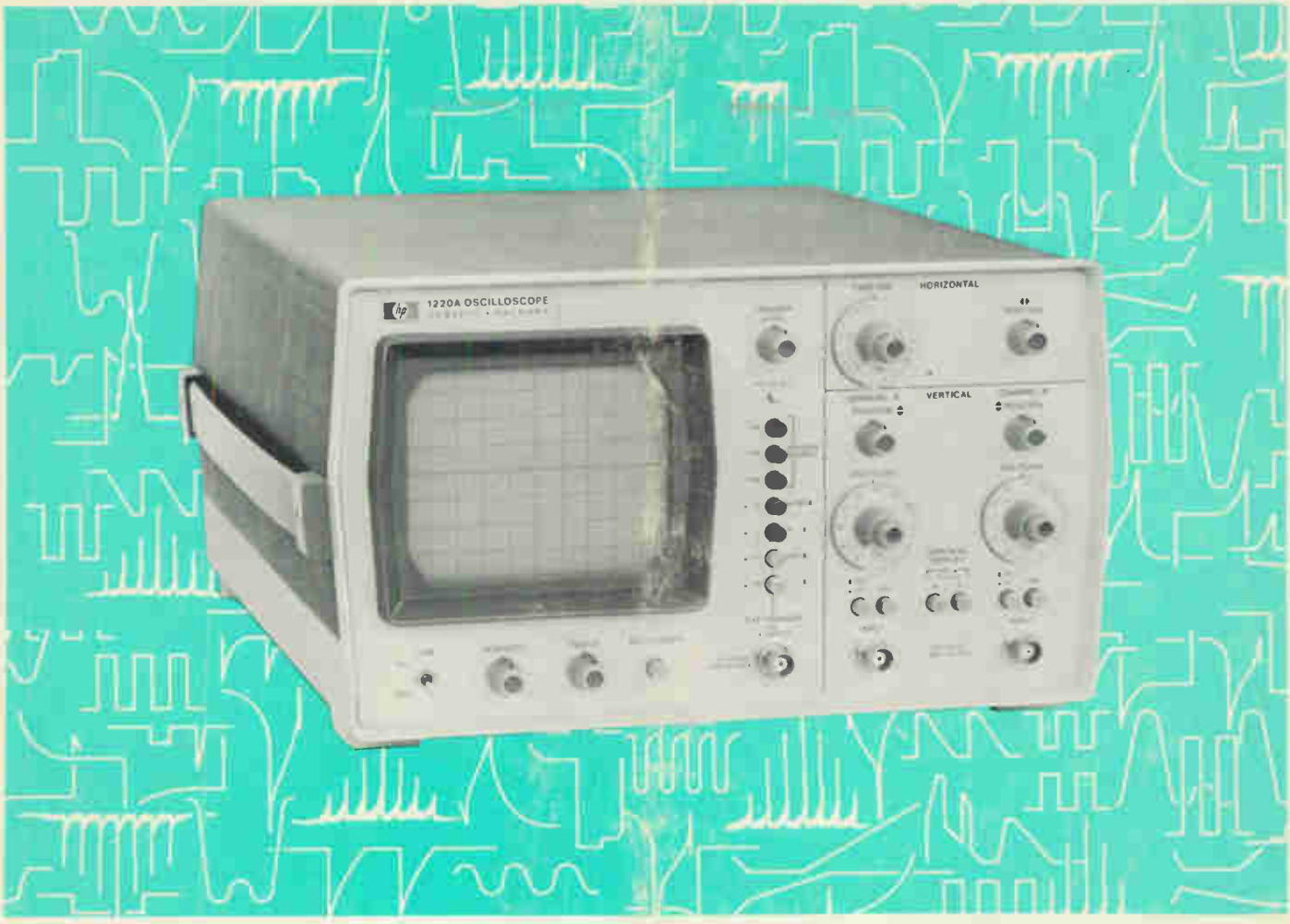


1220 A
OSCILLOSCOPE

OPERATING AND SERVICE MANUAL

HEWLETT hp PACKARD

COLORADO SPRINGS DIVISION

CERTIFICATION

Hewlett-Packard Company certifies that this instrument met its published specifications at the time of shipment from the factory. Hewlett-Packard Company 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 AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship for a period of one year from the date of shipment. Hewlett-Packard will, at its option, repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard, and provided the preventive maintenance procedures in this manual are followed. Repairs necessitated by misuse of the product are not covered by this warranty. NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANT-ABILITY AND FITNESS FOR A PARTICULAR PURPOSE. HEWLETT-PACKARD IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.

Service contracts or 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.

C W&A 9/76

OPERATING AND SERVICE MANUAL

MODEL 1220A OSCILLOSCOPE

(Including Option 007)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed 1609A.

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 1341A through 1538A.

HEWLETT-PACKARD COMPANY/COLORADO SPRINGS DIVISION
1900 GARDEN OF THE GODS ROAD, COLORADO SPRINGS, COLORADO, U.S.A.

Manual Part Number 01220-90901
Microfiche Part Number 01220-90801

PRINTED: JUNE 1976

SAFETY SUMMARY

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

GROUND THE INSTRUMENT.

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

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.

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

KEEP AWAY FROM LIVE CIRCUITS.

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

DO NOT SERVICE OR ADJUST ALONE.

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

USE CAUTION WHEN EXPOSING OR HANDLING THE CRT.

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

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

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

DANGEROUS PROCEDURE WARNINGS.

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

WARNING

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

SS-2-1/76

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. The Hewlett-Packard Model 1220A is a general-purpose oscilloscope designed for bench or field service. The 1220A provides accurate measurements of signals with 2 mV/div vertical deflection capability over the full 15 MHz bandwidth.

1-3. This manual contains installation and operating instructions, as well as maintenance information for the Model 1220A. Instrument specifications and procedures for verifying proper operation are included. Procedures are also included for adjusting the instrument to its performance specifications.

1-4. This section of the manual contains the performance specifications for the 1220A and a list of options available. It also lists the accessories supplied with the instrument.

1-5. SPECIFICATIONS.

1-6. Table 1-1 is a complete list of 1220A critical specifications that are controlled by tolerances. Table 1-2 contains general information that describes the operating characteristics of the 1220A.

1-7. Any change in the specifications due to manufacturing design, or traceability to the U.S. National Bureau of Standards will be listed on a manual change sheet included with this manual. The manual and manual change sheet supercede all previous information concerning specifications of the 1220A.

1-8. ACCESSORIES SUPPLIED.

1-9. The following accessories are supplied with the Model 1220A:

One ac power cord, HP Part No. 8120-1538.
One blue light filter, HP Part No. 4114-0521.
One fuse for 100/120-V operation, HP Part No. 2110-0202.
One fuse for 220/240-V operation, HP Part No. 2110-0201.

1-10. ACCESSORIES AVAILABLE.

1-11. The following accessories are available for the Model 1220A:

HP Model 10119A - Rack Mounting Kit
HP Model 10013A - 10:1 Attenuator Probe
HP Model 10110A - BNC/Banana Plug Adapter
HP Model 123A - Camera (requires adapter)
HP Model 10373A - Camera Adapter
HP Model 10117A - Front-panel Cover with accessory storage compartment
HP Model 10116A - Viewing Hood

1-12. OPTION.

1-13. The following option is available for the 1220A:

OPTION 007 (factory installed). Replaces standard P31 phosphor CRT (V1) with internal graticule P7 phosphor CRT.

1-14. INSTRUMENT AND MANUAL IDENTIFICATION.

1-15. Instrument identification serial number tag is located on the rear panel. Hewlett-Packard uses a two-section serial number consisting of a four-digit prefix and five-digit suffix, separated by a letter designating the country in which the instrument was manufactured. (A = U.S.A.; G = West Germany; J = Japan; U = United Kingdom.)

1-16. This manual applies to instruments with serial prefix numbers as shown on the title page. If changes have been made in the instrument since this manual was printed, a "Manual Changes" supplement supplied with the manual will define these changes. Be sure to record these changes in your manual. Backdating information in Section VII adapts this manual to instruments with serial numbers lower than that shown on the title page. Part numbers for the manual and the microfiche copy of the manual are also shown on the title page.

Table 1-1. Specifications

VERTICAL AMPLIFIERS

BANDWIDTH: <3 dB down from 50 kHz, 6-division reference signal (from terminated 50-ohm source).
DC Coupled: dc to 15 MHz.
AC Coupled: ≈2 Hz to 15 MHz.

DEFLECTION FACTOR
Ranges: 2 mV/div to 10 V/div (12 calibrated positions) in 1, 2, 5 sequence. ±3% attenuator accuracy in calibrated position on 20 mV/div to 10 V/div ranges. ±5% attenuator accuracy in calibrated position on 2 mV/div, 5 mV/div, and 10 mV/div ranges.
Vernier: continuously variable between all ranges; extends maximum deflection factor to at least 25 V/div.
Maximum Input: ±400 V (dc + pk ac).

TIME BASE

SWEEP
Ranges: 0.1 μs/div to 0.5 s/div (21 ranges) in 1, 2, 5 sequence. ±4% with expander in calibrated position.
Expander: expands (continuously) sweeps at least 10 times. Maximum usable sweep speed with expander is approximately 20 ns/div (0.2 μs/div range).

TRIGGERING
Internal: approx 10 Hz to 15 MHz on signals causing 1 div or more vertical deflection.
External: approx 10 Hz to 15 MHz on signals 0.1 V p-p or more.
TV Sync: Separator for + or — video; requires 1 div of video signal to trigger; automatic frame (0.5 s/div to 100 μs/div) and line select (50 μs/div to 0.1 μs/div).
Level and Slope
INTERNAL: at any point on waveform displayed.
EXTERNAL: continuously variable for +0.5 V to —0.5 V on either slope of trigger waveform; +5 V to —5 V in +10 position.

X-Y OPERATION

Bandwidth (X-axis): dc to 1 MHz.
Deflection Factor:

Expander	X-Mode Attenuator	Deflection Factor
CW	1:1	100 mV/div
Cal	1:1	1 V/div
Cal	1:10	10 V/div

Continuous adjustment between ranges by-expander.
X-Y Phase Shift: <3° at 100 kHz.

CATHODE-RAY TUBE AND CONTROLS

BEAM FINDER: returns trace to CRT screen regardless of setting of horizontal or vertical controls.
INTENSITY MODULATION (Z-AXIS INPUT): +5V (TTL compatible), 10 Hz to 1 MHz blanks trace of any intensity. Maximum input 7 V rms.

Table 1-2. General Information

VERTICAL AMPLIFIERS

MODES OF OPERATION: channel A; channel B; channels A and B displayed alternately on successive sweeps (0.1 μs/div to 0.5 ms/div); triggering by channel A or external; channel A and B displayed by switching between channels at approx 200 kHz rate with blanking during switching (1 ms/div to 0.5 s/div); alternate and chopped mode of display automatically selected by setting of TIME/DIV control.
RISE TIME: approx 23 ns.
INPUT RC: approx 1 megohm shunted by approx 30 pF.
INPUT COUPLING: selectable; AC, DC, or GND. GND position disconnects signal input and grounds amplifier input.

TIME BASE

SWP MODE: sweep triggered by internal, external, or line frequency signal.
X-Y MODE: sweep supplied by external signal.

X-INPUT

INPUT RC: approx 1 megohm shunted by approx 30 pF.

CATHODE-RAY TUBE AND CONTROLS

TYPE: mono-accelerator, approx 2 kV accelerating potential, P31 phosphor.
GRATICULE: 8- by 10-div internal graticule: 0.2 div subdivisions on major horizontal and vertical axes. 1 div = 1 cm.
INTENSITY MODULATION (Z-AXIS): input R approx 1000 ohms.

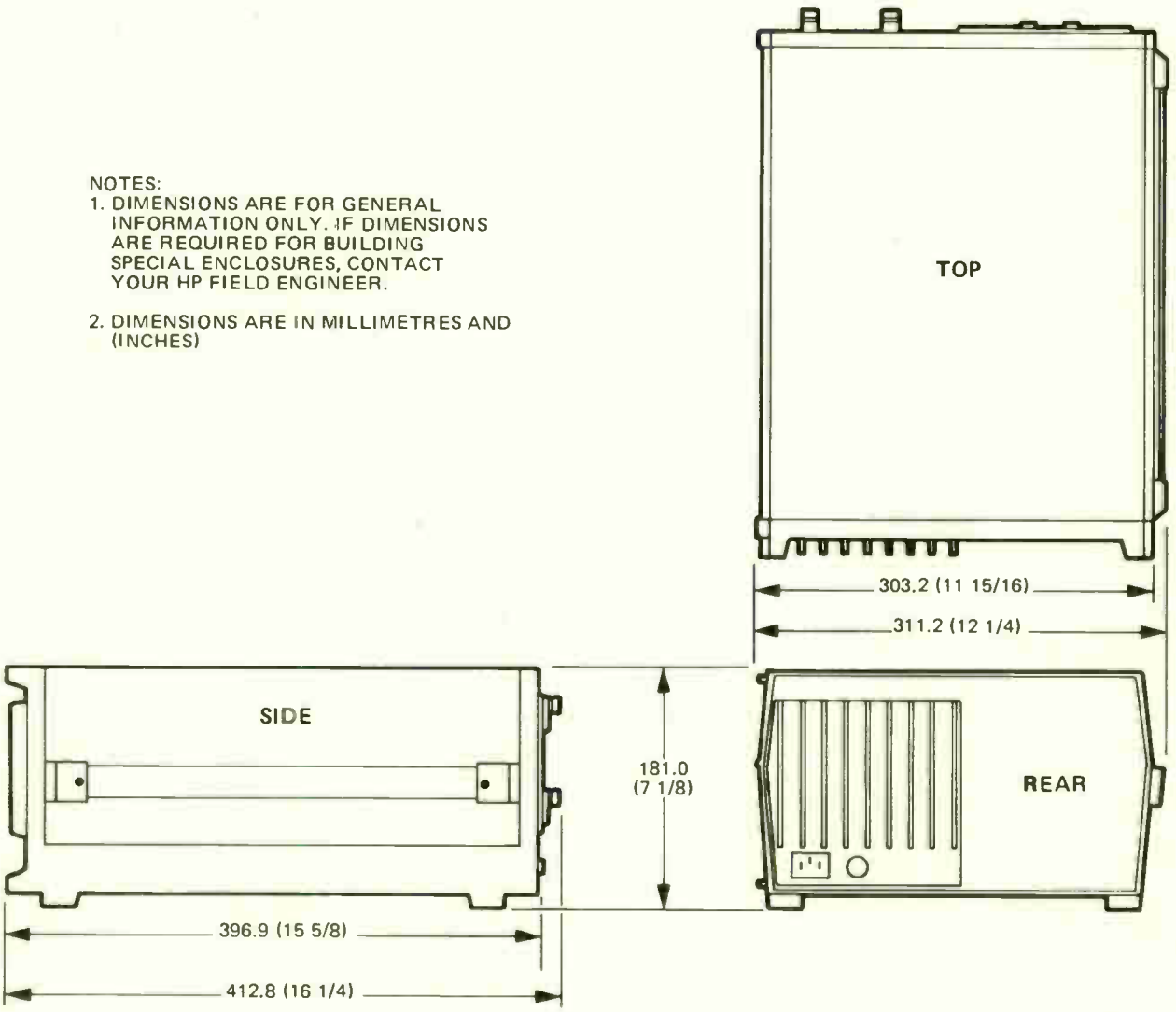
GENERAL

PROBE ADJUST: approx 0.5 V, 2 kHz square wave for probe compensation.
POWER: 100, 120, 220, and 240 Vac, —10% +5%, 48 to 66 Hz, approx 40 VA.
WEIGHT: net, 7.3 kg (16 lb); shipping, 9.5 kg (21 lb).
DIMENSIONS: see outline drawing.

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

ENVIRONMENT: (oscilloscope operates within specifications over the following ranges.)
Temperature: 0°C to +45°C (operating); —40°C to +75°C (non-operating).
Humidity: at 95% relative humidity to +40°C.
Altitude: to 4600 m (15 000 ft).
Vibration: vibrated in three planes for 15 minutes each with 0.25 mm (0.010 in.) excursion, 10 to 55 Hz.

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)



SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for installing and interfacing the Model 1220A Oscilloscope. Included are initial inspection procedures, power and grounding requirements, installation instructions, and procedures for repacking the instrument for shipment.

2-3. INITIAL INSPECTION.

2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of mars or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage incurred in transit. If the instrument was damaged in transit, file a claim with the carrier. Check for supplied accessories (listed in Section I) and test the electrical performance of the instrument using the performance test procedures outlined in Section V. If there is damage or deficiency, see the warranty in the front of this manual.

WARNING

Read the Safety Summary at the front of this manual before installing or operating the instrument.

2-5. POWER CORDS AND RECEPTACLES.

2-6. Figure 2-1 illustrates the standard configuration used for HP power cords. The HP part number directly above each drawing is the part number for an instrument power cord equipped with a connector of that configuration. If the appropriate power cord is not included with the instrument, notify the nearest HP Sales and Service Office and a replacement cord will be provided.

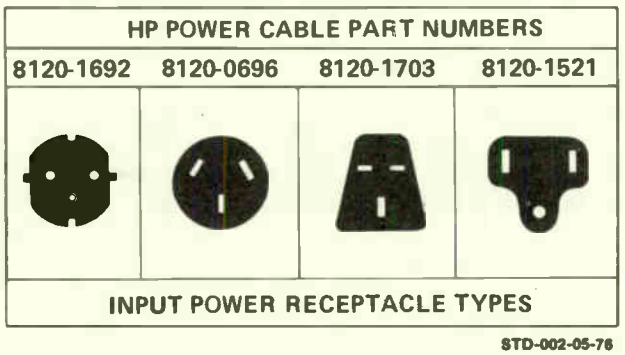


Figure 2-1. Types of Power Source Receptacles and Applicable Input Power Cable Part Numbers

2-7. POWER REQUIREMENTS.

2-8. The Model 1220A can be operated from any ac power source supplying 100 V, 120 V, 220 V, or 240 V (—10% +5%), 48 to 66 Hz (see figure 2-2 for proper switch positions). Power dissipation is approximately 40 watts. Refer to Section III for instrument turn-on procedure.

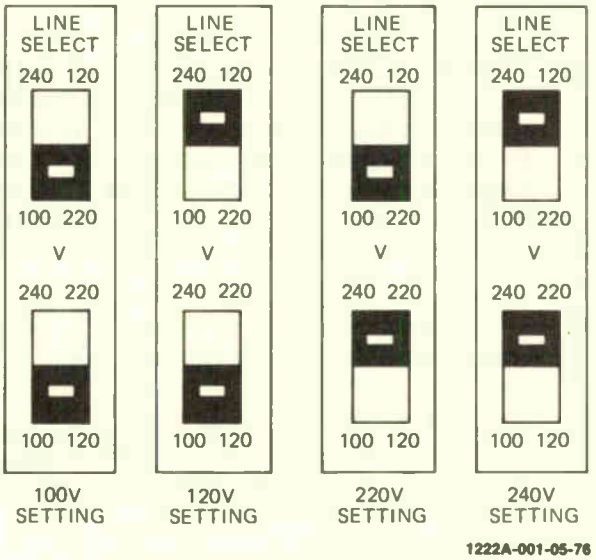
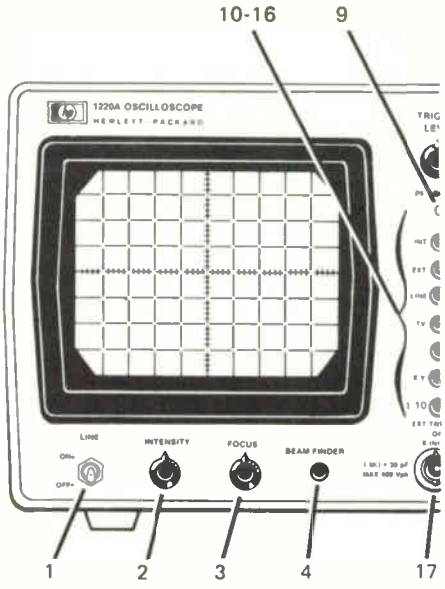


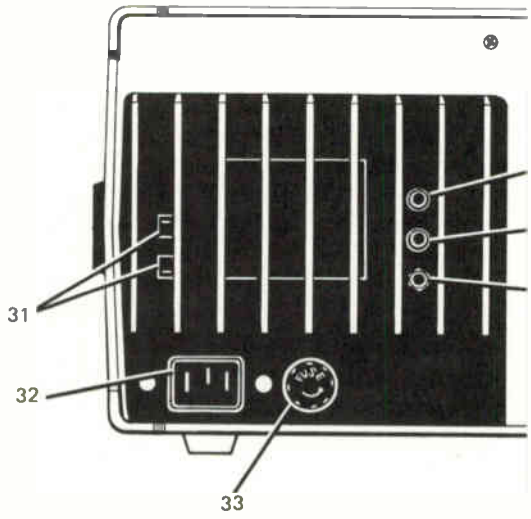
Figure 2-2. AC Input Switch Settings

2-9. REPACKING FOR SHIPMENT.

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

2-11. Use the original shipping carton and packing material. If the original packing material is not available, the Hewlett-Packard Sales/Service Office will provide information and recommendations on materials to be used.





1. **LINE.** Applies primary ac power to the instrument.

2. **INTENSITY.** Controls brightness of the display.

3. **FOCUS.** Controls sharpness and clarity of display.

4. **BEAM FINDER.** Returns display to viewing area of the CRT regardless of other control settings.

19. **Channel A VOLTS/DIV.** Selects channel A vertical deflection factor necessary for calibrated measurements when vernier is in CAL detent. Dial setting indicates voltage amplitude required for one division of vertical deflection.

20. **Channel A Vernier.** Provides continuous adjustment of volts/div between calibrated positions of VOLTS/DIV control (19).

21. **Channel A GND.** In GND position, this control disconnects the input signal applied to channel A and grounds the input to channel A vertical preamplifier.

22. **Channel A AC/DC.** Selects capacitive (AC) or direct (DC) coupling of the input signal to channel A vertical preamplifier.

23. **Channel A INPUT.** BNC connector for channel A input.

24-29. **Channel B controls same as channel A.** Refer to 18 thru 23.

30. **VERTICAL DISPLAY.** Selects input signal applied to channel A or channel B, or both to be displayed on CRT. With both channels selected, internal triggering occurs on input signal applied to channel A.

31. **LINE SELECT.** Switch provides selection of 100, 120, 220, or 240 Vac for correct primary input voltage.

32. **AC Input.** Power input connector.

33. **FUSE.** Ac input power fuse.

34. **Z-axis Input.** Banana jack connector used for intensity modulation (Z-axis). A +5 Vac signal applied to the Z-axis will blank a trace of any intensity. Maximum input is 7 V rms.

35. ⏚ Chassis ground connection for external equipment.

36. **~12 V.** 12 Vac output for external use.

Figure 3-1.
Front- and Rear-panel Features

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. This section contains information and instructions necessary for operation of the 1220A Oscilloscope. Included are power and warmup information, functional identification of all controls and connectors, and special applications information.

3-3. INSTRUMENT CAPABILITIES.

3-4. The 1220A oscilloscope contains dual vertical preamplifiers for dual-channel operation. Each channel offers a choice of ac or dc input coupling. With the dual trace feature, displays can be obtained on either channel A or channel B or on both channels. Simultaneous display of two signals is possible in either chop or alternate mode of display, depending on the TIME/DIV control setting. Slower sweep-speed settings on the TIME/DIV control automatically select the chop mode of display while faster sweep-speed settings automatically select the alternate mode of display.

3-5. Twelve calibrated switch settings on each vertical amplifier provide a deflection factor range from 2 mV/div to 10 V/div in 1, 2, 5 sequence. The vertical verniers permit continuous adjustment between calibrated steps and extends the least sensitive deflection factor (10 V/div) to at least 25 V/div.

3-6. Vertical input signals can be displayed by either an internally generated trigger or an external trigger signal. Trigger level and slope are also selectable.

3-7. Horizontal amplifier sweep-speed settings from 0.1 μs/div to 0.5 s/div are available in 1, 2, 5 sequence. Expander control allows continuous adjustment between steps and expands the sweep up to 10 times. Usable maximum sweep speed with the expander is approximately 20 ns.

3-8. A bright baseline is always present in the absence of a trigger input signal when using the 1220A. A trigger signal of 10 Hz or greater will override the auto function.

3-9. FRONT- AND REAR-PANEL DESCRIPTIONS.

3-10. Front- and rear-panel features are described in figure 3-1. Description numbers match the numbers on the illustration.

3-11. GENERAL OPERATING INSTRUCTIONS.

3-12. Before connecting ac power to the 1220A, make sure the rear-panel line selector switches are set to correspond to the voltage of the available power line, as shown in Section II. If the instrument is to be operated from a 220- or 240-volt ac power source, replace rear-panel fuse with 0.25-ampere slow-blow fuse. The instrument is normally shipped from the factory set to operate from a 120-volt ac source and is fused with a 0.5-ampere slow-blow fuse.

NOTE

In the following paragraphs all control numbers (in parentheses) refer to the numerical assignments in figure 3-1.

3-13. INITIAL TURN-ON PROCEDURE. To prepare the 1220A for operation, perform the following steps:

a. Set INTENSITY control (2) fully counterclockwise.

b. Set VERTICAL DISPLAY to channel A (30).

c. Set vertical vernier (20) for channel A fully clockwise to CAL detent position.

d. Set channel A input coupling to GND (21).

e. Set channel A POSITION control (18) to midrange.

f. Set horizontal POSITION control (5) to midrange.

g. Set TIME/DIV control (6) to 1 mSEC position.

h. Set sweep expander control (7) fully counterclockwise to CAL detent position.

i. Set TRIGGER SOURCE to INT (10).

j. Except for controls indicated in steps a thru i, make sure that all other pushbutton switches are disengaged.

CAUTION

Make sure ac power switches on rear panel of instrument are set for proper ac power input (refer to paragraph 3-12).

k. Set LINE switch (1) to ON and allow 30 minute warm-up period.

CAUTION

A trace or spot of very high intensity (brightness) may burn the phosphor inside the CRT face. To prevent such damage always adjust INTENSITY as low as possible for comfortable viewing.

l. Slowly turn INTENSITY control (2) clockwise until trace is just visible.

m. Set channel A AC/DC input coupling switch (22) to AC position.

n. Release channel A input coupling GND switch (21).

3-14. TRACE ALIGN ADJUSTMENT. The trace align adjustment compensates for external magnetic fields that may affect the 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, proceed as follows:

a. Accomplish paragraph 3-13.

b. Using channel A vertical POSITION control (18), position trace on center horizontal graticule line.

c. Using non-metallic alignment tool, adjust A3R25 (accessible through hole in side of case) until trace aligns with horizontal graticule.

NOTE

If intensity modulation of trace is apparent, refer to high-voltage power supply adjustment in Section V.

3-15. FOCUS ADJUSTMENT. To adjust the front-panel FOCUS control (3) for the best display, proceed as follows:

a. Accomplish paragraph 3-13.

b. Set INTENSITY control (2) fully counterclockwise.

c. Set X-Y/SWP switch (15) to X-Y position.

d. Slowly turn INTENSITY control (2) clockwise until spot becomes visible on CRT.

e. Using INTENSITY (2) and FOCUS (3) controls, adjust display for smallest, sharpest, spot possible.

f. Set INTENSITY control (2) fully counterclockwise.

g. Set X-Y/SWP switch (15) to SWP position.

3-16. SIGNAL APPLICATION. To apply an external signal, proceed as follows:

a. Accomplish paragraph 3-13.

b. Set channel A VOLTS/DIV control (19) to 10 V/div.

c. Connect sine-wave signal of 10 V amplitude, 1 kHz frequency to channel A INPUT connector (23).

d. Position display on CRT, using horizontal POSITION (5) and channel A POSITION (18) controls.

e. Adjust TRIGGER LEVEL control (8), if necessary, for stable display.

3-17. APPLICATION PROCEDURES.

3-18. PEAK-TO-PEAK VOLTAGE MEASUREMENTS. To measure the peak-to-peak voltage of an input signal, proceed as follows:

a. Accomplish paragraph 3-13.

b. Connect input signal to be measured to channel A INPUT connector (23).

c. Set channel A VOLTS/DIV control (19) for signal display of at least three divisions in amplitude.

d. Set TIME/DIV control (6) so that display contains two or three cycles of input signal.

e. Adjust TRIGGER LEVEL control (8) for stable display.

f. Using channel A POSITION control (18), position negative peaks of input signal on horizontal graticule line near bottom of graticule.

g. Using horizontal POSITION control (5), position one positive peak of input signal on center vertical graticule line.

h. Count number of vertical divisions from most negative to most positive portions of waveform (estimate to nearest tenth of division).

i. Multiply number of divisions noted in step h by channel A VOLTS/DIV control (19) setting for peak-to-peak voltage of input signal.

NOTE

If the input signal is applied through a divider probe, multiply the results obtained in step i by the attenuation factor of the probe.

3-19. DC VOLTAGE MEASUREMENTS. To determine the dc component of an input signal or a dc level point on an input signal, proceed as follows:

a. Accomplish paragraph 3-13.

b. Connect input signal to be measured to channel A INPUT connector (23).

c. With channel A input coupling GND switch (21) engaged, position baseline on convenient horizontal graticule line using channel A POSITION control (18).

NOTE

Reference for positive dc voltages should be below the center horizontal graticule line; reference for negative dc voltages should be above the center horizontal graticule line. Once a particular horizontal graticule line is selected as reference, do not change channel A POSITION control (18).

d. Set channel A AC/DC input coupling switch (22) to DC position.

e. Release channel A input coupling GND switch (21).

f. Set channel A VOLTS/DIV control (19) so that point of input signal to be measured is as far as possible from zero-volt reference line selected in step c.

g. Using horizontal POSITION control (5), move point on signal to be measured until it rests on center vertical graticule line.

h. Count number of vertical divisions between zero-volt reference graticule line and point on signal to be measured (estimate to nearest tenth of division).

i. Multiply number of divisions noted in step h by channel A VOLTS/DIV control (19) setting for dc voltage measurement.

NOTE

If the input signal is applied through a divider probe, multiply the results obtained in step i by the attenuation factor of the probe.

3-20. TIME-INTERVAL MEASUREMENTS. To measure the time interval between two events of interest, proceed as follows:

a. Accomplish paragraph 3-13.

b. Connect signal to be measured to channel A INPUT connector (23).

c. Set TIME/DIV control (6) so that both events of interest are displayed on CRT.

d. Adjust TRIGGER LEVEL control (8) for stable display.

e. Using horizontal POSITION control (5), position one measurement point on signal to convenient vertical graticule line.

f. Using channel A POSITION control (18), position other measurement point on center horizontal graticule line.

g. Count horizontal divisions between two measurement points (estimate to nearest tenth of division).

h. Multiply number of divisions noted in step g by TIME/DIV control setting for time interval between two events of interest.

3-21. FREQUENCY CALCULATION. To determine the approximate frequency of an input signal, proceed as follows:

a. Accomplish paragraph 3-20 using start and ending points of one cycle of input signal as events of interest.

b. Calculate input signal frequency using the following formula:

$$\frac{1}{\text{time in seconds noted in step a}}$$

3-22. PROBE COMPENSATION. To adjust divider probes having a compensation adjustment, proceed as follows:

a. Accomplish paragraph 3-13.

b. Connect divider probe cable to channel A INPUT connector (23).

c. Connect probe tip to PROBE ADJ terminal (9).

d. Set channel A VOLTS/DIV control (19) for square-wave display having two or three division of vertical deflection.

e. Set TIME/DIV control (6) for horizontal display of at least two full square waves.

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

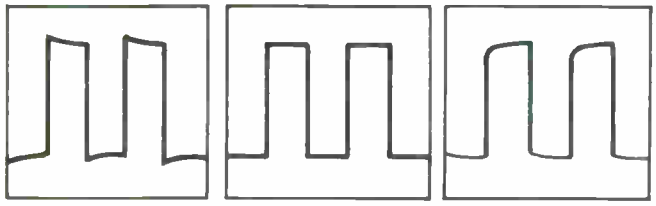


Figure 3-2. Divider Probe Adjustment Display

3-23. TV SIGNALS. To observe a television composite or sync-only signal, proceed as follows:

a. Accomplish paragraph 3-13.

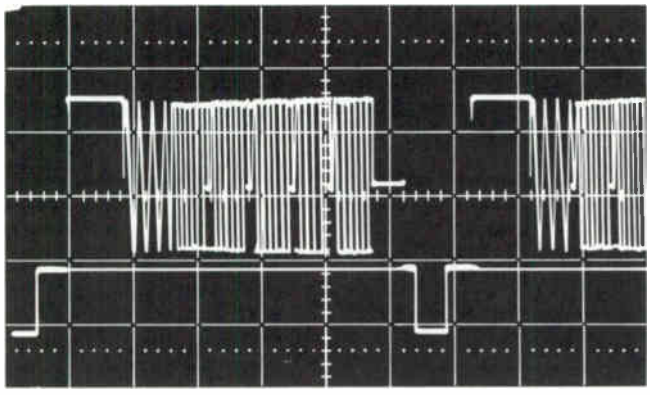
b. Connect input signal to be measured to channel A INPUT connector (23).

c. Set TV/NORM control (13) to TV position.

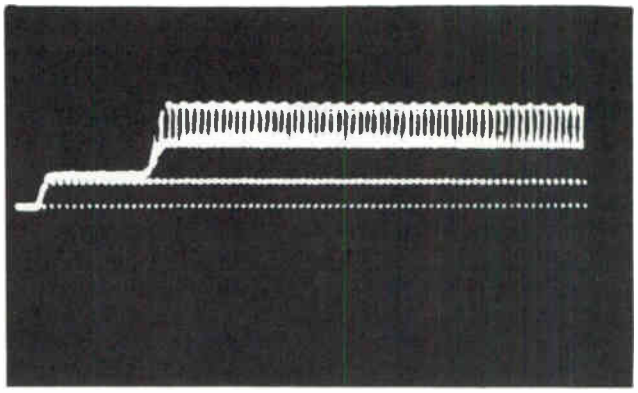
d. Set channel A VOLTS/DIV control (19) for desired vertical amplitude display.

e. Set TIME/DIV control (6) for desired horizontal display (typically in range area of TIME/DIV control dial marked FRAME).

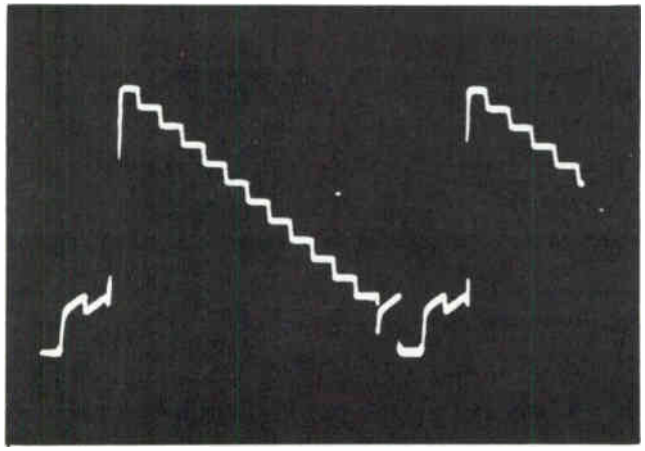
f. If individual lines of picture signal are to be observed, set TIME/DIV control dial to area marked LINE (typically 2 μs/div). Oscilloscope will trigger on each line sync pulse. (See figure 3-3 for typical TV waveforms.)



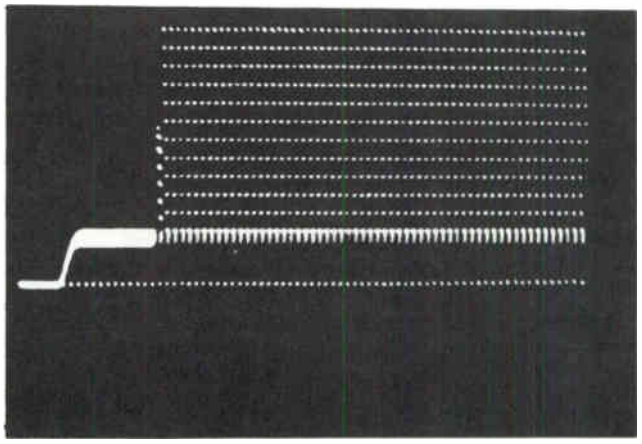
Pattern generator color TV signal, line trigger



Color bar signal frame trigger 0.5 ms/div



Staircase Signal, line trigger 10 μ/div



Color Staircase Signal, frame trigger 0.5 ms/div

1222A-004-05-76

Figure 3-3. Typical TV Waveforms

3-24. TIME DIFFERENCE MEASUREMENT. To measure the time difference between two events having a common source, for example, propagation delay, proceed as follows:

a. Accomplish paragraph 3-13 for both channel A and channel B.

b. Connect one signal of interest to channel A INPUT connector (23).

c. Connect other signal of interest to channel B INPUT connector (29).

NOTE

Make sure reference signal is connected to channel A since the trigger signal for both channel A and channel B is obtained from channel A.

d. Set channel A and channel B VOLTS/DIV controls (19/25) for desired vertical amplitude of display.

e. Set TIME/DIV control so that two events of interest are at least four horizontal divisions apart.

f. If necessary, adjust TRIGGER LEVEL control (8) for stable display.

NOTE

If stable display is not obtainable, externally trigger the oscilloscope with the common source signal.

g. Using horizontal POSITION control (5), position first event of interest on convenient vertical graticule line.

h. Using appropriate vertical POSITION control (18 or 24), position second event of interest on center horizontal graticule line.

i. Count horizontal divisions between two measurement points (to nearest tenth of division).

j. Multiply number of divisions noted in step i by TIME/DIV control (6) setting for time difference between events.

3-25. PHASE DIFFERENCE MEASUREMENTS. To measure the phase deference between two signals of the same frequency, proceed as follows:

a. Accomplish paragraph 3-13.

b. Set X-Y/SWP control (15) to X-Y position.

c. Connect one signal to channel A INPUT connector (23).

d. Using channel A VOLTS/DIV control (19), POSITION control (18), and vernier control (20), obtain two spots separated vertically by exactly eight divisions.

e. Using horizontal POSITION control (5), position two spots on center vertical graticule line.

f. Press channel A input coupling GND switch (21).

g. Connect second signal to X INPUT connector (17).

h. Using expander control (7) and channel A POSITION control (18), position two spots exactly eight divisions apart horizontally on center graticule line.

i. Release channel A input coupling GND switch (21).

j. Compare display to figure 3-4A for approximate phase difference of signals.

k. For actual phase difference, center ellipse at intersection of center vertical and horizontal graticule lines (see figure 3-4B).

l. Measure distance C and D.

m. Substitute measurements of C and D in formula given in figure 3-4B for sine of phase angle.

n. Refer to table of sines to determine phase angle.

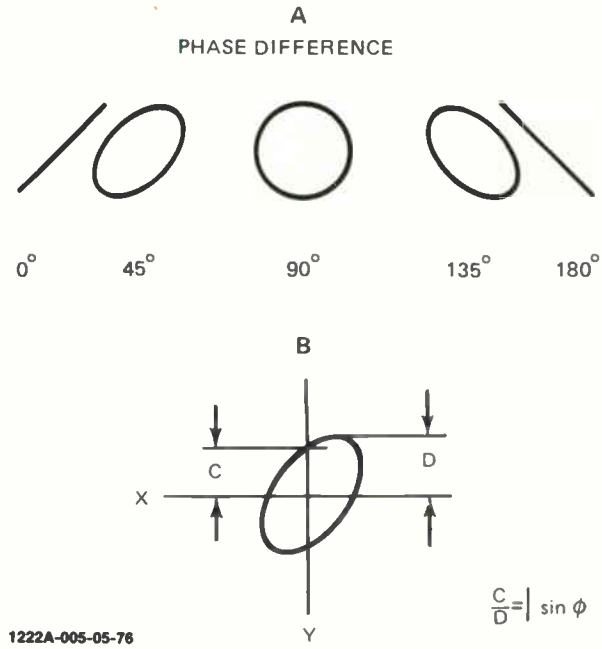


Figure 3-4. X-Y Phase Measurements

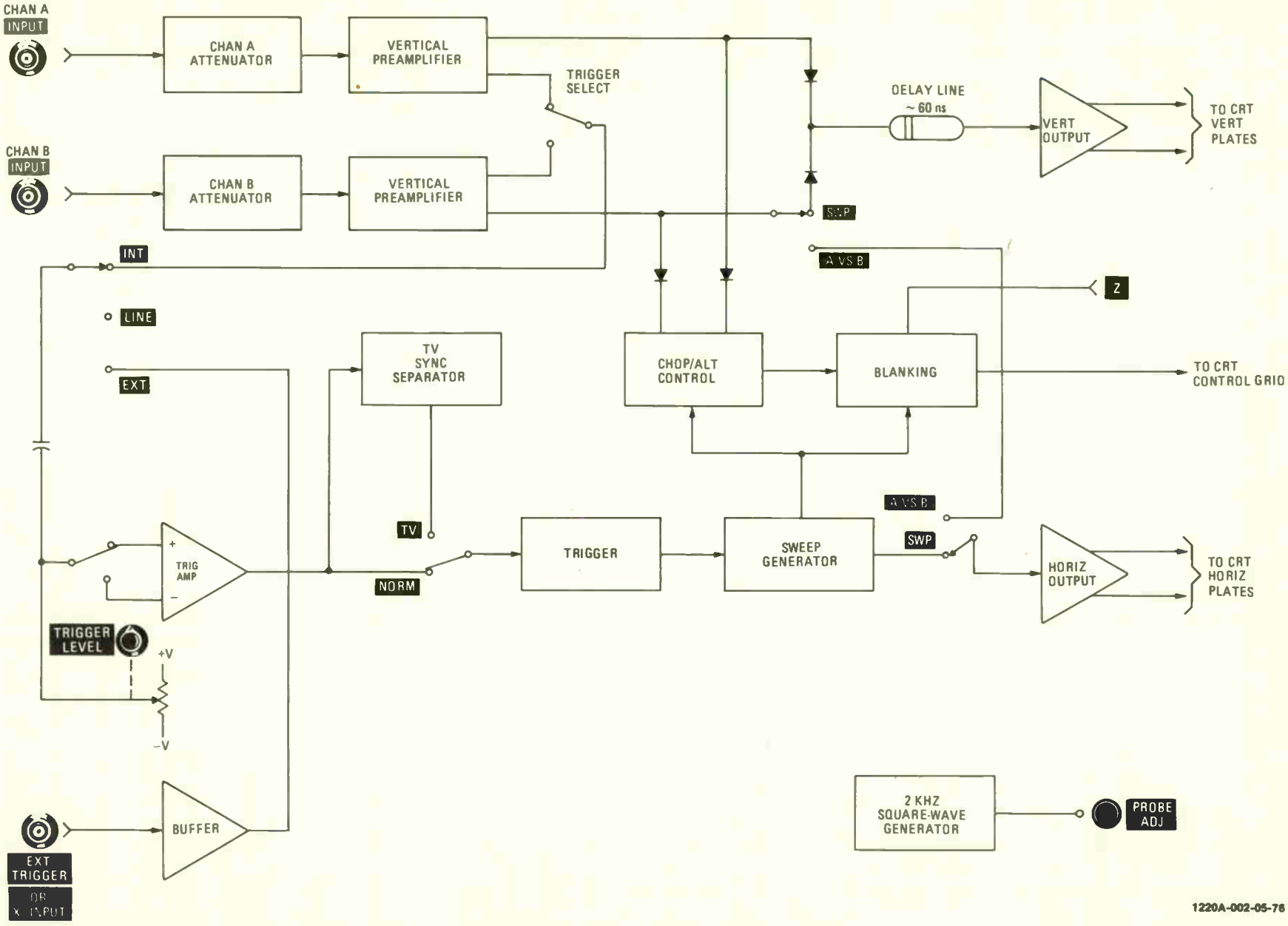


Figure 4-1. Simplified Block Diagram

SECTION IV

PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This section contains descriptions of circuits keyed to a simplified block diagram (figure 4-1) and a detailed theory of operation keyed to a functional block diagram (figure 4-3). Schematics are located in Section VIII of this manual.

4-3. OVERALL DESCRIPTION.

4-4. ATTENUATORS. Channel A and channel B attenuators accept the input signals applied to the front-panel INPUT connectors. The input signal can be coupled to the attenuator directly (DC) or capacitively (AC). A GND position is also available for disconnecting the input signal and grounding the attenuator input. The GND feature permits the operator to establish a baseline reference level without disconnecting the input signal from the INPUT connector.

4-5. The input impedance on all ranges is one megohm in parallel with approximately 30 pF. The vertical deflection factor is selected by the VOLTS/DIV switch which divides the input signal by 1, 10, or 100. Division by 1, 2, and 5 is accomplished in the preamplifier.

4-6. VERTICAL PREAMPLIFIER. The vertical preamplifier accepts the single-ended signal from the attenuator and converts it to a differential signal. The signal is amplified and a portion of it is used for the sync amplifier while the main path is applied to the vertical output amplifier.

4-7. VERTICAL OUTPUT. The vertical output amplifier converts the single-ended signal from the vertical preamplifier stages to a differential signal. It also provides the drive required by the vertical CRT plates.

4-8. TRIGGER CIRCUIT. The trigger switches select the source of the sync signal (INT, LINE, or EXT). The sync signal is ac coupled to the trigger amplifier and offset by the TRIGGER LEVEL control. Selection of trigger slope is also accomplished at the input to the trigger amplifier.

4-9. The signal from the trigger amplifier is applied to the trigger circuit through the TV/NORM switch. When the TV/NORM switch is in the TV position, the sync signal is developed by the TV Sync Separator circuit.

4-10. The trigger circuit develops the trigger signal required to start the sweep generator. The output voltage from the sweep generator increases linearly at a rate proportional to time established by the setting of the TIME/DIV control. The output of the sweep generator is buffered to the horizontal output circuit.

4-11. The horizontal output circuit provides drive to the CRT horizontal deflection plates.

4-12. DETAILED THEORY.

4-13. The following paragraphs provide explanations of the individual circuits in the 1220A. When using this portion of the manual, see figure 4-3 (functional block diagram) and the schematics which are located in Section VIII.

4-14. LOW-VOLTAGE POWER SUPPLIES. The low-voltage power supply provides +5 V, +12 V, +95 V, +210 V, and —12 V for operation of the various circuits in the instrument. All supplies are regulated except the +210 V supply. The +210 V supply is an unregulated +115 V which is offset by +95 V at the junction of CR7 and CR8 of bridge rectifier CR5 - CR8.

4-15. +5 V Supply. The output of the 12 Vac secondary of A4T1 is rectified by bridge rectifier CR1 - CR4 and regulated by U1.

4-16. +95 V Supply. The +95 V supply is a fully regulated, current-limiting supply. A sample of the output voltage is applied to pin 4 of U2 where it is compared with a reference voltage applied to pin 5. The difference between these two voltages cause an error output from pin 9 which is applied to the base of series-regulator transistor Q1. When the output voltage decreases, the error voltage causes Q1 to conduct more and supply more current to the load. When the output voltage increases, the error signal tends to cut off Q1 to reduce the output current and effect a lowering of the output voltage.

4-17. Current limiting is accomplished by R9 and a cut-off transistor in U1. As the current output increases, the voltage drop across R9 increases. Pins 2 and 3 of U1 are the base and emitter connections of the cut-off transistor. When the voltage drop across R9 is sufficient to cause the transistor to conduct, it removes the error signal from Q1 causing the output current to decrease, thereby reducing the output voltage.

4-18. +12 V Supply. The +12 V supply is also a series-regulated, current-limiting supply that operates in a similar manner to the +95 V supply. The reference voltage with which the output sample is compared is derived from the +95 V supply.

4-19. —12 V Supply. The —12 V supply is also a series-regulated, current-limiting supply. However, the sample of the output voltage is derived from both the +12 V and —12 V outputs, so that the difference between the +12 V and —12 V supplies is always constant. When the current through R23 is sufficient, it turns on Q4 and the transistor drains some of the current from U4 causing the output current to decrease.

