Errata

Title & Document Type: **1200A/B Dual Trace Oscilloscope Operating and Service Manual**

Manual Part Number: **01200-90904**

Revision Date: **November 1976**

About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, life sciences, and chemical analysis businesses are now part of Agilent Technologies. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A. We have made no changes to this manual copy.

Support for Your Product

Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

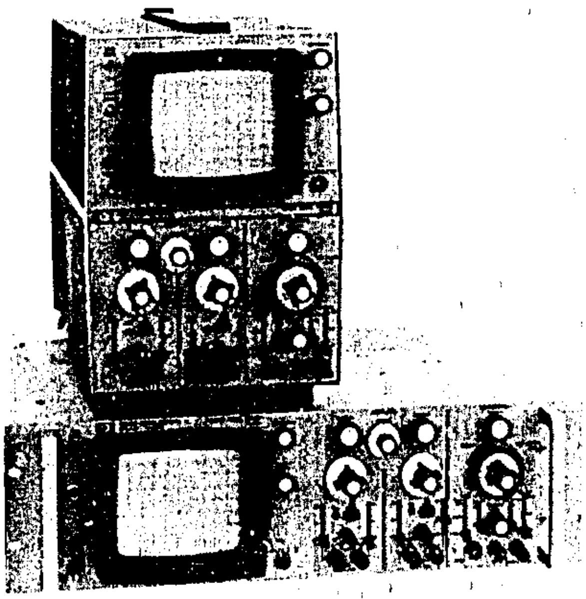
www.agilent.com

Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

Agilent Technologies

OPERATING AND SERVICE MANUAL

1200A/B
DUAL TRACE OSCILLOSCOPE



HEWLETT PACKARD

HP 1200A/B

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.

OPERATING AND SERVICE MANUAL

MODEL 1200A/B
DUAL TRACE OSCILLOSCOPE

(Including Options 001, 002, 004, 006, 007, 011, 602, 607, 611, and 631)

SERIAL NUMBERS

This manual applies directly to instruments with serial numbers prefixed **1632A** and **1633A.**

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed **808—** through **1202A.**

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

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

Manual Part Number 01200-90904
Microfiche Part Number 01200-90804

PRINTED: NOVEMBER 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.

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Cont'd)

LIST OF TABLES

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. This section contains complete instrument specifications, a description of features, warranty information, and data for manual and instrument identification.

1-3. INSTRUMENT DESCRIPTION.

1-4. In the following paragraphs key features of the instruments are described, both in general and according to circuit location.

1-5. GENERAL.

1-6. Hewlett-Packard Models 1200A and 1200B Dual Trace Oscilloscopes are electrically identical, general purpose instruments. Model 1200A is a cabinet version with a built-in tilt stand, convenient carrying handle on top, and feet mounted on both bottom and rear for either bench or upright operation. Designed primarily for rack mounting, the Model 1200B uses only 5-1/4 vertical inches of rack space and has front panel handles for portability.

1-7. Since all circuitry is solid state, power consumption is only about 50 watts, and a cooling fan is not needed. Complete specifications are given in table 1-1.

1-8. VERTICAL CIRCUITS.

1-9. These instruments make it possible to accurately measure and analyze low level signals. In addition to a calibrated sensitivity range of 100 μV/div to 20 V/div, the vertical amplifiers have low drift, typically less than 50 μV per hour, and less than 50 μV peak-to-peak noise at full 500 kHz bandwidth. Accuracy of low level signal measurements can be further improved by use of a front panel 50 kHz bandwidth limit switch.

1-10. Each instrument contains two identical vertical amplifiers for single or dual channel operation. Either single-ended or differential signals can be applied, with a choice of direct or capacitive coupling. Common mode rejection for differential input signals is from 100 dB at 100 μV/div to 30 dB at 20 V/div. Maximum safe vertical input potential (dc plus peak ac) is 400 volts.

1-11. Seventeen calibrated switch settings provide a deflection factor range of 100 μV/div to 20 V/div in a 1, 2, 5 sequence. A vertical vernier permits continuous adjustment between calibrated steps and extends the least sensitive deflection factor setting to 50 V/div.

1-12. With the dual trace feature, displays can be obtained of either channel alone, both channels together or one channel versus the other for X-Y comparison. Simultaneous display of two signals is possible in either a chop or alternate mode of operation. During chop, channels are switched at about a 100 kHz rate during each sweep. In the alternate mode of operation, the signal applied to each channel is displayed on alternate sweeps. Sweep is triggered by the channel A signal in the A, ALT, and CHOP modes and by the channel B signal in the B mode when using an internal trigger source. In X-Y operation the signal connected to channel A is applied to the vertical deflection plates, and the channel B signal is applied to the horizontal deflection plates. Since phase shift between channels is less than 1° up to 100 kHz, phase differences between the two signals can be measured accurately.

1-13. HORIZONTAL CIRCUITS.

1-14. Vertical input signals can be displayed either versus an internally generated time base or an externally applied horizontal signal. Horizontal amplifier bandwidth is dc to 300 kHz (low frequency cut-off is 1.6 Hz when ac coupled), and maximum safe input is ±350 V, dc plus peak ac. Four calibrated sensitivity settings provide a deflection factor range of 0.1 V/div to 1.0 V/div. A vernier permits continuous adjustment between steps and can be used to extend the minimum sensitivity to 2.5 V/div.

1-15. When the time base generator is used, sweep can be synchronized to a vertical display signal, a power-line signal or an external signal up to 1 MHz. Trigger level, slope, coupling and sweep mode are also selectable.

1-16. Sweep speed settings from 1 μsec/div to 5 sec/div are available in twenty-one calibrated steps in a 1, 2, 5 sequence. A vernier control provides continuous adjustment between steps and extends the slowest sweep speed to at least 12.5 sec/div. Using the direct readout sweep magnifier, fastest sweep speed can be expanded to 0.1 μsec/div.

1-17. By operating in automatic a bright time base is displayed even in the absence of a trigger input signal. When a trigger signal above 50 Hz is applied, it overrides the automatic circuit and controls the sweep. Free-run operation provides a non-synchronized baseline that is not affected by incoming trigger signals.

1-18. Single sweep operation can be used with any type of display and is particularly useful for viewing or photographing transient waveforms. One sweep is displayed, and then the sweep circuits must be manually reset to operate again. By pressing a push-button the circuits are immediately reset, and the time delay needed for a slow sweep to end is eliminated.

1-19. OPTIONS.

1-20. Options are modifications installed on HP instruments at the factory and are available on request. The following options extend the usefulness of the 1200A and 1200B:

NOTE

Replaceable parts for options covered by this manual are provided in Section VI except for Option 006 which is covered in Section VII.

OPTION 001: Operates from a 230-volt ac power source.

OPTION 002: The standard instrument with a special CRT has P2 phosphor.

OPTION 004: CRT has P4 phosphor and an internal graticule.

OPTION 006 (1200B only): Provides three rear panel connectors in parallel with front panel input connectors. Refer to Section VII for details and parts list.

OPTION 007: CRT has P7 phosphor. An amber contrast filter is also supplied.

OPTION 011: Has aluminized CRT with P11 phosphor. Also, a special A6 assembly in this option disables the intensification feature of the BEAM FINDER because P11 phosphor is easily burned by high-intensity displays.

OPTION 015 (not covered in this manual): Vertical channel outputs through rear panel connectors.

OPTION 602: CRT has P2 phosphor and no graticule.

OPTION 607: CRT has P7 phosphor and no graticule.

OPTION 611: CRT has P11 phosphor, is aluminized, and has no graticule. Also, a special A6 assembly in this option disables the intensification feature of the BEAM FINDER because P11 phosphor is easily burned by high-intensity displays.

OPTION 631: CRT has P31 phosphor and no graticule.

1-21. INSTRUMENTS COVERED BY MANUAL.

1-22. Attached to the instrument is a serial number plate. The serial number is in the form: 0000A00000. It is in two parts; the first four digits and the letter are the serial prefix and the last five digits are the suffix. The prefix is the same for all identical instruments; it changes only when a change is made to the instrument. The suffix however, is assigned sequentially and is different for each instrument. The contents of this manual apply to instruments with the serial number prefix(es) listed under SERIAL NUMBERS on the title page.

1-23. An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates the instrument is different from those described in this manual. The manual for this newer instrument is accompanied by a yellow Manual Changes supplement. This supplement contains "change information" that explains how to adapt the manual to the newer instrument.

1-24. In addition to change information, the supplement may contain information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is identified with the manual print date and part number, both of which appear on the manual title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-25. For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

Table 1-1. Specifications

VERTICAL AMPLIFIERS

DEFLECTION FACTOR:

Ranges: from 0.1 mV/div to 20 V/div (17 positions) in 1, 2, 5 sequence. ±3% accuracy with Vernier in calibrated position.

Vernier: continuously variable between all ranges; extends maximum deflection factor to at least 50 V/div.

BANDWIDTH: dc to 500 kHz with a maximum risetime of 0.7 μsec. 2 Hz to 500 kHz when ac-coupled. Front panel control provided to reduce upper frequency limit to approximately 50 kHz.

NOISE: less than 20 μV rms measured tangentially at full bandwidth.

INPUT: differential or single-ended on all ranges, selectable by front panel control.

COMMON MODE: (dc input coupling)

Frequency: dc to 10 kHz on all ranges.

Rejection Ratio: at least 100 dB (100 000 to 1) on 0.1 mV/div range, decreasing by less than 20 dB per decade of deflection factor to at least 40 dB on the 0.2 V/div range; CMRR is at least 30 dB on the 0.5 V/div to 20 V/div ranges.

Voltage: common mode signal up to ±10 V (dc + peak ac) on 0.1 mV/div to 0.2 V/div ranges; ±400 V (dc + peak ac) on all other ranges.

INPUT COUPLING: front panel selection of DC, AC, or OFF for both + and — inputs.

INPUT RC: 1 megohm shunted by 45 pF; constant on all ranges.

MAXIMUM INPUT: ±400 volts (dc + peak ac).

DISPLAY: Channel A; Channel B; Channels A and B (either Chop or Alternate). Channels A and B vs horizontal input (Chop only). Channel A vs B (A-vertical, B-horizontal). Chop frequency is approximately 100 kHz.

INTERNAL TRIGGER: by Channel A signal for A, Chop, and Alternate displays. Channel B signal for B display.

ISOLATION: greater than 80 dB between channels at 500 kHz, with input connectors shielded.

PHASE SHIFT: (for Channel A vs B) less than 1° to 100 kHz (Verniers in calibrated position).

TIME BASE

SWEEP:

Ranges: from 1 μsec/div to 5 sec/div (21 positions) in 1, 2, 5 sequence. ±3% accuracy with Vernier in calibrated position.

Vernier: continuously variable between ranges; extends slowest sweep to at least 12.5 sec/div.

X10 MAGNIFIER: indicates magnified sweep time/division directly with ±5% accuracy.

AUTOMATIC TRIGGERING: baseline is displayed in absence of an input signal.

Internal: 50 Hz to above 500 kHz on most signals causing 0.5 division or more vertical deflection. Triggering on line frequency also selectable.

External: 50 Hz to above 1 MHz on most signals at least 0.2 volt peak-to-peak. Input impedance is 1 megohm shunted by approximately 20 pF.

Trigger Slope: positive or negative slope on internal, external or line trigger signals.

AMPLITUDE SELECTION TRIGGERING:

Internal: dc to above 500 kHz on signals causing 0.5 division or more vertical deflection.

External: dc to 1 MHz on signals at least 0.2 volt peak-to-peak. Input impedance is 1 megohm shunted by approximately 20 pF.

Trigger Level and Slope: internal, any point on vertical waveform displayed; or continuously variable from +100 V to —100 V on either slope of the external trigger signal.

Trigger Coupling: dc or ac for external, line, or internal triggering. Lower ac cutoff is 2 Hz for external; 5 Hz for internal.

SINGLE SWEEP: selectable by front panel switch. Reset pushbutton with armed indicator light.

FREE RUN: selectable by front panel switch.

MAXIMUM INPUT: ±350 volts (dc + peak ac).

HORIZONTAL AMPLIFIER

BANDWIDTH: dc to 300 kHz. With input ac-coupled, low frequency cutoff is 2 Hz.

DEFLECTION FACTOR:

Ranges: 0.1 V/div, 0.2 V/div, 0.5 V/div, and 1 V/div.

Vernier: continuously variable between ranges; extends maximum deflection factor to at least 2.5 V/div.

INPUT: single-ended.

INPUT RC: 1 megohm shunted by approximately 20 pF.

MAXIMUM INPUT: ±350 volts (dc + peak ac).

GENERAL

CATHODE-RAY TUBE:

Type: mono-accelerator, 3 000 volt accelerating potential; P31 phosphor standard; etched safety glass faceplate reduces glare.

Graticule: 8 x 10 divisions; parallax-free internal graticule; 0.2 subdivision markings on horizontal and vertical major axes, 1 div = 1 cm.

Intensity Modulation: +2-volt signal blanks trace of normal intensity; +8-volt signal blanks any intensity. Dc-coupled input on rear panel; amplifier rise time approximately 200 ns; input resistance is 5 kilohms.

CALIBRATOR:

Type: line frequency square wave.

Output: 1 volt ±1.5%, front panel connector.

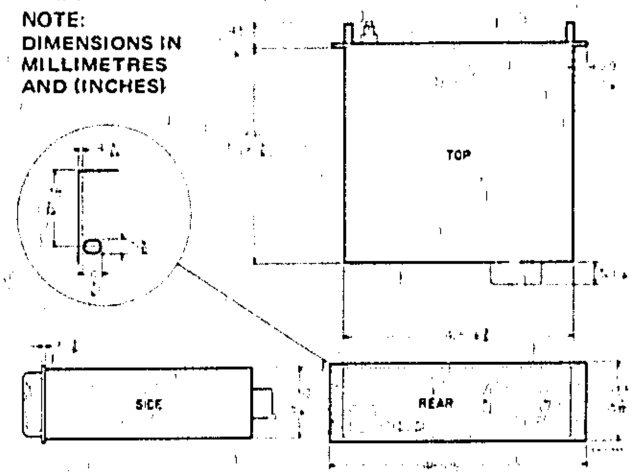
BEAM FINDER: pushbutton to locate beam on CRT screen regardless of setting of vertical, horizontal and intensity controls. The intensification feature is disabled in instruments having a CRT with P11 phosphor.

Table 1-1. Specifications (Cont'd)

DIMENSIONS:
Cabinet: 211.1 mm wide x 298.5 mm high x 474.4 mm deep (8-5/16 in. wide x 11-3/4 in. high x 18-11/16 in. deep).
Rack: Refer to outline drawing.

WEIGHT:
Cabinet: net, 11.3 kg (25 lb): shipping, 15.6 kg (34-1/2 lb).
Rack: net, 10.2 kg (22-1/2 lb): shipping, 15.8 kg (35 lb).
POWER: 115 or 230 volts ±10%; 47 to 440 Hz; approximately 50 watts.

NOTE:
DIMENSIONS 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 1200A or 1200B Dual Trace 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. 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 the manual before installing or operating the instrument.

2-5. POWER CORDS AND RECEPTACLES.

2-6. Figures 2-1 and 2-2 illustrate standard configurations used for HP power cords. The number directly above each drawing is the HP part number for a 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.

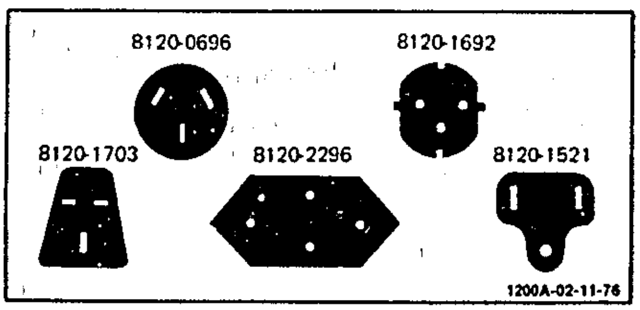


Figure 2-1. Model 1200A Power Cable Configurations

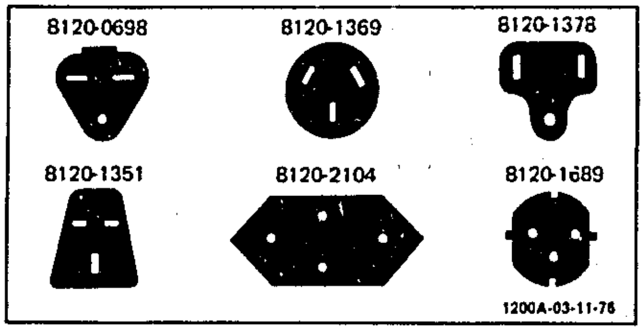


Figure 2-2. Model 1200B Power Cable Configurations

2-7. POWER REQUIREMENTS.

2-8. Model 1200A or 1200B can be operated from any power source supplying 115 V or 230 V, ±10%, 47 to 440 Hz. Power dissipation is approximately 50 VA.

CAUTION

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

2-9. The instrument is normally set at the factory for 115-volt operation. To operate the instrument from any other ac power source, proceed as follows:

a. Verify that power cable is not connected to any input power source.

b. Set line voltage SELECTOR switch on rear panel to 230 V.

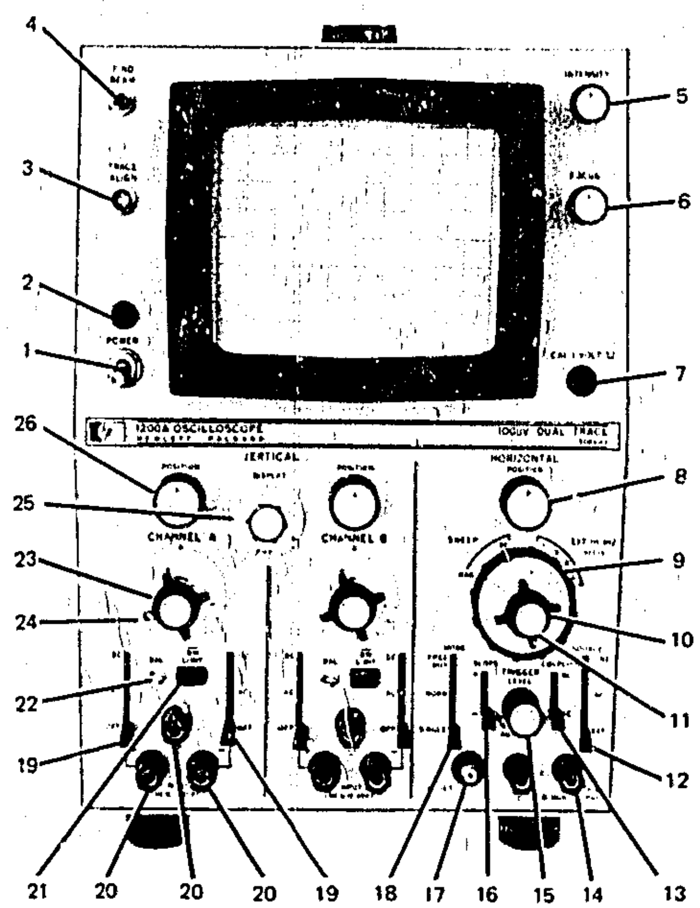
c. Replace 1.5-ampere line FUSE (F1) with 0.8-ampere fuse (HP Part No. listed in Section VI).

d. Connect input power cable to 230 Vac source.

2-10. REPACKING FOR SHIPMENT.

2-11. 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.

2-12. 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.



1200A-A-8A

1. **POWER.** Applies primary power to instrument.

2. **Indicator.** Lights when power is applied.

3. **TRACE ALIGN.** Aligns trace with horizontal axis.

4. **FIND BEAM.** When pressed, returns offset beam to CRT screen.

5. **INTENSITY.** Adjusts brightness of CRT display.

6. **FOCUS.** Adjusts sharpness of display.

7. **CAL.** Provides 1 V pk-pk, line frequency, square wave test signal at front panel jack.

8. **POSITION.** Adjusts horizontal position of display.

9. **SWEEP/EXT HORIZ.** In SWEEP, turns on sweep generator and allows magnification of sweep. In EXT HORIZ, determines deflection factor of external signal applied to TRIG & HORIZ INPUT jack.

10. **Time/Division.** Selects horizontal sweep speed.

11. **Horizontal Vernier.** Provides continuous adjustment of horizontal deflection factor between ranges of EXT HORIZ switch or of sweep time between ranges of Time/Division switch.

12. **SOURCE.** Selects origin of trigger signal that starts sweep.

13. **COUPLING.** In AC position, selected input signal is capacitively coupled. In DC position, input signal is direct coupled.

14. **TRIG & HORIZ INPUT.** Jack for applying external trigger signals to sweep generator or external horizontal signal to horizontal amplifiers.

15. **TRIGGER LEVEL.** Selects point on trigger waveform that starts sweep. In AUTO position, automatic triggers are generated at about a 40 Hz rate.

16. **SLOPE.** Selects positive or negative-going slope of trigger signal to start sweep.

17. **RESET.** In SINGLE mode, pressing the pushbutton resets sweep to zero, and releasing it arms circuit preparatory to receipt of trigger. Indicator lamp glows when sweep circuit is armed.

18. **MODE.** In NORM, sweep is periodically started by incoming trigger signal. In SINGLE, sweep is triggered only once, then must be manually reset. In FREE RUN, sweep cycles continuously and is not affected by trigger signals.

19. **Vertical Coupling.** Selects capacitive (AC) or direct (DC) coupling of vertical input signals. In OFF, vertical amplifier input circuit is grounded and INPUT jacks disconnected.

20. **INPUT.** Jacks connect either single-ended or differential input signals to respective vertical amplifiers.

21. **BW LIMIT.** When pressed, reduces bandpass to about 50 kHz to attenuate noise level. Press a second time to restore bandpass.

22. **BAL.** Adjustment to minimize trace shift when changing Volts/Division ranges.

23. **Vertical Vernier.** Provides continuous adjustment of vertical deflection factor between calibrated ranges of Volts/Division switch. In Cal detent, vertical deflection is selected by Volts/Division switch position.

24. **Volts/Division.** Selects vertical amplifier deflection factor in seventeen calibrated steps.

25. **DISPLAY.** Selects single channel, chop, alternate or A vs B CRT display.

26. **POSITION.** Adjusts vertical position of display.

Figure 3-1. Controls and Connectors

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. Front panel control operation and typical instrument application instructions are presented in this section. Though the position of the vertical and horizontal amplifiers in the Model 1200B is to the side of the CRT instead of below it, the controls and connectors are identical to those of the Model 1200A. Therefore, for simplicity, only operation of the Model 1200A is discussed in this section.

3-3. CONTROLS AND CONNECTORS.

3-4. As a quick reference, figure 3-1 shows the instrument's front panel with a brief description of control and connector applications. Since the Channel A and B controls are identical, only those for Channel A are described in the figure. For a more detailed explanation of control and connector use, refer to the following paragraphs.

3-5. Trace Align. This screwdriver adjustment is used to position the trace parallel to the horizontal graticule lines. Since external magnetic fields may shift the trace, check alignment each time the instrument is moved to a new location, and readjust when necessary.

3-6. Find Beam. Pressing this pushbutton increases intensity and reduces amplifier gain enough to return a displaced beam on screen. This enables the operator to locate the beam and determine the action necessary to center a display (examples: reduce input signal amplitude, change coupling, adjust deflection factor, trigger level, dc balance, position controls, or intensity). When centered properly, the beam remains on screen when the pushbutton is released.

NOTE

Due to phosphor burn sensitivity, instruments with a P11 phosphor do not have the beam finder intensification feature.

3-7. CAL Jack. This jack provides a 1 V pk-pk square wave signal, at power line frequency, to calibrate vertical deflection or compensate a divider probe. Signal amplitude is accurate to ±1.5%.

3-8. Sweep/Ext Horiz. This switch is used to select either of two modes of horizontal circuit operation. In the SWEEP X1 or MAG position a sweep signal is generated to establish a time base reference for vertical signals. Selecting MAG increases horizontal amplifier gain and, thus, sweep speed, by a factor of ten.

NOTE

In either the X1 or MAG position, sweep speed is read directly from the Time/Division dial, and no calculations are required.

3-9. In the EXT HORIZ position, the switch disables the sweep generator and applies external input signals to the horizontal amplifiers. Four switch settings provide calibrated horizontal deflection factors from 0.1 to 1 volt/division when the Horizontal Vernier is in the CAL detent.

3-10. Time/Division. This switch controls the time required for one horizontal division of sweep. Sweep speed settings from 1 μsec/div to 5 sec/div are available in twenty-one calibrated steps in a 1, 2, 5 sequence. A vernier control provides continuous adjustment between steps and extends the slowest sweep speed to at least 12.5 sec/div. Using the direct readout sweep magnifier, fastest sweep speed can be expanded to 0.1 μsec/div.

3-11. Horizontal Vernier. There are two uses for this control, one for each function of the SWEEP/EXT HORIZ switch. In the SWEEP mode, the vernier provides continuous adjustment of sweep speed between the calibrated positions of the Time/Division switch and extends the 5 sec/div range to at least 12.5 sec/div. In the EXT HORIZ mode, it provides continuous adjustment of horizontal deflection factor between the calibrated positions of the EXT HORIZ switch and extends the 1 V/div deflection factor to at least 2.5 V/div. When this control is rotated fully clockwise to the CAL detent, time per division and horizontal deflection factors are calibrated to the front panel control settings.

3-12. Trigger Source. The SOURCE switch selects trigger signal origin. In the LINE position a signal at the frequency of the power line is used for triggering. When the INT setting is selected, the Channel A vertical deflection signal triggers the sweep during A, ALT or CHOP display; the Channel B signal is the trigger for a B display. To trigger with an external signal, set the switch to the EXT position and apply a trigger to the TRIG & HORIZ INPUT jack.

3-13. Trigger Level and Slope. The point on a trigger signal that starts the sweep is selected by the

LEVEL control. This point can be chosen over a —100 V to +100 V range when triggering by external signal or at any point on the displayed waveform when triggering by internal signal. Set SLOPE to positive (+) to trigger on the positive-going portion of a signal or negative (—) to trigger on the negative-going portion.

3-14. By setting the LEVEL control to AUTO (fully counter-clockwise detent), the instrument is automatically triggered at a 40 Hz rate with no signal applied. In AUTO, however, if a trigger signal greater than about 50 Hz is applied, it overrides the automatic circuitry and triggers the sweep.

3-15. Mode Switch. This switch selects the type of sweep operation to be used. In the FREE RUN position, the sweep generator runs free at a rate controlled by the Time/Division switch. In the NORM position, input trigger signals (internal or external) produce a sweep on the CRT. In the SINGLE position, an incoming trigger signal produces one horizontal sweep cycle. The sweep generator must then be manually reset before the next trigger signal will produce another sweep cycle. To reset and arm the sweep generator, press and release the RESET pushbutton. The indicator lamp in the RESET pushbutton will glow when the sweep generator is armed and extinguish when the sweep cycle is completed.

3-16. Input Jacks (Channel A or B). The + and — INPUT jacks are used to apply an external signal up to ±400 V (dc + peak ac) to the vertical deflection circuits. For a single-ended signal, use either connector depending on the direction of deflection desired. Signals applied to the +INPUT jack are displayed in-phase on the CRT, and signals applied to the —INPUT jack are inverted. Use both connectors to apply a differential input signal. The amplitudes of the two input signals are algebraically subtracted. As a result, one waveform is displayed on the CRT and common mode (in-phase) components of the signal are rejected.

3-17. BW Limit (Channel A or B). Pressing this locking pushbutton switch connects a capacitor across the output circuit of the vertical preamplifier and reduces bandwidth from 500 kHz to about 50 kHz. Standard value for this capacitor (A1A1C13 for Channel A and A2A1C13 for Channel B) is 80 pF. However, other values can be substituted, as shown in figure 3-2, to vary the upper limit of bandwidth anywhere from about 400 Hz to 100 kHz. Also included in the figure is a formula for calculating capacitance values to obtain an upper bandwidth limit of 50 kHz or below. Use only the chart for higher frequencies.

3-18. The BW LIMIT switch is particularly useful as a means of rejecting high frequency noise when measuring low level signals. To return full 500 kHz bandwidth, press the switch a second time until it is in the out position.

3-19. Volts/Division (Channel A or B). This switch selects the vertical deflection factor of the display in mV/div or V/div. Seventeen settings provide calibrated steps from 0.1 mV/div to 20 V/div in a 1, 2, 5 sequence. When the Vertical Vernier control is in the CAL detent, multiply the number of vertical divisions of deflection by the Volts/Division switch setting to determine input signal pk-pk amplitude. If a divider probe is used, multiply this product by the division ratio. For example: if 3.5 vertical divisions are deflected when Volts/Division is set to 20 and a signal is applied to the vertical input connector via a 10:1 divider probe, then 3.5 x 20 x 10 = an input signal of 700 V pk-pk.

3-20. Vertical Vernier (Channel A or B). When this control is set to the fully clockwise CAL detent, vertical deflection is calibrated to the Volts/Division switch. By rotating the Vertical Vernier from the CAL detent, vertical deflection factors are continuously adjustable and the 20 V/div setting can be extended to at least 50 V/div. However, vertical deflection is calibrated to the Volts/Division switch only when the Vertical Vernier is in the CAL detent.

3-21. Display Switch. This five position switch selects the type of display presented on the CRT. Input signals can be displayed singly or simultaneously, as explained below.

a. Position A: presents a display of the vertical input signal applied to the Channel A input jacks.

b. Position B: presents a display of the vertical input signal applied to the Channel B input jacks.

c. Position A vs B: presents an X-Y display of the signals applied to the input jacks of both channels. The Channel A signal is applied to the vertical deflection plates, and the Channel B signal is applied to the horizontal deflection plates.

d. Position ALT: presents a separate display of each channel's input signal on alternate sweep cycles. In the INT position of the trigger SOURCE switch, the Channel A signal is selected to trigger the sweep generator.

e. Position CHOP: presents a separate display of each channel's input signal during each sweep cycle. Channels are switched at about a 100 kHz rate. Sweep is triggered by the Channel A signal when the trigger SOURCE switch is set to INT.

3-22. Z-axis Input Terminal. The Z-AXIS INPUT terminal, located on the rear panel, is normally grounded through a shorting link. External intensity modulation signals applied to this terminal are fed directly to the gate amplifier. About +2 volts are required to blank a trace of normal intensity; +8 volts blank a trace of any intensity.

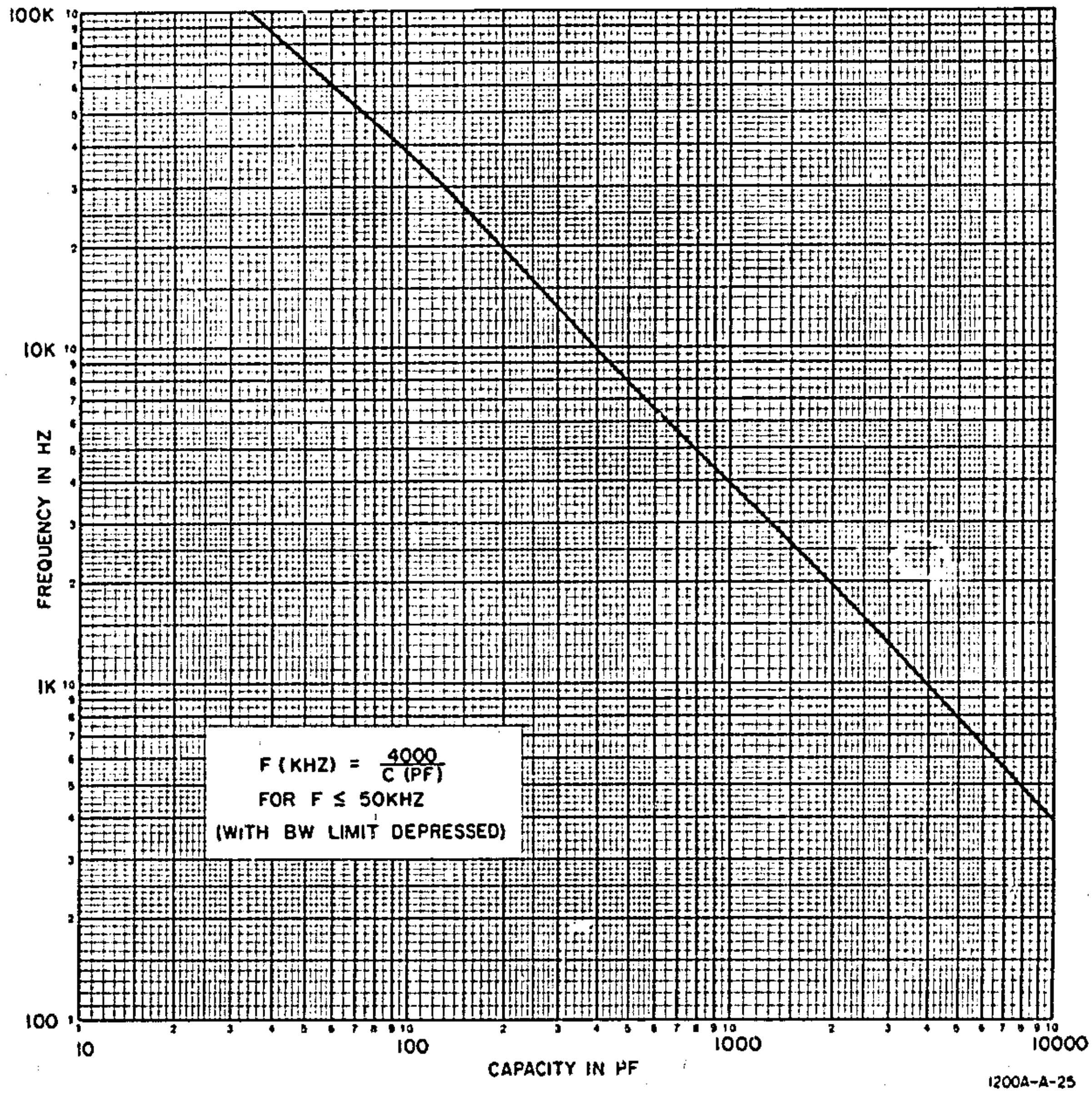


Figure 3-2. Bandwidth Upper Limit vs Selected Capacitance

3-23. OPERATING INSTRUCTIONS.

3-24. Before attempting to operate the Model 1200A/B, refer to the following paragraphs for detailed operating instructions.

3-25. APPLYING INPUT SIGNALS.

3-26. For measurements requiring low amplifier deflection factors and high impedance levels, a shielded input connection is desirable. An adapter (Model 10111A) that provides a shielded banana post-to-female-BNC is available for this purpose. For differential input operation, two adapters can be used. Also available is a frequency-compensated divider probe (Model 10001A) to provide a higher input impedance and reduce circuit loading effects.

3-27. TRIGGER SIGNAL REQUIREMENTS.

3-28. Sweep triggering requires application of a signal that will start the sweep at the same point on the displayed waveform during each sweep. Synchronous triggering is necessary to obtain a stable (jitter-free) display of a repetitive waveform. To observe two different waveforms simultaneously, the signals must have time-related repetition rates, or otherwise the one not harmonically related to the trigger signal will be non-synchronous with the display.

3-29. Table 3-1 shows the trigger signal requirements with various control setting combinations. The table provides frequency range, amplitude required and trigger point information for each possible trigger condition.

3-30. OPERATING PROCEDURES.

3-31. Paragraphs 3-32 through 3-41 contain step-by-step operating procedures. Due to the versatility of the instrument, numerous applications exist. However, only the basic operating techniques are explained in the procedures. Most of these can then be modified or combined to fulfill a wide variety of unique requirements.

CAUTION

The CRT has a plexiglass safety faceplate for operator protection. To clean the faceplate, use a soft cloth or tissue. Never use coarse or abrasive tissues because they will scratch the plexiglass.

3-32. Initial Turn-on Procedure. To turn on the 1200A or 1200B, proceed as follows:

a. Set INTENSITY fully counterclockwise.

b. Set Vertical POSITION (A and B) to midrange.

Table 3-1. Trigger Signal Requirements

Mode	Slope	Source	Trigger Level	Coupling	Required Signal: Frequency	Required Signal: Amplitude
NORM or SINGLE	+ or —	LINE	Selectable	DC or AC	Line Frequency	Internally Connected
			AUTO			
		INT	Selectable (Any point that can be displayed.)	DC	DC to 500 kHz	At least 0.5 div of deflection
				AC	5 Hz to 500 kHz	
			AUTO	DC or AC	50 Hz to 500 kHz	
		EXT	Selectable +100 V to —100 V	DC	DC to 1 MHz	0.2 V to 350 V pk-pk (dc plus peak ac)
				AC	1.6 Hz to 1 MHz	
			AUTO	DC or AC	50 Hz to 1 MHz	
FREE RUN	Provides a non-synchronous display					

c. Set DISPLAY to CHOP.

d. Set Volts/Division (A and B) to 20 V/DIV.

e. Set Vertical Vernier (A and B) to CAL detent.

f. Set BW LIMIT (A and B) to the out position.

g. Set + and −Vertical Coupling (A and B) to OFF.

h. Set Horizontal POSITION to midrange.

i. Set SWEEP/EXT HORIZ to X1.

j. Set Time/Division to 2 mSEC/DIV.

k. Set Horizontal Vernier to CAL detent.

l. Set MODE to FREE RUN.

m. Set SOURCE to INT.

n. Apply operating power (refer to power requirements paragraph in Section II), turn on POWER switch (note that indicator lights), and allow at least 15 minutes for warmup.

o. Adjust INTENSITY and FOCUS for two sharp and just visible traces.

3-33. Trace Alignment and Amplifier Balance. To adjust the display for proper trace alignment and amplifier balance, proceed as follows:

a. Do initial turn-on procedure in paragraph 3-32.

b. Using Vertical POSITION controls, set traces on horizontal graticule lines.

c. Adjust TRACE align so that traces are aligned parallel to horizontal graticule lines.

d. Turn channel A Volts/Division switch from 20 V/DIV to 0.1 mV/DIV.

e. If channel A trace shifts, adjust channel A BAL until trace remains stationary when Volts/Division switch is turned.

f. Repeat steps d and e for channel B.

3-34. Free-run Sweep Mode. The following procedure explains how to obtain a free-run mode display of the 1-volt p-p calibrator signal on channel A:

a. Do initial turn-on procedure in paragraph 3-32.

b. Set DISPLAY to A.

c. Set channel A Volts/Division to 0.2 V/DIV.

d. Set channel A +Vertical Coupling to AC.

e. Connect Cal 1 VOLT signal to channel A +INPUT jack.

f. Note free-running (unsynchronized) display, 5 vertical divisions in amplitude, of calibrator signal.

3-35. Normal Sweep Mode. The following procedure explains how to obtain a normal mode display of the 1-volt p-p calibrator signal on channel A:

a. Do initial turn-on procedure in paragraph 3-32.

b. Repeat steps b through e for free-run operation.

c. Set MODE to NORM.

d. Adjust TRIGGER LEVEL (or set to AUTO), and note stable display, 5 vertical divisions in amplitude, of calibrator signal.

3-36. Single Sweep Mode. To initiate a single sweep display, proceed as follows:

a. Do steps A and B of normal sweep mode operation (paragraph 3-35), and set TRIGGER LEVEL to midrange.

b. Set MODE to SINGLE and channel A +Vertical Coupling to OFF.

c. Press and release RESET pushbutton. Note that RESET indicator lights to signify sweep circuits are armed.

NOTE

Pressing RESET will immediately reset sweep without normal delay for sweep termination.

d. When sweep is armed, the first trigger input (in this case the trigger is applied internally since SOURCE is set to INT) will initiate one sweep cycle. Set +Vertical Coupling to AC and note a display. After the sweep cycle, the indicator goes out until the sweep is manually reset again (step c).

3-37. External Horizontal Input. In this type of operation, the horizontal circuits perform as an amplifier instead of a sweep generator. Proceed as follows:

a. Turn on POWER, and allow at least 15 minutes for warmup.

b. Set SWEEP/EXT HORIZ to EXT HORIZ position at desired sensitivity.

c. Set Horizontal COUPLING to either DC (direct) or AC (capacitive).

d. Connect signal to TRIG & HORIZ INPUT jack.

e. Set INTENSITY, FOCUS, DISPLAY, POSITION, and Horizontal Vernier for required display.

3-38. Single Channel Operation. To obtain a display on only one channel, proceed as follows:

a. Do initial turn-on procedure in paragraph 3-32, except set DISPLAY to A or B.

b. Set Vertical Coupling to AC (capacitive) or DC (direct).

c. Set Volts/Division for required deflection factor.

d. Leave BW LIMIT to out position for 500-kHz bandwidth, or press to in position for 50-kHz bandwidth.

e. Connect single-ended input signals between + or —INPUT jack and ground jack (signals applied to +INPUT are displayed in-phase on CRT; signals applied to —INPUT are displayed inverted on CRT). To display differential signal, connect between + and — INPUT jacks (ground jack not used).

f. Adjust other controls to meet specific requirements.

3-39. Dual Channel Operation. To obtain displays for both channels, proceed as follows:

a. Do steps a through f of single channel operation for channel A and B, and connect input signals to both channel A and B INPUT jacks.

b. Set DISPLAY to either CHOP or ALT.

c. ALT operation is preferable for use with fast sweep speeds; slow sweep speeds will make the display flicker. CHOP operation is usually best for use with slow sweep speeds; fast sweep speeds will cause a dotted trace. Set DISPLAY to CHOP when using EXT HORIZ.

3-40. A+B Operation. To obtain one trace which is the signal applied to one vertical amplifier displayed against the signal applied to the other vertical amplifier, proceed as follows:

a. Do initial turn-on procedure in paragraph 3-32.

b. Set DISPLAY to A vs B.

c. Set channel A and B Volts/Division as required.

d. Set channel A and B Vertical Coupling (one side ground for single-ended signals) to AC (capacitive) or DC (direct).

e. Connect desired vertical signal to channel A INPUT jacks.

f. Connect desired horizontal signal to channel B INPUT jacks.

g. Adjust channel A POSITION for desired vertical position of display.

h. Adjust channel B POSITION for desired horizontal position of display.

3-41. X-Y Operation. To obtain trace(s) which display channel A and/or channel B on an externally supplied horizontal time base, proceed as follows:

a. Set up vertical amplifier(s) for either single or dual channel operation as explained in paragraphs 3-38 or 3-39.

b. Set up horizontal amplifier for external horizontal input operation as explained in paragraph 3-37.

SECTION IV

PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. This section contains both an overall and detailed explanation of circuit theory. Refer to the overall block diagram and figures in this section and the schematics in Section VIII while reading the text.

4-3. GENERAL THEORY.

4-4. Following is an overall explanation of circuit operation based on the block diagram in Figure 4-10. This data is presented to create a basic understanding of the instrument in preparation for the detailed theory that follows.

4-5. For simplicity, the block diagram is drawn for function and doesn't necessarily show all details of the schematics.

4-6. This instrument consists of a CRT and seven modules: two independent vertical preamplifiers, a horizontal amplifier/sweep generator, a dual channel output amplifier, a low voltage power supply, and a high voltage regulator and rectifier. These function as follows.

4-7. VERTICAL PREAMPLIFIER MODULES.

4-8. Since operation of the channel A and B vertical preamplifiers is identical, the following text is applicable to either.

4-9. Incoming signals, single-ended or differential, are connected to the front panel jacks and applied to three-position coupling switches for either direct (DC) or capacitive (AC) coupling to the attenuators. A third alternative is to switch to OFF. In this setting, the incoming signal is disconnected internally, and the attenuator input is grounded. This can be done to set a 0-volt reference without removing the incoming signal from the input jack.

4-10. The incoming signal is attenuated before being applied to the preamplifiers when the Volts/Division switch is set to one of the six least sensitive positions (0.5 to 20 V/div). In the remaining 11 switch settings, the incoming signal is applied without attenuation direct to the preamplifier input.

4-11. In addition to amplifying the incoming signal, the preamplifier rejects common mode signals. Other features include an interstage attenuator controlled by the Volts/Division switch, a front panel BAL adjustment to keep the CRT trace from shifting when the deflection factor is changed, and a switch to limit amplifier bandwidth to 50 kHz.

4-12. Two signals are taken from the output of the preamplifiers: a single-ended signal is applied, via the DISPLAY switch, to the horizontal preamplifier for use as an internal trigger, and a differential signal is applied to the vertical amplifier in the output module for eventual application to the CRT's vertical deflection plates.

4-13. HORIZONTAL MODULE.

4-14. The horizontal module can operate in either of two ways: as a horizontal amplifier or as a sweep generator. Each mode of operation is explained separately in the following paragraphs.

4-15. HORIZONTAL AMPLIFIER. When the SWEEP/EXT HORIZ switch is in one of the four EXT HORIZ positions, the horizontal module acts as an amplifier. In this mode, the SOURCE switch is bypassed, and incoming signals applied to the TRIG & HORIZ INPUT jack are applied to a coupling switch for either direct or capacitive coupling. According to the SWEEP/EXT HORIZ switch settings, the signal is then attenuated in one of four steps and applied to the horizontal preamplifier.

4-16. The preamplifier amplifies the incoming signal and then applies it to the first horizontal amplifier stage for further amplification. At this point in the circuitry a POSITION control is provided to move the CRT beam horizontally. The single-ended output signal from the horizontal amplifier is next applied to the output module for further amplification, conversion to a differential signal and, finally, application to the CRT's horizontal deflection plates.

4-17. SWEEP GENERATOR. When the SWEEP/EXT HORIZ switch is set to SWEEP, the horizontal module acts as a sweep generator. Two sweep settings can be selected with the SWEEP/EXT HORIZ switch: x1 or MAG. In the MAG setting, sweep rate and length are magnified (increased) by x10; however, in either setting sweep rate is read directly from the Time/Division switch.

4-18. Sweep can be triggered or it can run-free, depending on the setting of the MODE switch. A negative control voltage is applied to the sweep generator and it runs-free at a rate set by the Time/Division switch when FREE RUN is selected. However, the sweep generator must be triggered when the MODE switch is set to NORM or SINGLE.

4-19. A sweep signal is generated each time a trigger signal is applied when NORM is selected. In the SINGLE position of the MODE switch, operation is similar to NORM except that an incoming trigger signal produces only one horizontal sweep cycle. The sweep generator must then be manually reset before the next trigger signal can produce another sweep cycle.

4-20. Three trigger choices can be selected by the SOURCE switch: an external signal applied to the TRIG & HORIZ INPUT jack, a signal taken from the vertical preamplifiers, or a power-line-frequency signal taken from the low voltage power supply.

4-21. A selected trigger signal is coupled, either direct or capacitively, to the horizontal preamplifier and is then amplified and applied to the trigger generator. Upon reception of the incoming signal, the trigger generator produces a fast-rise, negative-going step. This voltage step triggers the sweep generator to produce three output signals: a sweep signal, an unblanking gate, and a trigger for alternate channel display.

4-22. The sweep signal is amplified in the output module and is then applied to the CRT's horizontal deflection plates to set a time-base reference for vertical display signals. The unblanking gate is applied to an amplifier in the high voltage power supply and is used to unblank the CRT during sweep time. In the ALT display mode, the trigger from the sweep generator is used to activate the multivibrator in the output module.

4-23. Controls in the trigger and sweep generator circuits permit selection of either the positive or negative-going slope of the incoming signal for triggering, selection of the voltage level on the incoming signal that will activate the trigger generator, and variable sweep speed calibrated to the CRT graticule.

4-24. When the TRIGGER LEVEL control is set to the AUTO detent, trigger signals are automatically generated at about a 40 Hz rate to present a baseline even in the absence of a trigger input signal. However, if a trigger input signal 50 Hz or greater is applied, it overrides the automatic trigger signals and initiates the sweep cycle.

4-25. OUTPUT MODULE.

4-26. A display switching arrangement in the output module allows presentation of five types of display: channel A signal, channel B signal, channel A and B signals during alternate sweep cycles, channel A and B signals alternately switched on and off at a 100 kHz rate, and channel A signal vertically versus channel B signal horizontally.

4-27. The output module's vertical and horizontal amplifiers are controlled by current sources. When the DISPLAY switch is set to A, a negative voltage is applied to the A side of the multivibrator. The multivibrator then operates as a switch to turn on current source A. As a result, vertical amplifier A is turned on, the channel A signal is amplified, applied to the vertical output amplifier for further amplification, and then applied to the CRT's vertical deflection plates. During this time, a sweep signal is produced by the sweep generator, amplified by the horizontal output circuits, and applied to the CRT's horizontal deflection plates. On the CRT, the channel A signal is then displayed versus a time-base reference.

4-28. When the DISPLAY switch is set to B, operation is identical except that the channel A current source is turned off, and the channel B current source is turned on. Then, only the channel B signal is amplified and applied to the CRT's vertical deflection plates.

4-29. In the A vs. B setting, the multivibrator turns on current source A and vertical amplifier A. In addition, the current source that normally turns on the horizontal amplifier is coupled through the DISPLAY switch and turns on vertical amplifier B. Thus, the channel A signal from the preamplifier is amplified by vertical amplifier A and the vertical output amplifier and then applied to the CRT's vertical deflection plates. Instead of a sweep signal, the channel B signal is amplified by the horizontal output amplifiers and applied to the CRT's horizontal deflection plates for an X-Y type presentation.

4-30. When the DISPLAY switch is set to ALT, the multivibrator is triggered by a signal from the sweep generator and it operates in a bistable state. The multivibrator then turns on channel A during one sweep cycle and channel B during the next sweep cycle. Switching is at a rate determined by the setting of the Time/Division switch. Thus, the channel A and B signals are alternately applied to the vertical deflection plates while a sweep signal is applied to the horizontal deflection plates. In this way, the CRT display is of a different channel's signal during each successive sweep cycle, and the result is a dual-signal presentation on a time-shared basis.

4-31. A negative voltage applied to both the A and B sides of the multivibrator causes it to become astable when the DISPLAY switch is set to CHOP. In this mode, the multivibrator free-runs at a 100 kHz rate. In turn, the current sources switch on and off at the same rate. The channel A and B signals are amplified and applied to the CRT's vertical deflection plates via the same paths used during ALT operation. However, instead of being displayed separately during alternate sweep cycles, the vertical display is switched between channels at a 100 kHz rate during each sweep cycle.

4-32. Each channel has a POSITION control to vertically position the signal on the CRT, and a Vernier to adjust sensitivity between the calibrated settings of the Volts/Division switch. Pressing the FIND BEAM pushbutton switch reduces the current applied to the vertical and horizontal amplifiers so that an offset display can be located and returned to the viewing area.

4-33. Except when the DISPLAY switch is set to B, the internal trigger signal taken from the vertical preamplifiers and applied to the horizontal module is always the channel A display signal.

4-34. POWER SUPPLY MODULES.

4-35. Either 115 or 230 Vac, 47 to 440 Hz, can be applied to the input of the low voltage power supply as operating power. This voltage is then stepped-up or down by a transformer, rectified, filtered, and regulated to produce operating voltages for the various circuits of the instrument. In addition, the low voltage power supply module produces two other voltages. A line sync signal is applied to the horizontal module so that the sweep signal can be synchronized to the power-line frequency, if desired. Also, a 1V pk-pk line frequency square wave is applied to the front panel for use as a calibrating reference.

4-36. An oscillator, controlled by a regulator, and a step-up transformer are used in the high voltage power supply modules to generate high voltage for the CRT. Further, a gate amplifier in the high voltage supply is pulsed to unblank the CRT during sweep time. Chop blanking signals are also applied to the gate amplifier to eliminate switching cross-over, and external signals can be applied, via the Z-AXIS INPUT, to intensity modulate the CRT. The high voltage power supply also contains circuitry to adjust CRT focus, astigmatism, intensity and other characteristics.

4-37. DETAILED CIRCUIT THEORY.

4-38. The following detailed theory is sub-divided according to module type and referenced to fold-out schematics in Section VIII. Each schematic is numbered and indexed in the appropriate text for easy location. Also included is a separate detailed block diagram for each circuit function.

4-39. VERTICAL PREAMPLIFIER MODULES.

4-40. Operation of the channel A and B vertical preamplifiers is identical. Therefore, although the following theory describes only the channel A preamplifier, it is applicable to either channel. Refer to Figure 4-1 and Schematic 1, in Section VIII, while reading the following text.

4-41. ATTENUATORS. Either single-ended or differential signals can be applied to the vertical amplifier's INPUT jacks. A single-ended signal applied between the positive (J3) and ground (J2) input jacks results in an in-phase display on the CRT. Conversely, single-ended signals applied between the negative (J1) and ground (J2) input jacks are displayed inverted on the CRT. To display a differential signal, use only the positive and negative jacks.

4-42. From the input jacks, incoming signals are applied to three-position Coupling switches (A1S1 for signals applied to J1 and A1S2 for signals applied to J3). When DC coupling is selected, both the dc and ac components of the incoming signal are direct coupled to the attenuators. Only the ac signal component is coupled through capacitors A1C1 or A1C2 when AC coupling is selected. A third alternative is to switch A1S1 or A1S2 to OFF. In this setting, the incoming signal is disconnected internally, and the attenuator input is grounded. This can be done to set a 0-volt reference without removing the incoming signal from the input jack.

4-43. Signal attenuation is determined by the Volts/Division switch setting. When the switch is set to any of the 11 settings from 0.1 mV/div to 0.2 V/div, the attenuator is bypassed and the incoming signal is applied direct to the preamplifier input. In the six least sensitive settings (0.5 to 20 V/div) of the Volts/Division switch, the incoming signal is attenuated by a ÷100 factor before being applied to the preamplifiers.

4-44. The attenuator network is essentially a frequency compensated voltage divider used to control the input level to the preamplifier. Since the resistance of A1A2R2 approximately equals one-hundreth the total resistance of A1A2R1 plus A1A2R2, the attenuator is a ÷100 voltage divider. However, to maintain a constant 100:1 division ratio over a broad frequency range, capacitors A1A2C2 and A1A2C3 are selected with a capacitive reactance equal to the same proportion as the resistors. Capacitor A1A2C2 is a high frequency compensation capacitor, and it is adjusted for an optimum square wave response (since a square wave is multi-harmonic) to assure a constant attenuation ratio over a wide frequency range. Input capacitance is set by A1A2C1 and A1A2C4.

4-45. INPUT AMPLIFIERS. When the input signal is applied direct to the preamplifier without attenuation, A1A1C2 and A1A1C14 determine the input capacitance. Input resistance is set by A1A1R2 and A1A1R29, and input current is limited by A1A1R3 and A1A1R30 during overload.

4-46. Voltage at the preamplifier input is limited to about ±20V by a diode clamp circuit consisting of A1A1CR1-CR4 and associated components. If the voltage at either input exceeds the voltage at the junction of A1A1R14/R15 or A1A1R16/R17, one of the diodes will become forward biased to bypass the excessive current to ground and limit input voltage.

