw.

j. To replace, reverse removal procedure.

TIME/DIV SWITCH MAINTENANCE

To service the TIME/DIV rotor switch on assembly A17, proceed as follows:

a. Remove A17 as described above.

b. After removing A17, 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 circuit board. If contact area shows excessive wear, replace circuit board.

e. Check contact on both rotor sections. If contacts show excessive wear, replace rotor section.

f. Clean and lubricate contacts on circuit board and rotors as described in Section VIII, paragraph 8-20.

g. Place rotor sections on circuit board and reinstall retainer ring.

h. Position slotted portion of open rotor section as noted in step b.

i. Reinstall A17 in instrument

j. Reinstall TIME/DIV shaft and knob assembly.

TROUBLESHOOTING

Varying the START and STOP controls will allow schematic checkout of the operational amplifiers and comparators. Voltages shown on the schematic are referenced to ground.

U8 and U9 are TTL (T^2L).

Amplifier Voltages:

U1: $V_{pin\ 2} = V_{pin\ 3} = 0$ V

$V_{pin\ 6} = (-)\ V_{wiper}$ of START control

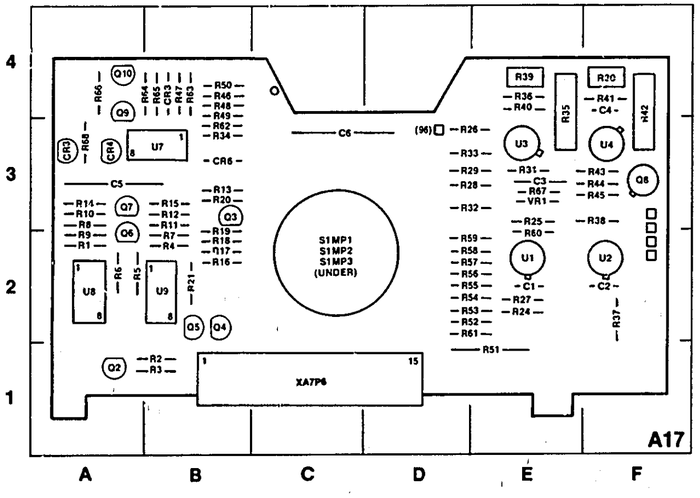
U2: $V_{pin\ 2} = V_{pin\ 3} = 1/2\ V_{pin\ 6}$