4-20. HIGH-VOLTAGE POWER SUPPLY. The voltage from the 1600 V secondary of A4T1 is rectified by A3CR1-A3CR4, filtered by A3C1, regulated by A3Q1, and applied to the intensity network and CRT filament circuit.

4-21. Regulation is accomplished by comparing a portion of the HV output with the +95 V supply and applying the comparison to A3U1. The output of A3U1 controls the emitter-collector resistance of A3Q1 so that the voltage drop across the transistor compensates for high-voltage fluctuations. A zener diode chain (VR1 - VR3) is connected across the collector and emitter of A3Q1 to prevent its breakdown potential from being reached.

4-22. The operating characteristic of the high-voltage supply is shown in figure 4-2. The horizontal position of the characteristic, and consequently the level of the high-voltage supply, is adjusted by A3R20. The vertical portion of the characteristic is set by A3R3 so that proper regulation occurs in the +5%, —10% range of the selected line voltage. If the line voltage goes outside this range, regulation will cease and ripple will cause visible trace modulation.

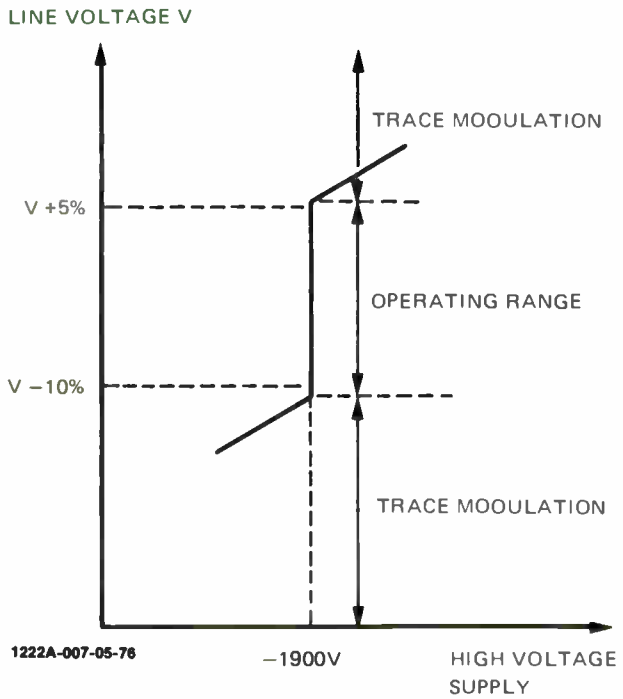


Figure 4-2. HVPS Operating Characteristic

NOTE

In areas where the line voltage excursions lie outside one of the regulator limits, A3R3 should be adjusted so that the characteristic brackets these excursions rather than the nominal 100, 120, 220 or 240 volts, +5% —10%.

4-23. VERTICAL SECTION. In the following discussion, circuits which are identical for both channels A and B are discussed for channel A only.

4-24. Attenuators. The input impedance on all ranges of the VOLT/DIV switch is one megohm shunted by a capacitance of approximately 30 pF. The attenuator divides the input signal by 1, 10, or 100. The resistor-divider network for the ÷10 range consists of R27 and R28. The resistor-divider network for the ÷100 range consists of R29 and R30.

4-25. Vertical Preamplifier. The preamplifier is a three-stage differential amplifier with switched gain control and input protection. Diodes CR21 and CR22 limit excessive signal swings from the attenuator to approximately ±4.1 V as established by zener diodes VR2 and VR3. The signal is applied to the first differential amplifier stage (pin 6 of U5) by way of source-follower Q5A and an emitter-follower section of U5 (pin 3).

4-26. In conjunction with the input attenuator, ranging is accomplished by selecting different emitter current paths in the first and third preamplifier stages. In the first stage, this is effected by differential switches Q6 and Q7 which are controlled by the position of the VOLTS/DIV switch. In the 2 mV, 5 mV, and 10 mV positions, the VOLTS/DIV switch connects the voltage from the junction of R24 and R25 to the base of Q7. Transistor Q6 cuts off and Q7 routes the emitter current through R54, R55, and CR23. In the other VOLTS/DIV switch positions, Q6 conducts (Q7 cuts off) and routes the emitter current through R52 and R53. In this instance, the amplification is one tenth of that selected in the three lower ranges of the VOLTS/DIV switch.

4-27. In the last preamplifier stage, gain is controlled in the same manner as the first preamplifier stage by U6. The voltage at the junction of R24 is applied to a particular transistor in U6, depending on the position of the VOLTS/DIV switch. The transistor that is turned on enables a particular current path which establishes the gain of the output stage of U6.

4-28. Fine control is achieved with vernier A2A2R3 in the second preamplifier stage. Overall gain of the vertical channel is accomplished by R144 (with vernier A2A2R3 in CAL detent position). Balance potentiometers R49, R62, and R64 are adjusted so that the trace does not move when switching from one range to another.

4-29. For internal triggering, one output of the preamplifier is buffered to the trigger circuits by common base stage Q13. The other output is buffered to the CHOP/ALT control by common base stage Q15. In this stage the signal is offset by a current derived from vertical position potentiometer R1.

4-30. The CHOP/ALT control (CR35-CR38) is biased by CHOP/ALT flip-flop A1A1U3A. During channel A operation, CR37 conducts causing CR38 to cut-off and block the channel B signal. At the same time, reverse bias is applied to CR35 cutting it off. This enables CR36 to pass the channel A signal to the output amplifier. During channel B operation, the situation is reversed so that only the channel B signal is displayed.

4-31. When both channels are to be displayed in the chopped mode of operation (TIME/DIV switch in 1 ms to 0.5 s range), the CHOP/ALT control switches between channel A and channel B so that both channels are displayed during the same sweep. When both channels are to be displayed in the alternate mode of operation (TIME/DIV switch in 0.5 ms to 0.1 μs range), the CHOP/ALT control alternately selects channel A on one sweep and channel B on the next.

4-32. Output Amplifier Input. The signal from the CHOP/ALT control circuit is applied to current amplifier Q17/Q18 which in turn drives vertical output amplifier. The output amplifier is comprised of a differential input stage that drives two identical negative feedback amplifiers.

4-33. The differential input stage consists of U9. Two of the transistors in U9 are connected as back-to-back diodes and linearize the logarithmic characteristic of the differential amplifier at high signal levels. At low signal levels the characteristics require no linearization. Diodes CR39 and CR40 prevent the amplifier from going into saturation when excessive signals are applied or when the vertical position control is at one of its extremes.

4-34. The BEAM FINDER switch, when pressed, disconnects R173 from the emitter circuit of the differential input stage. This reduces the overall gain of the output stage, so the trace is always displayed regardless of the vertical POSITION control setting. This does not affect the intensity.

4-35. Output Amplifier. The final output is comprised of two identical amplifier stages. Therefore, only one stage is described. Transistors A1A1Q3/Q4 form a cascode amplifier with negative feedback supplied to drive stage A1A1Q1/Q2. Transistors A1A1Q5/Q6, connected in series, comprise a driven current source. The steady-state current level is established by A1A1R22 while extra current for fast transients is supplied by A1A1C10. High-frequency components of the deflection signal are coupled through A1A1C8 to the current source.

4-36. HORIZONTAL SECTION. There are two basic modes of operation of the horizontal deflection circuits: X-Y operation and normal sweep operation. In X-Y operation, an external signal is used to provide the reference source for the horizontal axis of the display. A signal applied to the EXT TRIGGER/X INPUT connector is used for this purpose.

4-37. X-Input Signal Path. The X-input signal is applied through the EXT TRIGGER/X INPUT connector and external input buffer A1A1Q13/Q14 to the X-Y/SWP switch. With the X-Y/SWP switch in X-Y position, the signal from the external input buffer is applied directly to the horizontal-output amplifier circuit.

4-38. External Input Buffer. The external-input buffer is made up of A1A1Q13/14. The source follower (Q13) provides high-input impedance, and emitter follower (Q14) provides low-output impedance for driving the trigger amplifier.

4-39. Trigger Switches. The trigger switches select the source of the trigger signal. When EXT switch is pressed, the signal from the external input buffer is applied to the trigger amplifier. When LINE switch is pressed, the switch connects the line frequency signal (from the +5 V secondary winding of A4T1) to the trigger amplifier. When LINE is not selected, the line frequency signal is grounded through R46 so that it cannot be a source of line frequency interference. Similarly when EXT triggering is not selected, the output of the external input buffer is grounded through R45.

4-40. Trigger Amplifier. The trigger signal is ac coupled through C22 to the trigger amplifier which consists of Q15 - Q18, and Q21. At the input to the trigger amplifier, the signal is offset by TRIGGER LEVEL control R4 so that the output signal from the trigger amplifier is shifted relative to the threshold level of input Schmitt trigger U5A. This permits U5A to trigger at various levels of the input signal. The —/+ switch S1E selects the slope on which the threshold level is defined. Resistor R51 is a symmetry control that is adjusted so that the dc level of the trigger amplifier output is the same for inverting (—) or non-inverting (+) operation.

4-41. When TV/NORM switch is in TV position, the trigger signal is taken from Q16 and applied to the TV Sync Separator. Transistor Q21 cuts off to prevent

the unprocessed video signal from reaching the trigger circuit.

4-42. TV Sync Separator. The TV Sync Separator separates the Frame and Line Sync pulses of a composite video signal and outputs either Line sync pulses or a Frame signal to the trigger circuit.

4-43. RC network C24 and R61 filter the video portion of the signal to produce a mean dc level. When a sync pulse occurs, it is superimposed on this dc level and turns on Q19 so that only sync pulses reach the sync separator.

4-44. When the TIME/DIV switch is in the range 0.1 μs/div to 50 μs/div, flip-flop U3B is held in its preset state and only the Line circuit provides an output. In the Line circuit, Q22, U2B, and R73 are connected as a Schmitt trigger so that the sync pulses are only reshaped. When the TIME/DIV switch is set to sweep speeds of 0.1 ms/div or longer, the ground is removed from the preset input of U3B and the Frame circuit is enabled. This signal is integrated by R65/C25 and applied as a clock input to U3B by way of Schmitt trigger Q20, U2A, and R68.

4-45. Only when Frame sync pulses occur does the integrator output reach a sufficient level to clock U3B. Because U3B divides sync pulses by a factor of two, triggering occurs on alternate Frame sync pulses. When Frame circuit operation is selected, the Line circuit output is always high (+5 V) so that U4A is enabled and inverts the Frame signal from U3B. In the Line mode of operation, U3B is in the preset state and its Q output is high. This enables U4A which inverts the Line sync pulses.

4-46. Trigger Circuit. On the negative transition from either the trigger amplifier or the sync separator, the output of Schmitt trigger U5A (pin 6) goes high. The high is applied directly to an input on NAND gate U6D causing its output to go low since its other input from U1C is still high. However, the output of U6D is low only for the propagation delay time that it takes for the Schmitt trigger output to pass through U1A, U1B, and U1C. When the output of U1C goes low, the output of U6D again goes high.

4-47. The output of U5A also clocks U7A (through U1A) and U8 (through U1A and U1B). When the Q output of U8 goes high, it enables U2D. When the Q output of U7A goes high, it enables U6C.

4-48. After the propagation delay time of U1A, U1B, and U1C, the output of U6D (pin 11) goes high. The positive transition is inverted by U6C (enabled by U7A) clocking U7B. The Q output of U7B goes high and the $\overline{Q}$ output goes low. The low $\overline{Q}$ output enables the ramp generator and causes the blanking circuits to remove the blanking signal. The high Q output causes a low at the output of U2D (enabled by U8). A low at the output of U2D holds off input Schmitt trigger U5A.

4-49. Ramp Generator. The ramp generator consists of a constant current source (Q24 and associated circuitry) which charges a selected capacitor (C32/C33, C34, C35, or C36). Ramp output voltage increases linearly with time at a rate determined by the value of the selected capacitor and the charging current. The charging circuit is controlled by Q23. When conducting, Q23 functions as a current sink, discharging the selected ramp capacitor and preventing it from recharging. When Q23 is cut off, the current source charges the selected capacitor. Transistor Q23 is turned on or off by the signal generated in the trigger circuit.

4-50. Completion of the ramp signal is detected at the input of cut-off Schmitt trigger U5B. The negative transition of the output of U5B clears U7B. This disables the ramp generator, and the hold-off signal applied to the input Schmitt trigger U5A is removed. To prevent premature triggering, the hold-off circuit keeps U7A and U7B in the clear state (pins 3 and 8 low) until the ramp generator is fully reset. When the holdoff signal is removed, the next trigger signal will restart the sequence.

4-51. Bright-line Auto Operation. If no trigger signal is received within approximately 500 milliseconds of the last trigger signal, the bright-line auto monostable flip-flop U8 returns to its stable state (Q output low, $\overline{Q}$ output high). When the $\overline{Q}$ output goes high, it presets U7B by way of U6A. The ramp generator is enabled and a sweep occurs, although it is asynchronous. At the end of the sweep, if no new trigger signal has been received, the end of the hold-off signal presets U7B by way of U6A and another sweep is started. Until U8 is set to its quasi-stable state by a new trigger signal, continuous sweeps occur with minimum time between them. In the normal mode of operation (with trigger signals constantly applied), U8 is always in its quasi-stable state since it is a retriggerable monostable flip-flop.

4-52. Hold-off Circuit. The hold-off circuit is a monostable circuit that holds off the trigger circuit while the ramp generator capacitor is discharging. The circuit consists of A1A2A1C1-C4, U6B and R86. When the output of cut-off Schmitt trigger U5B goes low, the output of U2C goes high. The loop U2C/U6B retains this status for an interval of time determined by the selected capacitor (A1A2A1C1-C4) and R86. During this interval, U7B is held in a clear state and permits discharge of the ramp capacitor.

4-53. Sweep Output. The sweep output circuit Q25/Q26, connected as a Darlington pair, provides high-input impedance, low-output impedance, and high-current gain. The sweep output circuit buffers the ramp generator to the horizontal output amplifier.

4-54. Horizontal Output Amplifier. The horizontal output amplifier is very similar to the vertical output amplifier. The differential input stage Q27/Q28 provides gain adjustment and horizontal position control.

When the BEAM FINDER switch is pressed, the gain of the amplifier is reduced because +95 V is now applied to the input stage through R101 instead of directly from the switch. This reduction in gain shortens the sweep so that it can be seen on the display regardless of the position control setting. The output stage is made up of two channels which are identical to those described for the vertical output amplifier (paragraph 4-35).

4-55. Chop Oscillator. NAND gates U4B and U4C are connected as a free-running multivibrator. The oscillator which runs at approximately 200 kHz is disabled in the single channel display mode and at sweep speeds faster than 1 ms/div. The oscillator is also disabled between sweeps (by the Q output from U7B through R75).

4-56. CHOP - ALT Control. In the chop mode (sweep speeds of 1 ms/div and longer) with dual trace operation, the Chop-Alt control flip-flop U3A is clocked by the output of the chop oscillator by way of U4D. In the alternate mode of operation (sweep speeds of 0.5 ms/div and faster) with dual trace operation, flip-flop U3A is clocked at the end of each sweep by the signal from Schmitt trigger U5B. In single trace mode, the flip-flop is held in either the preset (channel A display) or the clear (channel B display) state.

4-57. Blanking. The purpose of the blanking circuit is to suppress the display (trace) during retrace, during switching in chop operation, and to provide a Z-input. Retrace is suppressed by the Q output of U7B through CR6, U4D, and RC network C15/R35 to the blanking amplifier. The connection through CR7 from Schmitt trigger U5B ensures that blanking takes place immediately when the sweep ends.

4-58. In chop operation, the output of U4D provides blanking during switching from one channel to the other.

4-59. Z-input and the output of U4D are fed through similar shaping networks to the blanking amplifier on assembly A3.

4-60. Blanking Amplifier. The blanking amplifier A3Q2-Q4 is an inverting amplifier that drives the grid of the CRT through A3C15 to cut off the electron beam during trace return, during chop mode of operation, and under control of the Z-axis input. A3Q2 acts as a static current source at low frequencies and as an active current source at high frequencies. Commutation capacitor A3C14 and decoupling capacitor A3C7 improve the high frequency response. A3Q4 acts as a preamplifier to improve response. A3C15 isolates the amplifier from the high grid voltage. A3Q5 and its associated circuitry ensure that the CRT remains blank until the start of a sweep. This feature is necessary when the bright-line auto circuit is inhibited. The probe calibrator signal ensures that a blanking signal is always applied to the CRT in the absence of an unblanking signal from chop-blanking NAND gate A1A1U4D.

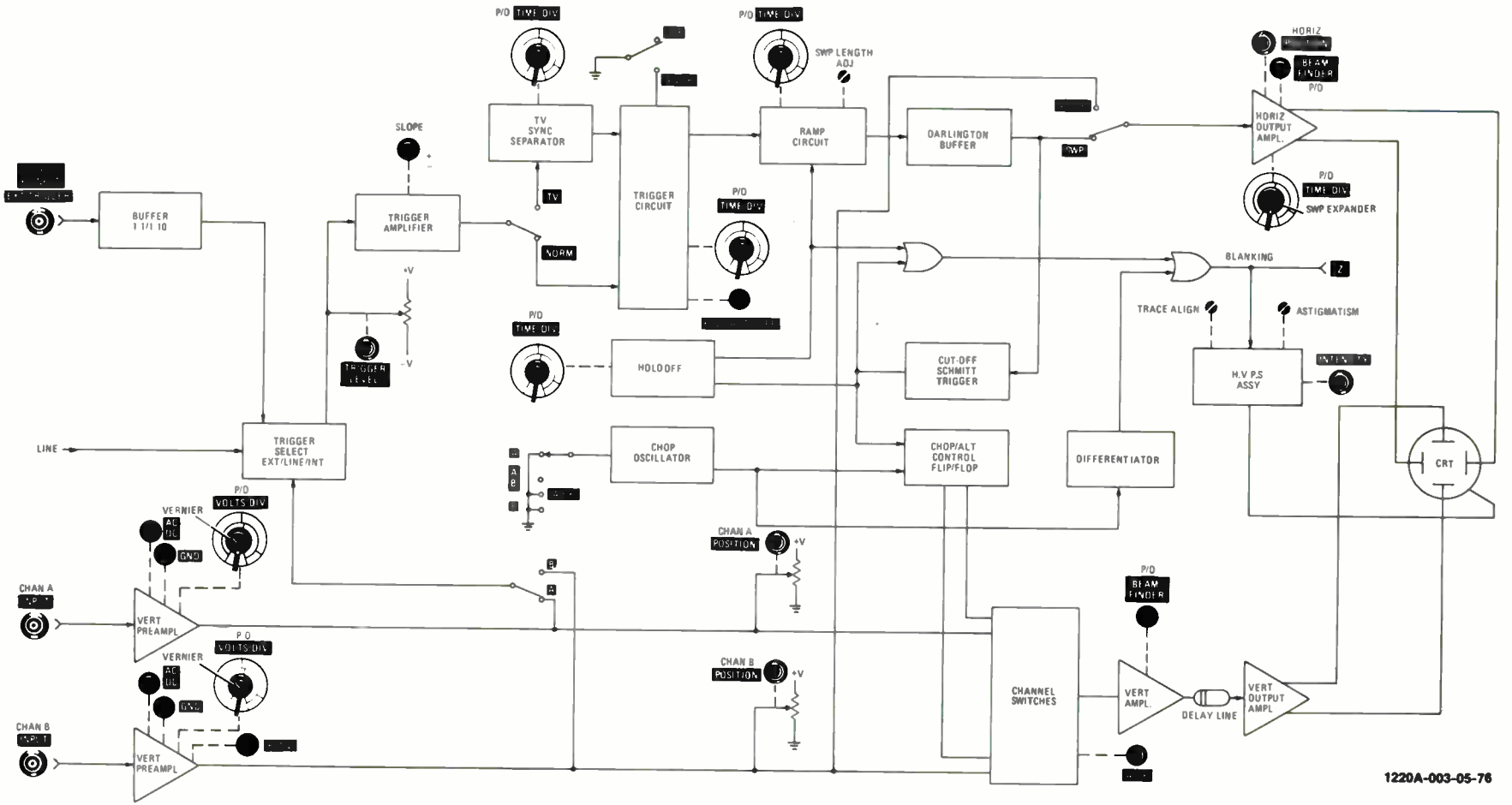


Figure 4-3. Functional Block Diagram

SECTION V

PERFORMANCE CHECK AND ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section contains performance checks and adjustment procedures for the 1220A. The performance checks verify that the instrument meets specifications as listed in table 1-1. Adjustment procedures are provided to help maintain the instrument within specification limits.

5-3. RECOMMENDED TEST EQUIPMENT.

5-4. Equipment required for the performance checks and adjustment procedures is listed in table 5-1. Any equipment that satisfies the required characteristics given in the table may be substituted for the recommended model(s).

5-5. PERFORMANCE CHECK RECORD.

5-6. A performance check record is provided at the end of this section for recording results of the performance checks. This form lists all performance checks and their acceptable limits. The form may be removed and retained as a permanent record of the incoming inspection or routine maintenance performed on the instrument.

NOTE

To ensure your instrument is operating within specifications, a 30-minute warmup period should be allowed after turn-on.

5-7. PERFORMANCE CHECKS.

5-8. These checks are provided to verify instrument performance within the specifications outlined in table 1-1 of this manual. None of these checks require access to the interior of the instrument. If it has been determined, after the performance checks, that the instrument does not meet one or more of its specifications refer to the adjustment procedures.

5-9. INITIAL CONTROL SETTINGS. The control settings listed below are to be used for each performance check and adjustment procedure. If a control is to be set to another position, it will be listed in the procedure. After the completion of each performance check or adjustment procedure, set the controls back to the original front-panel settings.

Control	Position
Vertical (channels A and B):	
POSITION	centered
VOLTS/DIV	100 mV
Input coupling	AC
Verniers	CAL
VERTICAL DISPLAY	A
Horizontal:	
POSITION	centered
TIME/DIV	0.1 msec
TRIGGER LEVEL	midrange
TRIGGER SOURCE	INT
TV/NORM	NORM
—/+	+
X-Y/SWP	SWP
1:10/1:1	1:1
INTENSITY	visible trace

5-10. DEFLECTION FACTOR. The ranges are from 2 mV/div to 10 V/div (12 ranges) in 1, 2, 5 sequence. With vernier in calibrated position, the attenuator accuracy is ±3% for 20 mV/div through 10 V/div ranges and ±5% for 2 mV/div, 5 mV/div, and 10 mV/div ranges. Vernier is continuously variable between all ranges and extends maximum deflection factor to at least 25 V/div.

5-11. The deflection factor is checked by applying a voltage-calibrated signal to the input. The displayed signal is compared against the voltage standard.

Equipment Required:

Voltmeter calibrator
Adapter (HP Part No. 1251-2277)
44-in. BNC cable

5-12. Perform deflection factor check as follows:

a. Connect equipment as shown in figure 5-1.

b. Set channel A and channel B VOLTS/DIV controls to 20 mV position.

c. Set voltmeter calibrator for 0 volt output.

d. Using channel A POSITION control, set trace to bottom horizontal graticule line.

Table 5-1. Recommended Test Equipment

Instrument		Required Characteristics	Required For
Type	Model		
Voltmeter Calibrator	HP Model H01-738BR	Voltage: 10 mV to 50 V Accuracy: to 0.1%	P
Oscillator	HP Model 204C	Output Voltage: >5 V rms Accuracy: ±3%	P
Constant Amplitude Signal Generator	(User's selection)	Frequency: 50 kHz to 15 MHz Accuracy: ±2%	P
Time-mark Generator	HP Model 226A	Time marks: 0.1 μs to 0.5 s	P
TV Sync Generator	Telechrome Model 3519	TV line and frame generator	P
Multifunction Digital Voltmeter	HP Model 34702A with 34740A	Voltage Range: >210 Vdc Accuracy: >±0.1%	A
Variable Transformer	HP Model K09-0982B	Voltage Range: 100 - 250 V Rating: >50 VA	A
Square-wave Generator	HP Model 211B	Frequency: 1 kHz Output Termination: 600 ohms	A
LCR Meter	HP Model 4332A	Range: to 36 pF	A
Adapter (2)	HP Part No. 1251-2277	Twin banana plug to BNC female adapter	P
44-in. BNC Cable (2)	HP Model 10501A	BNC, 44-in cable	P
Cable Assy	HP Model 11000A	Dual banana plug to dual banana plug	P
50-ohm Termination	HP Model 10100C	Termination: 50-ohm	P
9-in. BNC Cable (2)	HP Model 10502A	BNC, 9-in cable	P
BNC Tee	HP Part No. 1250-0781	BNC Tee Adapter	P
Test Leads (2)	HP Model 11002A		P, A
1000:1 Divider Probe	HP Model 11039A	Divider: 1000:1, >5 kV	A
BNC Barrel	HP Part No. 1250-0080	BNC female to BNC female	P, A
Adapter	HP Model 10110A	Twin banana plug to BNC male adapter	A

Note: P = Performance Check, A = Adjustment Procedure.

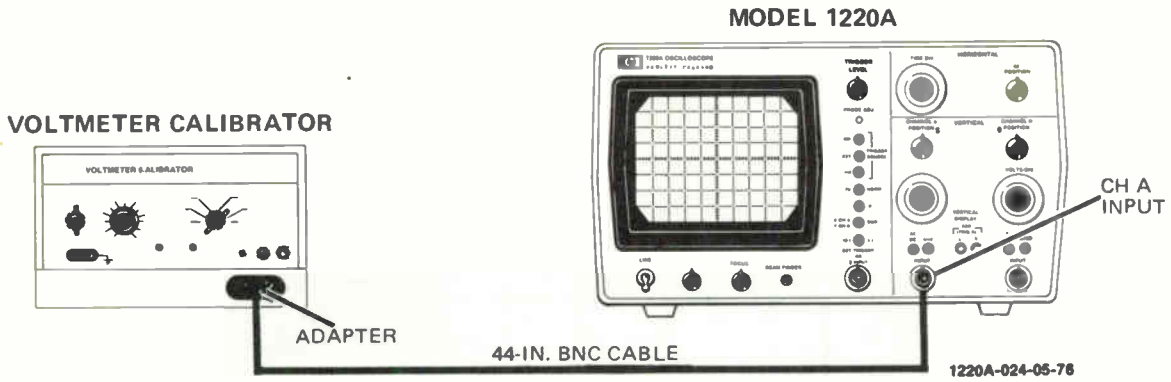


Figure 5-1. Deflection Factor Test Setup

e. Set voltmeter for +100 mV output.

f. Note display. Vertical deflection should be 5 divisions ±3%.

g. Observe vertical deflection factors specified in table 5-2.

Table 5-2. Deflection Factor Accuracy

Voltmeter Calibrator Settings (Volts p-p)	VOLTS/DIV Settings	Vertical Display (div)
.01	2 mV	5 ±5% (±.25)
.03	5 mV	6 ±5% (±.3)
.05	10 mV	5 ±5% (±.25)
.1	20 mV	5 ±3% (±.15)
.3	50 mV	6 ±3% (±.18)
.5	100 mV	5 ±3% (±.15)
1	200 mV	5 ±3% (±.15)
3	500 mV	6 ±3% (±.18)
5	1 V	5 ±3% (±.15)
10	2 V	5 ±3% (±.15)
30	5 V	6 ±3% (±.18)
50	10 V	5 ±3% (±.15)

h. Connect voltmeter calibrator to channel B INPUT connector.

i. Set VERTICAL DISPLAY control for channel B only operation.

j. Repeat steps c through g for channel B.

k. Disconnect test equipment.

l. Set Model 1220A front-panel controls to initial settings.

5-13. Z-AXIS BLANKING. A signal of +5 Vac, 10 Hz to 1 MHz blanks a trace of any intensity.

5-14. A trace of normal intensity is obtained on the CRT. A signal of +10 Vac pk-pk is applied to the Z-input connector on the rear panel and to the EXT TRIGGER connector on the front panel of Model 1220A. The display should be chop-blanked regardless of INTENSITY setting. The chop-blanking effect results from the sine wave input.

Equipment Required:

Oscillator
Two adapters (HP Part No. 1251-2277)
Two 44-in. BNC cables
9-in. BNC cable
BNC tee

5-15. Perform Z-axis blanking check as follows:

a. Set TIME/DIV control to 1 msec position.

b. Obtain baseline on CRT.

c. Adjust INTENSITY control for normal viewing level of baseline.

d. Connect equipment as shown in figure 5-2, and set 1220A TRIGGER SOURCE to EXT.

e. Set oscillator for 10 kHz, 10 V p-p output.

f. Verify modulated blanking of CRT regardless of INTENSITY setting.

g. Set INTENSITY control fully counterclockwise.

h. Disconnect test equipment.

i. Set Model 1220A front-panel controls to initial settings.

5-16. BANDWIDTH CHECK. <3 dB down from 50 kHz, 6-division reference signal (terminated 50-ohm source).

5-17. To check the bandwidth, a constant amplitude signal generator is used to apply a 6-division, 50 kHz reference signal to the input of Model 1220A. The

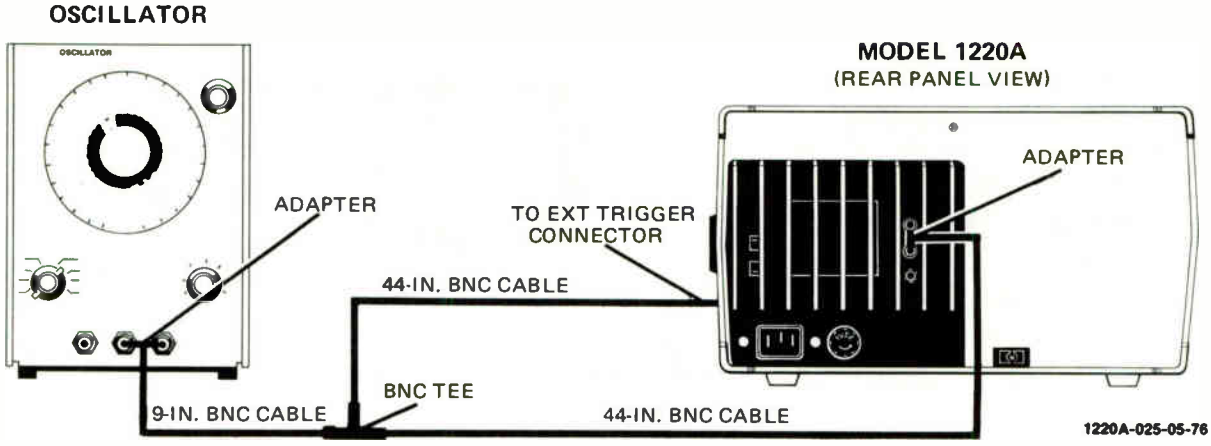


Figure 5-2. Z-axis Blanking Test Setup

constant amplitude signal generator frequency is increased to 15 MHz. Displayed amplitude on the CRT must be equal to or greater than 4.2 divisions.

Equipment Required:

Constant amplitude signal generator
44-in. BNC cable
50-ohm termination

5-18. Perform bandwidth check as follows:

a. Connect equipment as shown in figure 5-3.

b. Set channel A and channel B input coupling to DC position.

c. Set channel A and channel B VOLTS/DIV controls to 2 mV position.

d. Set TIME/DIV control as required.

e. Adjust constant amplitude signal generator for 50 kHz, 6-division display on CRT.

f. Increase frequency output of constant amplitude signal generator to 15 MHz.

g. Observe display on CRT. Signal amplitude is equal to or greater than 4.2 divisions.

h. Disconnect input signal from channel A INPUT connector.

i. Connect input signal to channel B INPUT connector.

j. Set VERTICAL DISPLAY to B only.

k. Repeat steps e through g for channel B.

l. Disconnect test equipment.

m. Set Model 1220A front-panel controls to initial settings.

5-19. TRIGGERING CHECK. Internal triggering occurs from approximately 10 Hz to 15 MHz on signals causing one division or more of vertical deflection. Triggering on line frequency is also selectable. External triggering occurs from approximately 10 Hz to 15 MHz on signals 0.1 V p-p or more.

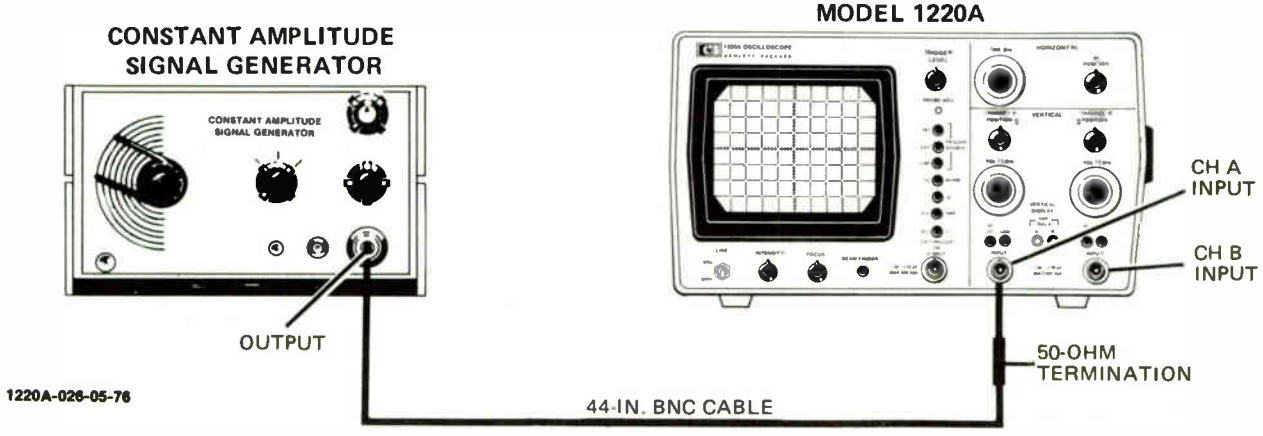


Figure 5-3. Bandwidth Test Setup

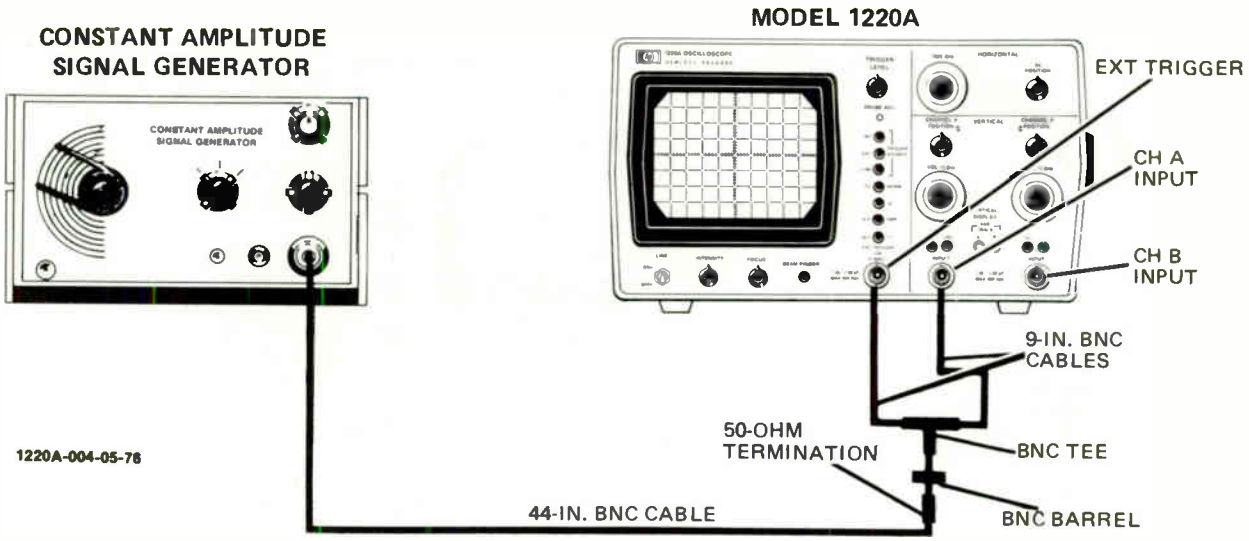


Figure 5-4. HF Triggering Test Setup

5-20. In the internal trigger mode of operation, triggering is checked against certain vertical deflections on the CRT. In the external mode of operation, the input signal amplitude determines trigger requirements.

Equipment Required:

Constant amplitude signal generator
Oscillator
Adapter (HP Part No. 1251-2277)
44-in. BNC cable
Two 9-in. BNC cables
BNC tee
One 50-ohm termination
BNC barrel

5-21. Perform triggering check as follows:

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

b. Set channel A and channel B input coupling to DC position.

c. Set TIME/DIV control as required.

d. Adjust constant amplitude signal generator for 15 MHz, 1 division amplitude display on CRT.

e. Adjust TRIGGER LEVEL control for stable display (if necessary). Stable display indicates proper triggering.

f. Change trigger slope from + to — and back to + position. Display remains stable. (If necessary, adjust TRIGGER LEVEL control for stable display.)

g. Set TRIGGER SOURCE to EXT position. Display remains stable. (If necessary, adjust TRIGGER LEVEL control for stable display.)

h. Set TRIGGER SOURCE to INT position.

i. Disconnect constant amplitude signal generator from instrument.

j. Connect HP Model 204C Oscillator to Model 1220A as shown in figure 5-5.

k. Set TIME/DIV control as required.

l. Adjust oscillator for 10 Hz, 1 division amplitude display on CRT.

m. Adjust TRIGGER LEVEL control for stable display (if necessary). Stable display indicates proper triggering.

n. Change trigger slope from + to — and back to + position. Display remains stable. (If necessary, adjust TRIGGER LEVEL control for stable display.)

o. Set TRIGGER SOURCE to EXT position. Display remains stable. (If necessary, adjust TRIGGER LEVEL control for stable display.)

p. Set TRIGGER SOURCE to INT position.

q. Set VERTICAL DISPLAY to B only.

r. Repeat steps c through o for channel B.

s. Disconnect test equipment.

t. Set Model 1220A front-panel controls to initial settings.

5-22. SWEEP TIME ACCURACY. The ranges are from 0.1 μs/div to 0.5 s/div (21 ranges) in 1, 2, 5 sequence. The accuracy is ±4% with sweep expander control in calibrated position.

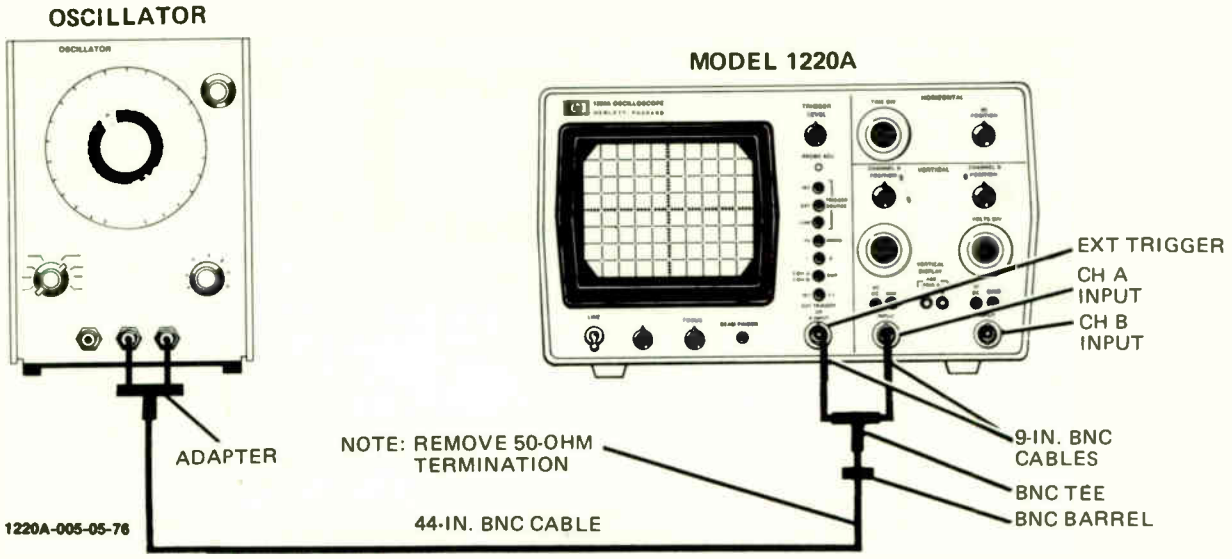


Figure 5-5. LF Triggering Test Setup

5-23. The Model 1220A time base is compared to a time-mark generator to verify accuracy.

Equipment Required:

Time-mark generator
44-in. BNC cable

5-24. Perform sweep time accuracy check as follows:

a. Connect equipment as shown in figure 5-6.

b. Set channel A and channel B input coupling to DC positions.

c. Set channel A and channel B VOLTS/DIV controls as required.

d. Check sweep time accuracy in accordance with table 5-3.

e. Disconnect test equipment.

f. Set Model 1220A front-panel controls to initial settings.

5-25. TV SYNC CHECK. The TV Sync Separator requires one division of video signal to trigger sweep. Automatic selection of line and frame display.

5-26. A signal from a TV Sync Generator is used to check the TV Sync Separator triggering circuit in the instrument.

Equipment Required:

TV sync generator
44-in. BNC cable
Two 9-in. BNC cables
BNC tee
BNC barrel

5-27. Perform TV Sync check as follows:

a. Connect equipment as shown in figure 5-7.

b. Set channel A input coupling to DC position.

c. Set channel A VOLTS/DIV control for one major division of display on CRT.

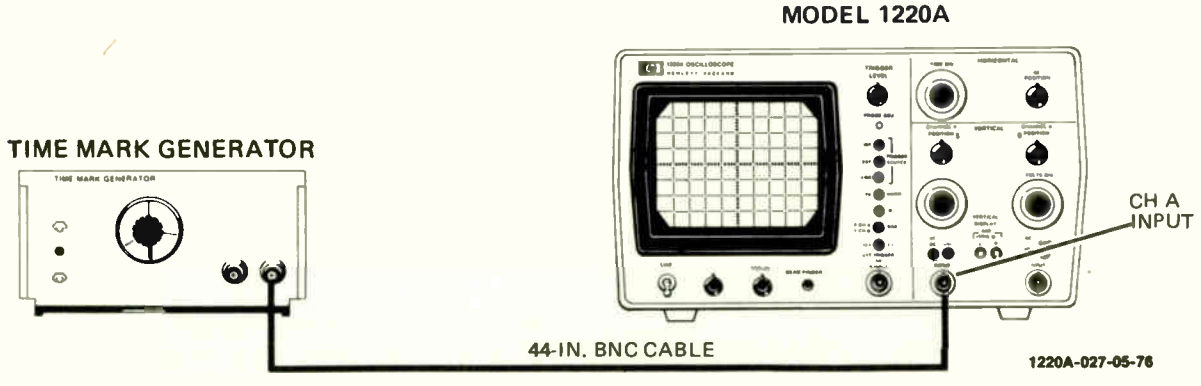


Figure 5-6. Sweep Time Accuracy Test Setup

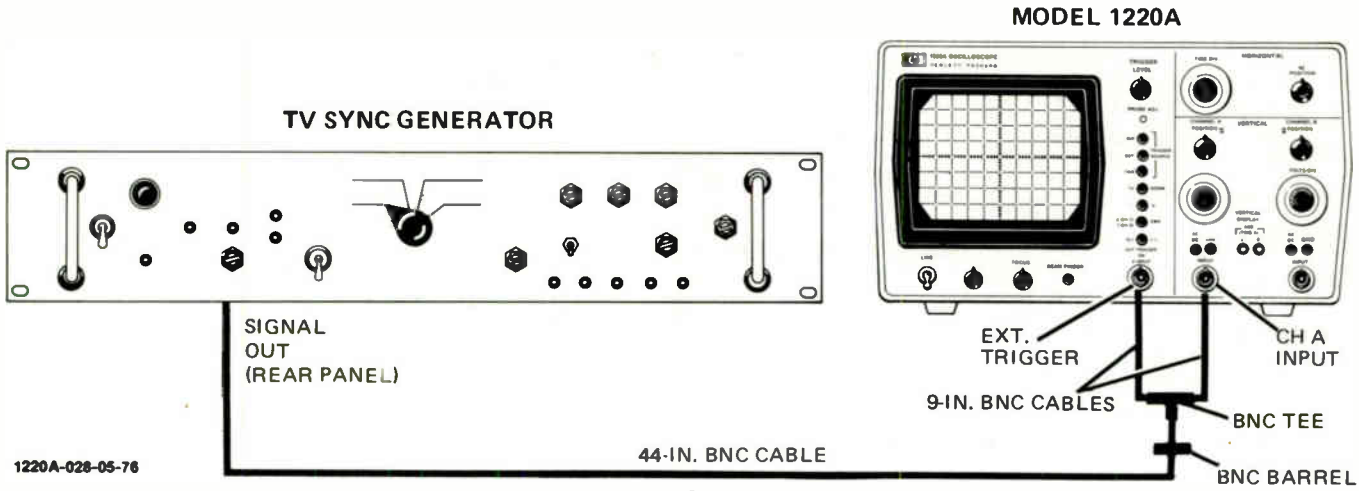


Figure 5-7. TV Sync Test Setup

d. Set —/+ switch to — position.

e. Set TV/NORM switch to TV position.

f. Set TV sync generator controls as follows:

MODE SELECTOR ..... DNA
SYNC ON/OFF ..... ON

g. Adjust TRIGGER LEVEL control for stable display. Stable display indicates proper triggering (frame).

h. Set TIME/DIV control to 20 μsec position.

i. If necessary, adjust TRIGGER LEVEL control for stable display. Stable display indicates proper triggering (line).

j. Set TIME/DIV control to 2 msec position.

k. Set TRIGGER SOURCE to EXT position.

l. Repeat steps g through i for external trigger.

m. Disconnect test equipment.

n. Set Model 1220A front-panel controls to initial settings.

5-28. X-Y PHASE CHECK. The phase shift in X-Y mode of operation is less than 3° to 100 kHz.

5-29. Identical 100 kHz signals are applied to the X INPUT connector and channel A INPUT connector. The phase angle is then checked for specifications.

Table 5-3. Sweep Time Accuracy

Time-mark Generator Setting	TIME/DIV Setting	Time Marks (10 divisions)	Limit (±4%)
.1 μsec	.1 μsec	11	±0.4 div
.2 μsec	.2 μsec	11	±0.4 div
.5 μsec	.5 μsec	11	±0.4 div
1 μsec	1 μsec	11	±0.4 div
2 μsec	2 μsec	11	±0.4 div
5 μsec	5 μsec	11	±0.4 div
10 μsec	10 μsec	11	±0.4 div
20 μsec	20 μsec	11	±0.4 div
50 μsec	50 μsec	11	±0.4 div
.1 msec	.1 msec	11	±0.4 div
.2 msec	.2 msec	11	±0.4 div
.5 msec	.5 msec	11	±0.4 div
1 msec	1 msec	11	±0.4 div
2 msec	2 msec	11	±0.4 div
5 msec	5 msec	11	±0.4 div
10 msec	10 msec	11	±0.4 div
20 msec	20 msec	11	±0.4 div
50 msec	50 msec	11	±0.4 div
.1 sec	.1 sec	11	±0.4 div
.2 sec	.2 sec	11	±0.4 div
.5 sec	.5 sec	11	±0.4 div

Equipment Required:

Oscillator
44-in. BNC cables
Two 9-in. BNC cables
BNC tee
Adapter (HP Part No. 1251-2277)

5-30. Perform X-Y phase measurement check as follows:

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

b. Set channel A input coupling to DC position.

c. Set channel A VOLTS/DIV control to 1 V position.

d. Set X-Y/SWP switch to X-Y position.

e. Set oscillator for 100 kHz output signal.

f. Adjust oscillator output amplitude for CRT display of eight divisions.

g. Observe CRT display. Phase angle is equal to or less than 0.42 major division (see figure 5-8).

h. Disconnect test equipment.

i. Set Model 1220A front-panel controls to initial settings.