4-47. The input amplifier is a three-stage feedback amplifier with common mode bootstrapping. Field-effect transistor (FET) A1A1Q1A/Q1B provides the preamplifier with a high input impedance to prevent loading the external circuit under test. The feedback amplifier consists of the negative input half (A1A1Q1A/Q3/Q6) connected differentially to the positive input half (A1A1Q1B/Q4/Q7). Constant current sources are

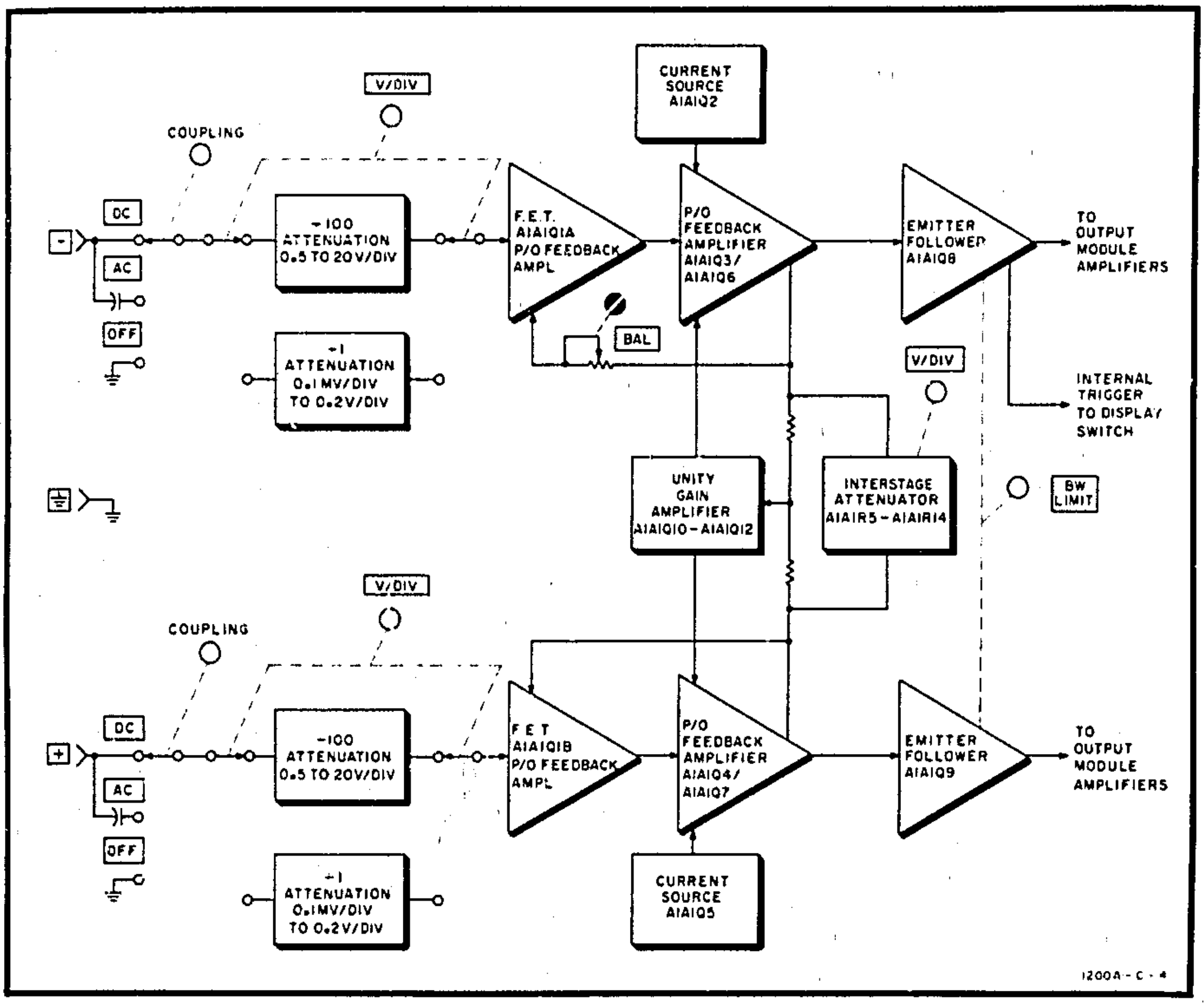


Figure 4-1. Channel A Attenuator and Preamplifier Block Diagram

provided by A1A1Q2 and A1A1Q5, and A1A1Q8 and A1A1Q9 are low impedance output emitter followers.

4-48. Feedback amplifier gain ranges from about 4,000:1 at 0.1 mV/div to 2:1 at 0.2 V/div. Gain is determined by the amount of resistance switched into the emitters of A1A1Q6 and A1A1Q7 by the interstage attenuator, A1A1R5-R14. BAL adjustment A1A2R15 equalizes the dc voltage across the interstage attenuator so that changing the Volts/Division switch does not affect the dc output voltage. Vernier balance is achieved by adjusting A1A1R19 so that 0V appears across the Vernier potentiometer in the output amplifier module.

4-49. The feedback amplifier works in conjunction with a unity-gain amplifier to improve the common mode rejection ratio (CMRR). Common mode input signals applied to the + and – input connectors appear at the input (junction of A1A1R26/R27) of the unity gain amplifier (A1A1Q10-Q12). The output of this amplifier is equal to the common mode input signal and is applied, via A1A1Q3 and A1A1Q4, to the drains of A1A1Q1A and A1A1Q1B. Since the common mode signal at the FET's drains, sources and gates is then equal, a 0-volt common mode potential is created across the FET. Therefore, the FET can't amplify the common mode signal applied to the gates, and a high CMRR (100 to 120 dB) is established.

4-50. Main bias current for the amplifier flows through the FET, the feedback paths (A1A2R15 and A1A1R34), and the third stage transistors (A1A1Q6/Q7). This current is set by the voltage across zener diode A1A1VR1, appearing across the FET load resistors (A1A1R18-R20). Quiescent output voltage of the amplifier is determined by the value of A1A1VR1.

4-51. The output of the feedback amplifier contains a BW LIMIT switch (A1A1S1) and a capacitor (A1A1C13). When the switch is pressed, the capacitor is connected across the feedback amplifier output to reduce bandwidth from 500 kHz to about 50 kHz. As explained in Section III, other capacitance values can be substituted to vary the upper limit of bandwidth anywhere from about 400 Hz to about 100 kHz. Pressing the BW LIMIT switch a second time releases it and restores normal bandwidth.

4-52. The output from A1A1Q6/Q7 drives emitter followers A1A1Q8/Q9. They, in turn, drive the amplifiers in the output module and supply an internal trigger signal to the horizontal preamplifier.

4-53. HORIZONTAL MODULE.

4-54. Depending on the setting of the SWEEP/EXT HORIZ switch, the horizontal module can operate either as a horizontal amplifier or time-base generator. To simplify the theory, each mode is explained separately, from input to output, in the following text.

4-55. HORIZONTAL AMPLIFIER. See Figure 4-2 and Schematic 5 in Section VIII. The horizontal module serves as an amplifier when SWEEP/EXT HORIZ switch A4A2S1 is in one of the four EXT HORIZ settings (0.1 to 1 V/DIV). SOURCE switch A4S1 is bypassed, and incoming signals connected to the TRIG & HORIZ INPUT jack (J7) are applied to an attenuator network. The attenuator consists of resistors A4R2 and A4A2R1-R4, compensated by capacitors A4C1 and A4A2C2-C3. Total resistance of the divider is about 1 megohm, and signal attenuation is determined by the tap-off point between resistors. For example: when the SWEEP/EXT HORIZ switch is set to 1 V/DIV the combination of A4R2 and A4A2R1-R3 (about 1 megohm) is in series with the incoming signal, and A4A2R4 (10 kilohms) is in parallel. Thus, attenuation ratio is 100:1. Ratio of the voltage divider is 50:1 at 0.5 V/DIV, 20:1 at 0.2 V/DIV and 10:1 at 0.1 V/DIV.

4-56. In addition to being attenuated, the incoming signal can be direct or capacitively coupled. In the AC setting of COUPLING switch A4S2, capacitor A4A2C1 is in series with the attenuator, and the signal is capacitively coupled. When the switch is set to DC, the capacitor is shorted, and the incoming signal is direct coupled to the horizontal preamplifier.

4-57. The horizontal preamplifier consists of a three-stage amplifier and a trigger level control circuit. Two things happen when the SWEEP/EXT HORIZ switch (A4A2S1) is set to the EXT HORIZ position: TRIGGER LEVEL potentiometer A4R3 is disconnected, and the short is removed from the Horizontal Vernier potentiometer.

4-58. Input impedance is high and, if no signal is applied, A4A1Q1 base potential is 0V. Consequently, A4A1Q2 emitter voltage is about −1.2V. Voltage at the emitter of A4A1Q5 is also about −1.2V when DC BAL adjustment A4A1R10A is properly set. Since the voltage on both sides of A4A1R3 and A4A2R5A is equal, no bias current flows through these resistors, and the circuit is balanced. In addition, current passing through the combination of A4A1R2/R4/R5 is sufficient to create a 1.2V drop across A4A1R4. This voltage drop opposes the voltage at the emitter of A4A1Q2 to produce a quiescent output voltage of about 0V. Thus, with no signal applied, the amplifier is balanced and no output is produced.

4-59. Amplifier gain is primarily determined by the ratio of A4A1R4 to the sum of A4A1R3 and A4A2R5A. Horizontal Vernier A4A2R5A adjusts gain to provide continuous adjustment of the horizontal deflection factor between settings of the SWEEP/EXT HORIZ switch. When

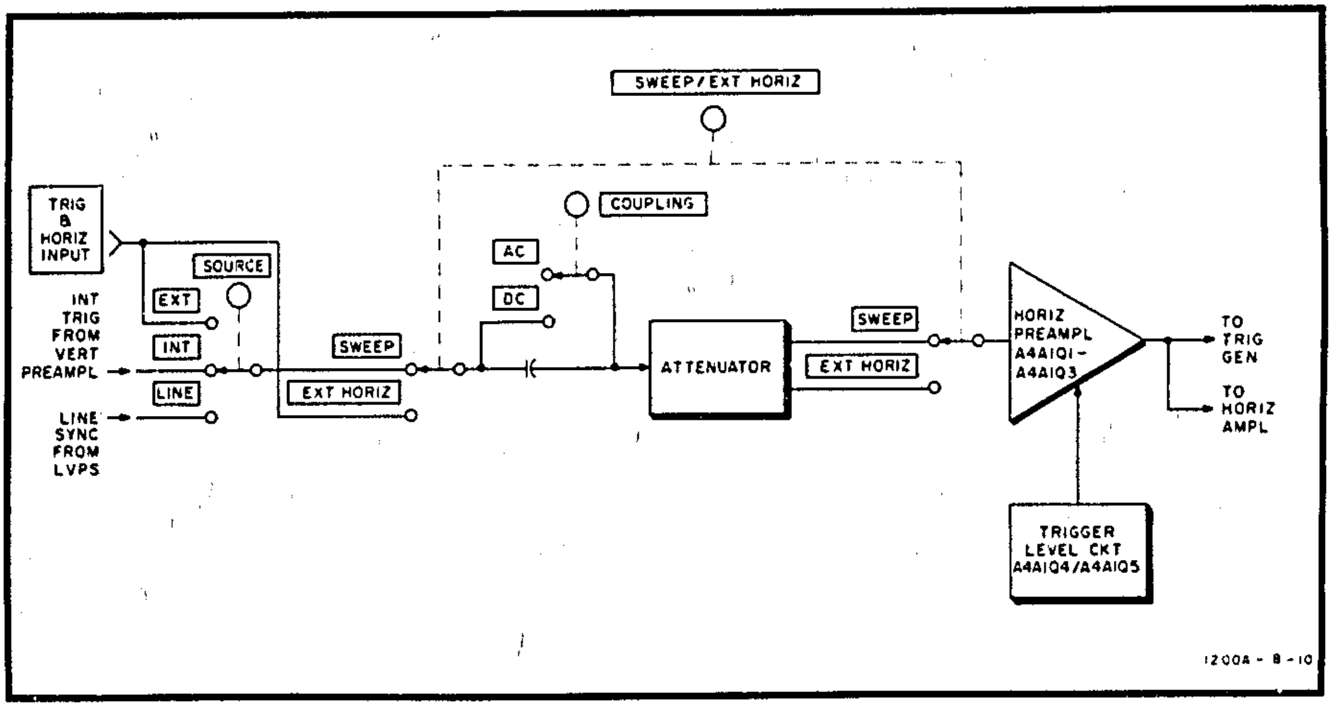


Figure 4-2. Horizontal Preamplifier Block Diagram

the control is set to CAL, or when operating in the sweep mode, the Horizontal Vernier control is shorted. At high frequencies, A4A1C1 provides additional base drive to A4A1Q2. Due to a low A4A1Q1/Q2 base current, dc drift is reduced. Degenerative feedback from the collector of A4A1Q3 to the emitter of A4A1Q2 increases amplifier bandwidth and creates a low output impedance to drive the input of the following stages. Temperature compensation is provided by A4A1Q4/Q5.

4-60. The signal from the preamplifier is next applied through the SWEEP/EXT HORIZ switch (see Figure 4-3 and Schematic 6), A4A2S1, to the horizontal amplifier circuit, A4A1Q10/Q11. Incoming signals are limited to about ±0.6V by diodes A4A1CR5/CR6 at the base of emitter follower A4A1Q10. Dc bias on the base of A4A1Q10 is varied by POSITION control A4R4, via emitter follower A4A2Q1 and the SWEEP/EXT HORIZ switch. A portion of the amplified signal at the collector of A4A1Q11 is applied to the base of A4A1Q10, via A4A1R38, as degenerative feedback. Potentiometer A4A1R36 is used to horizontally center the CRT trace at mid-screen when the POSITION control is at mid-range. The amplified signal at the collector of A4A1Q11 is applied to the output module for further amplification and eventual application to the CRT's horizontal deflection plates.

4-61. TIME BASE GENERATOR. When the SWEEP/EXT HORIZ switch is set to SWEEP, the horizontal module generates a sweep signal to provide a time-base reference on the CRT's horizontal axis.

4-62. Horizontal Preamplifier. See Figure 4-2 and Schematic 5. Input trigger signals can be selected from three sources by A4S1: external (EXT), internal (INT) or power-line (LINE). External trigger signals are applied at the front panel TRIG & HORIZ INPUT jack, internal trigger signals are taken from the vertical preamplifiers, and line trigger signals are power-line frequency signals taken from the low voltage power supply. The SWEEP/EXT HORIZ and SOURCE switches are interconnected so that the selected trigger signal is applied to A4S2, and the two remaining signals are grounded to prevent interference.

4-63. In the sweep mode of operation, the attenuator network is bypassed and the selected trigger signal is capacitively (AC) or direct (DC) coupled by A4S2 to the input of the horizontal preamplifier. Diodes A4A2CR1-CR2 limit the amplitude of the incoming signal to ±0.6V and, thus, permit triggering over an extended range of input signals.

4-64. The horizontal preamplifier consists of a trigger level circuit and a three stage amplifier with a high input impedance, low output impedance and high current gain. Horizontal Vernier A4A2R5A is shorted and TRIGGER LEVEL potentiometer A4R3 is connected in the sweep mode. Transistors A4A1Q4/Q5 provide temperature compensation for the amplifier to limit drift and, in addition, provide a high-input-to-low-output impedance for trigger level current.

4-65. TRIGGER LEVEL potentiometer A4R3 selects the point on the incoming signal that will trigger the sweep. When the potentiometer is varied, so is the amount of current through A4A1Q4/Q5. Level range is determined by voltage divider A4A1R7/R8.

4-66. Due to the differential connection of the trigger level and input amplifier circuits, the output voltage at the collector of A4A1Q3 changes in accordance with the setting of the TRIGGER LEVEL control. This voltage is then applied to the input of the trigger generator circuit as a composite of the level and input signals. A variable hold-off level is also taken from the circuit, at the top of A4A1R7, and applied to the sweep generator circuit.

4-67. Trigger Generator. The trigger generator can either be triggered by the signal from the horizontal preamplifier, or it can operate automatically. Each type of operation is explained separately in the following paragraphs.

4-68. See Figure 4-3 and Schematic 6. When the TRIGGER LEVEL control is not set to the fully counterclockwise AUTO detent, capacitors A4C2 and A4C3 are shorted from the circuit. In this case, the signal from the horizontal preamplifier is applied direct to the SLOPE switch (A4S4). According to the setting of the SLOPE switch, either the positive or negative-going portion of the incoming signal is used to trigger the sweep cycle.

4-69. The base of A4A1Q6 is grounded, and the incoming signal is applied to the base of A4A1Q7 when the positive slope is selected. During the negative alternation of the incoming signal, the base-to-emitter junction of A4A1Q7 is reverse biased, and the transistor is cut-off. However, when the positive-going alternation of the incoming signal reaches sufficient amplitude, A4A1Q7 conducts with a resultant negative-going collector voltage.

4-70. When the SLOPE switch is set to the negative position, the base of A4A1Q7 is grounded, and the incoming signal is applied to the base of A4A1Q6. During the positive alternation of the incoming signal, A4A1Q6 conducts and cuts off A4A1Q7. The result is no output. However, when the negative alternation of the incoming signal reaches a sufficient amplitude, A4A1Q6 cuts off and A4A1Q7 conducts enough to produce a negative-going collector voltage. Thus, either the positive or negative alternation of the incoming signal can be selected by the SLOPE switch to produce an output at the collector of A4A1Q7.

4-71. The negative-going signal at the collector of A4A1Q7 is amplified and inverted by A4A1Q8. Normally, tunnel diode A4A1CR4 is in the low voltage state. However, as the collector of A4A1Q8 rises in a positive

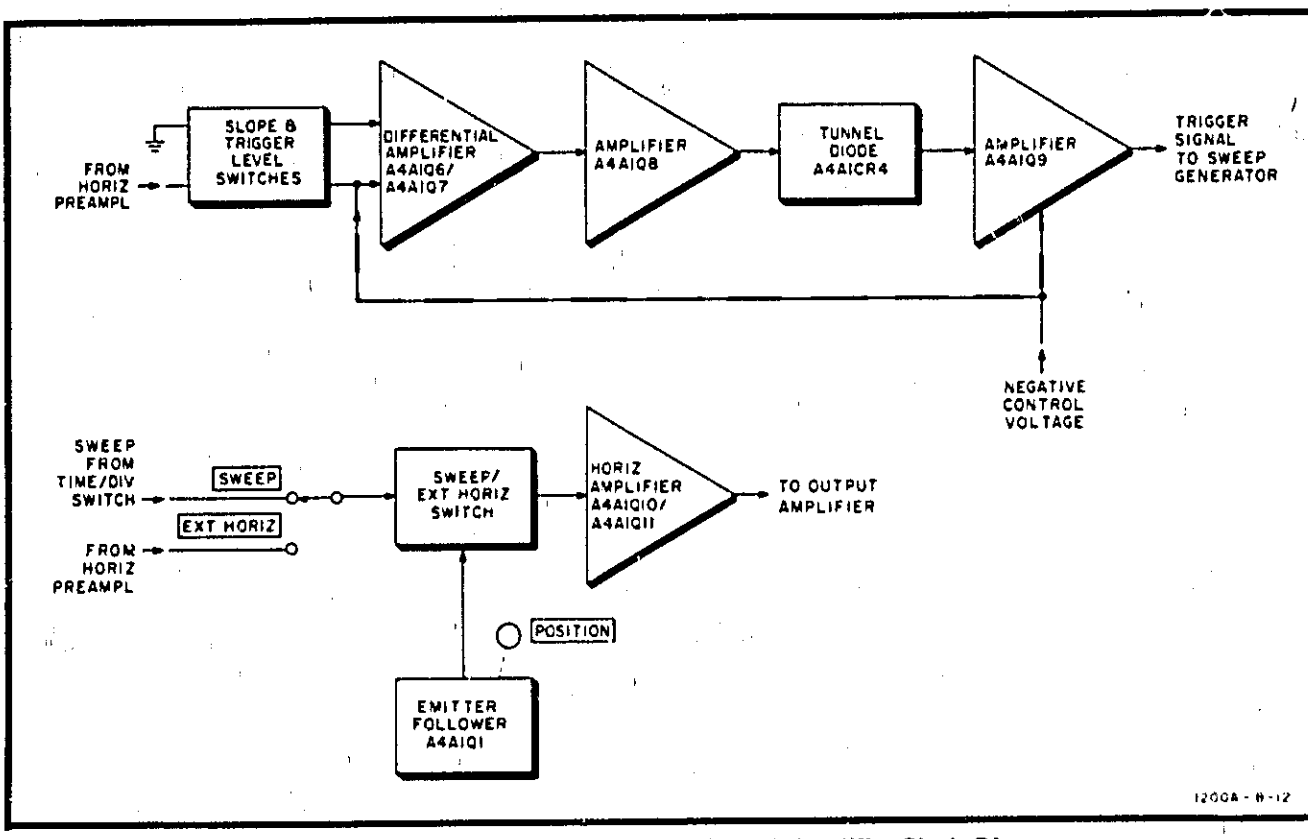


Figure 4-3. Trigger Generator and Horizontal Amplifier Block Diagram

direction, more current flows through the tunnel diode until it finally switches to the high voltage state. This increase in voltage, combined with the pre-bias voltage from the combination of A4A1R25-R28, is sufficient to turn on A4A1Q9. As a result, a fast-rise, negative-going step is produced at the collector of A4A1Q9.

4-72. When the TRIGGER LEVEL control is set fully counterclockwise to the AUTO detent, the trigger generator automatically generates triggers at about a 40-Hz rate to present a horizontal time base even in the absence of an incoming horizontal signal. However, incoming signals of the proper amplitude and frequency override the automatic trigger pulses and start the sweep cycle.

4-73. During automatic operation, capacitors A4C2 and A4C3 are switched into the input of the differential amplifier. Thus, the low resistance (ground) dc reference for the bases of A4A1Q6/Q7 is removed. The base of A4A1Q6 is held near ground potential by A4A1R15, but the base of A4A1Q7 is free to follow an auto feedback signal from the collector of A4A1Q9.

4-74. Automatic triggering rate is determined by the RC time constant of A4A1R31/C15 and is about 40 Hz. If an incoming signal of sufficient amplitude and greater than 50 Hz is applied, it will override the automatic operation. Since capacitors A4C2-C3 are inserted in the circuit, the TRIGGER LEVEL control is ineffective, and the voltage level at which overriding signals control the circuit is not selectable.

4-75. Sweep Generator. See Figure 4-4 and Schematic 7. Depending on the setting of the MODE switch (A4S5), the sweep generator can:

a. continuously be triggered to generate sweep signals (normal sweep mode).

b. generate only one sweep when triggered (single sweep mode). The sweep generator must then be manually reset before further trigger signals can produce additional sweep signals.

c. run-free (free-run sweep mode).

4-76. Normal Sweep. Transistors A4A1Q12/Q13 form a complementary trigger Schmitt circuit; that is, both transistors either conduct or don't conduct, simultaneously. The base of A4A1Q12 is armed (set to about 0 volt) by control Schmitt A4A1Q20's emitter when the MODE switch (A4S5) is set to NORM. However, with no input trigger, the trigger Schmitt transistors are cut off.

4-77. When a negative-going trigger signal is applied, it is differentiated by the input resistance/capacitance and applied, via A4A1CR7, to the emitter of A4A1Q12. Transistor A4A1Q12 then conducts, and the voltage drop at the collector turns on A4A1Q13. The voltage at the emitter of A4A1Q13 then turns-on A4A1Q14, and a negative-going voltage pulse is developed at the emitter.

4-78. The negative-going pulse at the emitter of A4A1Q14 is applied to three places:

a. to the multivibrator in the output module for alternate channel switching.

b. to the gate amplifier in the high voltage power supply to unblank the CRT during sweep time.

c. to the emitter of A4A1Q15 and the anode of A4A1CR15.

4-79. Before the negative-going pulse is applied to the emitter of A4A1Q15, the transistor conducts heavily. As a result, a large voltage is dropped across collector load resistor A4A1R52, and the collector becomes positive enough to forward bias diodes A4A1CR9-CR11. The potential at the gate of source follower A4A1Q16 is then about +5.4V. Amplifier A4A1Q16/Q17/Q18 conducts and A4A1Q15/Q23 form a comparator to drive the emitter of A4A1Q18 to about +5.4V. Since both sides of the selected sweep timing capacitor (either A4A2C5 or A4A2C6, depending on the setting of Time/Division) are equal (about +5.4V), the capacitor has no charge.

4-80. When a trigger signal is applied to the input of the sweep generator, a negative-going gate signal is coupled to the emitter of A4A1Q15 and the anode of A4A1CR15. Both of these devices are reverse biased and neither conducts. With no A4A1Q15 current, the collector moves toward the −50V supply potential and reverse biases diodes A4A1CR9-CR11. Timing capacitor A4A2C5 or A4A2C6 then starts to charge via the following long time constant path: through the timing resistance (A4A2R12-R18), A4A2C5/C6, A4A1R58 and emitter follower A4A1Q18. At the same time, A4A1Q17 and A4A1Q18 decrease conduction, and the emitter voltage of A4A1Q18 moves toward the +50V supply potential at a rate determined by the time constant of the sweep timing capacitance and resistance. Since current through the timing capacitor is constant, the linear ramp portion of the sweep signal is produced.

4-81. The rising ramp at the emitter of A4A1Q18 is applied through the Time/Division switch (Schematic 8) to the output module. By changing the sweep charge time and charge potential, ramp slope can be altered for the various sweep speeds. Ramp slope can be varied between settings of the Time/Division switch by Sweep Vernier potentiometer A4A2R58 to allow discreet adjustment of the CRT display. The Time/Division switch settings are calibrated on the front panel only when A4A2R58 is set fully clockwise to the CAL detent. Emitter follower A4A1Q26 is a voltage source for the sweep timing resistors, and A4A1R108/C/D are sweep timing adjustments.

4-82. See Figure 4-4 and Schematic 7. The rising ramp at the emitter of A4A1Q18 is also applied to the hold-off discharge, ramp control and control Schmitt circuits. As the ramp rises, A4A1Q24 turns on and discharges the hold-off capacitor (A4A2C7-C9, selected by the Time/Division switch). When the ramp voltage rises enough to overcome the forward bias on A4A1Q21, the transistor turns off and consequently turns off A4A1Q20.

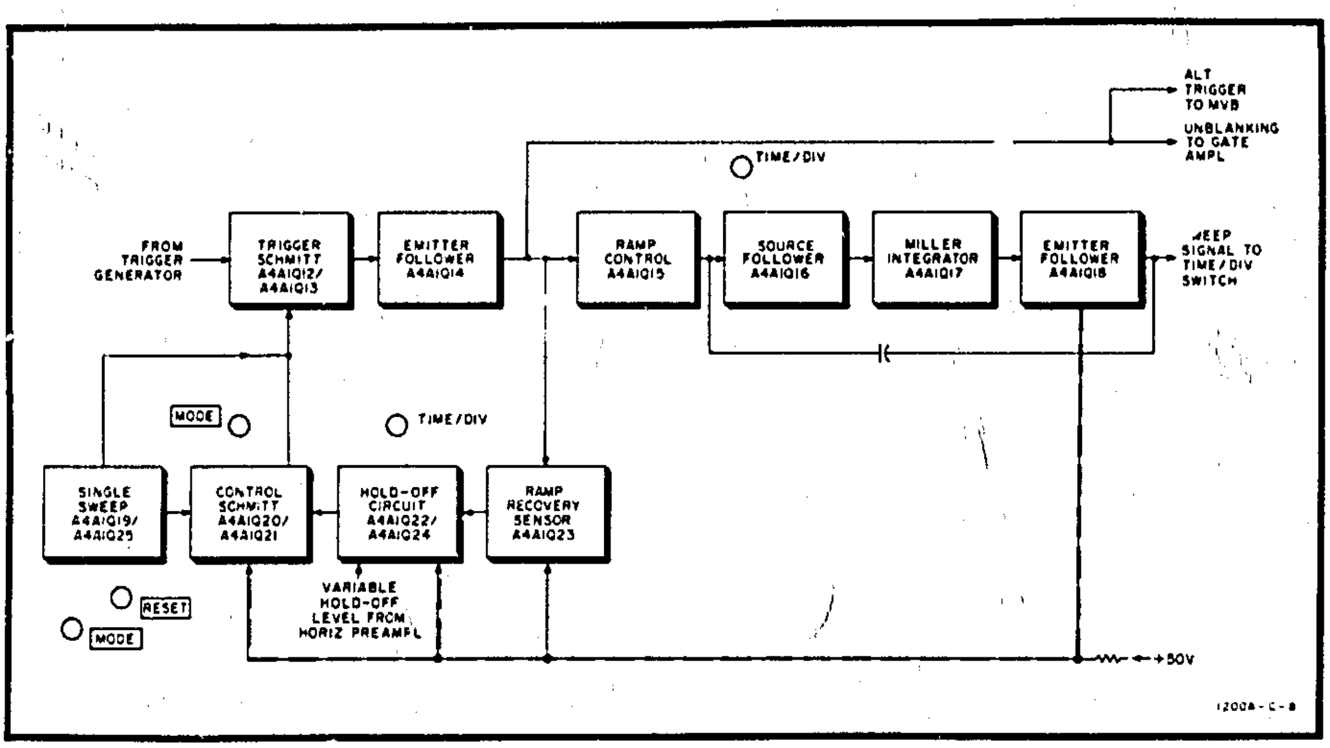


Figure 4-4. Sweep Generator Block Diagram

4-83. When the control Schmitt turns off, it removes the arming voltage applied to the base of A4A1Q12. Emitter follower A4A1Q14 then turns off, and the resulting positive-going voltage step at the emitter is applied to the gate amplifier in the high voltage power supply to blank the CRT. This positive-going voltage step also turns on ramp control transistor A4A1Q15. The ramp control transistor's collector voltage then moves in a positive direction and forward biases diodes A4A1CR9-CR11. Transistors A4A1Q17 and A4A1Q18 then conduct heavily, and the sweep timing capacitor discharges through the relatively fast path consisting of: through A4A1Q18 collector to emitter, A4A1R58, A4A2C5/C6, A4A1CR9-CR11, and into the collector of A4A1Q15. This action generates the flyback portion of the sweep signal.

4-84. The positive-going voltage step applied to the emitter of A4A1Q15 just prior to the timing capacitor's discharge also forward biases A4A1CR15. However, A4A1Q23 is still turned off by the ramp voltage. When the ramp falls to its minimum value, A4A1Q23 turns on and charges the hold-off capacitor (A4A2C7-C9). Hold-off time is defined as the minimum time between the end of the flyback portion of the sweep signal and the beginning of the next ramp. A positive-going hold-off ramp is produced as the hold-off capacitor charges. This ramp is applied to A4A1Q21 by emitter follower A4A1Q22. Also, a trigger level signal is applied to the base of A4A1Q22 to allow stable triggering of complex waveforms.

4-85. When the hold-off ramp potential is sufficient to forward bias A4A1Q21, it conducts and turns on A4A1Q20. Once again the control Schmitt circuit provides an arming voltage to the base of trigger Schmitt A4A1Q12, and it then stands by to initiate another sweep cycle upon reception of a trigger signal from the trigger generator.

4-86. Single Sweep. When the MODE switch is set to the SINGLE position, an incoming trigger signal produces one horizontal sweep cycle. The sweep generator must then be manually reset before the next trigger signal can produce another sweep cycle.

4-87. The main difference between single sweep and normal sweep is that the control Schmitt doesn't re-arm the trigger Schmitt circuit following the completion of a sweep ramp. This makes it impossible to start a new sweep cycle until the RESET (A4S6) pushbutton is pressed.

4-88. When the RESET pushbutton switch is pressed, the voltage across A4A1R81 increases to about +28V. This voltage, applied to the base of A4A1Q21, turns off the control Schmitt regardless of ramp condition. As a result, the trigger Schmitt is not armed, and the sweep is terminated.

4-89. During this time, the ramp recovery and hold-off circuits operate but are unable to turn the control Schmitt back on to arm the trigger Schmitt. Capacitors A4A1C30 and A4A1C31 charge to the +28V potential across A4A1R81, and arming delay transistor A4A1Q25 turns on. Current flowing from A4A1Q25 passes through A4A1R77 and A4A1R43, creating a voltage drop that reverse biases A4A1CR7. This prevents incoming trigger signals from reaching the trigger Schmitt circuit.

4-90. When the RESET pushbutton switch is released, A4A1C30 discharges and maintains the reverse bias on A4A1CR7 for about 0.5 second. Capacitor A4A1C31 discharges through A4A1R81 and A4A1R84, and the voltage drop across A4A1R84 then turns on A4A1Q21. The base of A4A1Q20 then goes positive, and the transistor conducts to provide 0 volt at the base of A4A1Q12 and arm the trigger Schmitt. When the 0.5-second arming delay ends, A4A1Q25 turns off. This removes the reverse bias from A4A1CR7 and allows incoming trigger signals to be applied to the trigger Schmitt. In addition, lamp A4DS1 lights to indicate that the circuit is armed.

4-91. The first incoming trigger signal applied to the trigger Schmitt after the circuit is armed initiates a sweep cycle as previously explained in the normal sweep mode, with the following exception. The control Schmitt circuit senses the maximum ramp voltage, turns off, and terminates the sweep ramp. Both the recovery sense and hold-off circuits function normally but are unable to overcome a fixed bias set by A4A1R84. Therefore, the control Schmitt doesn't turn on and re-arm the trigger Schmitt unless the RESET pushbutton switch is pressed again.

4-92. Free-Run Sweep. When the MODE switch is set to the FREE RUN position, the sweep generator runs free at a rate determined by the Time/Division switch and can't be controlled by an incoming trigger signal.

4-93. Resistor A4A1R77 is connected to the −50V supply by the MODE switch during free-run operation. The voltage drop across A4A1R77 then drives the emitter of A4A1Q12 so far negative that the trigger Schmitt changes state each time it receives an arming signal from the control Schmitt circuit. Thus, an incoming signal from the trigger generator is not needed to start a sweep cycle.

4-94. OUTPUT MODULE.

4-95. The output module consists of multivibrators, switched current sources and vertical and horizontal output amplifiers.

4-96. MULTIVIBRATOR. See Figure 4-5 and Schematic 4. Operation of multivibrator A3Q15/Q16 is set by DISPLAY switch A3S1. The multivibrator is:

a. a switch (one side on and the other off) for A, B, and A vs. B displays.

b. bistable for ALT (alternate) channel displays.

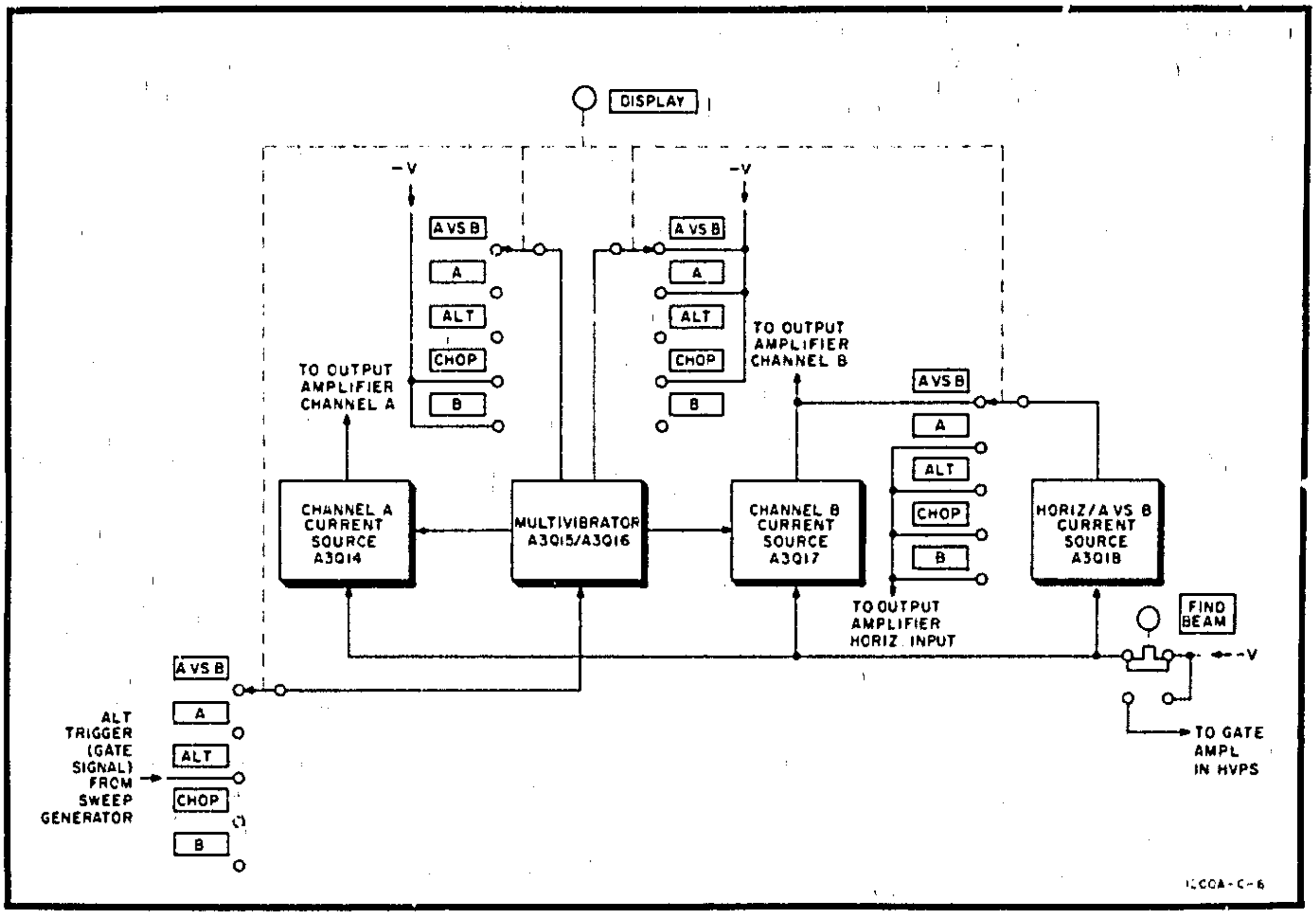


Figure 4-5. Multivibrator Block Diagram

c. astable at about 100 kHz for CHOP (mixed) displays.

4-97. In the A vs. B setting, −50V is applied through the DISPLAY switch (A3S1) and A3R46 to the base of A3Q15. As a result, A3Q15 turns on and the collector moves in a positive direction. This positive-going voltage ensures that A3Q16 won't conduct, and it forward biases the base-to-emitter junction of A3Q14. Current source A3Q14 then conducts to supply current to the channel A vertical amplifier (Schematic 3). When the DISPLAY switch is set to A, operation is the same, and current is again supplied to the channel A vertical amplifier.

4-98. The −50V is disconnected from the base of A3Q15 and applied to the base of A3Q16, via A3R44, when the DISPLAY switch is set to B. Transistor A3Q16 then conducts, ensuring no A3Q15 conduction, and forward biases the base-to-emitter junction of A3Q17. Current source A3Q17 then conducts to supply current to the channel B vertical amplifier.

4-99. When the DISPLAY switch is set to ALT, neither A3R44 or A3R46 is connected to the −50V supply, and the alt trigger (unblanking pulse) from the sweep generator is applied to the anodes of A3CR25 and A3CR26. The multivibrator then operates in a bistable mode, turning current sources A (A3Q14) and B (A3Q17) alternately on and off at the rate of the unblanking pulse. Thus, channel A current is supplied during one sweep and channel B current is supplied during the succeeding sweep.

4-100. The unblanking pulse is disconnected and −50V is applied through A3R44/R46 to the bases of both A3Q15/Q16 when the DISPLAY switch is set to CHOP. In this mode, the multivibrator is astable, and it free-runs at about a 100 kHz rate. When A3Q15 turns on, it turns off A3Q16 and turns on A3Q14 to supply channel A current for the vertical amplifier. Then the cycle reverses. Transistor A3Q16 turns on, turning off A3Q15 and turning on A3Q17 to supply channel B current for the vertical amplifier. Unlike ALT operation, the channels switch independent of the sweep signal at about a 100 kHz rate.

4-101. Current source A3Q18 always conducts. When the DISPLAY switch is set to A vs. B, it supplies current to the channel B vertical amplifier while A3Q14 supplies current to the channel A vertical amplifier. In all other setting of the DISPLAY switch, A3Q18 supplies current to the horizontal amplifier.

4-102. Current is normally supplied to the current sources from the −50V power supply, via the FIND BEAM pushbutton switch (S2) and A3R61. When the FIND BEAM switch is pressed, A3R61 is disconnected. Current is then supplied from the filtered −50V supply, via A3R58. Since the resistance of A3R58 is greater than that of A3R61, the current sources supply less current to the output amplifiers. And, since less current is supplied to the output amplifiers, vertical and horizontal deflection is decreased. The −50V that was connected to A3R61 is now applied to the gate amplifier in the high voltage power supply by the FIND BEAM switch. As a result, the CRT is unblanked. An offset CRT display can thus be returned to the viewing area.

4-103. Emitter follower A3Q13 is used to apply a chop blanking signal to the gate amplifier in the high voltage power supply when CHOP is selected by the DISPLAY

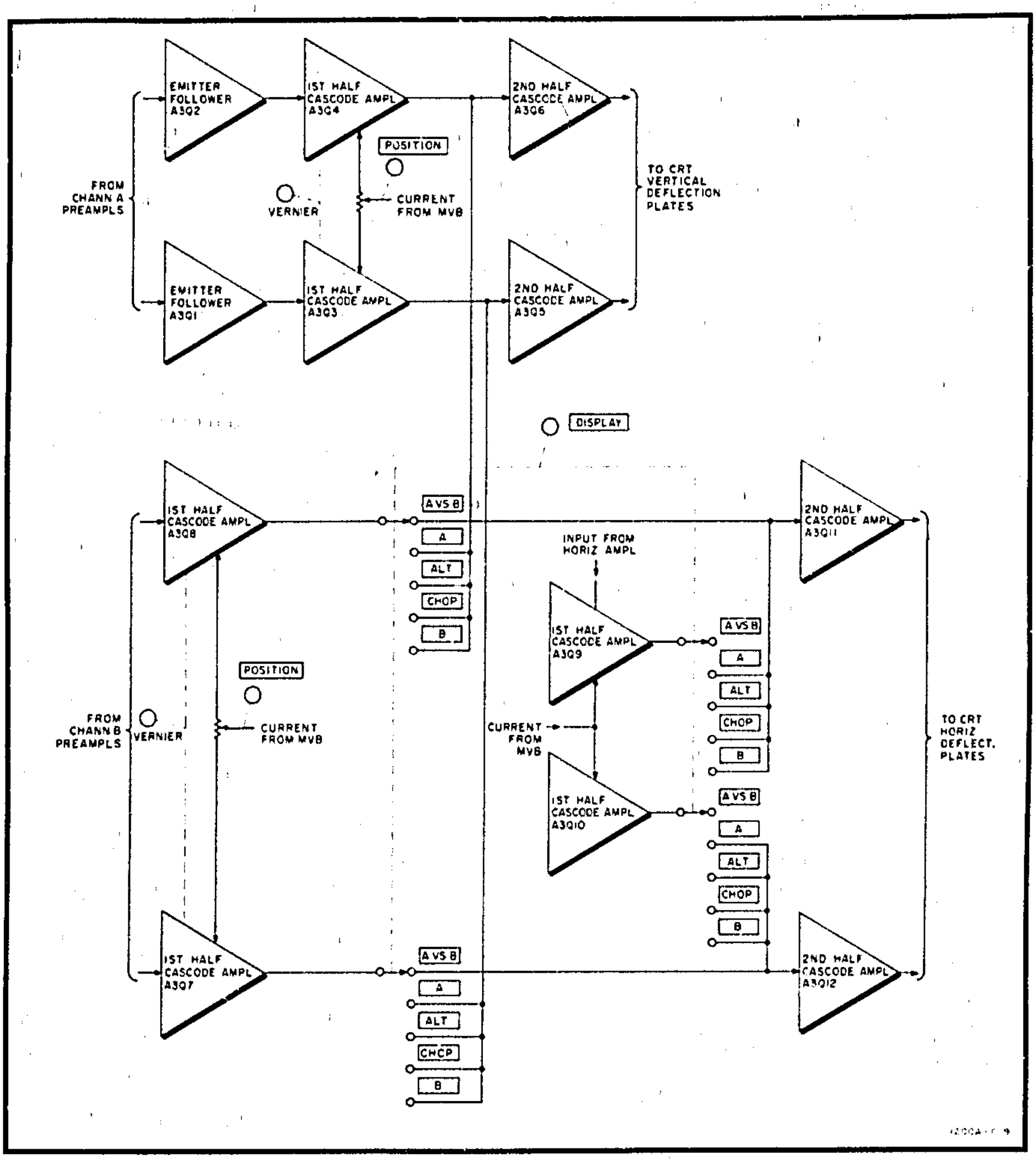


Figure 4-6. Output Amplifier Block Diagram

switch. This signal, taken from the multivibrator, blanks the CRT during switching time between channels.

4-104. Either the channel A or B display signal from the vertical preamplifiers can be applied as an internal trigger signal to the horizontal preamplifier. Except when the DISPLAY switch is set to B, the internal trigger signal is always taken from the channel A preamplifier.

4-105. OUTPUT AMPLIFIER. See Figure 4-6 and Schematic 3. Channel A signals are applied to the bases of A3Q1 and A3Q2 from the vertical preamplifiers. These two emitter followers isolate the preamplifier from chop and alt signals present in the emitters of A3Q3 and A3Q4. This isolation is needed to prevent interaction with the channel A trigger signal.

4-106. The channel B signal is applied to the bases of A3Q7 and A3Q8 from the channel B preamplifier. Isolation transistors are not needed because the channel B signal isn't used for triggering in the chop or alt modes.

4-107. Only operation of the channel A amplifier is explained in detail in the following paragraphs. The channel B and horizontal amplifiers are similar.

4-108. Diodes A3CR3-CR6 allow fast recovery of the amplifiers if they are driven into saturation. Protection diodes A3CR7 and A3CR8 prevent A3Q3 and A3Q4 emitter breakdown if the amplifier is overdriven. The input is neutralized by A3C1 and A3C2 to prevent coupling between channels when both are connected to A3Q5/Q6, as is the case in the alt or chop modes.

4-109. Output amplifier gain is about 40 when Vernier potentiometer A1A2R16 is set to the CAL detent. Since the vertical output stage is a differential cascode amplifier, gain is approximately equal to the ratio of A3R12 or A3R13 to one-half of the resistance between the emitters of A3Q3 and A3Q4.

4-110. Whether the channel A or B amplifiers are turned on or off is determined by the current sources applied to the arm of the POSITION potentiometers (R6 for channel A and R7 for channel B). Either channel (A or B) or both, at a 100 kHz rate (CHOP) or alternating at the sweep rate (ALT), can be applied to the second half of the output cascode amplifier (A3Q5/Q6), depending on the setting of the DISPLAY switch. Output signals are then applied to the CRT's vertical deflection plates.

4-111. Operation of the horizontal output amplifier is similar to that of the vertical output amplifier. The horizontal signal or sweep signal (depending on the SWEEP/EXT HORIZ switch setting) is applied to the base of A3Q9, converted to a differential signal, amplified and then applied to the CRT's horizontal deflection plates.

4-112. Current is supplied to the emitters of A3Q9 and A3Q10 from the multivibrator circuit at all settings of the DISPLAY switch except A vs. B. In this setting, the horizontal signal is disconnected from the second half of the cascode amplifier (A3Q11/Q12), and the channel B signal from the vertical amplifier is applied instead.

4-113. POWER SUPPLY MODULES.

4-114. There are two power supplies in this instrument: a low voltage supply and a high voltage supply. Each is explained separately in the following text.

4-115. LOW VOLTAGE SUPPLY. See Figure 4-8 and Schematic 9. Line voltage is transformed, rectified and filtered into two regulated outputs (+50V and −50V) and one unregulated output (+180V). In addition, 6.3 Vac is applied to the CRT filament, a calibrating signal is generated, and a power-line frequency sync signal is provided for the horizontal circuits.

4-116. Primary Power. Either 115 or 230 Vac (±10%, single phase, 47 to 440 Hz) can be applied as operating power, depending on the jumper wires connected to T1. When POWER switch S1 is turned on, lamp DS1 lights to indicate the presence of primary power, and fuse F1 prevents excessive input current from damaging the instrument. Since the instrument is fully transistorized (except for the CRT), no fan is needed, and cooling is by convection.

4-117. If 115 Vac is used as primary power, one side of the line voltage is applied to pins 1 and 3 of T1, and the other side is connected to pins 2 and 4. Thus, the two primary windings are in parallel. This is done so that primary power is divided between the two windings, and neither is as susceptible to breakdown.

4-118. When T1 is wired to accept 230 Vac, windings 1 to 2 and 3 to 4 are connected in series. This decreases the transformer step-up ratio by a factor of 50% so that secondary voltages remain the same as when 115 Vac is applied.

4-119. Basic Regulated Power Supply. A simplified block diagram of the type regulator used in the low voltage power supply is shown in Figure 4-7. In effect, this circuit

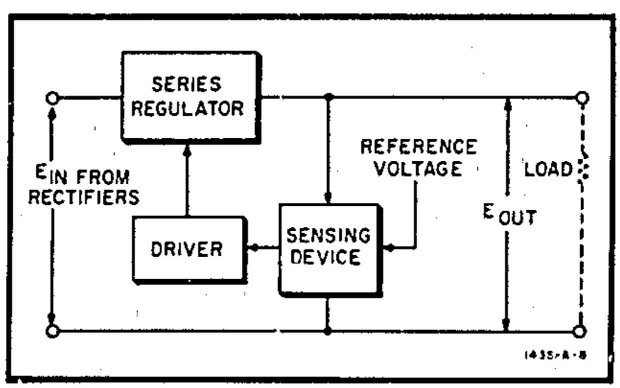


Figure 4-7. Regulated Power Supply Block Diagram

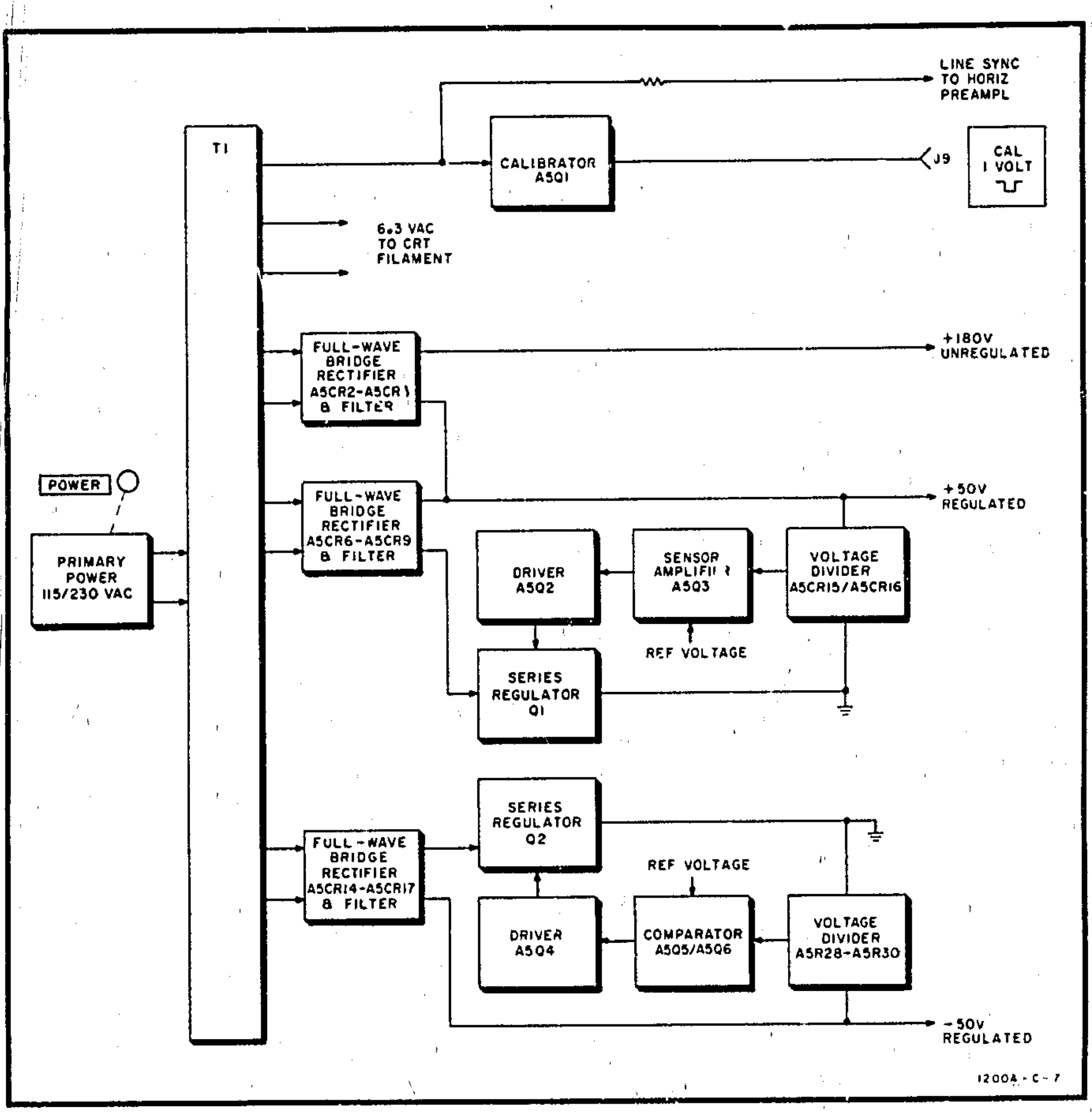


Figure 4-8. Low Voltage Power Supply Block Diagram

is simply a self-adjusting voltage divider. Its purpose is to keep output voltage constant.

4-120. Input voltage, from the rectifiers, is dropped proportionately across the series regulator and the parallel combination of load and sensing device. Changes in output voltage are detected by the sensing device (either a comparator or common emitter amplifier) and are then compared against a reference voltage. If sensor voltage doesn't agree with the reference voltage, a difference voltage is created and applied to the driver.

4-121. The driver, in turn, controls series regulator bias. Since the series regulator acts as a variable resistance, it either increases or decreases conduction. The resulting voltage drop opposes the output voltage change and, thus, output voltage remains at a constant level.

4-122. Secondary Power. AC voltage across each secondary winding (except calibrator and CRT filament voltages) is full-wave rectified by a bridge circuit. The resulting dc voltages are filtered and applied to the following circuits for regulation. Since the −50V supply acts as a reference for the other supplies, it is explained first.

4-123. −50 Volt Supply. From pins 9 and 10 of T1, secondary ac voltage is full-wave bridge rectified by

A5CR14-CR17. The resulting dc voltage, pulsating at 120 Hz, is filtered primarily by A5C5. Resistor A5R18 is a bleeder placed at the input as a protective device to discharge A5C5 if fuse A5F3 opens. Current is limited by A5R17 and, in case A5F3 opens, A5CR21 protects A5C9 from reverse charging.