U3: $V_{pin\ 2} = V_{pin\ 3}$

$V_{pin\ 6} = V_{pin\ 3} + (-\ V_{pin\ 3})$

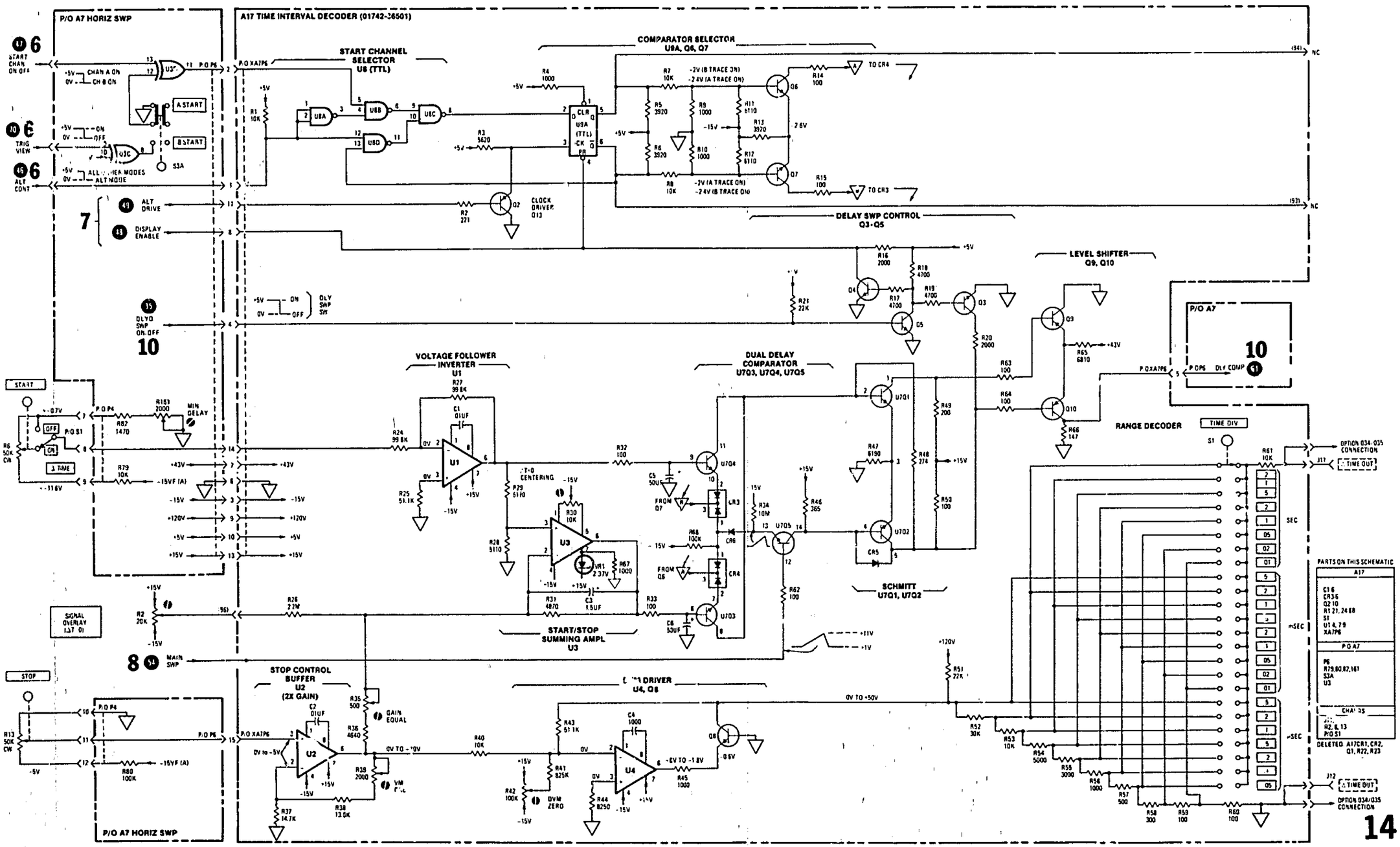
U4: $V_{pin\ 2} = V_{pin\ 3} = 0$ V

Q8: $V_{coll} = (-5)\ V_{wiper}$ of STOP control



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	E-2	R1	A-2	R20	B-3	R41	F-4	R60	E-3
C2	F-2	R2	B-1	R21	B-2	R42	F-4	R61	E-2
C3	E-3	R3	B-1	R24	E-2	R43	F-3	R62	B-3
C4	F-4	R4	B-2	R25	E-3	R44	F-3	R63	B-4
C5	A-3	R5	A-2	R26	E-3	R45	F-4	R64	B-4
C6	C-3	R6	A-2	R27	E-2	R46	B-4	R65	B-4
CR3	A-3	R7	B-2	R28	E-3	R47	B-4	R66	A-4
CR4	A-3	R8	A-3	R29	E-3	R48	B-4	R67	E-3
CR5	B-4	R9	A-3	R30	F-3	R49	B-4	R68	A-3
CR6	B-3	R10	A-3	R31	F-3	R50	B-4	S1	C-3
Q2	A-1	R11	B-3	R32	E-3	R51	E-2	U1	E-2
Q3	B-3	R12	B-3	R33	E-3	R52	E-2	U2	F-2
Q4	B-2	R13	B-3	R34	B-3	R53	E-2	U3	E-3
Q5	B-2	R14	A-3	R35	E-4	R54	E-2	U4	F-3
Q6	A-3	R15	B-3	R36	E-4	R55	E-2	U7	B-3
Q7	A-3	R16	B-3	R37	F-2	R56	E-2	U8	A-2
Q8	F-3	R17	B-2	R38	F-3	R57	E-2	U9	B-2
Q9	A-4	R18	B-2	R39	E-4	R58	E-2	VR1	E-3
Q10	A-4	R19	B-3	R40	E-4	R59	E-2	XA7P6	C-1