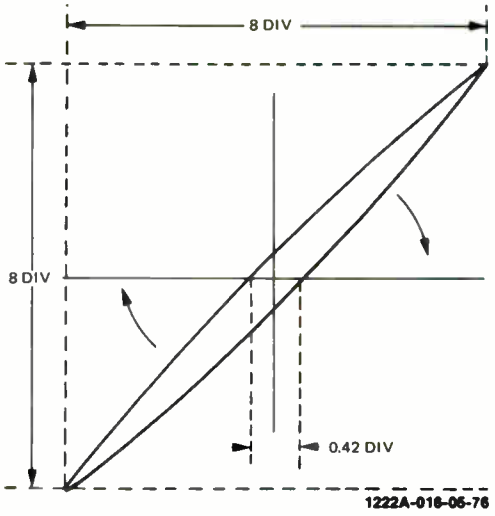


Figure 5-8. X-Y Phase Measurement

5-31. ADJUSTMENT PROCEDURES.

WARNING

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

5-32. The following is a complete adjustment procedure for the Model 1220A. These procedures should be performed only if it has been previously established by the performance checks that the instrument is out of adjustment. If the instrument cannot be brought into specifications by the following adjustments, refer to the troubleshooting hints given in Section VIII. See figure 5-14 for location of board assemblies.

5-33. LOW-VOLTAGE POWER SUPPLY ADJUSTMENT. (See figure 5-9.) The +95-volt supply is an adjustable reference for the ±12-volt and +210-volt supplies. It is normally adjusted to produce the greatest accuracy on the +12-volt supply.

Equipment Required:

Multifunction digital voltmeter
Test leads

5-34. Perform low-voltage power supply adjustment as follows:

a. Connect multifunction digital voltmeter lead (+) to test point A2A1TP4. Test point is marked +12.

b. Adjust A2A1R13 for an indication on multifunction digital voltmeter of +12 V ±0.05 V.

c. Check other voltages as listed in table 5-4.

d. Disconnect test equipment.

Table 5-4. Low-voltage Power Supply Output

Test Point	Voltage Indication
TP1 (+5)	+5 V ± 0.25 V
TP2 (+210)	+210 V ±20 V
TP3 (+95)	+95 V ± 2 V
TP5 (—12)	—12 V ± 0.3 V

5-35. HIGH-VOLTAGE POWER SUPPLY ADJUSTMENTS. (See figure 5-10.) For this adjustment the line voltage must be within 1% of the nominal voltage set on the LINE SELECT switches.

Equipment Required:

Variable transformer
1000:1 divider probe
Multifunction digital voltmeter

5-36. Perform high-voltage power supply adjustments as follows:

a. Connect variable transformer between ac source and 1220A power input.

b. Set LINE SELECT switches on rear panel of 1220A for 120-V operation (refer to Section II for settings of switches).

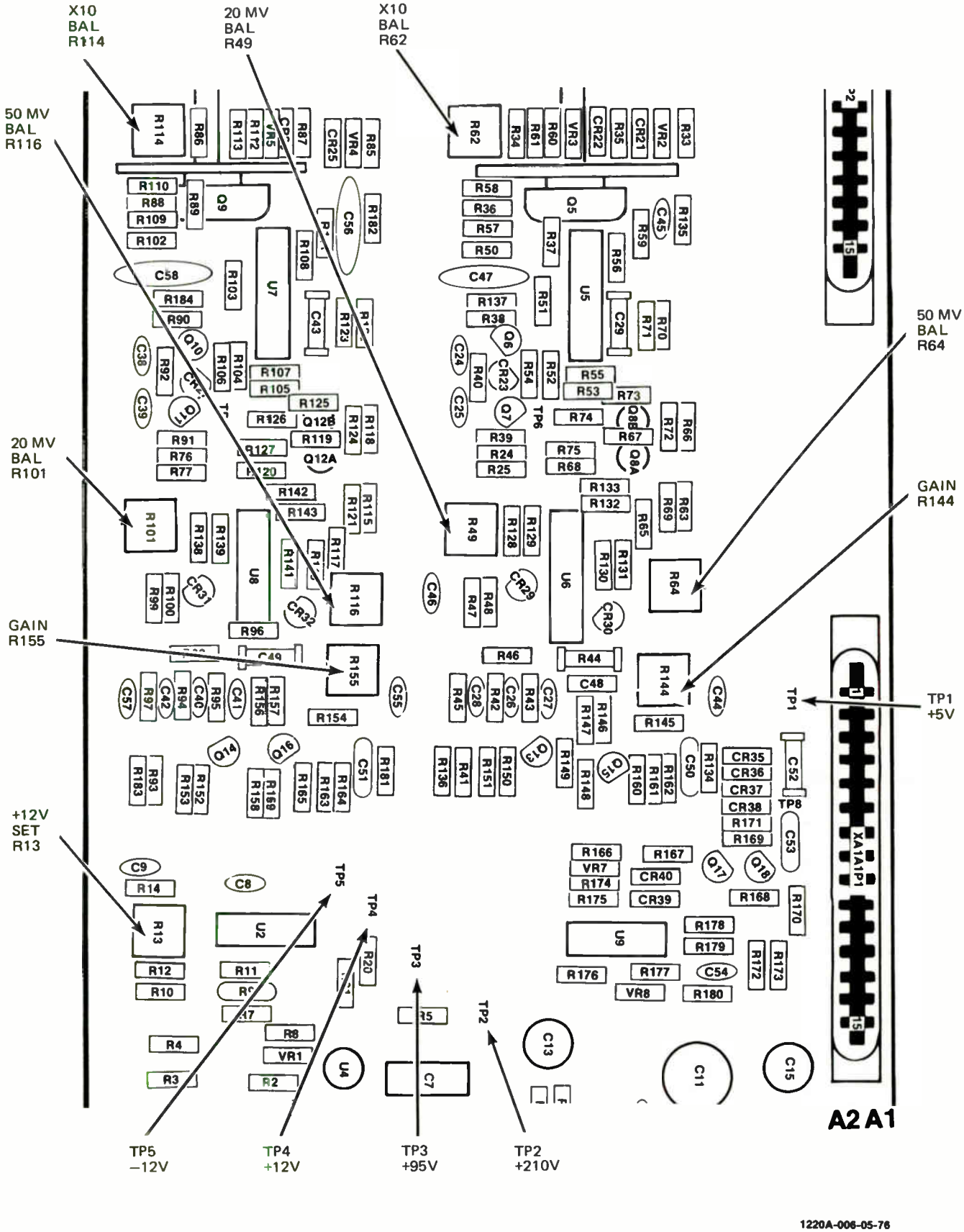


Figure 5-9. Vertical Assembly Adjustments

c. Set 1220A front-panel TIME/DIV control to 5 msec position.

d. Using digital voltmeter as monitor, adjust variable transformer for 108-Vac output.

e. Adjust A3R3 counterclockwise until trace modulation starts. Then adjust A3R3 clockwise about 10° until trace modulation stops.

f. Using digital voltmeter as monitor, adjust variable transformer for 120-Vac output.

g. Connect digital voltmeter through 1000:1 divider probe to A3TP2.

h. Adjust A3R20 for digital voltmeter indication of 1.99 V ±5 mV.

i. Using digital voltmeter as monitor, adjust variable transformer for 126-Vac output.

j. Adjust A3R3 clockwise until trace modulation starts. Then adjust A3R3 counterclockwise about 10° until trace modulation stops.

k. Repeat steps d and e if trace modulation is noted on lower ac input level.

l. Disconnect test equipment.

m. Set Model 1220A front-panel controls to initial settings.

5-37. FOCUS AND ASTIGMATISM ADJUSTMENTS. (See figure 5-10.) The trace is adjusted for optimum line definition over the entire screen.

Equipment Required:

Oscillator

5-38. Perform focus and astigmatism adjustments as follows:

a. Connect oscillator output to channel A input.

b. Adjust Model 1220A for two complete cycles of full screen display.

c. Adjust FOCUS control and A3R26 (ASTIGMATISM) for optimum line definition over entire screen. Line width should be nearly equal at top, middle, and bottom of screen.

5-39. INTENSITY LIMIT ADJUSTMENT. (See figure 5-10.) With front-panel INTENSITY control set to 11 o'clock position, the intensity limit is adjusted for just visible spot.

Equipment Required: None

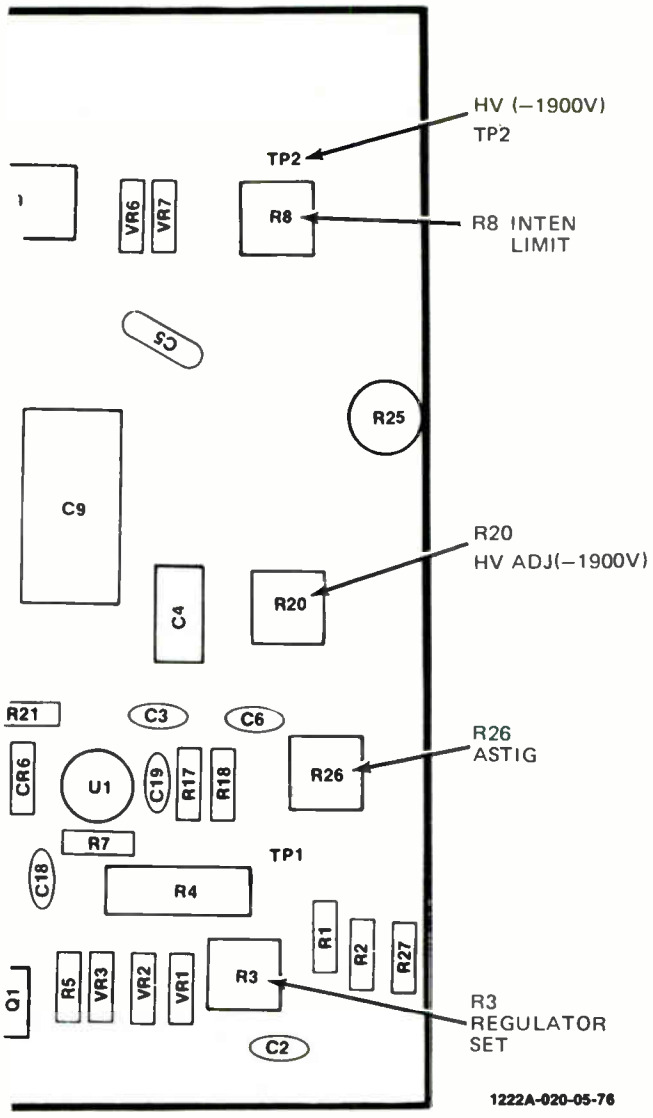


Figure 5-10. High-voltage Power Supply Adjustments

5-40. Perform intensity limit adjustment as follows:

a. Set X-Y/SWP switch to X-Y position.

b. Set INTENSITY control to 11 o'clock position.

c. Adjust intensity limit adjustment A3R8 until spot is just visible.

d. Set Model 1220A front-panel controls to initial settings.

5-41. VERTICAL PREAMPLIFIER BALANCE ADJUSTMENTS. (See figure 5-9.) The vertical preamplifier balance adjustments are set to balance the amplifier with the POSITION control.

Equipment Required: None

5-42. Perform vertical preamplifier balance adjustments as follows:

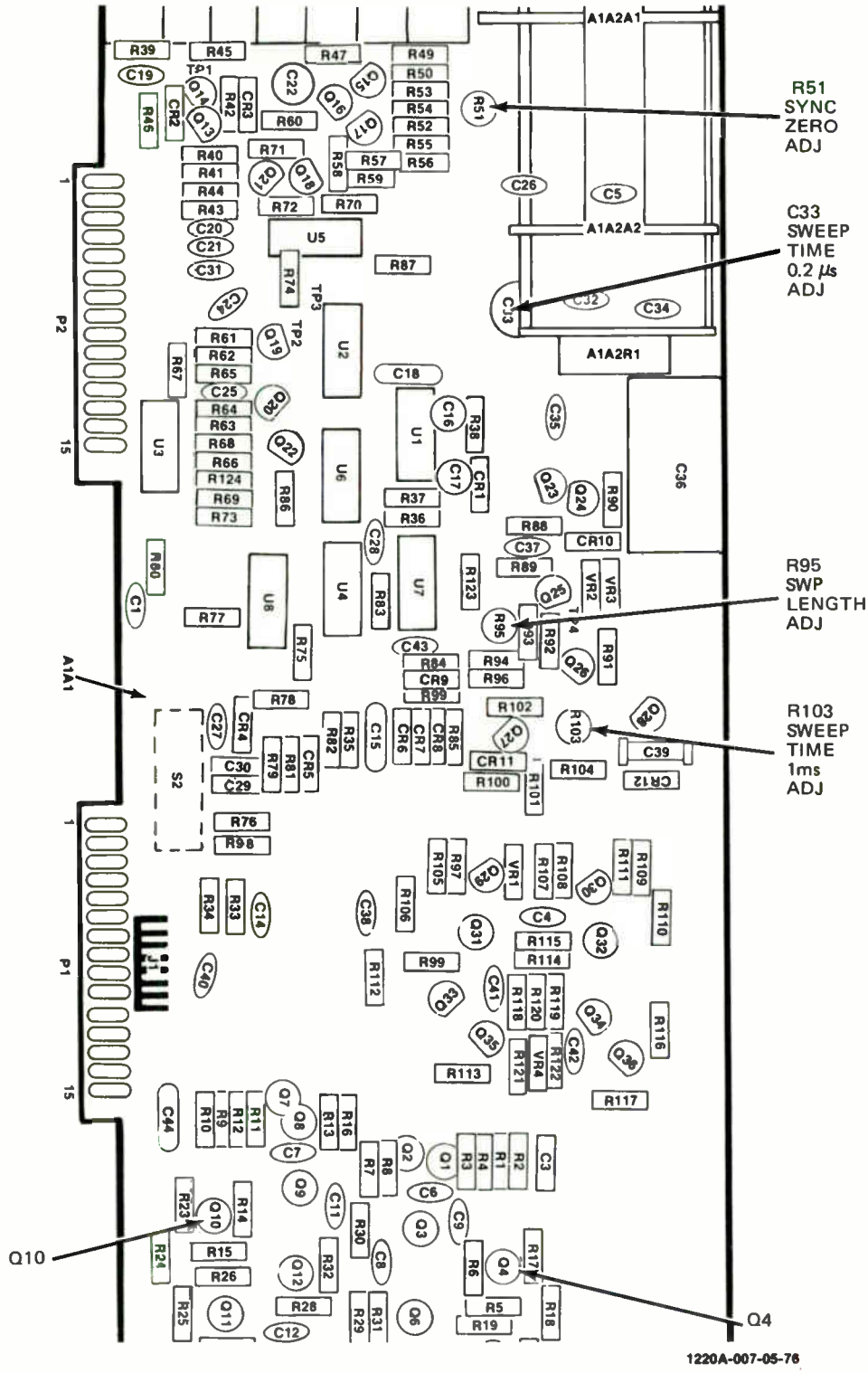


Figure 5-11. Sweep Assembly Adjustment

a. Set channel A input coupling to GND position.

b. Set channel A VOLTS/DIV control to 20 mV position.

c. Using channel A POSITION control, set trace to center horizontal graticule line.

d. Set channel A VOLTS/DIV control to 2 mV position.

e. Adjust A2A1R62 to recenter trace.

f. Repeat steps b through e until trace shift of no greater than one trace width occurs when channel A VOLTS/DIV control is moved from 20 mV to 2 mV position.

g. Set channel A VOLTS/DIV control to 100 mV position.

h. Using channel A POSITION control, set trace to center horizontal graticule line.

i. Set channel A VOLTS/DIV control to 50 mV position.

j. Adjust A2A1R64 to recenter trace.

k. Repeat steps g through j until trace shift of no greater than one trace width occurs when channel A VOLTS/DIV control is moved from 100 mV to 50 mV position.

l. Set channel A VOLTS/DIV control to 100 mV position.

m. If necessary, use channel A POSITION control to exactly center trace on center horizontal graticule line.

n. Set channel A VOLTS/DIV control to 20 mV position.

o. Adjust A2A1R49 to recenter trace.

p. Repeat steps 1 through o until trace shift to no greater than one trace width occurs when channel A VOLTS/DIV control is moved for 100 mV to 20 mV position.

q. Repeat steps a through p for channel B using adjustments A2R1R114, A2A1R116, and A2A1R101.

r. Set Model 1220A front-panel controls to initial settings.

5-43. SWEEP LENGTH ADJUSTMENT. (See figure 5-11.) The sweep length is adjusted for 10.5 horizontal divisions.

Equipment Required: None

5-44. Perform the sweep length adjustment as follows:

a. Using horizontal POSITION control, position trace so that beginning of trace is aligned with 1st vertical graticule line.

b. Adjust A1A1R95 for ten divisions of sweep.

c. Using horizontal POSITION control, move end of sweep exactly one-half division to left.

d. Adjust A1A1R95 so that end of sweep aligns with 11th vertical graticule line.

e. Set Model 1220A front-panel controls to initial settings.

5-45. VERTICAL ATTENUATOR COMPENSATION. (See figure 5-12.) The vertical preamplifier is balanced so that the trace does not shift when the attenuators are changed from range to range.

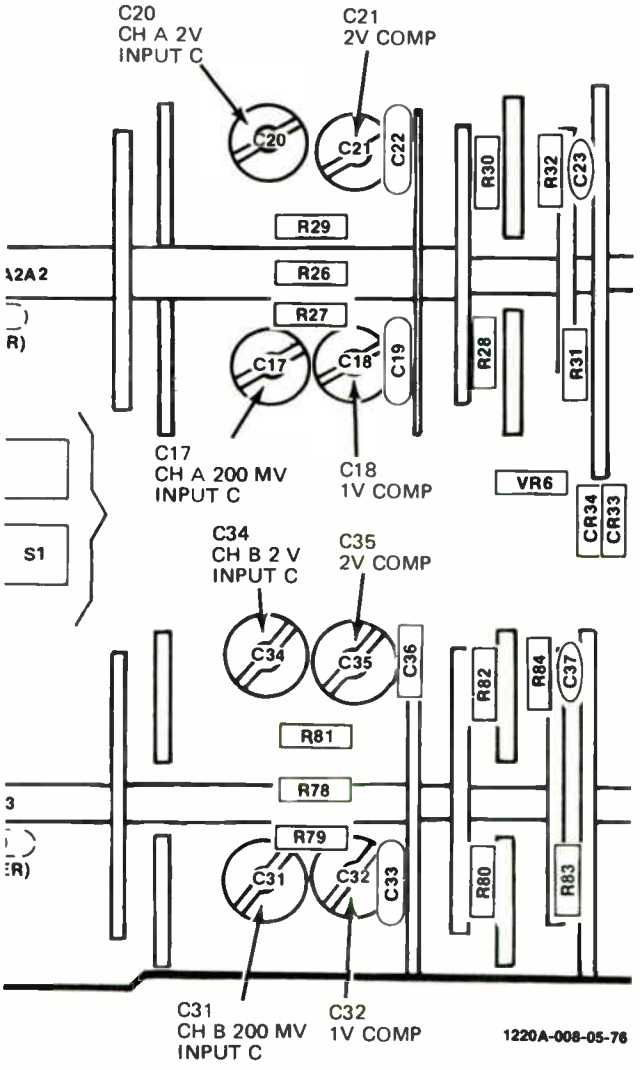


Figure 5-12. Attenuator Compensation Adjustments

Equipment Required:

Square-wave generator
44-in. BNC cable
Two 9-in. BNC cables
BNC tee
BNC barrel

5-46. Perform attenuator compensation adjustments as follows:

NOTE

The following adjustments are necessary only if repairs have been made to the attenuator assemblies.

a. Connect 600-ohm output of square-wave generator to channel A and channel B INPUT connectors using BNC tee and BNC barrel.

b. Set Model 1220A VERTICAL DISPLAY for A&B operation (both A and B switches engaged).

c. Set channel A and channel B input coupling to DC position.

d. Set channel A and channel B VOLTS/DIV controls to 1 V position.

e. Set TIME/DIV control to 0.2 msec position.

f. Adjust square-wave generator for 1 kHz, 6-division output.

g. Adjust A2A1C18 for best square wave response on channel A.

h. Adjust A2A1C32 for best square wave response on channel B.

i. Set channel A and channel B VOLTS/DIV controls to 2 V position.

j. Adjust square-wave generator for 6-division output.

k. Adjust A2A1C21 for best square wave response for channel A.

l. Adjust A2A1C35 for best square wave response for channel B.

m. Disconnect test equipment.

n. Set Model 1220A front-panel controls to initial settings.

5-47. INPUT CAPACITANCE ADJUSTMENTS. (See figure 5-12.) The input capacitance is adjusted so that the capacitance is the same for all ranges of the VOLTS/DIV control.

Equipment Required:

LCR meter
Adapter (HP Model 10110A)

5-48. Perform input capacitance adjustments as follows:

a. Set channel A and channel B input coupling to DC position.

b. Set channel A and channel B VOLTS/DIV controls to 100 mV position.

c. Connect LCR meter to channel A INPUT connector. Note capacitance reading (30 pF ±6 pF).

d. Set channel A VOLTS/DIV control to 200 mV position.

e. Adjust A2A1C17 for same capacitance indication on LCR meter as noted in step c.

f. Set channel A VOLTS/DIV control to 2 V position.

g. Adjust A2A1C20 for same capacitance indication on LCR meter as noted in step c.

h. Disconnect LCR meter from channel A INPUT connector.

i. Connect LCR meter to channel B INPUT connector.

j. Repeat steps c through g for channel B using A2A1C31 and A2A1C34 as adjustments for channel B.

k. Disconnect test equipment.

l. Set Model 1220A front-panel controls to initial settings.

5-49. VERTICAL GAIN ADJUSTMENT. (See figure 5-9.) The gain of vertical preamplifier is calibrated using a 500 mV p-p signal.

Equipment Required:

Voltmeter calibrator
44-in. BNC cable
Adapter (HP Part No. 1251-2277)

5-50. Perform vertical preamplifier gain adjustment as follows:

a. Set Model 1220A channel A input coupling to DC position.

b. Set TIME/DIV control to 1 msec position.

c. Connect output of voltmeter calibrator to channel A INPUT connector.

d. Set voltmeter calibrator for 400-Hz, 500-mV p-p amplitude output.

e. Adjust A2A1R144 for exactly 5 divisions of vertical display.

f. Repeat steps a through e for channel B using A2A1R155 as adjustment.

g. Disconnect test equipment.

h. Set Model 1220A front-panel controls to initial settings.

5-51. SWEEP SPEED ADJUSTMENTS. (See figure 5-11.) The main sweep is calibrated to a known time standard.

Equipment Required:

Time-mark generator
44-in. BNC cable
50-ohm termination

5-52. Perform sweep speed adjustment as follows:

a. Set channel A input coupling to DC position.

b. Set channel A VOLTS/DIV control to 0.5 V position.

c. Set TIME/DIV control to 1 msec position.

d. Connect time-mark generator through 50-ohm termination to channel A INPUT connector.

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

f. Adjust A1A1R103 until one marker is on each vertical graticule line.

g. Set time-mark generator for 0.2 μs output markers.

h. Set TIME/DIV control to 0.2 μsec position.

i. Adjust A1A1C33 until one marker is on each vertical graticule line.

j. Disconnect test equipment.

k. Set Model 1220A front-panel controls to initial settings.

5-53. PULSE AND BANDWIDTH. (See figure 5-11.) The bandwidth is adjusted for specification limits against a known standard.

Equipment Required:

Constant amplitude signal generator
Square-wave generator
44-in. BNC cable
50-ohm termination

5-54. Perform bandwidth adjustment as follows:

a. Set channel A VOLTS/DIV control to 2 mV position.

b. Set channel A input coupling to DC position.

c. Connect square-wave generator 50-ohm output through 50-ohm termination to channel A INPUT connector.

d. Set square-wave generator for 1 MHz, 6-division output display on CRT.

e. Set TIME/DIV control to 0.1 μsec position.

f. Adjust pulse response by bending wires away from or close to A1A1Q4 and A1A1Q10 for minimum overshoot and undershoot of displayed pulse.

g. Disconnect test equipment.

h. Connect the equipment as shown in figure 5-3.

i. Adjust constant amplitude signal generator for 50 kHz, 6-division display on CRT.

j. Increase signal output of constant amplitude signal generator to 15 MHz.

k. Amplitude of display must be equal to or greater than 4.2 divisions.

NOTE

If amplitude is low, recheck pulse response (step f). A slight peaking of the pulse is acceptable within specification limits.

l. Disconnect test equipment.

m. Set Model 1220A front-panel controls to initial settings.

5-55. TRIGGER AMPLIFIER BALANCE ADJUSTMENT. (See figures 5-11 and 5-13.) The + and — trigger slope circuits are balanced to a common signal.

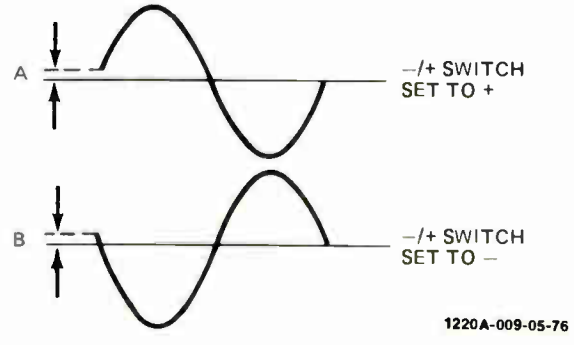


Figure 5-13. Trigger Balance Adjustment Display

Equipment Required:

Oscillator
44-in. BNC cable

5-56. Perform trigger amplifier balance adjustment as follows:

a. Disconnect W3 cable at A1A1J2 (W3 cable connects TRIGGER LEVEL control to A1A1 assembly).

b. Set TIME/DIV control to 0.1 msec position.

c. Set channel A VOLTS/DIV control to 100 mV position.

d. Connect 600-ohm oscillator output to channel A INPUT connector.

e. Set oscillator for 1 kHz, 600 mV p-p output signal.

f. While switching Model 1220A —/+ switch between + and — positions, adjust A1A1R51 so that both displays start at same point (see figure 5-13.)

g. Reconnect W3 cable to A1A1J2.

h. Disconnect test equipment.

i. Set Model 1220A front-panel controls to initial settings.

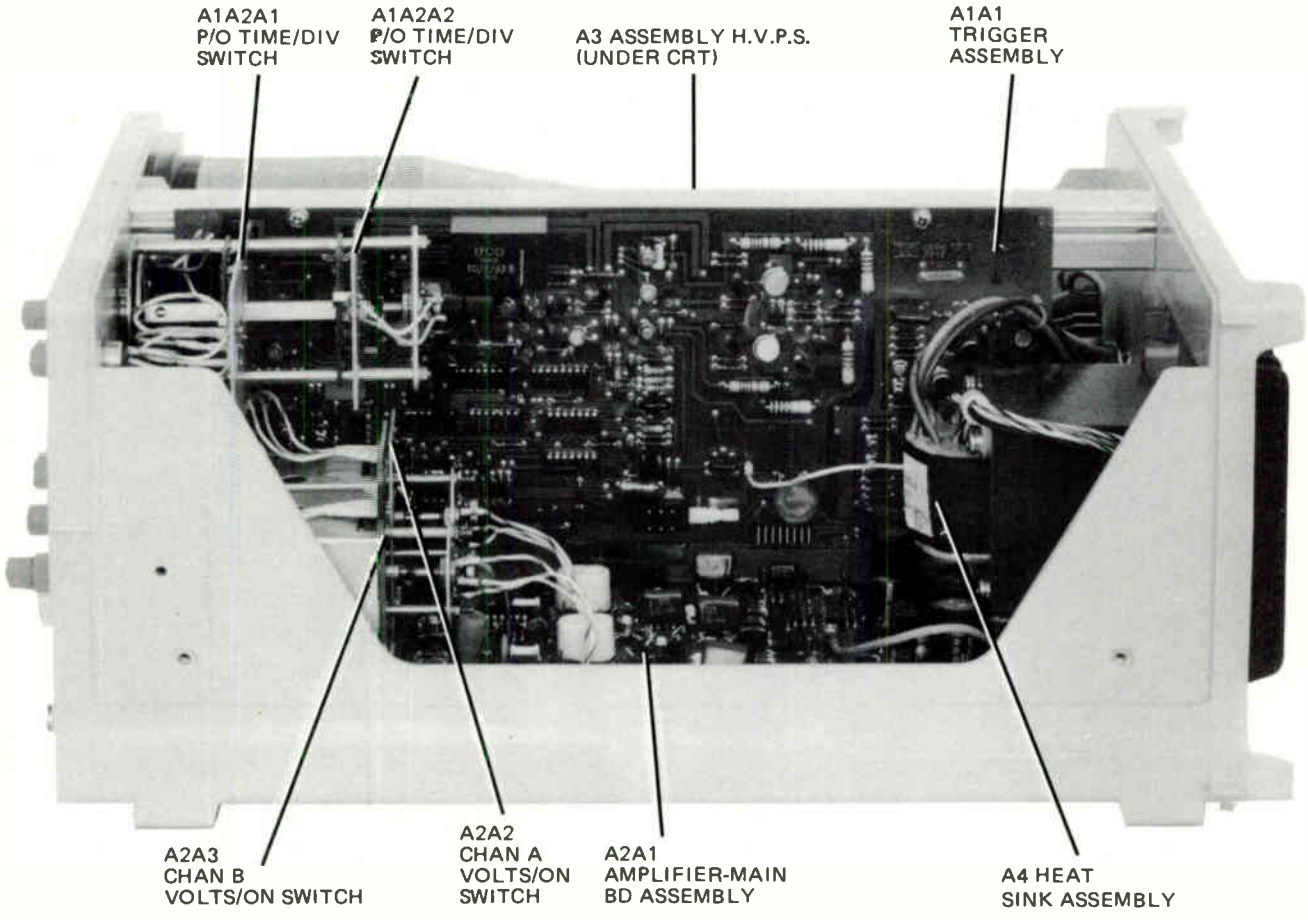


Figure 5-14. Assembly Locations

PERFORMANCE CHECK RECORD
MODEL 1220A

Instrument Serial Number _____ Date _____

Check	Specification	Measured
DEFLECTION FACTOR		CH A CH B
2 mV/div	5 ±5% (±.25)	_____ _____
5 mV/div	6 ±5% (±.3)	_____ _____
10 mV/div	5 ±5% (±.25)	_____ _____
20 mV/div	5 ±3% (±.15)	_____ _____
50 mV/div	6 ±3% (±.18)	_____ _____
100 mV/div	5 ±3% (±.15)	_____ _____
200 mV/div	5 ±3% (±.15)	_____ _____
500 mV/div	6 ±3% (±.18)	_____ _____
1 V/div	5 ±3% (±.15)	_____ _____
2 V/div	5 ±3% (±.15)	_____ _____
5 V/div	6 ±3% (±.18)	_____ _____
10 V/div	5 ±3% (±.15)	_____ _____
Z-AXIS BLANKING		
CRT Blanked	+5 Vac pk Input	_____
BANDWIDTH		
Channel A Bandwidth	≥4.2 div	_____
Channel B Bandwidth	≥4.2 div	_____
TRIGGERING CHECK		
Internal Triggering (15 MHz)	(√)	
Internal Triggering (10 Hz)	(√)	
External Triggering (15 MHz)	(√)	
External Triggering (10 Hz)	(√)	

PERFORMANCE CHECK RECORD (Cont'd)

MODEL 1222A

Instrument Serial Number _____ Date _____

Check	Specification	Measured
SWEEP TIME ACCURACY		
TIME/DIV Setting:		
.1 μsec	Over 10 div ±4% (0.4 div)	_____
.2 μsec		_____
.5 μsec		_____
1 μsec		_____
2 μsec		_____
5 μsec		_____
10 μsec		_____
20 μsec		_____
50 μsec		_____
.1 msec		_____
.2 msec		_____
.5 msec		_____
1 msec		_____
2 msec		_____
5 msec		_____
10 msec		_____
20 msec		_____
50 msec		_____
.1 sec		_____
.2 sec		_____
.5 sec		_____
TV SYNC CHECK		
Internal (frame)	(√)	
Internal (line)	(√)	
External (frame)	(√)	
External (line)	(√)	
X-Y PHASE CHECK		
Model 1220A	≤0.42 div	_____

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. The abbreviations used in the parts list are described in table 6-1. Table 6-2 lists the parts in alphanumeric order by reference designation and includes the manufacturer and manufacturer's part number. Table 6-3 contains the list of manufacturers' codes.

6-3. ORDERING INFORMATION.

6-4. To obtain replacement parts from Hewlett-Packard, address order or inquiry to the nearest Hewlett-Packard Sales/Service Office and supply the following information:

a. Instrument model and serial number.

b. HP part number of item(s).

c. Quantity of part(s) desired.

d. Reference designation of part(s).

6-5. To order a part not listed in the table, provide the following information:

a. Instrument model and serial number.

b. Description of the part, including function and location in the instrument.

c. Quantity desired.

Table 6-1. Abbreviations for Replaceable Parts List

A	AMPERE(S)	H	HENRY(IES)	NPN	NEGATIVE-POSITIVE-NEGATIVE	RWV	REVERSE WORKING VOLTAGE
ASSY	ASSEMBLY	HG	MERCURY	NSR	NOT SEPARATELY REPLACEABLE	S-B	SLOW-BLOW
BD	BOARD(S)	HP	HEWLETT-PACKARD			SCR	SILICON CONTROLLED RECTIFIER
BH	BINDER HEAD	HZ	HERTZ			SE	SELENIUM
BP	BANDPASS	IF	INTERMEDIATE FREQ.	OBD	ORDER BY DESCRIPTION	SEC	SECOND(S)
C	CENTI (10^{-2})	IMPG	IMPREGNATED	OH	OVAL HEAD	SECT	SECTION(S)
CAR	CARBON	INCD	INCANDESCENT	OX	OXIDE	SI	SILICON
CCW	COUNTERCLOCKWISE	INCL	INCLUDE(S)			SIL	SILVER
CER	CERAMIC	INS	INSULATION(ED)	P	PEAK	SL	SLIDE
CMO	CABINET MOUNT ONLY	INT	INTERNAL	PC	PRINTED (ETCHED) CIRCUIT(S)	SP	SINGLE POLE
COAX	COAXIAL	K	KILO (10^{3})	PF	PICOFARADS	SPL	SPECIAL
COEF	COEFFICIENT	KG	KILOGRAM	PHL	PHILLIPS	ST	SINGLE THROW
COMP	COMPOSITION	LB	POUND(S)	PIV	PEAK INVERSE VOLTAGE(S)	STD	STANDARD
CONN	CONNECTOR(S)	LH	LEFT HAND	PNP	POSITIVE-NEGATIVE-POSITIVE	TA	TANTALUM
CRT	CATHODE-RAY TUBE	LIN	LINEAR TAPER	P/O	PART OF	TD	TIME DELAY
CW	CLOCKWISE	LOG	LOGARITHMIC TAPER	PORC	PORCELAIN	TFL	TEFLON
D	DECI (10^{-1})	LPF	LOW-PASS FILTER(S)	POS	POSITION(S)	TGL	TOGGLE
DEPC	DEPOSITED CARBON	LVR	LEVER	POT	POTENTIOMETER(S)	THYR	THYRISTOR
DP	DOUBLE POLE	M	MILLI (10^{-3})	P-P	PEAK-TO-PEAK	TI	TITANIUM
DT	DOUBLE THROW	MEG	MEGA (10^{6})	PRGM	PROGRAM	TNLDIO	TUNNEL DIODE(S)
ELECT	ELECTROLYTIC	MET FILM	METAL FILM	PS	POLYSTYRENE	TOL	TOLERANCE
ENCAP	ENCAPSULATED	MET OX	METAL OXIDE	PWV	PEAK WORKING VOLTAGE	TRIM	TRIMMER
EXT	EXTERNAL	MFR	MANUFACTURER	RECT	RECTIFIER(S)	U	MICRO (10^{-6})
F	FARAD(S)	MINAT	MINIATURE	RF	RADIO FREQUENCY	V	VOLTS
FET	FIELD-EFFECT TRANSISTOR(S)	MOM	MOMENTARY	RFI	RADIO FREQUENCY INTERFERENCE	VAR	VARIABLE
FH	FLAT HEAD	MTG	MOUNTING	RH	ROUND HEAD OR RIGHT HAND	VDCW	DC WORKING VOLT(S)
FIL H	FILLISTER HEAD	MY	MYLAR	RMO	RACK MOUNT ONLY	W	WATT(S)
FXD	FIXED	N	NANO (10^{-9})	RMS	ROOT MEAN SQUARE	W/	WITH
G	GIGA (10^{9})	N/C	NORMALLY CLOSED			WIV	WORKING INVERSE VOLTAGE
GE	GERMANIUM	NE	NEON			W/O	WITHOUT
GL	GLASS	N/O	NORMALLY OPEN			WW	WIREWOUND
GRD	GROUNDED	NOP	NEGATIVE POSITIVE ZERO (ZERO TEMPERATURE COEFFICIENT)				

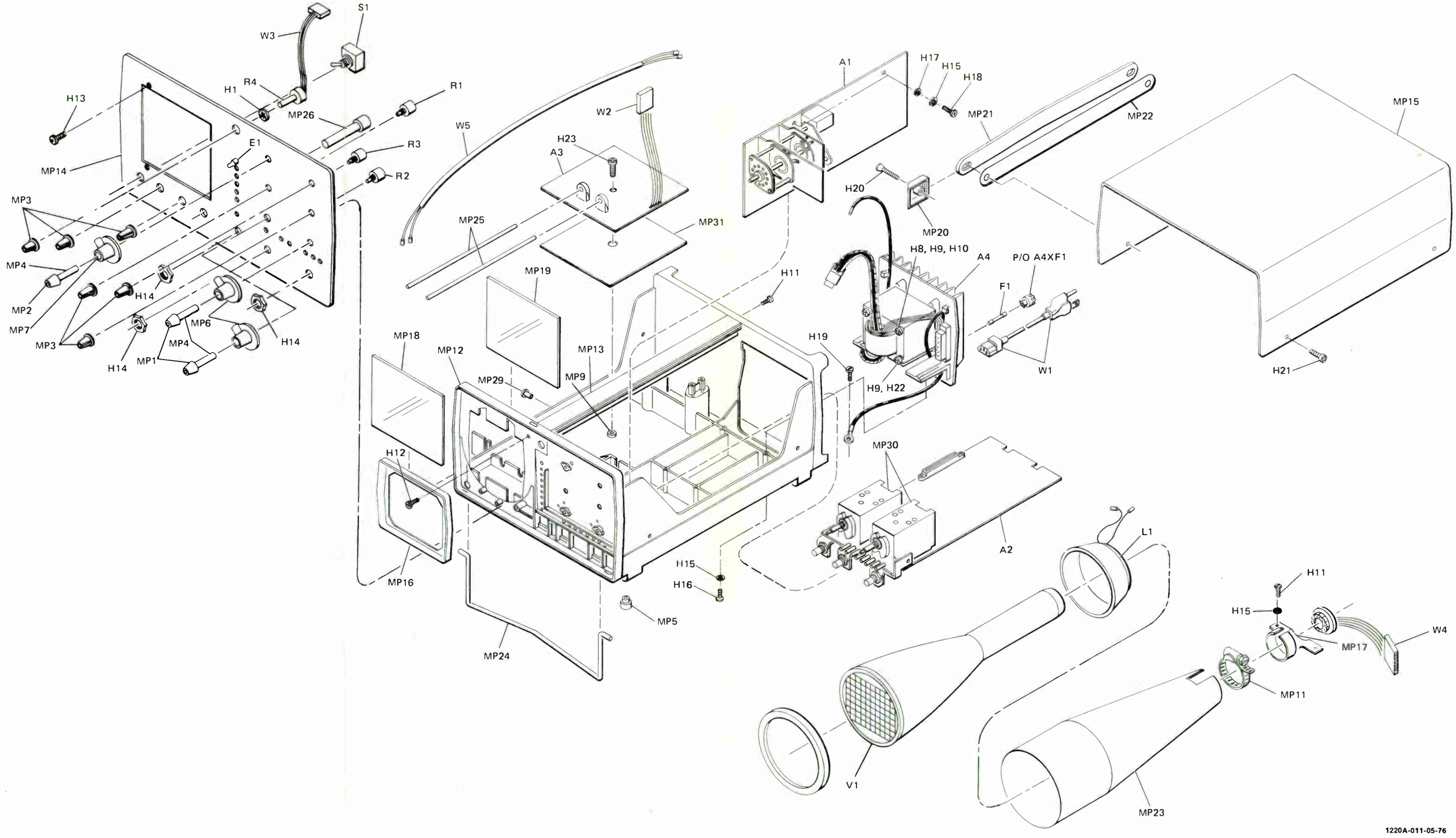


Figure 6-1.
Illustrated Parts Breakdown

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
			COMMON HARDWARE (See Figures 6-1 and 8-2)		
H1	2190-0033	2	WASHER-LK INTL T NO. 5/16 .314 IN ID	78189	1918-02
H2	2950-0007	1	NUT-HEX-DBL CHAM 5/16-32 THD .094 THK (P/O A4)	73734	9001
H3	2190-0084	5	WASHER-LK INTL T NO. 1/4 .256 IN ID	78189	1214-05
H4	2950-0072	4	NUT-HEX-DBL CHAM 1/4-32 THD .062-THK	82389	P-1975
H5	3050-0028	1	WASHER-FL MTLC NO. 12 .25 IN ID .438 IN OD (P/O A4)	28480	3050-0028
H6	3050-0389	1	WASHER-FL NM NO. 1/4 .26 IN ID .5 IN OD (P/O A4)	28480	3050-0389
H7	3050-0386	1	WASHER-SHLDR NO. 1/4 .25 IN ID .5 IN OD (P/O A4)	72653	6528
H8	3050-0001	1	WASHER-FL MTLC NO. 8 .172 IN ID .375 IN OD (P/O A4)	73734	1445
H9	2190-0017	4	WASHER-LK HLCL NO. 8 .168 IN ID .31 IN OD (P/O A4)	28480	2190-0017
H10	2510-0137	3	SCREW-MACH 8-32 2.75-IN-LG PAN HD (P/O A4)	28480	2510-0137
H11	0624-0263	2	SCREW-TPG 6-32 .438-IN-LG PAN HD	28480	0624-0263
H12	0624-0212	1	SCREW-TPG 6-32 .375-IN-LG 82 DEG FL-HD	28480	0624-0212
H13	0520-0127	2	SCREW-MACH 2-56 .188-IN-LG PAN HD	28480	0520-0127
H14	2950-0035	3	NUT-HEX-DBL CHAM 15/32-32-THD .078-THK	28480	2950-0035
H15	2190-0018	6	WASHER-LK HLCL NO. 6 .141 IN ID .269 IN OD	28480	2190-0018
H16	2360-0135	2	SCREW-MACH 6-32 1.5-IN-LG PAN HD	28480	2360-0135
H17	3050-0393	2	WASHER-FL MTLC NO. 5 .13 IN ID .313 IN OD	28480	3050-0393
H18	2360-0197	2	SCREW-MACH 6-32 .375-IN-LG PAN HD	28480	2360-0197
H19	2360-0115	1	SCREW-MACH 6-32 .312-IN-LG PAN HD	28480	2360-0115
H20	2360-0211	2	SCREW-MACH 6-32 .75-IN-LG 82 DEG FL HD	28480	2360-0211
H21	2360-0198	2	SCREW-MACH 6-32 .438-IN-LG 100 DEG FL HD	28480	2360-0198
H22	2510-0136	3	SCREW-MACH 8-32 2.5-IN-LG PAN HD (P/O A4)	28480	2510-0136
H23	2200-0143	1	SCREW MACH 4-40 .375-IN-LG PAN HD	28480	2200-0143
			CHASSIS PARTS		
A1	01220-66536		HORIZONTAL SWEEP ASSEMBLY	28480	01220-66536
A2	01220-66535		VERTICAL AMPLIFIER ASSEMBLY	28480	01220-66535
A3	01222-66532		HIGH VOLTAGE POWER SUPPLY	28480	01222-66532
A4	01220-61122		HEAT SINK ASSEMBLY	28480	01220-61122
E1	0360-1646	1	TERMINAL-PROBE ADJ	28480	0360-1646
L1	01220-67721		COIL ASSEMBLY, ALIGN	28480	01220-67721
MP1	0350-0824	2	KNOB CAP DECAL; .375 IN; PTR CW	28480	0350-0824
MP2	0350-0975	1	KNOB-DECAL-SKIRT; PTR CCW	28480	0350-0975
MP3	0370-1005	6	KNOB; BASE; PTR; .375 IN; JGK; SGI	28480	0370-1005
MP4	0370-2512	3	KNOB-VERNIER	28480	0370-2512
MP5	0403-0311	4	FEET-RUBBER	28480	0403-0311
MP6	01220-67421	2	KNOB ASSY, VOLTS/DIV	28480	01220-67421
MP7	01220-67422	1	KNOB ASSY, TIME/DIV	28480	01220-67422
MP8			NOT ASSIGNED		
MP9	01222-23221	1	COLLAR	28480	01222-23221
MP10			NOT ASSIGNED		
MP11	1400-0534	1	CLAMP; HOSE; 2.37 DIA .37 W STL	28480	1400-0534
MP12	01220-65201	1	HOUSING	28480	01220-65201
MP13	01220-24721	1	EXTRUSION-SPACER	28480	01220-24721
MP14	01220-00222	1	PANEL, FRONT	28480	01220-00222
MP15	01220-04121	1	COVER, HOUSING	28480	01220-04121
MP16	01220-42201	1	BEZEL	28480	01220-42201
MP17	01220-42301	1	HOLDER, TUBE	28480	01220-42301
MP18	4114-0521	1	FILTER, BLUE LIGHT	28480	4114-0521
MP19	5000-8895	1	PLATE, SAFETY	28480	5000-8895
MP20	01220-44101	1	COVER, HANDLE	28480	01220-44101
MP21	5000-8893	1	HANDLE, SIDE	28480	5000-8893
MP22	5000-8894	2	HANDLE, STRAP	28480	5000-8894
MP23	1220-0202	1	SHIELD	28480	1220-0202
MP24	1460-1406	1	TILT STAND, SST	28480	1460-1406
MP25	01220-43203	2	SHAFT, LONG	28480	01220-43203
MP26	01220-43206	1	SHAFT, BEAM FINDER	28480	01220-43206
MP27			NOT ASSIGNED		
MP28	01220-44103	1	HOLDER AND COVER-HV	28480	01220-44103
MP29	1520-0063	1	MOUNT, VIBRATION	28480	1520-0063
MP30	01220-00621	2	SHIELD, ATTENUATOR	28480	01220-00621
MP31	01220-05401	1	INSULATOR	28480	01220-05401
R1	2100-2488	3	RESISTOR-VAR 10K 20% CC (CH A POSITION)	28480	2100-2488
R2	2100-2488		RESISTOR-VAR 10K 20% CC (CH B POSITION)	28480	2100-2488
R3	2100-2488		RESISTOR-VAR 10K 20% CC (HORIZ POSITION)	28480	2100-2488
R4	2100-0592	1	RESISTOR-VAR 20K 20% CC (TRIGGER LEVEL)	28480	2100-0592
S1	3101-1732	1	SWITCH-TGL SUBMIN DPDT NS 2A 250VAC (LINE)	28480	3101-1732
V1	2090-0032	1	CRT:P31	28480	2090-0032
W1	8120-1521	1	CABLE-POWER, 7.5 FT	28480	8120-1521
W2	01220-61622	1	CABLE ASSY, LV INTERCONNECT	28480	01220-61622
W3	01220-61623	1	CABLE ASSY, POTENTIOMETER	28480	01220-61623
W4	01220-61627	1	CABLE ASSY, CRT	28480	01220-61627
W5	01220-61624	1	CABLE ASSY, POWER SWITCH	28480	01220-61624