4-124. Output voltage is sampled at voltage divider A5R28/R29/R30 and applied to the comparator, A5Q5/Q6. This voltage, applied to the base of A5Q6, is compared against a reference voltage set by A5VR4 at the base of A5Q5. A voltage difference is then amplified and applied to the driver, A5Q4. In turn, the driver changes the bias applied to series regulator Q2. This, in effect, changes the resistance of the regulator and keeps output voltage constant.

4-125. In case the −50V supply output is shorted to ground, A5VR3 protects the series regulator by turning on and causing A5Q2 to draw enough current to open fuse A5F3. RC network A5C6 and A5R21 is a high frequency roll-off path for frequencies above 10 kHz, and A5C7 bypasses noise caused by zener diode A5VR4. Diodes A5CR18-CR20 are protection diodes.

4-126. +50 Volt Supply. The +50V supply functions similar to the −50V supply. Sensor amplifier A5Q3 is referenced to the −50V supply. A voltage variation in the +50V supply output is sensed at the base of A5Q3, amplified and applied to the series regulator by driver A5Q2. The series regulator (Q1) then compensates with more or less series resistance and restores output voltage to the original level.

4-127. Bias for the driver is provided by A5VR2, and A5VR1 protects the series regulator. Diodes A5CR11 and A5CR12 are emitter-to-base protection diodes, and A5CR13 protects A5C2 and A5C4 by preventing the supply voltage from going negative. Frequencies above 10 kHz are rolled off by A5C3 and A5R12.

4-128. +180 Volt Supply. This supply consists of an unregulated +130V supply added onto the +50V supply. Input voltage is full-wave rectified by A5CR2-CR5, fused by A5F1, and filtered by A5C1. Resistor A5R6 is a bleeder. Since the supply is not regulated, output voltage may vary with the line voltage or load changes.

4-129. Calibrator. This circuit produces a 1V pk-pk power-line frequency square wave. Transistor A5Q1 operates as a switch. During the negative alternation of the power-line frequency signal taken from T1 pin 6, the transistor saturates, and output voltage at the front panel calibrator jack (J9) is 0V. The transistor cuts off during

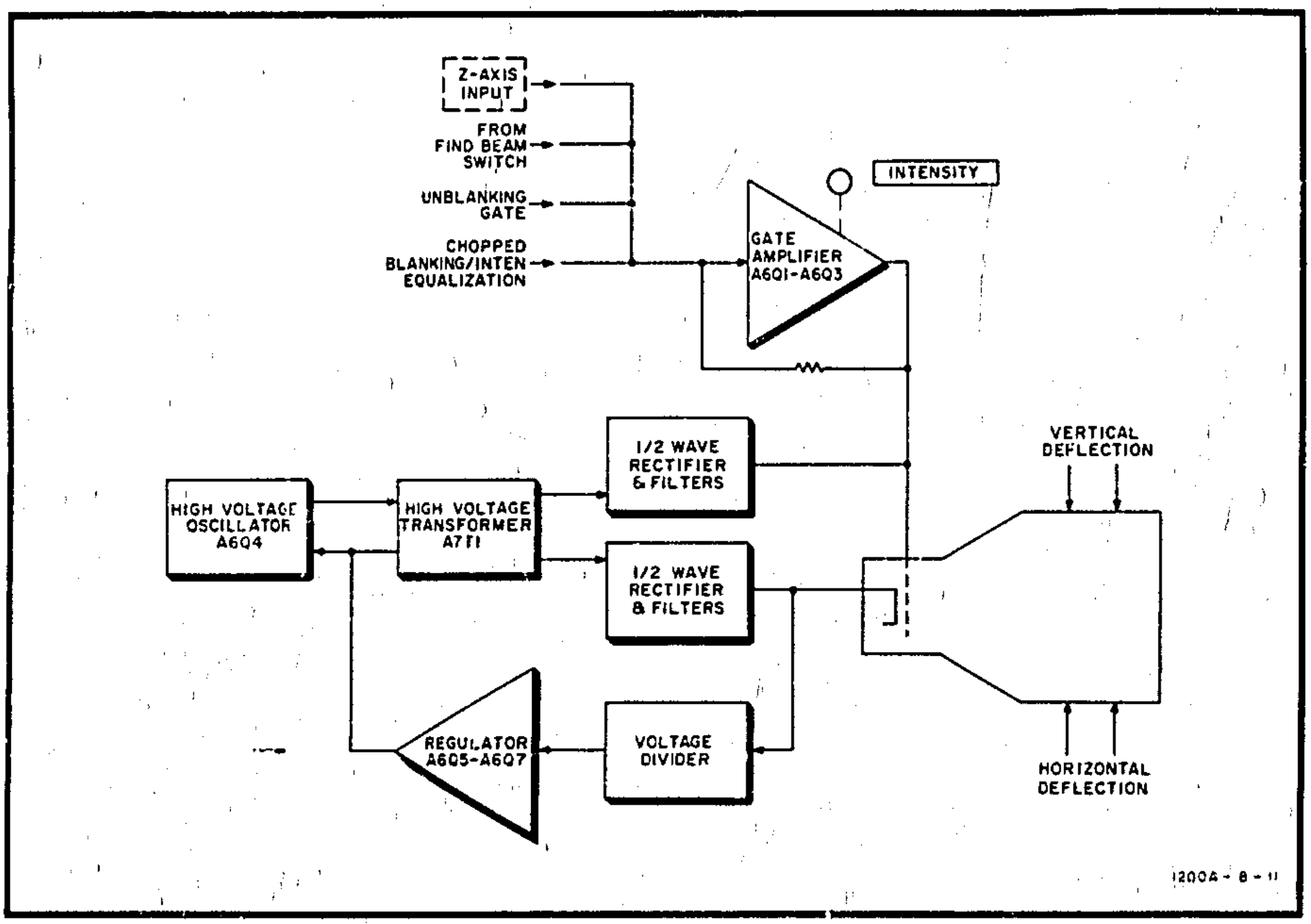


Figure 4-9. High Voltage Power Supply Block Diagram

the positive alternation of the input signal, and output voltage is set to −1V by voltage divider A5R3-R5. The signal that drives the calibrator is also attenuated by A5R1 and applied to the horizontal module for use as a power-line frequency sync signal.

4-130. HIGH VOLTAGE SUPPLY. See Figure 4-9 and Schematic 10. The high voltage power supply consists of three circuits: a high voltage regulator, high voltage rectifiers, and a gate amplifier. Each of these is explained separately, as follows.

4-131. High Voltage Regulator. High voltage oscillator A6Q4 produces a 50 kHz, 100V pk-pk, sine wave. To sustain oscillations, regenerative feedback is coupled from collector to base via the mutual inductance of A7T1. This signal is then stepped up in amplitude by the transformer and later rectified and filtered by the secondary circuits.

4-132. High voltage is regulated as follows. Half-wave rectified and filtered high voltage from A7CR2 is fedback to high-input-impedance field effect transistor A6Q7 by A6R27. In combination with A6R26 and A6R17B, resistor A6R27 forms a 45:1 (approximately) voltage divider. Since the top end of A6R26 is connected to the +50V supply, the gate of A6Q7 is close to ground potential. Bias for A6Q7 is set by A6R17B. Since this adjustment sets the bias of the input transistor, it also controls the conducting levels of A6Q5 and A6Q6 and sets the bias of the high voltage oscillator.

4-133. A variation in feedback voltage at the gate of A6Q7 is amplified by A6Q5-Q7 and applied to the base of A6Q4 to reestablish output voltage.

4-134. High Voltage Rectifiers. CRT cathode voltage is derived from the bottom secondary winding of A7T1. This ac voltage is half-wave rectified by A7CR2 and filtered by a capacitive input pi-filter network. A portion of this high voltage is returned to the high voltage regulator by means of A6R27 to provide a regulated −2915V CRT cathode potential.

4-135. In combination with A6R28-R32, FOCUS control R4 forms a voltage divider connected to the −2915V supply and provides CRT focusing potential.

4-136. CRT grid voltage is developed by the voltage divider string across the top secondary winding of high voltage transformer A7T1. The ac voltage is half-wave rectified by A7CR1 and filtered by A7C1 and A7R1 before it is applied to the voltage divider. Intensity Limit adjustment A6R14 is used to adjust current through the divider and, thus, limit the range of INTENSITY potentiometer R3. Both intensity potentiometers adjust CRT beam intensity by changing the grid-to-cathode bias.

4-137. CRT grid potential is normally about −2955V. Since grid potential is normally about 50V more negative than the cathode, the CRT beam is turned off. Neon bulbs A6VR2 and A6VR3 protect A6CR8. The grid is prevented from becoming excessively positive with respect to the cathode by A6CR8/R37.

4-138. Astigmatism, roundness of the spot, is adjusted by A6R17A, and R2 is used to align the trace with the CRT graticule.

4-139. Gate Amplifier. The gate amplifier, A6Q1-Q3, is a current-fed operational amplifier. Inputs to the base of A6Q1 are from the following sources:

a. INTENSITY potentiometer R3.

b. the unblanking gate from the sweep generator.

c. chopped blanking/intensity equalization from the sweep generator.

d. Z-axis signals from TB1.

e. BEAM FINDER S2.

f. feedback current through A6C3/R12.

4-140. These input currents are summed at the base of A6Q1, converted to a voltage, amplified by A6Q3 and applied to the CRT's grid as bias. Output voltage at the collector of A6Q3 is approximately equal to the current through A6CR3 multiplied by the resistance of A6R12.

4-141. Transistor A6Q2 is a constant current source at low frequencies and an active pull-up at high frequencies. If the current through A6CR3 increases, feedback current through A6C3/R12 increases, and less current is available for A6Q3. The collector voltage of A6Q3 then moves in a positive direction, reducing CRT grid bias and increasing CRT conduction. When a less negative signal is applied to the cathode of A6CR3, feedback current decreases and the current through A6Q3 increases. Thus, the collector of A6Q3 moves in a negative direction to increase CRT bias and decrease CRT conduction.

4-142. Diodes A6CR1/CR2/CR4 prevent the amplifier from being overdriven, and A6CR5 prevents the collectors of A6Q2/Q3 from being more positive than 50.6V. Due to the feedback current, amplifier gain is stable.

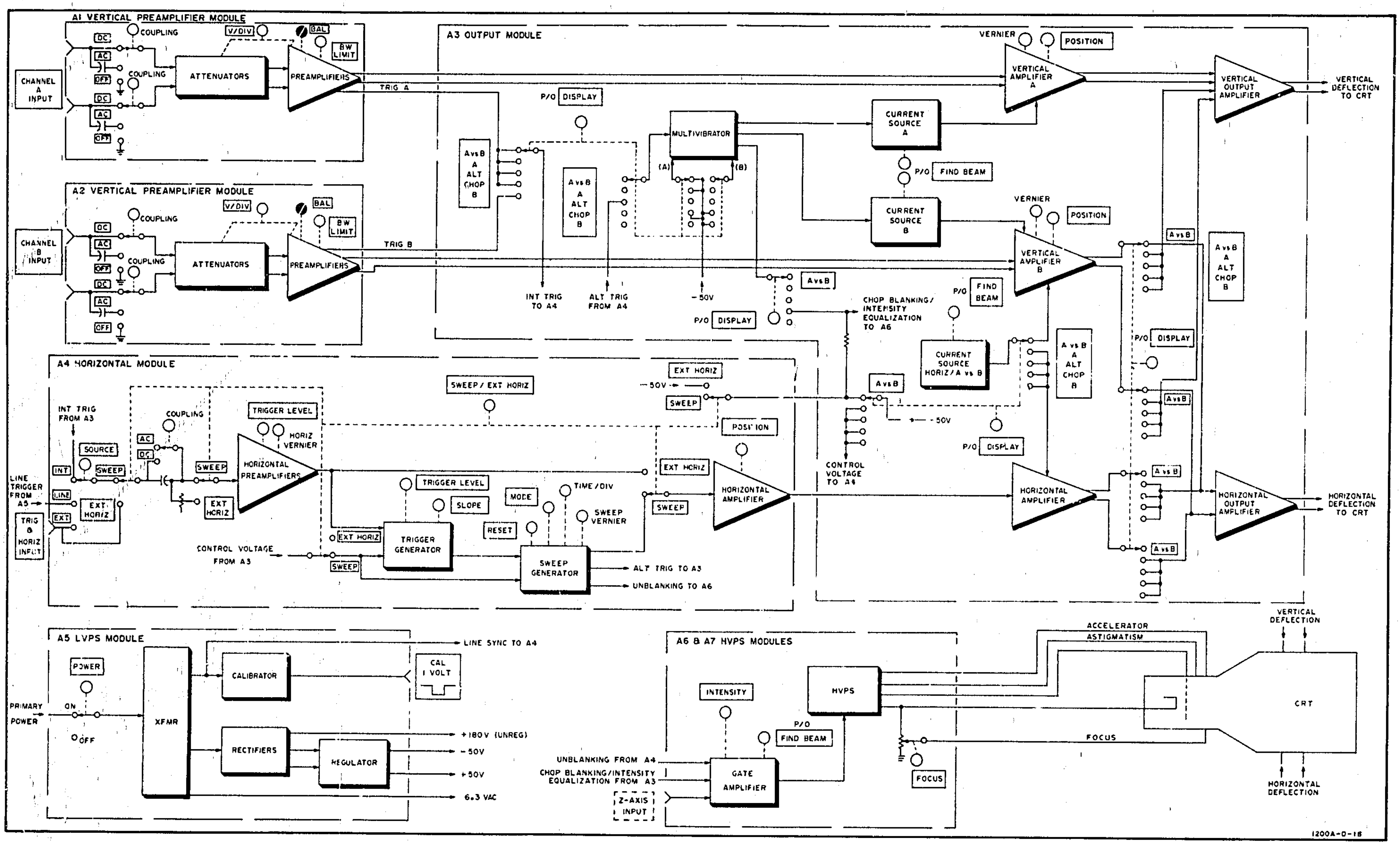


Figure 4-10. Overall Block Diagram

SECTION V

PERFORMANCE CHECK AND ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section contains step-by-step procedures required to check and maintain specified instrument performance. Photographs of all internal adjustments are also included; follow-up troubleshooting information and schematics are in Section VIII.

5-3. TEST EQUIPMENT.

5-4. Recommended test equipment is listed in table 5-1. Equivalent test equipment may be substituted, provided it has the required characteristics stated in the table. For proper results, use only recently calibrated test equipment.

5-5. PERFORMANCE CHECK AND ADJUSTMENTS.

5-6. The purpose of the performance check is to indicate whether or not the instrument is operating within the specifications stated in table 1-1. This check can be used as part of an incoming quality assurance inspection, as a periodic operational test, or to check calibration after repairs or adjustments are made. If the result of a performance check is unsatisfactory, refer to the indicated adjustment step (when given). If, after doing the appropriate adjustment, performance is still unsatisfactory, refer to Section VIII for detailed troubleshooting information.

5-7. It is preferable to do the performance check in the given sequence since succeeding steps depend on the control settings and results of earlier steps. However, steps may be done individually or out of sequence by referring to the preliminary control settings and the steps prior to the desired one.

5-8. Enter the results of the initial performance check on the Performance Check Record at the end of this section. Then remove the forms from the manual and file them for future reference (be sure to include the instrument serial number for identification).

5-9. PRELIMINARY CONTROL SETTINGS.

a. Set:

INTENSITY	ccw
FOCUS	mid-range
Volts/Division (A and B)	20 V/DIV
Vertical Vernier (A and B)	CAL
Vertical POSITION (A and B)	mid-range
+Vertical Coupling (A and B)	OFF
−Vertical Coupling (A and B)	OFF
BW LIMIT (A and B)	out position
DISPLAY	CHOP
Horizontal POSITION	mid-range
SWEEP/EXT HORIZ	X1
Time/Division	1 mSEC/DIV
Horizontal Vernier	CAL
MODE	FREE RUN
SLOPE	+
TRIGGER LEVEL	AUTO
SOURCE	INT
Horizontal COUPLING	DC

b. Apply operating power (refer to the power requirements paragraph in Section II), turn on the POWER switch and allow at least fifteen minutes for warmup.

5-10. PRELIMINARY CHECKS.

5-11. Paragraphs 5-12 through 5-17 contain preliminary operational checks of performance characteristics not specified in table 1-1. Since these characteristics are not specified, stated results are approximate.

5-12. INTENSITY.

a. Turn INTENSITY control from stop to stop.

b. Note that intensity of traces varies smoothly from extinguished to brighter than normal.

c. Refer to paragraph 5-44 for adjustment information, if required.

5-13. FOCUS.

a. Adjust INTENSITY for visible traces.

b. Turn FOCUS control from stop to stop.

c. Note that traces are focused when FOCUS is set to approximately mid-range.

5-14. TRACE ALIGN.

a. Using the POSITION controls, set the traces on horizontal graticule lines.

b. Adjust TRACE ALIGN, and note that the traces can be aligned parallel to the horizontal axis.

5-15. AMPLIFIER BALANCE.

a. Turn channel A Volts/Division from 20 V/DIV to 0.1 mV/DIV, and adjust front panel BAL (channel A) screwdriver adjustment.

Table 5-1. Recommended Test Equipment

Recommended Instrument		Required Characteristics	Required For
Type	Model		
DC Standard	HP Model 740B	0.5 mV to 100 V ±0.2%	Calibrator Check Vert. Ampl. Gain Check Vert. Vernier Check Trig. Point & Slope Check Horiz. Ampl. Gain Check Horiz. Vernier Check Horiz. Ampl. Gain Adj. Output Ampl. Gain Adj.
Oscillator	HP Model 200CD	50 Hz to 500 kHz; up to 8.0 V pk-pk at 500 kHz; 20 V pk-pk at 10 kHz.	Vert. Positioning Check Vert. Bandwidth Check CMR Check A vs B Phase Shift Check Channel Isolation Check Trig. Amplitude Check Trig. Point & Slope Check Horiz. Bandwidth Check CMRR Bal. Adj.
Time-mark Generator	HP Model 226A	Markers from 1 μsec to 5 sec.	Sweep Time Check Sweep Vernier Check Mag. Sweep Check Single Sweep Check Sweep Time Adj.
Digital DC Voltmeter	HP Model 3465A	±50 V; ±0.05% ±165 V; ±0.05%	L.V.P.S. Adj. H.V.P.S. Adj.
High Voltage 100:1 Divider Probe	HP Model 11044A	—3000 Vdc.	H.V.P.S. Adj.
LCR Meter	HP Model 4332A	45 pF ±3%	Input Cap Adj. Atten. Comp. Adj.
Square Wave Generator	HP Model 211B	4.5 V pk-pk at 1 kHz; rise time approx 0.5 μs	Horiz. Atten. Comp. Adj. Input Cap Adj. Atten. Comp. Adj.
Frequency Compensated Divider Probe	HP Model 10001A	10:1; dc to 30 MHz; 10 megohms; 10 pF; 2% 600V.	L.V.P.S. Adj. H.V.P.S. Adj.
Test Oscilloscope	HP Model 1200A/B	100 mV sensitivity; 100 kHz bandwidth	L.V.P.S. Adj. H.V.P.S. Adj.
AC Voltmeter	HP Model 427A	10 V; ±2% accurate 50 kHz to 500 kHz	Vert. Bandwidth Check Horiz. Bandwidth Check
BNC-to-binding-post adapter quantity: 2	HP Model 10111A	Shielded	Channel Isolation Check

b. Note that channel A trace can be prevented from shifting when turning Volts/Division.

c. Repeat steps a and b for channel B.

5-16. VERTICAL POSITIONING.

a. Set:
+Vertical Coupling (A and B) .... AC
Volts/Division (A and B) .... 0.1 V/DIV
MODE .... NORM
Time/Division .... 5 μSEC/DIV

b. Connect a 100 kHz signal from oscillator to channel A +INPUT jack.

c. Adjust oscillator for eight divisions of vertical deflection.

d. Turn channel A Vertical POSITION fully cw.

e. Note that the channel A display moves upward until offset from graticule.

f. Turn channel A Vertical POSITION fully ccw.

g. Note that the channel A display moves downward until offset from graticule.

h. Repeat steps b through g for channel B.

i. Disconnect oscillator.

5-17. BEAM FINDER.

a. Remove traces from screen by turning vertical and horizontal POSITION controls.

b. Set INTENSITY fully ccw.

c. Press FIND BEAM pushbutton.

d. Note that bright, defocused traces return to screen.

NOTE

The beamfinder intensification feature has been disabled in instruments having a CRT with P11 phosphor.

e. Readjust INTENSITY and POSITION controls to return traces to screen.

5-18. PERFORMANCE CHECK PROCEDURE.

5-19. VERTICAL AMPLIFIER GAIN.

a. Connect output from dc standard to channel A +INPUT jack.

b. Set channel A Volts/Division control to 10 mV/DIV.

c. Set Time/Division control to 0.5 mSEC/DIV.

d. Set base line to bottom graticule line on 1200A or 1200B.

e. Set dc standard controls for 50-mV dc output signal and +Vertical Coupling to DC.

f. Note display. Vertical deflection should be 5 divisions ±3% (±0.15 division).

g. Observe vertical deflection factors (±3%) specified in table 5-2.

h. Set dc standard output for 30 V.

i. Set channel A Volts/Division control to 5 V/DIV, and note 6 divisions of vertical deflection.

Table 5-2. Vertical Amplifier Gain

DC Standard Volts	Volts/Division	Vertical Deflection (divisions ±3%)
100 V	20 V	5 ±0.15
50 V	10 V	5 ±0.15
30 V	5 V	6 ±0.18
10 V	2 V	5 ±0.15
5 V	1 V	5 ±0.15
3 V	0.5 V	6 ±0.18
1 V	0.2 V	5 ±0.15
0.5 V	0.1 V	5 ±0.15
0.3 V	50 mV	6 ±0.18
0.1 V	20 mV	5 ±0.15
50 mV	10 mV	5 ±0.15
30 mV	5 mV	6 ±0.18
10 mV	2 mV	5 ±0.15
5 mV	1 mV	5 ±0.15
3 mV	0.5 mV	6 ±0.18
1 mV	0.2 mV	5 ±0.15
0.5 mV	0.1 mV	5 ±0.15

j. Rotate channel A Vertical Vernier fully ccw. Vertical deflection should decrease to less than 2.4 divisions.

k. Set channel A Vertical Vernier to Cal detent.

l. Connect dc standard to channel B +INPUT jack.

m. Set DISPLAY to B.

n. Repeat steps a through k for channel B.

o. Disconnect test equipment.

p. Set:
DISPLAY .... A
+Vertical Coupling A .... OFF
—Vertical Coupling A .... DC

q. Connect output from dc standard to channel A —INPUT jack.

r. Set dc standard output and channel A Volts/Division according to table 5-3, and observe vertical deflections specified.

Table 5-3. Vertical Amplifier Gain

DC Standard Volts	Volts/Division	Vertical Deflection (divisions)
3 V	0.5 V	6 ±0.18
1 V	0.2 V	5 ±0.15

s. Set:
DISPLAY .... B
+Vertical Coupling B .... OFF
—Vertical Coupling B .... DC

t. Repeat steps q and r for channel B.

u. Refer to paragraph 5-53 for adjustment information.

5-20. CALIBRATOR.

a. Connect output from dc standard to channel A +INPUT jack.

b. Set Time/Division to 5 mSEC/DIV.

c. Set Volts/Division to 0.2 V/DIV.

d. Set dc standard for 1 V dc output signal.

e. Note vertical deflection on CRT.

f. Disconnect dc standard from Model 1200A or 1200B.

g. Connect CAL 1 VOLT signal to channel A +INPUT jack.

h. Note vertical deflection on CRT. Vertical deflection should be same as noted in step e ±1%.

i. Disconnect test leads.

5-21. VERTICAL BANDWIDTH.

a. Set:
Vertical Vernier (A and B) .... CAL
Volts/Division (A and B) .... 1 V/DIV

b. Connect a 1 kHz signal from oscillator output to channel A —INPUT jack.

c. Monitor oscillator output with ac voltmeter.

d. Adjust oscillator for eight divisions of vertical deflection, and note ac voltmeter indication.

e. Adjust oscillator frequency for a 500 kHz signal.

f. Adjust signal amplitude for same voltage indication noted in step d.

g. Note 5.7 or more divisions of vertical deflection.

h. Set:
+Vertical Coupling A .... DC
—Vertical Coupling A .... OFF

i. Connect a 1 kHz signal from oscillator to channel A +INPUT jack.

j. Repeat steps c through g.

k. Press BW LIMIT (channel A) to the in position.

l. Adjust oscillator frequency for a 50 kHz signal.

m. Adjust signal amplitude for same voltage indication noted in step d.

n. Note 5.7 or more divisions of vertical deflection.

o. Set DISPLAY to B.

p. Connect a 1 kHz signal from oscillator to channel B —INPUT jack.

q. Repeat steps c through g.

r. Set:
+Vertical Coupling B .... DC
—Vertical Coupling B .... OFF

s. Connect 1 kHz signal from oscillator to channel B +INPUT jack.

t. Repeat steps c through g.

u. Press BW LIMIT (channel B) to the in position.

v. Adjust oscillator frequency for a 50 kHz signal.

w. Adjust signal amplitude for same voltage indication noted in step d.

x. Note 5.7 or more divisions of vertical deflection.

y. Disconnect oscillator and ac voltmeter.

z. Refer to paragraph 5-54 for adjustment information, if required.

5-22. NOISE.

a. Set:

DISPLAY	ALT
BW LIMIT (A and B)	out position
+Vertical Coupling (A and B)	OFF
—Vertical Coupling (A and B)	OFF
Volts/Division (A and B)	0.1 mV/DIV
Time/Division	1 mSEC/DIV
MODE	FREE RUN

b. Adjust channel A Vertical POSITION to set associated trace at center screen.

c. Adjust channel B Vertical POSITION to bring associated trace close to channel A trace. Continue adjustment until dark band between traces just disappears.

d. Press both BW LIMIT switches. There should be 40 μV(4 mm) or less separation between traces (20 μV rms noise or less on each trace).

5-23. COMMON MODE REJECTION RATIO.

a. Set:

+Vertical Coupling (A and B)	DC
—Vertical Coupling (A and B)	DC

b. Connect a 100 Hz, 20 V pk-pk signal from oscillator to channel A + and —INPUT jacks (jacks shorted together).

c. Note two divisions or less of vertical deflection.

d. Adjust oscillator frequency for 10 kHz, 20 V pk-pk signal.

e. Note two divisions or less of vertical deflection.

f. Set DISPLAY to B.

g. Disconnect oscillator from channel A and connect to channel B + and —INPUT jacks (jacks shorted together).

h. Note two divisions or less of vertical deflection.

i. Adjust oscillator frequency for a 100 Hz, 20 V pk-pk signal.

j. Note two divisions or less of vertical deflection.

k. Disconnect oscillator.

l. Refer to paragraph 5-55 for adjustment information, if required.

5-24. A vs B PHASE SHIFT.

a. Set:

DISPLAY	A vs B
Volts/Division (A and B)	0.2 V/DIV
—Vertical Coupling (A and B)	OFF

b. Connect a 100 kHz sine wave signal from oscillator output to channel A and B +INPUT jacks.

c. Adjust signal amplitude to obtain eight divisions of vertical deflection.

d. Note that minor diameter of elliptical display (display may appear as a straight, diagonal line) is 0.1 division or less.

e. Set Volts/Division (A and B) to 0.5 V/DIV.

f. Repeat steps c through d.

5-25. CHANNEL ISOLATION.

a. Set:

DISPLAY	ALT
Volts/Division A	1 V/DIV
Volts/Division B	0.1 mV/DIV
+Vertical Coupling (A and B)	DC
—Vertical Coupling (A and B)	DC
Time/Division	1 μSEC/DIV

b. Connect shielded BNC-to-binding-post adapters from channel B + and —INPUT jacks to ground jack.

c. Connect a 500 kHz signal from oscillator output to channel A + and —INPUT jacks (ground jack not used).

d. Adjust oscillator for one division of channel A vertical deflection.

e. Note less than one division of channel B vertical deflection.

f. Set:

Volts/Division A	0.1 mV/DIV
Volts/Division B	1 V/DIV

g. Repeat steps b through e with signal applied to channel B.

h. Disconnect oscillator and input adapters.

5-26. TRIGGER AMPLITUDE.

a. Set:
DISPLAY................................ A
+Vertical Coupling A.................. DC
—Vertical Coupling A................. OFF
Volts/Division A................ 1 V/DIV
Time/Division .... 5 mSEC/DIV

b. Connect a 50 Hz signal from oscillator output to channel A +INPUT jack.

c. Adjust oscillator for 0.5 division of vertical deflection.

d. Adjust TRIGGER LEVEL or set to AUTO detent, and note a stable display.

e. Set Time/Division to 1 µSEC/DIV.

f. Adjust oscillator frequency for a 500 kHz signal.

g. Repeat steps c and d.

h. Set:
SOURCE .... EXT
Volts/Division A.............. 50 mV/DIV

i. Connect 500 kHz signal from oscillator output to channel A +INPUT and TRIG & HORIZ INPUT jacks.

j. Adjust oscillator for four divisions of vertical deflection.

k. Adjust TRIGGER LEVEL or set to AUTO detent, and note a stable display.

l. Set Time/Division to 5 mSEC/DIV.

m. Adjust oscillator for a 50 Hz signal.

n. Repeat steps j and k.

5-27. TRIGGER POINT AND SLOPE.

a. Set SOURCE to INT.

b. Adjust oscillator for eight divisions of vertical deflection.

c. Adjust TRIGGER LEVEL through its range.

d. Note a stable display as trigger point moves smoothly along positive slope of waveform.

e. Set SLOPE to —.

f. Adjust TRIGGER LEVEL through its range.

g. Note a stable display as trigger point moves smoothly along negative slope of waveform.

h. Disconnect oscillator.

5-28. SWEEP TIME.

a. Set SLOPE to + and SOURCE to INT.

b. Connect time-mark generator to channel A +INPUT jack.

c. Set time-mark generator and Time/Division according to table 5-4. Adjust TRIGGER LEVEL for a stable display, and adjust INTENSITY and channel A Volts/Division as required to obtain three to five divisions of vertical deflection.

Table 5-4. Sweep Timing

Time-mark Generator	Time/Division
5 sec	5 SEC/DIV
2 sec	2 SEC/DIV
1 sec	1 SEC/DIV
500 msec	0.5 SEC/DIV
200 msec	0.2 SEC/DIV
100 msec	0.1 SEC/DIV
50 msec	50 mSEC/DIV
20 msec	20 mSEC/DIV
10 msec	10 mSEC/DIV
5 msec	5 mSEC/DIV
2 msec	2 mSEC/DIV
1 msec	1 mSEC/DIV
500 µsec	0.5 mSEC/DIV
200 µsec	0.2 mSEC/DIV
100 µsec	0.1 mSEC/DIV
50 µsec	50 µSEC/DIV
20 µsec	20 µSEC/DIV
10 µsec	10 µSEC/DIV
5 µsec	5 µSEC/DIV
2 µsec	2 µSEC/DIV
1 µsec	1 µSEC/DIV

d. Adjust Horizontal POSITION to align first marker with left edge of graticule.

e. Note that 11th marker is within 0.3 division of right edge of graticule.

f. Refer to paragraph 5-51 for adjustment information, if required.

5-29. SWEEP VERNIER.

a. Set time-mark generator for 1 msec markers.

b. Set Time/Division to 0.1 mSEC/DIV, and turn Horizontal Vernier fully ccw.

c. Adjust TRIGGER LEVEL for a stable display.

d. Note that any two markers are displayed in less than four horizontal divisions.

5-30. MAGNIFIED SWEEP.

a. Set:
SWEEP/EXT HORIZ .... MAG
Time/Division .... 0.1 mSEC/DIV
Horizontal Vernier .... CAL

b. Adjust TRIGGER LEVEL for a stable display.

c. Adjust Horizontal POSITION to align first marker with left edge of graticule.

d. Note that second marker is within 0.5 division of right edge of graticule.

5-31. SINGLE SWEEP.

a. Set:
SWEEP/EXT HORIZ X1
Time/Division .... 0.1 SEC/DIV
MODE .... SINGLE
TRIGGER LEVEL .... AUTO

b. Set time-mark generator for 100 msec markers.

c. Press RESET pushbutton; note that indicator lights, and one sweep cycle is displayed. Indicator goes out at end of sweep cycle.

d. Disconnect time-mark generator.

5-32. HORIZONTAL AMPLIFIER GAIN.

a. Set SWEEP/EXT HORIZ to 1 V/DIV.

b. Connect dc standard to TRIG & HORIZ INPUT jack.

Table 5-5. Horizontal Gain

DC Standard Volts	Ext Horiz V/DIV	Horizontal Deflection (divisions)
10 V	1 V	10 ±0.3
5 V	0.5 V	10 ±0.3
2 V	0.2 V	10 ±0.3
1 V	0.1 V	10 ±0.3

c. Set dc standard output and EXT HORIZ V/DIV according to table 5-5.

d. Observe horizontal deflection specified in table 5-5.

e. Refer to paragraph 5-45 for adjustment information, if required.

5-33. HORIZONTAL VERNIER.

a. Set EXT HORIZ to 1 V/DIV.

b. Set dc standard output for 10 V.

c. Set Horizontal Vernier fully ccw.

d. Note four or less divisions of horizontal deflection.

e. Disconnect dc standard.

5-34. HORIZONTAL BANDWIDTH.

a. Set Horizontal Vernier to CAL detent.

b. Connect 1 kHz signal from oscillator to TRIG & HORIZ INPUT jack.

c. Monitor oscillator output with ac voltmeter.

d. Adjust oscillator for 10 divisions of horizontal deflection, and note ac voltmeter indication.

e. Adjust oscillator frequency for a 300 kHz signal.

f. Adjust signal amplitude for same voltage indication noted in step c.

g. Note seven or more divisions of horizontal deflection.

h. Disconnect oscillator and ac voltmeter.

i. Refer to paragraph 5-47 for adjustment information, if required.

5-35. ADJUSTMENT PROCEDURE.

5-36. Procedures to calibrate the instrument so that it will perform as specified in table 1-1 are presented in the following paragraphs. It is preferable to do the adjustment procedure in the given sequence since succeeding steps depend on the control settings and results of earlier steps. However, steps can be done individually by referring to the steps prior to the desired one.

5-37. Physical location of all internal adjustments is shown in figures 5-1 through 5-5. Only channel A vertical attenuator and preamplifier adjustments are shown in figure 5-4. To find the corresponding channel B adjustments, simply change the A1 prefix to A2.

5-38. Use a non-metallic screwdriver and only calibrated test equipment with characteristics as specified in table 5-1. After adjustments are completed, check operation by doing the performance check in the previous paragraphs.

5-39. PRELIMINARY SETUP.

5-40. Remove side covers (bench instrument) or top and bottom covers (rack instrument). Apply power, and allow at least fifteen minutes for warmup.

5-41. LOW VOLTAGE POWER SUPPLY.

a. Connect digital voltmeter to output of —50 V supply (any violet wire on A5).

Table 5-6. Low Voltage Power Supply Outputs

Supply	Voltage	Ripple
—50 V	—50 V ±25 mV	2 mV pk-pk
+ 50 V	+ 50 V ± 1 V	2 mV pk-pk
+180 V (unreg)	+150 V to +200 V	1500 mV pk-pk

b. Adjust A5R29 (see figure 5-1) for an output of —50 V ±25 mV.

NOTE

Only the —50 V supply is adjustable. All other supply voltages are dependent on its adjustment.

c. Check power supply output voltages and maximum ripple according to table 5-6.

5-42. HIGH VOLTAGE POWER SUPPLY.

a. Connect digital voltmeter via the 100:1 divider probe, to output of —50 V supply (any violet wire on A5).

b. Note voltage reading.

c. Multiply result of step b by 58.30.

d. Monitor high voltage supply output (white-green-gray wire between A6 and A7) with digital voltmeter and divider probe.

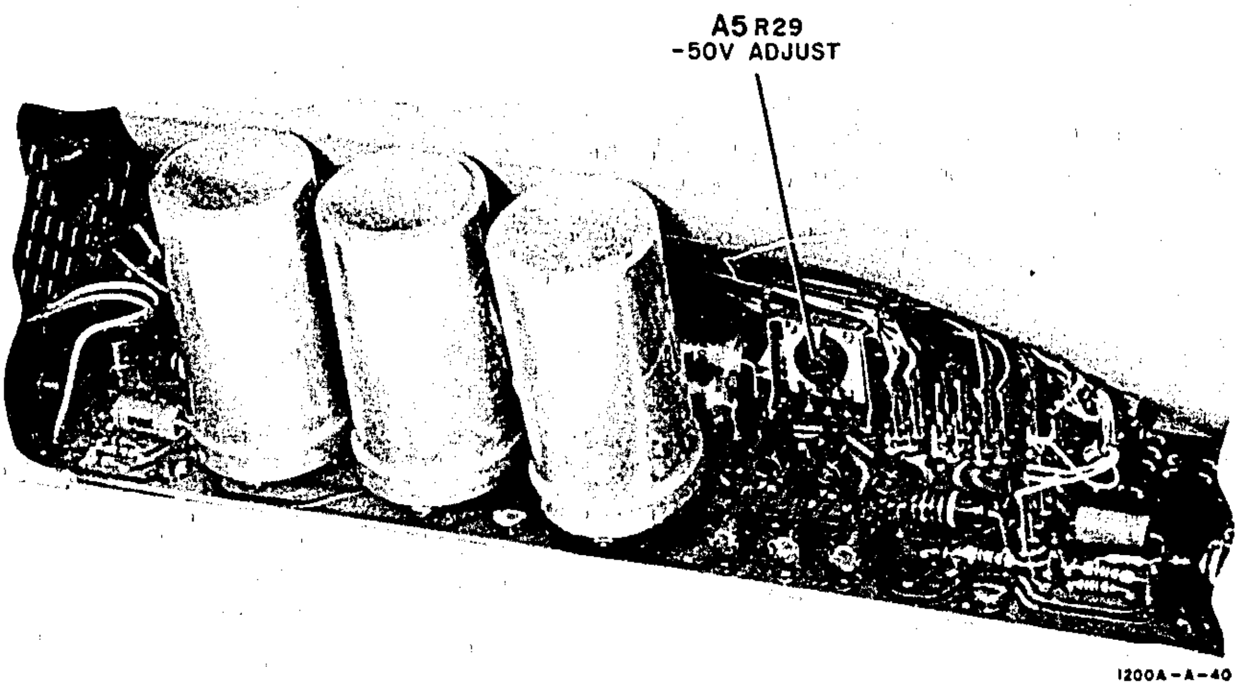


Figure 5-1. Low Voltage Power Supply Adjustment

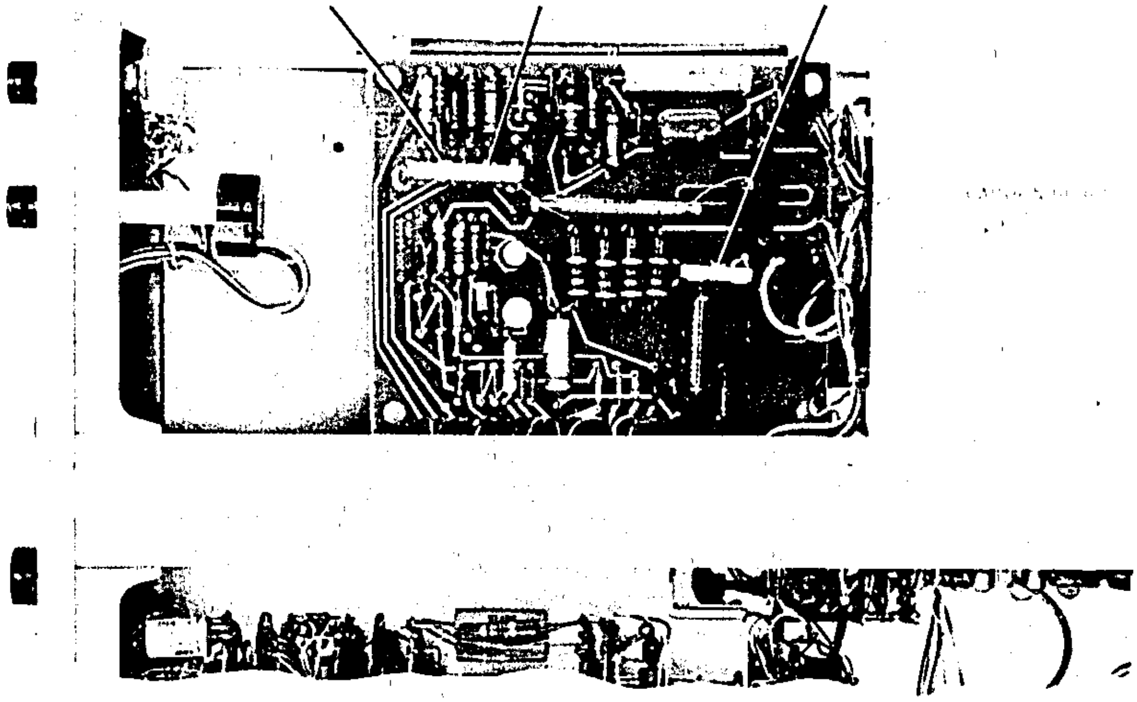


Figure 5-2. High Voltage Power Supply Adjustments

WARNING

Voltages present in the high voltage power supply are dangerous to life.

e. Adjust A6R17B (see figure 5-2) for same voltage as calculated in step c (—2,915 V ±5 V discounting probe attenuation).

NOTE

Divider probe inaccuracy is eliminated by this procedure.

f. Disconnect digital voltmeter.

5-43. ASTIGMATISM.

a. Set:

FOCUS	ccw
DISPLAY	A
Volts/Division A	1 V/DIV
SWEEP/EXT HORIZ	1 V/DIV

b. Set INTENSITY and vertical and horizontal POSITION controls to center a low intensity dot on CRT graticule.

c. Adjust A6R17A (see figure 5-2) for largest, roundest dot possible.

d. Adjust FOCUS for smallest, sharply focused dot. Astigmatism is properly adjusted if dot remains round when focused.

5-44. INTENSITY LIMIT.

a. Set FOCUS fully ccw.

b. Set INTENSITY to 9 o'clock.

c. Adjust A6R14 (see figure 5-2) until dot just disappears.

5-45. HORIZONTAL GAIN.

a. Set:

SWEEP/EXT HORIZ	0.1 V/DIV
Horizontal COUPLING	DC

b. Connect dc standard to TRIG & HORIZ INPUT jacks and set dc standard for 0 volt.

c. Adjust INTENSITY, FOCUS, and Vertical and Horizontal POSITION controls to place dot on left-hand vertical graticule line.

d. Set dc standard for 1 volt dc output.

e. Adjust A3R4D (see figure 5-5) to place dot on right-hand vertical graticule line.

f. Repeat steps b through e until 1-volt input causes 10-division deflection.

g. Disconnect dc standard.

5-46. HORIZONTAL VERNIER BALANCE.

a. Set Horizontal POSITION to center dot on screen.

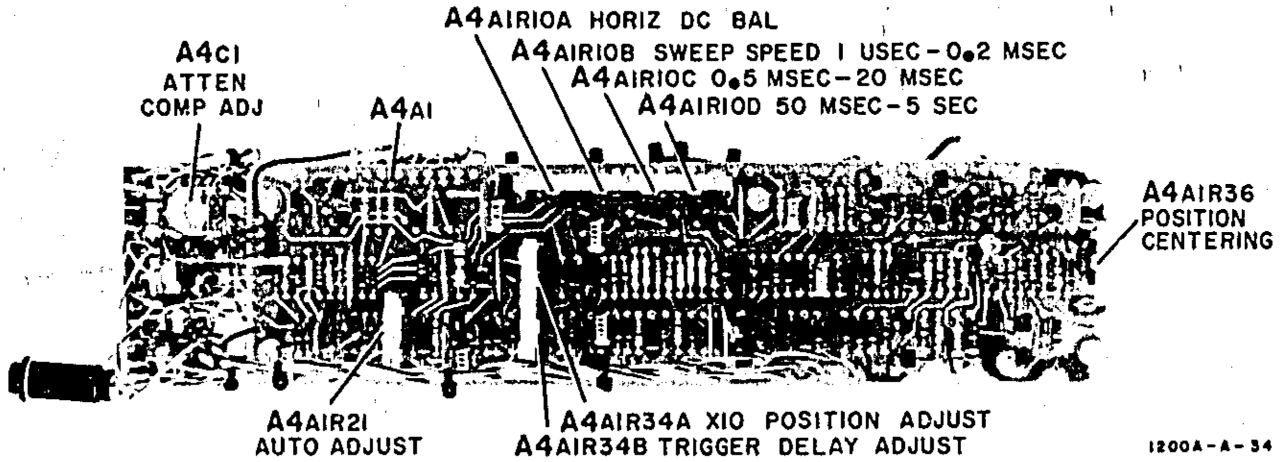


Figure 5-3. Horizontal Module Adjustments

b. Set Horizontal Vernier fully ccw.

c. Note horizontal position of dot.

d. Set Horizontal Vernier to CAL detent.

e. Set Horizontal POSITION to move dot to opposite side of center an amount equal to result of step c.

f. Adjust A4A1R10A (see figure 5-3) to center dot on screen.

g. Repeat steps b through f until dot remains stationary when Horizontal Vernier is turned.

5-47. HORIZONTAL ATTENUATOR COMPENSATION.

a. Connect 1 kHz signal from square-wave generator to TRIG & HORIZ INPUT jacks.

b. Set square-wave generator output for nine divisions of horizontal deflection (two dots nine div apart).

c. Adjust A4C1 (see figure 5-3) for minimum overshoot (observed as two well-defined dots nine div apart). Be sure that intensity is temporarily increased to observe overshoot.

d. Disconnect square-wave generator.

5-48. AUTO TRIGGERING.

a. Set:

DISPLAY	A
+Vertical Coupling A	AC
—Vertical Coupling A	OFF
Volts/Division A	0.2 V/DIV
TRIGGER LEVEL	AUTO
Time/Division	5 mSEC/DIV
Horizontal Vernier	CAL
SWEEP/EXT HORIZ	X1

b. Connect CAL 1 VOLT signal to channel A +INPUT jacks.

c. Set A4A1R21 (see figure 5-3) to mid-range.

d. Adjust A4A1R34B (see figure 5-3) cw until sweep free runs; then adjust it ccw until sweep stops. Center between these points.

e. Set channel A Volts/Division to 20 V/DIV.

f. Adjust A4A1R21 (see figure 5-3) to obtain triggering on both + and — settings of SLOPE switch.

g. Disconnect CAL 1 VOLT signal.

5-49. HORIZONTAL POSITION CENTERING.

a. Set channel A Volts/Division to 1 V/DIV.

b. Adjust A4A1R36 (see figure 5-3) so that beginning and end of trace are equidistant from graticule center when Horizontal POSITION is set fully cw or ccw.

5-50. MAGNIFIER CENTERING.

a. Set Horizontal POSITION to align beginning of trace with graticule center.

b. Set SWEEP/EXT HORIZ to MAG.

c. Adjust A4A1R34A (see figure 5-3) to align beginning of trace with graticule center.

5-51. SWEEP TIME CALIBRATION.

a. Set:

SOURCE	INT
MODE	NORM
Horizontal COUPLING	AC
SLOPE	+
SWEEP/EXT HORIZ	X1
Time/Division	5 μSEC/DIV
Horizontal Vernier	CAL

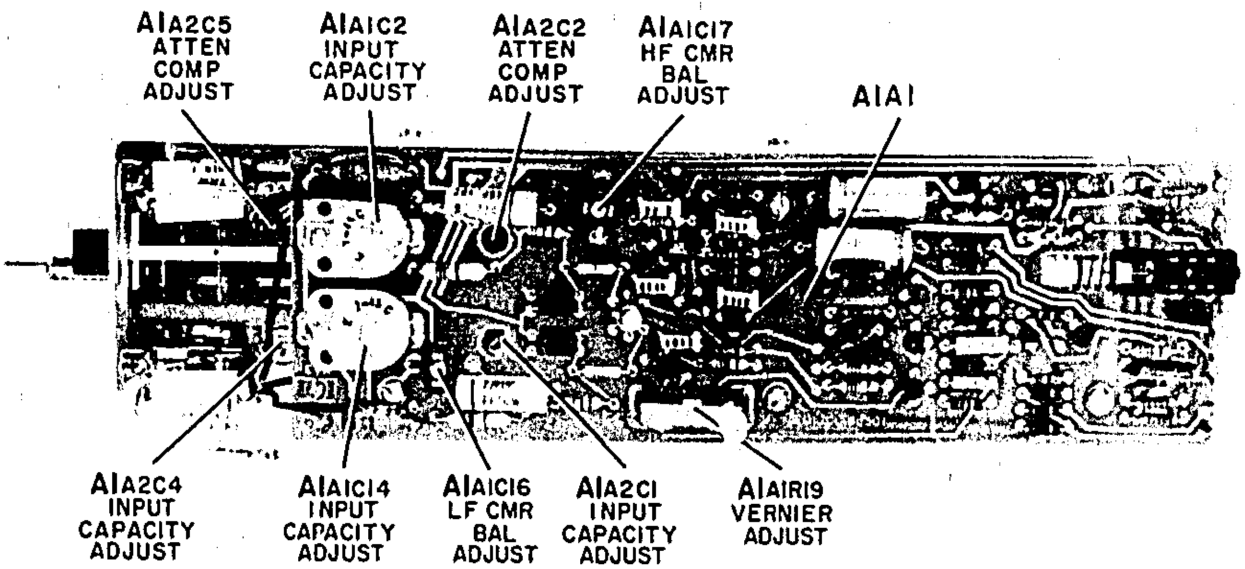


Figure 5-4. Vertical Preamplifier Module Adjustments

b. Connect 5 µsec time marks from time-mark generator to channel A +INPUT jacks.

c. Set TRIGGER LEVEL for a stable display.

d. Adjust Horizontal POSITION to align 1st marker with left edge of graticule.

e. Adjust A4A1R10B (see figure 5-3) to obtain one time mark per division.

f. Set Time/Division to 0.5 mSEC/DIV, and apply 0.5 msec time marks.

g. Set TRIGGER LEVEL for a stable display.

h. Adjust A4A1R10C (see figure 5-3) to obtain one time mark per division.

i. Set Time/Division to 50 mSEC/DIV, and apply 50 msec time marks.

j. Set TRIGGER LEVEL for a stable display.

k. Adjust A4A1R10D (see figure 5-3) to obtain one time mark per division.

l. Disconnect time-mark generator.

5-52. VERTICAL VERNIER AND VERTICAL AMPLIFIER BALANCE.

a. Set:

DISPLAY	CHOP
Volts/Division (A and B)	0.2 mV/DIV
+Vertical Coupling (A and B)	OFF
—Vertical Coupling (A and B)	OFF
Vertical Vernier (A and B)	CAL
Time/Division	1 mSEC/DIV
MODE	FREE RUN

b. Set Vertical POSITION A and B to align channel A and B traces with horizontal graticule lines.

c. Turn Vertical Vernier A ccw, and check for channel A trace shift.

d. Adjust A1A1R19 (see figure 5-4) until trace remains stationary when Vertical Vernier is turned.

e. Set Vertical Vernier A to CAL detent.

f. Repeat steps c through e for channel B except adjust A2A1R19 (see figure 5-4) for a stationary trace.

g. Turn Volts/Division A from 0.2 V/DIV to 0.1 mV/DIV, and check for channel A trace shift.

h. Adjust channel A BAL (front panel) until trace remains stationary when Volts/Division is turned.

i. Repeat steps g and h for channel B.

5-53. OUTPUT AMPLIFIER GAIN.

a. Set:

DISPLAY	A
Volts/Division (A and B)	1 V/DIV
+Vertical Coupling (A and B)	OFF
—Vertical Coupling (A and B)	OFF
Vertical Vernier (A and B)	CAL
Time/Division	1 mSEC/DIV

SLOPE	+
TRIGGER LEVEL	AUTO
Horizontal COUPLING	DC
SOURCE	INT
MODE	NORM

b. Adjust channel A Vertical POSITION to set trace on bottom horizontal graticule line.

c. Connect 5-volt dc signal from dc standard to channel A +INPUT jacks.

d. Set +Vertical Coupling for channel A to DC.

e. Adjust A3R4A (see figure 5-5) for 5 divisions of vertical deflection.

f. Set +Vertical Coupling for channel A to OFF.

g. Repeat steps b through f until a 5-volt input causes 5 divisions of vertical deflection.

h. Return +Vertical Coupling for channel A to OFF.

i. Set DISPLAY to A vs B.

j. Position dot on horizontal center line 2 divisions to left of center screen.

k. Connect 5-volt dc signal from dc standard to channel B +INPUT jacks.

l. Set +Vertical Coupling for channel B to DC.

m. Adjust A3R4B (see figure 5-5) for 5 divisions of horizontal deflection.

n. Set +Vertical Coupling for channel B to OFF.

o. Repeat steps j through n until 5-volt input causes 5-division horizontal deflection.

p. Return channel B +Vertical Coupling to OFF.

q. Set DISPLAY to B.

r. Position trace to bottom horizontal graticule line.

s. Connect 5-volt dc signal from dc standard to channel B +INPUT jacks.

t. Set +Vertical Coupling to DC.

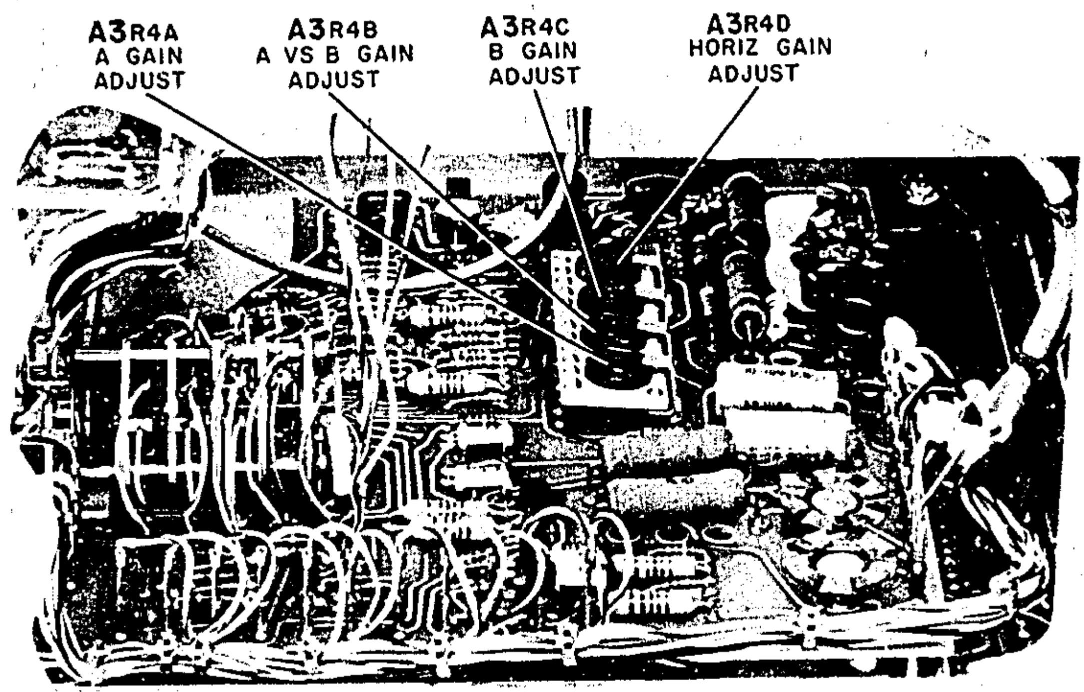


Figure 5-5. Dual Channel Output Amplifier Adjustments

u. Adjust A3R4C (see figure 5-5) for 5 divisions of vertical deflection.

v. Set +Vertical Coupling for channel B to OFF.

w. Repeat steps r through v until 5-volt input causes 5-division vertical deflection.

x. Disconnect dc standard.