Interval Decoder, A17, Component Identification



Service Sheet 14
Time Interval Decoder
8-33

MANUAL CHANGES

MANUAL CHANGES

MANUAL IDENTIFICATION

Model Number: 1746A
Date Printed: SEPTEMBER 1982
Part Number: 01746-90901

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
2302A	1
2306A	1, 2
2311A	1, 2, 3
2513A	1,2,3

Serial Prefix or Number	Make Manual Changes

▲ NEW ITEM

ERRATA

Title page.

Change serial number statement to read: This manual applies directly to instruments with serial numbers prefixed 2228A and 2229A.

Page 5-4, Adjustment Procedures.

Add test 5-19A.

5-19A. PATTERN ADJUSTMENT.

Equipment Required:

Test Oscillator ..... HP Model 651B

a. Set Model 1746A TRIGGER LEVEL (main) control fully clockwise.

b. Connect 100-kHz sine wave to channel A and adjust test oscillator output for 10-division vertical display.

c. Adjust PATTERN ADJ (A12R19) to obtain best raster display (minimum pincushioning or barreling).

NOTE

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

HEWLETT PACKARD

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ERRATA (Cont'd)

Page 6-9, Table 6-2. Replaceable Parts.
Change: A3CR29 and A3CR30 to HP and Mfr Part No. 1901-0979, DIODE-SM SIG SCHOTTKY, CD5.

Page 6-22, Table 6-2. Replaceable Parts.
Delete: A12R15 and A12R17.

Page 8-9, Service Sheet 2.
Change: A15R14 to 100 ohms.

Page 8-11, Service Sheet 3.
Delete A12R15 and A12R17. Reconnect +15 V to top of A12R16 and −15 V to bottom of A12R16.

CHANGE 1

Page 6-5, Table 6-2. Replaceable Parts.
Change: A4, HP and Mfr Part No. to 01740-61633, CD6.

CHANGE 2

Page 6-5, Table 6-2. Replaceable Parts.
Change: A8, HP and Mfr Part No. to 01740-66593, CD7.
Change: A9, HP and Mfr Part No. to 01740-66592, CD6
Change: A15, HP and Mfr Part No. to 01745-66506, CD7.

Page 6-17, Table 6-2. Replaceable Parts.
Change: A8, HP and Mfr Part No. to 01740-66593, CD7

Page 6-18, Table 6-2. Replaceable Parts.
Change: A9, HP and Mfr Part No. to 01740-66592, CD6

Page 6-19, Table 6-2. Replaceable Parts.
Change: A9R5 to HP and Mfr Part No. 0761-0011, RESISTOR 3.3K 5% 1W MO TC=0±200, Mfr Code 28480, CD7.
Change: A9U1 to HP Part No. 1826-0311, IC OP AMP GP 8-DIP-P PKG, Mfr Code 04713, Mfr Part No. MLM201AP1, CD9.
Delete: A9XU1.

Page 6-22, Table 6-2. Replaceable Parts.
Change: A15, HP and Mfr Part No. to 01745-66506, CD7.
Change: A15C3 to HP and Mfr Part No. 0160-0168, CAPACITOR-FXD .1UF ±10% 200VDC POLYE, CD1.

Page 6-23, Table 6-2. Replaceable Parts.
Delete: A15R4.
Add: A15VR2, HP and Mfr Part No. 1902-0025, DIODE-ZNR 10V 5% DO-35 PD=.4W TC=+.06%, Mfr Code 28480, CD4.

Page 8-9, Service Sheet 2.
Change: A15C3 to 0.1 UF.
Change: A15R4 to A15VR2, 10V. Cathode points toward A15CR2 cathode.

Page 8-25, Schematic 10.
Change: A9R5 to 3300 ohms.

▲CHANGE 3

Page 6-6, Table 6-2. Replaceable Parts.
Change: MP83 to HP and Mfr Part No. 5041-5214, CD1.
Change: MP85 to HP and Mfr Part No. 01745-60602, CD2.