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1	01220-66536	1	HORIZONTAL SWEEP ASSEMBLY	28480	01220-66536
A1A1		1	TRIGGER ASSEMBLY, NSR: ORDER A1		
A1A1C1	0160-0174	3	CAPACITOR-FXD .47UF +80-20% 25WVDC CER	28480	0160-0174
A1A1C2	0160-2903	5	CAPACITOR-FXD .05UF +-20% 500WVDC CER	28480	0160-2903
A1A1C3	0160-4213	11	CAPACITOR-FXD .1UF +80-20% 50WVDC CER	28480	0160-4213
A1A1C4	0160-3208	9	CAPACITOR-FXD .025UF +80-20% 100WVDC CER	28480	0160-3208
A1A1C5	0160-4213		CAPACITOR-FXD .1UF +80-20% 50WVDC CER	28480	0160-4213
A1A1C6	0160-2930	7	CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2930
A1A1C7	0160-2930		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2930
A1A1C8	0160-2930		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2930
A1A1C9	0160-2251	2	CAPACITOR-FXD 5.6PF +-.25PF 500WVDC CER	28480	0160-2251
A1A1C10	0160-2903		CAPACITOR-FXD .05UF +-20% 500WVDC CER	28480	0160-2903
A1A1C11	0160-2930		CAPACITOR-FXD .01UF +80-20% 100 WVDC CER	28480	0160-2930
A1A1C12	0160-2251		CAPACITOR-FXD 5.6PF +-.25PF 500WVDC CER	28480	0160-2251
A1A1C13	0160-2903		CAPACITOR-FXD .05UF +-20% 500WVDC CER	28480	0160-2903
A1A1C14			NOT ASSIGNED		
A1A1C15			NOT ASSIGNED		
A1A1C16	0160-0168	4	CAPACITOR-FXD .1UF +-10% 200WVDC POLYE	56289	292P10492
A1A1C17	0160-0168		CAPACITOR-FXD .1UF +-10% 200WVDC POLYE	56289	292P10492
A1A1C18	0160-4213		CAPACITOR-FXD .1UF +80-20% 50WVDC CER	28480	0160-4213
A1A1C19	0160-2913	1	CAPACITOR-FXD .01UF +85-20% 500WVDC CER	28480	0160-2913
A1A1C20	0160-3208		CAPACITOR-FXD .025UF +80-20% 100WVDC CER	28480	0160-3208
A1A1C21	0160-3208		CAPACITOR-FXD .025UF +80-20% 100WVDC CER	28480	0160-3208
A1A1C22	0180-0423	3	CAPACITOR-FXD 100UF +50-10% 25VDC AL	28480	0180-0423
A1A1C23	0160-4213		CAPACITOR-FXD .1UF +80-20% 50WVDC CER	28480	0160-4213
A1A1C24	0180-0374	1	CAPACITOR-FXD; 10UF+-10% 20VDC TA-SOLID	56289	1500106X9020B2
A1A1C25	0160-2959	13	CAPACITOR-FXD 1000PF +80-20% 1000WVDC	28480	0160-2959
A1A1C26	0160-4213		CAPACITOR-FXD .1UF +80-20% 50WVDC CER	28480	0160-4213
A1A1C27	0180-0229	2	CAPACITOR-FXD; 33UF+-10% 10VDC TA-SOLID	56289	1500336X9010B2
A1A1C28	0160-2141	1	CAPACITOR-FXD 680PF +-20% 1000WVDC	28480	0160-2141
A1A1C29	0160-0938	2	CAPACITOR-FXD 1000PF +-5% 100WVDC MICA	53021	D15C1E102J
A1A1C30	0160-0938		CAPACITOR-FXD 1000PF +-5% 100WVDC MICA	53021	D15C1E102J
A1A1C31	0160-0174		CAPACITOR-FXD .47UF +80-20% 25WVDC CER	28480	0160-0174
A1A1C32	0140-0196	3	CAPACITOR-FXD 150PF +-5% 300WVDC MICA	72136	DM15F151J0300WV1CR
A1A1C33	0121-0476	1	CAPACITOR-VAR POLY 5.5-65 PF 100VDCW	28480	0121-0476
A1A1C34	0160-3009	1	CAPACITOR-FXD 982PF +-1% 100WVDC MICA	28480	0160-3009
A1A1C35	0160-3255	1	CAPACITOR-FXD .1UF +-1% 250WVDC POLYSTY	28480	0160-3255
A1A1C36	0160-0599	1	CAPACITOR-FXD 10UF +-2% 63WVDC MET POLYC	28480	0160-0599
A1A1C37	0160-2959		CAPACITOR-FXD 1000PF +80-20% 1000WVDC	28480	0160-2959
A1A1C38	0160-2959		CAPACITOR-FXD 1000PF +80-20% 1000WVDC	28480	0160-2959
A1A1C39	0160-2261	1	CAPACITOR-FXD 15PF +-5% 500WVDC CER	28480	0160-2261
A1A1C40	0160-2903		CAPACITOR-FXD .05UF +-20% 500WVDC CER	28480	0160-2903
A1A1C41	0160-2959		CAPACITOR-FXD 1000PF +80-20% 1000WVDC	28480	0160-2959
A1A1C42	0160-2959		CAPACITOR-FXD 1000PF +80-20% 1000WVDC	28480	0160-2959
A1A1C43	0160-0174		CAPACITOR-FXD .47UF +80-20% 25WVDC CER	28480	0160-0174
A1A1C44	0160-4213		CAPACITOR-FXD .1UF +80-20% 50WVDC CER	28480	0160-4213
A1A1CR1	1901-0040	5	DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1A1CR2	1901-0376	5	DIODE-GEN PRP 35V 50MA	28480	1901-0376
A1A1CR3	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1A1CR4	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1A1CR5	1910-0034	5	DIODE-SWITCHING 8NS 30V 80MA	28480	1910-0034
A1A1CR6	1910-0034		DIODE-SWITCHING 8NS 30V 80MA	28480	1910-0034
A1A1CR7	1910-0034		DIODE-SWITCHING 8NS 30V 80MA	28480	1910-0034
A1A1CR8	1910-0034		DIODE-SWITCHING 8NS 30V 80MA	28480	1910-0034
A1A1CR9	1910-0034		DIODE-SWITCHING 8NS 30V 80MA	28480	1910-0034
A1A1CR10	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1A1CR11	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1A1CR12	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A1A1J1	1251-0567	1	CONNECTOR:8-PIN	28480	1251-0567
A1A1J2	1251-0566	1	CONNECTOR:4-PIN	28480	1251-0566
A1A1MP1	5040-1127	5	KNOB, PUSHBUTTON, GREEN	28480	5040-1127
A1A1MP2	5040-1123	2	KNOB, PUSHBUTTON, BLUE	28480	5040-1128
A1A1MP3	01220-43202	1	COUPLER, SWITCH	28480	01220-43202
A1A1MP4	1205-0095	1	HEAT-DISSIPATOR SGL TO-5/TO-39 PKG	28480	1205-0095
A1A1Q1	1854-0019	2	TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A1A1Q2	1853-0218	4	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0218
A1A1Q3	1854-0637	4	TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	28480	1854-0637
A1A1Q4	1854-0637		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	28480	1854-0637
A1A1Q5	1853-0314	4	TRANSISTOR PNP 2N2905A SI TO-5 PD=600MW	04713	2N2905A
A1A1Q6	1853-0314		TRANSISTOR PNP 2N2905A SI TO-5 PD=600MW	04713	2N2905A
A1A1Q7	1854-0019		TRANSISTOR NPN SI TO-18 PD=360MW	28480	1854-0019
A1A1Q8	1853-0218		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0218
A1A1Q9	1854-0637		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	28480	1854-0637
A1A1Q10	1854-0637		TRANSISTOR NPN 2N2219A SI TO-5 PD=800MW	28480	1854-0637

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A1Q11	1853-0314		TRANSISTOR PNP 2N2905A SI TO-5 PD=600MW	04713	2N2905A
A1A1Q12	1853-0314		TRANSISTOR PNP 2N2905A SI TO-5 PD=600MW	04713	2N2905A
A1A1Q13	1855-0201	1	TRANSISTOR J-FET N-CHAN D-MODE SI	28480	1855-0201
A1A1Q14	1853-0036	8	TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A1A1Q15	1854-0071	8	TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q16	1853-0034	2	TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A1A1Q17	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q18	1853-0034		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0034
A1A1Q19	1853-0015	1	TRANSISTOR PNP SI PD=200MW FT=500MHZ	28480	1853-0015
A1A1Q20	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q21	1854-0296	1	TRANSISTOR NPN SI TO-92 PD=310MW	28480	1854-0296
A1A1Q22	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q23	1854-0005	1	TRANSISTOR NPN 2N708 SI TO-18 PD=360MW	28480	1854-0005
A1A1Q24	1853-0086	1	TRANSISTOR PNP SI PD=310MW FT=40MHZ	28480	1853-0086
A1A1Q25	1854-0392	1	TRANSISTOR NPN SI PD=310MW FT=50MHZ	28480	1854-0392
A1A1Q26	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q27	1853-0218		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0218
A1A1Q28	1853-0218		TRANSISTOR PNP SI TO-18 PD=360MW	28480	1853-0218
A1A1Q29	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q30	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A1A1Q31	1854-0621	2	TRANSISTOR NPN SI TO-39 PD=800MW	01295	8F258
A1A1Q32	1854-0621		TRANSISTOR NPN SI TO-39 PD=800MW	01295	8F258
A1A1Q33	1853-0355	4	TRANSISTOR PNP SI PD=625MW	01295	8F398
A1A1Q34	1853-0355		TRANSISTOR PNP SI PD=625MW	01295	8F398
A1A1Q35	1853-0355		TRANSISTOR PNP SI PD=625MW	01295	8F398
A1A1Q36	1853-0355		TRANSISTOR PNP SI PD=625MW	01295	8F398
A1A1R1	0757-0394	9	RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A1A1R2	0757-0451	2	RESISTOR 24.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2432-F
A1A1R3	0757-0427	9	RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A1A1R4	0757-0401	16	RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A1R5	0757-0440	7	RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A1A1R6	0757-0440		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A1A1R7	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A1R8	0757-0427		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A1A1R9	0757-0394		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A1A1R10	0757-0451		RESISTOR 24.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2432-F
A1A1R11	0757-0427		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A1A1R12	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A1R13	0757-0427		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A1A1R14	0757-0440		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A1A1R15	0757-0440		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A1A1R16	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A1R17	0758-0005	8	RESISTOR 4.7K 5% .25W F TC=0+-100	24546	C5-1/4-T0-4701-J
A1A1R18	0758-0005		RESISTOR 4.7K 5% .25W F TC=0+-100	24546	C5-1/4-T0-4701-J
A1A1R19	0757-0282	4	RESISTOR 221 1% .125W F TC=0+-100	24546	C4-1/8-T0-221R-F
A1A1R20	0758-0005		RESISTOR 4.7K 5% .25W F TC=0+-100	24546	C5-1/4-T0-4701-J
A1A1R21	0758-0005		RESISTOR 4.7K 5% .25W F TC=0+-100	24546	C5-1/4-T0-4701-J
A1A1R22	0757-0282		RESISTOR 221 1% .125W F TC=0+-100	24546	C4-1/8-T0-221R-F
A1A1R23	0758-0005		RESISTOR 4.7K 5% .25W F TC=0+-100	24546	C5-1/4-T0-4701-J
A1A1R24	0758-0005		RESISTOR 4.7K 5% .25W F TC=0+-100	24546	C5-1/4-T0-4701-J
A1A1R25	0758-0005		RESISTOR 4.7K 5% .25W F TC=0+-100	24546	C5-1/4-T0-4701-J
A1A1R26	0757-0282		RESISTOR 221 1% .125W F TC=0+-100	24546	C4-1/8-T0-221R-F
A1A1R27	0758-0005		RESISTOR 4.7K 5% .25W F TC=0+-100	24546	C5-1/4-T0-4701-J
A1A1R28	0757-0282		RESISTOR 221 1% .125W F TC=0+-100	24546	C4-1/8-T0-221R-F
A1A1R29	0698-4467	1	RESISTOR 1.05K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1051-F
A1A1R30	0758-0019	1	RESISTOR 18K 5% .25W F TC=0+-100	24546	C5-1/4-T0-1802-J
A1A1R31	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A1R32	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A1R33	0757-0280	21	RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A1R34			NOT ASSIGNED		
A1A1R35	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A1R36	0757-0431	3	RESISTOR 2.43K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2431-F
A1A1R37	0757-0431		RESISTOR 2.43K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2431-F
A1A1R38	0757-0438	3	RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1A1R39	0757-0475	1	RESISTOR 274K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2743-F
A1A1R40	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A1R41	0757-0288	1	RESISTOR 9.09K 1% .125W F TC=0+-100	19701	MF4C1/8-T0-9091-F
A1A1R42	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A1R43	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A1R44	0757-0283	5	RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A1A1R45	0757-0419	3	RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A1A1R46	0757-0416	5	RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A1R47	0757-0346	13	RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A1A1R48	0698-3540	1	RESISTOR 15.4K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1542-F
A1A1R49	0757-0415	1	RESISTOR 475 1% .125W F TC=0+-100	24546	C4-1/8-T0-4752-F

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A1R50	0698-3150	2	RESISTOR 2.37K 1% .125W F TC=0+-100	16299	C4-1/8-T0-2371-F
A1A1R51	2100-0568	1	RESISTOR-VAR TRMR 100 OHM 10%	73138	72PR100K
A1A1R52	0698-3150		RESISTOR 2.37K 1% .125W F TC=0+-100	16299	C4-1/8-T0-2371-F
A1A1R53	0757-0274	2	RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A1A1R54	0698-4453	2	RESISTOR 402 1% .125W F TC=0+-100	24546	C4-1/8-T0-402R-F
A1A1R55	0757-0274		RESISTOR 1.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1213-F
A1A1R56	0698-4453		RESISTOR 402 1% .125W F TC=0+-100	24546	C4-1/8-T0-402R-F
A1A1R57	0698-4439	2	RESISTOR 3.24K 1% .125W F TC=0+-100	16299	C4-1/8-T0-3241-F
A1A1R58	0757-0394		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A1A1R59	0698-4439		RESISTOR 3.24K 1% .125W F TC=0+-100	16299	C4-1/8-T0-3241-F
A1A1R60	0757-0424	2	RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A1A1R61	0683-1055	1	RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB1055
A1A1R62	0757-0444	1	RESISTOR 12.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1212-F
A1A1R63	0757-0468	2	RESISTOR 130K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1303-F
A1A1R64	0698-4496	1	RESISTOR 45.3K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4532-F
A1A1R65	0757-0449	7	RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A1A1R66	0757-0459	1	RESISTOR 56.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5622-F
A1A1R67	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A1R68	0698-4495	3	RESISTOR 37.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3742-F
A1A1R69	0757-0465	14	RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A1A1R70	0757-0440		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A1A1R71	0757-0279	1	RESISTOR-FXD 3.16K 1% .125W F	24546	C4-1/8-T0-3161-F
A1A1R72	0757-0431		RESISTOR 2.43K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2431-F
A1A1R73	0757-0457	2	RESISTOR 47.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4752-F
A1A1R74	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A1R75	0757-0416		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A1R76	0757-0457		RESISTOR 47.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4752-F
A1A1R77	0698-4471		RESISTOR 7.15K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7151-F
A1A1R78	0757-0283		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A1A1R79	0757-0283		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A1A1R80	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A1R81	0757-0442	7	RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A1R82	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A1A1R83	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A1R84	0757-0407	14	RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A1A1R85	0757-0283		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A1A1R86	0757-0420	8	RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A1A1R87	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A1R88	0757-0394		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A1A1R89	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A1A1R90	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A1A1R91	0758-0006	1	RESISTOR 10K 5% .25W F TC=0+-100	24546	C5-1/4-T0-1002-J
A1A1R92	0757-0407		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A1A1R93	0757-0453	1	RESISTOR 30.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3012-F
A1A1R94	0757-0427		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A1A1R95	2100-3211	1	RESISTOR-VAR TRMR 1K OHM 10% C	32997	3389P-1-102
A1A1R96	0757-0430	2	RESISTOR 2.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2211-F
A1A1R97	0698-3225	2	RESISTOR 1.43K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1431-F
A1A1R98	0757-0407		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A1A1R99	0757-0283		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A1A1R100	0698-4495		RESISTOR 37.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3742-F
A1A1R101	0757-0454	3	RESISTOR 33.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3322-F
A1A1R102	0757-0399	7	RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A1A1R103	2100-3252	3	RESISTOR-VAR TRMR 5K OHM 10% C	32997	3389P-1-502
A1A1R104	0698-4495		RESISTOR 37.4K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3742-F
A1A1R105	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A1A1R106	0757-0044	2	RESISTOR 33.2K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-3322-F
A1A1R107	0757-0416		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A1R108	0757-0416		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A1A1R109	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A1A1R110	0757-0044		RESISTOR 33.2K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-3322-F
A1A1R111	0698-3225		RESISTOR 1.43K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1431-F
A1A1R112	0761-0028	4	RESISTOR 12K 5% 1W MO TC=0+-200	24546	FP32-1-T00-1202-J
A1A1R113	0761-0028		RESISTOR 12K 5% 1W MO TC=0+-200	24546	FP32-1-T00-1202-J
A1A1R114	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A1A1R115	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A1A1R116	0761-0028		RESISTOR 12K 5% 1W MO TC=0+-200	24546	FP32-1-T00-1202-J
A1A1R117	0761-0028		RESISTOR 12K 5% 1W MO TC=0+-200	24546	FP32-1-T00-1202-J
A1A1R118	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A1A1R119	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A1A1R120	0757-0469	1	RESISTOR 150K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1503-F
A1A1R121	0757-0420		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A1A1R122	0757-0420		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A1A1R123	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A1A1R124	0757-0449		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A1A1S1	3101-0562	1	SWITCH; PB -STA DPDT	28480	3101-0562
A1A1S2	3101-0561	1	SWITCH-PB DPDT	28480	3101-0561
A1A1U1	1820-0424	1	IC SN74H 04 N	01295	SN74H04N
A1A1U2	1820-0054	2	IC SN74 00 N	01295	SN7400N
A1A1U3	1820-0596	1	IC DM74L 74N	27014	DM74L74N
A1A1U4	1820-0370	1	IC SN74H 00 N	01295	SN74H00N
A1A1U5	1820-0537	1	IC SN74 13 N	01295	SN7413N
A1A1U6	1820-0054		IC SN74 00 N	01295	SN7400N
A1A1U7	1820-0715	1	IC SN74H 106 N	01295	SN74H106N
A1A1U8	1820-0704	1	IC SN74 122 N	01295	SN74122N
A1A1VR1	1902-3125	2	DIODE-ZNR 6.98V 2% DO-7 PD=.4W TC=+.045%	04713	SZ 10939-138
A1A1VR2	1902-3092	2	DIODE-ZNR 4.99V 2% DO-7 PD=.4W TC=-.012%	04713	SZ 10939-96
A1A1VR3	1902-3092		DIODE-ZNR 4.99V 2% DO-7 PD=.4W TC=-.012%	04713	SZ 10939-96
A1A1VR4	1902-3125		DIODE-ZNR 6.98V 2% DO-7 PD=.4W TC=+.045%	04713	SZ 10939-138
A1A2	01220-61904	1	SWITCH, ROTARY, TIME/DIV	28480	01220-61904
A1A2MP1	01220-00624	1	BRACKET, MOUNTING	28480	01220-00624
A1A2R1	2100-0591	1	RESISTOR-VAR 25K 20% CC (SWP EXPANDER)	28480	2100-0591
A1A2A1	01220-66533	1	SWITCH, P/O TIME/DIV	28480	01220-66533
A1A2A1C1	0160-2218	1	CAPACITOR-FXD 1000PF +-5% 300WVDC MICA	28480	0160-2218
A1A2A1C2	0160-3996	1	CAPACITOR-FXD .027UF +-10% 250WVDC MET	GM051	DGJPM 4270K
A1A2A1C3	0180-1745	1	CAPACITOR-FXD: 1.5UF+-10% 20VDC TA	56289	150D155X9020A2
A1A2A1C4	0180-0229		CAPACITOR-FXD: 33UF+-10% 10VDC TA-SOLID	56289	150D336X9010B2
A1A2A1R1	0757-0424		RESISTOR 1.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1101-F
A1A2A1R2	0757-0200	1	RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A1A2A1S1	3130-0507	1	SHAFT AND INDEX ASSY	28480	3130-0507
A1A2A2	01220-66522	1	SWITCH, P/O TIME/DIV	28480	01220-66522
A1A2A2R1	0698-5323	1	RESISTOR 4K .5% .125W F TC=0+-50	03888	PME55S
A1A2A2R2	0698-6755	1	RESISTOR 8K .5% .125W F TC=0+-50	24546	NC4-1/8-T2-8001-D
A1A2A2R3	0698-6885	1	RESISTOR 20K .5% .125W F TC=0+-50	03888	PME55S
A1A2A2R4	0698-6871	1	RESISTOR 10K .5% .125W F TC=0+-50	03888	PME55S
A1A2A2R5	0698-5573	1	RESISTOR 50K .5% .125W F TC=0+-100	24546	C4-1/8-T0-5002-D
A1A2A2R6	0698-6770	1	RESISTOR 100K .5% .125W F TC=0+-50	03888	PME55S
A1A2A2R7	0698-6217	1	RESISTOR 200K .5% .125W F TC=0+-100	03888	PME55S
A1A2A2R8	0698-3263	1	RESISTOR 500K 1% .125W F TC=0+-100	91637	MFF-1/8, T-1
A1A2A2S1	3130-0508	1	SHAFT AND INDEX ASSY	28480	3130-0508
A2	01220-66535	1	VERTICAL AMPLIFIER ASSEMBLY	28480	01220-66535
A2A1		1	AMPLIFIER-MAIN BD ASSY NSR: ORDER A2		
A2A1C1	0180-0424	3	CAPACITOR-FXD 470UF 25 WVDC AL	28480	0180-0424
A2A1C2	0160-4213		CAPACITOR-FXD .1UF +80-20% 50WVDC CER	28480	0160-4213
A2A1C3	0180-0425	2	CAPACITOR-FXD 4.7UF 250 WVDC AL	28480	0180-0425
A2A1C4	0180-0426	2	CAPACITOR-FXD 22UF 250 WVDC AL	28480	0180-0426
A2A1C5	0180-0425		CAPACITOR-FXD 4.7UF 250 WVDC AL	28480	0180-0425
A2A1C6	0180-0426		CAPACITOR-FXD 22UF 250 WVDC AL	28480	0180-0426
A2A1C7	0160-3719	1	CAPACITOR-FXD .068UF +-10% 250WVDC MET	28480	0160-3719
A2A1C8	0160-2140	1	CAPACITOR-FXD 470PF +80-20% 1000WVDC CER	28480	0160-2140
A2A1C9	0160-2930		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2930
A2A1C10	0160-2930		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-2930
A2A1C11	0180-0424		CAPACITOR-FXD 470UF 25 WVDC AL	28480	0180-0424
A2A1C12	0160-2141	1	CAPACITOR-FXD 680PF +-20% 1000WVDC CER	28480	0160-2141
A2A1C13	0180-0423		CAPACITOR-FXD 100UF +50-10% 25VDC AL	28480	0180-0423
A2A1C14	0180-0424		CAPACITOR-FXD 470UF 25 WVDC AL	28480	0180-0424
A2A1C15	0180-0423		CAPACITOR-FXD 100UF +50-10% 25VDC AL	28480	0180-0423
A2A1C16	0160-3581	2	CAPACITOR-FXD .1UF +-20% 1000WVDC MET	28480	0160-3581
A2A1C17	0121-0061	4	CAPACITOR; VAR; TRMR; CER; 5.5/18PF	73899	DV11PS18A
A2A1C18	0121-0060	4	CAPACITOR; VAR; TRMR; CER; 2/8PF	73899	DV11PS8A
A2A1C19	0140-0191	2	CAPACITOR-FXD 56PF +-5% 300WVDC MICA	72136	DM15E560J0300WV1CR
A2A1C20	0121-0061		CAPACITOR; VAR; TRMR; CER; 5.5/18PF	73899	DV11PS18A
A2A1C21	0121-0060		CAPACITOR; VAR; TRMR; CER; 2/8PF	73899	DV11PS8A
A2A1C22	0160-2940	2	CAPACITOR-FXD 470PF +-5% 300WVDC MICA	28480	0160-2940
A2A1C23	0160-3226	2	CAPACITOR-FXD .01UF +-10% 400WVDC MET	28480	0160-3226
A2A1C24	0160-3447	4	CAPACITOR-FXD 470PF +-10% 1000WVDC CER	28480	0160-3447
A2A1C25	0160-3447		CAPACITOR-FXD 470PF +-10% 1000WVDC CER	28480	0160-3447
A2A1C26	0160-2959		CAPACITOR-FXD 1000PF +80-20% 1000WVDC	28480	0160-2959
A2A1C27	0160-2959		CAPACITOR-FXD 1000PF +80-20% 1000WVDC	28480	0160-2959
A2A1C28	0160-2959		CAPACITOR-FXD 1000PF +80-20% 1000WVDC	28480	0160-2959
A2A1C29	0150-0059	4	CAPACITOR-FXD 3.3PF +-.25PF 500WVDC CER	28480	0150-0059
A2A1C30	0160-3581		CAPACITOR-FXD .1UF +-20% 1000WVDC MET	28480	0160-3581

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2A1C31	0121-0061		CAPACITOR; VAR; TRMR; CER; 5.5/18PF	73899	OV11PS18A
A2A1C32	0121-0060		CAPACITOR; VAR; TRMR; CER; 2/8PF	73899	OV11PS8A
A2A1C33	0140-0191		CAPACITOR-FXD 56PF +-5% 300WVDC MICA	72136	DM15E560J0300WV1CR
A2A1C34	0121-0061		CAPACITOR; VAR; TRMR; CER; 5.5/18PF	73899	OV11PS18A
A2A1C35	0121-0060		CAPACITOR; VAR; TRMR; CER; 2/8PF	73899	OV11PS8A
A2A1C36	0160-2940		CAPACITOR-FXD 470PF +-5% 300WVDC MICA	28480	0160-2940
A2A1C37	0160-3226		CAPACITOR-FXD .01UF +-10% 400WVDC MET	28480	0160-3226
A2A1C38	0160-3447		CAPACITOR-FXD 470PF +-10% 1000WVDC CER	28480	0160-3447
A2A1C39	0160-3447		CAPACITOR-FXD 470PF +-10% 1000WVDC CER	28480	0160-3447
A2A1C40	0160-2959		CAPACITOR-FXD 1000PF +80-20% 1000WVDC	28480	0160-2959
A2A1C41	0160-2959		CAPACITOR-FXD 1000PF +80-20% 1000WVDC	28480	0160-2959
A2A1C42	0160-2959		CAPACITOR-FXD 1000PF +80-20% 1000WVDC	28480	0160-2959
A2A1C43	0150-0059		CAPACITOR-FXD 3.3PF +-.25PF 500WVDC CER	28480	0150-0059
A2A1C44	0160-4213		CAPACITOR-FXD .1UF +80-20% 50WVDC CER	28480	0160-4213
A2A1C45	0160-3208		CAPACITOR-FXD .025UF +80-20% 100WVDC CER	28480	0160-3208
A2A1C46	0160-4213		CAPACITOR-FXD .1UF +80-20% 50WVDC CER	28480	0160-4213
A2A1C47	0160-3208		CAPACITOR-FXD .025UF +80-20% 100WVDC CER	28480	0160-3208
A2A1C48	0150-0059		CAPACITOR-FXD 3.3PF +-.25PF 500WVDC CER	28480	0150-0059
A2A1C49	0150-0059		CAPACITOR-FXD 3.3PF +-.25PF 500WVDC CER	28480	0150-0059
A2A1C50	0140-0196		CAPACITOR-FXD 150PF +-5% 300WVDC MICA	72136	DM15F151J0300WV1CR
A2A1C51	0140-0196		CAPACITOR-FXD 150PF +-5% 300WVDC MICA	72136	DM15F151J0300WV1CR
A2A1C52	0160-2243	1	CAPACITOR-FXD 2.7PF +-.25PF 500WVDC CER	28480	0160-2243
A2A1C53	0140-0193	1	CAPACITOR-FXD 82PF +-5% 300WVDC MICA	72136	DM15E820J0300WV1CR
A2A1C54	0160-2959		CAPACITOR-FXD 1000PF +80-20% 1000WVDC	28480	0160-2959
A2A1C55	0160-4213		CAPACITOR-FXD .1UF +80-20% 50WVDC CER	28480	0160-4213
A2A1C56	0160-3208		CAPACITOR-FXD .025UF +80-20% 100WVDC CER	28480	0160-3208
A2A1C57	0160-4213		CAPACITOR-FXD .1UF +80-20% 50WVDC CER	28480	0160-4213
A2A1C58	0160-3208		CAPACITOR-FXD .025UF +80-20% 100WVDC CER	28480	0160-3208
A2A1C59	0140-0202	1	CAPACITOR-FXD 15PF +-5% 500WVDC MICA	72136	DM15C150J0500WV1CR
A2A1C60	0140-0195	1	CAPACITOR-FXD 130PF +-5% 300WVDC MICA	72136	DM15F131J0300WV1CR
A2A1CR1	1901-0159	16	DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A2A1CR2	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A2A1CR3	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A2A1CR4	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A2A1CR5	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A2A1CR6	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A2A1CR7	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A2A1CR8	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A2A1CR9	1901-0033	5	DIODE-GEN PRP 180V 200MA	28480	1901-0033
A2A1CR10	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A2A1CR11	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A2A1CR12	1901-0033		DIODE-GEN PRP 180V 200MA	28480	1901-0033
A2A1CR13	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A2A1CR14	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A2A1CR15	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A2A1CR16	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A2A1CR17	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A2A1CR18	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A2A1CR19	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A2A1CR20	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A2A1CR21	1901-0376		DIODE-GEN PRP 35V 50MA	28480	1901-0376
A2A1CR22	1901-0376		DIODE-GEN PRP 35V 50MA	28480	1901-0376
A2A1CR23	1901-0358	6	DIODE; MULT; SILICON; DUAL	04713	MSD6101
A2A1CR24			NOT ASSIGNED		
A2A1CR25	1901-0376		DIODE-GEN PRP 35V 50MA	28480	1901-0376
A2A1CR26	1901-0376		DIODE-GEN PRP 35V 50MA	28480	1901-0376
A2A1CR27	1901-0358		DIODE; MULT; SILICON; DUAL	04713	MSD6101
A2A1CR28			NOT ASSIGNED		
A2A1CR29	1901-0358		DIODE; MULT; SILICON; DUAL	04713	MSD6101
A2A1CR30	1901-0358		DIODE; MULT; SILICON; DUAL	04713	MSD6101
A2A1CR31	1901-0358		DIODE; MULT; SILICON; DUAL	04713	MSD6101
A2A1CR32	1901-0358		DIODE; MULT; SILICON; DUAL	04713	MSD6101
A2A1CR33	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2A1CR34	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2A1CR35	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2A1CR36	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2A1CR37	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2A1CR38	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A2A1CR39	1901-0535	2	DIODE-SCHOTTKY	28480	1901-0535
A2A1CR40	1901-0535		DIODE-SCHOTTKY	28480	1901-0535
A2A1J1	1250-0518	3	CONNECTOR:BNC	28480	1250-0518
A2A1J2	1250-0518		CONNECTOR:BNC	28480	1250-0518
A2A1J3	1250-0518		CONNECTOR:BNC	28480	1250-0518
A2A1MP1	0340-0473	3	INSULATOR-POWER XSTR	28480	0340-0473
A2A1MP2	0340-0530	2	INSULATOR-XSTR	28480	0340-0530
A2A1MP3	01220-01201	1	BRACKET, BNC	28480	01220-01201
A2A1MP4	5040-1126	4	KNOB, PUSHBUTTON, GRAY	28480	5040-1126
A2A1MP5	5040-1128	2	KNOB, PUSHBUTTON, BLUE	28480	5040-1128

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2A1Q1	1854-0330	1	TRANSISTOR NPN SI PD=21W FT=10MHZ	28480	1854-0330
A2A1Q2	1854-0402	2	TRANSISTOR NPN SI PD=30W FT=3MHZ	28480	1854-0402
A2A1Q3	1854-0402		TRANSISTOR NPN SI PD=30W FT=3MHZ	28480	1854-0402
A2A1Q4	1854-0071		TRANSISTOR NPN SI PD=300MW FT=200MHZ	28480	1854-0071
A2A1Q5	1855-0211	2	TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0211
A2A1Q6	1854-0215	5	TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2A1Q7	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2A1Q8	5080-1081	2	TRANSISTOR-MATCHED (SELECTED PAIR)	28480	5080-1081
A2A1Q9	1855-0211		TRANSISTOR-JFET DUAL N-CHAN D-MODE SI	28480	1855-0211
A2A1Q10	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2A1Q11	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A2A1Q12	5080-1081		TRANSISTOR-MATCHED (SELECTED PAIR)	28480	5080-1081
A2A1Q13	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2A1Q14	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2A1Q15	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2A1Q16	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2A1Q17	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2A1Q18	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A2A1R1	0757-0449		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A2A1R2	0757-0159		RESISTOR 1K 1% .5W F	30983	MFC1/2-T0-1RD-F
A2A1R3	0761-0069	2	RESISTOR 5.1K 5% 1W MO TC=0+-200	24546	FP32-1-T00-5101-J
A2A1R4	0761-0069		RESISTOR 5.1K 5% 1W MO TC=0+-200	24546	FP32-1-T00-5101-J
A2A1R5	0757-0472	1	RESISTOR 200K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2003-F
A2A1R6	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A1R7	0757-0429	1	RESISTOR 1.82K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1821-F
A2A1R8	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A1R9	0757-0384	5	RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A2A1R10	0757-0279	2	RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A1R11	0757-0279		RESISTOR 3.16K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3161-F
A2A1R12	0757-0430		RESISTOR 2.21K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2211-F
A2A1R13	2100-0554	1	RESISTOR-VAR TRMR 500 OHM 10%	73138	72PR500K
A2A1R14	0757-0461	1	RESISTOR 68.1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-6812-F
A2A1R15	0698-0077	1	RESISTOR 93.1K 1% .125W F TC=0+-100	03888	PME55-1/8-T0-9312-F
A2A1R16	0757-0440		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A2A1R17	0698-6254	2	RESISTOR 1.8 5% .5W CC TC=0+412	01121	EB18G5
A2A1R18	0757-0440		RESISTOR 7.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-7501-F
A2A1R19	0757-0438		RESISTOR 5.11K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5111-F
A2A1R20	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A1R21	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A1R22	0757-0407		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2A1R23	0698-6254		RESISTOR 1.8 5% .5W CC TC=0+412	01121	EB18G5
A2A1R24	0757-0427		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A2A1R25	0757-0427		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A2A1R26	0698-3431	2	RESISTOR 23.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-23R7-F
A2A1R27	0757-0054	3	RESISTOR 900K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-9003-F
A2A1R28	0698-5470	2	RESISTOR 111K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1113-F
A2A1R29	0757-0057	2	RESISTOR 990K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-9903-F
A2A1R30	0698-3109	2	RESISTOR 10.1K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1012-F
A2A1R31	0757-0059	2	RESISTOR 1M 1% .5W F TC=0+-100	19701	MF7C1/2-T0-1004-F
A2A1R32	0686-2245	2	RESISTOR 220K 5% .5W CC TC=0+882	01121	EB2245
A2A1R33	0757-0437	5	RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
A2A1R34	0757-0437		RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
A2A1R35	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2A1R36	0698-0085	4	RESISTOR 2.61K 1% .125W F TC=0+-100	16299	C4-1/8-T0-2611-F
A2A1R37	0757-0394		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A2A1R38	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A1R39	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A1R40	0757-0419		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-6810-F
A2A1R41	0757-0449		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A2A1R42	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A1R43	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A1R44	0698-3447	6	RESISTOR 422 1% .125W F TC=0+-100	16299	C4-1/8-T0-422R-F
A2A1R45	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A1R46	0757-0407		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2A1R47	0698-3447		RESISTOR 422 1% .125W F TC=0+-100	16299	C4-1/8-T0-422R-F
A2A1R48	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A1R49	2100-0554	4	RESISTOR-VAR TRMR 500 OHM 10%	73138	72PR500K
A2A1R50	0757-0273	12	RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A2A1R51	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2A1R52	0757-0420		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A2A1R53	0757-0420		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A2A1R54	0698-4384	4	RESISTOR 54.9 1% .125W F TC=0+-100	16299	C4-1/8-T0-54R9-F
A2A1R55	0698-4384		RESISTOR 54.9 1% .125W F TC=0+-100	16299	C4-1/8-T0-54R9-F
A2A1R56	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2A1R57	0757-0273		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A2A1R58	0698-0085		RESISTOR 2.61K 1% .125W F TC=0+-100	16299	C4-1/8-T0-2611-F
A2A1R59	0757-0394		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A2A1R60	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2A1R61	0757-0124	2	RESISTOR 39.2K 1% .125W F TC=0+-100	24546	C5-1/4-T0-3922 F
A2A1R62	2100-0558	3	RESISTOR-VAR TRMR 20KOHM 10%	73138	72P
A2A1R63	0698-3268	2	RESISTOR 11.5K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1152-F
A2A1R64	2100-0558		RESISTOR-VAR TRMR 20K OHM 10% C	73138	72P
A2A1R65	0757-0454		RESISTOR 33.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3322-F
A2A1R66	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A1R67	0757-0317	4	RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A2A1R68	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A1R69	0698-3447		RESISTOR 422 1% .125W F TC=0+-100	16299	C4-1/8-T0-422R-F
A2A1R70	0757-0407		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2A1R71	0757-0407		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2A1R72	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A1R73	0757-0317		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A2A1R74	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A1R75	0757-0410	2	RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A2A1R76	0757-0427		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A2A1R77	0757-0427		RESISTOR 1.5K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1501-F
A2A1R78	0698-3431		RESISTOR 23.7 1% .125W F TC=0+-100	03888	PME55-1/8-T0-23R7-F
A2A1R79	0757-0054		RESISTOR 900K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-9003-F
A2A1R80	0698-5470		RESISTOR 111K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1113-F
A2A1R81	0757-0057		RESISTOR 990K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-9903-F
A2A1R82	0698-3109		RESISTOR 10.1K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1012-F
A2A1R83	0757-0059		RESISTOR 1M 1% .5W F TC=0+-100	19701	MF7C1/2-T0-1004-F
A2A1R84	0686-2245		RESISTOR 220K 5% .5W CC TC=0+882	01121	E82245
A2A1R85	0757-0437		RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
A2A1R86	0757-0437		RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-T0-4751-F
A2A1R87	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2A1R88	0698-0085		RESISTOR 2.61K 1% .125W F TC=0+-100	16299	C4-1/8-T0-2611-F
A2A1R89	0757-0394		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A2A1R90	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A1R91	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A1R92	0757-0419		RESISTOR 681 1% .125W F TC=0+-100	24546	C4-1/8-T0-681R-F
A2A1R93	0757-0449		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A2A1R94	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A1R95	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A1R96	0698-3447		RESISTOR 422 1% .125W F TC=0+-100	16299	C4-1/8-T0-422R-F
A2A1R97	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A2A1R98	0757-0407		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2A1R99	0698-3447		RESISTOR 422 1% .125W F TC=0+-100	16299	C4-1/8-T0-422R-F
A2A1R100	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A2A1R101	2100-0558		RESISTOR-VAR TRMR 20K OHM 10% C	73138	72P
A2A1R102	0757-0273		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A2A1R103	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2A1R104	0757-0420		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A2A1R105	0757-0420		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-T0-751-F
A2A1R106	0698-4384		RESISTOR 54.9 1% .125W F TC=0+-100	16299	C4-1/8-T0-54R9-F
A2A1R107	0698-4384		RESISTOR 54.9 1% .125W F TC=0+-100	16299	C4-1/8-T0-54R9-F
A2A1R108	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2A1R109	0757-0273		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3011-F
A2A1R110	0698-0085		RESISTOR 2.61K 1% .125W F TC=0+-100	16299	C4-1/8-T0-2611-F
A2A1R111	0757-0394		RESISTOR 51.1 1% .125W F TC=0+-100	24546	C4-1/8-T0-51R1-F
A2A1R112	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-T0-101-F
A2A1R113	0757-0124		RESISTOR 39.2K 1% .125W F TC=0+-100	24546	C5-1/4-T0-3922-F
A2A1R114	2100-0558		RESISTOR-VAR TRMR 20K OHM 10% C	73138	72P
A2A1R115	0698-3268		RESISTOR 11.5K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1152-F
A2A1R116	2100-0558		RESISTOR-VAR TRMR 20K OHM 10% C	73138	72P
A2A1R117	0757-0454		RESISTOR 33.2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-3322-F
A2A1R118	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A1R119	0757-0317		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A2A1R120	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A1R121	0698-3447		RESISTOR 422 1% .125W F TC=0+-100	16299	C4-1/8-T0-422R-F
A2A1R122	0757-0407		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2A1R123	0757-0407		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A2A1R124	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A1R125	0757-0317		RESISTOR 1.33K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1331-F
A2A1R126	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A2A1R127	0757-0410		RESISTOR 301 1% .125W F TC=0+-100	24546	C4-1/8-T0-301R-F
A2A1R128	0698-4402	4	RESISTOR 97.6 1% .125W F TC=0+-100	16299	C4-1/8-T0-97R6-F
A2A1R129	0698-4402		RESISTOR 97.6 1% .125W F TC=0+-100	16299	C4-1/8-T0-97R6-F
A2A1R130	0698-3252	4	RESISTOR 450 1% .125W F TC=0+-50	03888	PME55
A2A1R131	0698-3252		RESISTOR 450 1% .125W F TC=0+-50	03888	PME55
A2A1R132	0698-3530	4	RESISTOR 470 .5% .125W F TC=0+-100	03888	PME55-1/8-T0-470R-D
A2A1R133	0698-3530		RESISTOR 470 .5% .125W F TC=0+-100	03888	PME55-1/8-T0-470R-D
A2A1R134	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F
A2A1R135	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-T0-10R0-F

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2A1R136	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-TO-10R0-F
A2A1R137	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-TO-10R0-F
A2A1R138	0698-4402		RESISTOR 97.6 1% .125W F TC=0+-100	16299	C4-1/8-TO-97R6-F
A2A1R139	0698-4402		RESISTOR 97.6 1% .125W F TC=0+-100	16299	C4-1/8-TO-97R6-F
A2A1R140	0698-3252		RESISTOR 450 1% .125W F TC=0+-50	03888	PME55S
A2A1R141	0698-3252		RESISTOR 450 1% .125W F TC=0+-50	03888	PME55S
A2A1R142	0698-3530		RESISTOR 470 .5% .125W F TC=0+-100	03888	PME55-1/8-TO-470R-0
A2A1R143	0698-3530		RESISTOR 470 .5% .125W F TC=0+-100	03888	PME55-1/8-TO-470R-0
A2A1R144	2100-3252		RESISTOR-VAR TRMR 5K OHM 10% C	32997	3389P-1-502
A2A1R145	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A2A1R146	0757-0407		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-TO-201-F
A2A1R147	0757-0407		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-TO-201-F
A2A1R148	0698-3510	4	RESISTOR 453 1% .125W F TC=0+-100	16299	C4-1/8-TO-453R-F
A2A1R149	0698-3510		RESISTOR 453 1% .125W F TC=0+-100	16299	C4-1/8-TO-453R-F
A2A1R150	0757-0273		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3011-F
A2A1R151	0757-0273		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3011-F
A2A1R152	0757-0273		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3011-F
A2A1R153	0757-0273		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3011-F
A2A1R154	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A2A1R155	2100-3252		RESISTOR-VAR TRMR 5KOHM 10% C	32997	3389P-1-502
A2A1R156	0757-0407		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-TO-201-F
A2A1R157	0757-0407		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-TO-201-F
A2A1R158	0698-3510		RESISTOR 453 1% .125W F TC=0+-100	16299	C4-1/8-TO-453R-F
A2A1R159	0698-3510		RESISTOR 453 1% .125W F TC=0+-100	16299	C4-1/8-TO-453R-F
A2A1R160	0757-0434	2	RESISTOR 3.65K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3651-F
A2A1R161	0757-0273		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3011-F
A2A1R162	0757-0273		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3011-F
A2A1R163	0757-0273		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3011-F
A2A1R164	0757-0273		RESISTOR 3.01K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3011-F
A2A1R165	0757-0434		RESISTOR 3.65K 1% .125W F TC=0+-100	24546	C4-1/8-TO-3651-F
A2A1R166	0757-0437		RESISTOR 4.75K 1% .125W F TC=0+-100	24546	C4-1/8-TO-4751-F
A2A1R167	0757-0384		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-TO-20R0-F
A2A1R168	0757-0421	1	RESISTOR 825 1% .125W F TC=0+-100	24546	C4-1/8-TO-825R-F
A2A1R169	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1001-F
A2A1R170	0757-0453	1	RESISTOR 30.1K 1% .125W F	24546	C4-1/8-TO-3012-F
A2A1R171	0757-0420		RESISTOR 750 1% .125W F TC=0+-100	24546	C4-1/8-TO-751-F
A2A1R172	0698-3151	3	RESISTOR 2.87K 1% .125W F TC=0+-100	16299	C4-1/8-TO-2871-F
A2A1R173	0698-3151		RESISTOR 2.87K 1% .125W F TC=0+-100	16299	C4-1/8-TO-2871-F
A2A1R174	0698-4435	1	RESISTOR 2.49K 1% .125W F TC=0+-100	16299	C4-1/8-TO-2491-F
A2A1R175	0698-3262	2	RESISTOR 40.2 1% .125W F TC=0+-100	16299	C4-1/8-TO-4022-F
A2A1R176	0698-3151		RESISTOR 2.87K 1% .125W F TC=0+-100	16299	C4-1/8-TO-2871-F
A2A1R177	0698-3262		RESISTOR 40.2 1% .125W F TC=0+-100	16299	C4-1/8-TO-4022-F
A2A1R178	0757-0384		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-TO-20R0-F
A2A1R179	0757-0384		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-TO-20R0-F
A2A1R180					
A2A1R181	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-TO-10R0-F
A2A1R182	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-TO-10R0-F
A2A1R183	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-TO-10R0-F
A2A1R184	0757-0346		RESISTOR 10 1% .125W F TC=0+-100	24546	C4-1/8-TO-10R0-F
A2A1R185	0757-0401		RESISTOR 100 1% .125W F TC=0+-100	24546	C4-1/8-TO-101-F
A2A1R186	0757-0054		RESISTOR 900K 1% .5W F TC=0+-100	19701	MF7C1/2-TO-9003-F
A2A1R187	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-TO-1003-F
A2A1S1	3101-0560	1	SWITCH: PB 6 STA	28480	3101-0560
A2A1U1	1826-0122	1	IC REGULATOR	07263	7805UC
A2A1U2	1820-0439	1	IC REGULATOR	07263	723PC
A2A1U3	1820-0196	1	IC REGULATOR	07263	723MC
A2A1U4	1820-0217	2	IC AMPLIFIER	28480	1820-0217
A2A1U5	1821-0001	5	IC CA3046	02735	CA3046
A2A1U6	1821-0001		IC CA3046	02735	CA3046
A2A1U7	1821-0001		IC CA3046	02735	CA3046
A2A1U8	1821-0001		IC CA3046	02735	CA3046
A2A1U9	1821-0001		IC CA3046	02735	CA3046
A2A1VR1	1902-3234	1	DIODE-ZNR 19.6V 5% DO-7 PD=.4W TC=+.073%	04713	SZ 10939-266
A2A1VR2	1902-3048	5	DIODE-ZNR 3.48V 5% DO-7 PD=.4W TC=-.058%	04713	SZ 10939-50
A2A1VR3	1902-3048		DIODE-ZNR 3.48V 5% DO-7 PD=.4W TC=-.058%	04713	SZ 10939-50
A2A1VR4	1902-3048		DIODE-ZNR 3.48V 5% DO-7 PD=.4W TC=-.058%	04713	SZ 10939-50
A2A1VR5	1902-3048		DIODE-ZNR 3.48V 5% DO-7 PD=.4W TC=-.058%	04713	SZ 10939-50
A2A1VR6	1902-3048		DIODE-ZNR 3.48V 5% DO-7 PD=.4W TC=-.058%	04713	SZ 10939-50
A2A1VR7	1902-3036	1	DIODE-ZNR 3.16V 5% DO-7 PD=.4W TC=-.064%	04713	SZ 10939-3P
A2A1VR8	1902-3137	1	DIODE-ZNR 8.06V 2% DO-7 PD=.4W TC=+.052%	04713	SZ 10939-156
A2A1XA1A1P1	1251-0213	2	CONNECTOR; PC EDGE; 15-CONT; DIP SOLDER	90949	143-015-07-109
A2A1XA1A1P2	1251-0213		CONNECTOR; PC EDGE; 15-CONT; DIP SOLDER	90949	143-015-07-109