5-54. INPUT CAPACITANCE AND ATTENUATOR COMPENSATION.

a. Set:
DISPLAY .... ALT
Volts/Division (A and B)........ 0.2 V/DIV
Time/Division .... 0.2 mSEC/DIV

b. Connect LC meter between channel A +INPUT and ground jacks.

c. Adjust A1A1C14 (see figure 5-4) for a 45 pF indication on LC meter.

d. Set:
+Vertical Coupling A.................. OFF
—Vertical Coupling A.................. DC

e. Connect LC meter between channel A —INPUT and ground jacks.

f. Adjust A1A1C2 (see figure 5-4) for a 45 pF indication on LC meter.

g. Connect LC meter between channel B +INPUT and ground jacks.

h. Adjust A2A1C14 (see figure 5-4) for a 45 pF indication on LC meter.

i. Set:
+Vertical Coupling B.................. OFF
—Vertical Coupling B.................. DC

j. Connect LC meter between channel B —INPUT and ground jacks.

k. Adjust A2A1C2 (see figure 5-4) for a 45 pF indication on LC meter.

l. Disconnect LC meter.

m. Set Volts/Division (A and B) to 0.5 V/DIV.

n. Connect a 1 kHz signal from square-wave generator to channel A —INPUT jacks.

o. Set square-wave generator for six divisions of vertical deflection.

p. Adjust A1A2C2 (see figure 5-4) for best square-wave response.

q. Set:
+Vertical Coupling A.................. DC
—Vertical Coupling A.................. OFF

r. Connect 1 kHz signal from square-wave generator to channel A +INPUT jacks.

s. Adjust A1A2C5 (see figure 5-4) for best square-wave response.

t. Connect 1 kHz signal from square-wave generator to channel B —INPUT jacks.

u. Adjust A2A2C2 (see figure 5-4) for best square-wave response.

v. Set:
+Vertical Coupling B.................. DC
—Vertical Coupling B.................. OFF

w. Connect 1 kHz signal from square-wave generator to channel B +INPUT jacks.

x. Adjust A2A2C5 (see figure 5-4) for best square-wave response.

y. Disconnect square-wave generator.

z. Connect LC meter between channel A +INPUT and ground jacks.

aa. Adjust A1A2C4 (see figure 5-4) for a 45 pF indication on LC meter.

bb. Set:
+Vertical Coupling A.................. OFF
—Vertical Coupling A.................. DC

cc. Connect LC meter between channel A —INPUT and ground jacks.

dd. Adjust A1A2C1 (see figure 5-4) for a 45 pF indication on LC meter.

ee. Connect LC meter between channel B +INPUT and ground jacks.

ff. Adjust A2A2C4 (see figure 5-4) for a 45 pF indication on LC meter.

gg. Set:
+Vertical Coupling B.................. OFF
—Vertical Coupling B.................. DC

hh. Connect LC meter between channel B —INPUT and ground jacks.

ii. Adjust A2A2C1 (see figure 5-4) for a 45 pF indication on LC meter.

jj. Disconnect LC meter.

5-55. CMRR BALANCE.

a. Set:

DISPLAY	A
Volts/Division (A and B)	0.1 mV/DIV
+Vertical Coupling (A and B)	DC
—Vertical Coupling (A and B)	DC

b. Connect a 100 Hz, 20 V pk-pk signal from oscillator to channel A + and —INPUT jacks (jacks shorted together) and ground.

c. Adjust A1A1C16 (see figure 5-4) for minimum vertical deflection (two div or less).

d. Adjust oscillator frequency for a 10 kHz, 20 V pk-pk signal.

e. Adjust A1A1C17 (see figure 5-4) for minimum vertical deflection (two div or less).

f. Set DISPLAY to B.

g. Repeat steps b through e for channel B; adjust A2A1C16 in step c and A2A1C17 in step e (see figure 5-4).

PERFORMANCE CHECK RECORD
MODEL 1200A/B

Serial No. ________

REFERENCE STEP	DESCRIPTION	RESULTS		
		MIN	ACTUAL	MAX
5-12b	INTENSITY	extinguished	________	brighter than normal
5-13c	FOCUS	focuses at mid-range	________	
5-14b	TRACE ALIGN	horizontal traces	________	
5-15b, c	AMPLIFIER BALANCE	stationary trace	A ____ B ____	
5-16e, h	VERTICAL POSITIONING	display moves upward off graticule	A ____ B ____	
5-16g, h		display moves downward off graticule	____ ____	
5-17d	BEAM FINDER (P11 CRT not intensified)	bright defocused traces	________	
	VERTICAL AMPLIFIER GAIN		A B	
5-19g	20 V/DIV	4.85 div.	____ ____	5.15 div.
	10 V/DIV	4.85 div.	____ ____	5.15 div.
	5 V/DIV	5.82 div.	____ ____	6.18 div.
	2 V/DIV	4.85 div.	____ ____	5.15 div.
	1 V/DIV	4.85 div.	____ ____	5.15 div.
	0.5 V/DIV	5.82 div.	____ ____	6.18 div.
	0.2 V/DIV	4.85 div.	____ ____	5.15 div.
	0.1 V/DIV	4.85 div.	____ ____	5.15 div.
	50 MV/DIV	5.82 div.	____ ____	6.18 div.
	20 MV/DIV	4.85 div.	____ ____	5.15 div.

PERFORMANCE CHECK RECORD (CONT'D)
MODEL 1200A/B

Serial No. ____________

REFERENCE STEP	DESCRIPTION	RESULTS MIN	RESULTS ACTUAL	RESULTS MAX
5-19g (Cont'd)	VERTICAL AMPLIFIER GAIN (Cont'd)			
	10 MV/DIV	4.85 div.	______ ______	5.15 div.
	5 MV/DIV	5.82 div.	______ ______	6.18 div.
	2 MV/DIV	4.85 div.	______ ______	5.15 div.
	1 MV/DIV	4.85 div.	______ ______	5.15 div.
	0.5 MV/DIV	5.82 div.	______ ______	6.18 div.
	0.2 MV/DIV	4.85 div.	______ ______	5.15 div.
	0.1 MV/DIV	4.85 div.	______ ______	5.15 div.
5-19r	0.5 V/DIV	5.82 div.	______ ______	6.18 div.
	0.2 V/DIV	4.35 div.	______ ______	5.15 div.
5-20h	CALIBRATOR	4 div + 9.5 minor div.	____________	5 div + 0.5 minor div.
	VERTICAL BANDWIDTH		A B	
5-21g, j, q, t	500 kHz check	5.7 div.	______ ______	
5-21n, x	50 kHz check		______ ______	5.7 div.
	NOISE		A B	
5-22b, d			______ ______	0.5 div.
	COMMON MODE REJECTION RATIO		A B	
5-23c, j	100 Hz signal		______ ______	2 div.
5-23e, h	10 kHz signal		______ ______	2 div.

PERFORMANCE CHECK RECORD (CONT'D)
MODEL 1200A/B

Serial No. ____________

REFERENCE STEP	DESCRIPTION	RESULTS		
		MIN	ACTUAL	MAX
	A vs. B PHASE SHIFT			
5-24 d	0.2 V/DIV		________	0.14 div.
5-24f	0.5 V/DIV		________	0.14 div.
	CHANNEL ISOLATION		A B	
5-25e, g			____ ____	1 div.
	TRIGGER AMPLITUDE			
5-26d	internal; 50 Hz signal	stable display	________	
5-26g	internal; 500 kHz signal	stable display	________	
5-26k	external; 500 kHz signal	stable display	________	
5-26n	external; 50 Hz signal	stable display	________	
	TRIGGER POINT AND SLOPE			
5-27d	internal; positive slope	stable display	________	
5-27g	internal; negative slope	stable display	________	
5-27m	external; negative slope	stable display	________	
5-27p	external; positive slope	stable display	________	
	SWEEP TIME			
5-28e	5 SEC/DIV	11 in 9.7 div.	________	11 in 10.3 div.
	2 SEC/DIV	21 in 9.7 div.	________	21 in 10.3 div.
	1 SEC/DIV	11 in 9.7 div.	________	11 in 10.3 div.
	0.5 SEC/DIV	11 in 9.7 div.	________	11 in 10.3 div.
	0.2 SEC/DIV	21 in 9.7 div.	________	21 in 10.3 div.
	0.1 SEC/DIV	11 in 9.7 div.	________	11 in 10.3 div.
	50 MSEC/DIV	11 in 9.7 div.	________	11 in 10.3 div.
	20 MSEC/DIV	21 in 9.7 div.	________	21 in 10.3 div.
	10 MSEC/DIV	11 in 9.7 div.	________	11 in 10.3 div.
	5 MSEC/DIV	11 in 9.7 div.	________	11 in 10.3 div.
	2 MSEC/DIV	21 in 9.7 div.	________	21 in 10.3 div.

PERFORMANCE CHECK RECORD (CONT'D)
MODEL 1200A/B

Serial No. ____________

REFERENCE STEP	DESCRIPTION	RESULTS		
		MIN	ACTUAL	MAX
	1 MSEC/DIV	11 in 9.7 div.	________	11 in 10.3 div.
	0.5 MSEC/DIV	11 in 9.7 div.	________	11 in 10.3 div.
	0.2 MSEC/DIV	21 in 9.7 div.	________	21 in 10.3 div.
	0.1 MSEC/DIV	11 in 9.7 div.	________	11 in 10.3 div.
	50 USEC/DIV	11 in 9.7 div.	________	11 in 10.3 div.
	20 USEC/DIV	21 in 9.7 div.	________	21 in 10.3 div.
	10 USEC/DIV	11 in 9.7 div.	________	11 in 10.3 div.
	5 USEC/DIV	11 in 9.7 div.	________	11 in 10.3 div.
	2 USEC/DIV	21 in 9.7 div.	________	21 in 10.3 div.
	1 USEC/DIV	11 in 9.7 div.	________	11 in 10.3 div.
5-29d	SWEEP VERNIER		________	2 in 4 div.
5-30d	MAGNIFIED SWEEP	2 in 9.5 div.	________	2 in 10.5 div.
5-31c	SINGLE SWEEP	indicator lights; one sweep cycle; indicator goes out	________	same as minimum
5-32d	HORIZONTAL AMPLIFIER GAIN 1 V/DIV	9.7 div.	________	10.3 div.
	0.5 V/DIV	9.7 div.	________	10.3 div.
	0.2 V/DIV	9.7 div.	________	10.3 div.
	0.1 V/DIV	9.7 div.	________	10.3 div.
5-33d	HORIZONTAL VERNIER		________	4 div.
5-34g	HORIZONTAL BANDWIDTH	7 div.	________	

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Reference designators and abbreviations are defined in table 6-1, and table 6-2 lists the parts in alphanumeric order by reference designation. Exploded-view drawings of most mechanical parts, and identification photographs of other parts are in Section VIII.

6-3. ORDERING INFORMATION.

6-4. To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number, indicate the quantity required, and address the order to the nearest Hewlett-Packard office.

6-5. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, the description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

6-6. DIRECT MAIL ORDER SYSTEM.

6-7. Within the USA, Hewlett-Packard can supply parts through a direct mail order system. Advantages of using the system are as follows:

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

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

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

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

6-8. Mail order forms and specific ordering information is available through your local HP office. Addresses and phone numbers are located at the back of this manual.

Table 6-1. Reference Designators And Abbreviations

REFERENCE DESIGNATORS

A	= assembly	E	= misc. electronic part	M	= meter	TB	= terminal board
AT	= attenuator, resistive termination	F	= fuse	MP	= mechanical part	TP	= test point
B	= motor, fan	FL	= filter	P	= plug	U	= microcircuit(non-repairable)
C	= capacitor	H	= hardware	PS	= power supply	V	= vacuum tube, neon bulb, photocell, etc.
CP	= coupling	IC	= integrated circuit	Q	= transistor	VR	= voltage regulator (diode)
CR	= diode	J	= jack	R	= resistor	W	= cable
DL	= delay line	K	= relay	RT	= thermistor	X	= socket
DS	= device signaling (lamp)	L	= inductor	S	= switch	Y	= crystal
		LS	= speaker	T	= transformer		

ABBREVIATIONS

A	= ampere(s)	Ge	= germanium	minat	= miniature	s-b	= slow-blow
ampl	= amplifier(s)	G	= giga (10^{9})	mom.	= momentary	Se	= selenium
assy	= assembly	gl	= glass	mtg	= mounting	sect	= section(s)
bd	= board(s)	grd	= ground(ed)	my.	= mylar	semicon	= semiconductor(s)
bp	= bandpass	H	= henry(ies)	n	= nano (10^{-9})	Si	= silicon
c	= cents (10^{-2})	Hg	= mercury	n/c	= normally closed	sil	= silver
car.	= carbon	hr	= hour(s)	Ne	= neon	sl	= slide
ccw	= counterclockwise	HP	= Hewlett-Packard	n/o	= normally open	sp	= single pole
cer	= ceramic	Hz	= hertz	npo	= negative positive zero (zero temperature coefficient)	spl	= special
coax.	= coaxial	if	= intermediate freq	nsr	= not separately replaceable	st	= single throw
coef	= coefficient	impg	= impregnated	obd	= order by description	std	= standard
com	= common	incd	= incandescent	ox	= oxide	Ta	= tantalum
comp	= composition	incl	= include(s)	p	= pico (10^{-12})	td	= time delay
conn	= connector(s)	ins	= insulation(ed)	pc	= printed (etched) circuit(s)	TD	= tunnel diode(s)
CRT	= cathode-ray tube	int	= internal	PGM	= program	tgl	= toggle
cw	= clockwise	k	= kilo (10^{3})	piv	= peak inverse voltage(s)	Ti	= titanium
d	= deci (10^{-1})	lb	= pound(s)	p/o	= part of	tol	= tolerance
depc	= deposited carbon	lev	= lever	poly	= polystyrene	trim.	= trimmer
dp	= double pole	lin	= linear taper	porc	= porcelain	u	= micro (10^{-6})
dt	= double throw	log.	= logarithmic taper	pos	= position(s)	V	= volt(s)
elect.	= electrolytic	lpf	= low-pass filter(s)	pot.	= potentiometer(s)	var	= variable
encap	= encapsulated	m	= milli (10^{-3})	pk-pk	= peak-to-peak	W	= watt(s)
ext	= external	M	= mega (10^{6})	rect	= rectifier(s)	w/	= with
F	= farad(s)	metflm	= metal film	rf	= radio frequency	w/o	= without
fet	= field-effect transistor(s)	mtlox	= metal oxide			wVdc	= dc working volt(s)
fxd	= fixed					ww	= wirewound

Table 6-2. Replaceable Parts

Ref Desig	HP Par. No.	TQ	Description (Refer to Table 6-1.)
			CHASSIS PARTS
A1	01200-63506		A: channel A 100 uV preamplifier module
A2	01200-63506		A: channel B 100 uV preamplifier module
A3	01200-66504		A: dual channel output amplifier
A4	01200-66503		A: horizontal module
A5	01200-66514		A: low voltage power supply
A6	01200-66515		A: high voltage regulator
A7	01200-66505		A: high voltage rectifier
DS1	1450-0419		DS: neon (power indicator)
F1	2110-0059		F: 1.5 amp slow-blow (115V operation); standard
F1	2110-0020		F: 0.8 amp slow-blow (230V operation); optional
J1	1510-0084	5	J: banana, red (Channel A –Input)
J2	1510-0087	3	J: banana, black (Channel A ground)
J3	1510-0084		J: banana, red (Channel A +Input)
J4	1510-0084		J: banana, red (Channel B –Input)
J5	1510-0087		J: banana, black (Channel B ground)
J6	1510-0084		J: banana, red (Channel B +Input)
J7	1510-0084		J: banana, red (Trig and Horiz Input)
J8	1510-0087		J: banana, black (ground)
J9	1251-0463		J: banana, black (Cal 1 Volt)
J10	1251-2357		J: power
L1	01200-66001		L: CRT trace alignment
MP1			Insulator: binding post, black (consists of 1510-0087, 0340-0732, and 0340-0749)
MP2			Insulator: binding post, red (consists of 1510-0084, 0340-0732, and 0340-0749)
MP3	0340-0450		Insulator: transistor, mica (Q1 and Q2)
MP4	0370-0432		Knob: lever switch, black
MP5	0370-0453		Knob: w/dual index (sweep time switch)
MP6	0510-0097		Fastener: push on (power indicator)
MP7	0905-0016		Strip: felt
MP8	1410-0052		Bushing: potentiometer mounting 3/8–32 (trace align control)
MP9	1431-0039		Shaft: 8.187 ±0.03 in long (DISPLAY switch)
MP10	1490-0841		Coupler: shaft 1/8 in (DISPLAY switch)
MP11	5020-0476		Bezel: CRT
MP12	5020-0510		Filter: CRT, clear
MP13	5020-0530		Filter: CRT, amber (used only with P7 phosphor)
MP14	5040-0444		Shield: light
MP15	5040-0453		Insulator: cover (FOCUS control)
MP16	00180-01218		Bracket: alignment coil
MP17	00180-67402		Knob: black w/arrow (INTENSITY/FOCUS controls)
MP18	01200-04113		Cover: CRT
MP19	01200-44701		Support: CRT
MP20	01200-44702		Support: circuit board

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			CHASSIS PARTS (CONT'D)
MP21	01200-44703		Support: CRT shield
MP22	01200-44704		Spacer: knob (TRIGGER LEVEL control)
MP23	01200-60601		Shield: CRT
MP24	01200-67401		Assembly: knob (Volts/Division switch)
MP25	01200-67402		Assembly: knob (sweep time switch)
MP26	01200-67403		Assembly: knob (DISPLAY switch)
MP27	01200-67404		Assembly: knob w/arrow (POSITION controls)
MP28	01821-67401		Knob: +/0/– w/arrows (TRIGGER LEVEL control)
MP29	01821-67403		Knob: CAL w/arrow (Vernier controls)
MP30	0510-1075		Fastener: push on (Balance control); Model 1200A only
MP31	1440-0074		Handle: Model 1200A only
MP32	5040-0447		Foot: rear panel; Model 1200A only
MP33	01200-00103		Deck: horizontal; Model 1200A only
MP34	01200-00209		Panel: front; Model 1200A only
MP35	01200-00606		Shield: high voltage power supply; Model 1200A only
MP36	01200-01205		Bracket: high voltage board, top mounting, Model 1200A only
MP37	01200-01206		Bracket: high voltage board, bottom mounting; Model 1200A only
MP38	01200-04114		Cover: top; Model 1200A only
MP39	01200-04106		Cover: high voltage power supply; Model 1200A only
MP40	01200-04107		Cover: transformer top; Model 1200A only
MP41	01200-04109		Cover: transformer side; Model 1200A only
MP42	01200-21701		Bushing: panel (Balance control); Model 1200A only
MP43	01200-23702		Rail: top; Model 1200A only
MP44	01200-23703		Rail: side; Model 1200A only
MP45	01200-20502		Frame: rear; Model 1200A only
MP46	01200-40503		Frame: front; Model 1200A only
MP47	01200-42301		Retainer: handle; Model 1200A only
MP48	01200-64105		Assembly: bottom cover; Model 1200A only
MP49	01200-67501		Terminal Board: transformer; Model 1200A only
MP50	5020-0522		Handle: 5 1/4 inches; Model 1200B only
MP51	01200-00210		Panel: front; Model 1200B only
MP52	01200-00604		Shield: high voltage power supply; Model 1200B only
MP53	01200-04101		Cover: top; Model 1200B only
MP54	01200-04102		Cover: bottom; Model 1200B only
MP55	01200-60505		Assembly: frame; Model 1200B only
MP56	01710-04103		Cover: transformer
MP101	5020-0530		Filter: amber, CRT (option 007)
P1			P: power (nsr p/o W1)
Q1	1853-0079		Q: Si pnp
Q2	1854-0320		Q: Si npn
R1	0684-4731		R: fxd comp 47 kilohms 10% 1/4W
R2	2100-0013		R: var comp 50 kilohms 10% 1/4W
R3	2100-2663		R: var comp 5000 ohms 20% 1/3W
R4	2100-2563		R: var comp 5 megohms 20% 1/2W
R5			Not assigned

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			CHASSIS PARTS (CONT'D)
R6	2100-2594		R: var comp 2500 ohms 10% 1/4W
R7	2100-2594		R: var comp 2500 ohms 10% 1/4W
R8	0684-1041		R: fxd comp 100 kilohms 10% 1/4W
S1	3101-0036		S: toggle (POWER)
S2	3101-1310		S: pushbutton (FIND BEAM)
S3	3101-1234		S: slide dpdt
T1	9100-1124		T: power; Model 1200A only
T1	9100-1125		T: power; Model 1200B only
TB1	0360-0104		TB: w/captive shorting link (Z Axis Input)
V1	5083-1853		V: cathode ray tube, P31 phosphor, nonaluminized, internal graticule (standard)
V1	5083-1823		V: cathode ray tube, P2 phosphor, nonaluminized, internal graticule (option 002)
V1	5083-1862		V: cathode ray tube, P4 phosphor, nonaluminized, internal graticule (option 004)
V1	5083-1833		V: cathode ray tube, P7 phosphor, nonaluminized, internal graticule (option 007)
V1	5083-1842		V: cathode ray tube, P11 phosphor, aluminized, internal graticule (option 011)
V1	5083-1820		V: cathode ray tube, P2 phosphor, nonaluminized, no graticule (option 602)
V1	5083-1830		V: cathode ray tube, P7 phosphor, nonaluminized, no graticule (option 607)
V1	5083-1841		V: cathode ray tube, P11 phosphor, aluminized, no graticule (option 611)
V1	5083-1850		V: cathode ray tube, P31 phosphor, nonaluminized, no graticule (option 631)
W1	8120-1538		W: power; Model 1200A only
W1	8120-1348		W: power; Model 1200B only
W2	01200-61626		W: main; Model 1200A only
W2	01200-61601		W: main; Model 1200B only
XF1	1400-0084		XF: cartridge
XQ1	5060-0585		Cable: for Q1 and Q2
XQ2	5060-0585		Cable: for Q1 and Q2
XV1	1200-0037		XV: CRT
			A1
A1	01200-63506		A: channel A 100 uV preamplifier module
A1A1	01200-66522		A: 100 uV preamplifier subassembly
A1A2	01200-61903		A: 100 uV attenuator switch subassembly
A1C1, A1C2	0160-0917		C: fxd my 0.1 uF 20% 600 wVdc matched pair
A1MP1	0370-0500		Knob: pushbutton (BW LIMIT switch)
A1MP2	01200-00610		Shield: preamplifier module
A1MP3	01200-23704		Shaft: potentiometer (BAL control)
A1MP4	01200-63701		Assembly: pushbutton shaft (BW LIMIT switch)
A1S1	3100-1376		S: lever (−Coupling)
A1S2	3100-1376		S: lever (+Coupling)

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			A1A1
A1A1	01200-66522		A: 100 uV preamplifier subassembly
A1A1C1	0180-0091		C: fxd al elect 10 uF −10 +50% 100 wVdc
A1A1C2	0121-0045		C: var 7–45 pF 500 wVdc
A1A1C3	0170-0040		C: fxd mylar .047 uF 10% 200 wVdc
A1A1C4	0160-2239		C: fxd cer 1.8 pF ±0.25 pF 500 wVdc
A1A1C5	0160-2258		C: fxd cer 11 pF 500 wVdc
A1A1C6	0160-2264		C: fxd cer 20 pF 5% 500 wVdc
A1A1C7	0160-3638		C: fxd cer 0.22 uF +80 −20% 200 wVdc
A1A1C8	0160-3638		C: fxd cer 0.22 uF +80 −20% 200 wVdc
A1A1C9	1060-2914		C: fxd cer 0.1 uF −20% +80% 50 wVdc
A1A1C10	0180-0228		C: fxd ta elect 22 uF 10% 15 wVdc
A1A1C11	0180-0376		C: fxd ta elect 0.47 uF 10% 35 wVdc
A1A1C12	0160-3073		C: fxd cer 100 pF 600 wVdc
A1A1C13	0140-0215		C: fxd mica 80 pF 2% 300 wVdc
A1A1C14	0121-0045		C: var cer 7–45 pF 500 wVdc
A1A1C15	0170-0040		C: fxd mylar .047 uF 10% 200 wVdc
A1A1C16	0132-0004		C: var poly 0.7-3 pF 350 wVdc
A1A1C17	0132-0004		C: var poly 0.7–3 pF 350 wVdc
A1A1C18	0160-2258		C: fxd cer 11 pF 5% 500 wVdc
A1A1C19	0160-2264		C: fxd cer 20 pF 5% 500 wVdc
A1A1C20	0180-0091		C: fxd al elect 10 uF −10 +50% 100 wVdc
A1A1CR1	1901-0579		CR: Si
A1A1CR2	1901-0579		CR: Si
A1A1CR3	1901-0579		CR: Si
A1A1CR4	1901-0579		CR: Si
A1A1CR5	1901-0040		CR: Si
A1A1CR6	1901-0040		CR: Si
A1A1MP1	1205-0031		Heat sink
A1A1Q1	1855-0086		Q: FET dual
A1A1Q2	1854-0071		Q: Si npn 2N3391
A1A1Q3	1853-0049		Q: Si pnp
A1A1Q4	1853-0049		Q: Si pnp
A1A1Q5	1854-0071		Q: Si npn 2N3391
A1A1Q6	1853-0036		Q: Si pnp 2N3906
A1A1Q7	1853-0036		Q: Si pnp 2N3906
A1A1Q8	1853-0036		Q: Si pnp 2N3906
A1A1Q9	1853-0036		Q: Si pnp 2N3906
A1A1Q10	1855-0057		Q: FET
A1A1Q11	1854-0215		Q: Si npn 2N3904
A1A1Q12	1853-0036		Q: Si pnp

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			A1A1 (CONT'D)
A1A1R1	0684-6801		R: fxd comp 68 ohms 10% 1/4W
A1A1R2	0757-0059		R: fxd metflm 1 megohm 1% 1/2W
A1A1R3	0698-3423		R: fxd metflm 46.4 kilohms 1% 1/2W
A1A1R4	0757-0421		R: fxd metflm 825 ohms 1% 1/8W
A1A1R5	0757-0409		R: fxd metflm 274 ohms 1% 1/8W
A1A1R6	0684-3331		R: fxd comp 33 kilohms 10% 1/4W
A1A1R7	0684-1231		R: fxd comp 12 kilohms 10% 1/4W
A1A1R8	0684-3331		R: fxd comp 33 kilohms 10% 1/4W
A1A1R9	0757-0453		R: fxd metflm 30.1 kilohms 1% 1/8W
A1A1R10	0684-5611		R: fxd comp 560 ohms 10% 1/4W
A1A1R11	0684-2211		R: fxd comp 220 ohms 10% 1/4W
A1A1R12	0684-2211		R: fxd comp 220 ohms 10% 1/4W
A1A1R13	0684-8221		R: fxd comp 8200 ohms 10% 1/4W
A1A1R14	0757-0437		R: fxd metflm 4750 ohms 1% 1/8W
A1A1R15			Deleted
A1A1R16	0757-0437		R: fxd metflm 4750 ohms 1% 1/8W
A1A1R17			Deleted
A1A1R18	0757-0442		R: fxd metflm 10 kilohms 1% 1/8W
A1A1R19	2100-0940		R: var comp 500 ohms 20% 1/4W
A1A1R20	0757-0442		R: fxd metflm 10 kilohms 1% 1/8W
A1A1R21	0684-4741		R: fxd comp 470 kilohms 10% 1/4W
A1A1R22	0684-2731		R: fxd comp 27 kilohms 10% 1/4W
A1A1R23	0684-1011		R: fxd comp 100 ohms 10% 1/4W
A1A1R24	0757-0200		R: fxd metflm 5620 ohms 1% 1/8W
A1A1R25	0684-1011		R: fxd comp 100 ohms 10% 1/4W
A1A1R26	0757-0442		R: fxd metflm 10 kilohms 1% 1/8W
A1A1R27	0757-0442		R: fxd metflm 10 kilohms 1% 1/8W
A1A1R28	0757-0467		R: fxd metflm 121 kilohms 1% 1/8W
A1A1R29	0757-0059		R: fxd metflm 1 megohm 1% 1/2W
A1A1R30	0698-3423		R: fxd metflm 46.4 kilohms 1% 1/2W
A1A1R31	0757-0421		R: fxd metflm 825 ohms 1% 1/8W
A1A1R32	0757-0409		R: fxd metflm 274 ohms 1% 1/8W
A1A1R33	0684-3331		R: fxd comp 33 kilohms 10% 1/4W
A1A1R34	0698-3432		R: fxd metflm 26.1 ohms 1% 1/8W
A1A1R35	0757-0453		R: fxd metflm 30.1 kilohms 1% 1/8W
A1A1R36	0684-5611		R: fxd comp 560 ohms 10% 1/4W
A1A1R37	0684-2211		R: fxd comp 220 ohms 10% 1/4W
A1A1R38	0684-8221		R: fxd comp 8200 ohms 10% 1/4W
A1A1R39	0684-6801		R: fxd comp 68 ohms 10% 1/4W
A1A1S1	3101-1285		S: pushbutton (BW LIMIT)
A1A1VR1	1902-3150		VR: breakdown 9.09V 2% 400 mW
A1A1VR2	1902-0017		VR: breakdown 6.8V 10% 400 mW
A1A1VR3	1902-0055		VR: breakdown 14.7V 10% 400 mW
A1A1VR4	1902-3234		VR: breakdown 19.6V 5% 0.4W
A1A1VR5	1902-3234		VR: breakdown 19.6V 5% 0.4W

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			A1A2
A1A2	01200-61903		A: 100 uV attenuator switch subassembly
A1A2C1	0130-0001		C: var cer 7–45 pF 500 wVdc
A1A2C2	0130-0003		C: var cer 1.5–7 pF 500 wVdc
A1A2C3	0140-0090		C: mica 200 pF 1% 300 wVdc
A1A2C4	0130-0001		C: var cer 7–45 pF 500 wVdc
A1A2C5	0130-0003		C: var cer 1.5–7 pF 500 wVdc
A1A2C6	0140-0090		C: fxd mica 200 pF 1% 300 wVdc
A1A2MP1	3130-0038		Coupler: vertical vernier
A1A2R1	0698-8502		R: fxd metflm 990 kilohms 1% 1/2W
A1A2R2	0698-3109		R: fxd metflm 10.1 kilohms 1% 1/8W
A1A2R3	0698-8502		R: fxd metflm 990 kilohms 1% 1/2W
A1A2R4	0698-3109		R: fxd metflm 10.1 kilohms 1% 1/8W
A1A2R5	0757-0449		R: fxd metflm 20 kilohms 1% 1/8W
A1A2R6	0698-3484		R: fxd metflm 6650 ohms 1% 1/8W
A1A2R7	0757-0430		R: fxd metflm 2210 ohms 1% 1/8W
A1A2R8	0698-4467		R: fxd metflm 1050 ohms 1% 1/8W
A1A2R9	0757-0416		R: fxd metflm 513 ohms 1% 1/8W
A1A2R10	0698-6729		R: fxd metflm 202 ohms 1% 1/8W
A1A2R11	0757-0401		R: fxd metflm 100 ohms 1% 1/8W
A1A2R12	0757-0277		R: fxd metflm 49.9 ohms 1% 1/8W
A1A2R13	0757-0384		R: fxd metflm 20 ohms 1% 1/8W
A1A2R14	0757-0346		R: fxd metflm 10 ohms 1% 1/8W
A1A2R15	2100-2614		R: var comp 60 ohms 10% 1/2W
A1A2R16	2100-2617		R: var comp log 4000 ohms 10% 1/4W
A1A2S1	3100-3523		S: rotary (Volts/Division)
A1A2S2			S: nsr; p/o A1A2R16
			A2
A2	01200-63506		A: channel B 100 uV preamplifier module (same as A1 assembly breakdown)
			A3
A3	01200-66504		A: dual channel output amplifier
A3C1	0160-2240		C: fxd cer 2 pF ±0.25 pF 500 wVdc
A3C2	0160-2240		C: fxd cer 2 pF ±0.25 pF 500 wVdc
A3C3	0160-2240		C: fxd cer 2 pF ±0.25 pF 500 wVdc
A3C4	0160-2240		C: fxd cer 2 pF ±0.25 pF 500 wVdc
A3C5	0160-2237		C: fxd cer 1.2 pF ±0.25 pF 500 wVdc

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			A3 (CONT'D)
A3C6	0160-2913		C: fxd cer 0.01 uF −20 +80% 500 wVdc
A3C7	0140-0205		C: fxd mica 62 pF 5% 300 wVdc
A3C8	0140-0206		C: fxd mica 270 pF 5% 500 wVdc
A3C9	5081-7647		C: fxd mica 270 pF 5% 500 wVdc (matched pair-includes A3C12)
A3C10	0160-2203		C: fxd mica 91 pF 5% 300 wVdc
A3C11	0160-2203		C: fxd mica 91 pF 5% 300 wVdc
A3C12	5081-7647		C: fxd mica 270 pF 5% 500 wVdc (matched pair-includes A3C9)
A3C13	0160-2930		C: fxd cer 0.01 uF −20 +80% 100 wVdc
A3C14	0180-0091		C: fxd al elect 10 uF −10 +50% 100 wVdc
A3C15	0180-0091		C: fxd al elect 10 uF −10 +50% 100 wVdc
A3CR1	1901-0040		CR: Si
A3CR2	1901-0040		CR: Si
A3CR3	1901-0050		CR: Si
A3CR4	1901-0040		CR: Si
A3CR5	1901-0040		CR: Si
A3CR6	1901-0050		CR: Si
A3CR7	1901-0040		CR: Si
A3CR8	1901-0040		CR: Si
A3CR9	1901-0050		CR: Si
A3CR10	1901-0040		CR: Si
A3CR11	1901-0040		CR: Si
A3CR12	1901-0050		CR: Si
A3CR13	1901-0040		CR: Si
A3CR14	1901-0040		CR: Si
A3CR15	1901-0050		CR: Si
A3CR16	1901-0040		CR: Si
A3CR17	1901-0040		CR: Si
A3CR18	1901-0040		CR: Si
A3CR19	1901-0040		CR: Si
A3CR20	1901-0040		CR: Si
A3CR21	1901-0040		CR: Si
A3CR22	1901-0040		CR: Si
A3CR23	1901-0040		CR: Si
A3CR24	1901-0040		CR: Si
A3CR25	1901-0040		CR: Si
A3CR26	1901-0040		CR: Si
A3CR27	1901-0040		CR: Si
A3CR28	1901-0040		CR: Si
A3CR29	1901-0040		CR: Si
A3CR30	1901-0040		CR: Si
A3CR31	1901-0040		CR: Si
A3L1	9140-0137		L: fxd 1 mH
A3L2	9140-0137		L: fxd 1 mH
A3L3	9140-0137		L: fxd 1 mH
A3L4	9140-0137		L: fxd 1 mH

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			A3 (CONT'D)
A3MP1	01200-01201		Bracket: switch mounting (DISPLAY)
A3MP2	01205-0095		Heat sink: transistor
A3Q1	1853-0098		Q: Si pnp 2N5086
A3Q2	1853-0098		Q: Si pnp 2N5086
A3Q3	1854-0215		Q: Si npn 2N3904
A3Q4	1854-0215		Q: Si npn 2N3904
A3Q5	1854-0234		Q: Si npn 2N3440
A3Q6	1854-0234		Q: Si npn 2N3440
A3Q7	1854-0215		Q: Si npn 2N3904
A3Q8	1854-0215		Q: Si npn 2N3904
A3Q9	1854-0215		Q: Si npn 2N3904
A3Q10	1854-0215		Q: Si npn 2N3904
A3Q11	1854-0234		Q: Si npn 2N3440
A3Q12	1854-0234		Q: Si npn 2N3440
A3Q13	1854-0022		Q: Si npn
A3Q14	1854-0022		Q: Si npn
A3Q15	1853-0036		Q: Si pnp 2N3906
A3Q16	1853-0036		Q: Si pnp 2N3906
A3Q17	1854-0022		Q: Si npn
A3Q18	1854-0022		Q: Si npn
A3R1	0757-0416		R: fxd metflm 511 ohms 1% 1/8W
A3R2	0684-8221		R: fxd comp 8200 ohms 10% 1/4W
A3R3	0698-3447		R: fxd metflm 422 ohms 1% 1/8W
A3R4	2100-2578		R: var comp 1500 ohms 4 sect 30% 1/4W
A3R5	0684-8221		R: fxd comp 8200 ohms 10% 1/4W
A3R6	0684-2211		R: fxd comp 220 ohms 10% 1/4W
A3R7	0684-2211		R: fxd comp 220 ohms 10% 1/4W
A3R8	0683-3935		R: fxd comp 39 kilohms 5% 1/4W
A3R9	0683-3935		R: fxd comp 39 kilohms 5% 1/4W
A3R10	0757-0822		R: fxd metflm 1300 ohms 1% 1/2W
A3R11	0757-0822		R: fxd metflm 1300 ohms 1% 1/2W
A3R12	0767-0008		R: fxd metox 10 kilohms 5% 3W
A3R13	0767-0008		R: fxd metox 10 kilohms 5% 3W
A3R14	0757-0416		R: fxd metflm 511 ohms 1% 1/8W
A3R15	0757-0416		R: fxd metflm 511 ohms 1% 1/8W
A3R16	0698-3447		R: fxd metflm 422 ohms 1% 1/8W
A3R17	0683-3935		R: fxd comp 39 kilohms 5% 1/4W
A3R18	0683-3935		R: fxd comp 39 kilohms 5% 1/4W
A3R19	0757-0822		R: fxd metflm 1300 ohms 1% 1/2W
A3R20	0757-0822		R: fxd metflm 1300 ohms 1% 1/2W
A3R21	0757-0442		R: fxd metflm 10 kilohms 1% 1/8W
A3R22	0683-3935		R: fxd comp 39 kilohms 5% 1/4W
A3R23	0757-0274		R: fxd metflm 1210 ohms 1% 1/8W
A3R24	0757-0274		R: fxd metflm 1210 ohms 1% 1/8W
A3R25	0757-0445		R: fxd metflm 13 kilohms 1% 1/8W

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			A3 (CONT'D)
A3R26	0757-0416		R: fxd metflm 511 ohms 1% 1/8W
A3R27	0698-3447		R: fxd metflm 422 ohms 1% 1/8W
A3R28	0757-0822		R: fxd metflm 1300 ohms 1% 1/2W
A3R29	0757-0822		R: fxd metflm 1300 ohms 1% 1/2W
A3R30	0767-0822		R: fxd metox 10 kilohms 5% 3W
A3R31	0767-0008		R: fxd metox 10 kilohms 5% 3W
A3R32	0757-0401		R: fxd metflm 100 ohms 1% 1/8W
A3R33	0757-0456		R: fxd metflm 43.2 kilohms 1% 1/8W
A3R34	0684-1051		R: fxd comp 1 megohm 10%, 1/4W
A3R35	0757-0442		R: fxd metflm 10 kilohms 1% 1/8W
A3R36	0757-0486		R: fxd metflm 750 kilohms 1% 1/8W
A3R37	0698-3457		R: fxd metflm 316 kilohms 1% 1/8W
A3R38	0684-1541		R: fxd comp 150 kilohms 10% 1/4W
A3R39	0757-0428		R: fxd metflm 1620 ohms 1% 1/8W
A3R40	0757-0751		R: fxd metflm 7500 ohms 1% 1/4W
A3R41	0757-0438		R: fxd metflm 5110 ohms 1% 1/8W
A3R42	0757-0433		R: fxd metflm 3320 ohms 1% 1/8W
A3R43	0757-0458		R: fxd metflm 51.1 kilohms 1% 1/8W
A3R44	0757-0467		R: fxd metflm 121 kilohms 1% 1/8W
A3R45	0698-5102		R: fxd comp 1.2 megohms 10% 1/4W
A3R46	0757-0467		R: fxd metflm 121 kilohms 1% 1/8W
A3R47	0698-5102		R: fxd comp 1.2 megohms 10% 1/4W
A3R48	0757-0443		R: fxd metflm 11 kilohms 1% 1/8W
A3R49	0757-0458		R: fxd metflm 51.1 kilohms 1% 1/8W
A3R50	0757-0438		R: fxd metflm 5110 ohms 1% 1/8W
A3R51	0757-0433		R: fxd metflm 3320 ohms 1% 1/8W
A3R52	0757-0441		R: fxd metflm 8250 ohms 1% 1/8W
A3R53	0757-0428		R: fxd metflm 1620 ohms 1% 1/8W
A3R54	0757-0751		R: fxd metflm 7500 ohms 1% 1/4W
A3R55	0684-1541		R: fxd comp 150 kilohms 10% 1/4W
A3R56	0757-0413		R: fxd metflm 392 ohms 1% 1/8W
A3R57	0757-0414		R: fxd metflm 432 ohms 1% 1/8W
A3R58	0684-4711		R: fxd comp 470 ohms 10% 1/4W
A3R59	0698-0085		R: fxd metflm 2610 ohms 1% 1/8W
A3R60	0757-0289		R: fxd metflm 13.3 kilohms 1% 1/8W
A3R61	0757-0394		R: fxd metflm 51.1 ohms 1% 1/8W
A3R62	0757-0397		R: fxd metflm 68.1 ohms 1% 1/8W
A3S1	3100-1377		S: rotary (DISPLAY)
A3W1	01200-61603		W: trigger

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			A4
A4	01200-63503		A: horizontal module
A4A1	01200-66508		A: sweep circuit
A4A2	01200-61902		A: sweep time switch
A4C1	0130-0016		C: var npo 5-25 pF 305 wVdc
A4C2	0180-0155		C: fxd ta elect 2.2 uF 20% 20 wVdc
A4C3	0180-0155		C: fxd ta elect 2.2 uF 20% 20 wVdc
A4DS1			DS: nsr p/o A4S6
A4MP1	01200-60602		Shield: sweep module
A4R1	01200-61501		R: fxd comp 220 ohms 10% 1/4W
A4R2	0757-0350		R: fxd metflm 909 kilohms 1% 1/4W
A4R3	2100-2613		R: var comp 100 kilohms 20% 1/5W
A4R4	2100-1509		R: var comp 20 kilohms 20% 1/3W
A4S1	3100-1375		S: lever (SOURCE)
A4S2	3100-1374		S: lever (COUPLING)
A4S3			S: dpdt; nsr p/o A4R3
A4S4	3100-1373		S: lever (SLOPE)
A4S5	3100-1372		S: lever (MODE)
A4S6	3101-0944		S: pushbutton w/neon (RESET)
A4W1	01200-61607		W: sweep
			A4A1
A4A1	01200-66508		A: horizontal circuit
A4A1C1	0160-2959		C: fxd cer 0.001 uF −0 +100% 600 wVdc
A4A1C2	0160-2917		C: fxd cer 0.05 uF −20 +80% 100 wVdc
A4A1C3	0160-2917		C: fxd cer 0.05 uF −20 +80% 100 wVdc
A4A1C4	0160-2917		C: fxd cer 0.05 uF −20 +80% 100 wVdc
A4A1C5	0160-2917		C: fxd cer 0.05 uF −20 +80% 100 wVdc
A4A1C6	0160-2917		C: fxd cer 0.05 uF −20 +80% 100 wVdc
A4A1C7	0180-0155		C: fxd ta elect 2.2 uF 20% 20 wVdc
A4A1C8	0160-2258		C: fxd cer 11 pF 5% 500 wVdc
A4A1C9	0160-2258		C: fxd cer 11 pF 5% 500 wVdc
A4A1C10	0140-0198		C: fxd mica 200 pF 5% 300 wVdc
A4A1C11	0160-2917		C: fxd cer 0.05 uF −20 +80% 100 wVdc
A4A1C12	0160-2258		C: fxd cer 11 pF 5% 500 wVdc
A4A1C13	0160-2917		C: fxd cer 0.05 uF −20 +80% 100 wVdc
A4A1C14	0160-2959		C: fxd cer 0.001 uF −0 +100% 600 wVdc
A4A1C15	0180-0155		C: fxd ta elect 2.2 uF 20% 20 wVdc

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			A4A1 (CONT'D)
A4A1C16	0150-0115		C: fxd cer 27 pF 10% 500 wVdc
A4A1C17	0160-2917		C: fxd cer 0.05 uF –20 +80% 100 wVdc
A4A1C18	0160-2917		C: fxd cer 0.05 uf –20 +80% 100 wVdc
A4A1C19	0160-2258		C: fxd cer 11 pF 5% 500 wVdc
A4A1C20	0160-2258		C: fxd cer 11 pF 5% 500 wVdc
A4A1C21	0140-0198		C: fxd mica 200 pF 5% 300 wVdc
A4A1C22	0150-0115		C: fxd cer 27 pF 10% 500 wVdc
A4A1C23	0140-0198		C: fxd mica 200 pF 5% 300 wVdc
A4A1C24	0150-0115		C: fxd cer 27 pF 10% 500 wVdc
A4A1C25	0160-2913		C: fxd cer 0.01 uF –20 +80% 500 wVdc
A4A1C26	0140-0198		C: fxd mica 200 pF 5% 300 wVdc
A4A1C27	0140-0207		C: fxd mica 330 pF 5% 500 wVdc
A4A1C28	0160-2917		C: fxd cer 0.05 uF –20 +80% 100 wVdc
A4A1C29	0140-0207		C: fxd mica 330 pF 5% 500 wVdc
A4A1C30	0160-2917		C: fxd cer 0.05 uF –20 +80% 100 wVdc
A4A1C31	0160-2913		C: fxd cer 0.01 uF –20 +80% 500 wVdc
A4A1C32	0150-0115		C: fxd cer 27 pF 10% 500 wVdc
A4A1CR1	1901-0040		CR: Si
A4A1CR2	1901-0040		CR: Si
A4A1CR3	1901-0040		CR: Si
A4A1CR4	1912-0009		CR: Ge tunnel 1 ma 1N3712
A4A1CR5	1901-0040		CR: Si
A4A1CR6	1901-0040		CR: Si
A4A1CR7	1901-0040		CR: Si
A4A1CR8	1901-0040		CR: Si
A4A1CR9	1901-0376		CR: Si
A4A1CR10	1901-0040		CR: Si
A4A1CR11	1901-0040		CR: Si
A4A1CR12	1901-0040		CR: Si
A4A1CR13	1910-0016		CR: Ge
A4A1CR14	1901-0040		CR: Si
A4A1CR15	1901-0040		CR: Si
A4A1CR16	1901-0040		CR: Si
A4A1CR17	1901-0040		CR: Si
A4A1Q1	1854-0539		Q: Si npn
A4A1Q2	1854-0539		Q: Si npn
A4A1Q3	1853-0036		Q: Si pnp 2N3906
A4A1Q4	1854-0539		Q: Si npn
A4A1Q5	1854-0539		Q: Si npn

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			A4A1 (CONT'D)
A4A1Q6	1854-0071		Q: Si npn
A4A1Q7	1854-0071		Q: Si npn
A4A1Q8	1853-0036		Q: Si pnp 2N3906
A4A1Q9	1854-0215		Q: Si npn 2N3904
A4A1Q10	1854-0071		Q: Si npn
A4A1Q11	1853-0036		Q: pnp 2N3906
A4A1Q12	1854-0071		Q: npn
A4A1Q13	1853-0036		Q: pnp 2N3906
A4A1Q14	1853-0036		Q: pnp 2N3906
A4A1Q15	1853-0036		Q: pnp 2N3906
A4A1Q16	1855-0090		Q: FET
A4A1Q17	1854-0071		Q: Si npn
A4A1Q18	1853-0036		Q: Si pnp 2N3906
A4A1Q19	1853-0036		Q: Si pnp 2N3906
A4A1Q20	1854-0071		Q: Si npn
A4A1Q21	1853-0036		Q: Si pnp 2N3906
A4A1Q22	1854-0071		Q: Si npn
A4A1Q23	1853-0036		Q: Si pnp 2N3906
A4A1Q24	1854-0071		Q: Si npn
A4A1Q25	1854-0071		Q: Si npn
A4A1Q26	1853-0036		Q: Si pnp 2N3906
A4A1R1	0698-5092		R. fxd metflm 160 kilohms 1% 1/8W
A4A1R2	0757-0976		R: fxd metflm 150 kilohms 2% 1/4W
A4A1R3	0757-0427		R: fxd metflm 1500 ohms 1% 1/8W
A4A1R4	0757-0289		R: fxd metflm 13.3 kilohms 1% 1/8W
A4A1R5	0687-1531		R: fxd comp 15 kilohms 10% 1/2W
A4A1R6	0757-0443		R: fxd metflm 11 kilohms 1% 1/8W
A4A1R7	0757-0959		R: fxd metflm 30 kilohms 2% 1/4W
A4A1R8	0757-0914		R: fxd metflm 390 ohms 2% 1/4W
A4A1R9	0757-0964		R: fxd metflm 47 kilohms 2% 1/4W
A4A1R10	2100-0347		R: var comp 25 kilohms 4 sect 30% 1/4W
A4A1R11	0684-2231		R: fxd comp 22 kilohms 10% 1/4W
A4A1R12	0698-3640		R: fxd metox 1800 ohms 5% 2W
A4A1R13	0684-2201		R: fxd comp 22 ohms 10% 1/4W
A4A1R14	0684-2231		R: fxd comp 22 kilohms 10% 1/4W
A4A1R15	0684-2231		R: fxd comp 22 kilohms 10% 1/4W
A4A1R16	0684-2211		R: fxd comp 220 ohms 10% 1/4W
A4A1R17	0684-2211		R: fxd comp 220 ohms 10% 1/4W
A4A1R18	0684-4741		R: fxd comp 470 kilohms 10% 1/4W
A4A1R19	0757-0924		R: fxd metflm 1000 ohms 2% 1/4W
A4A1R20	0757-0952		R: fxd metflm 15 kilohms 2% 1/4W

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			A4A1 (CONT'D)
A4A1R21	2100-0940		R: var comp 500 ohms 20% 1/4W
A4A1R22	0698-6814		R: fxd metflm 10 kilohms 2% 1/2W
A4A1R23	0684-2231		R: fxd comp 22 kilohms 10% 1/4W
A4A1R24	0757-0935		R: fxd metflm 3000 ohms 2% 1/4W
A4A1R25	0684-3331		R: fxd metflm 33 kilohms 10% 1/4W
A4A1R26	0757-0914		R: fxd metflm 390 ohms 2% 1/4W
A4A1R27	0757-0962		R: fxd metflm 390 kilohms 2% 1/4W
A4A1R28	0684-2211		R: fxd comp 220 ohms 10% 1/4W
A4A1R29	0698-6816		R: fxd metflm 6200 ohms 2% 1/2W
A4A1R30	0757-0928		R: fxd metflm 1500 ohms 2% 1/4W
A4A1R31	0684-2231		R: fxd comp 22 kilohms 10% 1/4W
A4A1R32	0684-2241		R: fxd comp 220 kilohms 10% 1/4W
A4A1R33	0684-2211		R: fxd comp 220 ohms 10% 1/4W
A4A1R34	2100-2581		R: var comp 20 kilohms 2 sect 20% 1/4W
A4A1R35	0684-2211		R: fxd comp 220 ohms 10% 1/4W
A4A1R36	2100-0381		R: var comp 25 kilohms 30% 1/4W
A4A1R37	0757-0972		R: fxd metflm 100 kilohms 2% 1/4W
A4A1R38	0757-0457		R: fxd metflm 47.5 kilohms 1% 1/8W
A4A1R39	0684-3331		R: fxd comp 33 kilohms 10% 1/4W
A4A1R40	0684-1041		R: fxd comp 100 kilohms 10% 1/4W
A4A1R41	0684-2211		R: fxd comp 220 ohms 10% 1/4W
A4A1R42	0684-3331		R: fxd comp 33 kilohms 10% 1/4W
A4A1R43	0757-0928		R: fxd metflm 1500 ohms 2% 1/4W
A4A1R44	0757-0972		R: fxd metflm 100 kilohms 2% 1/4W
A4A1R45	0757-0964		R: fxd metflm 47 kilohms 2% 1/4W
A4A1R46	0698-3155		R: fxd metflm 4640 ohms 1% 1/8W
A4A1R47	0757-0453		R: fxd metflm 30.1 kilohms 1% 1/8W
A4A1R48	0757-0449		R: fxd metflm 20 kilohms 1% 1/8W
A4A1R49	0757-0914		R: fxd metflm 390 ohms 2% 1/4W
A4A1R50	0698-6816		R: fxd metflm 6200 ohms 2% 1/2W
A4A1R51	0757-0931		R: fxd metflm 2000 ohms 2% 1/4W
A4A1R52	0757-0972		R: fxd metflm 100 kilohms 2% 1/4W
A4A1R53	0757-0952		R: fxd metflm 15 kilohms 2% 1/4W
A4A1R54	0684-4741		R: fxd comp 470 kilohms 10% 1/4W
A4A1R55	0684-3331		R: fxd comp 33 kilohms 10% 1/4W
A4A1R56	0757-0288		R: fxd metflm 9090 ohms 1% 1/8W
A4A1R57	0684-2201		R: fxd comp 22 ohms 10% 1/4W
A4A1R58	0684-2201		R: fxd comp 22 ohms 10% 1/4W
A4A1R59	0757-0924		R: fxd metflm 1000 ohms 2% 1/4W
A4A1R60	0684-1041		R: fxd comp 100 kilohms 10% 1/4W