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A2A2	01220-61903	2	SWITCH, ROTARY (CHAN A VOLTS/DIV)	28480	01220-61903
A2A2MP1	3130-0038	2	COUPLER:SWITCH SST U-SHAPED	76854	12276-6
A2A2MP2	01220-00622	2	SHIELD	28480	01220-00622
A2A2MP3	01220-00623	2	BRACKET	28480	01220-00623
A2A2R1	0757-0386	2	RESISTOR 24.3 1% .125W F TC=0+-100	19701	MF4C1/8-T0-24R3-F
A2A2R2	0757-0393	2	RESISTOR 47.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-47R5-F
A2A2R3	2100-0590	2	RESISTOR-VAR 500 OHM 20% CC (VERNIER)	28480	2100-0590
A2A2S1	01220-66528	2	BOARD ASSEMBLY, SWITCH	28480	01220-66528
A2A2S2	01220-66526	2	BOARD ASSEMBLY, SWITCH	28480	01220-66526
A2A2S3	01220-66532	2	BOARD ASSEMBLY, SWITCH	28480	01220-66532
A2A3	01220-61903		SWITCH, ROTARY (CHAN B VOLTS/DIV)	28480	01220-61903
A2A3MP1	3130-0038		COUPLER:SWITCH SST U-SHAPED	76854	12276-6
A2A3MP2	01220-00622		SHIELD	28480	01220-00622
A2A3MP3	01220-00623		BRACKET	28480	01220-00623
A2A3R1	0757-0386		RESISTOR 24.3 1% .125W F TC=0+-100	19701	MF4C1/8-T0-24R3-F
A2A3R2	0757-0393		RESISTOR 47.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-47R5-F
A2A3R3	2100-0590		RESISTOR-VAR 500 OHM 20% CC (VERNIER)	28480	2100-0590
A2A3S1	01220-66528		BOARD ASSEMBLY, SWITCH	28480	01220-66528
A2A3S2	01220-66526		BOARD ASSEMBLY, SWITCH	28480	01220-66526
A2A3S3	01220-66532		BOARD ASSEMBLY, SWITCH	28480	01220-66532
A3	01222-66532	1	HIGH VOLTAGE POWER SUPPLY	28480	01222-66532
A3C1	0160-4280	2	CAPACITOR-FXD .22UF +-20% 4000WVDC MET	56289	430P224040
A3C2	0160-2902	2	CAPACITOR-FXD .01UF +-20% 1000WVDC CER	28480	0160-2902
A3C3	0160-2959		CAPACITOR-FXD 1000PF +80-20% 1000WVDC	28480	0160-2959
A3C4	0160-4213		CAPACITOR-FXD .1UF +-20% 50WVDC POLYE	28480	0160-4213
A3C5	0160-0151	2	CAPACITOR-FXD .0047 UF +80-20% 4000 WVDC	28480	0160-0151
A3C6	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A3C7	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A3C8	0160-4213		CAPACITOR-FXD .1 UF +-20% 50WVDC POLYE :T	28480	0160-4213
A3C9	0160-4042	2		28480	0160-4042
A3C10	0160-3720	1	CAPACITOR-FXC .1UF +-10% 160WVDC MET	28480	0160-3720
A3C11	0160-2902		CAPACITOR-FXD .01UF +-20% 1000WVDC CER	28480	0160-2902
A3C12	0160-3724	1	CAPACITOR-FXD .47UF +-10% 40WVDC MET	28480	0160-3724
A3C13	0160-3451		CAPACITOR-FXD .01UF +80-20% 100WVDC CER	28480	0160-3451
A3C14	0160-2959		CAPACITOR-FXD 1000PF +80-20% 1000WVDC	28480	0160-2959
A3C15	0160-4042			28480	0160-4042
A3C16	0160-0151		CAPACITOR-FXD .0047 UF +80-20% 4000 WVDC	28480	0160-0151
A3C17	0160-3447		CAPACITOR-FXD 470PF +-10% 1000WVDC CER	28480	0160-3447
A3C18	0160-2959	1	CAPACITOR-FXD 1000 PF +80-20% 1000 WVDC	28480	0160-2959
A3C19	0160-2959		CAPACITOR-FXD 1000 PF +80-20% 1000 WVDC	28480	0160-2959
A3CR1	1901-0489	4	DIODE-HV RECT 2.5KV 250MA	04713	SR 2016-4
A3CR2	1901-0489		DIODE-HV RECT 2.5KV 250MA	04713	SR 2016-4
A3CR3	1901-0489		DIODE-HV RECT 2.5KV 250MA	04713	SR 2016-4
A3CR4	1901-0489		DIODE-HV RECT 2.5KV 250MA	04713	SR 2016-4
A3CR5	1901-0050	4	DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A3CR6	1901-0050		DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A3CR7	1901-0050		DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A3CR8	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A3CR9	1901-0518	1	DIODE-SCHOTTKY	28480	1901-0518
A3CR10	1901-0050		DIODE-SWITCHING 2NS 80V 200MA	28480	1901-0050
A3CR11	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A3CR12	1901-0159		DIODE-PWR RECT 400V 750MA	04713	SR1358-4
A3CR13	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A3CR14	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A3CR15	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A3CR16	1901-0040		DIODE-SWITCHING 2NS 30V 50MA	28480	1901-0040
A3CR17	1901-0159		DIODE-PWR RECT 400 V 750 MA	04713	SR1358-4
A3CR18	1901-0159		DIODE-PWR RECT 400 V 750 MA	04713	SR1358-4
A3P1	1251-2496	1	CONNECTOR, 9-CONT, MALE, UTILITY	27264	1292-P-1
A3Q1	1854-0622	1	TRANSISTOR NPN SI PD=20W	28480	1854-0622
A3Q2	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q3	1854-0215		TRANSISTOR NPN SI PD=310MW FT=300MHZ	04713	SPS 3611
A3Q4	1853-0036		TRANSISTOR PNP SI PD=310MW FT=250MHZ	28480	1853-0036
A3Q5	1854-0409	1	TRANSISTOR NPN 2N5210 SI TO-18 PD=310MW	04713	2N5210
A3R1	0683-2035	3	RESISTOR-FXD 20 K 5% .25 W CC	24546	C5-1/4-T0-4752-F
A3R2	0686-1025	1	RESISTOR 1K 5% .5W CC TC=0+647	01121	FB1025
A3R3	2100-3214	3	RESISTOR-VAR TRMR 100KOHM 10% C TOP ADJ	73138	72PR100K
A3R4	0690-1061	1	RESISTOR 10M 10% 1W CC TC=0+1059	01121	GP1061
A3R5	0687-1011	2	RESISTOR-FXD 100 OHM 10% .5 W CC	01121	EB 1011
A3R6	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R7	0757-0416		RESISTOR 511 1% .125W F TC=0+-100	24546	C4-1/8-T0-511R-F
A3R8	2100-3214		RESISTOR-VAR TRMR 100KOHM 10% C TOP ADJ	73138	72PR100K
A3R9	2100-0595	1	RESISTOR-VAR 2.5 MEGOHM	28480	2100-0595
A3R10	0698-3455	1	RESISTOR 261K 1% .125W F TC=0+-100	16299	C4-1/8-T0-2613-F

See introduction to this section for ordering information

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

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
A3R11	0683-2265	1	RESISTOR 22M 5% .25W FC TC=-900/+1200	01121	CB2265
A3R12	0684-3941	1	RESISTOR-FXD 390K 10% .25W CC	28480	0684-3941
A3R13	0698-5038	1	RESISTOR 560K 1% .5W F TC=0+-100	24546	NA6
A3R14	2100-0594	1	RESISTOR-VAR 5 MEGOHM	28480	2100-0594
A3R15	0757-0476	1	RESISTOR-FXD 301K 1% .125 WF	24546	C4-1/8-T0-3013-F
A3R16	0757-0052	4	RESISTOR 500K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-5003-F
A3R17	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R18	0757-0468		RESISTOR 130K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1303-F
A3R19	0757-0768		RESISTOR 47.5K 1% .25W F TC=0+-100	24546	C5-1/4-T0-4752-F
A3R20	2100-0558		RESISTOR-VAR TRMR 20KOHM 10% C TOP ADJ	73138	72PR20K
A3R21	0698-3452	1	RESISTOR 147K 1% .125W F TC=0+-100	16299	C4-1/8-T0-1473-F
A3R22	0757-0052		RESISTOR 500K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-5003-F
A3R23	0757-0052		RESISTOR 500K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-5003-F
A3R24	0757-0052		RESISTOR 500K 1% .5W F TC=0+-100	19701	MF7C1/2-T0-5003-F
A3P25	2100-3274		RESISTOR-VAR TRMR 10KOHM 10% C SIDE ADJ	73138	72XR10K
A3R26	2100-3214		RESISTOR-VAR TRMR 100 K OHM 10% C TOP ADJ	73138	72PR100K
A3R27	0687-1011		RESISTOR-FXD 100 OHM 10% .5W CC	01121	EB 1011
A3R28	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R29	0757-0407		RESISTOR 200 1% .125W F TC=0+-100	24546	C4-1/8-T0-201-F
A3R30	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R31	0757-0384		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A3R32	0757-0403	1	RESISTOR 121 1% .125W F TC=0+-100	24546	C4-1/8-T0-121R-F
A3R33	0757-0200		RESISTOR 5.62K 1% .125W F TC=0+-100	24546	C4-1/8-T0-5621-F
A3R34	0757-0449		RESISTOR 20K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2002-F
A3R35	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R36	0757-0384		RESISTOR 20 1% .125W F TC=0+-100	19701	MF4C1/8-T0-20R0-F
A3R37	0686-1015		RESISTOR 100 5% .5W CC TC=0+529	01121	EB 1015
A3R38	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R39	0757-0280		RESISTOR 1K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1001-F
A3R40	0757-0283		RESISTOR 2K 1% .125W F TC=0+-100	24546	C4-1/8-T0-2001-F
A3R41	0757-0465		RESISTOR 100K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1003-F
A3R42	0757-0442		RESISTOR 10K 1% .125W F TC=0+-100	24546	C4-1/8-T0-1002-F
A3R43	0757-0441	1	RESISTOR 8.25K 1% .125W F TC=0+-100	24546	C4-1/8-T0-8251-F
A3R44	0683-1055		RESISTOR 1M 5% .25W FC TC=-800/+900	01121	CB 1055
A3S1	3101-1734	1	SWITCH ASSY	28480	3101-1734
A3U1	1826-0043	1	IC LM307H	27014	LM307H
A3VR1	1902-0586	3	DIODE-ZNR 150V 5% DO-15 PD=1W TC=+.087%	04713	SZ 11213-440
A3VR2	1902-0586		DIODE-ZNR 150V 5% DO-15 PD=1W TC=+.087%	04713	SZ 11213-440
A3VR3	1902-0586		DIODE-ZNR 150V 5% DO 15-PD=1W TC=+.087%	04713	SZ 11213-440
A3VR4	1902-3290	2	DIODE-ZNR 31.6V 5% DO-7 PD=.4W TC=+.074%	04713	SZ 10939-326
A3VR5	1902-3345	1	DIODE-ZNR 51.5V 5% DO-7 PD=.4W TC=+.081%	04713	SZ 10939-386
A3VR6	1902-0243	1	DIODE-ZNR 30.1V 5% DO-7 PD=.4W TC=+.075%	04713	SZ 10939-320
A3VR7	1902-3315	1	DIODE-ZNR 39.2V 5% DO-7 PD=.4W TC=+.075%	04713	SZ 10939-354
A4	01220-61122	1	HEAT SINK ASSEMBLY	28480	01220-61122
A4F1	2110-0202	1	FUSE .5 250V SLO-BLO 1.25 x .25 IEC	75915	313.500S
A4J1			NOT ASSIGNED		
A4J2	1251-0406	1	CONNECTOR, TEL JACK, 2 CKTS .141 SHK DIA	82389	41
A4J3	1251-0229	1	CONNECTOR, BNA JACK SINGLE	83330	219-2
A4J4	1251-0463	1	CONNECTOR, BNA JACK SINGLE	74970	108-903
A4J5	1251-2495	1	CONNECTOR, 9-PIN F UTILITY (ALSO ORDER CRIMP TERMINALS (4) PART NO. 1251-2990 AS REQUIRED)	27264	1292-R-2
A4P1	1251-2357	1	CONNECTOR; AC PWR; HP-9 MALE FLANGE	28480	1251-2357
A4S1	3101-1609	1	SWITCH-SL 2-DPDT-NS SID 3A 125 VAC SLDR	82389	11E-1036
A4T1	9100-3476	1	TRANSFORMER-POWER (SEPARATE REPLACEMENT NOT RECOMMENDED; NORMALLY ORDER A4 ASSY PART NO. 01220-61122)	28480	9100-3476
A4W1	01220-61626	1	CABLE ASSY, AC PWR SWITCH	28480	01220-61626
A4XA2	1251-0166	1	CONNECTOR; PC EDGE; 10-CONT; TWISTED U	9D949	143-010-08 (1158)
A4XF1	1400-0084	1	FUSEHOLDER-EXTR POST 15A 250V UL	28480	1400-0084
A5	01222-66529	1	DELAY LINE ASSEMBLY	28480	01222-66529
A5DL1	8120-1171	1	DELAY LINE	28480	8120-1171
A5MP1	01222-01201	1	BRACKET	28480	01222-01201
A5R1	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A5R2	0757-0399		RESISTOR 82.5 1% .125W F TC=0+-100	24546	C4-1/8-T0-82R5-F
A5R3	0698-6324	1	RESISTOR 187 1% .125W F TC=0+-100	24546	C4-1/8-T0-187R-F

See introduction to this section for ordering information

Table 6-3. List of Manufacturers' Codes

MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
GM051	NO M/F DESCRIPTION FOR THIS MFG NUMBER		
01121	ALLEN BRADLEY CO	MILWAUKEE WI	53212
01295	TEXAS INSTR INC SEMICOND CMPNT DIV	DALLAS TX	75231
02735	RCA CORP SOLID STATE DIV	SOMERVILLE NJ	08876
03888	PYROFILM CORP	WHIPPANY NJ	07981
04713	MOTOROLA SEMICONDUCTOR PRODUCTS	PHOENIX AZ	85008
07263	FAIRCHILD SEMICONDUCTOR DIV	MOUNTAIN VIEW CA	94040
16299	CORNING GL WK ELEC CMPNT DIV	RALEIGH NC	27604
19701	MEPCO/ELECTRA CORP	MINERAL WELLS TX	76067
24546	CORNING GLASS WORKS (BRADFORD)	BRADFORD PA	16701
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA CA	95051
27264	MOLEX PRODUCTS CO	DOWNERS GROVE IL	60515
28480	HEWLETT-PACKARD CO CORPORATE HQ	PALO ALTO CA	94304
53021	SANGAMO ELECTRIC CO	SPRINGFIELD IL	62705
56289	SPRAGUE ELECTRIC CO	NORTH ADAMS MA	01247
72136	ELECTRO MOTIVE MFG CO INC	WILLIMANTIC CT	06226
73138	BECKMAN INSTRUMENTS INC HELIPOT DIV	FULLERTON CA	92634
73734	FEDERAL SCREW PRODUCTS CO	CHICAGO IL	60618
73899	J F D ELECTRONICS CORP	BROOKLYN NY	11219
74970	JOHNSON E F CO	WASECA MN	56093
75915	LITTELFUSE INC	DES PLAINES IL	60016
76854	OAK IND INC SW DIV	CRYSTAL LAKE IL	60014
82389	SWITCHCRAFT INC	CHICAGO IL	60630
83330	SMITH HERMAN H INC	BROOKLYN NY	11207
84048	TRW INC ST PETERSBURG DIV	ST PETERSBURG FL	33702
90949	AMPHENOL SALES DIV OF BUNKER-RAMO	HAZELWOOD MO	63042
91637	DALE ELECTRONICS INC	COLUMBUS NE	68601

See introduction to this section for ordering information

SECTION VII

MANUAL CHANGES

7-1. INTRODUCTION.

7-2. This section contains information required to backdate this manual for a specific instrument.

7-3. MANUAL CHANGES.

7-4. This manual applies directly to the instrument having the same serial prefix shown on the manual title page. If the serial prefix of the instrument is not the same as the one on the title page, find your serial prefix in table 7-1 and make the changes to the manual that are listed for that serial prefix. When making changes listed in table 7-1, make the change with the highest number first. Example: if backdating changes 1, 2, and 3 are required for your serial prefix, do changes 3 first, then change 2, and finally change 1. If the serial prefix of the instrument is not listed either on the title page or in table 7-1, refer to the enclosed MANUAL CHANGES sheet for updating information. Also, if a MANUAL CHANGES sheet is supplied, make all indicated ERRATA corrections.

Table 7-1. Manual Changes

Serial Prefix	Make Changes
1341A, 1416A	3, 2, 1
1516A, 1534A	3, 2
1538A	3

CHANGE 1

Table 6-2,

A4: Change HP Part No. and Mfr Part No. to 01220-61121.

Add: MP8, HP Part No. 1500-0375, CABLE, BOWDEN, Mfr Code 28480, Mfr Part No. 1500-0375.

Add: MP9, HP Part No. 01220-47401, KNOB, POWER, Mfr Code 28480, Mfr Part No. 01220-47401.

Add: MP10, HP Part No. 01220-43204, SHAFT, VERTICAL POSITION, Mfr Code 28480, Mfr Part No. 01220-43204.

MP14: Change HP Part No. and Mfr Part No. to 01220-00221.

Add: MP27, HP Part No. 01220-43205, SHAFT, TRIGGER BD, Mfr Code 28480, Mfr Part No. 01220-43205.

R1: Change to HP Part No. 2100-0593, RESISTOR-VAR 10 K 10% LIN PART OF A2A2, Mfr Code 28480, Mfr Part No. 2100-0593.

R2: Change to HP Part No. 2100-0593, RESISTOR-VAR 10 K 10% LIN PART OF A2A3, Mfr Code 28480, Mfr Part No. 2100-0593.

R3: Change to HP Part No. 2100-0593, RESISTOR-VAR 10 K 10% LIN PART OF A1A2, Mfr Code 28480, Mfr Part No. 2100-0593.

Delete: W5.

A1A2: Change HP Part No. and Mfr Part No. to 01220-61902.

A1A2A1: Change HP Part No. and Mfr Part No. to 01220-66523.

A2A2: Change HP Part No. and Mfr Part No. to 01220-61901.

A2A2S3: Change HP Part No. and Mfr Part No. to 01220-66525.

A2A3: Change HP Part No. and Mfr Part No. to 01220-61901.

A2A3S3: Change HP Part No. and Mfr Part No. to 01220-66525.

A4: Change HP Part No. and Mfr Part No. to 01220-61121.

Add: A4C1, HP Part No. 0160-4026, CAPACITOR-FXD 0.2 UF 20% 25 WVDC, Mfr Code 28480, Mfr Part No. 0160-4026.

Add: A4MP1, HP Part No. 01220-47403, PUSH-BUTTON SHRR, Mfr Code 28480, Mfr Part No. 01220-47403.

Add: A4S2, HP Part No. 3101-0555, SWITCH, LINE POWER, Mfr Code 28480, Mfr Part No. 3101-0555.

Schematic 1,

Add: A4C1 (0.2 UF) between pin 2 and pin 9 of A4S1.

W5S1: Change reference designator to A4S2.

Schematic 5,

R1: Show as part of A2A2.

S2: Show as part of A2A3.

Schematic 10,

R3: Show as part of A1A2.

CHANGE 2

Table 6-2,

A3: Change HP Part No. and Mfr Part No. to 01222-66527.

V1: Change HP Part No. and Mfr Part No. to 01220-69502.

W4: Change HP Part No. and Mfr Part No. to 01220-61621.

A3R12: Change to HP Part No. 0698-4522; RESISTOR 165 K 1% .125 WF TC=0 +—100, Mfr Code 24546, Mfr Part No. C4-1/8-T0-1653-F.

A3R15: Change to HP Part No. 0757-0052; RESISTOR 500 K 1% .5 WF TC=0 +100, Mfr Code 19701, Mfr Part No. MF7C1/2-T0-5003-F.

Paragraph 7-11,
Change CRT Part No. to HP Part No. 01220-69501.
Schematic 2,
A3R12: Change value to 165 K.
A3R15: Change value to 500 K.

CHANGE 3

Table 6-2,
Add: A1A1C14: HP Part No. 0160-2204, CAPACITOR - FXD 100 PF +—5% 300 WVDC MICA, Mfr Code 28480, Mfr Part No. 0160-2204.
Add: A1A1C15: HP Part No. 0160-2204, CAPACITOR - FXD 100 PF +—5% 300 WVDC MICA, Mfr Code 28480, Mfr Part No. 0160-2204.
Add: A1A1R34: HP Part No. 0698-4471, RESISTOR 7.15 K 1% .125 WF TC=0 +—100, Mfr Code 24546, Mfr Part No. C4-1/8-T0-7151-F.
A3: Change HP Part No. and Mfr Part No. to 01220-66534.
A3C3: Change to HP Part No. 0160-3443, CAPACITOR - FXD .1 UF +80 —20% 50 WVDC CER, Mfr Code 28480, Mfr Part No. 0160-3443.
A3C4: Change to HP Part No. 0160-3443, CAPACITOR - FXD .1 UF +80 —20% 50 WVDC CER, Mfr Code 28480, Mfr Part No. 0160-3443.
A3C5: Change to HP Part No. 0160-2959, CAPACITOR - FXD 1000 PF +80 —20% 1000 WVDC, Mfr Code 28480, Mfr Part No. 0160-2959.
A3C6: Change to HP Part No. 0160-0168, CAPACITOR - FXD .1 UF +—10% 200 WVDC POLYE, Mfr Code 56289, Mfr Part No. 292P10492.
A3C7: Change to HP Part No. 0160-0151, CAPACITOR - FXD 4700 PF +80 —20% 4000 WVDC, Mfr Code 28480, Mfr Part No. 0160-0151.
A3C8: Change to HP Part No. 0160-2930, CAPACITOR - FXD .01 UF +80 —20% 100 WVDC CER, Mfr Code 28480, Mfr Part No. 0160-2930.
A3C9: Change to HP Part No. 0160-2930, CAPACITOR - FXD .01 UF +80 —20% 100 WVDC CER, Mfr Code 28480, Mfr Part No. 0160-2930.
A3C10: Change to HP Part No. 0160-3208, CAPACITOR - FXD .025 UF +80 —20% 100 WVDC CER, Mfr Code 28480, Mfr Part No. 0160-3208.
A3C11: Change to HP Part No. 0160-3208, CAPACITOR - FXD .025 UF +80 —20% 100 WVDC CER, Mfr Code 28480, Mfr Part No. 0160-3208.
A3C12: Change to HP Part No. 0160-0168, CAPACITOR - FXD .1 UF +—10% 200 WVDC POLYE, Mfr Code 56289, Mfr Part No. 292P10492.
A3C13: Change to HP Part No. 0160-4042, CAPACITOR - FXD .015 UF 3 kV MY, Mfr Code 28480, Mfr Part No. 0160-4042.
A3C14: Change to HP Part No. 0160-3720, CAPACITOR - FXD .1 UF +—10% 160 WVDC MET, Mfr Code 28480, Mfr Part No. 0160-3720.
A3C16: Change to HP Part No. 0160-2902, CAPACITOR - FXD .01 UF +—20% 1000 WVDC CER, Mfr Code 28480, Mfr Part No. 0160-2902.
Delete: A3C17, A3C18, and A3C19.
A3CR8: Change to HP Part No. 1901-0050, DIODE - SWITCHING 2 NS 80 V 200 MA, Mfr Code 28480, Mfr Part No. 1901-0050.
A3CR9: Change to HP Part No. 1901-0033, DIODE - GEN PRP 180 V 200 MA, Mfr Code 28480, Mfr Part No. 1901-0033.
A3CR11: Change to HP Part No. 1901-0040, DIODE - SWITCHING 2 NS 30 V 50 MA, Mfr Code 28480, Mfr Part No. 1901-0040.
Delete: A3CR12 - A3CR18.
Delete: A3Q4 and A3Q5.
A3R20: Change to HP Part No. 2100-2030, RESISTOR - VAR TRMR 20 K OHM 10% C TOP ADJ., Mfr Code 84048, Mfr Part No. 170-203.
A3R26: Change to HP Part No. 2100-2655, RESISTOR - VAR TRMR 100 K OHM 10% C TOP ADJ., Mfr Code 19701, Mfr Part No. ET50W104.
A3R27: Change to HP Part No. 0757-0768, RESISTOR 47.5 K 1% .25 WF TC=0 +—100, Mfr Code 24546, Mfr Part No. C5-1/4-T0-4752-F.
A3R28: Change to HP Part No. 0758-0057, RESISTOR 5.6 K 5% .25 WF TC=0 +—100, Mfr Code 24546, Mfr Part No. C5-1/4-T0-5601-J.
A3R29: Change to HP Part No. 0757-0433, RESISTOR 3.32 K 1% .125 WF TC=0 +—100, Mfr Code 24546, Mfr Part No. C4-1/8-T0-3321-F.
A3R30: Change to HP Part No. 0757-0449, RESISTOR 20 K 1% .125 WF TC=0 +—100, Mfr Code 24546, Mfr Part No. C4-1/8-T0-2002-F.
A3R31: Change to HP Part No. 0757-0449, RESISTOR 20 K 1% .125 WF TC=0 +—100, Mfr Code 24546, Mfr Part No. C4-1/8-T0-2002-F.
A3R33: Change to HP Part No. 0698-3495, RESISTOR 866 1% .125 WF TC=0 +—100, Mfr Code 16299, Mfr Part No. C4-1/8-T0-866R-F.
A3R34: Change to HP Part No. 0757-0433, RESISTOR 3.32 K 1% .125 WF TC=0 +—100, Mfr Code 24546, Mfr Part No. C4-1/8-T0-3321-F.
A3R35: Change to HP Part No. 0757-0394, RESISTOR 51.1 1% .125 WF TC=0 +—100, Mfr Code 24546, Mfr Part No. C4-1/8-T0-51R1-F.
A3R37: Change to HP Part No. 0687-1011, RESISTOR 100 10% .5 W CC TC=0 +529, Mfr Code 01121, Mfr Part No. EB1011.
Delete: A3R38 - A3R44.
A3U1: Change to HP Part No. 1820-0217, IC Amplifier, Mfr Code 28480, Mfr Part No. 1820-0217.
A3VR4: Change to HP Part No. 1902-3082, DIODE - ZNR 4.64 V 5% DO-7 PD=.4 W TC=.023%, Mfr Code 04713, Mfr Part No. SZ10939-86.
A3VR5: Change to HP Part No. 1902-3290, DIODE - ZNR 31.6 V 5% DO-7 PD=.4 W TC=+.074%, Mfr Code 04713, Mfr Part No. SZ10939-326.
Add: A3VR8; HP Part No. 1902-0586, DIODE - ZNR 150 V 5% DO-15 PD=1 W TC=+.087%, Mfr Code 04713, Mfr Part No. SZ11213-440.
Figure 8-5,
Replace with figure 7-1.
Schematic 2,
Replace with figure 7-2.
Schematic 8,
Add: A1A1C14 in parallel with A1A1R33.
Add: A1A1C15 in parallel with A1A1R35.
Delete: Jumper wire (4) from A1A1R35.
Delete: Jumper wire (6) from A1A1U1F.

SECTION VIII

SCHEMATICS AND TROUBLESHOOTING

8-1. INTRODUCTION.

8-2. This section contains repair procedures, troubleshooting information, and schematics for the Model 1220A. Nonstandard symbols and conventions used in schematics are defined in table 8-2.

8-3. PREVENTIVE MAINTENANCE.

8-4. CLEANING. Painted surfaces can be cleaned with a commercial, spray-type, window cleaner or with a a mild soap and water solution. Excess grease can be removed with a degreaser such as M-180 FREON TF DEGREASER produced by Miller-Stevenson Company.

8-5. SWITCH MAINTENANCE. The pushbutton switches used in this instrument have been designed for long, trouble-free service. If one of these switches becomes defective, replacement rather than repair is recommended.

8-6. Conventional rotary switches are serviced by cleaning the contacts with a degreaser such as M-180 FREON TF DEGREASER. Lubricate contact surfaces with a lubricant comparable to LUBRIPLATE FML produced by Fiske Brothers Refining Company. LUBRIPLATE FML is also available from the Hewlett-Packard Company (HP Part No. 6040-0305).

8-7. REMOVAL AND REINSTALLATION.

8-8. The following paragraphs provide procedures for removal and reinstallation of assemblies, subassemblies, and components. Special repair instructions for etched circuit boards are provided in paragraph 8-17. Section VI provides a detailed parts list for use in ordering replacement parts.

8-9. TOP COVER REMOVAL AND REINSTALLATION. To remove the top cover of the instrument, proceed as follows:

a. Disconnect ac power cord.

b. Remove four screws from sides of instrument.

c. Lift cover from instrument.

d. Replace one screw in right, front securing lug. This screw connects interior metalizing of cabinet with internal grounding system.

e. To reinstall top cover reverse removal procedure.

8-10. HEAT SINK ASSEMBLY REMOVAL AND REINSTALLATION. To remove heat sink assembly A4, proceed as follows:

a. Remove two heat sink screws from bottom of case.

b. Disconnect grounding wire at vertical assembly A2A1.

c. Disconnect HV cable connector.

d. Disconnect front-panel LINE switch connector.

e. Disconnect Z-input wire at trigger assembly A1A1.

f. Lift assembly A4 to disengage lugs.

g. Pull assembly A4 out of rear panel.

NOTE

When reinstalling assembly A4, make sure sheet insulators are in place over power transistors on vertical assembly and that insulator surfaces are coated with a thermal compound, such as, HP Part No. 6040-0239.

h. To reinstall assembly A4, reverse removal procedure.

8-11. CRT REMOVAL PROCEDURE. To remove the CRT proceed as follows:

WARNING

To prevent personal injury, wear a face mask or goggles when handling the CRT. Wear protective gloves and handle the CRT carefully.

a. Disconnect trace alignment leads from assembly A3.

b. Disconnect leads from trigger assembly to CRT at trigger assembly A1A1.

c. Remove CRT collar retaining screws (see figure 6-1 for parts identification).

d. Lever CRT collar base away from mounting.

e. Lift CRT base.

f. Carefully remove CRT socket from CRT base.

g. Lift CRT away from instrument.

h. To reinstall CRT, reverse removal procedure.

NOTE

If a new CRT is to be installed, proceed to paragraph 8-12.

8-12. INSTALLING A NEW CRT. To install a new CRT, proceed as follows:

WARNING

To prevent personal injury, wear a face mask or goggles when handling the CRT. Wear protective gloves and handle the CRT carefully.

a. Accomplish paragraph 8-11 except step h.

b. Mark orientation of CRT base and CRT collar on CRT shield using pencil.

c. Loosen circle clip.

d. Remove CRT collar and circle clip.

e. Remove rubber ring at face of CRT.

f. Remove CRT from shield.

g. Make sure that flat rubber ring is fitted to neck of new CRT near base.

h. Insert new CRT into shield.

i. Align CRT base with mark on shield.

j. Fit rubber ring at face of CRT.

k. Place CRT and shield face down on smooth surface.

l. Press down on CRT base for firm fit into rubber ring at face.

m. Fit CRT collar and circle clip on neck of tube over rubber ring.

n. Align CRT collar with mark on shield and push toward CRT face so that shield is firmly clamped.

CAUTION

When tightening circle clip, use a torque screwdriver set to 0.11 kg-m (10 in-lb).

o. Clamp collar, taking care not to overtighten circle clip.

p. To install new CRT, perform removal procedure (paragraph 8-11) in reverse order.

8-13. REMOVAL AND REINSTALLATION OF CIRCUIT BOARDS. To remove circuit boards from the instrument, proceed as follows:

a. Accomplish paragraph 8-10.

b. Disconnect cable from A1A1J1 at trigger assembly.

c. Disconnect cable from A1A1J2 at trigger assembly.

d. Remove all front-panel control knobs except channel A and channel B POSITION controls.

e. Disconnect channel A POSITION control wires from assembly A2A2.

f. Disconnect channel B POSITION control wires from assembly A2A3.

g. Remove retaining rings from three front-panel BNC connectors.

h. Disconnect all wires from rear of trigger assembly.

i. Remove two screws from top edge of trigger assembly and ease away from rail.

CAUTION

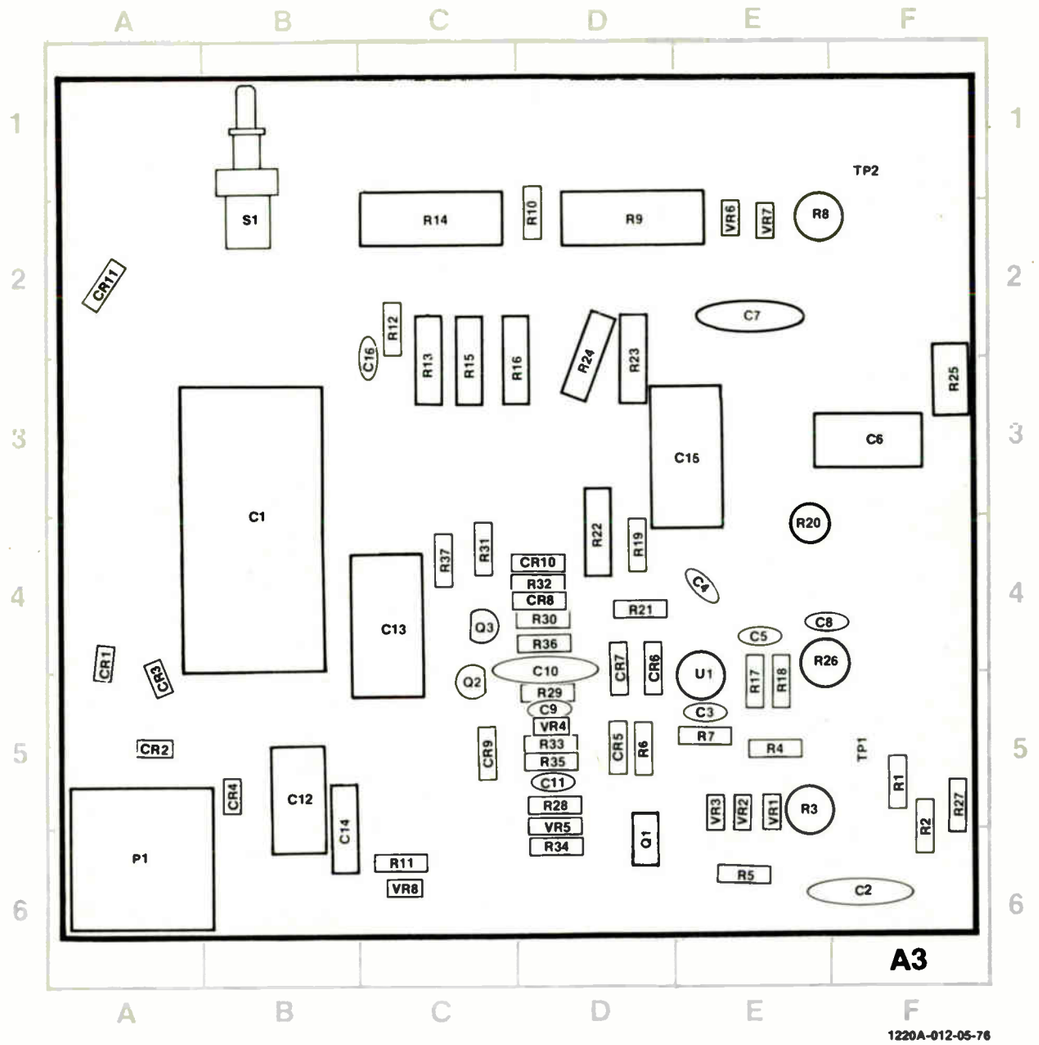
Be careful when removing assemblies to prevent damage to pins on rear of trigger assembly.

j. Pull circuit boards toward rear of instrument.

k. When clearance permits, disengage trigger assembly from vertical amplifier assembly.

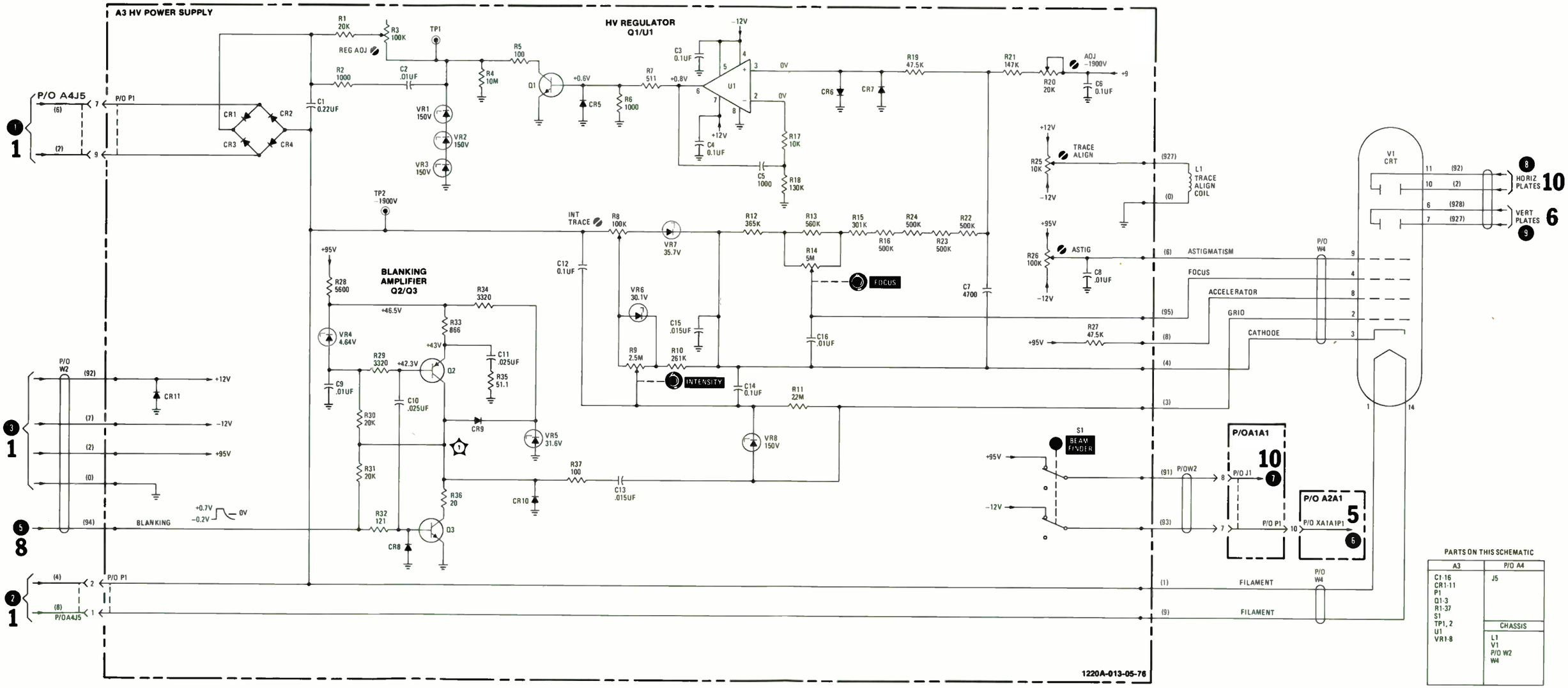
l. Remove assemblies from instrument.

m. To reinstall circuit boards, reverse removal procedure.



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-4	C12	B-6	CR7	D-5	R3	E-5	R14	C-2	R26	D-4	S1	B-2
C2	F-6	C13	C-4	CR8	D-4	R4	E-5	R15	C-3	R27	F-5	TP1	F-5
C3	E-5	C14	B-6	CR9	C-5	R5	E-6	R16	D-3	R28	D-6	TP2	F-1
C4	E-4	C15	E-3	CR10	D-4	R6	D-5	R17	E-5	R29	D-5	U1	E-5
C5	E-4	C16	C-3	CR11	A-2	R7	E-5	R18	E-5	R30	D-4	VR1	E-5
C6	F-3	CR1	A-5	P1	A-6	R8	E-2	R19	D-4	R31	C-4	VR2	E-5
C7	E-2	CR2	A-5	Q1	D-6	R9	D-2	R20	E-4	R32	D-4	VR3	E-5
C8	E-4	CR3	A-5	Q2	C-5	R10	D-2	R21	D-4	R33	D-5	VR4	D-5
C9	D-5	CR4	B-6	Q3	C-5	R11	C-6	R22	D-4	R34	D-6	VR5	D-6
C10	D-5	CR5	D-5	R1	F-5	R12	C-3	R23	D-3	R35	D-5	VR6	E-2
C11	D-5	CR6	D-5	R2	F-6	R13	C-3	R24	D-3	R36	D-4	VR7	E-2
								R25	F-3	R37	C-4	VR8	C-6

Figure 7-1. A3 High-voltage Power Supply Component Locations



PARTS ON THIS SCHEMATIC

A3	P/O A4
C1-16 CR1-11 P1 Q1-3 R1-37 S1 TP1, 2 U1 VR1-8	J5
	CHASSIS
	L1 V1 P/O W2 W4

Figure 7-2. Schematic 2, High-voltage Power Supply (A3)

8-14. REPLACEMENT OF CIRCUIT BOARDS.

8-15. HORIZONTAL ASSEMBLY A1. Horizontal assembly A1 consists of trigger assembly A1A1 and TIME/DIV switch assembly A1A2. If trigger assembly A1A1 become damaged or nonrepairable, replacement of the complete horizontal assembly A1 is recommended. The TIME/DIV switch assembly is made up of assemblies A1A2A1 and A1A2A2, and unsoldering and resoldering of TIME/DIV switch assembly A1A2 to trigger assembly A1A1 are delicate and time consuming. Therefore, if facilities and trained service personnel are not available, replacement of the of the complete A1 assembly is recommended.

8-16. VERTICAL ASSEMBLY A2. Vertical assembly A2 consists of vertical amplifier A2A1, channel A VOLTS/DIV switch A2A2, and channel B VOLTS/DIV switch A2A3. If assembly A2A1 become damaged or nonrepairable, replacement of the complete vertical assembly A2 is recommended. The unsoldering and resoldering of channel A and channel B VOLTS/DIV switches are delicate and time consuming. Therefore, if facilities and trained service personnel are not available, replacement of the complete A2 assembly is recommended.

8-17. REPAIR OF CIRCUIT BOARDS.

8-18. The following paragraphs provide servicing procedures and special soldering considerations for repairing etched circuit boards.

8-19. SERVICING ETCHED CIRCUIT BOARDS. All the etched circuit boards have plated-through component holes. This allows components to be removed or replaced by unsoldering or soldering from either side of the board. When removing large components such as potentiometers, rotate the soldering iron tip from lead to lead while applying pressure to the part to lift it from the board. HP Service Note M-20E contains additional information for repair of etched circuit boards.

8-20. SEMICONDUCTOR REMOVAL AND REPLACEMENT. Figure 8-1 is included to help identify the leads on the common shapes and sizes of semiconductor devices. When removing a semiconductor, use long-nosed pliers as a heat sink between the device and the soldering iron. When replacing a semiconductor, ensure sufficient lead length to dissipate the soldering heat by using the same length of exposed lead as used for the original part.

8-21. INTEGRATED CIRCUIT REMOVAL AND REPLACEMENT.

CAUTION

Unless an integrated circuit has definitely failed, be careful to prevent damage when removing or replacing it.

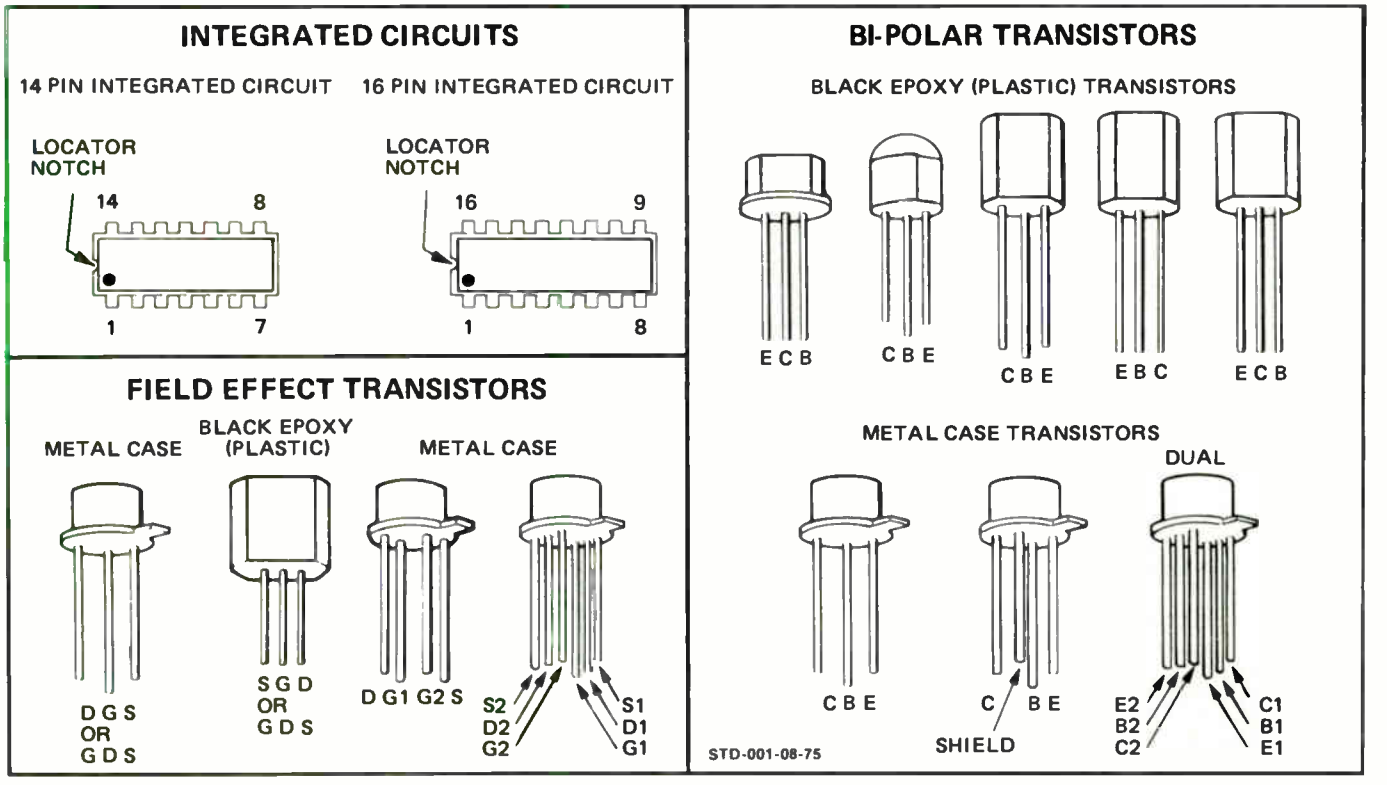


Figure 8-1. Semiconductor Terminal Identification

8-22. TROUBLESHOOTING.

CAUTION

Read the Safety Summary at the front of this manual before troubleshooting the instrument.

8-23. Two important prerequistes for successful troubleshooting are understanding how the instrument is designed to operate and correct use of front-panel controls. Improper control settings or circuit connections can cause apparent malfunctions. Read Section III (Operation) for an explanation of controls, connectors, and general operating considerations. Read Section IV (Principles of Operation) for explanation of circuit theory.

8-24. If trouble is suspected, visually inspect the instrument. Look for loose or burned components that may suggest a source of trouble. Verify that all circuit board connections are making good contact and are not shorting to an adjacent circuit. If no obvious trouble is found, check power supply voltages in the instrument; also check external power sources.

8-25. DC VOLTAGES. On some schematics, dc voltages are indicated for active components (transistors, IC's etc.). Conditions for making these voltage measurements are listed adjacent to the schematics. Since the conditions for making measurements may differ from one circuit to another, always check the specific conditions listed adjacent to the schematic.

8-26. INITIAL TROUBLESHOOTING PROCEDURE. Before troubleshooting the instrument in detail, try to perform the adjustment procedures listed in Section V of this manual. Some apparent malfunctions can be corrected by these adjustments; in addition, the inability to obtain a correct adjustment will often reveal the source of trouble.

8-27. If possible, perform the adjustment procedures in listed sequence since the power supplies should be checked first for any malfunction.

8-28. TROUBLE DIAGNOSIS. By use of front-panel controls, note as many symptoms of the malfunction as possible. From these symptoms, it can usually be determined which section (vertical, horizontal, or power supplies) is malfunctioning. Normally, the vertical and horizontal sections will not malfunction simultaneously, although symptoms may indicate that this has occurred.

8-29. VERTICAL SECTION TROUBLESHOOTING. Although a sweep may not be generated on the CRT, vertical deflection of an input signal on the CRT will normally indicate that the vertical section is functioning properly.

8-30. The sync pulse required for internal triggering is developed in the vertical preamplifier and trigger amplifier located on assembly A1A1. If the instrument does not trigger internally but triggers properly when an external trigger is applied, the vertical preamplifier section should be checked.

8-31. Due to low levels of the signal in the vertical preamplifier, signal tracing becomes difficult. When troubleshooting the preamplifier, check dc bias voltages for best results.

8-32. HORIZONTAL SECTION TROUBLESHOOTING. The horizontal section of the instrument consists of the trigger assembly, TIME/DIV switch, and high voltage power supply. From symptoms derived in paragraph 8-28, check the input and output signals of the suspected circuit(s) until the problem is isolated. Refer to table 8-1 for troubleshooting hints.

NOTE

Table 8-1 is to be used as a guide only. Slight variations in described symptoms may be noted.

Table 8-1. Troubleshooting Hints

1. Initial Conditions:

a. Disconnect all external inputs except ac power.

b. Set ac power switches on rear panel of instrument for proper ac power input.

c. Set front-panel controls as follows:

VOLTS/DIV (both channels)	10 V/div
VERTICAL DISPLAY	A & B
Input Coupling (both channels)	GND
Vertical POSITION (both channels)	midrange
Vertical Verniers (both channels)	CAL
INTENSITY	midrange
FOCUS	midrange
TIME/DIV	0.2 ms/div
Sweep Expander	CAL
TRIGGER SOURCE	INT
TRIGGER LEVEL	1 o'clock
All other pushbutton switches	out position
LINE (AC Power)	ON

NOTE

If top cover of the instrument is removed, make sure cover retaining screw is reinserted in right, front securing lug. The screw connects the interior metalizing of cabinet with internal grounding system.

Table 8-1. Troubleshooting Hints (Cont'd)

2. Power Supplies. The power supplies have decoupling components located near the individual circuits that may cause the power supply to current limit, giving the indication of a defective power supply. If the voltage across current sensing resistor A2A1R17 in the +12 V supply or across current sensing resistor A2A1R23 in the —12 V supply exceeds approximately 0.5 V, the supply is most likely in its current-limit state. To isolate the circuit causing the overload, lift one end of each decoupling resistor, such as A2A1R135, while monitoring the current sensing resistor that indicates an overload. When the power supply indicates normal operation, the faulty circuit has been isolated. For the +95 V supply, measure the voltage between pins 2 and 3 of A2A1U2. The voltage should not be greater than 0.5 V (pin 2 more positive than pin 3).

3. Symptom Chart. The symptom chart presented in this table is intended to get the service technician to the general area of the trouble but not necessarily to a specific component. A list of the major components associated with the listed trouble areas follows the symptom chart. To use the symptom chart, proceed down the symptom column until the difficulty is noted. Then check the major components associated with the trouble area(s).

4. Trouble-area Components. Check the trouble-area components as listed below: (Parts are listed alphanumerically).

a. H.V. Power Supply

A3C1
A3CR1 - CR4
A4T1
V1

b. Power Transformer

A4T1

c. +210 V Supply

A2A1C3, C4
A2A1CR5 - CR8
A2A1R2
A2A1R5

d. +95 V Supply

A2A1C5 - C9
A2A1CR9 - CR12
A2A1Q1
A2A1R3
A2A1R4
A2A1R6 - R14
A2A1U1
A2A1VR1

e. +12 V Supply

A2A1C10 - C13
A2A1CR13 - CR16
A2A1Q2
A2A1R15 - R19
A2A1U3

f. +5 V Supply

A2A1C1, C2
A2A1CR1 - CR4
A2A1U1

g. —12 V Supply

A2A1C14, C15
A2A1CR17 - CR20
A2A1Q3, Q4
A2A1R20 - R23
A2A1U4

h. H.V. Regulator

A3Q1
A3U1

i. Horizontal Output Amplifier

A1A1Q27 - Q36

j. Sweep Generator

A1A1Q23 - Q26
A1A1U1, U2
A1A1U5 - U8

k. Trigger

A1A1Q13 - Q22
A1A1U2 - U4

l. Vertical Output Amplifier

A1A1Q1 - Q12

m. Vertical Preamplifiers

A2A1Q5 - Q12
A2A1Q15 - Q18
A2A1U5 - U9

n. Attenuators

Channel A: A2A2S1 - S3
Channel B: A2A3S1 - S3

Table 8-1. Troubleshooting Hints (Cont'd)

SYMPTOM CHART

SYMPTOM \ POSSIBLE TROUBLE AREA	POWER TRANS.	+95 V SUPPLY	+12 V SUPPLY	−12 V SUPPLY	+5 V SUPPLY	+210 V SUPPLY	H.V. POWER SUPPLY	H.V. REGULATOR	CRT	HORIZ. OUTPUT AMP	SWEEP GEN.	SWEEP SW. ASSEM	VERT. OUTPUT	VERT. PREAMP	ATTENUATORS	TRIGGER	CHOP OSC.	CHANNEL SW.	BLANKING AMP.	CALIBRATOR
BLOWS FUSE	X	X	X	X	X	X	X		X											
NO BEAM (BEAM FIND)	X						X	X	X											
NO SWEEP					X					X	X	X				X				
INTENSITY MODULATION		X	X	X				X												
NO HORIZ. POSIT.										X		X								
NO VERT. POSIT.													X	X						
NO VERT. DEFL.													X	X						
NO TRIGGER					X						X					X				
TRACE SHIFT													X	X						
NO RETRACE BLANK																			X	
NO CHOP/ALT.					X												X	X		
NO PROBE ADJ.					X															X

o. Sweep Switch Assembly

A1A2

p. Chop Oscillator

A1A1U4

q. Channel Switches

A2A1CR35 - CR38
A1A1U3, U4

r. Blanking Amplifier

A3Q2 - Q4

s. Calibrator

A1A1U1

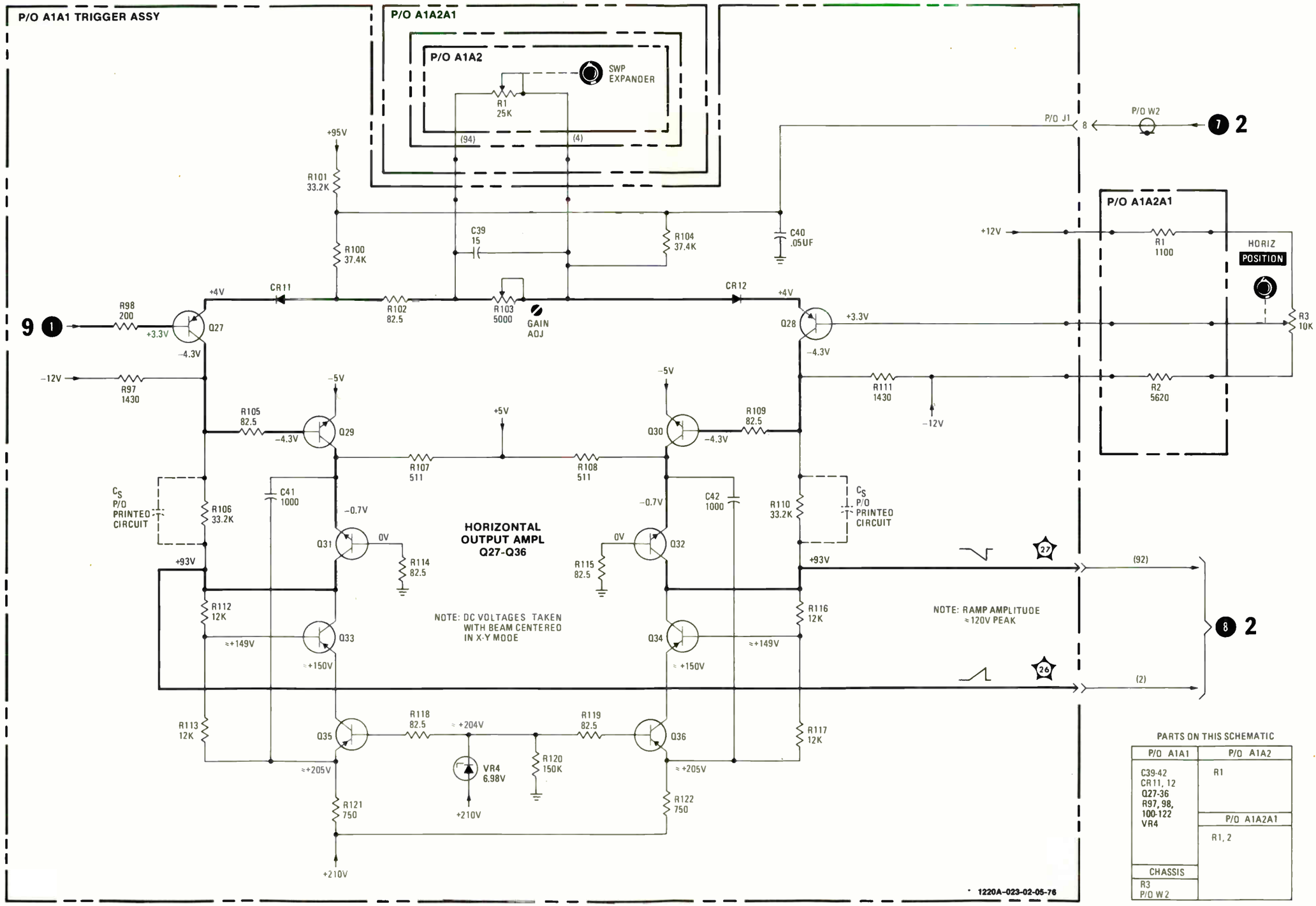


Figure 8-16.
Schematic 10, Horizontal Output, A1A1, (Sheet 2 of 2)

HEWLETT hp PACKARD

SALES & SERVICE OFFICES

UNITED STATES

ALABAMA
8290 Whitesburg Dr , S E
P O Box 4207
Huntsville 35802
Tel (205) 881-4591
TWX 810-726-2204

Medical Only
228 W Valley Ave ,
Room 220
Birmingham 35209
Tel (205) 942-2081

ARIZONA
2336 E Magnolia St.
Phoenix 85034
Tel (602) 244-1361

2424 East Aragon Rd
Tucson 85706
Tel (602) 294-3148

***ARKANSAS**
Medical Service Only
P.O Box 5646
Brady Station
Little Rock 72205
Tel (501) 664-8773

CALIFORNIA
1430 East Orangethorpe Ave
Fullerton 92631
Tel (714) 870-1000

3939 Lankershim Boulevard
North Hollywood 91604
Tel (213) 877-1282
TWX 910-499-2170

6305 Arizona Place
Los Angeles 90045
Tel (213) 649-2511
TWX 910-328-6147

***Los Angeles**
Tel (213) 776-7500

3003 Scott Boulevard
Santa Clara 95050
Tel (408) 249-7000
TWX 910-338-0518

***Ridgecrest**
Tel (714) 446-6165

2220 Watt Ave
Sacramento 95825
Tel (916) 482-1463

9606 Aero Drive
P O Box 23333
San Diego 92123
Tel (714) 279-3200

COLORADO
5600 South Ulster Parkway
Englewood 80110
Tel (303) 771-3455

CONNECTICUT
12 Lunar Drive
New Haven 06525
Tel (203) 389-6551
TWX 710-465-2029

FLORIDA
P O Box 24210
2806 W Oakland Park Blvd
Ft. Lauderdale 33307
Tel (305) 731-2020
TWX 510-955-4099

***Jacksonville**
Medical Service only
Tel (904) 725-6333

P O Box 13910
6177 Lake Ellenor Dr
Orlando 32809
Tel (305) 859-2900
TWX 810-850-0311

P O Box 12826
Pensacola 32575
Tel (904) 434-3081

GEORGIA
P O Box 105005
Atlanta 30348
Tel (404) 434-4000
TWX 810-766-4890

Medical Service Only
***Augusta** 30903
Tel (404) 736-0592

HAWAII
2875 So King Street
Honolulu 96814
Tel (808) 955-4455

ILLINOIS
5500 Howard Street
Skokie 60076
Tel (312) 677-0400
TWX 910-223-3613

***St. Joseph**
Tel (217) 469-2133

INDIANA
7301 North Shadeland Ave
Indianapolis 46250
Tel (317) 842-1000
TWX 810-260-1796

IOWA
1902 Broadway
Iowa City 52240
Tel (319) 338-9466
Night (319) 338-9467

***KANSAS**
Derby
Tel (316) 267-3655

KENTUCKY
Medical/Calculator Only
Atkinson Square
3901 Atkinson Dr ,
Suite 207
Louisville 40218
Tel (502) 456-1573

LOUSIANA
P.O Box 840
3239 Williams Boulevard
Kenner 70062
Tel (504) 721-8201
TWX 810-955-5524

MARYLAND
6707 Whitestone Road
Baltimore 21207
Tel (301) 944-5400
TWX 710-862-9157

2 Choke Cherry Road
Rockville 20850
Tel (301) 948-6370
TWX 710-828-9684

MASSACHUSETTS
32 Hartwell Ave
Lexington 02173
Tel (617) 861-8960
TWX 710-326-6904

MICHIGAN
23855 Research Drive
Farmington Hills 48024
Tel (313) 476-6400
TWX 810-242-2900

MINNESOTA
2400 N Prior Ave
Roseville 55113
Tel (612) 636-0700
TWX 910-563-3734

MISSISSIPPI
***Jackson**
Medical Service only
Tel (601) 982-9363

MISSOURI
11131 Colorado Ave
Kansas City 64137
Tel (816) 763-8000
TWX 910-771-2087

148 Weldon Parkway
Maryland Heights 63043
Tel: (314) 567-1455
TWX 910-764-0830

NEBRASKA
Medical Only
7171 Mercy Road
Suite 110
Omaha 68106
Tel: (402) 392-0948

NEW JERSEY
W. 120 Century Rd
Paramus 07652
Tel: (201) 265-5000
TWX 710-990-4951

NEW MEXICO
P O Box 11634
Station E
11300 Lomas Blvd . N E
Albuquerque 87123
Tel. (505) 292-1330
TWX 910-989-1185

156 Wyatt Drive
Las Cruces 88001
Tel: (505) 526-2485
TWX 910-983-0550

NEW YORK
6 Automation Lane
Computer Park
Albany 12205
Tel: (518) 458-1550
TWX 710-441-8270

New York City
Manhattan, Bronx
Contact Paramus, NJ Office
Tel (201) 265-5000
Brooklyn, Queens, Richmond
Contact Woodbury, NY Office
Tel: (516) 921-0300

201 South Avenue
Poughkeepsie 12601
Tel (914) 454-7330
TWX 510-248-0012

39 Saginaw Drive
Rochester 14623
Tel: (716) 473-9500
TWX 510-253-5981

5858 East Molloy Road
Syracuse 13211
Tel (315) 455-2486
TWX 710-541-0482

1 Crossways Park West
Woodbury 11797
Tel: (516) 921-0300
TWX 710-990-4951

NORTH CAROLINA
P O. Box 5188
1923 North Main Street
High Point 27262
Tel (919) 885-8101
TWX 510-926-1516

OHIO
16500 Sprague Road
Cleveland 44130
Tel. (216) 243-7300
TWX 810-423-9431

330 Progress Rd
Dayton 45449
Tel: (513) 859-8202
TWX 810-474-2818

1041 Kingsmill Parkway
Columbus 43229
Tel (614) 436-1041

OKLAHOMA
P O. Box 32008
Oklahoma City 73132
Tel (405) 721-0200
TWX: 910-830-6862

OREGON
17890 SW Lower Boones
Ferry Road
Tualatin 97062
Tel: (503) 620-3350

PENNSYLVANIA
111 Zeta Drive
Pittsburgh 15238
Tel: (412) 782-0400
Night: 782-0401
TWX 710-795-3124

1021 8th Avenue
King of Prussia Industrial Park
King of Prussia 19406
Tel (215) 265-7000
TWX: 510-660-2670

SOUTH CAROLINA
6941-0 N. Trenholm Road
Columbia 29260
Tel: (803) 782-6493

TENNESSEE
***Memphis**
Medical Service only
Tel: (901) 274-7472

***Nashville**
Medical Service only
Tel: (615) 244-5448

TEXAS
P.O Box 1270
201 E. Arapaho Rd
Richardson 75080
Tel. (214) 231-6101
TWX: 910-867-4723

P O Box 27409
6300 Westpark Drive
Suite 100
Houston 77027
Tel: (713) 781-6000
TWX 910-881-2645

205 Billy Mitchell Road
San Antonio 78226
Tel: (512) 434-8241
TWX 910-871-1170

UTAH
2160 South 3270 West Street
Salt Lake City 84119
Tel: (801) 487-0715

VIRGINIA
Medical Only
P O. Box 12778
No. 7 Koger Exec Center
Suite 212
Norfolk 23502
Tel: (804) 497-1026/7

P.O. Box 9854
2914 Hungary Springs Road
Richmond 23228
Tel. (804) 285-3431
TWX 710-956-0157

WASHINGTON
Bellefield Office Pk
1203-114th Ave S.E.
Bellevue 98004
Tel: (206) 454-3971
TWX: 910-443-2446

***WEST VIRGINIA**
Medical/Analytical Only
Charleston
Tel: (304) 345-1640

WISCONSIN
9004 West Lincoln Ave
West Allis 53227
Tel (414) 541-0550

FOR U.S. AREAS NOT LISTED:
Contact the regional office
nearest you Atlanta, Georgia
North Hollywood, California
Rockville, Maryland Skokie,
Illinois. Their complete
addresses are listed above

***Service Only**

CANADA

ALBERTA
Hewlett-Packard (Canada) Ltd
11748 Kingsway Ave
Edmonton T5G 0X5
Tel (403) 452-3670
TWX 610-831-2431 EDTH

Hewlett-Packard (Canada) Ltd
915-42 Avenue S E Suite 102
Calgary T2G 1Z1
Tel (403) 267-1672
TWX 610-821-6141

BRITISH COLUMBIA
Hewlett-Packard (Canada) Ltd
837 E Cordova **Street**
Vancouver V5A 3R2
Tel (604) 254-0531
TWX 610-922-5059 VCR

MANITOBA
Hewlett-Packard (Canada) Ltd
513 Century St
St James
Winnipeg R3H 0L8
Tel (204) 786-7581
TWX 610-671-3531

NOVA SCOTIA
Hewlett-Packard (Canada) Ltd.
800 Windmill Road
P O Box 931
Dartmouth B2Y 3Z6
Tel (902) 469-7820
TWX 610-271-4482 HFX

ONTARIO
Hewlett-Packard (Canada) Ltd
1785 Woodward Dr.
Ottawa K2C 0P9
Tel (613) 225-6530
TWX 610-562-8968

Hewlett-Packard (Canada) Ltd
6877 Goreway Drive
Mississauga L4V 1L9
Tel (416) 678-9430
TWX 610-492-4246

QUEBEC
Hewlett-Packard (Canada) Ltd
275 Hymus Blvd
Pointe Claire H9R 1G7
Tel (514) 697-4232
TWX 610-422-3022
TLX 05-821521 HPCL

Hewlett-Packard (Canada) Ltd
2376 Galvani Street
Ste-Foy G1N 4G4
Tel (418) 688-8710
TWX 610-571-5525

FOR CANADIAN AREAS NOT LISTED:
Contact Hewlett-Packard (Canada)
Ltd in Mississauga

CENTRAL AND SOUTH AMERICA

ARGENTINA
Hewlett-Packard Argentina
S A C e I
Lavalle 1171-3° Piso
Buenos Aires
Tel 35-0436, 35-0627, 35-0341
Telex Public Booth No 9
Cable HEWPACK ARG

BOLIVIA
Stambuk & Mark (Bolivia) Ltda
Av Mariscal, Santa Cruz 1342
La Paz
Tel 40626, 53163, 52421
Telex 3560014
Cable BUKMAR

BRAZIL
Hewlett-Packard Do Brasil
I E C Ltda
Rua Frei Caneca, 1140/52 Bela Vista
01307-São Paulo-SP
Tel 288-71-11, 287-81-20,
287-61-93
Telex 391-1123602 HPBR-BR
Cable HEWPACK São Paulo

Hewlett-Packard Do Brasil
I E C Ltda
Praca Dom Feliciano, 78-8°
andar (Sala 806/8)
90000-**Pôrto Alegre-RS**
Tel 25-84-70-DDD (0512)
Cable HEWPACK Pôrto Alegre

Hewlett-Packard Do Brasil
I E C Ltda
Rua Siqueira Campos. 53, 4°
andar-Copacabana
20000-**Rio de Janeiro-GB**
Tel 257-80-94-DDD (021)
Telex 391-212-1905 HEWP-BR
Cable HEWPACK
Rio de Janeiro

CHILE
Calcagni y Metcalfe Ltda
Alameda 580-Of 807
Casilla 2118
Santiago, 1
Tel 396813
Telex 350001 CALMET
Cable CALMET Santiago

Medical Only
General Machinery Co , Ltda
Paraguay 494
Casilla 13910
Santiago
Tel 31123, 31124
Cable GEMCO Santiago

COLOMBIA
Instrumentación
Henrik A Langebaek & Kier S A
Carrera 7 No 48-75
Apartado Aéreo 6287
Bogotá, I D E
Tel 69-88-77
Cable AARIS Bogotá
Telex 044-400

COSTA RICA
Científica Costarricense S A
Calle Central, Avenidas 1 y 3
Apartado 10159
San José
Tel 21-86-13
Cable GALGUR San José

ECUADOR
Medical Only
A F Vascalno Compañía Ltda
Av Rio Amazonas No 239
P O Box 2925
Quito
Tel 527-088, 527-804
Cable ASTOR Quito

Calculators Only
Computadoras y Equipos
Electrónicos
P O Box 2695
Avda 12 De Octubre No 2207
Quito
Tel 233869, 236783
Telex 02-2113 Sagita Ed
Cable Sagitra-Quito

EL SALVADOR
IPESA
Bulevar de los Heroes II-48
San Salvador
Tel 252787

GUATEMALA
IPESA
Avenida La Reforma 3-48,
Zona 9
Guatemala City
Tel 63627, 64786
Telex 4192 Teletro Gu

MEXICO
Hewlett-Packard Mexicana,
S A de C V
Torres Adalid No 21, 11° Piso
Col del Valle
Mexico 12, D F
Tel (905) 543-42-32
Telex 017-74-507

Hewlett-Packard Mexicana,
S A de C V
Ave Constitución No 2184
Monterrey, N L
Tel 48-71-32, 48-71-84
Telex 038-843

NICARAGUA
Roberto Terán G
Apartado Postal 689
Edificio Terán
Managua
Tel 25114, 23412,23454
Cable ROTERAN Managua

PANAMA
Electrónico Balboa, S A
P O Box 4929
Calle Samuel Lewis
Cuidad de Panamá
Tel 64-2700
Telex 3431103 Curunda
Canal Zone
Cable ELECTRON Panama

PARAGUAY
Z J Melamed S R L
Divisaón Aparatos y Equipos
Médicos
División Aparatos y Equipos
Científicos y de Investigación
P O Box 676
Chile-482, Edificio Victoria
Asunción
Tel 4-5069, 4-6272
Cable RAMEL

PERU
Compañía Electro Médica S A
Los Flamencos 145
San Isidro Casilla 1030
Lima 1
Tel 413485
Cable ELMED Lima

PUERTO RICO
Hewlett-Packard Inter-Americas
Puerto Rico Branch Office
P O Box 2908I
65th Inf Station
San Juan 00929
Calle 272, Urb Country Club
Carolina 00639
Tel (809) 762-7355/7455/7655
Telex 3450514

URUGUAY
Pablo Ferrando S A
Comercial e Industrial
Avenida Italia 2877
Casilla de Correo 370
Montevideo
Tel 40-3102
Cable. RADIUM Montevideo

VENEZUELA
Hewlett-Packard de Venezuela
C A
Apartado 50933, Caracas 105
Edificio Segre
Tercera Transversal
Los Ruices Norte
Caracas 107
Tel 35-0-07, 35-00-84,
35-00-65, 35-00-31
Telex 25146 HEWPACK
Cable HEWPACK Caracas

FOR AREAS NOT LISTED, CONTACT:
Hewlett-Packard
Inter-Americas
3200 Hillview Ave
Palo Alto, **California 94304**
Tel (415) 493-1501
TWX 910-373-1260
Cable HEWPACK Palo Alto
Telex 034-8300, 034-8493

P/O A1A1 TRIGGER ASSY

RAMP AMPLIFIER Q25/26

C37 1000

+12V

R93 30.1K

+10.7V

+0.2V

R88 51.1

R89 100

Q25

+12V

26

8

R123 1000

Q23

SWEEP SW Q23

INTEGRATOR CURRENT SOURCE Q24

Q24

CR10

R90 5110

VR2 4.99V

VR3 4.99V

R91 10K

+95V

R92 200

Q26

+9.5V

-1V

TP4

25

SWP

P/O S2

1 10

X-Y

R94 1500

SWP LENGTH ADJ

R95 1000

28 8

R96 2210

-12V

7

24

P/O S2

SWP

X-Y

27

8

R99 2000

C38 1000

+5V

P/O A1A2A1

TIME DIV P/O S1

RAMP ADJ

C33 5.5-65

C32 150

C34 982

C35 0.1UF

C36 10UF

1 2 .5 1 2 5 10 20 50 uSEC

1 2 5 1 2 5 10 20 50 mSEC

1 2 5 SEC

P/O A1A2A2

TIME DIV P/O S1

R1 4000

R2 8000

R3 20K

R4 10K

R5 50K

R6 100K

R7 200K

R8 500K

1 2 5 1 2 5 10 20 50 uSEC

1 2 5 1 2 5 10 20 50 mSEC

1 2 5 SEC

1220A-022-02-05-76

PARTS ON THIS SCHEMATIC

P O A1A1	P/O A1A2A1	P/O A1A2A2	CHASSIS
C32-38 CR10 Q23-26 R88-96, R99 P/OS2 VR2,3,	P/OS1	R1-8 P/OS1	

9

Figure 8-15.
Schematic 9, Main Sweep, A1A1, (Sheet 2 of 2)

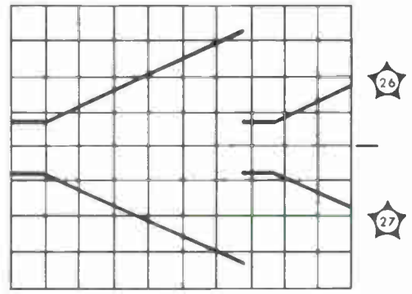
WAVEFORM MEASUREMENT CONDITIONS
SCHEMATIC 10

1. Set front-panel controls in accordance with paragraph 5-9, Section V, except as follows:

   TIME/DIV ..... 1 ms/div

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

3. Apply a 2-kHz, 0.6 V p-p sine wave to channel A INPUT connector.



50 V/div
2 ms/div

1220A-023-01-05-76

Figure 8-16. Schematic 10, Horizontal Output, A1A1, (Sheet 1 of 2)

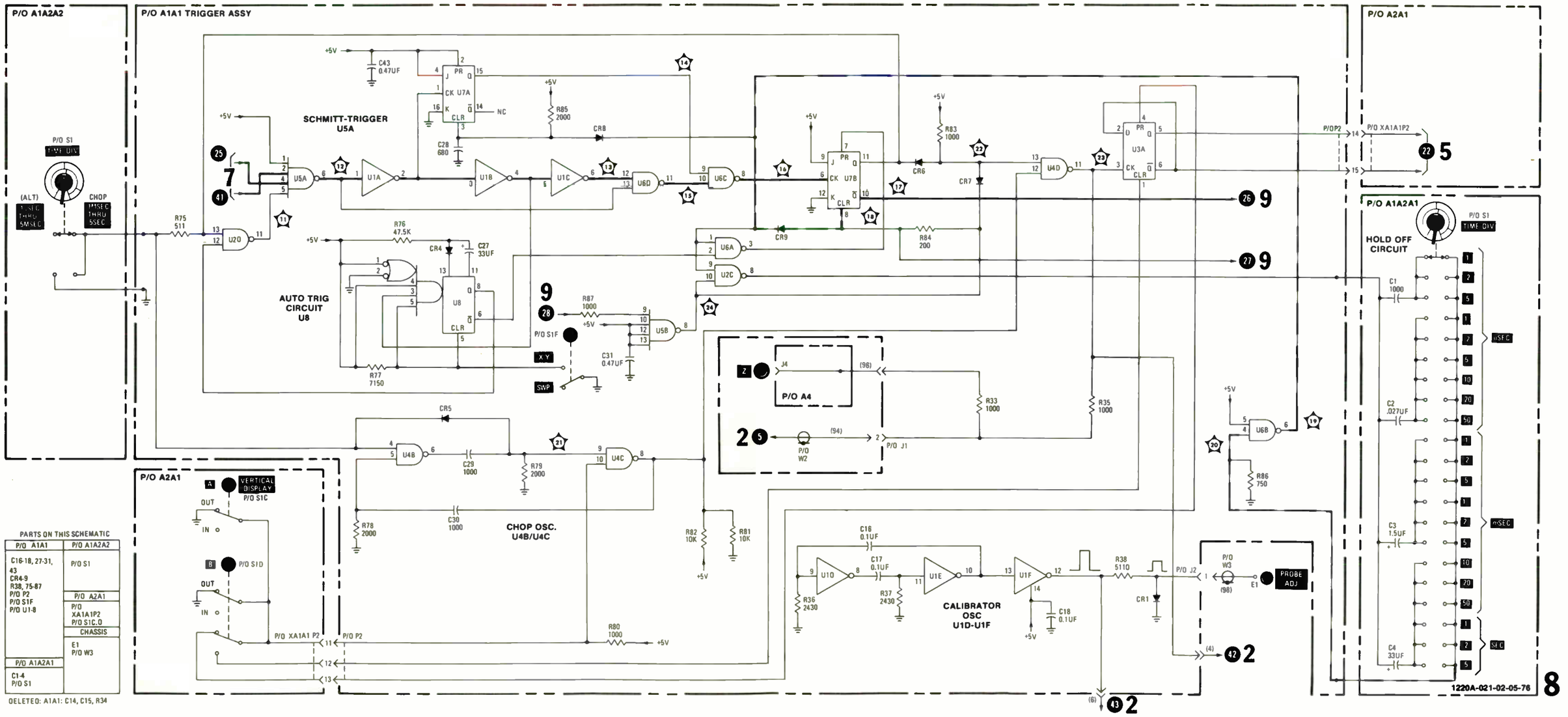
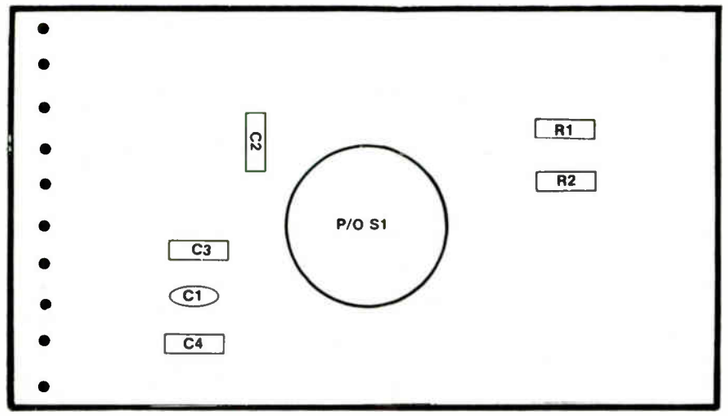
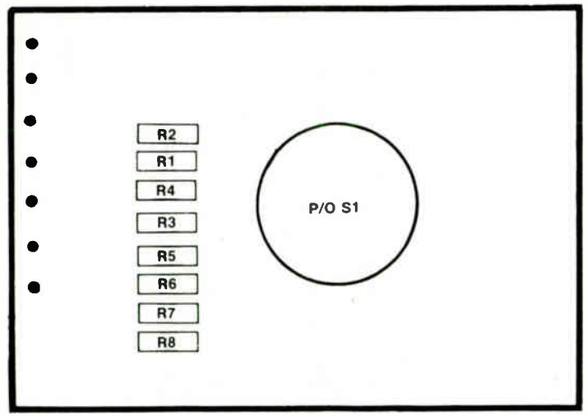


Figure 8-13.
Schematic 8, Trigger Generator (Sheet 2 of 2)
8-23



A1A2A1



A1A2A2

1222A-039-05-76

Figure 8-14. A1A2A1 and A1A2A2, P/O Time/Div Switch, Component Locations

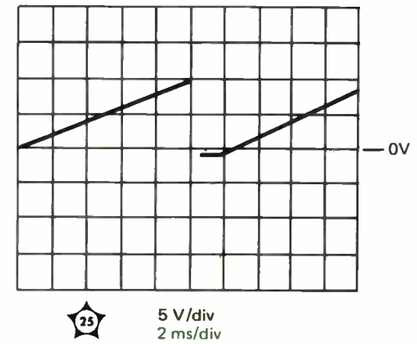
WAVEFORM MEASUREMENT CONDITIONS
SCHEMATIC 9

1. Set front-panel controls in accordance with paragraph 5-9, Section V, except as follows:

   TIME/DIV ..... 1 ms/div

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

3. Apply a 2-kHz, 0.6-V p-p sine wave to channel A INPUT connector.



1220A-022-01-05-76

Figure 8-15. Schematic 9, Main Sweep, A1A1,(Sheet 1 of 2)

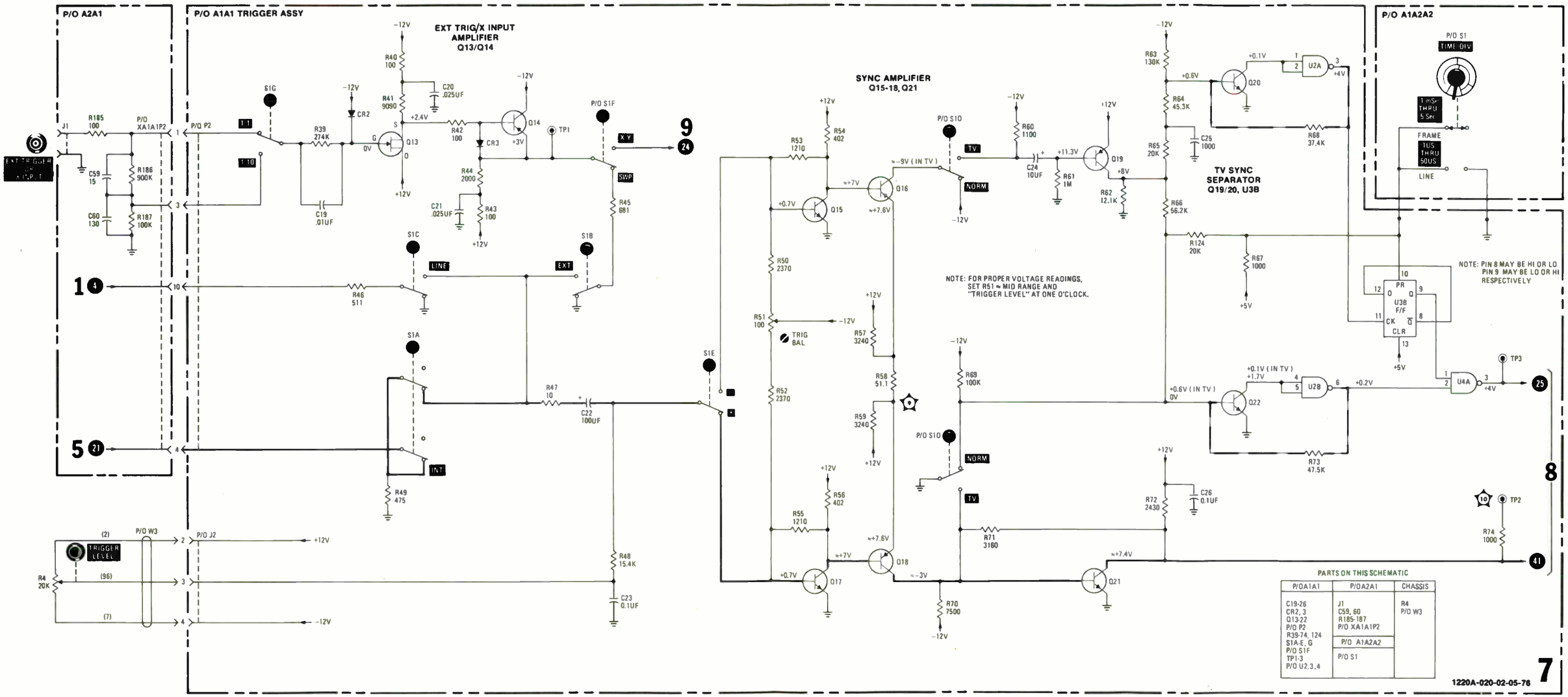


Figure 8-12.
Schematic 7, Sync Input, A1A1, (Sheet 2 of 2)
8-21

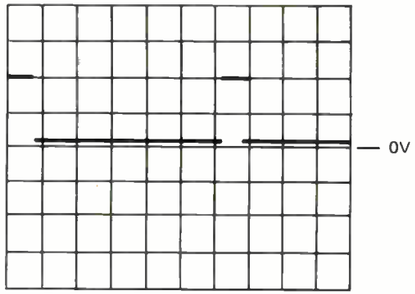
WAVEFORM MEASUREMENT CONDITIONS
SCHEMATIC 8

1. Set front-panel controls in accordance with paragraph 5-9, Section V, except as follows:

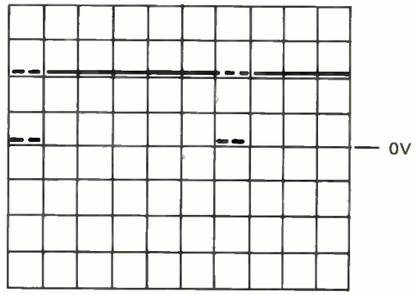
   TIME/DIV ..... 1 ms/div

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

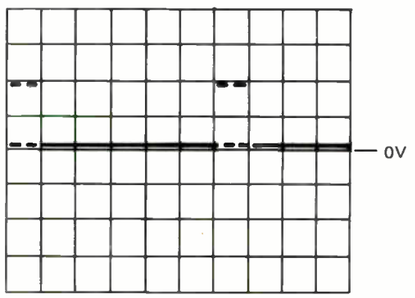
3. Apply a 2-kHz, 0.6-V p-p sine wave to channel A INPUT connector.



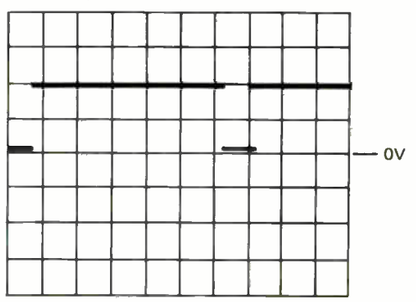
11 2 V/div 2 ms/div



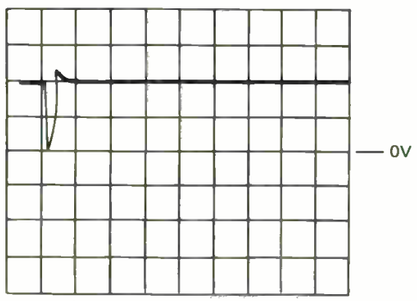
12 2 V/div 2 ms/div



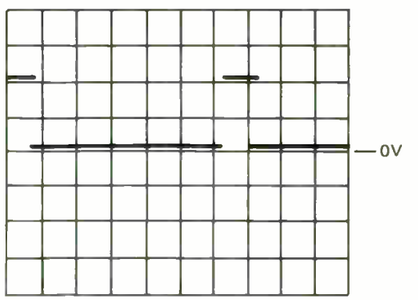
13 2 V/div 2 ms/div



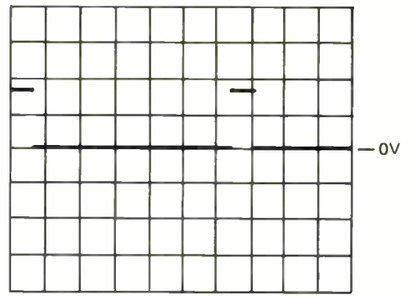
14 2 V/div 2 ms/div



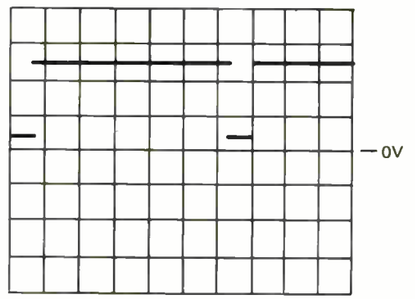
15 2 V/div 0.1 µs/div



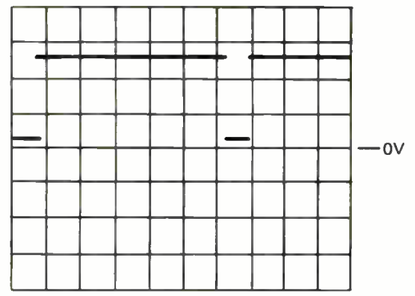
16 2 V/div 2 ms/div



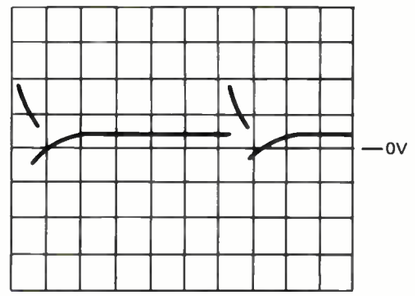
17 2 V/div 2 ms/div



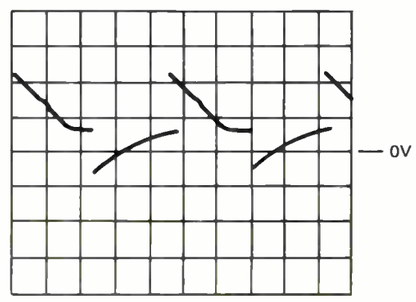
18 2 V/div 2 ms/div



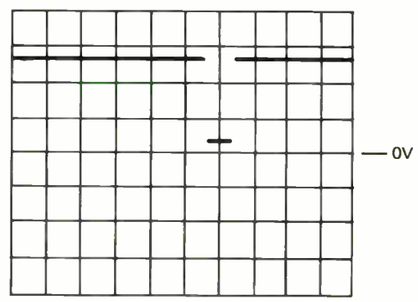
19 2 V/div 2 ms/div



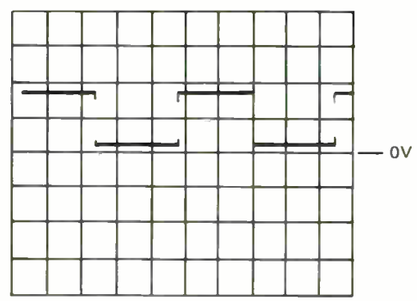
20 2 V/div 2 ms/div



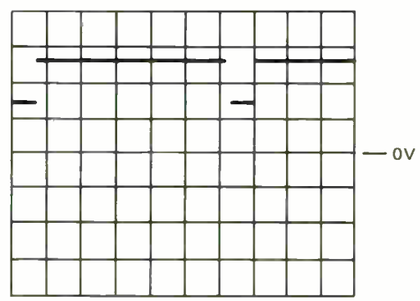
21 2 V/div 1 µs/div



22 2 V/div 2 ms/div



23 2 V/div 1 µs/div



24 2 V/div 2 ms/div

1220A-021-01-05-76

Figure 8-13. Schematic 8, Trigger Generator (Sheet 1 of 2)

P/O A2A1

P/O A1A1 TRIGGER ASSY

5 (20) P/O XA1A1P1 13 — P/O P1 — R1 51.1

R2 24.3K (−12V)

R3 1500 (−12V)

C6 .01UF

R4 100 (+12V)

R8 1500 (+12V)

Q1 (+0.8V)

Q2 (+0.2V, +0.7V)

R5 7500

R6 7500

R7 100 (−12V)

R18 4700

R17 4700

Q3 (+22V)

Q4 (+22.7V)

+45V

R19 221

R20 4700

Q5 (+67.3V)

R21 4700

C9 5.6

C10 .05UF

+91.7V

R22 221 — +95V

Q6 (+91V)

+68V

(0) 18 AWG

C8 .01UF

C_{STRAY}

C_{STRAY}

(0) 18 AWG

C11 .01UF

R29 1050 (+95V)

+91V

R30 18K

R31 100

R32 100

P/O W4 (927) (928) — 9 2

7

0

−12V

+12V

R11 1500

C7 .01UF

R13 1500

+0.8V

Q7

R12 100 (+12V)

+0.7V

+68V

Q12 (+91V)

C12 5.6

+91.7V

Q11 (+67.3V)

R27 4700

C13 .05UF

R28 221 — +95V

R25 4700

R26 221

+45V

+22V

Q9

Q10 (+22.7V)

R23 4700

R24 4700

5 (40) 14 — R9 51.1

Q8 (+0.2V, +0.7V)

R10 24.3K (−12V)

R16 100 (−12V)

R15 7500

R14 7500

1220A-029-05-76

7

0

20 V/div
0.2 ms/div

WAVEFORM MEASUREMENT CONDITIONS SCHEMATIC 6

1. Set front-panel controls in accordance with paragraph 5-9, Section V, except as follow:

   TIME/DIV ..... 0.2 ms/div

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

3. Apply a 2-kHz, 0.6-V p-p sine wave to channel A INPUT connector.

PARTS ON THIS SCHEMATIC

P/O A1A1	CHASSIS
C6-18 Q1-12 R1-32 U1	P/O W4

6

Figure 8-11.
Schematic 6, Vertical Output A1A1

WAVEFORM MEASUREMENT CONDITIONS
SCHEMATIC 7

1. Set front-panel controls in accordance with paragraph 5-9, Section V, except as follows:

   TIME/DIV ..... 1 ms/div

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

3. Apply a 2-kHz, 0.6-V sine wave to channel A INPUT connector.

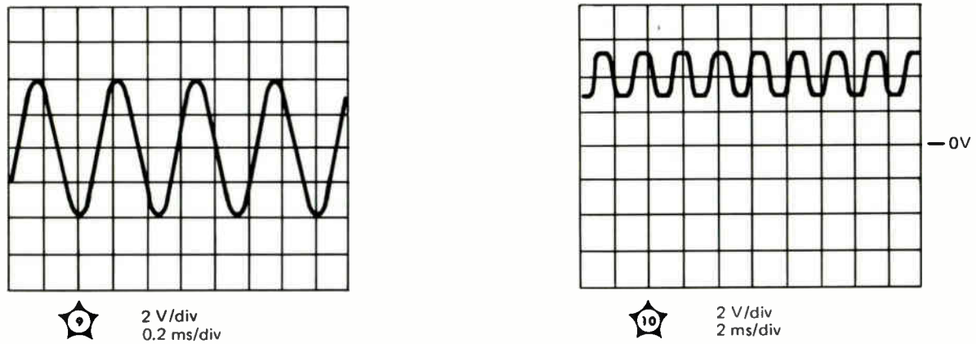


Figure 8-12. Schematic 7, Sync Input, A1A1,(Sheet 1 of 2)