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			A4A1 (CONT'D)
A4A1R61	0684-1041		R: fxd comp 100 kilohms 10% 1/4W
A4A1R62	0757-0935		R: fxd metflm 3 kilohms 2% 1/4W
A4A1R63	0757-0972		R: fxd metflm 100 kilohms 2% 1/4W
A4A1R64	0757-0964		R: fxd metflm 47 kilohms 2% 1/4W
A4A1R65	0757-0757		R: fxd metflm 15 kilohms 1% 1/4W
A4A1R66	0757-0281		R: fxd metflm 2740 ohms 1% 1/8W
A4A1R67	0698-6814		R: fxd metflm 10 kilohms 2% 1/2W
A4A1R68	0757-0944		R: fxd metflm 6800 ohms 2% 1/4W
A4A1R69	0698-3450		R: fxd metflm 42.2 kilohms 1% 1/8W
A4A1R70	0684-1051		R: fxd comp 1 megohm 10% 1/4W
A4A1R71	0757-0952		R: fxd metflm 15 kilohms 2% 1/4W
A4A1R72	0757-0289		R: fxd metflm 13.3 kilohms 1% 1/8W
A4A1R73	0684-2231		R: fxd comp 22 kilohms 10% 1/4W
A4A1R74	0757-0976		R: fxd metflm 150 kilohms 2% 1/4W
A4A1R75	0757-0959		R: fxd metflm 30 kilohms 2% 1/4W
A4A1R76	0757-0095		R: fxd metflm 5100 ohms 2% 1/2W
A4A1R77	0757-0950		R: fxd metflm 12 kilohms 2% 1/4W
A4A1R78	0757-0928		R: fxd metflm 1500 ohms 2% 1/4W
A4A1R79	0757-0330		R: fxd metflm 1800 ohms 2% 1/4W
A4A1R80	0698-6815		R: fxd metflm 1800 ohms 2% 1/2W
A4A1R81	0757-0944		R: fxd metflm 6800 ohms 2% 1/4W
A4A1R82	0757-0940		R: fxd metflm 4700 ohms 2% 1/4W
A4A1R83	0757-0956		R: fxd metflm 22 kilohms 2% 1/4W
A4A1R84	0757-0930		R: fxd metflm 1800 ohms 2% 1/4W
A4A1R85	0684-2211		R: fxd comp 220 ohms 10% 1/4W
A4A1R86	0698-3155		R: fxd metflm 4640 ohms 1% 1/8W
A4A1R87	0698-3155		R: fxd metflm 4640 ohms 1% 1/8W
A4A1VR1	1902-0025		VR: breakdown 10V 5% 400 mW
A4A1VR2	1902-0055		VR: breakdown 14.7V 10% 400 mW
A4A1VR3	1902-0049		VR: breakdown 6.19V 5% 400 mW
			A4A2
A4A2	01200-61902		A: sweep time switch
A4A2C1	0170-0022		C: fxd my .1 uF 20% 600 wVdc
A4A2C2	0160-2204		C: fxd mica 100 pF 5% 300 wVdc
A4A2C3	0160-2258		C: fxd cer 11 pF 5% 500 wVdc
A4A2C4	0150-0093		C: fxd cer .01 uF −20 +80% 100 wVdc
A4A2C5	0160-3133		C: fxd my 2 uF 10% 100 wVdc
A4A2C6	0170-0063		C: fxd my .02 uF 10% 400 wVdc
A4A2C7	0160-0168		C: fxd my .1 uF 10% 200 wVdc
A4A2C8	0160-0194		C: fxd my .015 uF 10% 200 wVdc
A4A2C9	0160-0155		C: fxd my .0033 uF 10% 200 wVdc

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			A4A2 (CONT'D)
A4A2CR1	1901-0040		CR: Si
A4A2CR2	1901-0040		CR: Si
A4A2MP1	3130-0038		Coupler: horizontal vernier
A4A2MP2	01200-01203		Bracket: sweep time switch mounting
A4A2Q1	1854-0358		Q: Si npn
A4A2R1	0698-4009		R: fxd metflm 50 kilohms 1% 1/8W
A4A2R2	0757-0453		R: fxd metflm 30.1 kilohms 1% 1/8W
A4A2R3	0757-0442		R: fxd metflm 10 kilohms 1% 1/8W
A4A2R4	0757-0442		R: fxd metflm 10 kilohms 1% 1/8W
A4A2R5A	2100-2616		R: var dual comp 7000 ohms 30%
A4A2R5B			R: nsr: p/o R5A var comp 25 kilohms 20%
A4A2R6	0698-5092		R: fxd metflm 160 kilohms 1% 1/8W
A4A2R7	0757-0959		R: fxd metox 30 kilohms 2% 1/4W
A4A2R8	0757-0124		R: fxd metflm 39.2 kilohms 1% 1/8W
A4A2R9	0757-0479		R: fxd metflm 392 kilohms 1% 1/8W
A4A2R10	0757-0471		R: fxd metflm 182 kilohms 1% 1/8W
A4A2R11	0698-4482		R: fxd metflm 17.4 kilohms 1% 1/8W
A4A2R12	0757-0472		R: fxd metflm 200 kilohms 1% 1/8W
A4A2R13	0757-0465		R: fxd metflm 100 kilohms 1% 1/8W
A4A2R14	0698-6733		R: fxd carflm 30 megohms 1% 1W
A4A2R15	0698-7091		R: fxd metflm 10 megohms 1% 1/2W
A4A2R16	0698-7091		R: fxd metflm 10 megohms 1% 1/2W
A4A2R17	0757-0344		R: fxd metflm 1 megohm 1% 1/4W
A4A2R18	0757-0344		R: fxd metflm 1 megohm 1% 1/4W
A4A2R19	0757-0950		R: fxd metox 12 kilohms 2% 1/4W
A4A2S1	3100-1378		S: rotary
A4A2S2			S: nsr p/o A4A2R5
A4A2S3			S: nsr p/o A4A2S1
A4A2W1	01200-61628		W: sweep switch
			A5
A5	01200-66514		A: low voltage power supply
A5C1	0180-2138		C: fxd al elect 150 uF –10 +50% 250 wVdc
A5C2	0180-2159		C: fxd al elect 300 uF –10 +75% 150 wVdc
A5C3	0160-0168		C: fxd my 0.1 uF 10% 200 wVdc
A5C4	0180-2134		C: fxd al elect 20 uF –10 +50% 100 wVdc
A5C5	0180-2159		C: fxd al elect 300 uF –10 +75% 150 wVdc
A5C6	0160-0168		C: fxd my 0.1 uF 10% 200 wVdc
A5C7	0180-0155		C: fxd ta elect 2.2 uF 20% 20 wVdc
A5C8	0180-1731		C: fxd ta elect 4.7 uF 10% 50 wVdc
A5C9	0180-2134		C: fxd al elect 20 uF –10 +50% 100 wVdc

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			A5 (CONT'D)
A5CR1	1901-0040		CR: Si
A5CR2	1901-0028		CR: Si
A5CR3	1901-0028		CR: Si
A5CR4	1901-0028		CR: Si
A5CR5	1901-0028		CR: Si
A5CR6	1901-0026		CR: Si
A5CR7	1901-0026		CR: Si
A5CR8	1901-0026		CR: Si
A5CR9	1901-0026		CR: Si
A5CR10	1901-0040		CR: Si
A5CR11	1901-0040		CR: Si
A5CR12	1901-0040		CR: Si
A5CR13	1901-0026		CR: Si
A5CR14	1901-0026		CR: Si
A5CR15	1901-0026		CR: Si
A5CR16	1901-0026		CR: Si
A5CR17	1901-0026		CR: Si
A5CR18	1901-0040		CR: Si
A5CR19	1901-0040		CR: Si
A5CR20	1901-0040		CR: Si
A5CR21	1901-0026		CR: Si
A5F1	2110-0004		F: 1/4 amp 250V
A5F2	2110-0012		F: 1/2 amp 250V
A5F3	2110-0012		F: 1/2 amp 250V
A5MP1	2110-0269		Clip: Fuse (F1, F2, F3)
A5Q1	1853-0020		Q: Si pnp
A5Q2	1854-0071		Q: Si npn
A5Q3	1853-0036		Q: Si pnp
A5Q4	1854-0022		Q: Si npn
A5Q5	1854-0071		Q: Si npn
A5Q6	1854-0071		Q: Si npn
A5R1	0684-2251		R: fxd comp 2.2 megohms 10% 1/4W
A5R2	0684-1031		R: fxd comp 10 kilohms 10% 1/4W
A5R3	0698-6734		R: fxd metflm 29.6 kilohms 0.5% 1/8W
A5R4	0698-6218		R: fxd metflm 20 kilohms 0.5% 1/8W
A5R5	0698-4055		R: fxd metflm 1000 ohms 0.25% 1/8W
A5R6	0684-1041		R: fxd comp 100 kilohms 10% 1/4W
A5R7	0684-1041		R: fxd comp 100 kilohms 10% 1/4W
A5R8	0698-3605		R: fxd metox 15 ohms 5% 2W
A5R9	0684-1021		R: fxd comp 1000 ohms 10% 1/4W
A5R10	0757-0456		R: fxd metflm 43.2 kilohms 1% 1/8W

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			A5 (CONT'D)
A5R11	0764-0043		R: fxd metox 2700 ohms 5% 2W
A5R12	0757-0392		R: fxd metflm 43.2 ohms 1% 1/8W
A5R13	0757-0450		R: fxd metflm 22.1 kilohms 1% 1/8W
A5R14	0757-0401		R: fxd metflm 100 ohms 1% 1/8W
A5R15	0757-0110		R: fxd metflm 12.8 kilohms 1% 1/4W
A5R16	0698-7142		R: fxd metflm 12.3 kilohms 1% 1/4W
A5R17	0698-3605		R: fxd metox 15 ohms 5% 2W
A5R18	0684-1041		R: fxd comp 100 kilohms 10% 1/4W
A5R19	0684-1021		R: fxd comp 1000 ohms 10% 1/4W
A5R20	0684-5631		R: fxd comp 56 kilohms 10% 1/4W
A5R21	0698-3443		R: fxd metflm 287 ohms 1% 1/8W
A5R22	0757-0750		R: fxd metflm 6810 ohms 1% 1/4W
A5R23	0684-3331		R: fxd comp 33 kilohms 10% 1/4W
A5R24	0684-4741		R: fxd comp 470 kilohms 10% 1/4W
A5R25	0757-0757		R: fxd metflm 15 kilohms 1% 1/4W
A5R26	0684-4741		R: fxd comp 470 kilohms 10% 1/4W
A5R27	0757-0389		R: fxd metflm 33.2 ohms 1% 1/8W
A5R28	0757-0433		R: fxd metflm 3320 ohms 1% 1/8W
A5R29	2100-0935		R: var comp 1000 ohms 20% 1/4W
A5R30	0698-3264		R: fxd metflm 11.8 kilohms 1% 1/8W
A5R31	0684-3321		R: fxd comp 3300 ohms 10% 1/4W
A5VR1	1902-3357		VR: breakdown 56.2V 5% 400 mW
A5VR2	1902-0034		VR: breakdown 5.76V 400 mW
A5VR3	1902-3357		VR: breakdown 56.2V 5% 400 mW
A5VR4	1902-0018		VR: breakdown 11.7V 5% 400 mW, temperature compensated 0.01%/c
			A6
A6	01200-66515		A: high voltage regulator assembly (standard)
A6	01200-66519		A: high voltage regulator assembly (options 011 and 611)
A6C1	0150-0096		C: fxd cer .05 uF −20 +80% 100 wVdc
A6C2	0160-0163		C: fxd my .033 uF 10% 200 wVdc
A6C3	0160-2234		C: fxd cer .51 pF ±.25 pF 500 wVdc
A6C4	0150-0096		C: fxd cer .05 uF −20 +80% 100 wVdc
A6C5	0180-0109		C: fxd al elect 18 uF 100 wVdc
A6C6	0160-3008		C: fxd cer .0047 uF ±20% 4000 wVdc
A6C7	0160-3008		C: fxd cer .0047 uF ±20% 4000 wVdc
A6C8	0160-3007		C: fxd cer .0047 uF ±20% 4000 wVdc
A6C9	0160-3007		C: fxd cer .0047 uF ±20% 4000 wVdc
A6C10	0160-3007		C: fxd cer .0047 uF ±20% 4000 wVdc
A6C11	0160-0165		C: fxd my 0.056 uF 10% 200 wVdc
A6C12	0160-2056		C: fxd my .22 uF 20% 200 wVdc
A6C13	0160-2403		C: fxd cer .0015 uF 20% 5000 wVdcc
A6C14	0160-0165		C: fxd my .056 uF 10% 200 wVdc
A6C15	0180-0091		C: fxd al elect 10 uF −10 +50% 100 wVdc

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			A6 (CONT'D)
A6CR1	1901-0040		CR: Si
A6CR2	1901-0040		CR: Si
A6CR3	1901-0040		CR: Si
A6CR4	1901-0040		CR: Si
A6CR5	1901-0045		CR: Si
A6CR6	1901-0049		CR: Si
A6CR7	1901-0040		CR: Si
A6CR8	1901-0033		CR: Si
A6L1	9140-0118		L: fxd 500 uH
A6L2	9140-0179		L: fxd 22 uH
A6MP1	0340-0451		Insulator: mica, transistor
A6MP2	01201-01101		Heat sink: (Q4)
A6Q1	1854-0071		Q: Si npn
A6Q2	1853-0037		Q: Si pnp
A6Q3	1854-0022		Q: Si npn
A6Q4	1854-0330		Q: Si npn
A6Q5	1854-0071		Q: Si npn
A6Q6	1853-0036		Q: Si pnp 2N3906
A6Q7	1855-0057		Q: FET
A6R1	0698-3200		R: fxd metflm 8000 ohms 1% 1/8W
A6R2	0757-0424		R: fxd metflm 1100 ohms 1% 1/8W
A6R3	0757-0941		R: fxd comp 5100 ohms 2% 1/4W
A6R4	0684-4731		R: fxd comp 47 kilohms 10% 1/4W (standard)
A6R4			Deleted (options 011 and 611)
A6R5	0757-0439		R: fxd metflm 6810 ohms 1% 1/8W
A6R6	0698-3158		R: fxd metflm 23.7 kilohms 1% 1/8W
A6R7	0687-1211		R: fxd comp 120 ohms 10% 1/2W
A6R8	0698-8397		R: fxd metflm 4320 ohms 1% 1W
A6R9	0698-8398		R: fxd metflm 4750 ohms 1% 1W
A6R10	0757-0280		R: fxd metflm 1000 ohms 1% 1/8W
A6R11	0757-0757		R: fxd metflm 15 kilohms 1% 1/4W
A6R12	0757-0456		R: fxd metflm 43.2 kilohms 1% 1/8W
A6R13	0757-0411		R: fxd metflm 332 ohms 1% 1/8W
A6R14	2100-2692		R: var cermet 1 megohm 20% type V 1/2W
A6R15	0698-8719		R: fxd carflm 29 megohms 10% 1W
A6R16	0684-1051		R: fxd comp 1 megohm 10% 1/4W
A6R17	2100-2580		R: var 2 sect 250 kilohms (A) 100 kilohms (B) 30% 1/4W
A6R18	0687-5631		R: fxd comp 56 kilohms 10% 1/2W
A6R19	0698-3417		R: fxd metflm 23.7 kilohms 1% 1/2W
A6R20	0698-4935		R: fxd metflm 41.2 kilohms 1% 1/2W
A6R21	0684-1511		R: fxd comp 150 ohms 10% 1/4W
A6R22	0684-2211		R: fxd comp 220 ohms 10% 1/4W
A6R23	0757-0465		R: fxd metflm 100 kilohms 1% 1/8W
A6R24	0757-0463		R: fxd metflm 82.5 kilohms 1% 1/8W (factory selected)
A6R25	0684-1241		R: fxd comp 120 kilohms 10% 1/4W

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
			A6 (CONT'D)
A6R26	0757-0791		R: fxd metflm 619 kilohms 1% 1/4W
A6R27	0698-8018		R: fxd cond plastic 30 megohms 1% 3W
A6R28	0687-3351		R: fxd comp 3.3 megohms 10% 1/2W
A6R29	0693-6851		R: fxd comp 6.8 megohms 10% 2W
A6R30	0693-6851		R: fxd comp 6.8 megohms 10% 2W
A6R31	0693-6851		R: fxd comp 6.8 megohms 10% 2W
A6R32	0693-6851		R: fxd comp 6.8 megohms 10% 2W
A6R33	0698-3643		R: fxd metox 4300 ohms 5% 2W
A6R34	0687-1001		R: fxd comp 10 ohms 10% 1/2W
A6R35	0684-1021		R: fxd comp 1000 ohms 10% 1/4W
A6R36	0757-0124		R: fxd metflm 39.2K ohms 1% 1/8W
A6R37	0687-2221		R: fxd comp 2200 ohms 10% 1/2W
A6VR1	1902-0041		VR: breakdown 5.11V 5% 400 mW
A6VR2	2140-0013		VR: neon
A6VR3	2140-0013		VR: neon
			A7
A7	01200-66505		A: high voltage rectifier
A7C1	0160-3007		C: fxd cer .0047 uF 4000 wVdc
A7C2	0160-3008		C: fxd cer .0047 uF 4000 wVdc
A7CR1	1901-0683		CR: Si rect hv 10k V 5 mA
A7CR2	1901-0683		CR: Si rect hv 10k V 5 mA
A7R1	0684-2231		R: fxd comp 22 kilohms 10% 1/4W
A7R2	0684-1531		R: fxd comp 15 kilohms 10% 1/4W
A7T1	01200-61101		T: high voltage

SECTION VII

MANUAL CHANGES

7-1. INTRODUCTION.

7-2. This section contains information required to backdate this manual for a specific instrument. Descriptions of special and standard options are also provided in this section.

7-3. MANUAL CHANGES.

7-4. This manual applies directly to instruments having the same serial prefix shown on the manual title page. If the serial prefix of your instrument is not the same as the one on the title page, find your serial prefix in table 7-1 and make all 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. For example, if backdating changes 1, 2, and 3 are required for your serial prefix, do change 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
806—	11 thru 1
839—	11 thru 2
843—	11 thru 3
846—	11 thru 4
849—	11 thru 5
913—	11 thru 6
916—	11 thru 7
924—	11 thru 7
930—	11 thru 8
931—	11 thru 8
1047A	11 thru 9
1129A	11 and 10
1131A	11 and 10
1150A	11
1202A	11

CHANGE 1

Table 6-2, Replaceable Parts,
- Q1: Change to A5Q2: Si pnp; HP Part No. 1853-0079.
- Q2: Change to A5Q6: Si npn; HP Part No. 1854-0320.
- A5: Change HP Part No. to 01200-66502.
- A5Q2: Change reference designator to A5Q3.
- A5Q3: Change reference designator to A5Q4.
- A5Q4: Change reference designator to A5Q5.
- A5Q5: Change reference designator to A5Q7.
- A5Q6: Change reference designator to A5Q8.
- A5R12: Change HP Part No. to 0757-0280; R: fxd metflm 1 kilohm 1% 1/8W.

Page 8-27, figure 8-41,
- Delete: replace with figure 7-2.

Page 8-27, figure 8-42,
- Q1, Q2: Delete wire colors.
- Q1: Change to A5Q2.
- Q2: Change to A5Q6.
- A5Q2: Change to A5Q3.
- A5Q3: Change to A5Q4.
- A5Q4: Change to A5Q5.
- A5Q5: Change to A5Q7.
- A5Q6: Change to A5Q8.
- A5R12: Change value to 1 kilohm.

CHANGE 2

Page 1-4, table 1-1,
- Change intensity modulation specification as follows:
  +5V signal blanks trace of normal intensity; +12V signal blanks any intensity. DC-coupled input on rear panel; amplifier rise time approx 200 ns; input resistance is 10 kilohms.

Table 6-2, Replaceable Parts,
- A6R3: Change to R: fxd comp 10 kilohms 10% 1/4W; HP Part No. 0684-1031.

Page 8-29/8-30, figure 8-46,
- A6R3: Change value to 10 kilohms.

CHANGE 3

Rack instruments in this category are identified on the front panel as Model 1200AR. In all other respects, Model 1200AR is identical to Model 1200B.

CHANGE 4

Table 6-2, Replaceable Parts,
- A6L2: Delete.
- A6R35: Delete.

Page 8-29/8-30, figure 8-46,
- A6L2: Delete.
- A6R35: Delete.

CHANGE 5

Table 6-2, Replaceable Parts,
- A6R36: Delete.

CHANGE 5 (Cont'd)

Page 8-15, figure 8-22,
Change: —50V to —50 VF at top of A3R25.
Page 8-29/8-30, figure 8-46,
A6R36: Delete.

CHANGE 6

Table 6-2, Replaceable Parts,
MP46: Change HP Part No. to 01200-40501.

CHANGE 7

Table 6-2, Replaceable Parts,
A6: Change HP Part No. to 01200-66506.
Delete: A6CR8, A6R37, A6VR2 and A6VR3.
Page 8-28, figure 8-44,
Delete: replace with figure 7-3.
Page 8-29/8-30, figure 8-46,
Delete: A6CR8, A6R37, A6VR2 and A6VR3.

CHANGE 8

Page 1-2, NOTE,
Change last line to read have the beam finder feature.
Page 1-2, Option 011,
Delete: entries for A6 and A6R4.
Page 1-2, Option 611,
Delete: entires for A6 and A6R4.
Page 1-3, table 1-1, BEAM FINDER,
Delete last line of specification.
Page 3-1, NOTE,
Change last line of note to read have the beam finder feature.
Page 5-2, paragraph 5-17,
Delete the word intensification from the note below step d.
Page 5-6a, PERFORMANCE CHECK RECORD,
In entry for reference step 5-17d, change notation to read (not available in P11 CRT).
Table 6-2,
W1: Change to HP Part No. 8120-1202 for 1200A and 1200B.
MP45: Change HP Part No. to 01200-40502.
MP55: Change HP Part No. to 01200-60501.
Delete: J10, S3, and A1A1MP1.
Schematic 9,
Replace T1 primary circuits with figure 7-1.

CHANGE 9

Table 6-2,
DS1: Change to HP Part No. 1450-0048, DS: neon (power indicator).

CHANGE 10

Table 6-2,
MP18: Change HP Part No. to 01200-04105.
MP34: Change HP Part No. to 01200-00203.
MP38: Change HP Part No. to 01200-04103.

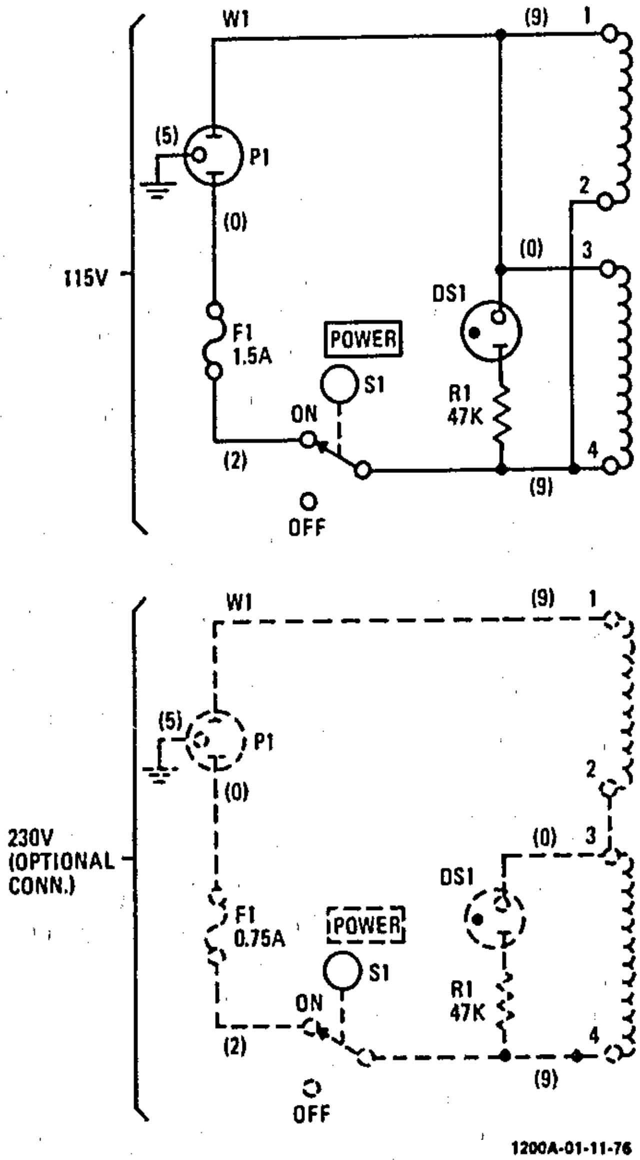


Figure 7-1. T1 Primary Circuits

MP48: Change HP Part No. to 01200-66521.
MP51: Change HP Part No. to 01200-00201.

CHANGE 11

Table 6-2,
A1: Change HP Part No. to 01200-63504 (two places).
A1A1: Change HP Part No. to 01200-66516 (two places).
A2: Change HP Part No. to 01200-63504 (two places).
A1A1C3 and A1A1C15: Change to HP Part No. 0160-3127, C:fxd my 0.022 μF 5% 400 wVdc.
A1A1C7 and A1A1C8: Change to HP Part No. 0160-2914, C:fxd cer 0.1 μF +80—20% 50 wVdc.
A1A1R3 and A1A1 R30: Change to HP Part No. 0757-0342, R:fxd metflm 100 kilohms 1% 1/4W.
Add: A1A1R15 and A1A1R17: HP Part No. 0757-0433, R:fxd metflm 3320 ohms 1% 1/8W.
Delete: A1A1VR4 and A1A1VR5.

Schematic 1,
A1A1C3 and A1A1C15: Change value to .022 UF.
A1A1R3 and A1A1R30: Change value to 100K.
A1A1C7 and A1A1C8: Change value to 0.1 UF.
A1A1VR5: Change symbol to fixed resistor. Designate as A1A1R15 (3320 ohms).
A1A1VR4: Change symbol to fixed resistor. Designate as A1A1R17 (3320 ohms).

Schematic 2,
A2A1C3 and A2A1C15: Change value to .022 UF.
A2A1R3 and A2A1R30: Change value to 100K.
A2A1C7 and A2A1C8: Change value to 0.1 UF.
A2A1VR5: Change symbol to fixed resistor. Designate as A2A1R15 (3320 ohms).
A2A1VR4: Change symbol to fixed resistor. Designate as A2A1R17 (3320 ohms).

7-5. OPTION 006.

7-6. This option is available for Model 1200B only. Three rear panel connectors are added in parallel to front panel inputs: one each for CHANNEL A and CHANNEL B INPUTS; and one for TRIG & HORIZ INPUT. The input impedance specification is changed as follows:

VERTICAL: 1 megohm shunted by approximately 100 pF for all ranges.

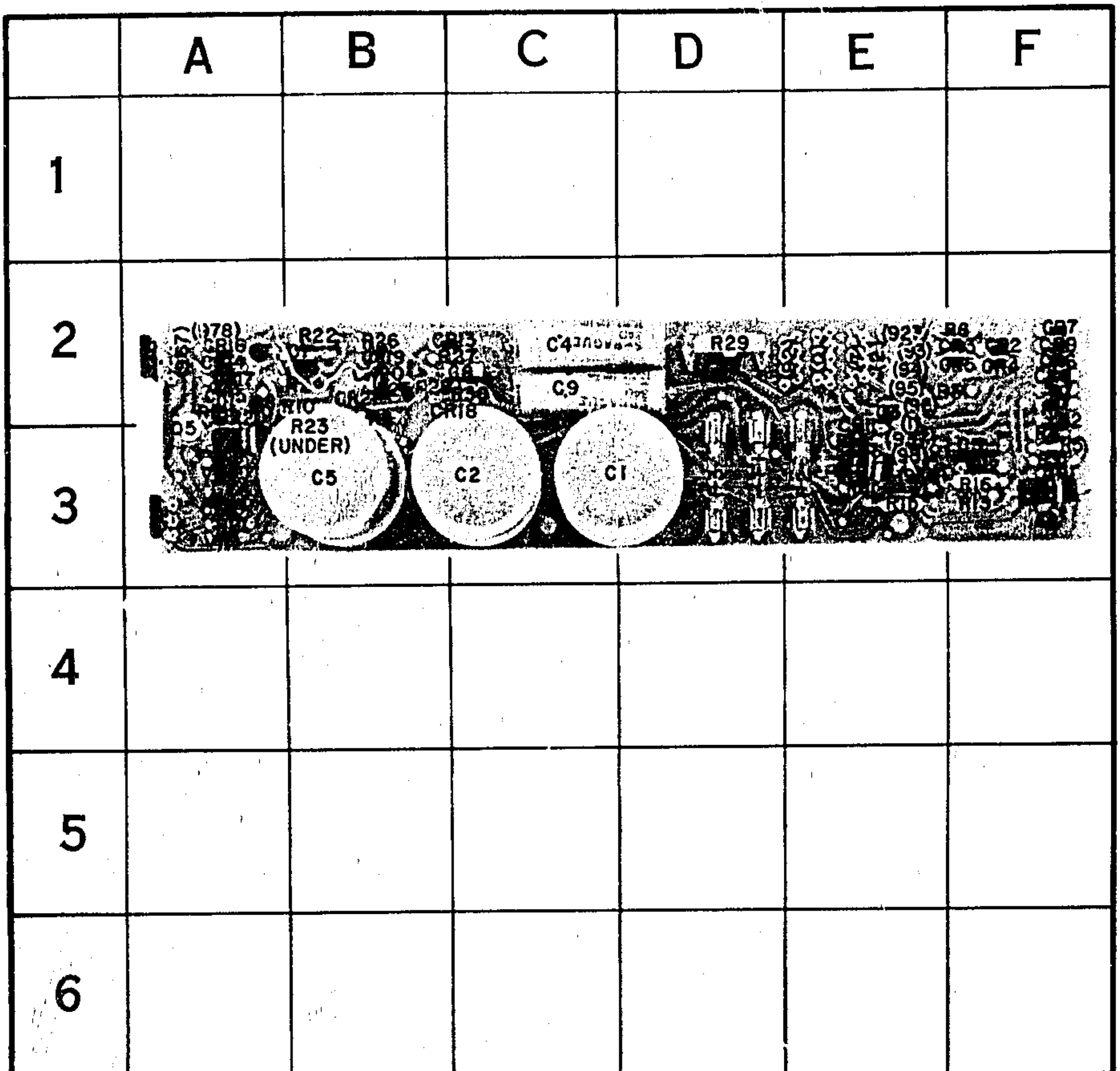
HORIZONTAL: 1 megohm shunted by approximately 75 pF.

Replaceable parts for Option 006 are listed in table 7-2 and schematic connections are shown in figure 7-4.

Table 7-2. Option 006 Replaceable Parts

Item	HP Part No.	TQ	Description
1.	1250-0063	2	Connector Hood, RF (part of associated cable assy)
2.	1250-0083	1	BNC connector, female (HORIZ rear panel connector)
3.*	1251-0038	2	Connector, 3-pin, male
4.	1251-0039	2	Connector, 3-pin, female (part of VERT A and VERT B cable assy)
5.*	1251-0236	2	Connector, cable clamp
6	01200-61620	1	Cable assembly, Horiz
7.	01200-61621		Cable assembly, VERT A (includes items 1, 4, 6, and 8)
8.	01200-61622		Cable assembly, VERT B (includes items 1, 4, 7, and 8)

*Items 3 and 5 are external cabling mating connector hardware for item 4.

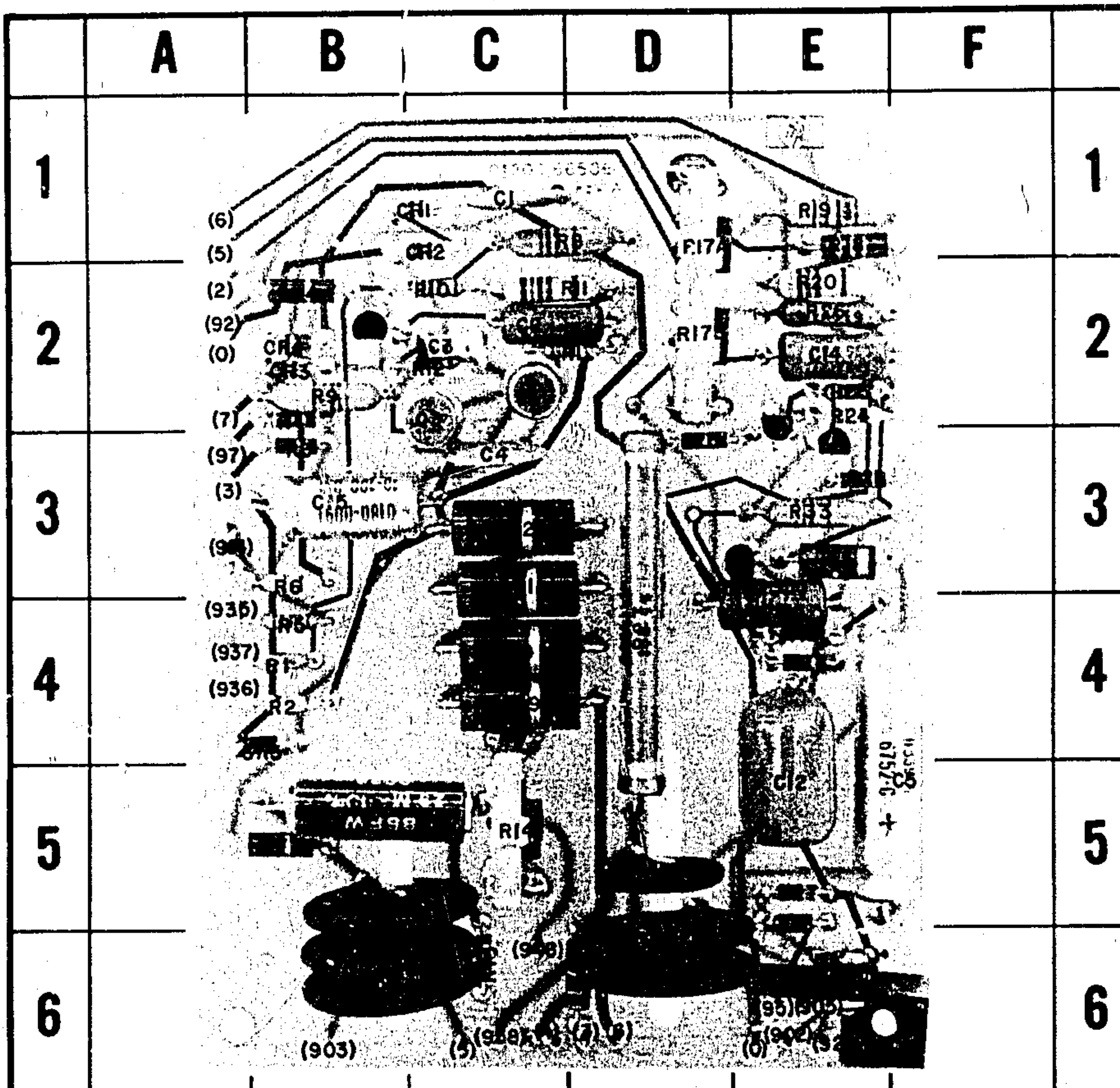


REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	D-3	CR5	F-2	CR18	C-2	Q7	A-2	R12	F-3	R24	B-2
C2	C-3	CR6	F-2	CR19	B-2	Q8	A-2	R13	F-3	R25	B-2
C3	F-3	CR7	F-2	CR20	B-2	R1	F-2	R14	E-3	R26	B-2
C4	C-2	CR8	F-2	CR21	B-2	R2	F-3	R15	E-3	R27	C-2
C5	B-3	CR9	F-2	F1	D-3	R3	F-3	R16	F-3	R28	B-2
C6	A-3	CR10	A-3	F2	E-3	R4	F-3	R17	A-3	R29	D-2
C7	B-2	CR11	E-3	F3	D-3	R5	F-3	R18	A-2	R30	C-2
C8	C-2	CR12	E-3	Q1	F-3	R6	F-2	R19	A-3	R31	F-2
C9	C-2	CR13	C-2	Q2	A-3	R7	F-2	R20	A-2	VR1	A-3
CR1	F-3	CR14	A-2	Q3	E-2	R8	F-3	R21	A-3	VR2	E-3
CR2	F-2	CR15	A-2	Q4	E-3	R9	B-2	R22	B-2	VR3	A-3
CR3	F-2	CR16	A-2	Q5	A-3	R10	B-2	R23	B-3	VR4	B-2
CR4	F-2	CR17	A-2	Q6	A-2	R11	E-3				

Note: For complete reference designation, prefix component designators with A5.

1200A-A-4

Figure 7-2. Low Voltage Power Supply, A5, Component Identification



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	C-1	C12	E-5	L1	E-3	R4	B-2	R15	B-5	R25	D-3
C2	C-2	C13	D-5	Q1	B-2	R5	B-4	R16	C-6	R26	E-2
C3	C-2	C14	E-2	Q2	C-2	R6	B-3	R17A	D-1	R27	D-4
C4	C-3	C15	B-3	Q3	C-2	R7	B-5	R17B	D-2	R28	D-6
C5	F-5	CR1	C-1	Q4	E-6	R8	D-1	R18	E-1	R29	C-4
C6	D-6	CR2	C-1	Q5	E-3	R9	B-2	R19	E-1	R30	C-4
C7	D-6	CR3	B-2	Q6	E-3	R10	C-2	R20	E-2	R31	C-3
C8	B-5	CR4	B-2	Q7	E-3	R11	D-2	R21	E-3	R32	C-3
C9	C-6	CR5	B-4	R1	B-4	R12	C-2	R22	E-4	R33	E-3
C10	B-6	CR6	E-5	R2	B-4	R13	D-2	R23	E-2	R34	B-2
C11	E-4	CR7	E-5	R3	B-3	R14	C-[illegible]	R24	E-2	VR1	E-4

Note: For complete reference designation, prefix component designators with A6.

1200A-A-5

Figure 7-3. High Voltage Regulator, A6, Component Identification

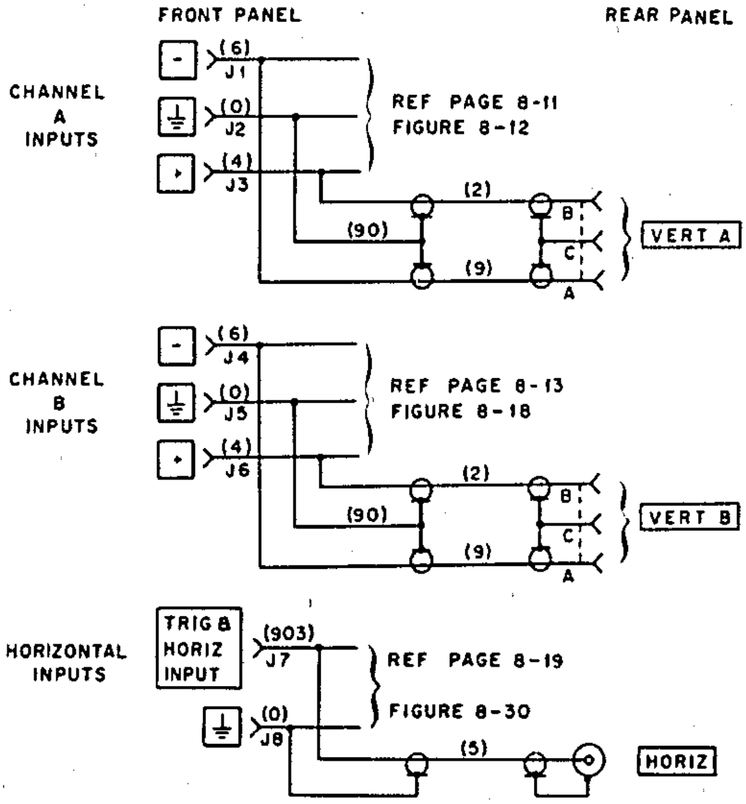


Figure 7-4. Option 006 Schematic Connections

SECTION VIII

SCHEMATICS AND TROUBLESHOOTING

8-1. INTRODUCTION.

8-2. This section contains schematics and component location photographs along with troubleshooting, repair and replacement information.

8-3. SCHEMATICS.

8-4. All schematics are on fold-out pages to allow reference to the text and figures in other sections. To find one by circuit name, refer to the List of Illustrations at the front of the manual. The schematics are drawn to show electronic function, and any one may include all or part of several different physical assemblies. Symbols and conventions are defined in Table 8-2.

8-5. For ready reference, a block diagram of each schematic is on the adjacent page. An overall block diagram of the entire instrument is in Section IV.

8-6. Each schematic is identified by a number in the lower right-hand corner. These numbers make it easy to find a point of reference. For example, the trigger signal from A1A1Q8 on Schematic 1 is referred to A3S1 on Schematic 4. On Schematic 4, the trigger input signal to A3S1 is referred back to A1A1Q8 on Schematic 1.

8-7. To find a component on the schematics, first check the reference designation boxes. These are located in the lower right-hand corner whenever compatible with circuit layout and indicate which components are on a particular schematic.

8-8. Components within the shaded areas of the schematics are physically located on an etched circuit board. Subassembly components, other than those on a circuit board, are shown within a shaded border for better distinction.

8-9. All component reference designators are complete on the schematics. Do not add any additional prefixes to these designators.

8-10. COMPONENT LOCATION.

8-11. All adjustments are shown in Section V, and mechanical parts are shown on exploded-view drawings in this section. For ready reference, assembly photographs are given adjacent to the appropriate schematics.

8-12. Circuit board assembly photographs are subdivided by a grid, and components within each subdivision are indexed to a table below the photograph. Thus, a component can be easily found on the photograph by first referring to the table. However, reference designators are not complete on assembly photographs. For the complete reference designator, add the assembly number (and subassembly number, if any) stated in the photograph to each component designator.

8-13. TROUBLESHOOTING.

8-14. Troubleshooting is easier if more than one symptom of a trouble is evident. Observe the instrument, and note all indications of faulty operation. If symptoms indicate more than one trouble, treat each problem individually and locate one trouble at a time. Don't waste time making random checks. Follow the procedure presented here, and refer to other areas of information in this manual if necessary.

8-15. FRONT-PANEL CONTROLS.

8-16. Equipment troubles are frequently due simply to improper front-panel control settings. Refer to the operating instructions in Section III for a complete explanation of each control's function along with typical operating instructions if in doubt. Use the controls as a guide to help isolate a trouble to a specific area of the instrument.

8-17. PERFORMANCE CHECK.

8-18. Make a thorough check of instrument performance. A complete procedure is given in Section V, and forms are included to record results. A trouble, such as incorrect vertical gain or sweep speed, may be due to lack of calibration. If a performance check result can be adjusted, the last step of the check refers to the appropriate adjustment procedure.

8-19. TROUBLESHOOTING TABLE.

8-20. Troubleshooting tips are given in Table 8-1. The table is not intended as a fool-proof tool for pin-pointing every possible trouble; only some of the most common symptoms and probable faults are given. Before doing the checks, be sure that the symptom is valid by checking control settings. For example, what may at first appear as no display may really be a no sweep problem.

8-21. To check the vertical circuits for an unbalance, measure the vertical preamplifier output voltages (white and green wires at module rear).

8-22. The unbalance is in the output amplifier if these voltages are equal. If the voltages are unequal, either the preamplifier or output amplifier may be defective.

8-23. To further isolate the trouble source, disconnect the preamplifier output leads, and measure the voltages again. Check the preamplifier for an unbalance if the voltages are unequal; check the output amplifier for an unbalance if the voltages are equal.

8-24. Measure the dc voltage at symmetrical points on each half of the differential amplifiers to detect a defective stage. Voltages should be the same, as indicated on the schematics.

8-25. The vertical preamplifier modules can also be checked by exchanging output connections. If the inoperative channel is then O.K., the module originally connected to that channel is defective.

8-26. VISUAL CHECKS.

8-27. After localizing a trouble to a specific area of the instrument, make a good visual check of that area. Check for burned or broken components, loose wires or circuit board connections, faulty switch contacts, or any similar condition suggesting a source of trouble. If everything appears normal, proceed to the next step.

8-28. WAVEFORMS AND VOLTAGES.

8-29. Let the instrument warm up for about 15 minutes before taking any measurements. Conditions for measuring waveforms and dc voltages are stated adjacent to each schematic. These conditions must be observed to obtain the proper results.

8-30. A triangle with an enclosed number is shown at key locations throughout the schematics. These are waveform measurement points and are referenced to the waveform photographs adjacent to each schematic.

8-31. Waveforms can be used to measure gain, locate a differential amplifier unbalance, or pin-point a defective stage.

8-32. DC voltages are shown on the schematics near active components such as transistors. As an aid to locating measurement points, a small dot is etched on the circuit boards near the emitter of transistors, source of field-effect transistors, cathode of diodes and positive lead of electrolytic capacitors. Use a needle-tip probe to avoid creating a short circuit.

8-33. FINAL CHECKS.

8-34. Read the theory of operation in Section IV to learn how a circuit should operate. With the aid of this information, it will be easier to discover why a defective circuit is inoperative. Finally, make resistance checks to uncover a faulty component. If it appears necessary to calibrate the instrument, refer to Section V for the correct procedures.

8-35. REPAIR AND REPLACEMENT.

8-36. The following paragraphs contain recommended procedures for repair and replacement of defective components. A complete list of components, with Hewlett-Packard part numbers and ordering information, is in Section VI. Contact the nearest HP Sales/Service Office listed at the rear of this manual if satisfactory repair or operation cannot be achieved.

8-37. SERVICING ETCHED CIRCUIT BOARDS.

8-38. Circuit boards in this instrument have plated-through holes with conductive surfaces on both sides. Components can be removed or replaced by unsoldering from either side of a board. When removing a large component, such as a potentiometer, rotate the soldering iron from lead-to-lead while pulling upward on the part. The following extract from HP Service Note M-20E contains further etched circuit board repair information:

a. Don't apply excessive heat. Use a 37- to 48-watt soldering iron.

b. Clip the leads of the damaged component. Remove the component, and then unsolder the leads from the board.

c. Use a toothpick or other pointed object to clean the circuit board holes while heating with a soldering iron.

d. Shape the leads of replacement components to fit the circuit board holes. Don't use force.

e. If the metal-plated conductive surface lifts from the board, cement it back with a small amount of quick-drying, acetate-base cement with good insulating properties. Or, solder a wire along the damaged area.

8-39. SEMICONDUCTOR REPLACEMENT.

8-40. Semiconductor devices are available in a wide variety of shapes and sizes. This can make it confusing to identify the leads. Examples of some of the most common configurations are shown in Figure 8-1.

8-41. When removing a semiconductor, use a pair of long nose pliers as a heat sink between the device and the soldering iron. And, when replacing a semiconductor, ensure sufficient lead length to dissipate soldering heat by using the same length of exposed lead as used for the original part.

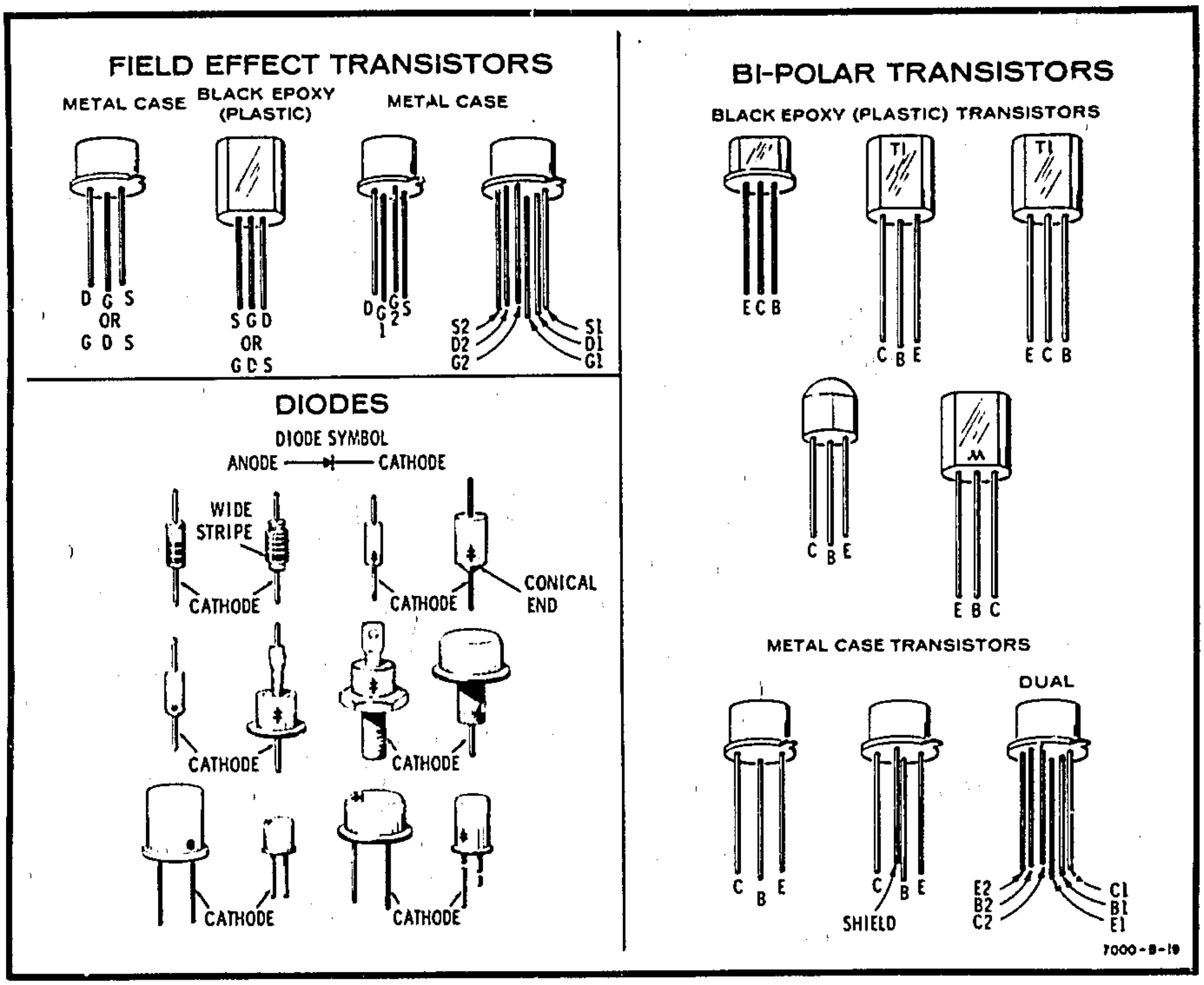


Figure 8-1. Semiconductor Identification

8-42. CRT REMOVAL AND REPLACEMENT.

8-43. Remove the CRT as follows:

WARNING

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

a. Remove Model 1200A top cover by loosening the two captive screws; remove Model 1200B bottom cover by first removing four retaining screws.

b. Remove rear-panel CRT socket cover by first removing two retaining screws.

c. Remove front-panel CRT light shield by squeezing at mid-point, top and bottom.

d. Remove CRT bezel by first removing four retaining screws.

e. Carefully remove CRT socket.

f. Loosen screw at bottom of CRT clamp (an access hole is provided at rear of Model 1200B side panel).

g. Put one hand on CRT face; use other hand to slide CRT forward and out of instrument.

8-44. To install a CRT, do the reverse of the above procedure. If a new CRT is installed, also do the adjustment procedure given in Section V.

8-45. VERTICAL PREAMPLIFIER MODULE REMOVAL AND REPLACEMENT.

8-46. Remove the vertical preamplifier modules as follows (see Figures 8-5 and 8-6 for exploded-view drawings):

NOTE

To remove the Model 1200B channel A preamplifier module, first remove the channel B module to provide clearance.

a. Remove knobs from Vertical Vernier, Volts/Division, and + and −Vertical Coupling switches (lever-switch knobs pull off).

b. Remove nut from attenuator shaft.

c. Disconnect wires from square-pin connectors (note locations for replacement).

d. Slide module about 1/4 inch to rear, and lift out.

8-47. To install the module, do the reverse of the above procedure. Wire colors are shown in the appropriate component identification photograph in this section. When sliding the module forward, be sure that the bottom slots catch on the retaining clips.

8-48. HORIZONTAL MODULE REMOVAL AND REPLACEMENT.

8-49. Remove the horizontal module as follows (see Figures 8-5 and 8-6 for exploded-view drawings):

a. Remove all knobs from horizontal section of front panel (lever-switch knobs pull off).

b. Remove nut from SWEEP/EXT HORIZ switch shaft and RESET lamp mounting nut.

c. Disconnect wires from square-pin connectors (note locations for replacement). A yellow coaxial cable connected between module and dual channel output board cannot be disconnected until module is partially removed.

d. Slide module about 1/4 inch to rear, and lift out.

8-50. To install the module, do the reverse of the above procedure. Wire colors are shown in the appropriate component identification photograph in this section. When sliding the module forward, be sure that the bottom slots catch on the retaining clips.

8-51. DUAL CHANNEL OUTPUT BOARD REMOVAL AND REPLACEMENT.

8-52. Remove the dual channel output board as follows (see Figures 8-5 and 8-6 for exploded-view drawings):

a. Remove four power transformer screws, and temporarily move transformer to gain access to board.

b. Disconnect wires from square-pin connectors (note locations for replacement).

c. Remove DISPLAY switch coupler shaft. To do this, slightly spread vertical preamplifier modules, and insert a long Allen driver. Loosen two Allen set screws on either end of shaft, turning DISPLAY switch as required to reach screws.

CAUTION

To avoid damaging the instrument, spread the vertical preamplifier modules only enough to insert the Allen driver.

d. Remove three support screws from board.

e. Slide board toward rear of instrument, and lift out.

8-53. To install the board, do the reverse of the above procedure. Wire colors are shown in the appropriate component identification photograph in this section.

Table 8-1. Troubleshooting Tips

Symptom	Check
No display, both channels	1. Press FIND BEAM. 2. If display returns: adjust INTENSITY, POSITION controls, and BAL. Check vertical and horizontal amplifiers for an unbalance (refer to paragraphs 8-21 thru 8-25). 3. If display doesn't return check: gate amplifier, low and high voltages, and CRT.
No display, one channel	1. Adjust vertical POSITION and BAL of defective channel. 2. Select another mode of vertical coupling to check input path (switch could also be defective). 3. Turn Volts/Division through its range. 4. If no display only from 0.5V to 20 V/DIV, check ÷100 attenuator path. 5. If no display only from 0.1 MV to 0.2 V/DIV, check unattenuated attenuator path. 6. Check current source A3Q14 or A3Q17 for, respectively, no channel A or B display. 7. Check vertical preamplifier and amplifiers of defective channel for an unbalance (refer to paragraphs 8-21 thru 8-25).
No alt display	1. Check alt trigger from sweep generator to multivibrator. 2. Check A3S1, A3Q15 and A3Q16.
No chop display	1. Check A3S1, A3Q15 and A3Q16.
No A vs. B display	1. Check A3S1 and A3Q18.
Unstable display	1. Check horiz. preamplifier. 2. Check trigger generator. 3. Check hold-off circuit. 4. If no LINE triggering, check signal from L.V.P.S. to horiz. preampl. 5. If no INT triggering, check signal from vert. preampl. to horiz. preampl. 6. If no EXT triggering, check signal from J7 to horiz. preampl.

Table 8-1. Troubleshooting Tips (Con't)

Symptom	Check
Poor CMRR	1. Refer to paragraph 5-55, CMRR BALANCE adjustment. 2. Check unity gain amplifier and vertical preamplifier. 3. Check for unsymmetrical gain on each side of vertical differential amplifiers.
No sweep	1. Set SWEEP/EXT HORIZ to EXT HORIZ, and apply signal to J7. 2. If no horizontal deflection, check horiz. preamplifier and amplifiers. 3. If horizontal deflection, check trigger and sweep generators.
No norm sweep	1. Check input signal from input of horiz. preampl. to trigger generator (A4A1Q6/Q7). 2. Check A4S5.
No auto sweep	1. Check feedback loop from A4A1Q9 collector to A4A1Q7 base. 2. Check A4S3, A4C2 and A4C3.
No single sweep	1. Check A4S5. 2. Check A4S6. 3. Check A4A1Q25 and associated components.
No free run sweep	1. Check A4S5, –50V applied to A4S5, and A4A1R77.
No magnified sweep	1. Check A4A2S1. 2. Check A4A2Q1 and associated components.

Table 8-2. Schematic Notes

Refer to MIL-STD-15-1A for schematic symbols not listed in this table.

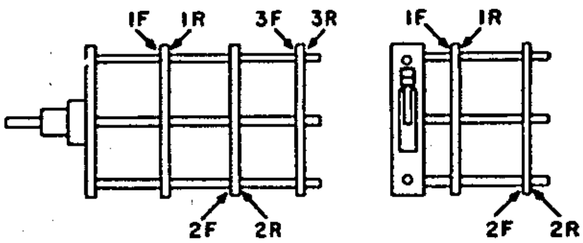
	=	Etched circuit board
	=	Front panel marking
	=	Rear panel marking
	=	Front panel control
	=	Screwdriver adjustment
P/O	=	Part of
CW	=	Clockwise end of variable resistor
N C	=	No connection
	=	Waveform test point (with number)
	=	Common electrical point (with letter) not necessarily ground
	=	Single pin connector on board
	=	Pin of a plug-in board (with letter or number)
	=	Main signal path
	=	Primary feedback path
	=	Secondary feedback path
*	=	Optimum value selected at factory, average value shown; part may have been omitted.
G D S	=	Field effect transistor (N-channel)
	=	Breakdown diode
	=	Tunnel diode
	=	Step recovery diode
	=	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.

Unless otherwise indicated:
resistance in ohms
capacitance in picofarads
inductance in microhenries

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

Switch wafers are identified as follows:



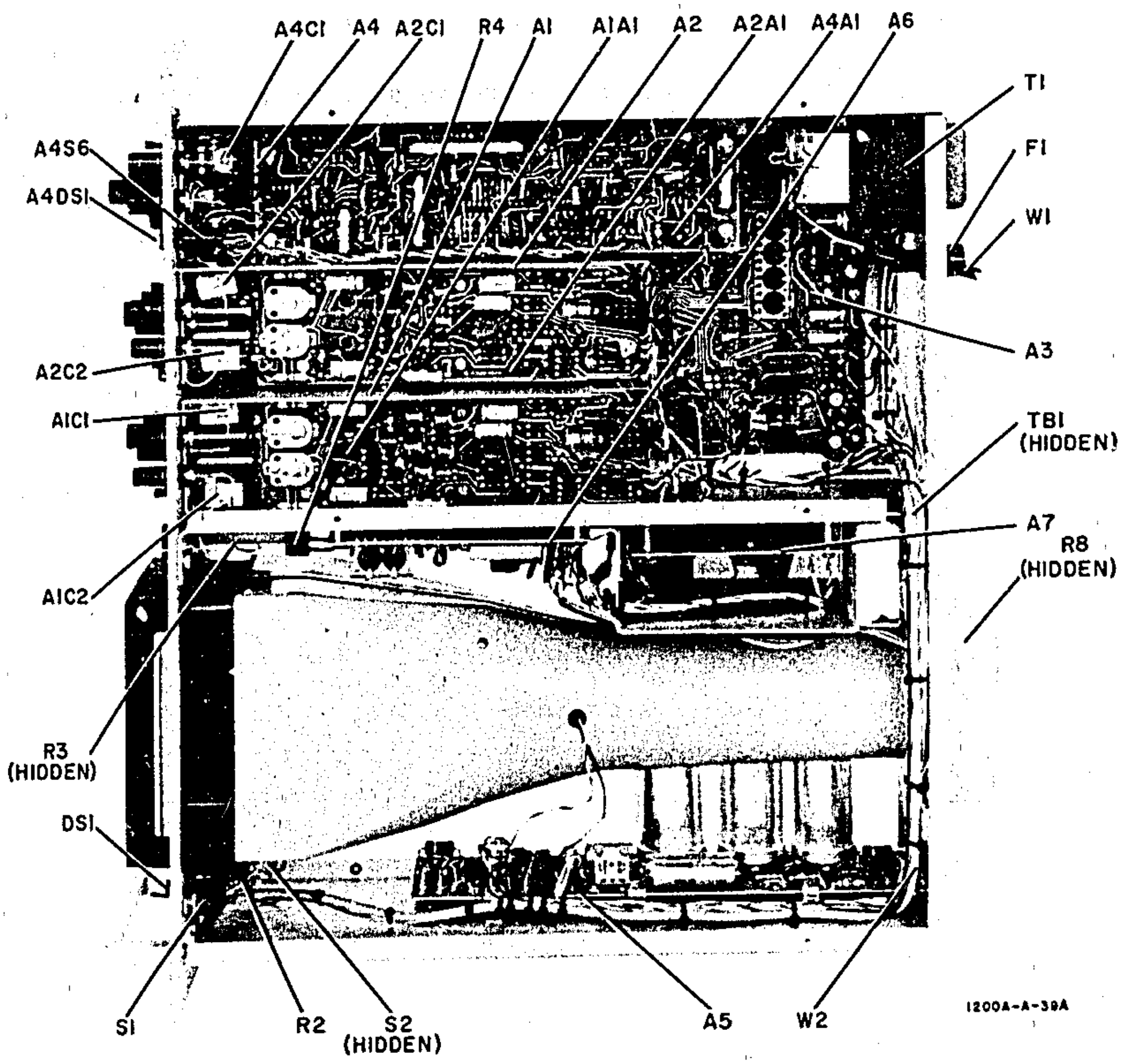


Figure 8-2. Model 1200B Bottom View

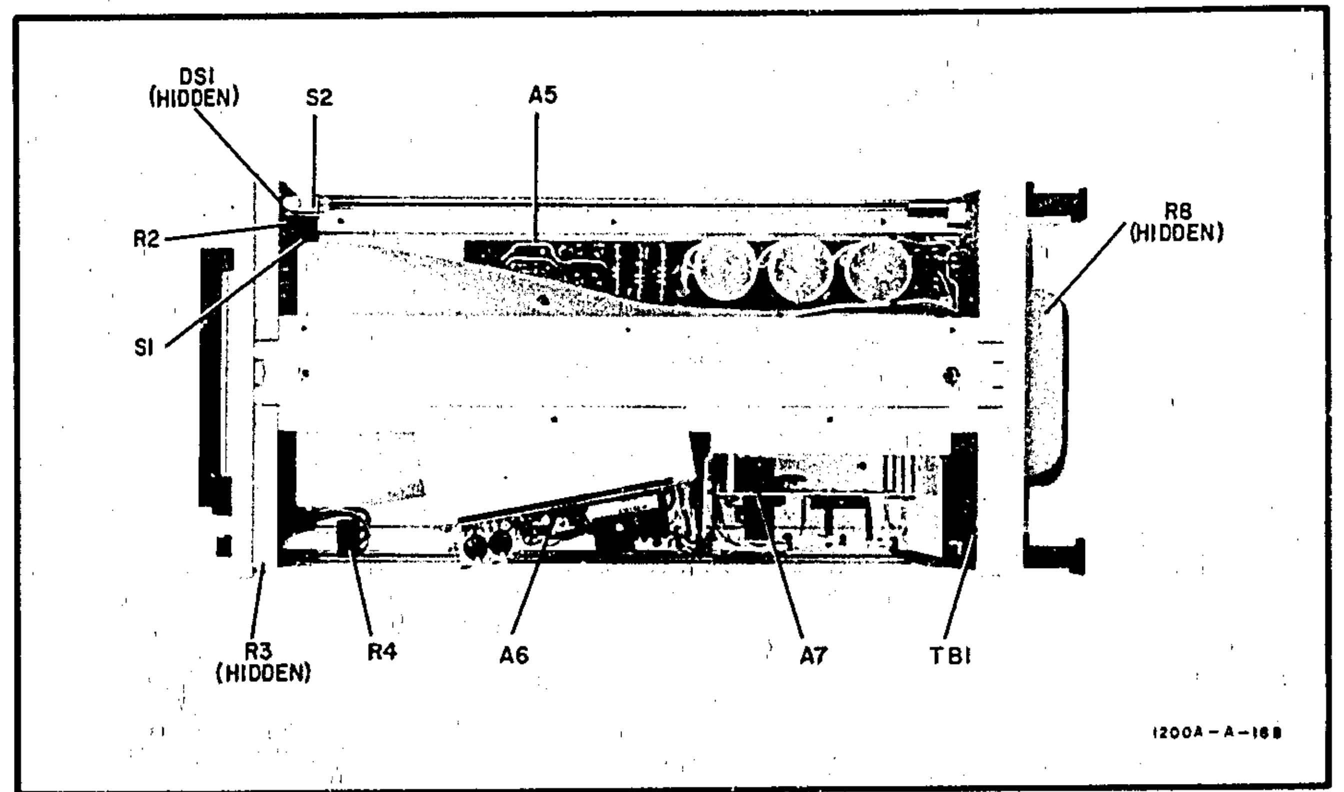


Figure 8-3. Model 1200A Top View

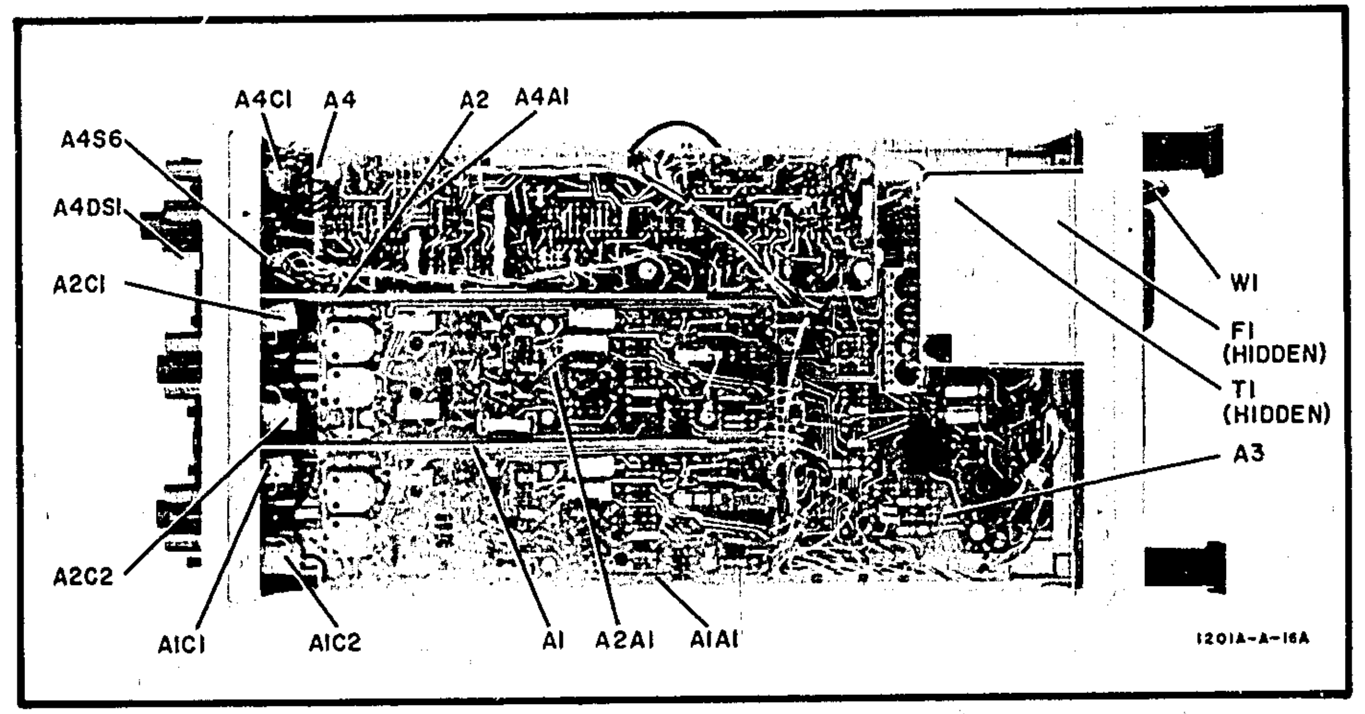


Figure 8-4. Model 1200A Bottom View

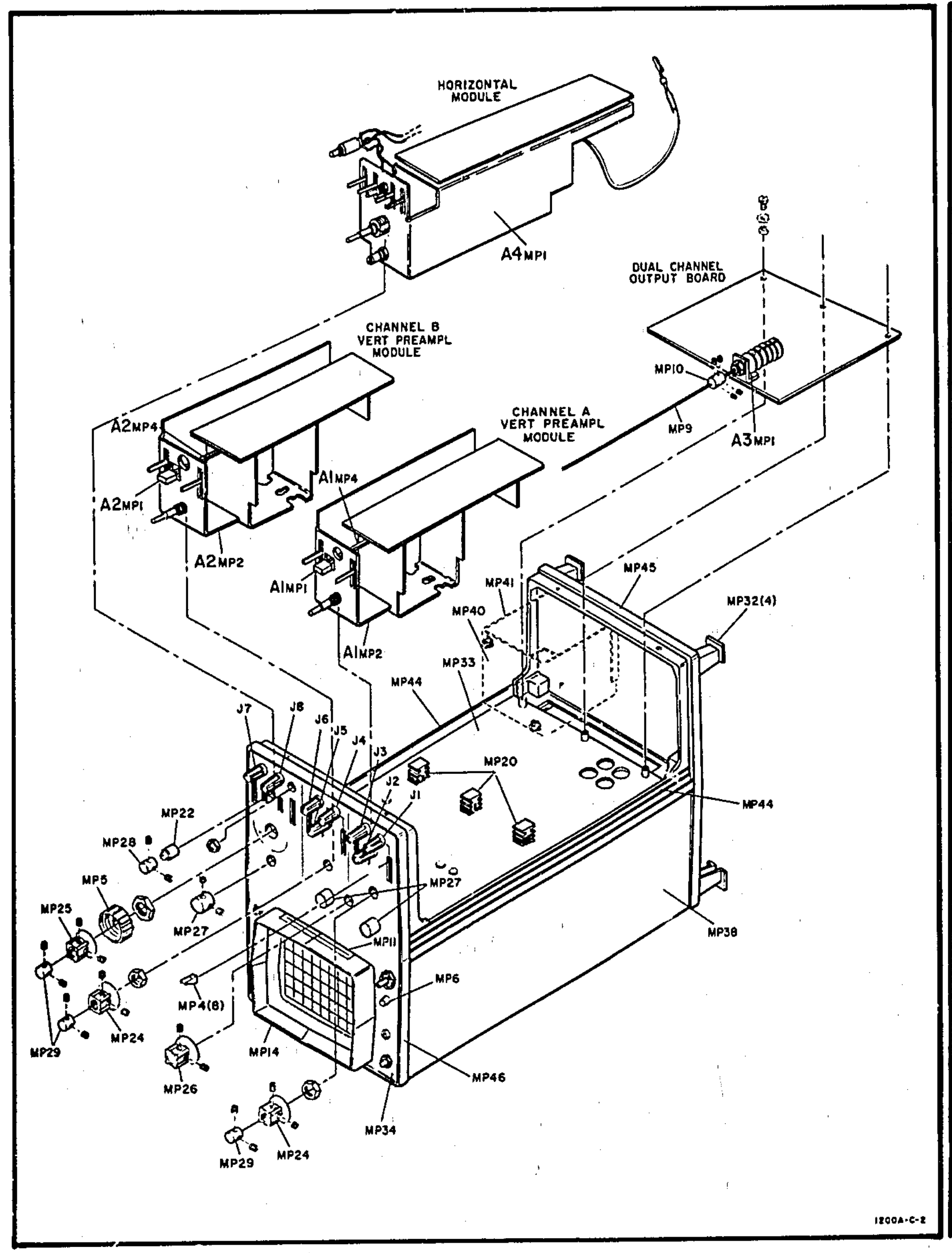


Figure 8-5. Model 1200A Exploded View

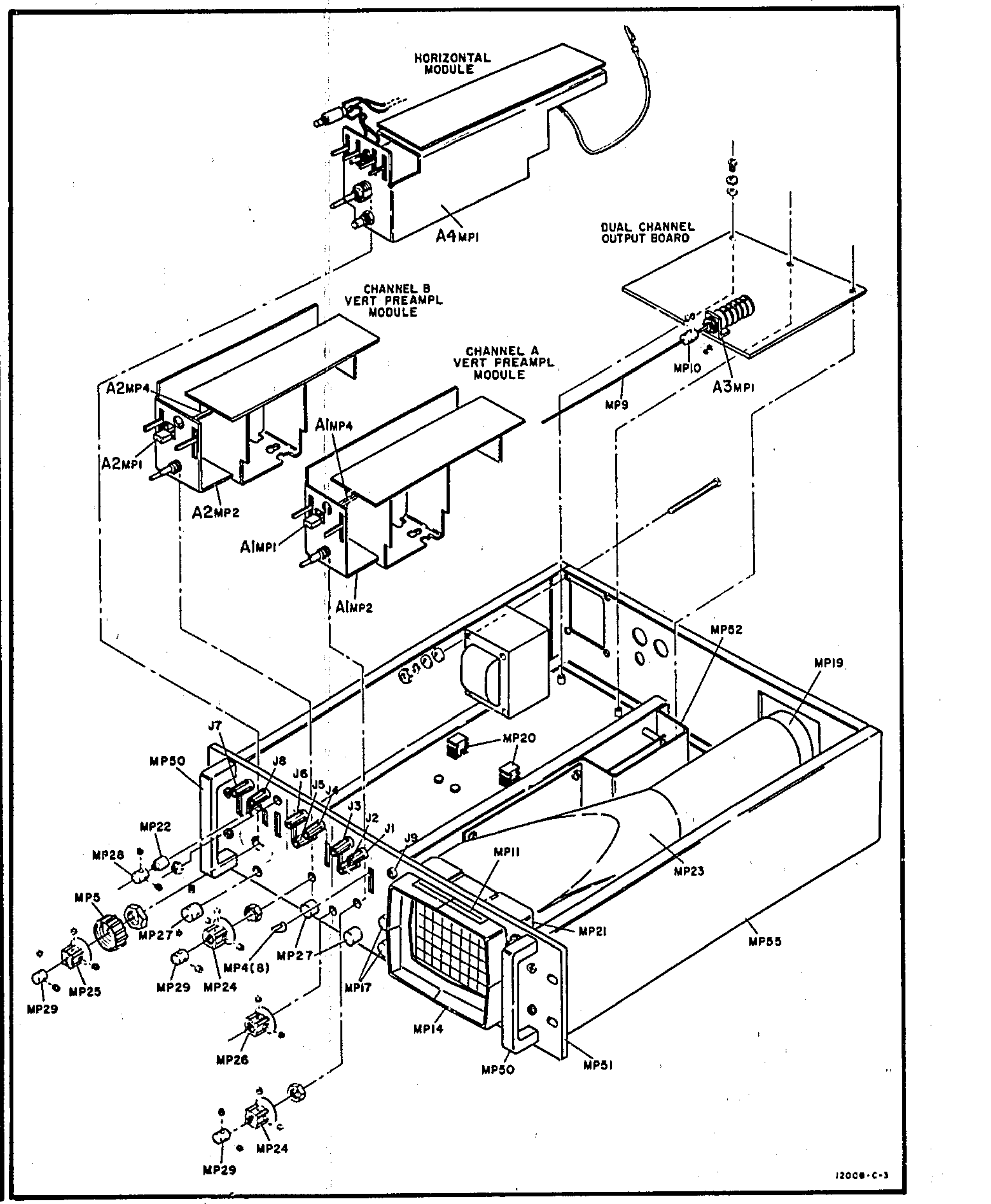
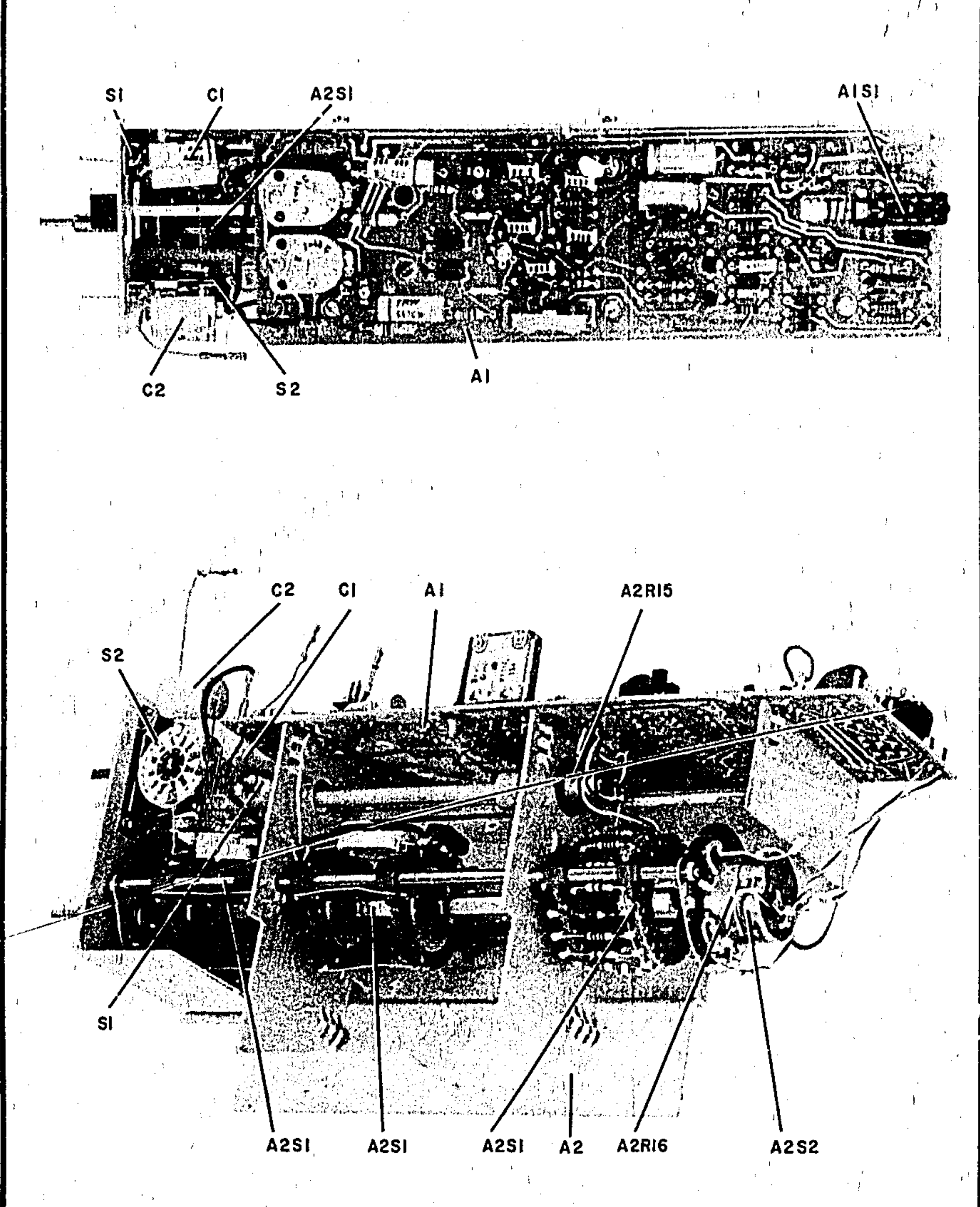


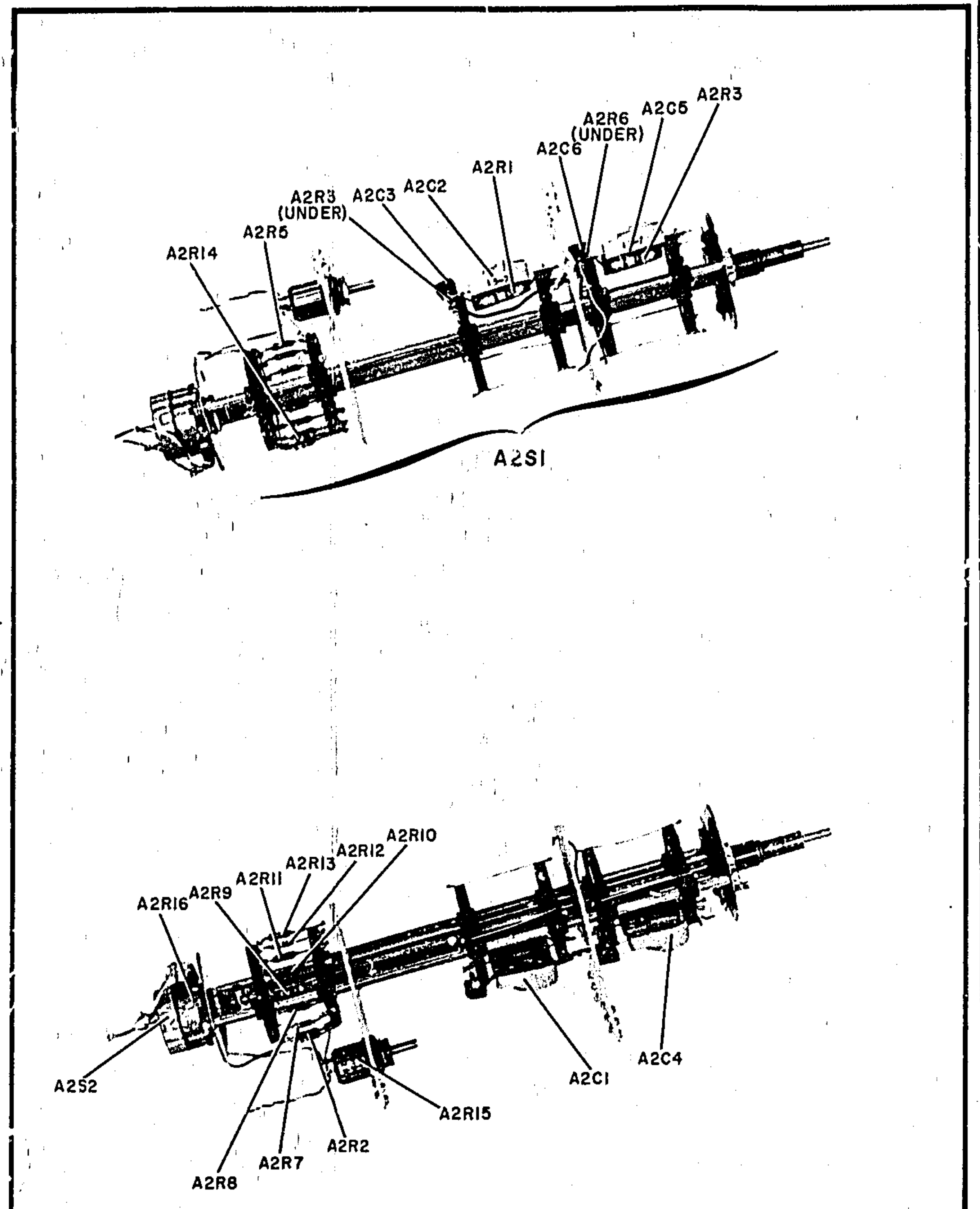
Figure 8-6. Model 1200B Exploded View



Note: For complete reference designation, prefix component designators with A1.

1200A-A-38B

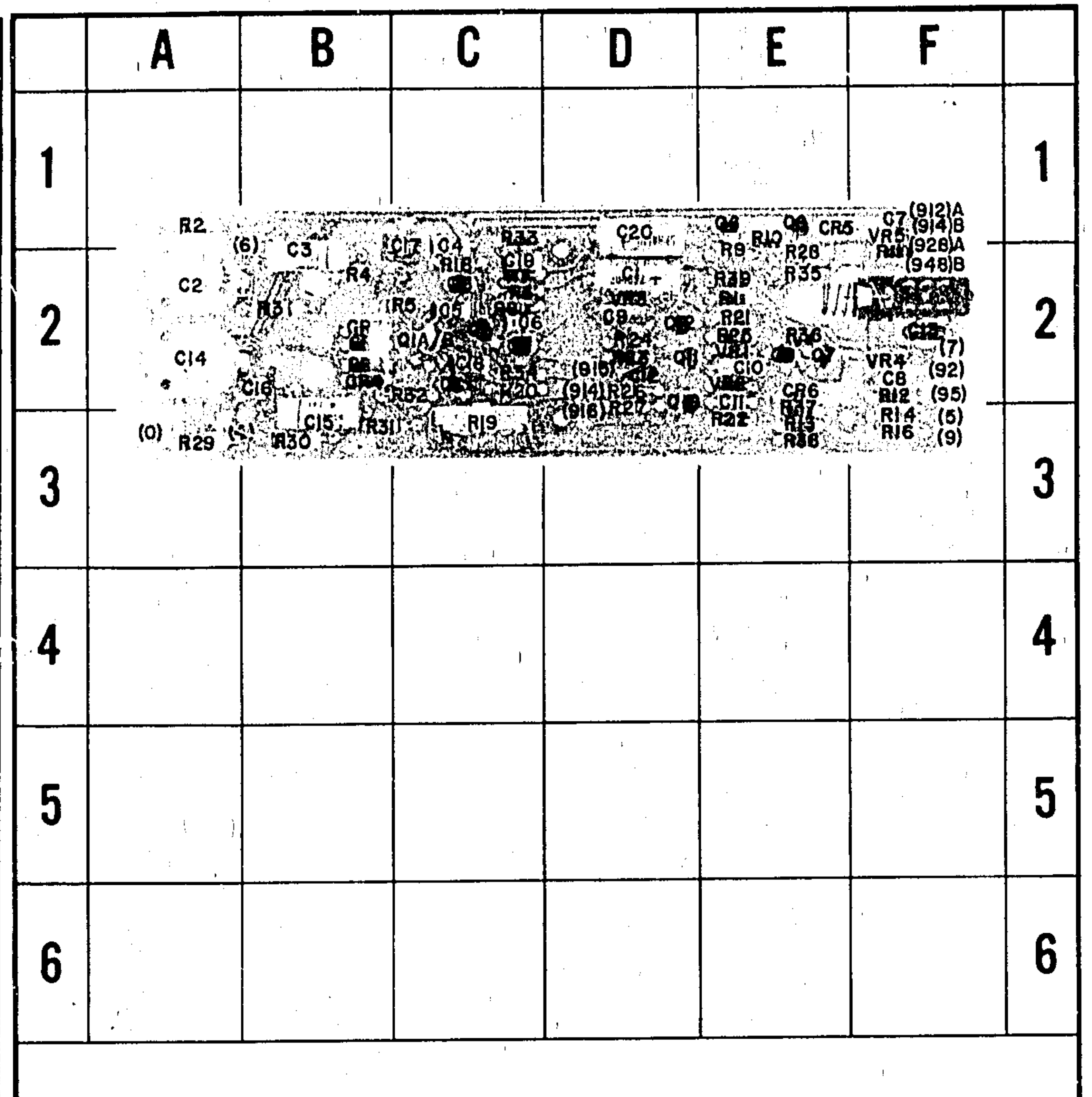
Figure 8-7. 100 uV Preamplifier Module, A1, Component Identification



Note: For complete reference designation, prefix component designators with A1.

1200A-A-16A

Figure 8-8. Volts/Division Switch, A1A2, Component Identification



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	D-2	C12	D-2	CR2	B-2	Q6	E-1	R4	B-2	R14	F-3	R26	D-2	R36	E-2
C2	A-2	C13	F-2	CR3	B-2	Q7	E-2	R5	C-2	R16	F-3	R27	D-2	R37	E-2
C3	B-1	C14	A-2	CR4	B-2	Q8	E-1	R6	C-2	R18	C-2	R28	E-1	R38	E-3
C4	C-1	C15	B-3	CR5	E-1	Q9	E-2	R7	C-2	R19	C-3	R29	A-3	R39	E-2
C5	C-2	C16	B-2	CR6	E-2	Q10	D-2	R8	C-2	R20	C-2	R30	B-3	S1	F-2
C6	C-2	C17	C-1	Q1A/B	C-2	Q11	D-2	R9	E-1	R21	E-2	R31	B-3	VR1	E-2
C7	F-1	C18	C-2	Q2	C-2	Q12	D-2	R10	E-1	R22	E-3	R32	C-2	VR2	E-2
C8	F-2	C19	C-2	Q3	C-2	R1	E-2	R11	F-1	R23	D-2	R33	C-1	VR3	D-2
C9	D-2	C20	D-1	Q4	C-2	R2	A-1	R12	F-2	R24	D-2	R34	C-2	VR4	F-2
C10	E-2	CR1	B-2	Q5	C-2	R3	B-2	R13	E-3	R25	E-2	R35	E-2	VR5	F-1
C11	E-2														

Note: For complete reference designation, prefix component designators with A1A1.

1200A-A-2-11-76

Figure 8-9. Vertical Preamplifier, A1A1, Component Identification

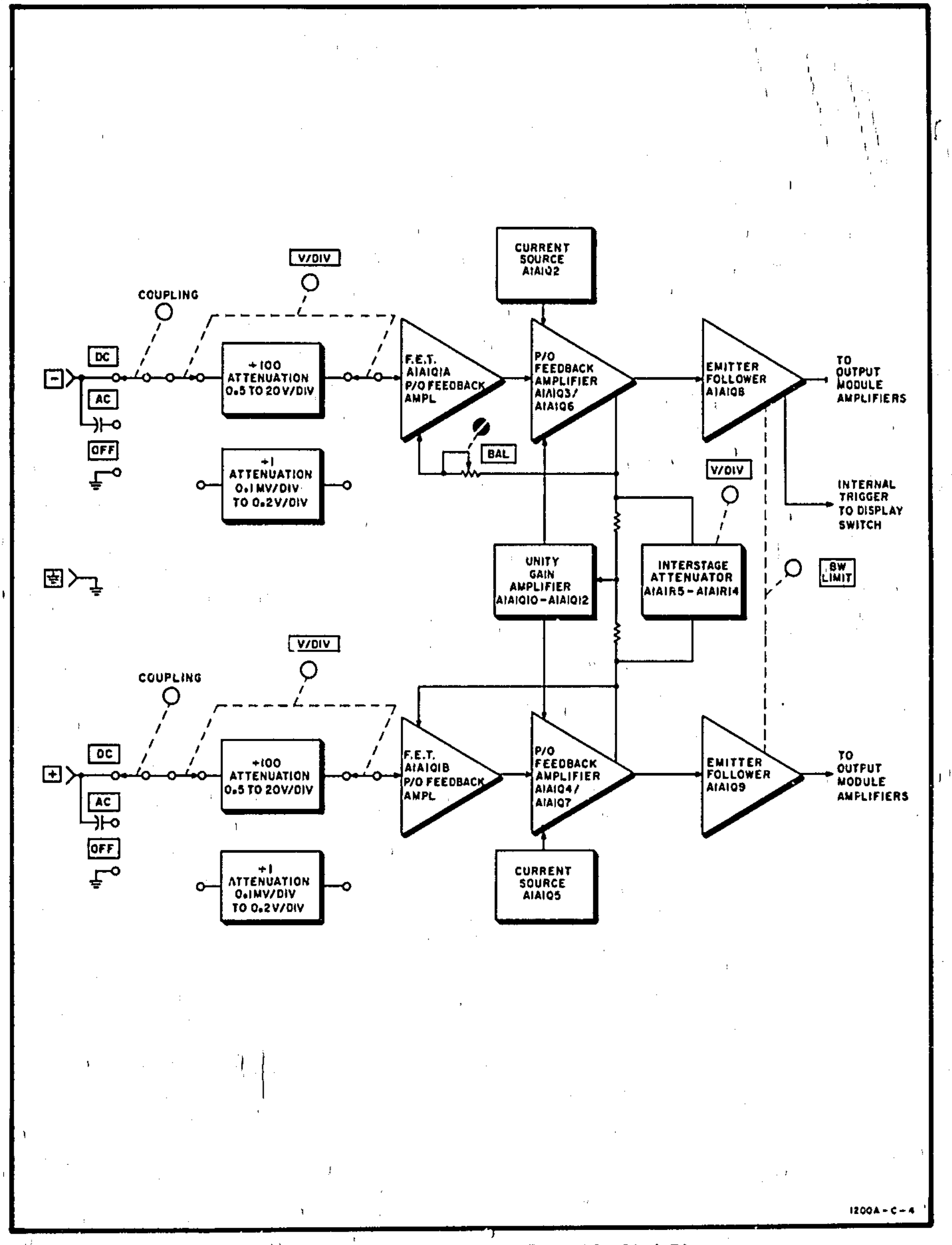


Figure 8-10. Channel A Attenuator and Preamplifier Block Diagram

DC VOLTAGE MEASUREMENT CONDITIONS

1. Set:
   - Volts/Division A .... 1 V/DIV
   - +Vertical Coupling A .... OFF
   - −Vertical Coupling A .... OFF

2. Voltages are referenced to chassis ground. All indications are approximate and may vary slightly from instrument to instrument.

WAVEFORM MEASUREMENT CONDITIONS

1. Set:
   - Volts/Division A .... 1 V/DIV
   - +Vertical Coupling A .... AC
   - −Vertical Coupling A .... OFF

2. Connect a 5V pk-pk, 1 kHz sine wave to channel A +INPUT jack.

3. All waveforms are referenced to chassis ground. Monitor oscilloscope's vertical sensitivity (using a 1:1 probe) and sweep speed settings are shown below each waveform photograph.

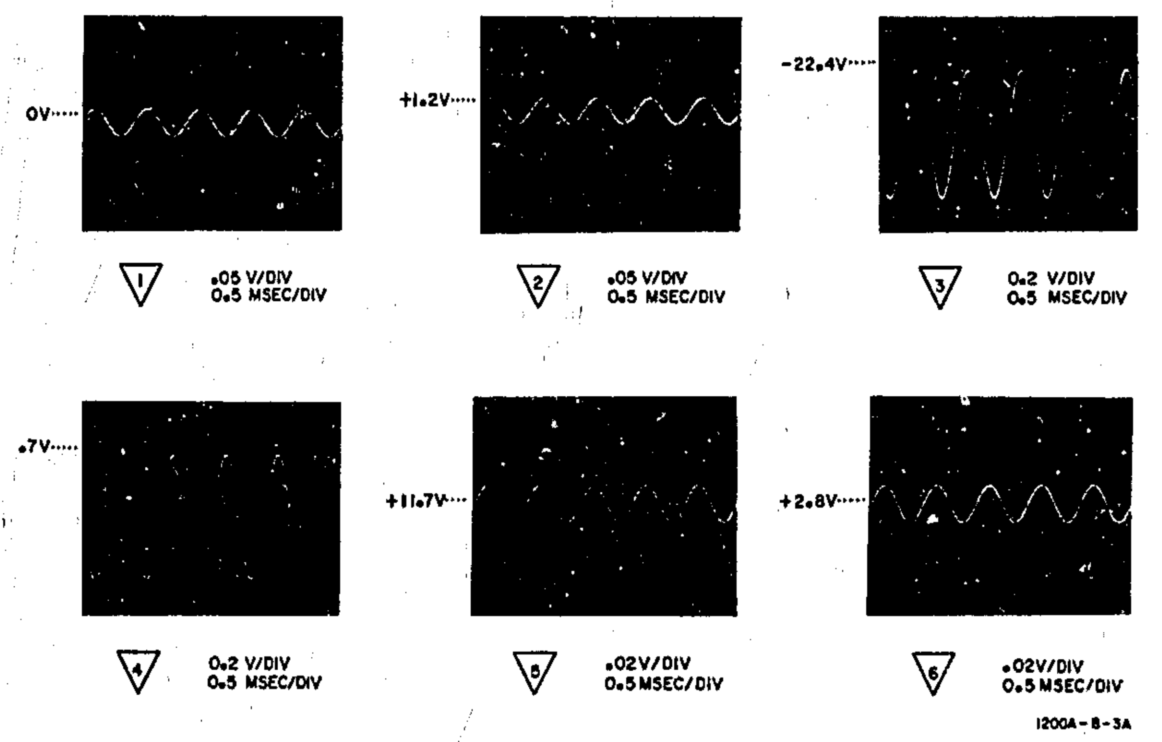


Figure 8-11. Channel A Preamplifier Module Measurement Conditions and Waveforms

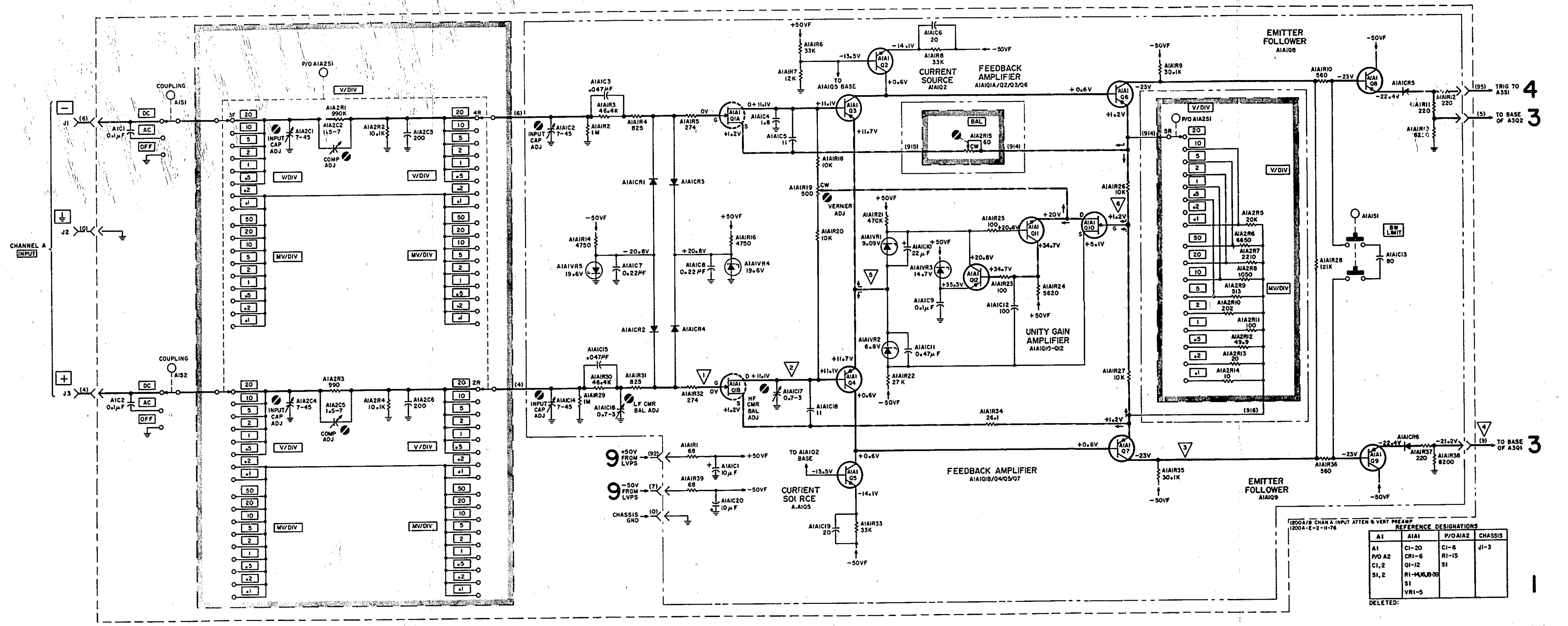
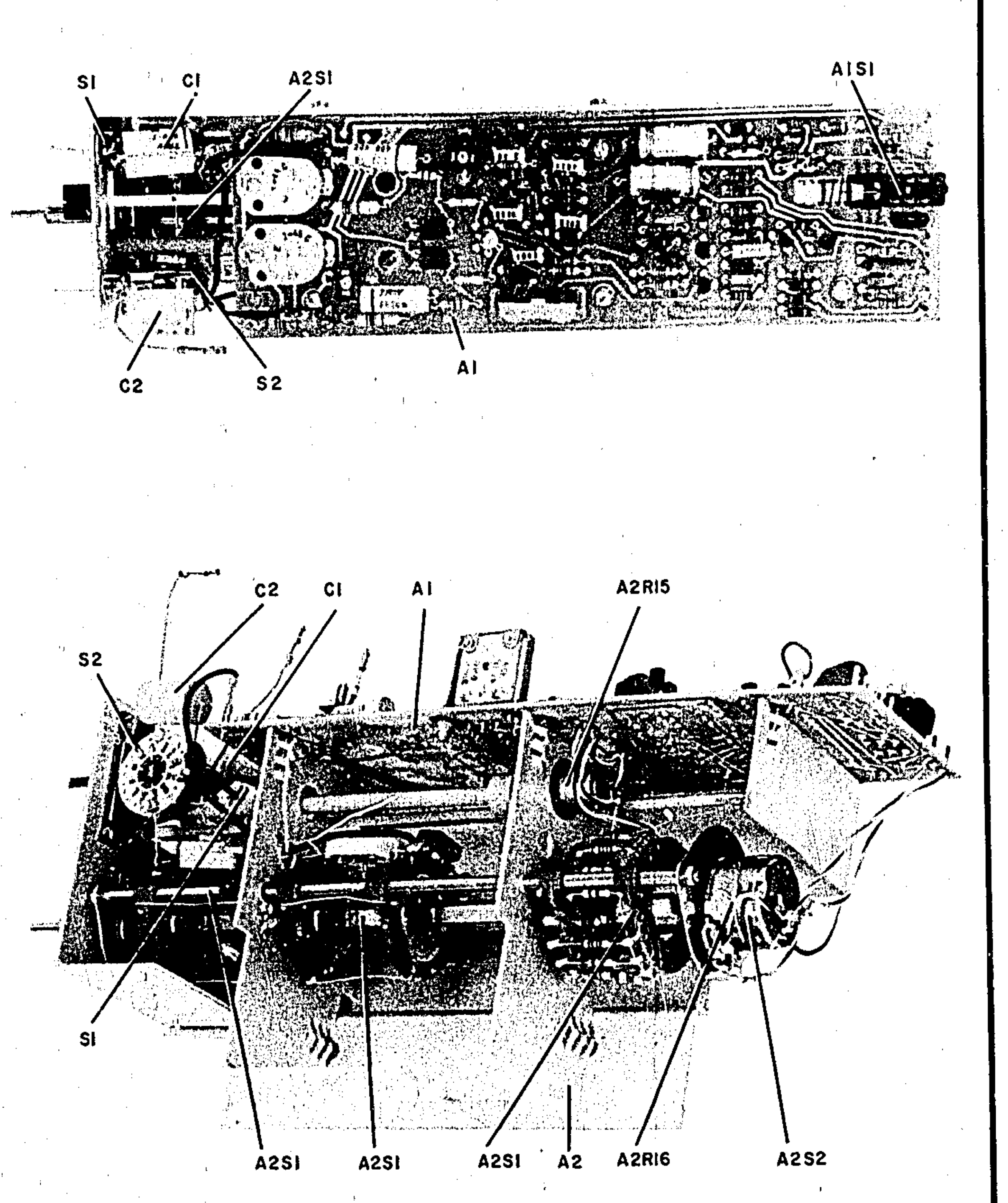


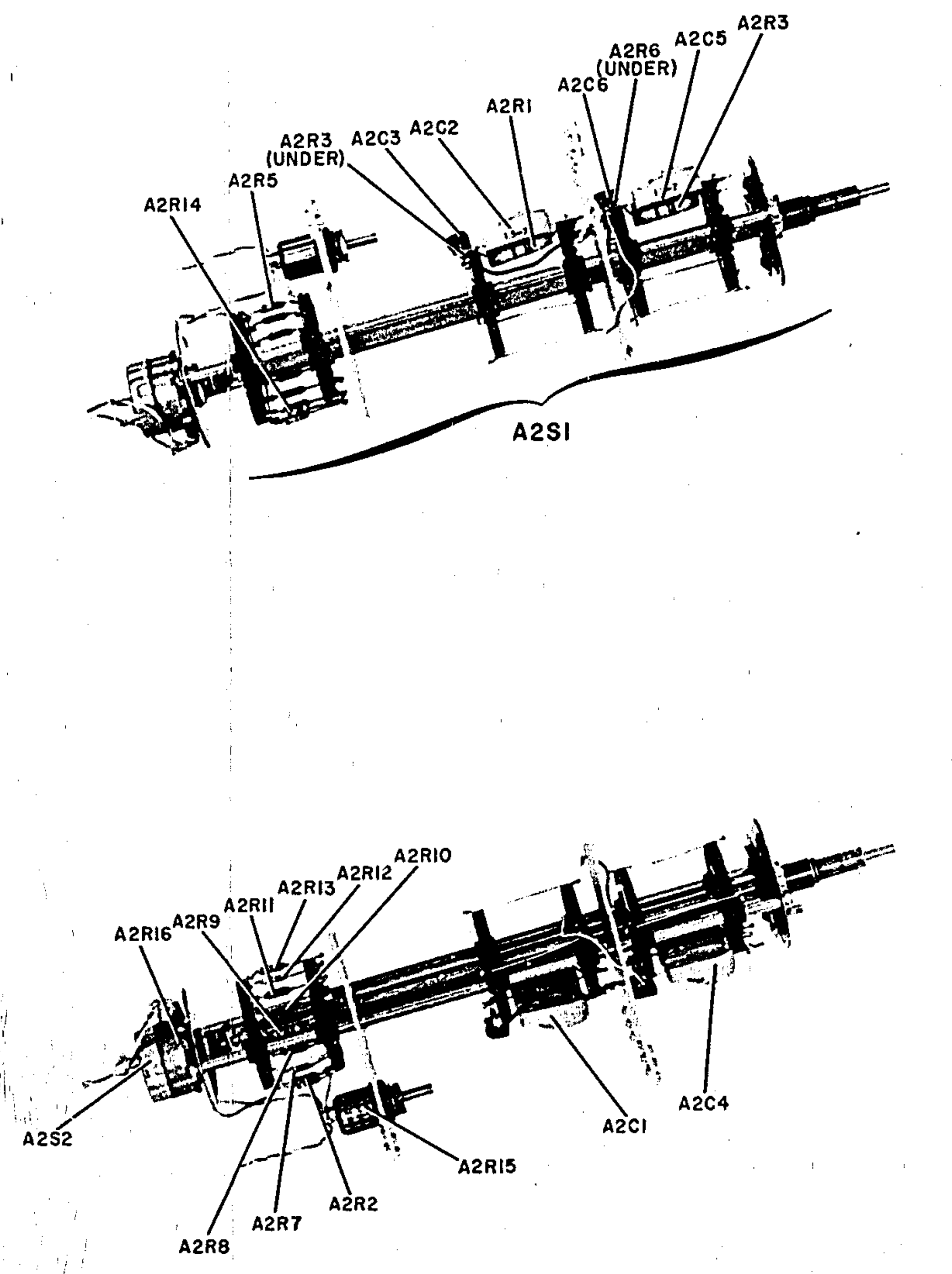
Figure 8-12. Channel A Preamplifier Module Schematic



Note: For complete reference designation, prefix component designators with A2.

1200A-A-38B

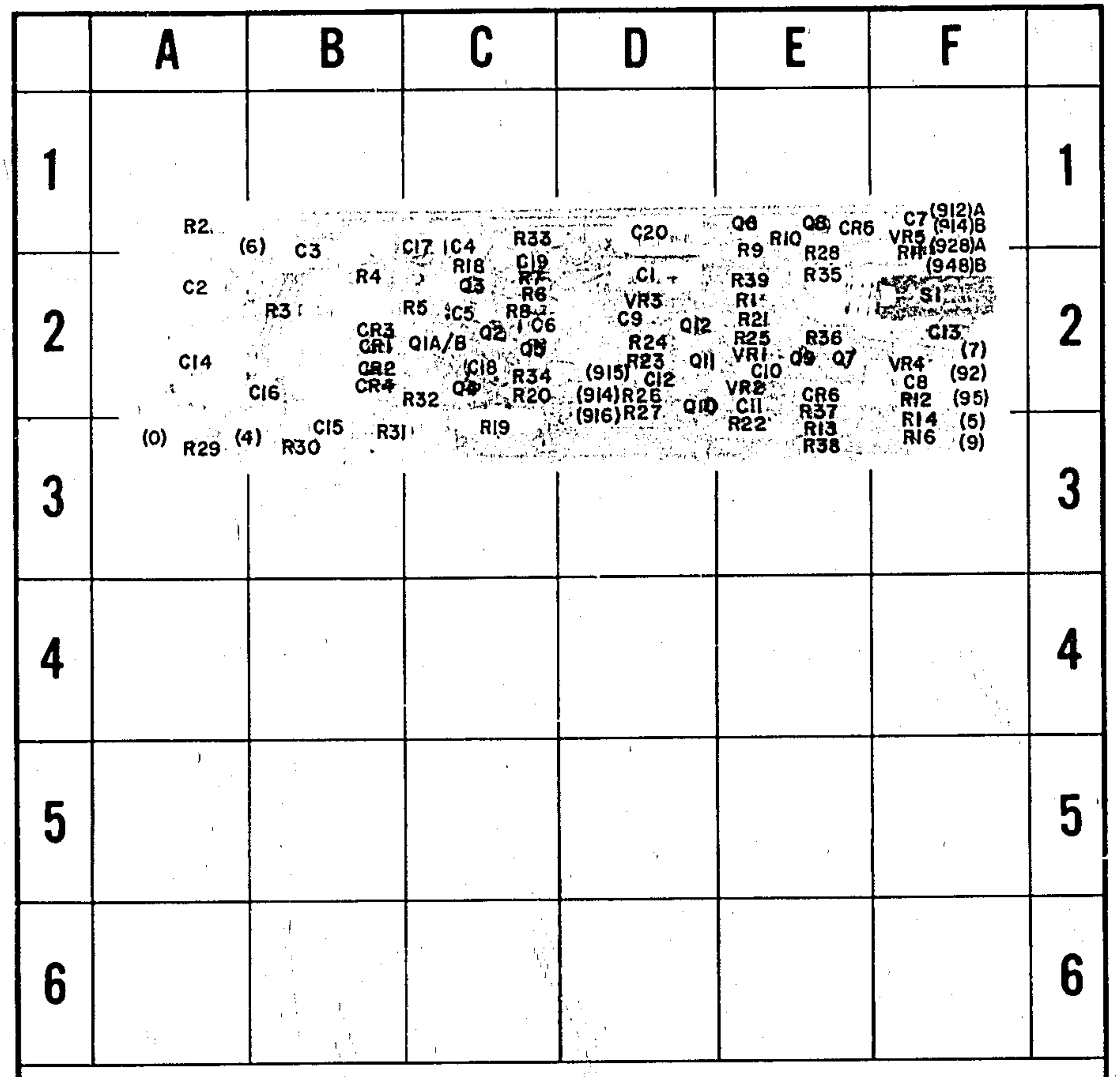
Figure 8-13. 100 uV Preamplifier Module, A2, Component Identification



Note: For complete reference designation, prefix component designators with A2.