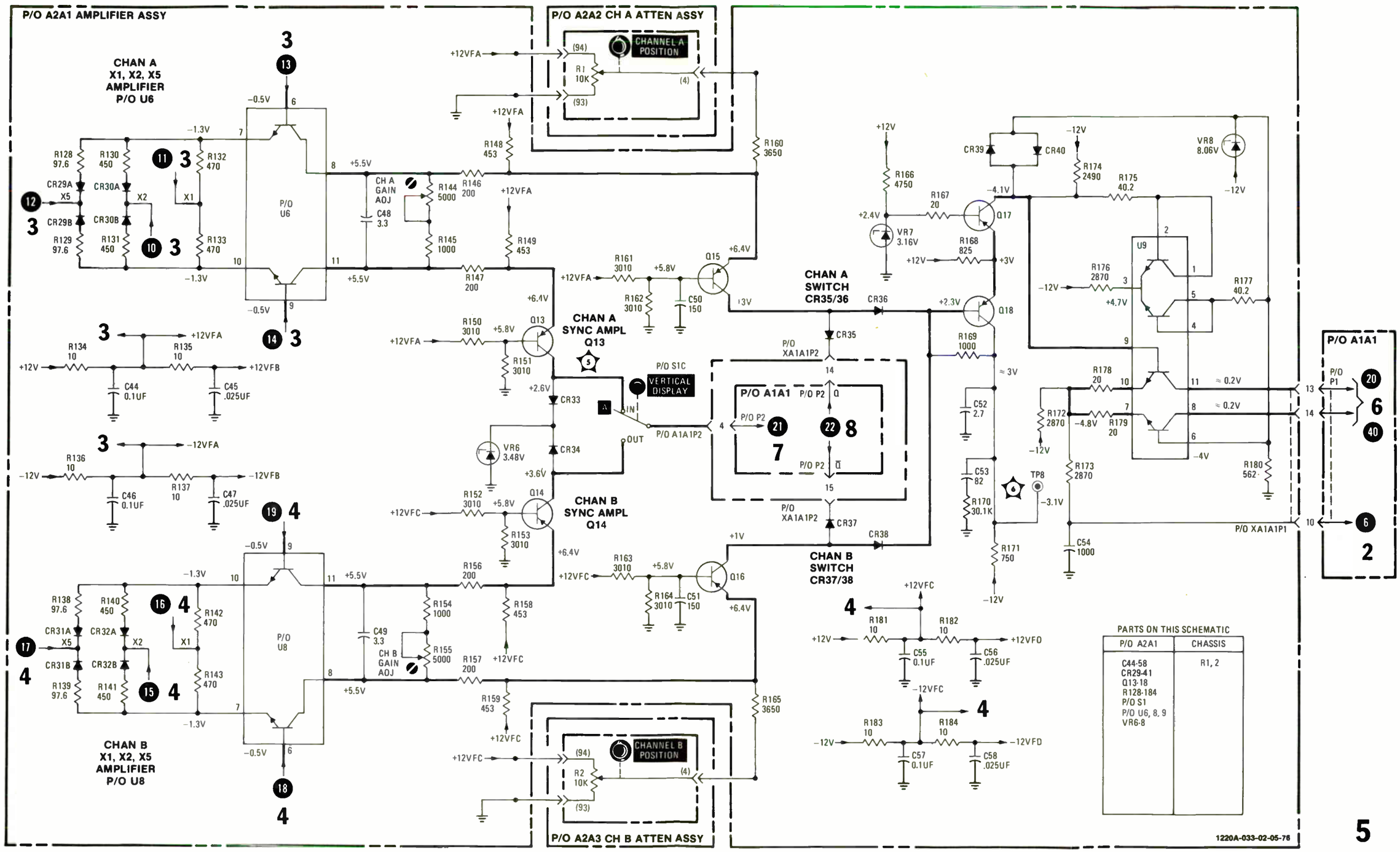
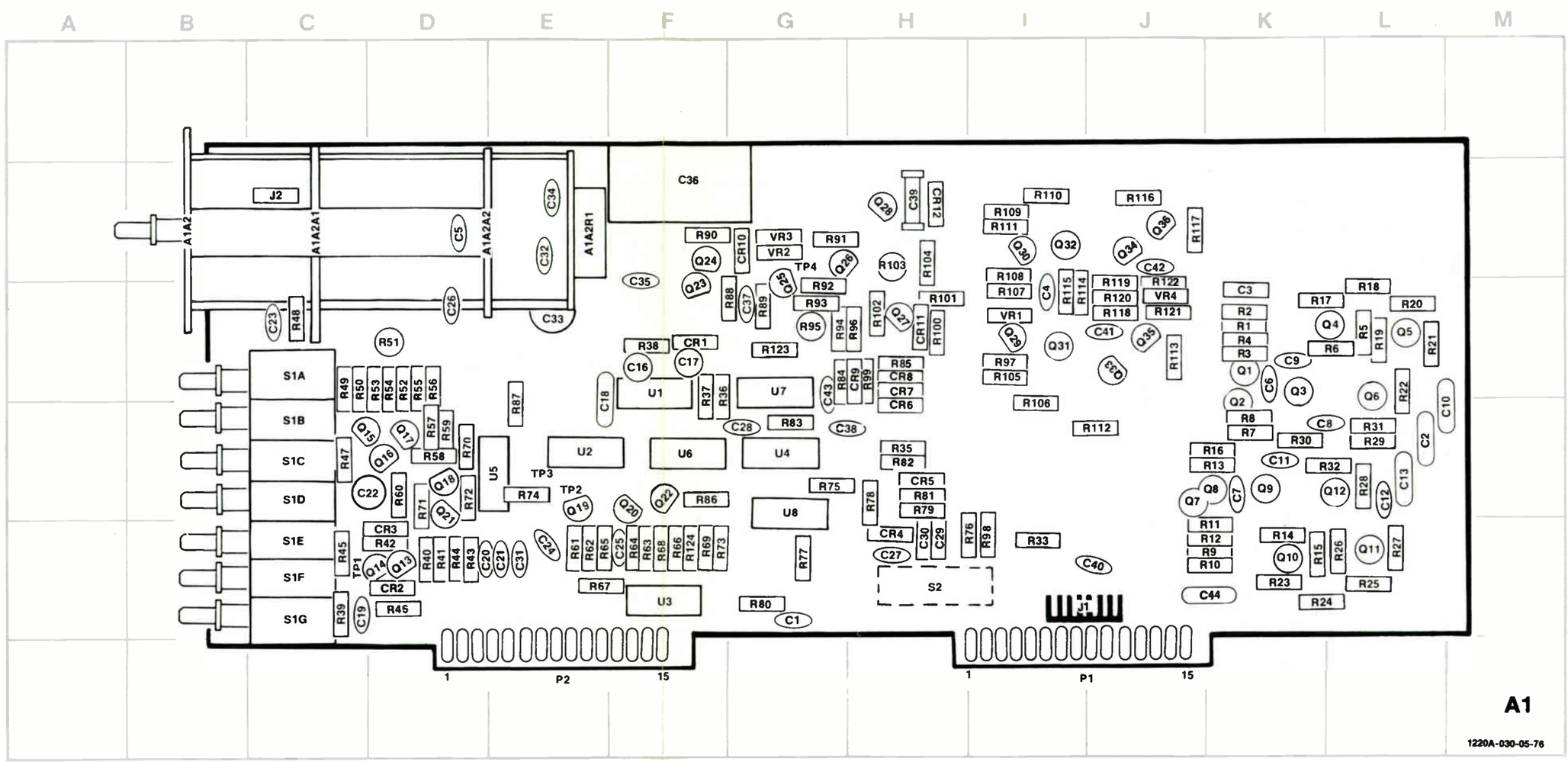


Figure 8-9.
Schematic 5, Vertical Preamplifiers and Channel Switching A2A1, (Sheet 2 of 2)
8-17



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	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
A1A2	B-2	C16	F-3	C31	E-5	CR3	D-5	Q3	K-3	Q19	E-4	Q35	J-3	R15	K-5	R31	L-4	R47	C-4	R63	F-5	R79	H-4	R95	G-3	R111	I-2	TP1	C-5
A2A1	C-2	C17	F-3	C32	E-2	CR4	H-5	Q4	L-3	Q20	F-4	Q36	J-2	R16	K-4	R32	L-4	R48	C-3	R64	F-5	R80	G-5	R96	H-3	R112	J-4	TP2	E-4
A2A2	E-2	C18	E-3	C33	E-3	CR5	H-4	Q5	L-3	Q21	D-4	R1	K-3	R17	K-3	R33	I-5	R49	C-3	R65	E-5	R81	H-4	R97	I-3	R113	J-3	TP3	E-4
A2R1	E-2	C19	C-5	C34	E-2	CR6	H-4	Q6	L-3	Q22	F-4	R2	K-3	R18	L-3	R35	H-4	R50	C-3	R66	F-5	R82	H-4	R98	I-5	R114	I-3	TP4	G-2
C1	G-5	C20	D-5	C35	F-2	CR7	H-3	Q7	J-4	Q23	F-3	R3	K-3	R19	L-3	R36	F-3	R51	D-3	R67	E-5	R83	G-4	R99	H-3	R115	I-3	U1	F-3
C2	L-4	C21	E-5	C36	F-2	CR8	H-3	Q8	K-4	Q24	F-2	R4	K-3	R20	L-3	R37	F-3	R52	D-3	R68	F-5	R84	G-3	R100	H-3	R116	J-2	U2	E-4
C3	K-3	C22	D-4	C37	G-3	CR9	H-3	Q9	K-4	Q25	G-2	R5	L-3	R21	L-3	R38	F-3	R53	D-3	R69	F-5	R85	H-3	R101	H-3	R117	J-2	U3	F-5
C4	I-3	C23	C-3	C38	G-4	CR10	G-2	Q10	K-5	Q26	G-2	R6	L-3	R22	L-3	R39	C-5	R54	D-3	R70	D-4	R86	F-4	R102	H-3	R118	J-3	U4	G-4
C5	D-2	C24	E-5	C39	H-2	CR11	H-3	Q11	L-5	Q27	H-3	R7	K-4	R23	K-5	R40	D-5	R55	D-3	R71	D-4	R87	E-4	R103	H-2	R119	J-3	U5	E-4
C6	K-3	C25	F-5	C40	J-5	CR12	H-2	Q12	L-4	Q28	H-2	R8	K-4	R24	K-5	R41	D-5	R56	D-3	R72	D-4	R88	F-3	R104	H-2	R120	J-3	U6	F-4
C7	K-4	C26	D-3	C41	J-3	J1	C-2	Q13	D-5	Q29	I-3	R9	K-5	R25	L-5	R42	D-5	R57	D-4	R73	F-5	R89	G-3	R105	I-3	R121	J-3	U7	G-3
C8	K-4	C27	H-5	C42	J-2	J2	C-2	Q14	D-5	Q30	I-2	R10	K-5	R26	L-5	R43	D-5	R58	D-4	R74	E-4	R90	F-2	R106	I-4	R122	J-3	U8	G-4
C9	K-3	C28	G-4	C43	G-3	P1	I-6	Q15	C-4	Q31	I-3	R11	K-5	R27	L-5	R44	D-5	R59	D-4	R75	G-4	R91	G-2	R107	I-3	R123	G-3	VR1	I-3
C10	L-4	C29	H-5	C44	K-5	P2	E-6	Q16	D-4	Q32	I-2	R12	K-5	R28	L-4	R45	C-5	R60	D-4	R76	I-5	R92	G-3	R108	I-2	R124	F-5	VR2	G-2
C11	K-4	C30	H-4	CR1	F-3	Q1	K-3	Q17	D-4	Q33	J-3	R13	K-4	R29	L-4	R46	D-5	R61	E-5	R77	G-5	R93	G-3	R109	I-2	S1	C-3	VR3	G-2
C12	L-4			CR2	D-5	Q2	K-4	Q18	D-4	Q34	J-2	R14	K-5	R30	K-4			R62	E-5	R78	H-4	R94	G-3	R110	I-2	S2	H-5	VR4	J-3
C13	L-4																												

Figure 8-10. A1 Horizontal, Trigger, and Vertical Output Component Locations

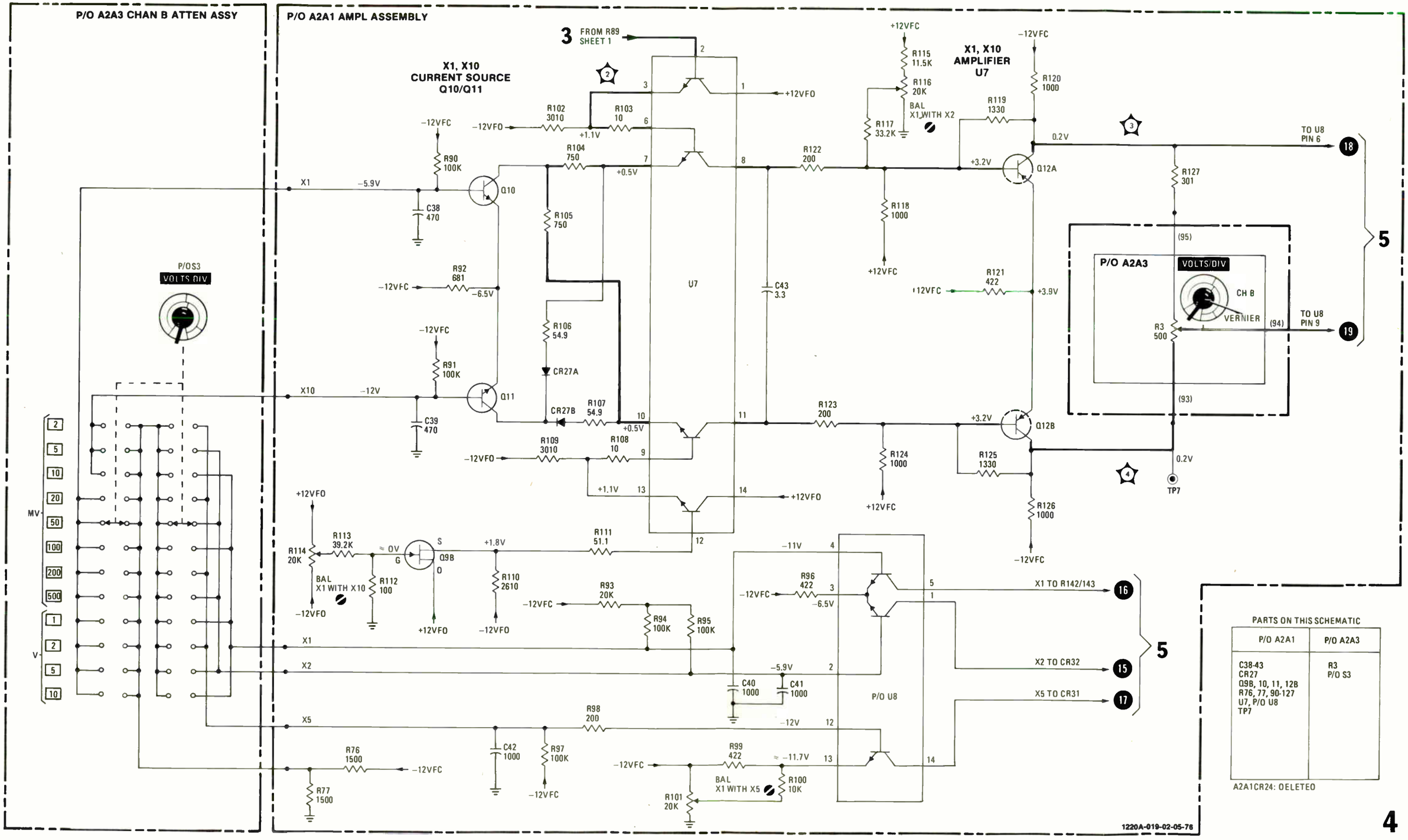


Figure 8-8.
Schematic 4, Channel B Preamplifier (Sheet 2 of 2)

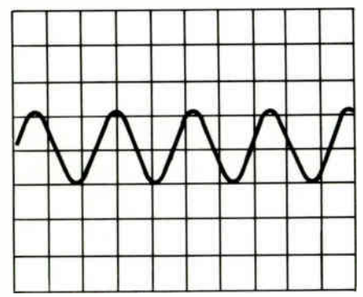
WAVEFORM MEASUREMENT CONDITIONS
SCHEMATIC 5

1. Set front-panel controls in accordance with paragraph 5-9, Section V, except as follows:

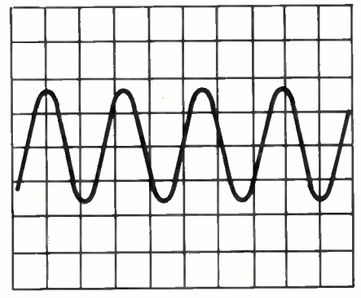
   TIME/DIV ..... 0.2 ms/div

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

3. Apply a 2-kHz, 0.6-V p-p sine wave to channel A INPUT connector (to channel B INPUT connector when checking channel B).



5 mV/div
0.2 ms/div



0.2 V/div
0.2 ms/div

1220A-033-01-05-76

Figure 8-9. Schematic 5, Vertical Preamplifiers and Channel Switching A2A1,(Sheet 1 of 2)

P/O A2A2 CHAN A ATTEN ASSY

P/O A2A1 AMPL ASSY

3 FROM R37 SHEET 1

X1, X10 CURRENT SOURCE Q6/Q7

X1, X10 AMPLIFIER U5

P/O S3 VOLTS DIV

P/O A2A2 VOLTS DIV CH A VERNIER

TO U6, 6

TO U6, 9

P/O U6

TP6

PARTS ON THIS SCHEMATIC

P/O A2A1	P/O A2A2
C24-29 CR23 Q5-8 R24, 25, 38-59, 63-75 U5, P/O U6 TP6	R3 P/O S3

A2A1CR24: DELETED

1220A-018-02-05-76

Figure 8-7.
Schematic 3, Channel A Preamplifier (Sheet 2 of 2)

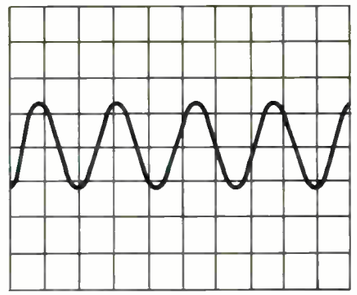
WAVEFORM MEASUREMENT CONDITIONS
SCHEMATIC 4

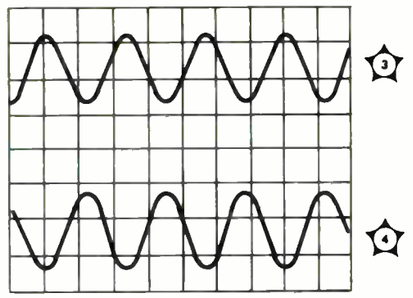
1. Set front-panel controls in accordance with paragraph 5-9, Section V, except as follows:

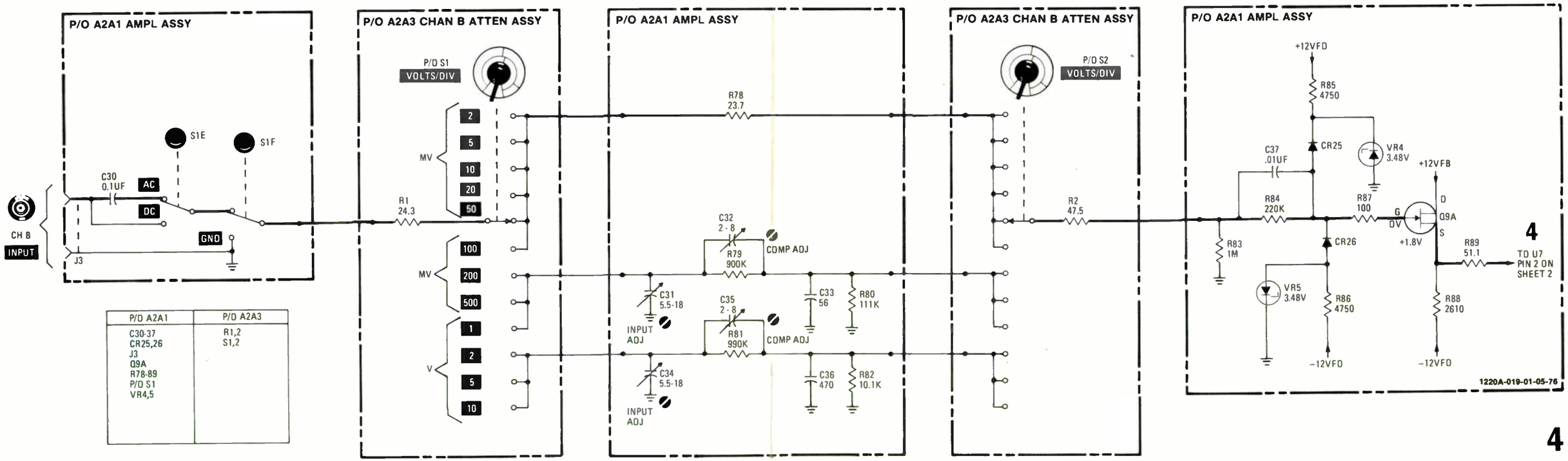
   TIME/DIV ..... 0.2 ms/div

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

3. Apply a 2-kHz, 0.6-V p-p sine wave to channel A INPUT connector (to channel B INPUT connector when checking channel B).

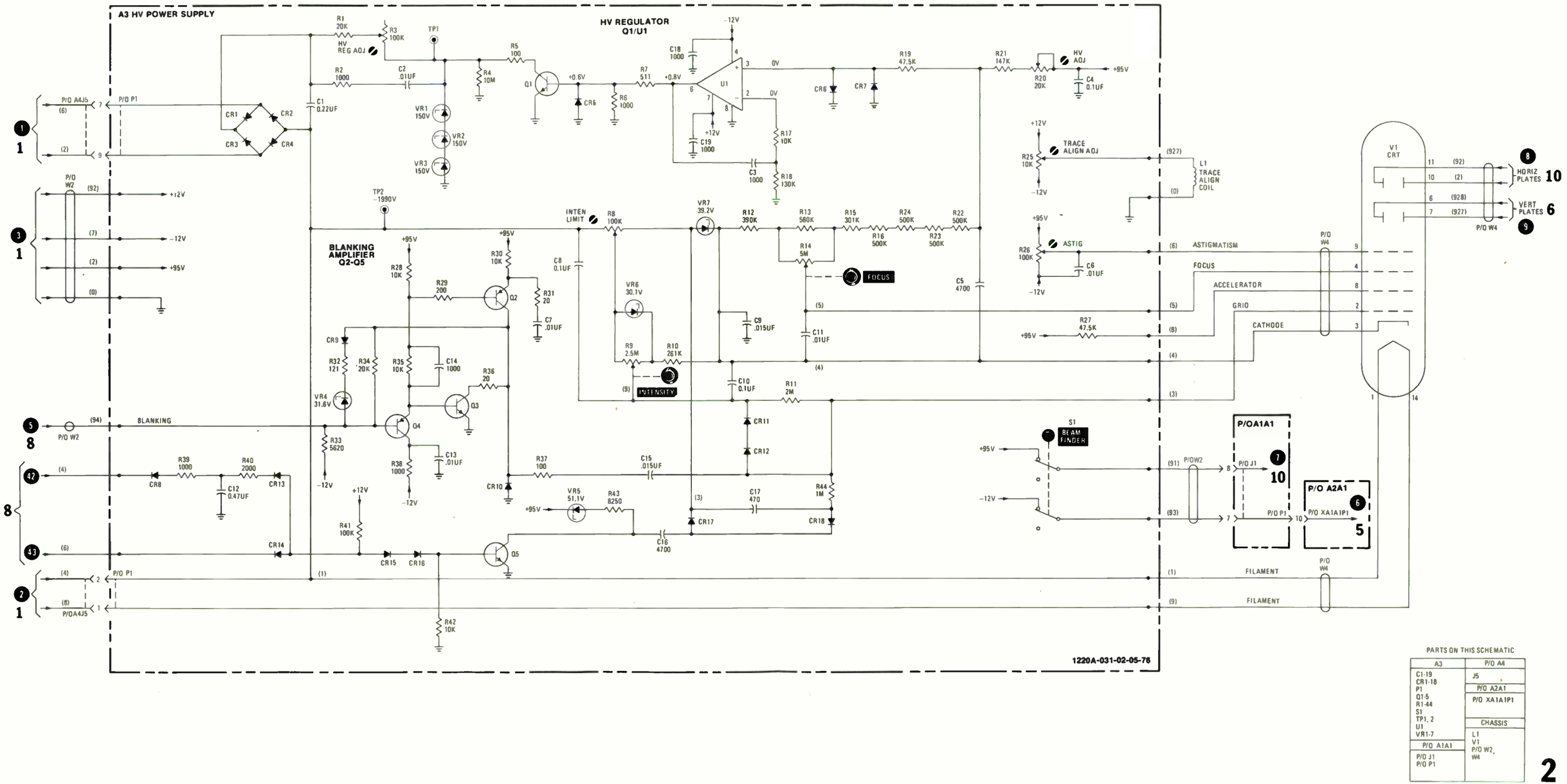






P/O A2A1	P/O A2A3
C30-37 CR25,26 J3 Q9A R78-89 P/O S1 VR4,5	R1,2 S1,2

Figure 8-8. Schematic 4, Channel B Attenuator (Sheet 1 of 2)



PARTS ON THIS SCHEMATIC

A3	P/O A4
C1-19 CR1-18 P1 Q1-5 R1-44 S1 TP1, 2 U1 VR1-7	J5
P/O A1A1	P/O A2A1
P/O J1 P/O P1	P/O XA1A1P1
	CHASSIS
	L1 V1 P/O W2, W4

Figure 8-6.
Schematic 2, High-voltage Power Supply A3,(Sheet 2 of 2)
8-11

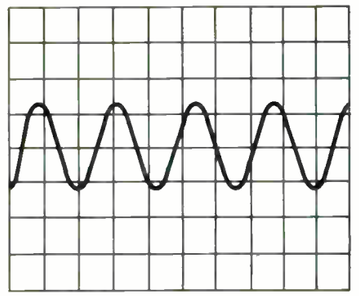
WAVEFORM MEASUREMENT CONDITIONS
SCHEMATIC 3

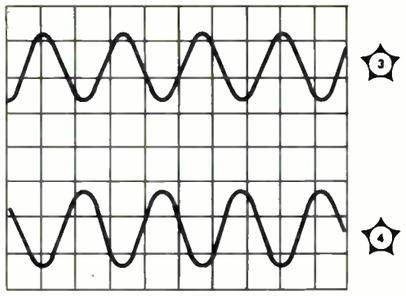
1. Set front-panel controls in accordance with paragraph 5-9, Section V, except as follows:

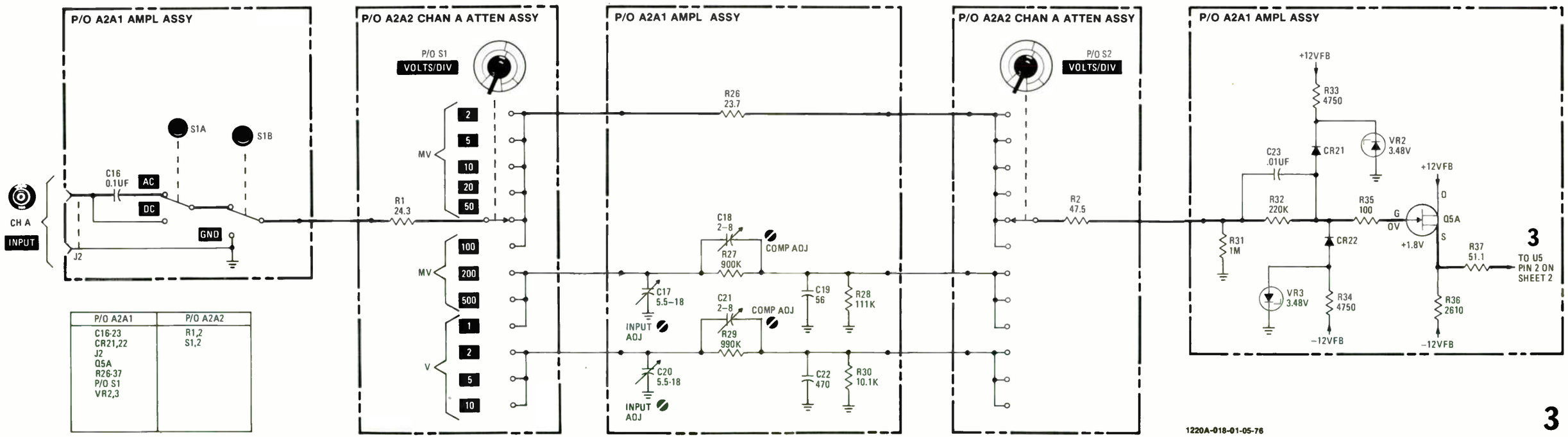
   TIME/DIV ..... 0.2 ms/div

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

3. Apply a 2-kHz, 0.6-V p-p sine wave to channel A INPUT connector (to channel B INPUT connector when checking channel B).

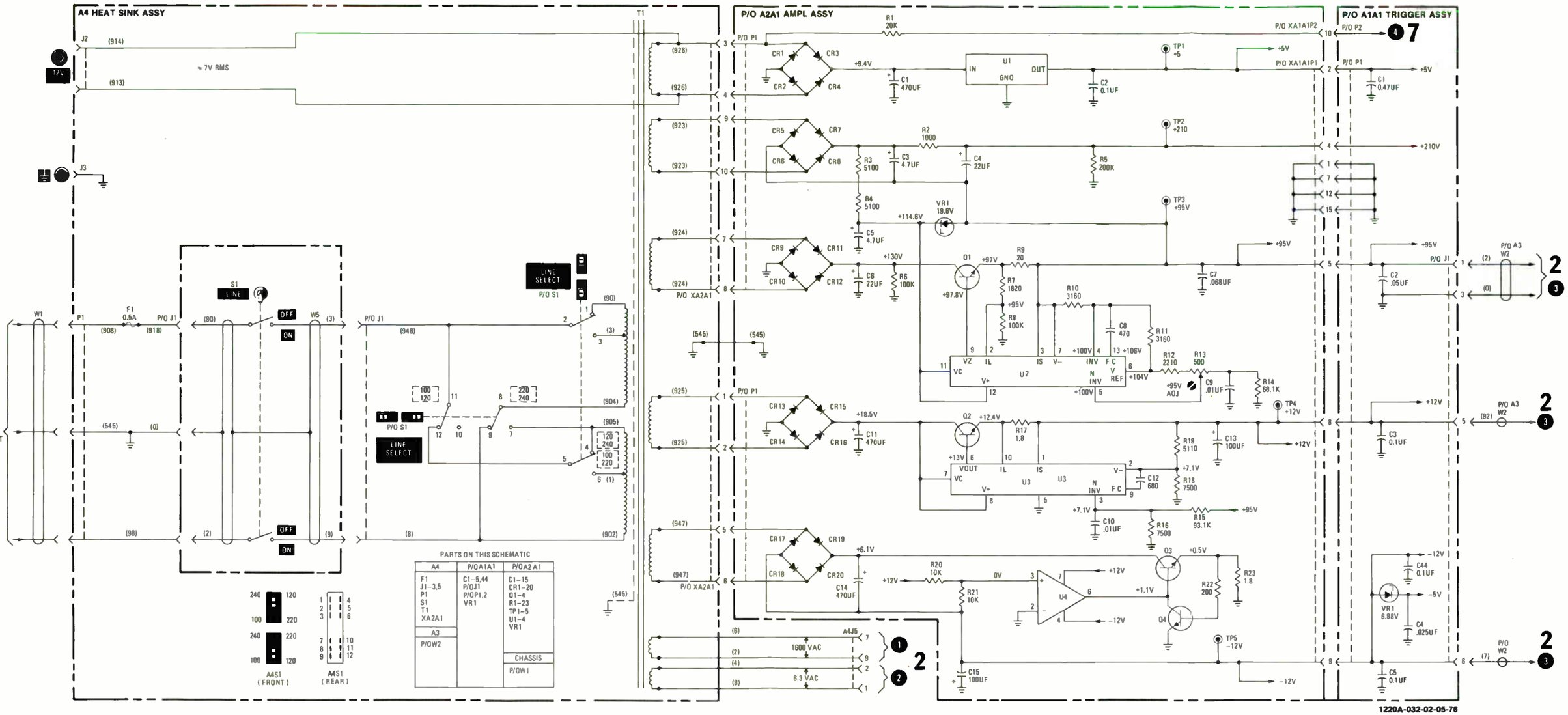




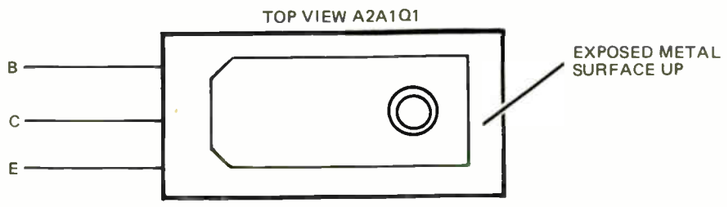


P/O A2A1	P/O A2A2
C16-23 CR21,22 J2 Q5A R26-37 P/O S1 VR2,3	R1,2 S1,2

Figure 8-7. Schematic 3, Channel A Attenuator (Sheet 1 of 2)



INSTALLATION OF A2A1: U1, Q1, Q2, Q3



NOTE

POWER TRANSISTOR INSULATORS (A2A1MP1, 3 REQUIRED) MUST BE USED ON A2A1Q1, Q2, AND Q3. INSULATOR IS NOT REQUIRED ON A2A1U1.

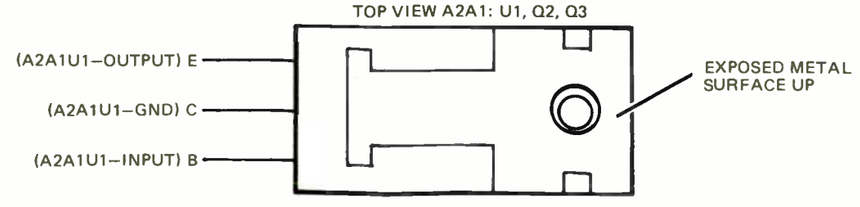
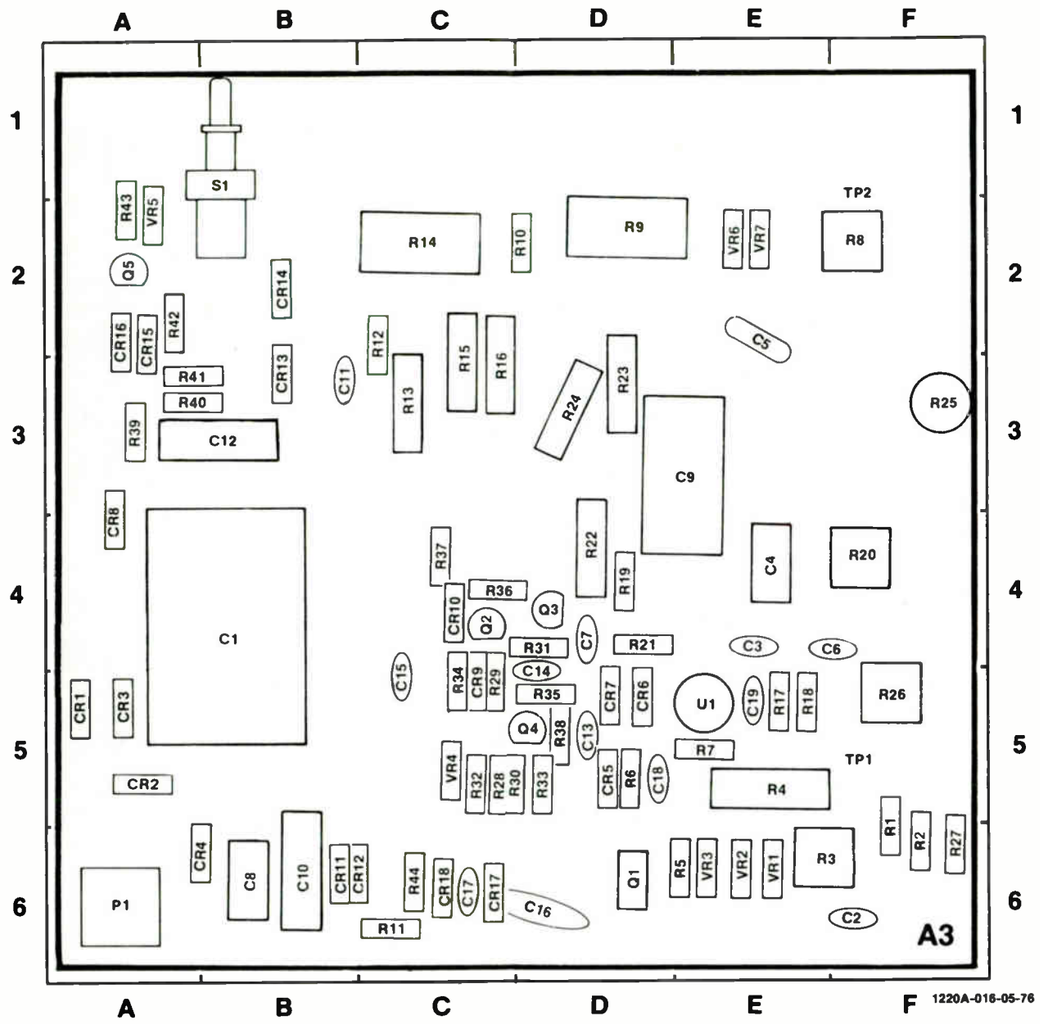


Figure 8-4.
Schematic 1, AC Input and Power Supplies A4, A2A1



1220A-016-05-76

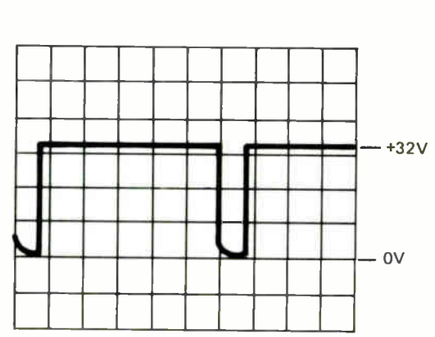
REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-4	C15	C-5	CR10	C-4	Q5	A-2	R14	C-2	R28	C-5	R42	A-2
C2	F-6	C16	D-6	CR11	B-6	R1	F-6	R15	C-3	R29	C-5	R43	A-2
C3	E-4	C17	C-6	CR12	B-6	R2	F-6	R16	C-3	R30	C-5	R44	C-6
C4	E-4	C18	D-5	CR13	B-3	R3	E-6	R17	E-5	R31	D-4	S1	8-1
C5	E-2	C19	E-5	CR14	B-3	R4	E-5	R18	E-5	R32	C-5	TP1	F-5
C6	E-4	CR1	A-5	CR15	A-2	R5	E-6	R19	D-4	R33	C-5	TP2	F-2
C7	D-4	CR2	A-5	CR16	A-2	R6	D-5	R20	F-4	R34	C-5	U1	E-5
C8	B-6	CR3	A-5	CR17	C-6	R7	E-5	R21	D-4	R35	D-5	VR1	E-6
C9	E-3	CR4	A-6	CR18	C-6	R8	F-2	R22	D-4	R36	C-4	VR2	E-6
C10	B-6	CR5	D-5	P1	A-6	R9	D-2	R23	D-3	R37	C-4	VR3	E-6
C11	B-3	CR6	D-5	Q1	D-6	R10	D-2	R24	D-3	R38	D-5	VR4	C-5
C12	A-3	CR7	D-5	Q2	C-4	R11	C-6	R25	F-5	R39	A-3	VR5	A-2
C13	D-5	CR8	A-4	Q3	D-4	R12	C-2	R26	F-5	R40	A-3	VR6	E-2
C14	D-5	CR9	C-5	Q4	C-5	R13	C-3	R27	F-6	R41	A-3	VR7	E-2

Figure 8-5. A3 High-voltage Power Supply Component Locations

WAVEFORM MEASUREMENT CONDITIONS
SCHEMATIC 2

1. Set front-panel controls in accordance with paragraph 5-9, Section V.

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



1 RETRACE BLANKING (SINGLE CHANNEL)

10 V/div
2 μs/div

1 RETRACE AND CHOP BLANKING (CHOP MODE)

10 V/div
2 ms/div

1220A-031-01-05-76

Figure 8-6. Schematic 2, High-voltage Power Supply A3,(Sheet 1 of 2)

Table 8-2. Schematic Notes

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

ETCHED CIRCUIT BOARD

ASSEMBLY

ETCHED CIRCUIT BOARD ON ASSEMBLY

FRONT- AND 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

TP4 TEST POINT (TP WITH NUMBER)

SCREWDRIVER ADJUSTMENT

WAVEFORM TEST POINT (WITH NUMBER)

COMMON ELECTRICAL POINT (WITH LETTER); NOT NECESSARILY GROUND

70 SIGNAL REFERENCE

9 SCHEMATIC REFERENCE

BREAKDOWN DIODE (VOLTAGE REGULATOR)

LIGHT EMITTING DIODE (LED)

TUNNEL DIODE

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

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

(925) WIRE COLORS ARE GIVEN BY NUMBERS IN PARENTHESES USING THE RESISTOR COLOR CODE

[(925) IS WHT-RED-GRN]

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

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

UNLESS OTHERWISE INDICATED: 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

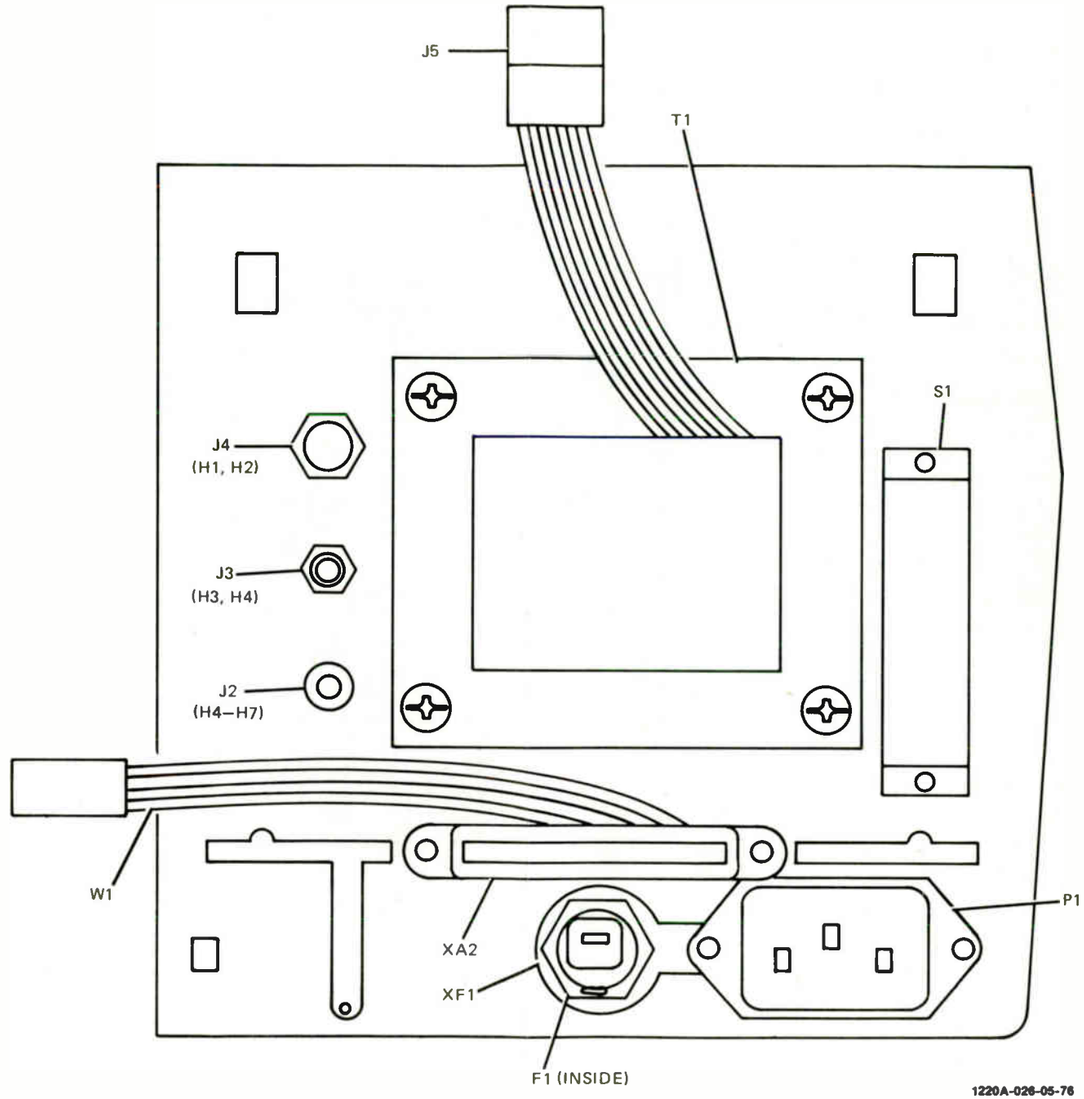
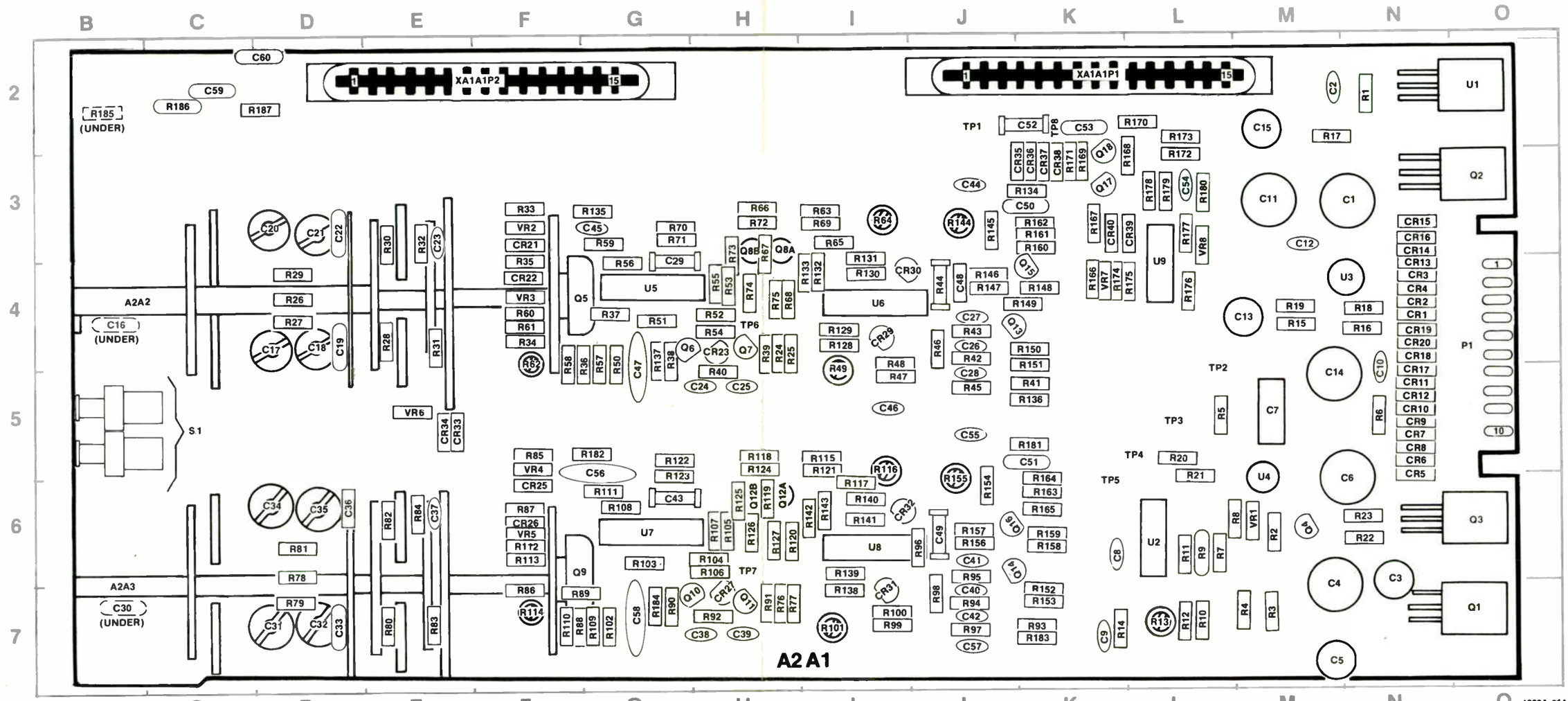