1200A-A-16A

Figure 8-14. Volts/Division Switch, A2A2, Component Identification

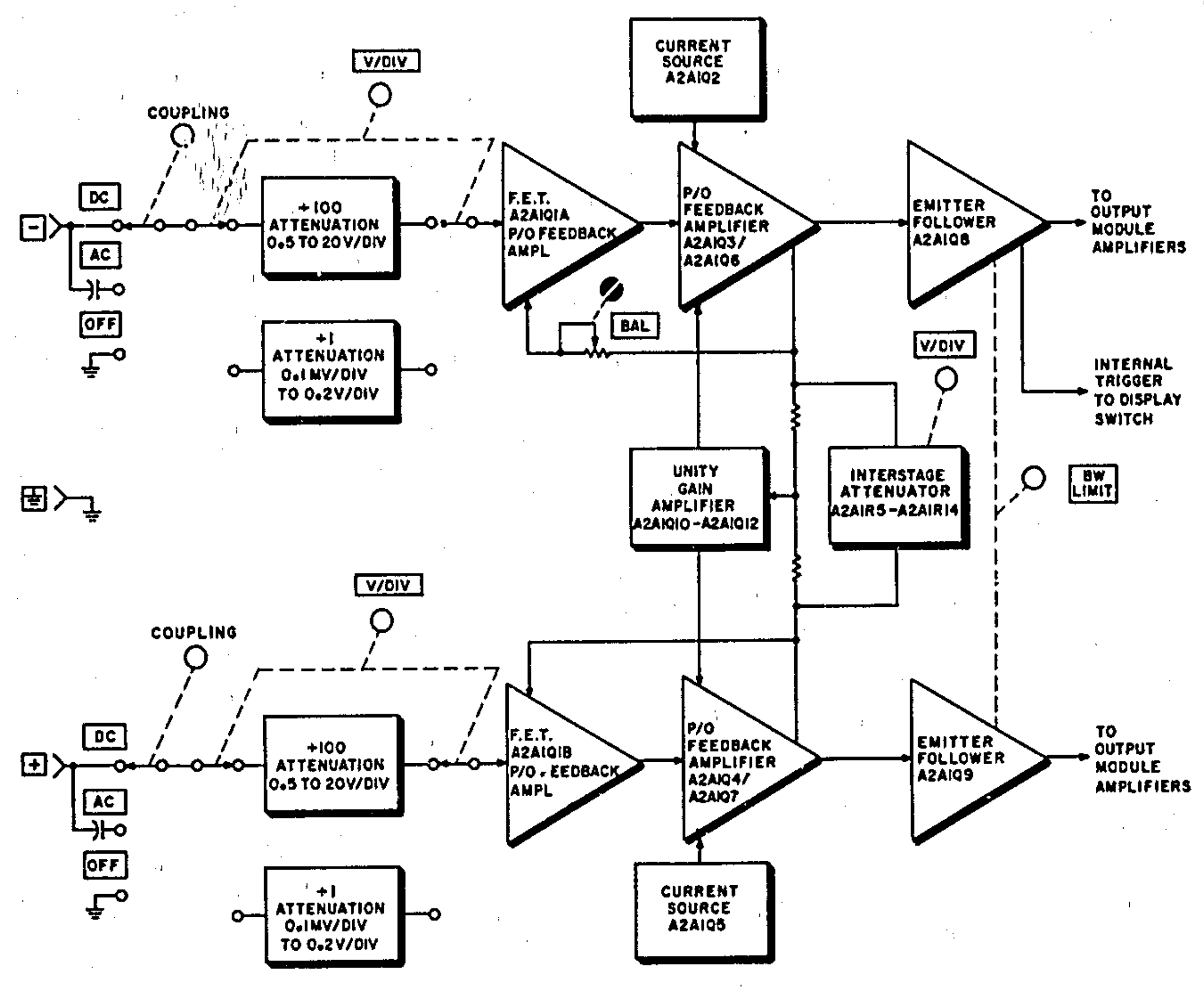


REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	D-2	C12	D-2	CR2	B-2	Q6	E-1	R4	B-2	R14	F-3	R26	D-2	R36	E-2
C2	A-2	C13	F-2	CR3	B-2	Q7	E-2	R5	C-2	R16	F-3	R27	D-2	R37	E-2
C3	B-1	C14	A-2	CR4	B-2	Q8	E-1	R6	C-2	R18	C-2	R28	E-1	R38	E-3
C4	C-1	C15	B-3	CR5	E-1	Q9	E-2	R7	C-2	R19	C-3	R29	A-3	R39	E-2
C5	C-2	C16	B-2	CR6	E-2	Q10	D-2	R8	C-2	R20	C-2	R30	B-3	S1	F-2
C6	C-2	C17	C-1	Q1A/B	C-2	Q11	D-2	R9	B-1	R21	E-2	R31	B-3	VR1	E-2
C7	F-1	C18	C-2	Q2	C-2	Q12	D-2	R10	E-1	R22	E-3	R32	C-2	VR2	E-2
C8	F-2	C19	C-2	Q3	C-2	R1	E-2	R11	F-1	R23	D-2	R33	C-1	VR3	D-2
C9	D-2	C20	D-1	Q4	C-2	R2	A-1	R12	F-2	R24	D-2	R34	C-2	VR4	F-2
C10	E-2	CR1	B-2	Q5	C-2	R3	B-2	R13	E-3	R25	E-2	R35	E-2	VR5	F-1
C11	E-2														

Note: For complete reference designation, prefix component designators with A2A1.

1200A-A-2-II-76

Figure 8-15. Vertical Preamplifier, A2A1, Component Identification



1200A-C-5

Figure 8-16. Channel B Attenuator and Preamplifier Block Diagram

DC VOLTAGE MEASUREMENT CONDITIONS

1. Set:
   - Volts/Division B .... 1 V/DIV
   - +Vertical Coupling B .... OFF
   - −Vertical Coupling B .... OFF
2. Voltages are referenced to chassis ground. All indications are approximate and may vary slightly from instrument to instrument.

WAVEFORM MEASUREMENT CONDITIONS

1. Set:
   - Volts/Division B .... 1 V/DIV
   - +Vertical Coupling B ....
   - −Vertical Coupling B .... OFF
2. Connect a 5V pk-pk, 1 kHz sine wave to channel B +INPUT jack.
3. All waveforms are referenced to chassis ground. Monitor oscilloscope's vertical sensitivity (using a 1:1 probe) and sweep speed settings are shown below each waveform photograph.

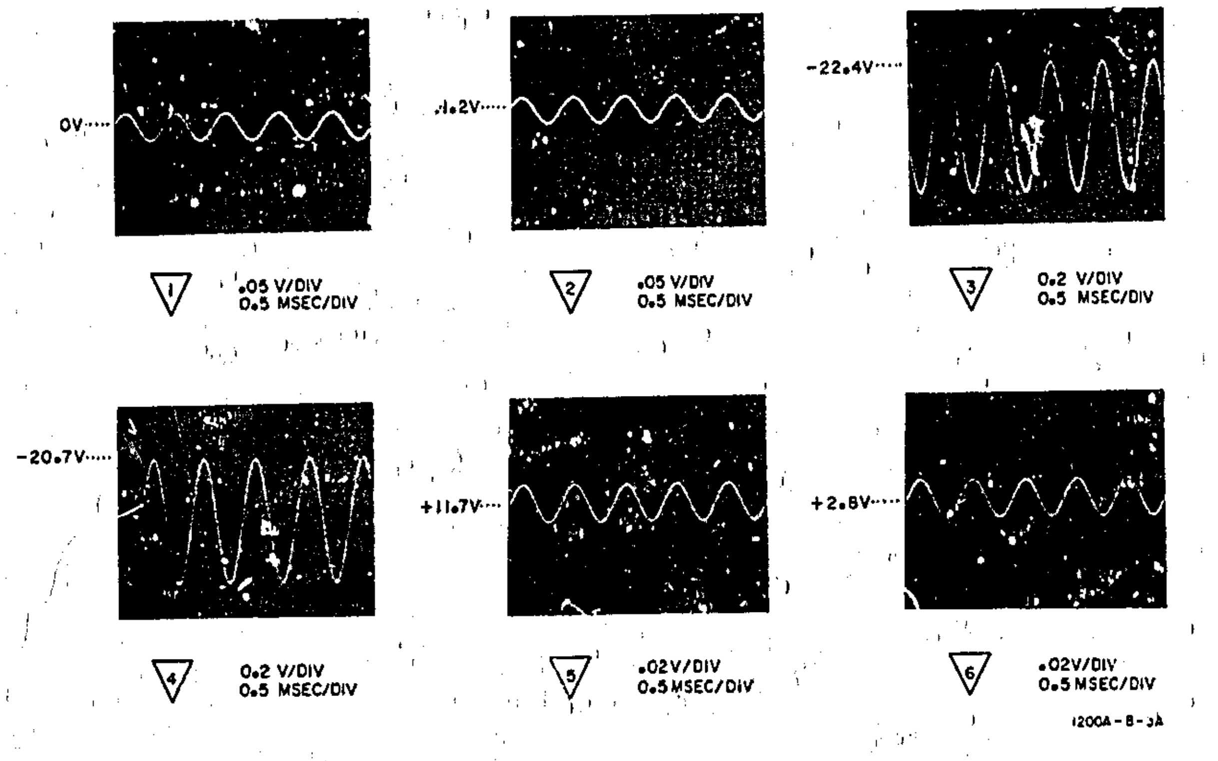


Figure 8-17. Channel B Preamplifier Module Measurement Conditions and Waveforms

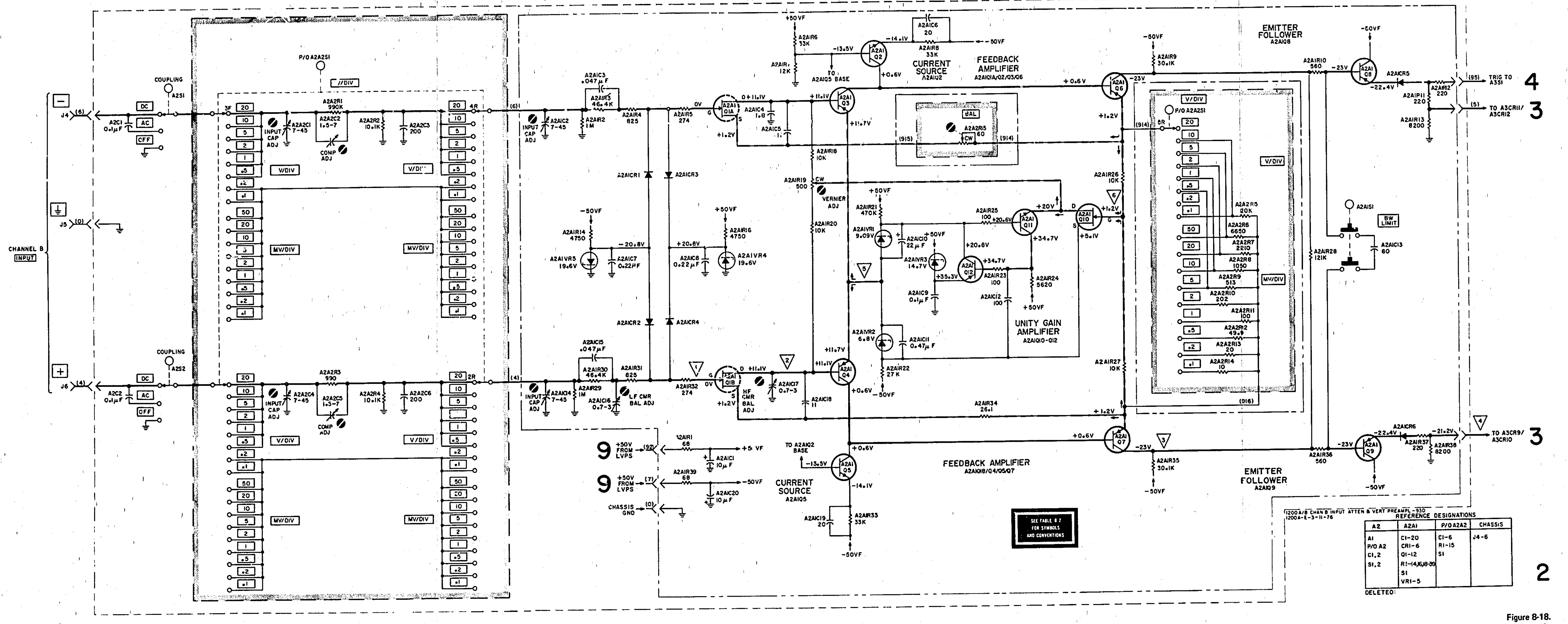
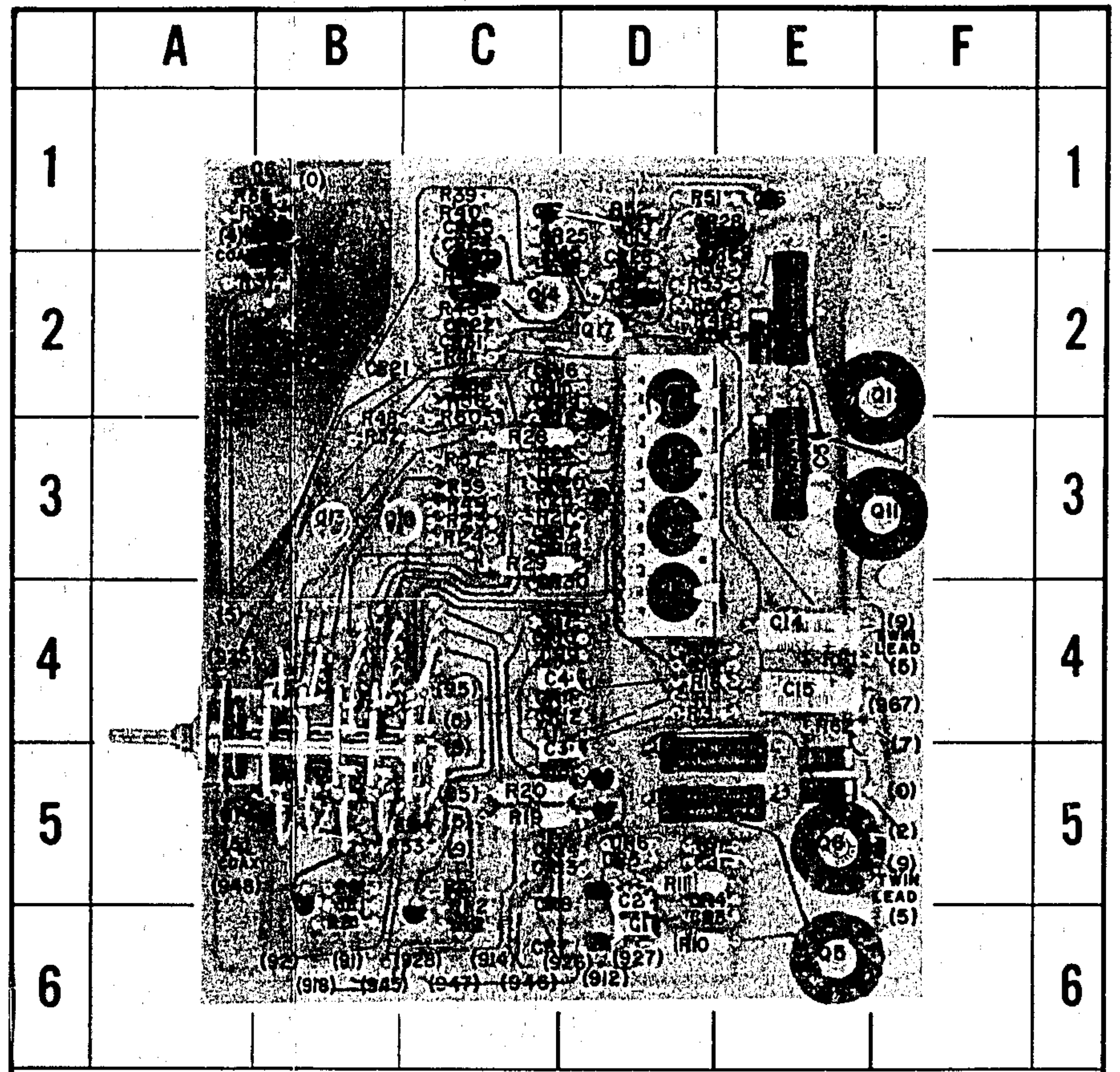


Figure 8-18. Channel B Preamplifier Module Schematic



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	D-6	CR3	D-6	CR20	C-3	Q2	C-6	R1	D-4	R15	D-4	R32	B-3	R48	B-2
C2	D-5	CR4	D-5	CR21	B-2	Q3	D-6	R2	B-6	R16	D-4	R33	C-5	R49	D-2
C3	C-5	CR5	D-5	CR22	C-2	Q4	D-5	R3	D-4	R17	C-4	R34	C-5	R50	D-2
C4	C-4	CR6	D-5	CR23	C-1	Q5	E-6	R4A	D-4	R18	C-5	R35	A-1	R51	D-1
C5	E-3	CR7	C-6	CR24	C-1	Q6	E-5	R4B	D-3	R19	C-5	R36	A-1	R52	D-1
C6	B-1	CR8	C-6	CR25	C-1	Q7	D-5	R4C	D-3	R20	C-5	R37	A-2	R53	D-2
C7	B-1	CR9	C-4	CR26	D-2	Q8	D-6	R4D	D-2	R21	C-3	R38	D-2	R54	D-2
C8	B-1	CR10	C-4	CR27	D-1	Q9	D-3	R5	C-5	R22	D-3	R39	C-1	R55	D-2
C9	C-2	CR11	C-4	CR28	D-1	Q10	D-3	R6	B-5	R23	C-3	R40	C-1	R56	C-2
C10	C-2	CR12	C-4	CR29	E-1	Q11	F-3	R7	C-6	R24	C-3	R41	C-2	R57	C-3
C11	D-2	CR13	C-5	CR30	C-4	Q12	F-3	R8	D-5	R25	C-3	R42	C-2	R58	C-2
C12	E-1	CR14	C-5	CR31	C-2	Q13	B-3	R9	D-5	R26	C-3	R43	C-2	R59	C-3
C13	D-1	CR15	C-2	L1	E-5	Q14	C-2	R10	D-6	R27	C-3	R44	C-3	R60	C-2
C14	E-4	CR16	C-2	L2	E-5	Q15	C-1	R11	D-5	R28	C-3	R45	D-1	R61	E-4
C15	E-4	CR17	C-3	L3	E-3	Q16	E-1	R12	D-5	R29	C-3	R46	D-2	R62	E-4
CR1	B-6	CR18	C-3	L4	E-2	Q17	D-2	R13	D-5	R30	E-3	R47	D-2	S1	A-4
CR2	C-6	CR19	C-2	Q1	B-5	Q18	B-3	R14	D-4	R31	E-2				

Note: For complete reference designation, prefix component designators with A3.

1200A-A-6

Figure 8-19. Dual Channel Output Amplifier, A3, Component Identification

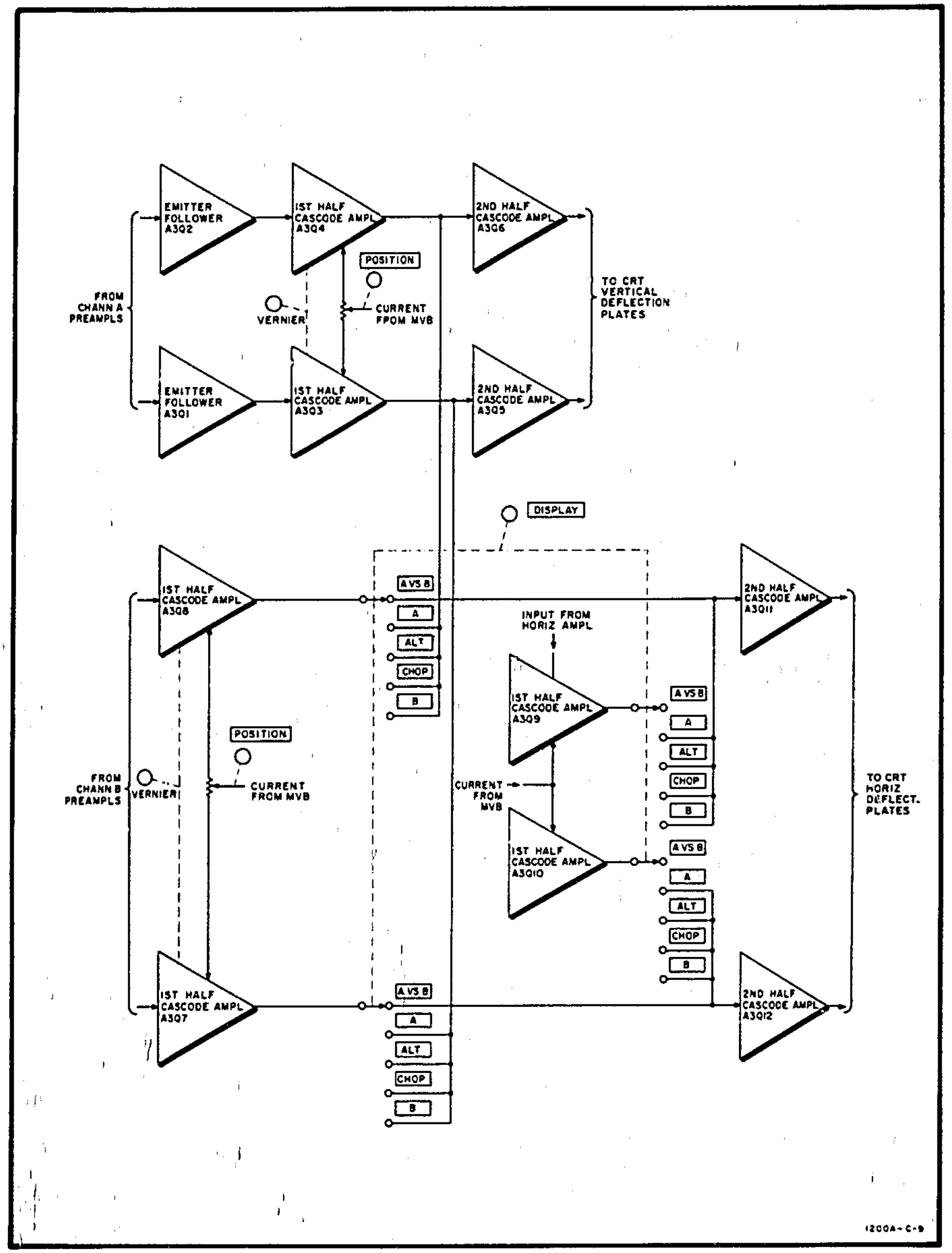


Figure 8-20. Dual Channel Output Amplifier Block Diagram

Table 8-3. Dual Channel Output Amplifier Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Set:
   - DISPLAY .... A
   - Vertical POSITION (A and B) .... midrange
   - Vertical Vernier (A and B) .... CAL
   - Volts/Division (A and B) .... 1 V/DIV
   - +Vertical Coupling (A and B) .... OFF
   - −Vertical Coupling (A and B) .... OFF
   - Horizontal POSITION .... midrange
   - SWEEP/EXT HORIZ .... 1 V/DIV

2. Voltages are referenced to chassis ground. All indications are approximate and may vary slightly from instrument to instrument.

3. *To measure voltages with an asterisk, set DISPLAY to A vs B.

WAVEFORM MEASUREMENT CONDITIONS

1. Set:
   - DISPLAY .... A
   - Vertical POSITION (A and B) .... midrange
   - Volts/Division (A and B) .... 1 V/DIV
   - Vertical Vernier (A and B) .... CAL
   - +Vertical Coupling A .... AC
   - −Vertical Coupling A .... OFF
   - +Vertical Coupling B .... AC
   - −Vertical Coupling B .... OFF
   - Horizontal POSITION .... midrange
   - SWEEP/EXT HORIZ x1
   - Time/Division .... 0.2 MSEC/DIV
   - Horizontal Vernier .... CAL
   - SLOPE .... +
   - MODE .... NORM
   - TRIGGER LEVEL .... AUTO
   - Horizontal COUPLING .... DC
   - SOURCE .... INT

2. Connect a 5V pk-pk, 1 kHz sine wave to channel A +INPUT jack.

3. ▽ To measure these waveforms, connect a 5V pk-pk, 1 kHz sine wave to both channel A and B +INPUT jacks. Set the controls as indicated in step 1, except set DISPLAY to A vs B.

4. All waveforms are referenced to chassis ground. Monitor oscilloscope's vertical sensitivity (using a 1:1 probe) and sweep speed settings are shown below each waveform photograph.

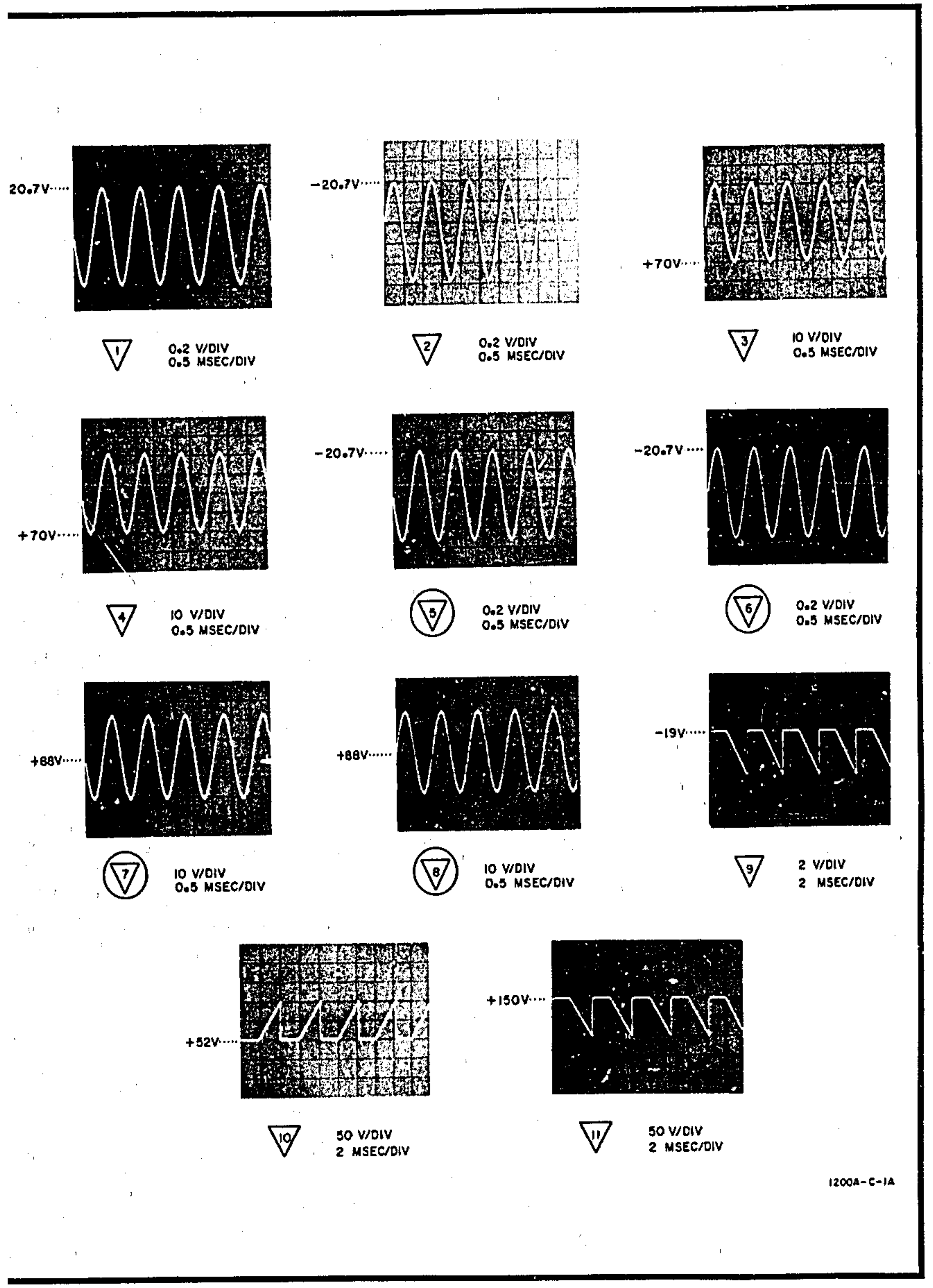


Figure 8-21. Dual Channel Output Amplifier Waveforms

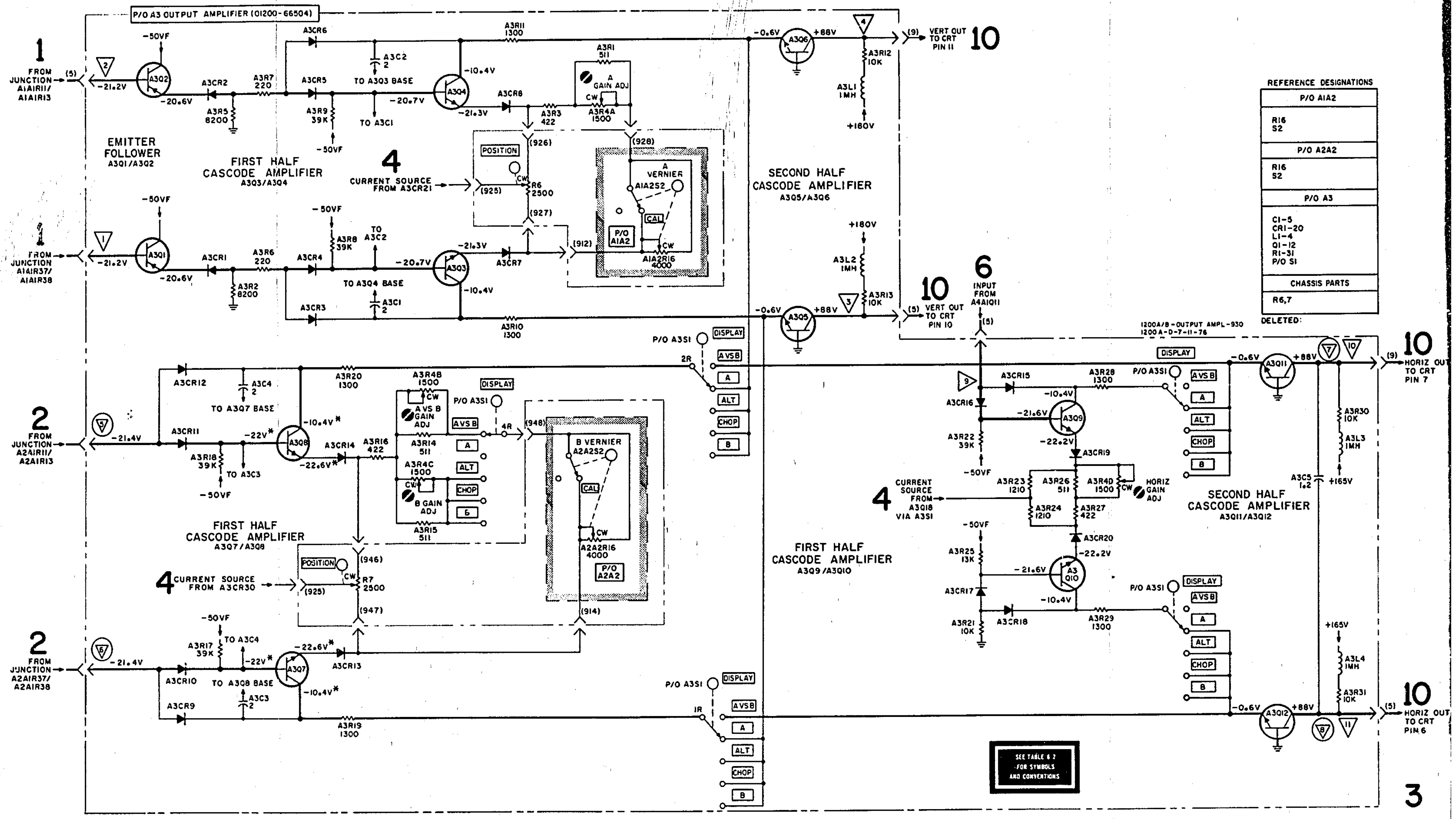
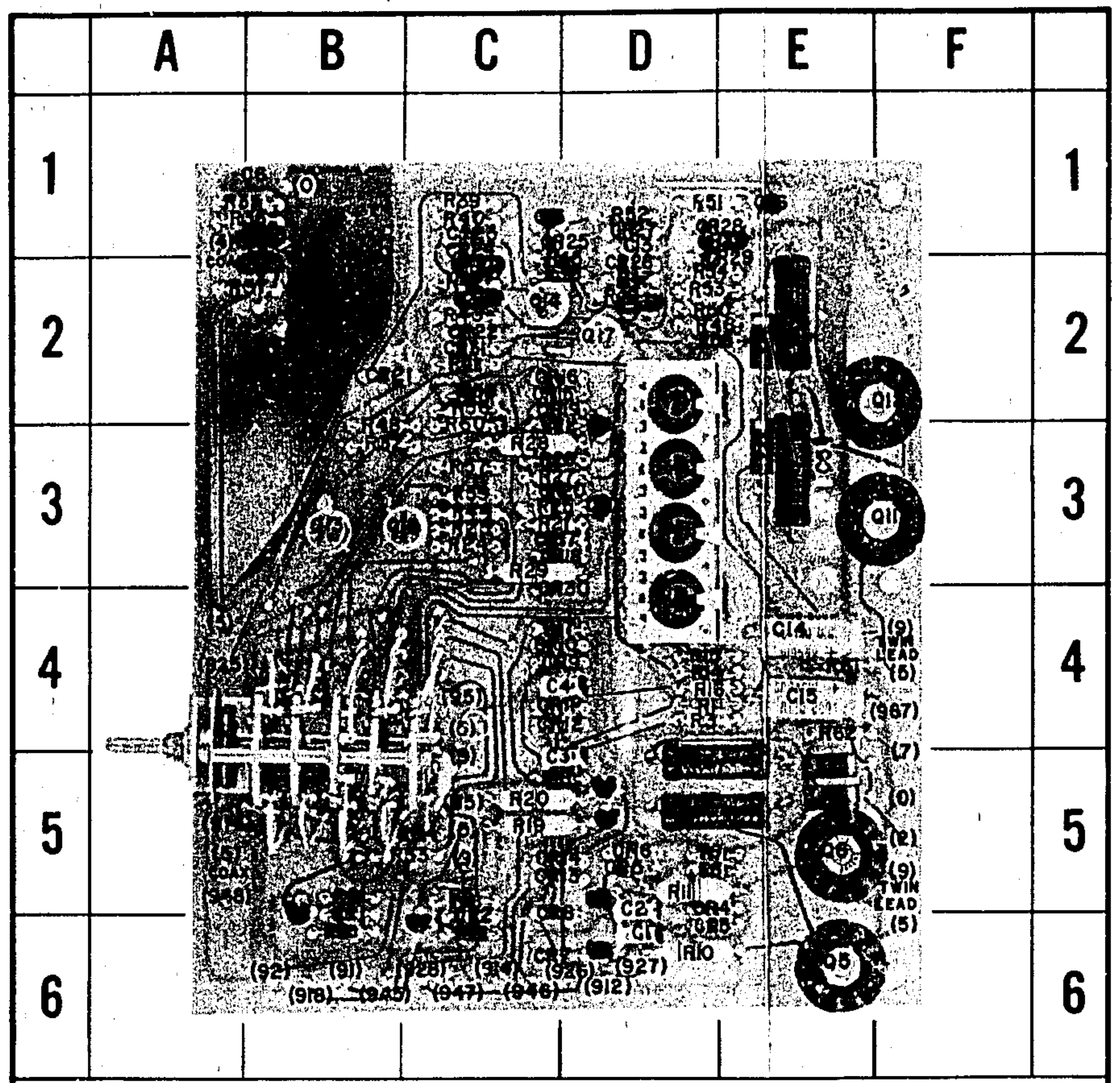


Figure 8-22
Dual Channel Output Amplifier Schemati



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	D-6	CR3	D-6	CR20	C-3	Q2	C-6	R1	D-4	R15	D-4	R32	B-3	R48	B-2
C2	D-5	CR4	D-5	CR21	B-2	Q3	D-6	R2	B-6	R16	D-4	R33	C-5	R49	D-2
C3	C-5	CR5	D-5	CR22	C-2	Q4	D-5	R3	D-4	R17	C-4	R34	C-5	R50	D-2
C4	C-4	CR6	D-5	CR23	C-1	Q5	E-6	R4A	D-4	R18	C-5	R35	A-1	R51	D-1
C5	E-3	CR7	C-6	CR24	C-1	Q6	E-5	R4B	D-3	R19	C-5	R36	A-1	R52	D-1
C6	B-1	CR8	C-6	CR25	C-1	Q7	D-5	R4C	D-3	R20	C-5	R37	A-2	R53	D-2
C7	B-1	CR9	C-4	CR26	D-2	Q8	D-5	R4D	D-2	R21	C-3	R38	D-2	R54	D-2
C8	B-1	CR10	C-4	CR27	D-1	Q9	D-3	R5	C-5	R22	D-3	R39	C-1	R55	D-2
C9	C-2	CR11	C-4	CR28	D-1	Q10	D-3	R6	B-5	R23	C-3	R40	C-1	R56	C-2
C10	C-2	CR12	C-4	CR29	E-1	Q11	F-3	R7	C-6	R24	C-3	R41	C-2	R57	C-3
C11	D-2	CR13	C-5	CR30	C-4	Q12	F-2	R8	D-5	R25	C-3	R42	C-2	R58	C-2
C12	E-1	CR14	C-5	CR31	C-2	Q13	B-3	R9	D-5	R26	C-3	R43	C-2	R59	C-3
C13	D-1	CR15	C-2	L1	E-5	Q14	C-2	R10	D-6	R27	C-3	R44	C-3	R60	C-2
C14	E-4	CR16	C-2	L2	E-6	Q15	C-1	R11	D-5	R28	C-3	R45	D-1	R61	E-4
C15	E-4	CR17	C-3	L3	E-3	Q16	E-1	R12	D-5	R29	C-3	R46	D-2	R62	E-4
CR1	B-6	CR18	C-3	L4	E-2	Q17	D-2	R13	D-5	R30	E-3	R47	D-2	S1	A-4
CR2	C-6	CR19	C-2	Q1	B-5	Q18	B-3	R14	D-4	R31	E-2				

Note: For complete reference designation, prefix component designators with A3.

1200A-A-6

Figure 8-23. Multivibrator, A3, Component Identification

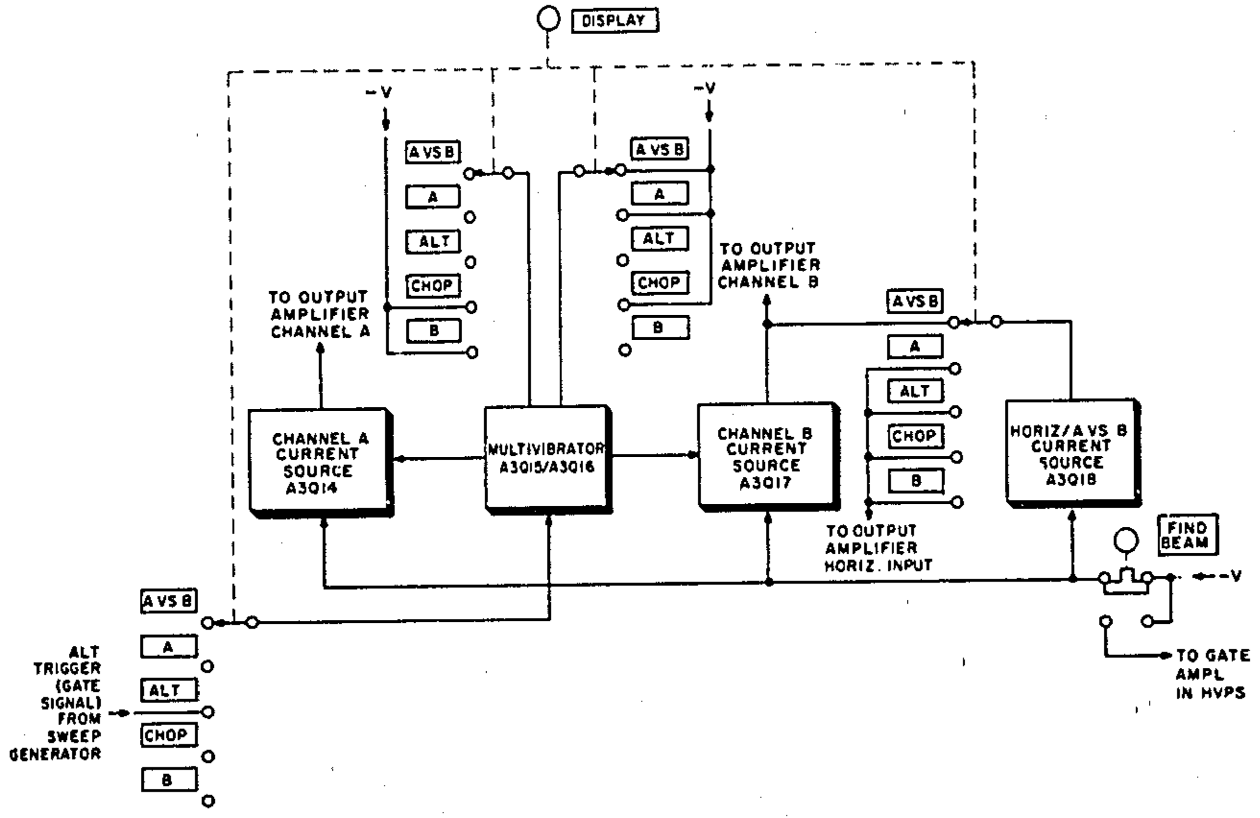


Figure 8-24. Multivibrator Block Diagram

Table 8-4. Multivibrator Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Set:
   DISPLAY .... A
   Vertical POSITION (A and B) ...... midrange
   Horizontal POSITION .... midrange

2. Voltages are referenced to chassis ground. All indications are approximate and may vary slightly from instrument to instrument.

WAVEFORM MEASUREMENT CONDITIONS

1. Set:

   DISPLAY .... CHOP
   Vertical POSITION (A and B) ...... midrange
   Horizontal POSITION .... midrange

2. All waveforms are referenced to chassis ground. Monitor oscilloscope's vertical sensitivity (using a 1:1 probe) and sweep speed settings are shown below each waveform photograph.

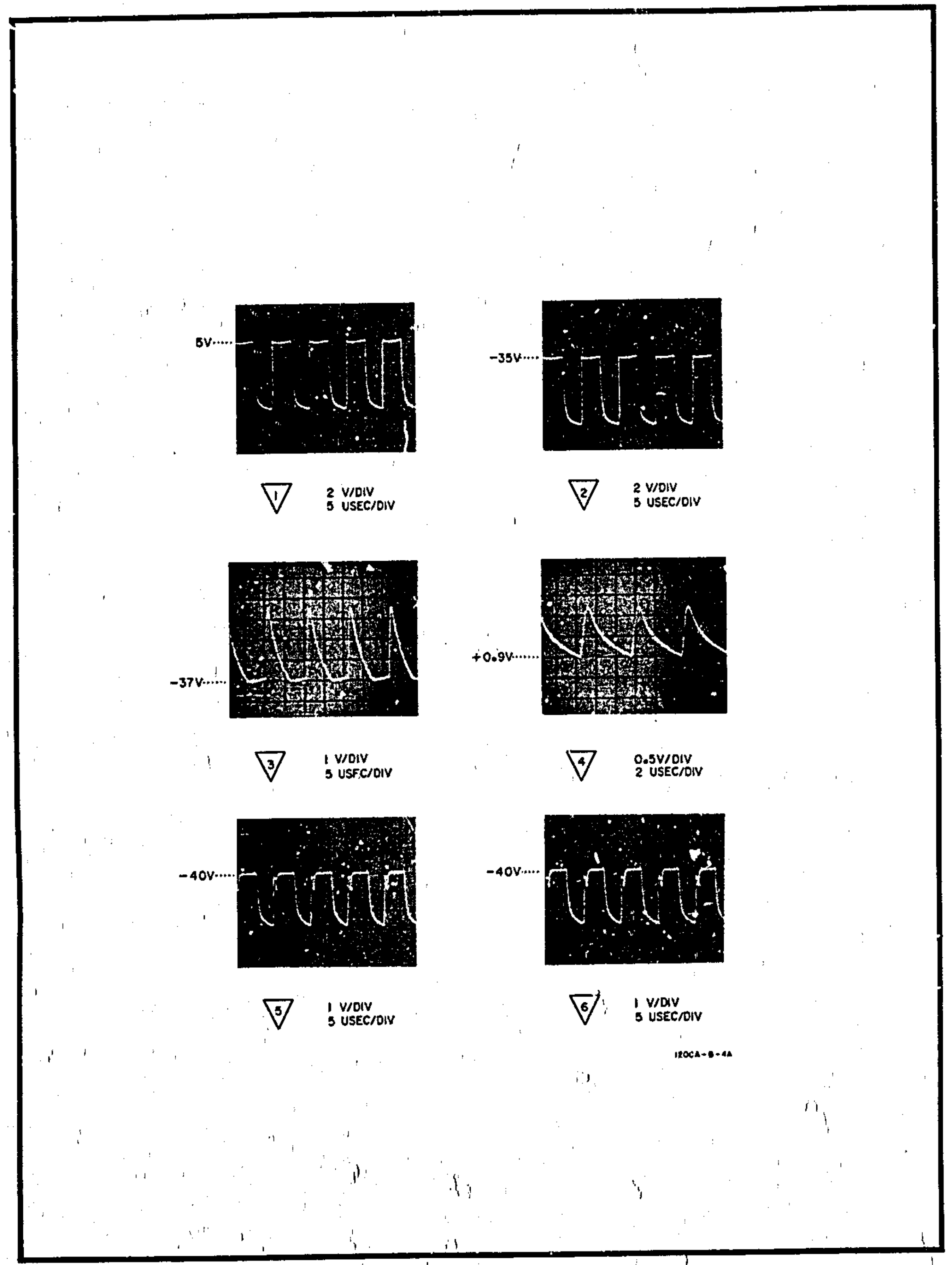


Figure 8-25. Multivibrator Waveforms

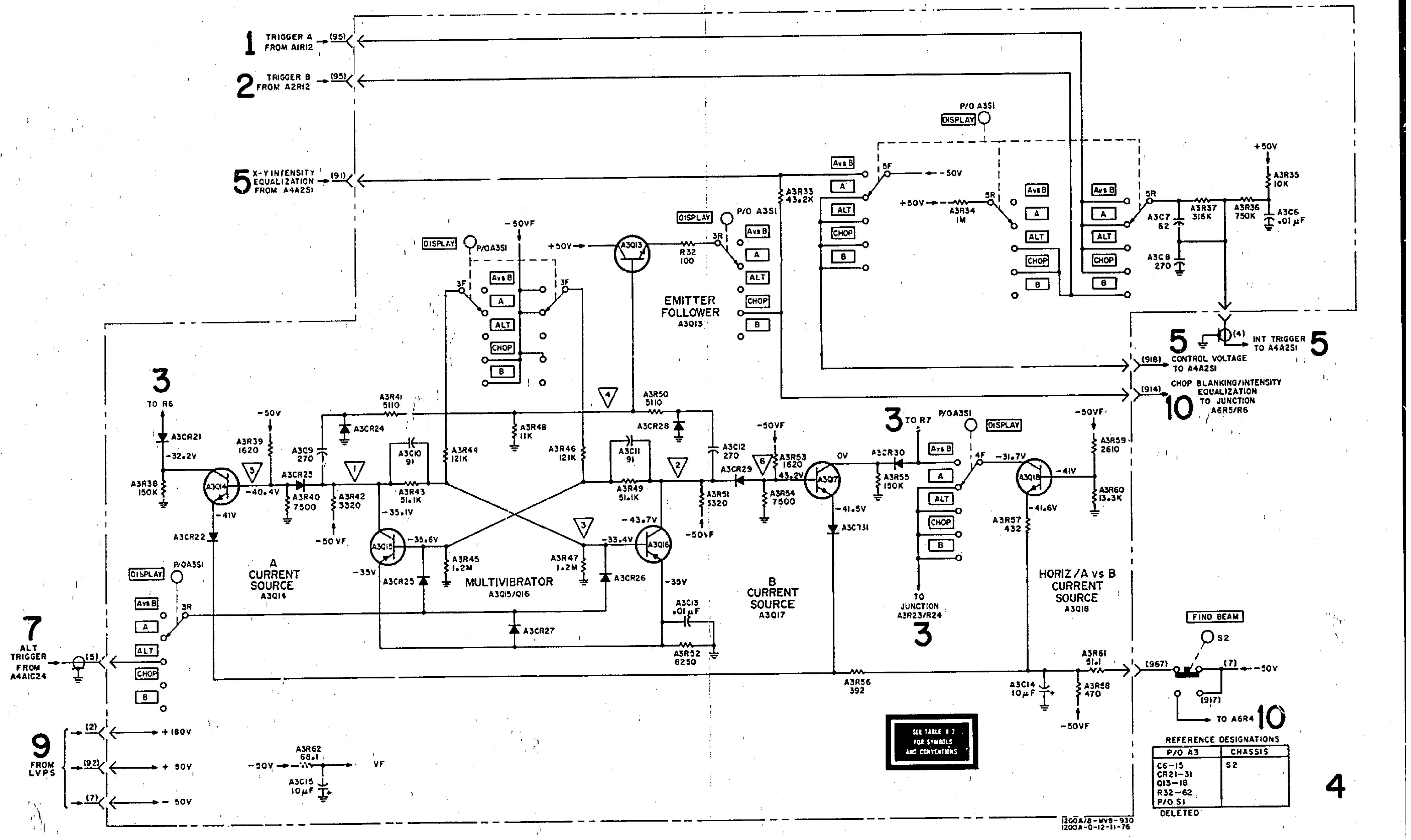
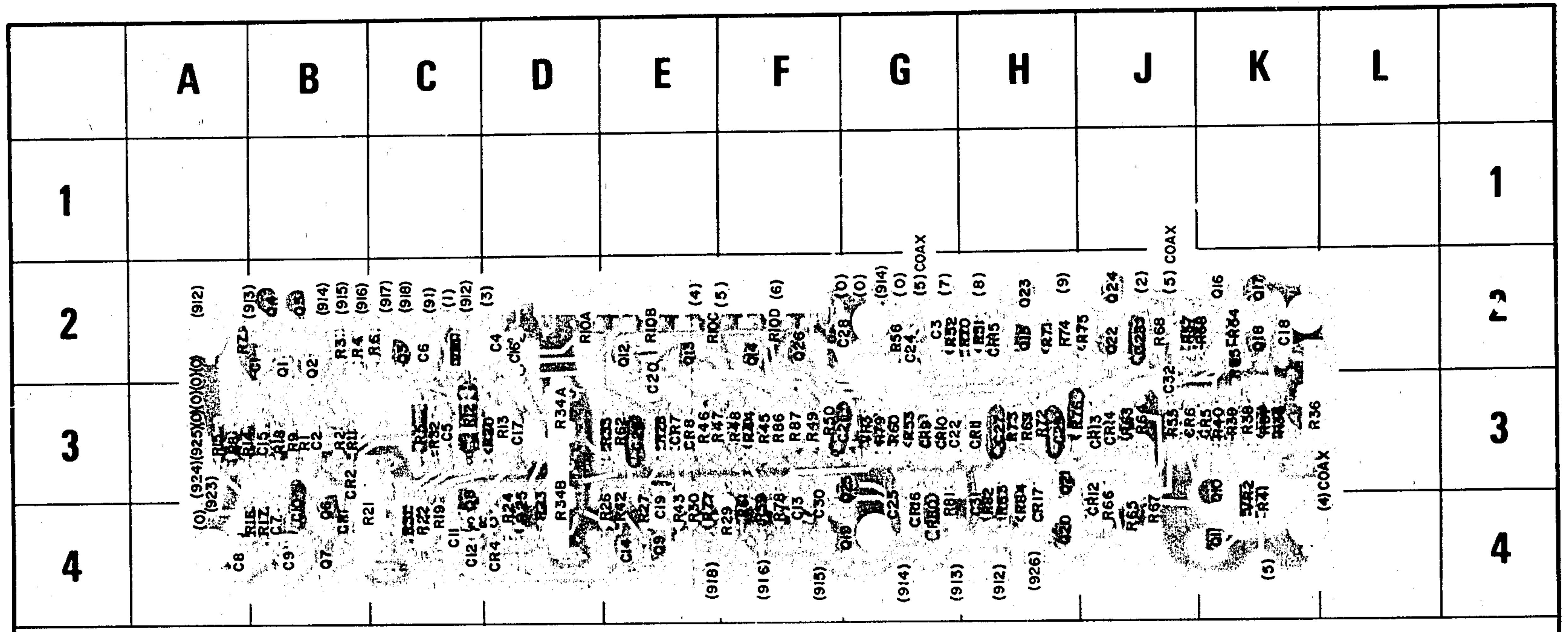


Figure 8-26.
Multivibrator Schematic



REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	B-2	C23	J-2	CR12	J-4	Q16	K-2	R10B	E-2	R29	F-4	R49	F-3	R70	H-2
C2	B-3	C24	G-2	CR13	J-3	Q17	K-2	R10C	E-2	R30	E-4	R50	F-3	R71	H-2
C3	G-2	C25	G-4	CR14	J-3	Q18	K-2	R10D	F-2	R31	C-4	R51	H-2	R72	H-3
C4	D-2	C26	E-3	CR15	H-2	Q19	F-4	R11	B-3	R32	C-3	R52	G-2	R73	H-3
C5	C-3	C27	H-3	CR16	G-4	Q20	H-4	R12	C-3	R33	E-3	R53	G-3	R74	H-2
C6	C-2	C28	G-2	CR17	H-4	Q21	H-3	R13	D-3	R34A	D-3	R54	K-2	R75	J-2
C7	B-4	C29	H-3	Q1	B-2	Q22	J-2	R14	A-3	R34B	D-4	R55	J-3	R76	H-3
C8	A-4	C30	F-4	Q2	B-2	Q23	H-2	R15	A-3	R35	K-3	R56	C-2	R77	E-4
C9	B-4	C31	H-3	Q3	C-2	Q24	J-2	R16	A-4	R36	K-3	R57	J-2	R78	F-4
C10	B-4	C32	J-3	Q4	B-2	Q25	G-3	R17	B-4	R37	K-3	R58	K-2	R79	G-3
C11	C-4	CR1	B-4	Q5	B-2	Q26	F-2	R18	B-3	R38	K-3	R59	F-4	R80	G-4
C12	C-4	CR2	B-3	Q6	B-4	R1	B-3	R19	C-4	R39	K-3	R60	G-3	R81	G-4
C13	F-4	CR3	C-3	Q7	B-4	R2	B-3	R20	D-3	R40	K-3	R61	F-4	R82	H-4
C14	E-4	CR4	D-4	Q8	C-3	R3	B-2	R21	B-4	R41	K-4	R62	E-3	R83	H-4
C15	B-3	CR5	K-3	Q9	E-4	R4	B-2	R22	C-4	R42	E-4	R63	J-3	R84	H-4
C16	D-2	CR6	J-3	Q10	K-4	R5	C-3	R23	D-4	R43	F-4	R64	J-3	R85	K-3
C17	D-3	CR7	F-3	Q11	K-4	R6	C-2	R24	D-4	R44	F-3	R65	J-4	R86	F-3
C18	K-2	CR8	F-3	Q12	F-2	R7	A-2	R25	D-4	R45	F-3	R66	J-4	R87	F-3
C19	F-4	CR9	G-3	Q13	E-2	R8	A-3	R26	D-4	R46	E-3	R67	J-4	VR1	C-2
C20	F-3	CR10	G-3	Q14	F-2	R9	B-3	R27	F-4	R47	E-3	R68	J-2	VR2	K-4
C21	F-3	CR11	H-4	Q15	H-2	R10A	D-2	R28	E-3	R48	F-3	R69	H-3	VR3	G-3
C22	G-3														

Note: For complete reference designation, prefix component designators with A4A1.