Figure 8-2. A4 Sink Assembly, Component Locations



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	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	REF DESIG	GRID LOC
C1	N-3	C20	D-3	C39	H-7	C58	G-7	CR17	N-5	CR38	K-3	Q16	J-6	R17	M-2	R36	G-4	R55	H-4	R74	H-4	R92	H-7	R110	F-7	R128	I-4	R146	J-4	R164	K-6	R182	G-5	U4	M-6
C2	M-2	C21	D-3	C40	J-7	C59	C-2	CR18	N-4	CR39	K-3	Q17	K-3	R18	N-4	R37	G-4	R56	G-4	R75	H-4	R93	K-7	R111	G-6	R129	I-4	R147	J-4	R165	K-6	R183	K-7	U5	G-4
C3	N-6	C22	D-3	C41	J-6	C60	D-2	CR19	N-4	CR40	K-3	Q18	K-3	R19	M-4	R38	G-4	R57	G-4	R76	H-7	R94	J-7	R112	F-6	R130	I-4	R148	K-4	R166	K-6	R184	G-7	U6	I-4
C4	N-7	C23	E-3	C42	J-7	CR1	N-4	CR20	N-4	P1	O-4	R1	N-2	R20	L-5	R39	H-4	R58	F-4	R77	H-7	R95	J-6	R113	F-6	R131	I-3	R149	K-4	R167	K-3	R185	8-2	U7	G-6
C5	N-7	C24	H-5	C43	G-6	CR2	N-4	CR21	F-3	Q1	O-7	R2	M-6	R21	L-5	R40	H-5	R59	G-3	R78	D-6	R96	J-6	R114	F-7	R132	I-4	R150	K-4	R168	L-3	R186	C-2	U8	I-6
C6	N-6	C25	H-5	C44	J-3	CR3	N-4	CR22	F-4	Q2	O-3	R3	M-7	R22	N-6	R41	K-5	R60	F-4	R79	D-7	R97	J-7	R115	I-5	R133	I-4	R151	K-4	R169	K-3	R187	D-2	U9	L-4
C7	M-5	C26	J-4	C45	G-3	CR4	N-4	CR23	H-4	Q3	O-6	R4	M-7	R23	N-6	R42	J-4	R61	F-4	R80	E-7	R98	J-7	R116	I-5	R134	K-3	R152	K-7	R170	L-2	S1	8-5	VR1	M-6
C8	K-6	C27	J-4	C46	I-5	CR5	N-5	CR25	F-6	Q4	M-6	R5	L-5	R24	H-4	R43	J-4	R62	F-4	R81	D-6	R99	I-7	R117	I-6	R135	G-3	R153	K-7	R171	K-3	TP1	J-2	VR2	F-3
C9	K-7	C28	J-5	C47	G-4	CR6	N-5	CR26	F-6	Q5	G-4	R6	N-5	R25	H-4	R44	J-4	R63	I-3	R82	E-6	R100	I-7	R118	H-5	R136	K-5	R154	J-6	R172	L-3	TP2	L-5	VR3	F-4
C10	N-5	C29	G-3	C48	J-4	CR7	N-5	CR27	I-7	Q6	G-4	R7	L-5	R26	D-4	R45	J-5	R64	I-3	R83	E-7	R101	I-7	R119	H-6	R137	G-4	R155	J-6	R173	L-2	TP3	L-5	VR4	F-5
C11	M-3	C30	B-7	C49	J-6	CR8	N-5	CR29	I-4	Q7	H-4	R8	L-5	R27	D-4	R46	J-4	R65	I-3	R84	E-6	R102	G-7	R120	H-6	R138	I-7	R156	J-6	R174	K-4	TP4	L-5	VR5	F-6
C12	M-3	C31	O-7	C50	K-3	CR9	N-5	CR30	I-4	Q8A, 8	H-3	R9	L-5	R28	E-4	R47	H-5	R66	H-3	R85	F-5	R103	G-6	R121	I-5	R139	I-6	R157	J-6	R175	L-4	TP5	K-6	VR6	E-5
C13	M-4	C32	D-7	C51	K-5	CR10	N-5	CR31	I-7	Q9	F-6	R10	L-7	R29	D-4	R48	I-4	R67	H-3	R86	F-7	R104	H-6	R122	G-5	R140	H-6	R158	K-6	R176	L-4	TP6	H-4	VR7	K-4
C14	M-5	C33	D-7	C52	K-2	CR11	N-5	CR32	I-6	Q10	G-7	R11	L-5	R30	E-3	R49	I-5	R68	H-4	R87	F-6	R105	H-6	R123	G-5	R141	H-6	R159	K-6	R177	L-3	TP7	H-6	VR8	L-3
C15	M-2	C34	D-6	C53	K-2	CR12	N-5	CR33	E-5	Q11	H-7	R12	L-7	R31	E-4	R50	G-4	R69	I-3	R88	F-7	R106	H-6	R124	H-5	R142	H-6	R160	K-3	R178	L-3	TP8	K-2	XA1P1	K-2
C16	B-4	C35	D-6	C54	L-3	CR13	N-4	CR34	E-5	Q12A, 8	H-6	R13	L-7	R32	E-3	R51	G-4	R70	G-3	R89	F-7	R107	H-6	R125	H-6	R143	H-6	R161	K-3	R179	L-3	U1	O-2	XA1P2	E-2
C17	D-4	C36	D-6	C55	J-5	CR14	N-3	CR35	K-3	Q13	J-4	R14	K-7	R33	F-3	R52	K-2	R71	G-3	R90	G-7	R108	G-6	R126	H-6	R144	J-3	R162	K-3	R180	L-3	U2	L-6	A2A2	8-4
C18	D-4	C37	E-6	C56	G-5	CR15	N-3	CR36	K-3	Q14	J-6	R15	M-4	R34	F-4	R53	H-4	R72	H-3	R91	H-7	R109	G-7	R127	H-6	R145	J-3	R163	K-6	R181	K-5	U3	N-4	A2A3	8-7
C19	D-4	C38	H-7	C57	J-7	CR16	N-3	CR37	K-3	Q15	K-4	R16	N-4	R35	F-3	R54	H-4	R73	H-3																

Figure 8-3. A2 Vertical Assembly, Component Locations

HEWLETT hp PACKARD

SALES & SERVICE OFFICES

AFRICA, ASIA, AUSTRALIA

AMERICAN SAMOA
Calculators Only
Oceanic Systems Inc
P O Box 777
Pago Pago Bayfront Road
Pago Pago 96799
Tel 633 5513
Cable OCEANIC Pago Pago

ANGOLA
Telectra
Empresa Tecnica de Equipamentos Electricos S A R L
R Barbosa Rodrigues 42 r DT
Caixa Postal 6487
Luanda
Tel 35515/6
Cable TELECTRA Luanda

AUSTRALIA
Hewlett Packard Australia Pty Ltd
31 41 Joseph Street
Blackburn Victoria 3130
P O Box 36
Doncaster East Victoria 3109
Tel 89 6351
Telex 31-024
Cable HEWPARD Melbourne
Hewlett Packard Australia Pty Ltd
31 Bridge Street
Pymble
New South Wales 2073
Tel 449 6566
Telex 21561
Cable HEWPARD Sydney
Hewlett Packard Australia Pty Ltd
153 Greenhill Road
Parkside 5063 S A
Tel 272-5911
Telex 82536 ADEL
Cable HEWPARD ADELAIDE
Hewlett Packard Australia Pty Ltd
141 Stirling Highway
Nedlands W A 6009
Tel 86 5455
Telex 93859 PERTH
Cable HEWPARD PERTH
Hewlett Packard Australia Pty Ltd
121 Wollongong Street
Fyshwick A C T 2609
Tel 95 3733
Telex 62650 Canberra
Cable HEWPARD CANBERRA
Hewlett Packard Australia Pty Ltd
5th Floor
Teachers Union Building
495 499 Boundary Street
Spring Hill 4000 Queensland
Tel 29 1544
Telex 42133 BRISBANE

GUAM
Medical Pocket Calculators Only
Guam Medical Supply Inc
Jay Ease Building Room 210
P O Box 8947
Tamuning 96911
Tel 646 4513
Cable EAIMED Guam

HONG KONG
Schmidt & Co (Hong Kong) Ltd
P O Box 297
Connaught Centre
39th Floor
Connaught Road Central
Hong Kong
Tel H 255281 5
Telex 74766 SCHMC HX
Cable SCHMIDTCO Hong Kong

INDIA
Blue Star Ltd
Kasturi Buildings
Jamshedji Tata Rd
Bombay 400 020
Tel 29 50 21
Telex 2156
Cable BLUEFROST
Blue Star Ltd
Sahas
414/2 Vir Savarkar Marg
Prabhadevi
Bombay 400 025
Tel 45 73 01
Telex 3751
Cable BLUESTAR
Blue Star Ltd
14/40 Civil Lines
Kanpur 208 001
Tel 6 88 82
Telex 292
Cable BLUESTAR
Blue Star Ltd
7 Hare Street
P O Box 506
Calcutta 700 001
Tel 23 0131
Telex 7655
Cable BLUESTAR
Blue Star Ltd
7th & 8th Floor
Bhandari House
91 Nehru Place
New Delhi 110024
Tel 634770 & 635166
Telex 2463
Cable BLUESTAR
Blue Star Ltd
Blue Star House
11-11A Magarath Road
Bangalore 560 025
Tel 55668
Telex 430
Cable BLUESTAR
Blue Star Ltd
Meenakshi Mandiran
xxx 1678 Mahatma Gandhi Rd
Cochin 682 016 Kerala
Tel 32069 32161 32782
Telex 0468514
Cable BLUESTAR
Blue Star Ltd
1 1 1 & 1
Sardem Dem Road
Secunderabad 500 303
Tel 70126 70127
Cable BLUEFROST
Telex 459
Blue Star Ltd
2/34 Kodambakkan High Road
Madras 600034
Tel 82056
Telex 041-379
Cable BLUESTAR
Blue Star Ltd
Nathraj Mansions
2nd Floor Balupur
Jamshedpur 831 001
Tel 6963
Cable BLUESTAR
Telex 240

INDONESIA
BERCA Indonesia P T
P O Box 496
1st Floor JL Cikini Raya 61
Jakarta
Tel 56038 40369 49886
Telex 42895
Cable BERCACON
BERCA Indonesia P T
63 JL Raja Gubeng
Surabaya
Tel 44309

ISRAEL
Electronics & Engineering Div of Motorola Israel Ltd
16 Kremenetski Street
P O Box 25016
Tel-Aviv
Tel 03-389 73
Telex 33569
Cable BASTEL Tel Aviv

JAPAN
Yokogawa Hewlett Packard Ltd
Ohashi Building
1-59-1 Yoyogi
Shibuya-ku **Tokyo**
Tel 03 370 2281 92
Telex 232-2024YHP
Cable YHPMARKET TOK 23 724
Yokogawa Hewlett Packard Ltd
Nisso Ibaraki Building
2-8 Kasuga 2-chome Ibaraki-shi
Osaka 567
Tel (0726) 23-1641
Telex 5332 385 YHP OSAKA
Yokogawa Hewlett Packard Ltd
Nakamo Building
24 Kami-Sasajima-cho
Nakamura-ku **Nagoya** 450
Tel (052) 571 5171
Yokogawa Hewlett Packard Ltd
Tachibana Building
2-24-1 Tsuruya-cho
Kanagawa-ku
Yokohama 221
Tel 045 312 1252
Telex 382 3204 YHP YOK
Yokogawa Hewlett Packard Ltd
Mito Mitsui Building
105-1 chome Sannomaru
Mito Ibaraig 310
Tel 0292 25 7470
Yokogawa Hewlett Packard Ltd
Inoue Building
1348-3 Asahi-cho 1-chome
Atsugi Kanagawa 243
Tel 0462 24 0452
Yokogawa Hewlett Packard Ltd
Inoue Building
1348-3 Asahi-cho 1-chome
Atsugi Kanagawa 243
Tel 0462 24-0452
Yokogawa Hewlett-Packard Ltd
Kimura Building
3rd Floor 20
2-chome Tsukuba
Kumagaya Saitama 360
Tel 0485 24-6563

KENYA
Technical Engineering Services (E A)Ltd
P O Box 18311
Nairobi
Tel 557726 556762
Cable PROTON
Medical Only
International Aeradio(E A)Ltd
P O Box 19012
Nairobi Airport
Nairobi
Tel 336055 56
Telex 22201 22301

KOREA
Samsung Electronics Co Ltd
20th Fl Dongbang Bldg 250
2-KA C P O Box 2775
Taepyung-Ro Chung-Ku
Seoul
Tel (24) 2410-9
Telex 22575

MALAYSIA
Teknik Mutu Sdn Bhd
2 Lorong 13/6A
Section 13
Petaling Jaya Selangor
Tel Kuala Lumpur 54994
Telex MA 37605
Protel Engineering
P O Box 1917
Lot 259 Satok Road
Kuching **Sarawak**
Tel 2400

MOZAMBIQUE
A N Goncalves Lta
162 1 Apt 14 Av D Luis
Caixa Postal 107
Lourenco Marques
Tel 27091 27114
Telex 6-203 Negon Mo

NEW ZEALAND
Hewlett Packard (N Z) Ltd
4-12 Cruickshank Street
Kilbirnie Wellington 3
Mailing Address Hewlett Packard (N Z) Ltd
P O Box 9443
Courtenay Place
Wellington
Tel 877 199
Telex NZ 3839
Cable HEWPACK Wellington
Hewlett Packard (N Z) Ltd
Pakuranga Professional Centre
267 Pakuranga Highway
Box 51092
Pakuranga
Tel 569 651
Telex NZ 3839
Cable HEWPACK Auckland
Analytical Medical Only
Medical Supplies N Z Ltd
Scientific Division
79 Carlton Gore Rd Newmarket
P O Box 1234
Auckland
Tel 75 289
Telex 2958 MEDISUP
Cable DENTAL Auckland
Analytical Medical Only
Medical Supplies N Z Ltd
P O Box 1994
147-161 Tory St
Wellington
Tel 859 799
Telex 3858
Cable DENTAL Wellington
Analytical Medical Only
Medical Supplies N Z Ltd
P O Box 309
239 Stanmore Road
Christchurch
Tel 892 019
Cable DENTAL Christchurch
Analytical Medical Only
Medical Supplies N Z Ltd
303 Great King Street
P O Box 233
Dunedin
Tel 88 817
Cable DENTAL Dunedin

NIGERIA
The Electronics Instrumentations Ltd
NEB 770 Oyo Road
Oluseun House
P M B 5402
Ibadan
Tel 61577
Telex 31231 TEIL Nigeria
Cable THETEIL Ibadan
The Electronics Instrumentations Ltd
144 Agege Motor Road Mushin
P O Box 6645
Lagos
Cable THETEIL Lagos

PAKISTAN
Mushko & Company Ltd
Oosman Chambers
Abdullah Haroon Road
Karachi 3
Tel 511027 512927
Telex KR894
Cable COOPERATOR Karachi
Mushko & Company Ltd
38B Satellite Town
Rawalpindi
Tel 41924
Cable FEMUS Rawalpindi

PHILIPPINES
The Online Advanced Systems Corporation
Filcapital Bldg
11th Floor Ayala Ave
Makati **Rizal**
Tel 85 34 91 85 35 81
Telex 3274 ONLINE

RHODESIA
Field Technical Sales
45 Kelvin Road North
P O Box 3458
Salisbury
Tel 705231 (5 lines)
Telex RH 4122

SINGAPORE
Hewlett Packard Singapore (Pte) Ltd
Blk 2 6th Floor Jalan Bukit Merah
Redhill Industrial Estate
Alexandra P O Box 58
Singapore 3
Tel 636022
Telex HPSG RS 21486
Cable HEWPACK Singapore

SOUTH AFRICA
Hewlett Packard South Africa (Pty) Ltd
Private Bag Wendywood
Sandton Transvaal 2144
Hewlett Packard House
Daphne Street Wendywood
Sandton Transvaal 2144
Tel 802 104016
Telex SA43 4782JH
Cable HEWPACK JOHANNESBURG
Hewlett Packard South Africa (Pty) Ltd
P O Box 120
Howard Place Cape Province 7450
Pine Park Center Forest Drive
Pinelands Cape Province 7405
Tel 53 7955 thru 9
Telex 57-0006
Hewlett-Packard South Africa (Pty) Ltd
P O Box 37099
Overport Durban 4067
641 Ridge Road Durban
Durban 4001
Tel 88-7478/9
Telex 6-7954
Cable HEWPACK

TAIWAN
Hewlett Packard Far East Ltd
Taiwan Branch
39 Chung Shiao West Road
Sec 1 7th Floor
Taipei
Tel 3819160-4 (5 Lines)
Telex 21824 HEWPACK
Cable HEWPACK TAIPEI
Hewlett-Packard Far East Ltd
Taiwan Branch
68 2 Chung Cheng 3rd Road
Kaohsiung
Tel 107) 242318 Kaohsiung
Analytical Only
San Kwang Instruments Co Ltd
No 20 yung Sui Road
Taipei 100
Tel 3715171-4 (5 lines)
Telex 22894 SANKWANG
Cable SANKWANG TAIPEI

TANZANIA
Medical Only
International Aeradio(E A) Ltd
P O Box 861
Daressalaam
Tel 21251 Ext 265
Telex 41031

THAILAND
UNIMESA Co Ltd
Elcom Research Building
Bangjak Sukumvit Ave
Bangkok
Tel 932387 930338
Cable UNIMESA Bangkok

UGANDA
Medical Only
International Aeradio(E A) Ltd
P O Box 2577
Kampala
Tel 54185
Cable INTAERIO kampala

ZAMBIA
R J Tilbury (Zambia) Ltd
P O Box 2792
Lusaka
Tel 73793
Cable ARJAYTEE Lusaka

OTHER AREAS NOT LISTED, CONTACT:
Hewlett Packard Intercontinental
3200 Hillview Ave
Palo Alto California 94304
Tel (415) 493-1501
TWX 910-373-1267
Cable HEWPACK Palo Alto
Telex 034-8300 034-8493

CANADA

ALBERTA
Hewlett-Packard (Canada) Ltd
11620A 168 Street
Edmonton T5M 3T9
Tel (403) 452-3670
TWX 610-831-2431 EDTH
Hewlett Packard (Canada) Ltd
915-42 Ave S E Suite 102
Calgary T2G 1Z1
Tel (403) 287-1672
Twx 610-821-6141

BRITISH COLUMBIA
Hewlett Packard (Canada) Ltd
837 E Cordova Street
Vancouver V6A 3R2
Tel (604) 254 0531
TWX 610 922 5059 VCR

MANITOBA
Hewlett Packard (Canada) Ltd
513 Century St
St James
Winnipeg R3H 0L8
Tel (204) 786 7581
TWX 610 671 3531

NOVA SCOTIA
Hewlett-Packard (Canada) Ltd
800 Windmill Road
P O Box 9331
Dartmouth B2Y 3Z6
Tel (902) 469 7820
TWX 610 271 4482 HFX

ONTARIO
Hewlett-Packard (Canada) Ltd
1785 Woodward Dr
Ottawa K2C 0P9
Tel (613) 225-6530
TWX 610 562-8968
Hewlett-Packard (Canada) Ltd
6877 Goreway Drive
Mississauga L4V 1M8
Tel (416) 678-9430
TWX 610 492 4246

QUEBEC
Hewlett-Packard (Canada) Ltd
275 Hymus Blvd
Pointe Claire H9R 1G7
Tel (514) 697-4232
TWX 610-422-3022
TLX 05-821521 HPCL

FOR CANADIAN AREAS NOT LISTED:
Contact Hewlett-Packard (Canada) Ltd in Mississauga

CENTRAL AND SOUTH AMERICA

ARGENTINA
Hewlett-Packard Argentina S A
Av Leandro N Alem 822 12
1001 **Buenos Aires**
Tel 31 6063 4 5 6 and 7
Telex Public Booth N 9
Cable HEWPACK ARG

BOLIVIA
Stambuk & Mark (Bolivia) Ltda
Av Mariscal Santa Cruz 1342
La Paz
Tel 40626 53163 52421
Telex 3560014
Cable BUKMAR

BRAZIL
Hewlett-Packard do Brasil I E C Ltda
Avenida Rio Negro 980
Alphaville
06400 Barueri-a **Sao Paulo**
Tel 429-2148/9 429-2118/9
Hewlett-Packard do Brasil I E C Ltda
Rua Padre Chagas 32
90000 Porto Alegre RS
Tel (0512) 22-2998 22-5621
Cable HEWPACK porto Alegre
Hewlett-Packard do Brasil I E C Ltda
Rua Siqueira Campos 53-4 andar Copacabana
20000 **Rio de Janeiro** GB
Tel 257 80 94 DDD (021)
Telex 391 212 1905 HEWP BR
Cable HEWPACK Rio de Janeiro

CHILE
Calcagni y Metcalfe Ltda
Alameda 580 Of 807
Casilla 2118
Santiago 1
Tel 398613
Telex 3520001 CALMET
Cable CALMET Santiago
Medical Only
General Machinery Co Ltda
Paraguay 494
Casilla 13910
Santiago
Tel 31 723 31124
Cable GEMCO Santiago

COLOMBIA
Instrumentacion
Henrik A Langebaek & Kier S A
Carrera 7 No 48 75
Apartado Aereo 6287
Bogota, D E
Tel 69 88 77
Cable AARIS Bogota
Telex 044-400

COSTA RICA
Cientifica Costarricense S A
Calle Central Avenidas 1 y 3
Apartado 10159
San Jose
Tel 21 86 13
Cable GALGUR San Jose

ECUADOR
Medical Only
A F Viscaino Compania Ltda
Av Rio Amazonas No 239
P O Box 2925
Quito
Tel 242 150 243 032 034
Cable Astor Quito
Calculators Only
Computadoras y Equipos Electronicos
P O Box 2695
990 Toledo (y Corderot
Quito
Tel 525 982
Telex 02-2113 Sagita Ed
Cable Sagita Quito

EL SALVADOR
Instrumentacion y Procesamiento Electronico de el Salvador
Bulevar de los Heroes 11-48
San Salvador
Tel 25278

GUATEMALA
IPESA
Avenida La Reforma 3-48 Zona 9
Guatemala City
Tel 63627 64786
Telex 4192 Teletro Gu

MEXICO
Hewlett-Packard Mexicana S A de C V
Torres Adalid No 21 11 Piso
Col del Valle
Mexico 12 D F
Tel (905) 543 42 32
Telex 017-74-507
Hewlett-Packard Mexicana S A de C V
Ave Constitucion No 2184
Monterrey N L
Tel 48 71 32 48 71 84
Telex 038 843

NICARAGUA
Roberto Teran G
Apartado Postal 689
Edificio Teran
Managua
Tel 25114 23412 23454
Cable ROTERAN Managua

PANAMA
Electronics Balboa S A
P O Box 4929
Calle Samuel Lewis
Cuidad de Panama
Tel 64 2700
Telex 3431103 Curunda Canal Zone
Cable ELECTRON Panama

PARAGUAY
C A Melamed S R L
Division Aparatos y Equipos Medicos
Division Aparatos y Equipos Cientificos y de Investigacion
P O Box 676
Chile 482 Edificio Victoria
Asuncion
Tel 4 5069 4 6272
Cable RAMEL

PERU
Compania Electro Medica S A
Los Flamencos 145
San Isidro Casilla 1030
Lima 1
Tel 41 4325
Cable ELMED Lima

PUERTO RICO
Hewlett-Packard Inter-Americas
Puerto Rico Branch Office
Calle 272 Urb Country Club
Carolina 00639
Tel (809) 762-7355 7455 7655
Telex HPIC PR 3450514

URUGUAY
Pablo Ferrando S A
Comercial e Industrial
Avenida Italia 2877
Casilla de Correo 370
Montevideo
Tel 40 3102
Cable RADIUM Montevideo

VENEZUELA
Hewlett Packard de Venezuela C A
Apartado 50933 Caracas 105
Edificio Segre
Tercera Transversal
Los Ruices Norte
Caracas 107
Tel 35 00 05 35 00 84
35 00 65 35 00 31
Telex 25146 HEWPACK
Cable HEWPACK Caracas

FOR AREAS NOT LISTED, CONTACT:
Hewlett Packard
Inter-Americas
3200 Hillview Ave
Palo Alto California 94304
Tel (415) 493 1501
TWX 910-373-1260
Cable HEWPACK Palo Alto
Telex 034-8300 034-8493

EUROPE, NORTH AFRICA AND MIDDLE EAST

AUSTRIA
Hewlett-Packard Ges m b H
Handelskai 52
P O box 7
A-1205 **Vienna**
Tel (0222) 35 16 21 to 27
cable HEWPAK Vienna
Telex 75923 hewpak a

BELGIUM
Hewlett-Packard Benelux
S A / N V
Avenue de Col-Vert 1
(Groenkraaglaan)
B 1170 **Brussels**
Tel (02) 672 22 40
Cable PALOBEN Brussels
Telex 23 494 paloben bru

CYPRUS
Kypronics
19 Gregorios & Xenopoulos Rd
P O Box 1152
CY **Nicosia**
Tel 45628/29
Cable KYPRONICS PANDEHIS
Telex 3018

CZECHOSLOVAKIA
Vyvojova a Provozni Zakladna
Vyzkumnych Ustavu v Bechovicich
CSSR-25097
Bechovice u Prahy
tel 89 93 41
Telex 121333

DDR
Entwicklungslabor der TU Dresden
Forschungsinstitut Meinsberg
ODR-7305
Waldheim/Meinsberg
Tel 37 667
Telex 518741

Firma Forgber
Schlegelstrasse 15
1040 **Berlin**
Tel 28 27 411
Telex 112889

DENMARK
Hewlett-packard A/S
Datavej 52
DK 3460 **Birkerod**
Tel (02) 81 66 40
Cable HEWPACK AS
Telex 166 40 hpas

Hewlett-Packard A/S
Navervej 1
DK-8600 **Silkeborg**
Tel (06) 82 71 66
Telex 166 40 hpas
Cable HEWPACK AS

FINLAND
Hewlett-Packard OY
Nahkahousunlie 5
P O Box 6
SF-00211 **Helsinki** 21
Tel 6923031
Cable HEWPACKOY Helsinki
Telex 12 1563

FRANCE
Hewlett-Packard France
Duartier de Courtaboeuf
Boite Postale No 6
F-91401 **Orsay** Cédex
Tel (1) 907 78 25
Cable HEWPACK Orsay
Telex 600048

Hewlett-Packard France
Le Saquin
Chemin des Mouilles
Boite Postale No 12
F-69130 **Ecully**
Tel (78) 33 81 25
Cable HEWPACK Eculy
Telex 310617

Hewlett-Packard France
Agence Régionale
Péricentre de la Cépière
Chemin de la Cépière 20
F 31300 **Toulouse-Le Mirail**
Tel (61) 40 11 12
Cable HEWPACK 51957
Telex 510957

Hewlett-Packard France
Agence Régionale
Aéroport principal de
Marseille-Marignane
F 13721 **Marignane**
Tel (91) 89 12 36
Cable HEWPACK MARGN
Telex 410770

Hewlett-Packard France
Agence Régionale
63 Avenue de Rochester
Boîte Postale
F 35014 **Rennes** Cédex
Tel (99) 36 33 21
Cable HEWPACK 74912
Telex 740912

Hewlett-Packard France
Agence Régionale
74 Allée de la Robertsau
F 67000 **Strasbourg**
Tel (88) 35 23 20/21
Telex 890141
Cable HEWPACK STRBG

Hewlett-Packard France
Agence Régionale
Centre Vauban
201 rue Colbert
Entrée A2
F 59000 **Lille**
Tel (20) 51 44 14
Telex 820744

GERMAN FEDERAL REPUBLIC
Hewlett-Packard GmbH
Vertriebszentrale Frankfurt
Bernerstrasse 117
Posttach 560 140
D-6000 **Frankfurt** 56
Tel (0611) 50 04-1
Cable HEWPACKSA Frankfurt
Telex 04 13249 hpffmd

Hewlett-Packard GmbH
Technisches Buero Boblingen
Herrenbergerstrasse 110
D 7030 **Boblingen** Wurttemberg
Tel (07031) 667-1
Cable HEPAK Boblingen
Telex 07265739 bbn

Hewlett-Packard GmbH
Technisches Buero Dusseldorf
Emanuel Leutze Str 1 (Seestern)
D 4000 **Dusseldorf**
Tel (0211) 59 71 1
Telex 085/86 533 hpdd d

Hewlett-Packard GmbH
Technisches Buero Hamburg
Wendenstrasse 23
D-2000 **Hamburg** 1
Tel (040) 24 13 93
Cable HEWPACKSA Hamburg
Telex 21 63 032 hphh d

Hewlett-Packard GmbH
Technisches Buero Hannover
Am Grossmarkt 6
D-3000 **Hannover 91**
Tel (0511) 46 60 01
Telex 092 3259

Hewlett-Packard GmbH
Technisches Buero Nuremberg
Neumeyer Str 90
D 8500 **Nuremberg**
Tel (0911) 56 30 83/85
Telex 0623 860

Hewlett-Packard GmbH
Technisches Buero Munchen
Unterhachinger Strasse 28
ISAR Center
D-8012 **Ottobrunn**
Tel (089) 601 30 61-7
Cable HEWPACKSA Munchen
Telex 0524985

Hewlett-Packard GmbH
Technisches Buero Berlin
Keith Strasse 2-4
D 1000 **Berlin** 30
Tel (030) 24 90 86
Telex 18 3405 hpbln d

GREECE
Kostas Karayannis
18 Ermou Street
GR **Athens** 126
Tel 3237731
Cable RAKAR Athens
Telex 21 59 62 rkar gr

Analytical Only
INTECO
G Papathanassiou & Cn
Marni 17
GR **Athens** 103
Tel 522 1915
Cable INTEKNIKA Athens
Telex 21 5329 INTE GR

Medical Only
Technomed Hellas Ltd
52 Skouta Street
GR **Athens** 135
Tel 362 6972 363 3830
Cable etalak athens
Telex 21 4693 ETAL GR

HUNGARY
MTA
Muszeruggyi és Méréstechnika
Szolgalata
Lenin Krt 67
1391 **Budapest** VI
Tel 42 03 38
Telex 22 51 14

ICELAND
Medical Only
Eiding Trading Company Inc
Hafnarhvoll Tryggvatotu
IS **Reykjavik**
Tel 1 58 20
Cable ELDING Reykjavik

IRAN
Hewlett-Packard Iran Ltd
No 13 Fourteenth St
Miremad Avenue
P O Box 41-2419
IR **Tehran**
Tel 851082 7
Telex 213405 HEWP IR

IRELAND
Hewlett-Packard Ltd
King Street Lane
GB **Winnersh**, Wokingham
Berks RG11 5AR
Tel (0734) 78 47 74
Telex 847178

ITALY
Hewlett-Packard Italiana S p A
Casella postale 3645
I-20100 **Milano**
Tel (2) 6251 (10 lines)
Cable HEWPACKIT Milano
Telex 32046

Hewlett-Packard Italiana S p A
Via Pietro Maroncelli 40 ,
(ang Via Visentin)
I 35100 **Padova**
Tel (49) 66 48 88
Telex 41612 Hewpack

Medical only
Hewlett-Packard Italiana S p A
Via d Aghardi 7
I-56100 **Pisa**
Tel (050) 2 32 04
Telex 32046 via Milano

Hewlett-Packard Italiana S p A
Via G Armellini 10
I-00143 **Roma**
Tel (06) 54 69 61
Telex 61514
Cable HEWPACKIT Roma

Hewlett-Packard Italiana S p A
Via San Quintino 46
I-10121 **Torino**
Tel (011) 52 82 64-54 84 68
Telex 32046 via Milano

Medical-Calculators Only
Hewlett-Packard Italiana S p A
Via Principe Nicola 43 G/C
I-95126 **Catania**
Tel (095) 37 05 04

Hewlett-Packard Italiana S p A
Via Amerigo Vespucci 9
I-80142 **Napoli**
Tel (081) 33 77 11

Hewlett-Packard Italiana S p A
Via E Masi 9/8
I-40137 **Bologna**
Tel (051) 30 78 87

KUWAIT
Al-Khaldiya Trading &
Contracting Co
P O Box 830
Kuwait
Tel 42 49 10
Cable VISCOUNT

LUXEMBURG
Hewlett-Packard Benelux
S A / N V
Avenue du Col-Vert 1
(Groenkraaglaan)
B-1170 **Brussels**
Tel (02) 672 22 40
Cable PALOBEN Brussels
Telex 23 494

MOROCCO
Gerep
190 Blvd Brahim Roudani
Casablanca
Tel 25 16 76 25-90 99
Cable Gerep-Casa
Telex 23739

NETHERLANDS
Hewlett-Packard Benelux N V
Van Heuven Goedhartlaan 121
P O Box 667
NL **Amstelveen** 1134
Tel (020) 47 20 21
Cable PALOBEN Amsterdam
Telex 13 216 hepa nl

NORWAY
Hewlett Packard Norge A/S
Nesveien 13
Box 149
N-1344 **Haslum**
Tel (02) 53 83 60
Telex 16621 hpnas n

POLAND
Biuro Informacji Technicznej
Hewlett-Packard
Ul Stawki 2 6P
00-950 **Warsaw**
Tel 39 67 43
Telex 81 24 53 hepa pl

UNIPAN
Zaklad Doswiadczalny
Budowy Aparatury Naukowej
Ul Krajowej Rady
Narodowej 51/55
00-800 **Warsaw**
Tel 20 62 21
Telex 81 46 48

Zaklady Naprawcze Sprzetu
Medycznego
Plac Komuny Paryskiej 6
90-007 **Lodz**
Tel 334 41 337 83

PORTUGAL
Telectra Empresa Técnica de
Equipamentos Eléctricos S a r l
Rua Rodrigo da Fonseca 103
P O Box 2531
P **Lisbon** 1
Tel (19) 68 60 72
Cable TELECTRA Lisbon
Telex 12598

Medical only
Mundinter
Intercambio Mundial de Comércio
S a r l
Av A A de Aguiar 138
P O Box 2761
P **Lisbon**
Tel (19) 53 21 31 7
Cable INTERCAMBIO Lisbon

RUMANIA
Hewlett-Packard Reprezentanta
BD N Balcescu 16
Bucharest
Tel 158023 138885
Telex 10440

I I R U C
Intreprinderea Pentru
Intretinerea
Si Repararea Utilajelor de Calcul
Bdul prof Dimitrie Pompei 6
Bucharest Sectorul 2
Tel 12 64 30
Telex 01183716

SAUDI ARABIA
Modern Electronic Establishment
King Abdul Aziz str (Head office)
P O Box 1228
Jeddah
Tel 31173 332201
Cable ELECTRA

P O Box 2728 (Service center)
Riyadh
Tel 62596 66232
Cable RAOUFCO

SPAIN
Hewlett-Packard Española S A
Jerez No 3
E **Madrid** 16
Tel (1) 458 26 00 (10 lines)
Telex 23515 hpe

Hewlett-Packard Española S A
Milanesado 21-23
E **Barcelona** 17
Tel (3) 203 6200 (5 lines)
Telex 52603 hpbe e

Hewlett-Packard Española S A
Av Ramón y Cajal 1-9
(Edificio Sevilla I)
E-**Seville** 5
Tel 64 44 54 58

Hewlett-Packard Española S A
Edificio Albia II 7 8
E-**Bilbao** 1
Tel 23 83 06 23 82 06

Calculators Only
Hewlett-Packard Española S A
Gran Via Fernando El Catdlico 67
E **Valencia** 8
Tel 326 67 28/326 85 55

SWEDEN
Hewlett-Packard Sverige AB
Enighetsvägen 3
Fack
S 161 20 **Bromma** 20
Tel (08) 730 05 50
Cable MEASUREMENTS
Stockholm
Telex 10721

Hewlett-Packard Sverige AB
Frötallsgatan 30
S 421 32 **Vastra Frolunda**
Tel (031) 49 09 50
Telex 10721 Via Bromma Office

SWITZERLAND
Hewlett-Packard (Schweiz) AG
Zurcherstrasse 20
P O Box 307
CH-8952 **Schlieren-Zurich**
Tel (01) 730 52 40
Cable HPAG CH
Telex 53933 hpag ch

Hewlett-Packard (Schweiz) AG
Château Bloc 19
CH 1219 **Le Lignon-Geneva**
Tel (022) 96 03 22
Cable HEWPACKAG Geneva
Telex 27 333 hpag ch

SYRIA
Medical/Calculator only
Sawah & Co
Place Azmé
B P 2308
SYR **Damascus**
Tel 16367 19697 14268
Cable SAWAH Damascus

TURKEY
Telekom Engineering Bureau
P O Box 437
Beyoglu
TR **Istanbul**
Tel 49 40 40
Cable TELEMATION Istanbul
Telex 23609

Medical only
E M A
Muhendislik Kollektif Sirketi
Adakale Sokak 41/6
TR **Ankara**
Tel 175622

Analytical only
Yilmaz Özyurek
Milli Mudafaa Cad No 16/6
Kizilay
TR **Ankara**
Tel 25 03 09
Telex 42576 Ozek tr

UNITED KINGDOM
Hewlett-Packard Ltd
King Street Lane
GB **Winnersh**, Wokingham
Berks RG11 5AR
Tel (0734) 78 47 74
Cable Hewpie London
Telex 847178/9

Hewlett-Packard Ltd
The Grattons
Stamford New Road
GB **Altrincham**
Cheshire WA14 1QQ
Tel (0611) 9289021
Cable Hewpie Manchester
Telex 668068

Hewlett-Packard Ltd
Lygon Court
Dudley Road
GB **Halesowen** Worcs
Tel (021) 550 9911
Telex 339105

Hewlett-Packard Ltd
Wedge House
799 London Road
GB-**Thornton Heath**
Surrey CR4 6XL
Tel (01) 6640103
Telex 946825

Hewlett-Packard Ltd
c/o Makro
South Service Wholesale Centre
Wear Industrial Estate
Washington
GB-**New Town** County Durham
Tel Washington 464001 ext 57/58

Hewlett-Packard Ltd
10 Wesley St
GB **Castleford**
West Yorkshire WF10 1AE
Tel (09775) 50402
Telex 557355

Hewlett-Packard Ltd
1 Wallace Way
GB-**Hitchin**
Herts
Tel (0462) 52824 56704
Telex 825981

USSR
Hewlett Packard
Representative Office USSR
Pokrovsky Boulevard 4/17-KV 12
Moscow 101000
Tel 294-2024
Telex 7825 hewpak su

YUGOSLAVIA
Iskra-standard Hewlett-Packard
Miklosiceva 38/VII
61000 **Ljubljana**
Tel 31 58 79/32 16 74
Telex 31300

SOCIALIST COUNTRIES NOT SHOWN PLEASE CONTACT:
Hewlett-Packard Ges m b H
P O Box 7
A-1205 **Vienna** Austria
Tel (0222) 35 16 21 to 27
Cable HEWPAK Vienna
Telex 75923 hewpak a

MEDITERRANEAN AND MIDDLE EAST COUNTRIES NOT SHOWN PLEASE CONTACT:
Hewlett-Packard S A
Mediterranean and Middle
East Operations
35 Kolokotroni Street
Plaka Kefallonia
GR Kifissia-**Athens** Greece
Tel 8080337/359/429
8081741/742/743/744
Telex 21 6588
Cable HEWPACKSA Athens

FOR OTHER AREAS NOT LISTED CONTACT
Hewlett-Packard S A
7 rue du Bois du Lan
P O Box
CH-1217 Meyrin 2 **Geneva**
Switzerland
Tel (022) 41 54 00

UNITED STATES

ALABAMA
8290 Whitesburg Dr S E
P O Box 4207
Huntsville 35802
Tel (205) 881-4591

Medical Only
228 W Valley Ave
Room 220
Birmingham 35209
Tel (205) 942-2081

ARIZONA
2336 E Magnolia St
Phoenix 85034
Tel (602) 244 1361

2424 East Aragon Rd
Tucson 85706
Tel (602) 294-3148

***ARKANSAS**
Medical Service Only
P O Box 5646
Brady Station
Little Rock 72205
Tel (501) 664-8773

CALIFORNIA
1430 East Orangethorpe Ave
Fullerton 92631
Tel (714) 870-1000

3939 Lankershim Boulevard
North Hollywood 91604
Tel (213) 877 1282
TWX 910 499 2170

6305 Arizona Place
Los Angeles 90045
Tel (213) 649-2511
TWX 910 328 6147

***Los Angeles**
Tel (213) 776-7500

3003 Scott Boulevard
Santa Clara 95050
Tel (408) 249-7000
TWX 910 338-0518

***Ridgecrest**
Tel (714) 446-6165

646 W North Market Blvd
Sacramento 95834
Tel (916) 929-7222

9606 Aero Drive
P O Box 23333
San Diego 92123
Tel (714) 279-3200

COLORADO
5600 South Ulster Parkway
Englewood 80110
Tel (303) 771-3455

CONNECTICUT
12 Lunar Drive
New Haven 06525
Tel (203) 389 6551
TWX 710 465 2029

FLORIDA
P O Box 24210
2806 W Oakland Park Blvd
Ft Lauderdale 33310
Tel (305) 731 2020

***Jacksonville**
Medical Service only
Tel (904) 725-6333

P O Box 13910
6177 Lake Ellenor Dr
Orlando 32809
Tel (305) 859 2900

P O Box 12826
Pensacola 32575
Tel (904) 434 3081

GEORGIA
P O Box 105005
Atlanta 30348
Tel (404) 955 1500
TWX 810 766 4890

Medical Service Only
***Augusta** 30903
Tel (404) [illegible]

HAWAII
2875 So King Street
Honolulu 96814
Tel (808) 955-4455

ILLINOIS
5201 Tollview Dr
Rolling Meadows 60008
Tel (312) 255 9800
TWX 910 687 2260

INDIANA
7301 North Shadeland Ave
Indianapolis 46250
Tel (317) 842 1000
TWX 810 260 1797

IOWA
1902 Broadway
Iowa City 52240
Tel (319) 338 9466
Night (319) 338 9467

KENTUCKY
Medical Only
Atkinson Square
3901 Atkinson Dr
Suite 207
Louisville 40218
Tel (502) 456 1573

LOUISIANA
P O Box 840
3239 Williams Boulevard
Kenner 70062
Tel (504) 721 6201

MARYLAND
6707 Whitestone Road
Baltimore 21207
Tel (301) 944 5400
TWX 710 862 9157

2 Choke Cherry Road
Rockville 20850
Tel (301) 948 6370
TWX 710 828 9684

MASSACHUSETTS
32 Hartwell Ave
Lexington 02173
Tel (617) 861 8960
TWX 710 326 6904

MICHIGAN
23855 Research Drive
Farmington Hills 48024
Tel (313) 476-6400
TWX 810 242 2900

MINNESOTA
2400 N Prior Ave
Roseville 55113
Tel (612) 636 0700
TWX 910 563 3734

MISSISSIPPI
***Jackson**
Medical Service only
Tel (601) 982 9363

MISSOURI
11131 Colorado Ave
Kansas City 64137
Tel (816) 763 8000
TWX 910 771 2087

148 Weldon Parkway
Maryland Heights 63043
Tel (314) 567-1455
TWX 910 764 0830

NEBRASKA
Medical Only
7171 Mercy Road
Suite 101
Omaha 68106
Tel (402) 392 0948

NEW JERSEY
W 120 Century Rd
Paramus 07652
Tel (201) 265-5000
TWX 710 990 4951

NEW MEXICO
P O Box 11634
Station E
11300 Lomas Blvd N E
Albuquerque 87123
Tel (505) 292-1330
TWX 910 989 1185

156 Wyatt Drive
Las Cruces 88001
Tel (505) 526 2485
TWX 910 983 0550

NEW YORK
6 Automation Lane
Computer Park
Albany 12205
Tel (518) 458 1550

203 South Avenue
Poughkeepsie 12601
Tel (914) 454 7330
TWX 510 248 0012

39 Saginaw Drive
Rochester 14623
Tel (716) 473 9500
TWX 510 253 5981

5858 East Molloy Road
Syracuse 13211
Tel (315) 454 2486

1 Crossways Park West
Woodbury 11797
Tel (516) 921 0300
TWX 710 990 4951

NORTH CAROLINA
P O Box 5188
1923 North Main Street
High Point 27262
Tel (919) 885 8101

OHIO
16500 Sprague Road
Cleveland 44130
Tel (216) 243 7300
TWX 810 423 9431

330 Progress Rd
Dayton 45449
Tel (513) 859 8202
TWX 810 474 2618

1041 Kingsmill Parkway
Columbus 43229
Tel (614) 436 1041

OKLAHOMA
P O Box 32008
Oklahoma City 73132
Tel (405) 721-0200

OREGON
17890 SW Lower Boones
Ferry Road
Tualatin 97062
Tel (503) 620 3350

PENNSYLVANIA
111 Zeta Drive
Pittsburgh 15238
Tel (412) 782 0400
TWX 710 795 3124

1021 8th Avenue
King of Prussia Industrial Park
King of Prussia 19406
Tel (215) 265-7000
TWX 510 660 [illegible]

SOUTH CAROLINA
6941-0 N Trenholm Road
Columbia 29260
Tel (803) 782 6493

TENNESSEE
***Knoxville**
Medical Services only
Tel (615) 523-5022

1473 Madison Avenue
Memphis 38104
Tel (901) 274-7472

Nashville
Medical Service only
Tel (615) 244-5448

TEXAS
P O Box 1270
201 E Arapaho Rd
Richardson 75080
tel (214) 231 6101

P O Box 27409
6300 Westpark Drive
Suite 100
Houston 77027
Tel (713) 781 6000

205 Billy Mitchell Road
San Antonio 78226
Tel (512) 434 8241

UTAH
2160 South 3270 West Street
Salt Lake City 84119
Tel (801) 487-0715

VIRGINIA
Medical Only
P O Box 12778
No 7 Koger Exec Center
Suite 212
Norfolk 23502
Tel (804) 497-1026 7

P O Box 9854
2914 Hungary Springs Road
Richmond 23228
Tel (804) 285 3431

WASHINGTON
Bellefield Office Pk
1203 114th Ave S E
Bellevue 98004
Tel (206) 454 3971
TWX 910 443-2446

***WEST VIRGINIA**
Medical/Analytical Only
Charleston
Tel (304) 345-1640

WISCONSIN
9004 West Lincoln Ave
West Allis 53227
Tel (414) 541 0550

FOR U.S. AREAS NOT LISTED:
Contact the regional office
nearest you. Atlanta, Georgia
North Hollywood, California
Rockville, Maryland. Rolling Meadows
Illinois. Their complete
addresses are listed above.

***Service Only**