1200A-B-2

Figure 8-27. Horizontal Circuits, A4A1, Component Identification

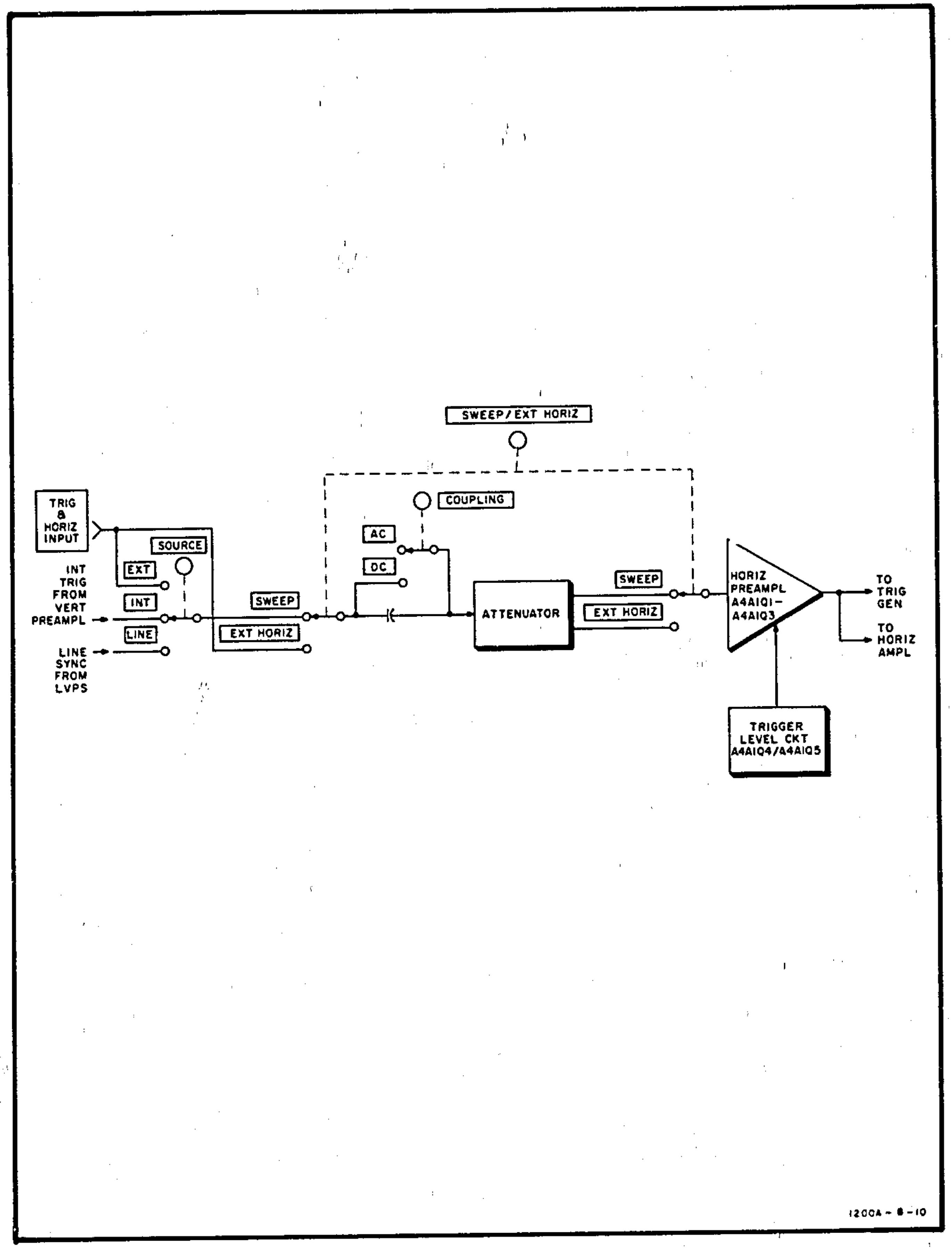


Figure 8-28. Horizontal Preamplifier Block Diagram

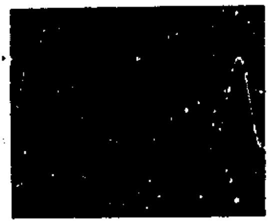
DC VOLTAGE MEASUREMENT CONDITIONS

1. Set:
   - SWEEP/EXT HORIZ .... 1 V/DIV
   - Horizontal Vernier .... CAL
   - TRIGGER LEVEL .... AUTO
   - SOURCE .... EXT
   - Horizontal COUPLING .... DC
2. Voltages are referenced to chassis ground. All indications are approximate and may vary slightly from instrument to instrument.

WAVEFORM MEASUREMENT CONDITIONS

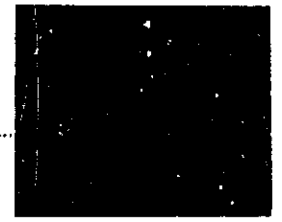
1. Set:
   - DISPLAY .... A
   - Vertical POSITION A .... midrange
   - Volts/Division A .... 1 V/DIV
   - Vertical Vernier A .... CAL
   - +Vertical Coupling A .... AC
   - −Vertical Coupling A .... OFF
   - Horizontal POSITION .... midrange
   - SWEEP/EXT HORIZ x1
   - Time/Division .... 0.2 MSEC/DIV
   - Horizontal Vernier .... CAL
   - SLOPE .... +
   - MODE .... NORM
   - TRIGGER LEVEL .... AUTO
   - Horizontal COUPLING .... DC
   - SOURCE .... INT
2. Connect a 5V pk-pk, 1 kHz sine wave to channel A +INPUT jack.
3. All waveforms are referenced to chassis ground. Monitor oscilloscope's vertical sensitivity (using a 1:1 probe) and sweep speed settings are shown below each waveform photograph.

−0.2V



1: .05 V/DIV, 0.5 MSEC/DIV

+4.8V



2: 0.5 V/DIV, 0.5 MSEC/DIV

1200A-8-6A

Figure 8-29. Horizontal Preamplifier Measurement Conditions and Waveforms

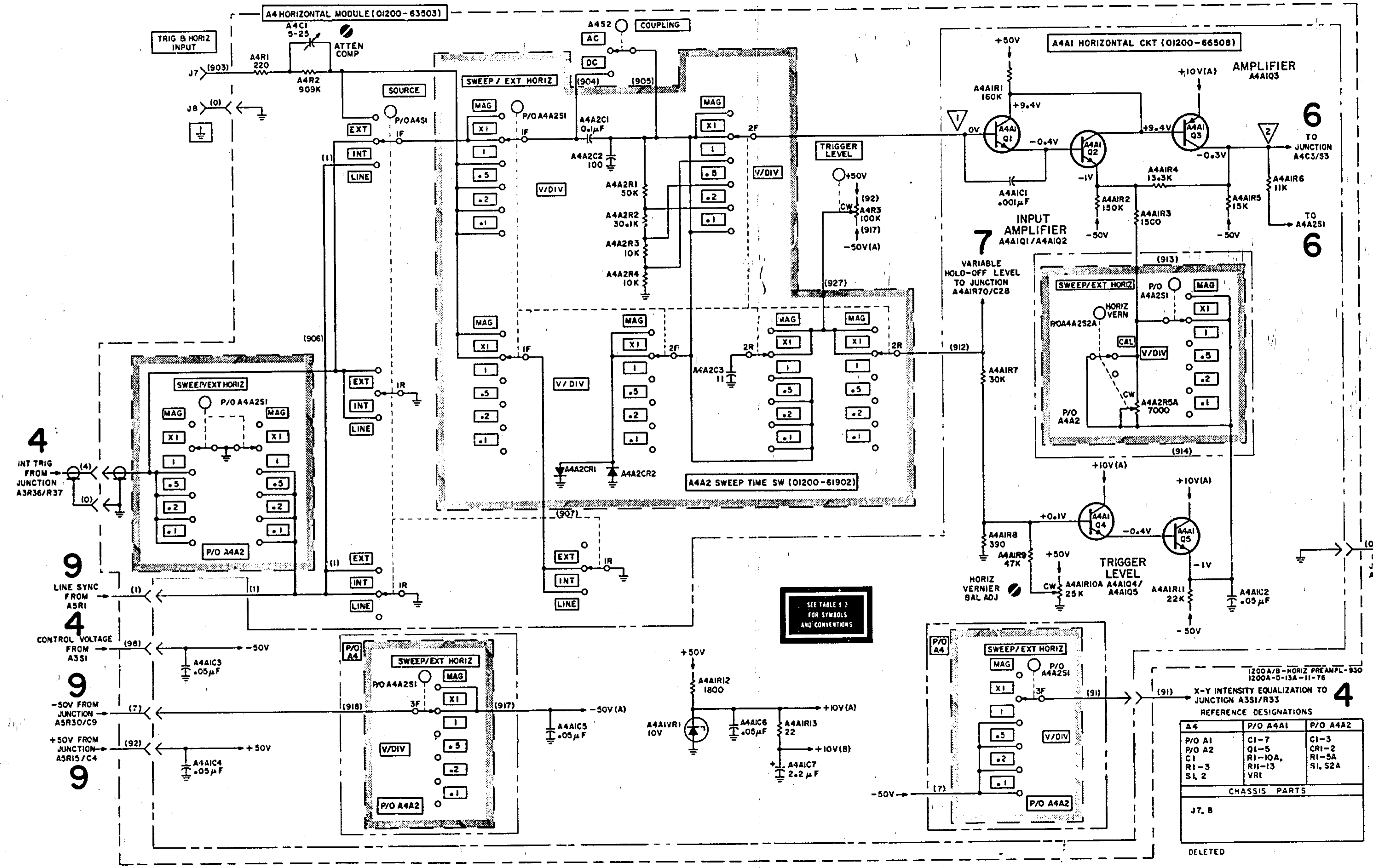


Figure 8-30. Horizontal Preamplifier Schematic

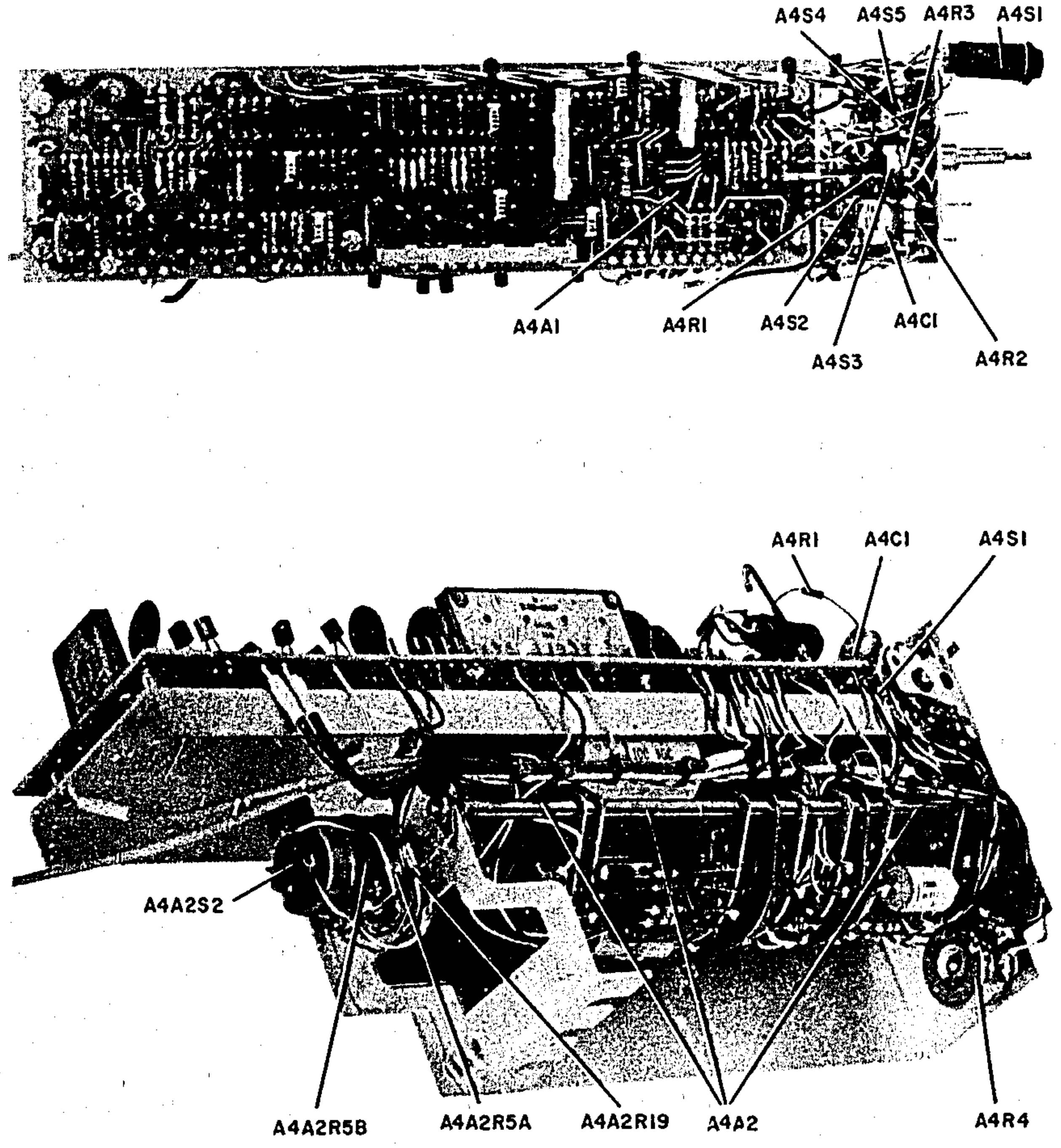


Figure 8-31. Horizontal Module, A4, Component Identification

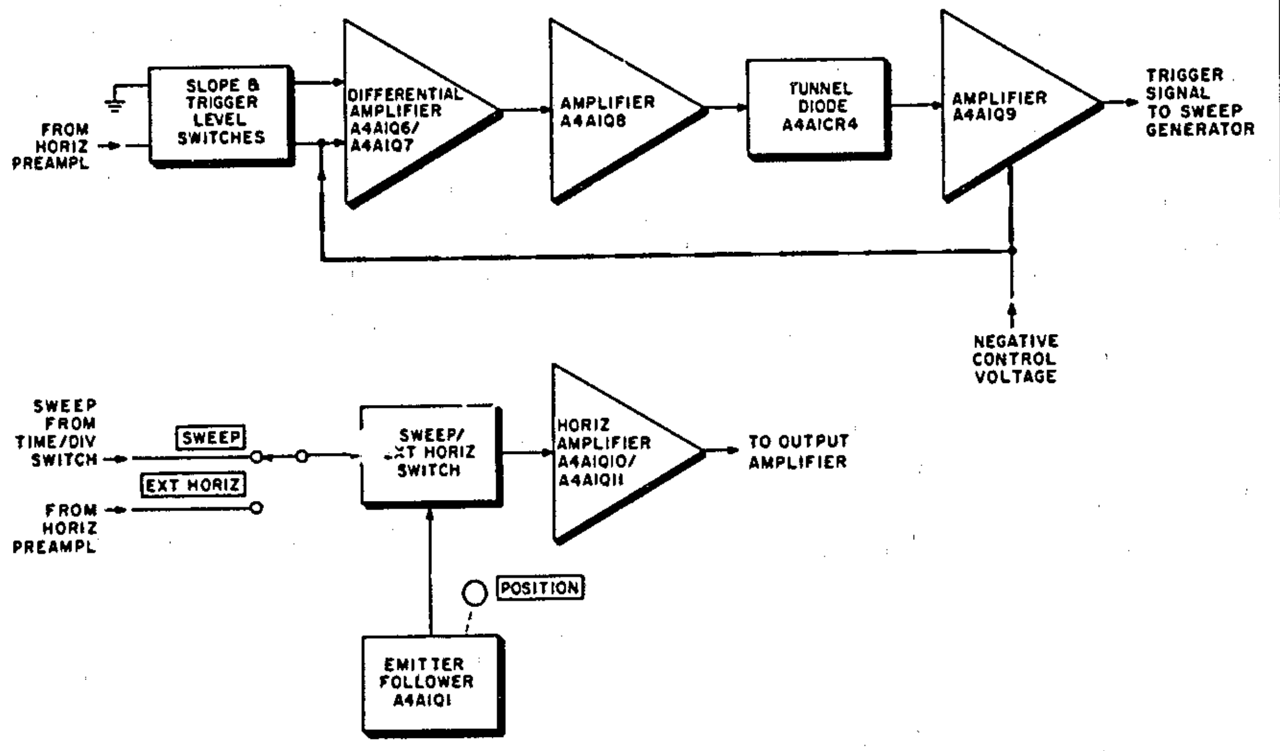


Figure 8-32. Trigger Generator and Horizontal Amplifier Block Diagram

Table 8-5. Trigger Generator and Horizontal Amplifier Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Set:
   - Horizontal POSITION .... midrange
   - SWEEP/EXT HORIZ x1
   - MODE .... NORM
   - SLOPE .... +
   - TRIGGER LEVEL .... ccw (not in AUTO)
   - Horizontal COUPLING .... DC
   - SOURCE .... INT

2. Voltages are referenced to chassis ground. All indications are approximate and may vary slightly from instrument to instrument.

WAVEFORM MEASUREMENT CONDITIONS

1. Set:
   - DISPLAY .... A
   - Vertical POSITION A .... midrange
   - Volts/Division A .... 1 V/DIV
   - Vertical Vernier A .... CAL
   - +Vertical Coupling A .... AC
   - −Vertical Coupling A .... OFF
   - Horizontal POSITION .... midrange
   - SWEEP/EXT HORIZ x1
   - Time/Division .... 0.2 MSEC/DIV
   - Horizontal Vernier .... CAL
   - SLOPE .... +
   - MODE .... NORM
   - TRIGGER LEVEL .... AUTO
   - Horizontal COUPLING .... DC
   - SOURCE .... INT

2. Connect a 5V pk-pk, 1 kHz sine wave to channel A +INPUT jack.

3. ⓥ To measure this waveform, connect a 5V pk-pk, 1 kHz sine wave to the TRIG & HORIZ INPUT jack. Set the controls as indicated in step 1, except set SWEEP/EXT HORIZ to 0.5 V/DIV.

4. All waveforms are referenced to chassis ground. Monitor oscilloscope's vertical sensitivity (using a 1:1 probe) and sweep speed settings are shown below each waveform photograph.

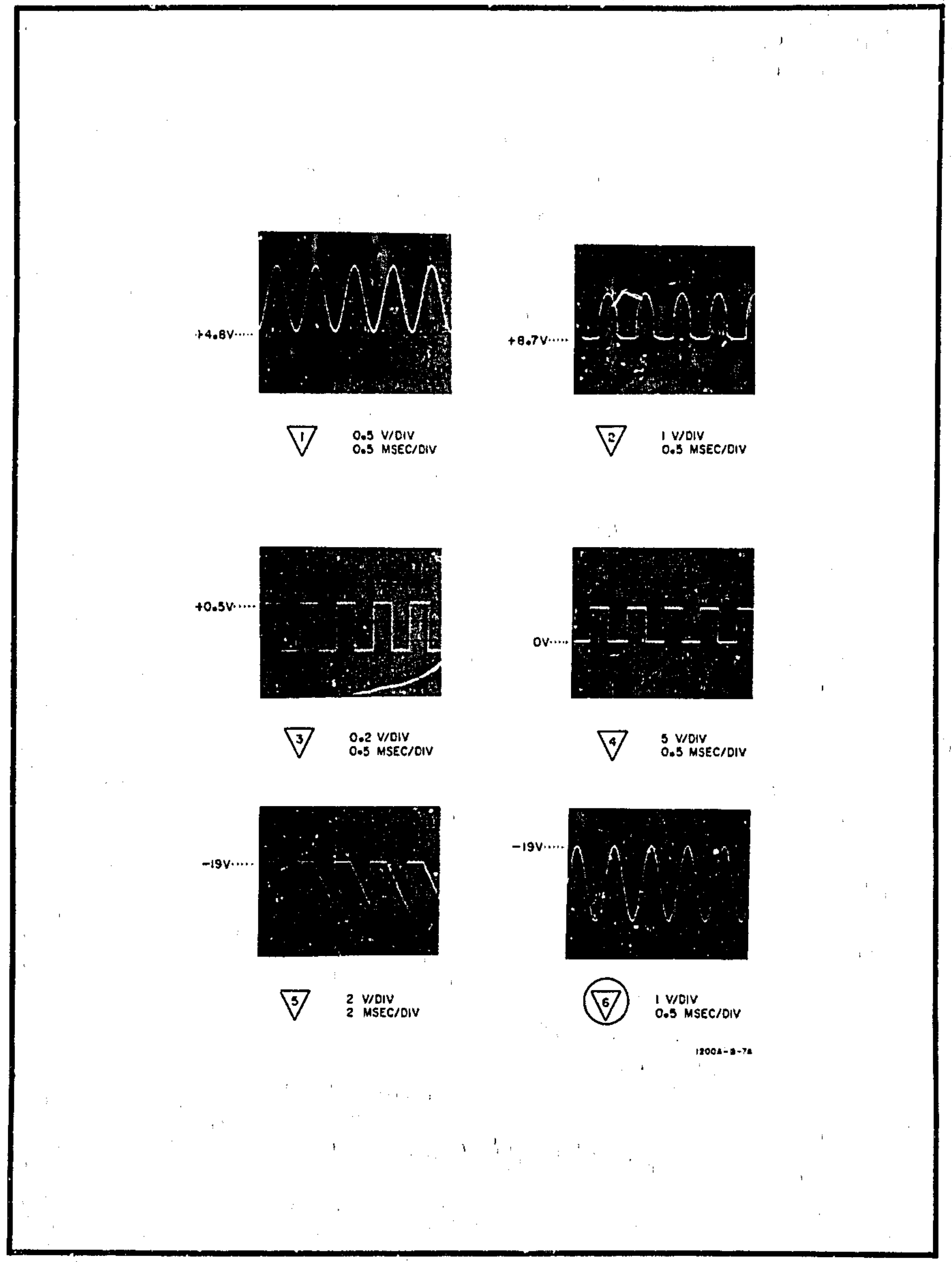


Figure 8-33. Trigger Generator and Horizontal Amplifier Waveforms

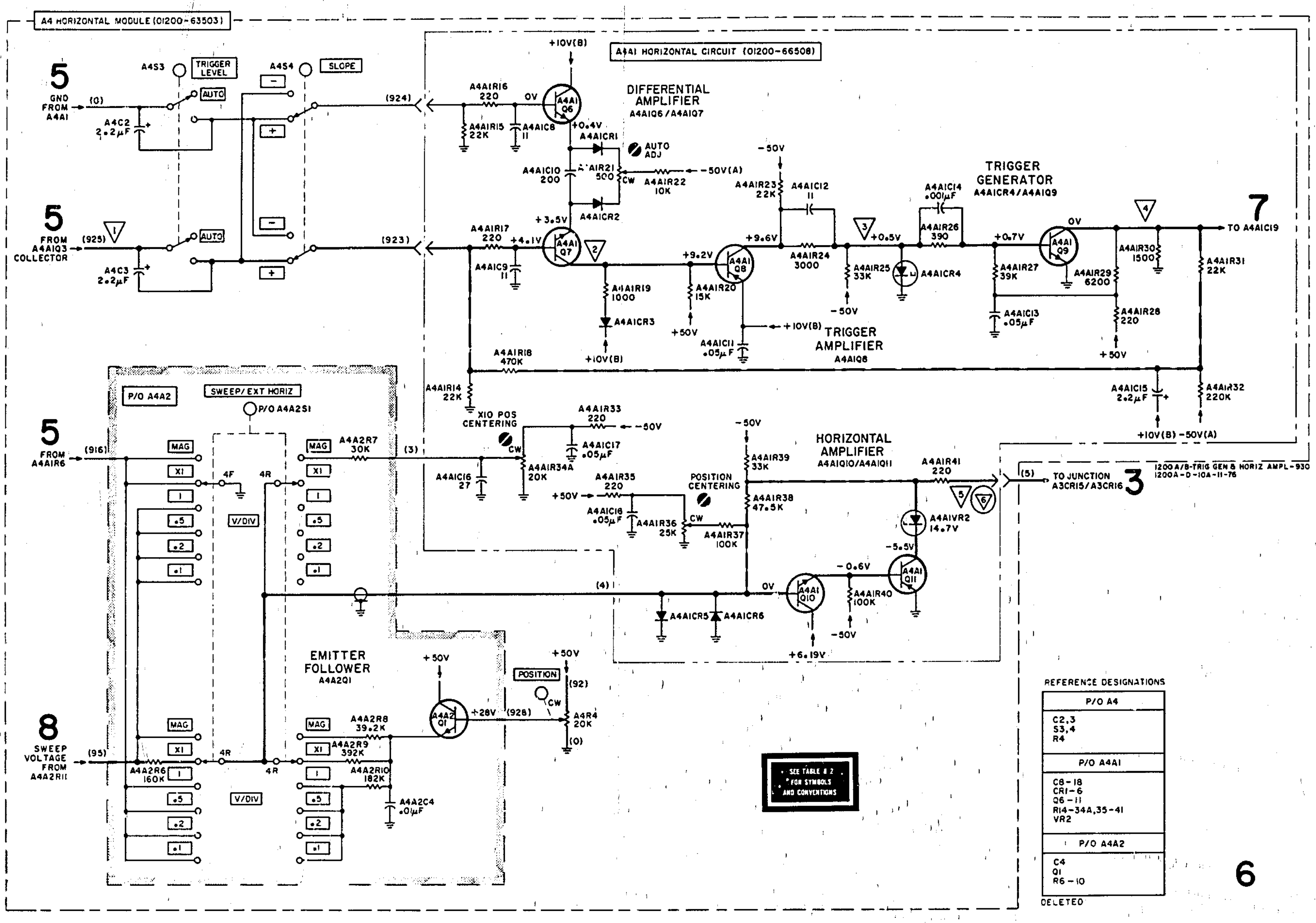


Figure 8-34.
Trigger Generator and Horizontal Amplifier Schematic

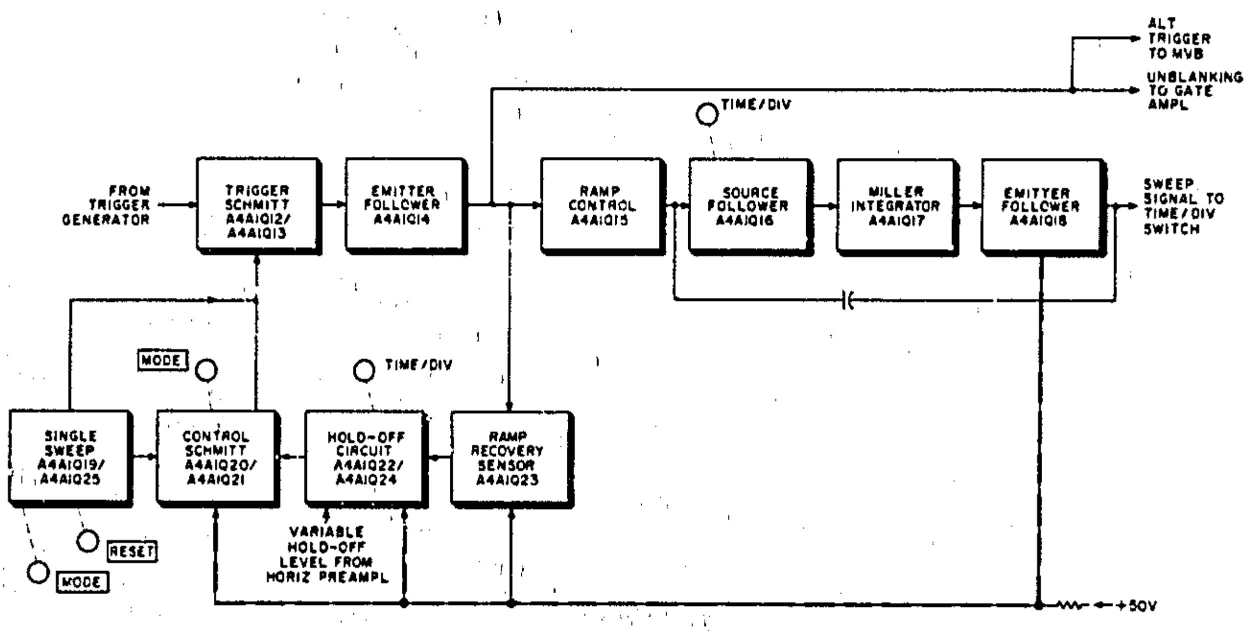


Figure 8-35. Sweep Generator Block Diagram

Table 8-6. Sweep Generator Measurement Conditions

DC VOLTAGE MEASUREMENT CONDITIONS

1. Set:
   - Horizontal POSITION .... midrange
   - SWEEP/EXT HORIZ x1
   - Time/Division .... 0.2 MSEC/DIV
   - Horizontal Vernier .... CAL
   - MODE .... SINGLE
   - SLOPE .... +
   - TRIGGER LEVEL .... ccw (not in AUTO)
   - SOURCE .... INT
   - RESET .... armed (light on)*

2. *Measure voltages in parenthesis with RESET pressed. Measure all other voltages with the sweep generator armed (light on).

3. Voltages are referenced to chassis ground. All indications are approximate and may vary slightly from instrument to instrument.

WAVEFORM MEASUREMENT CONDITIONS

1. Set:
   - DISPLAY .... A
   - Vertical POSITION A .... midrange
   - Volts/Division A .... 1 V/DIV
   - Vertical Vernier A .... CAL
   - +Vertical Coupling A .... AC
   - –Vertical Coupling A .... OFF
   - Horizontal POSITION .... midrange
   - SWEEP/EXT HORIZ x1
   - Time/Division .... 0.2 MSEC/DIV
   - Horizontal Vernier .... CAL
   - SLOPE .... +
   - MODE .... NORM
   - TRIGGER LEVEL .... AUTO
   - Horizontal COUPLING .... DC
   - SOURCE .... INT

2. Connect a 5V pk-pk, 1 kHz sine wave to channel A +INPUT jack.

3. ⊽ To measure this waveform, change the vertical input frequency to 50 kHz.

4. All waveforms are referenced to chassis ground. Monitor oscilloscope's vertical sensitivity (using a 1:1 probe) and sweep speed settings are shown below each waveform photograph.

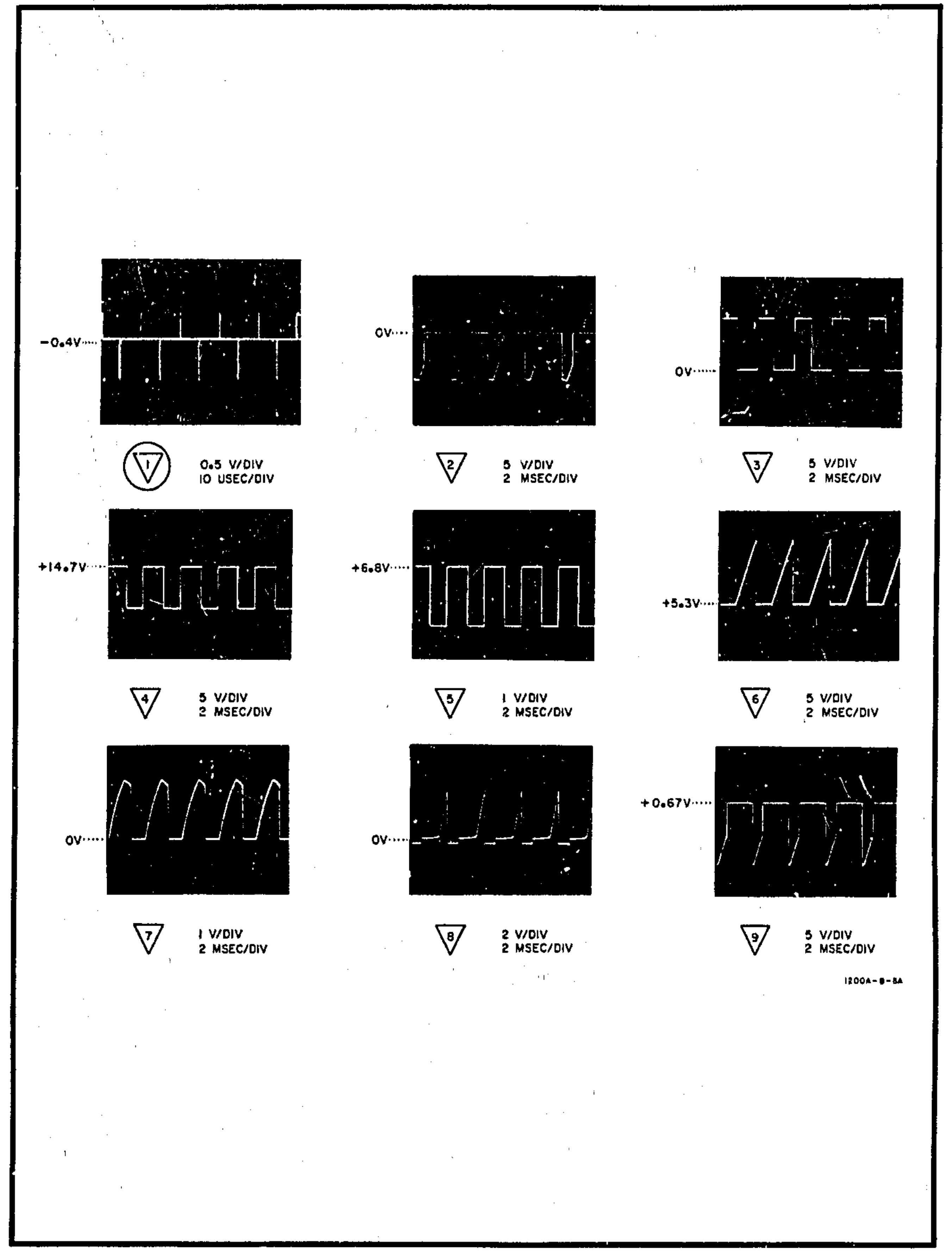


Figure 8-36. Sweep Generator Waveforms

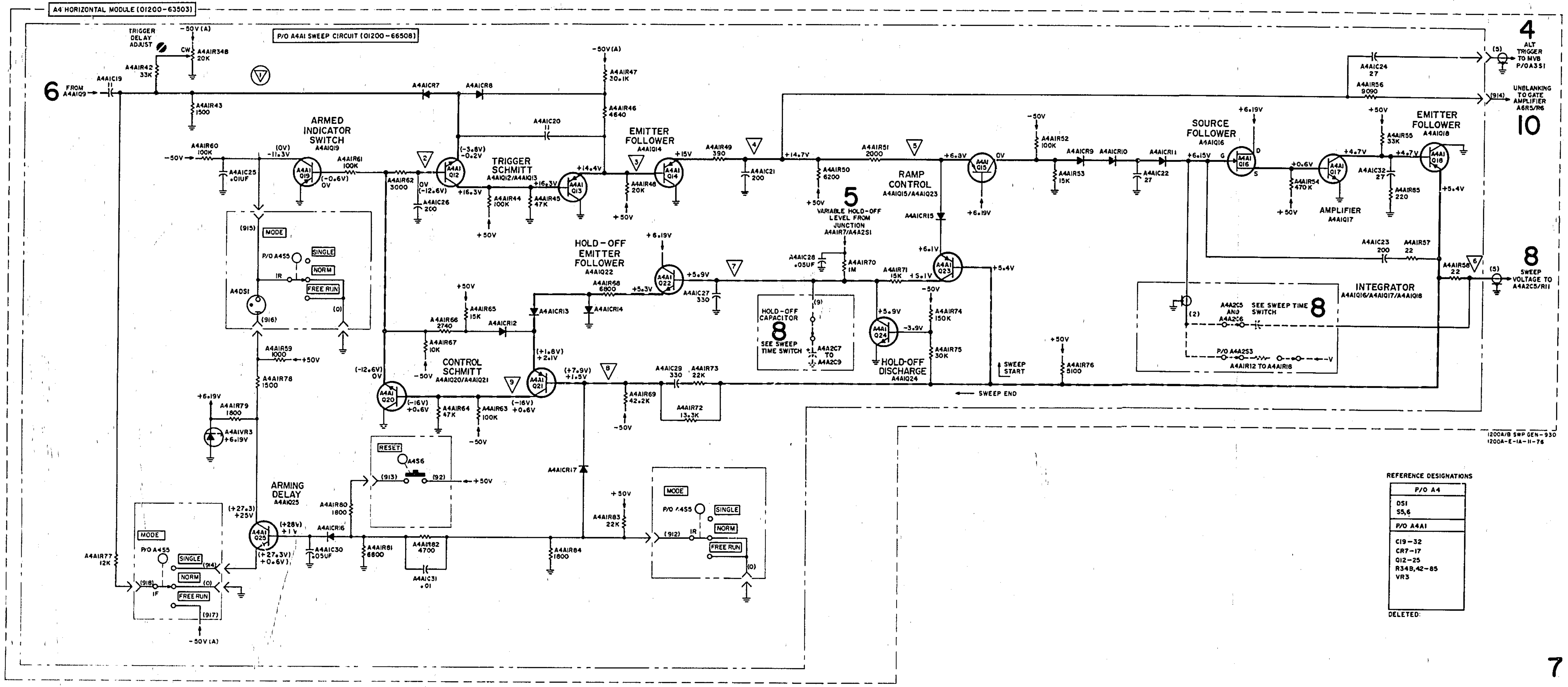
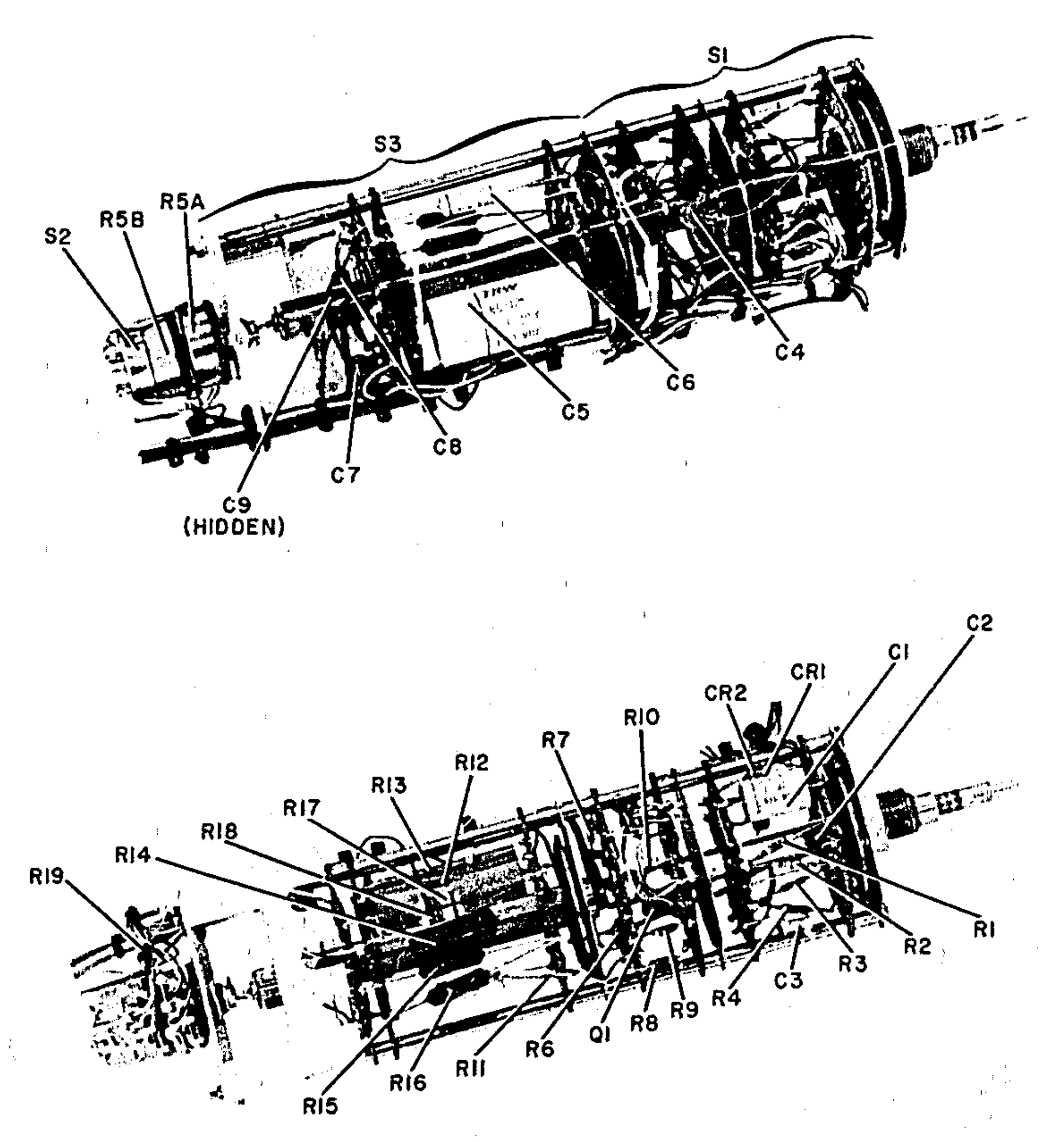


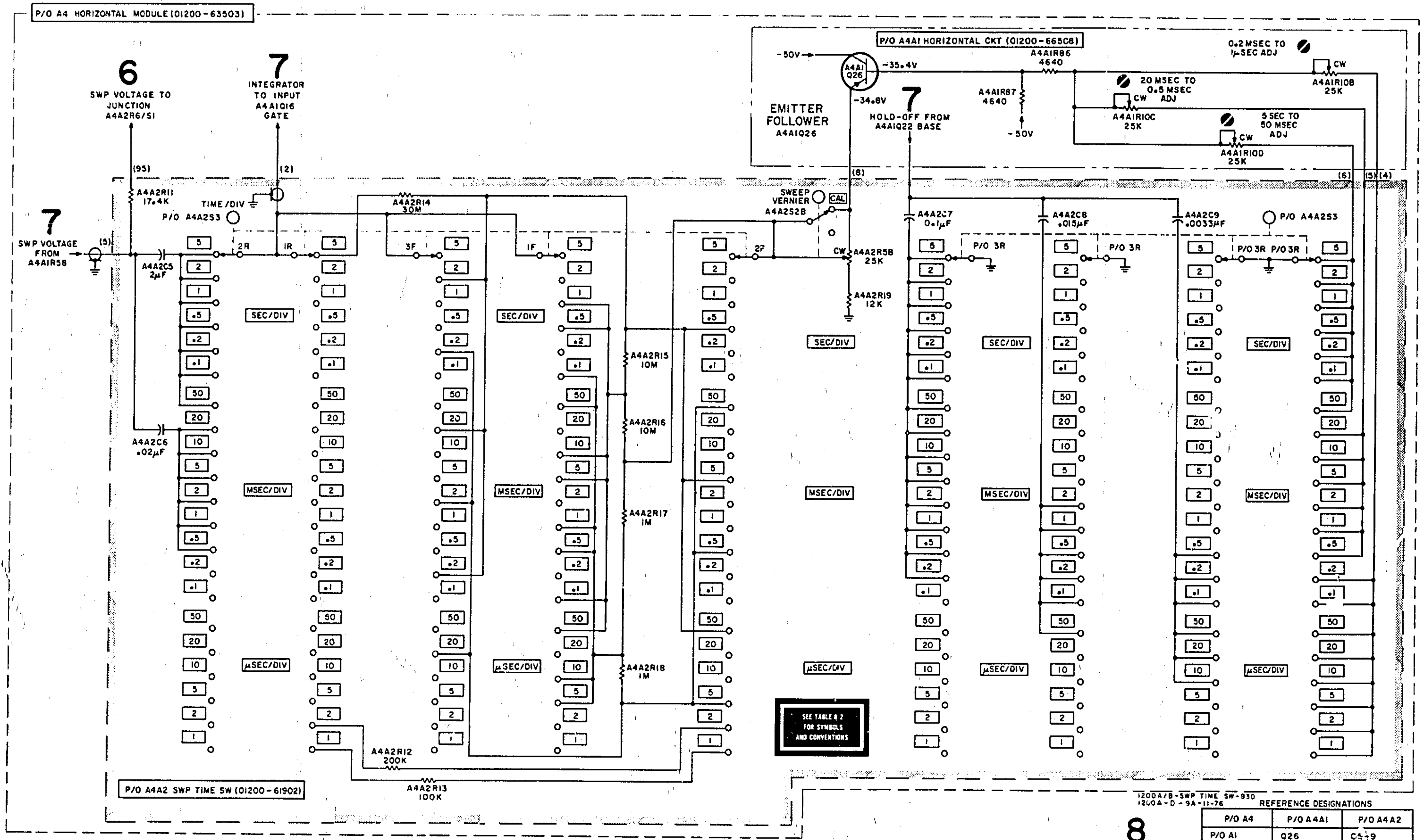
Figure 8-37.
Sweep Generator Schematic



Note: For complete reference designation, prefix component designators with A4A2.

1201A-A-15

Figure 8-38. Time/Division Switch, A4A2, Component Identification



REFERENCE DESIGNATIONS

P/O A4	P/O A4A1	P/O A4A2
P/O A1 P/O A2	Q26 R10B,C,D R86, 87	C5-9 R58,11-19 S2B, 3

DELETED:

Figure 8-39.
Time/Division Switch Schematic

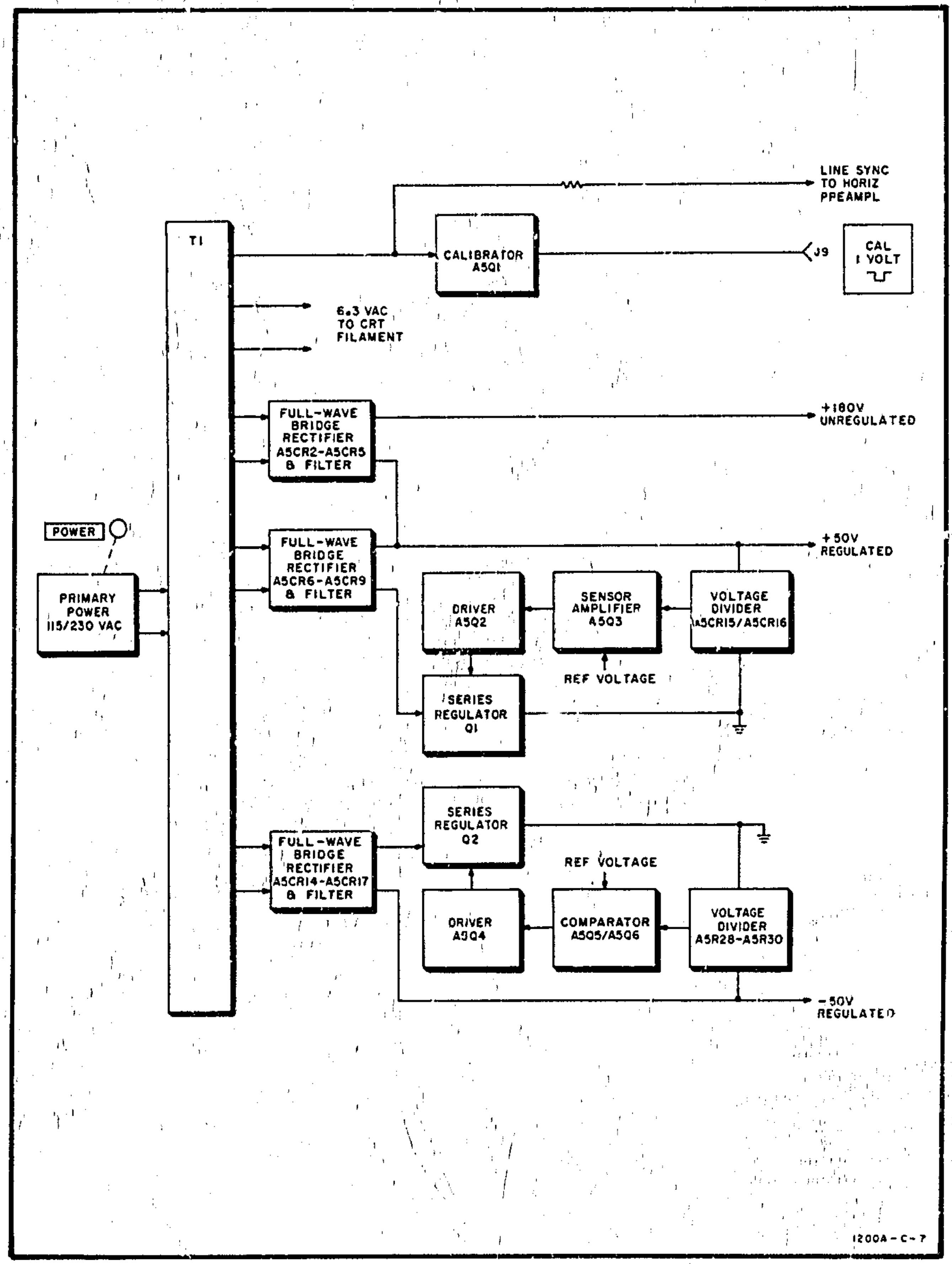
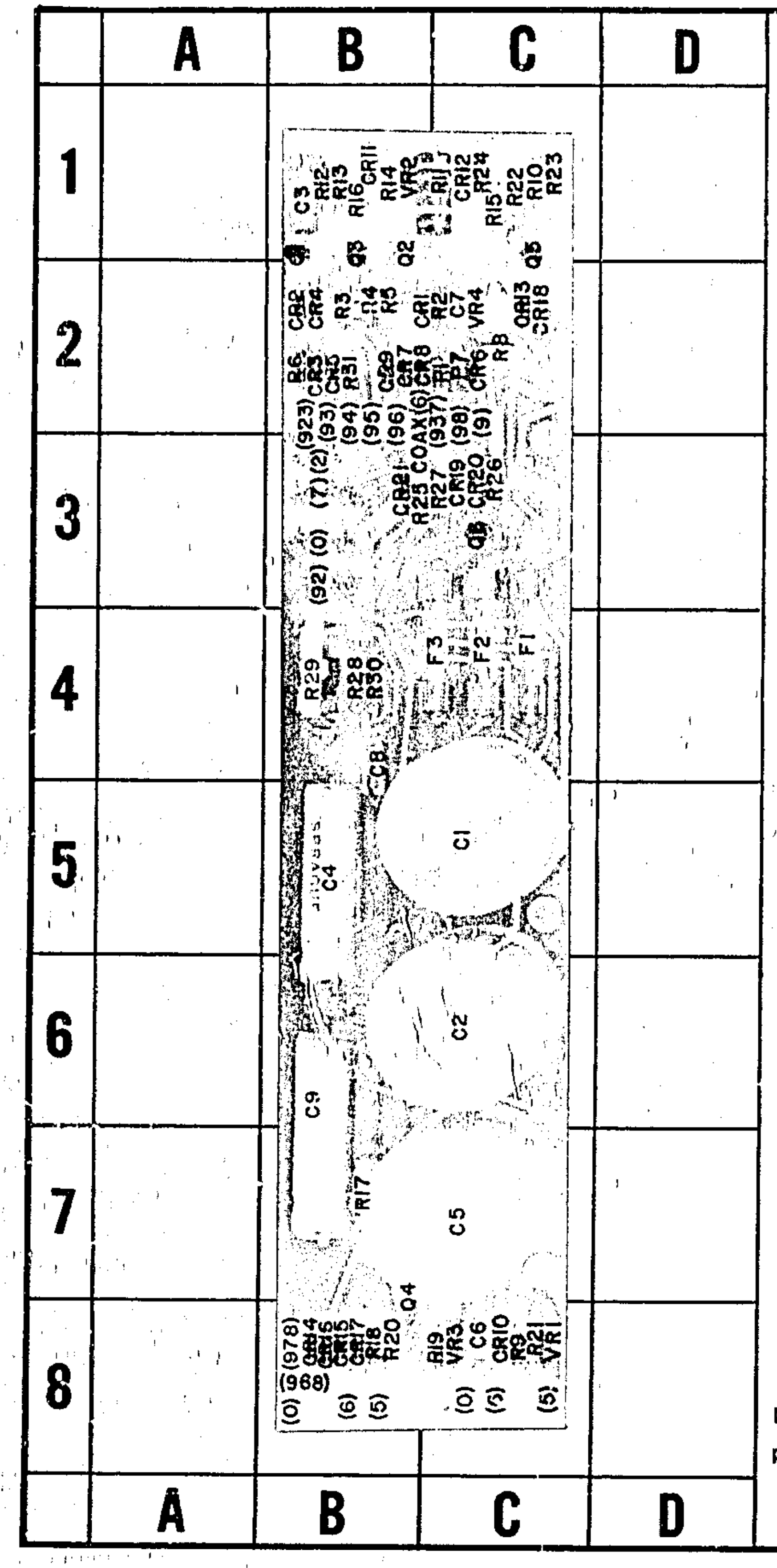


Figure 8-40. Low Voltage Power Supply Block Diagram



REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	C-5	Q5	C-1
C2	C-6	Q6	C-3
C3	B-1	R1	C-2
C4	B-5	R2	C-2
C5	C-7	R3	B-2
C6	C-8	R4	B-2
C7	C-2	R5	B-2
C8	B-4	R6	B-2
C9	B-6	R7	C-2
CR1	B-2	R8	C-2
CR2	B-2	R9	C-8
CR3	B-2	R10	C-1
CR4	B-2	R11	C-1
CR5	B-2	R12	B-1
CR6	C-2	R13	B-1
CR7	B-2	R14	B-1
CR8	B-2	R15	C-1
CR9	B-2	R16	B-1
CR10	C-8	R17	B-7
CR11	B-1	R18	B-8
CR12	C-1	R19	C-8
CR13	C-2	R20	B-8
CR14	B-8	R21	C-8
CR15	B-8	R22	C-1
CR16	B-8	R23	C-1
CR17	B-8	R24	C-1
CR18	C-2	R25	B-3
CR19	C-3	R26	C-3
CR20	C-3	R27	C-3
CR21	B-3	R28	B-4
F1	C-4	R29	B-4
F2	C-4	R30	B-4
F3	C-4	R31	B-2
Q1	B-1	VR1	C-8
Q2	B-1	VR2	B-1
Q3	B-1	VR3	C-8
Q4	B-7	VR4	C-2

Note: For complete reference designation prefix component designators with A5.

1200A-A-33A

Figure 8-41. Low Voltage Power Supply, A5, Component Identification

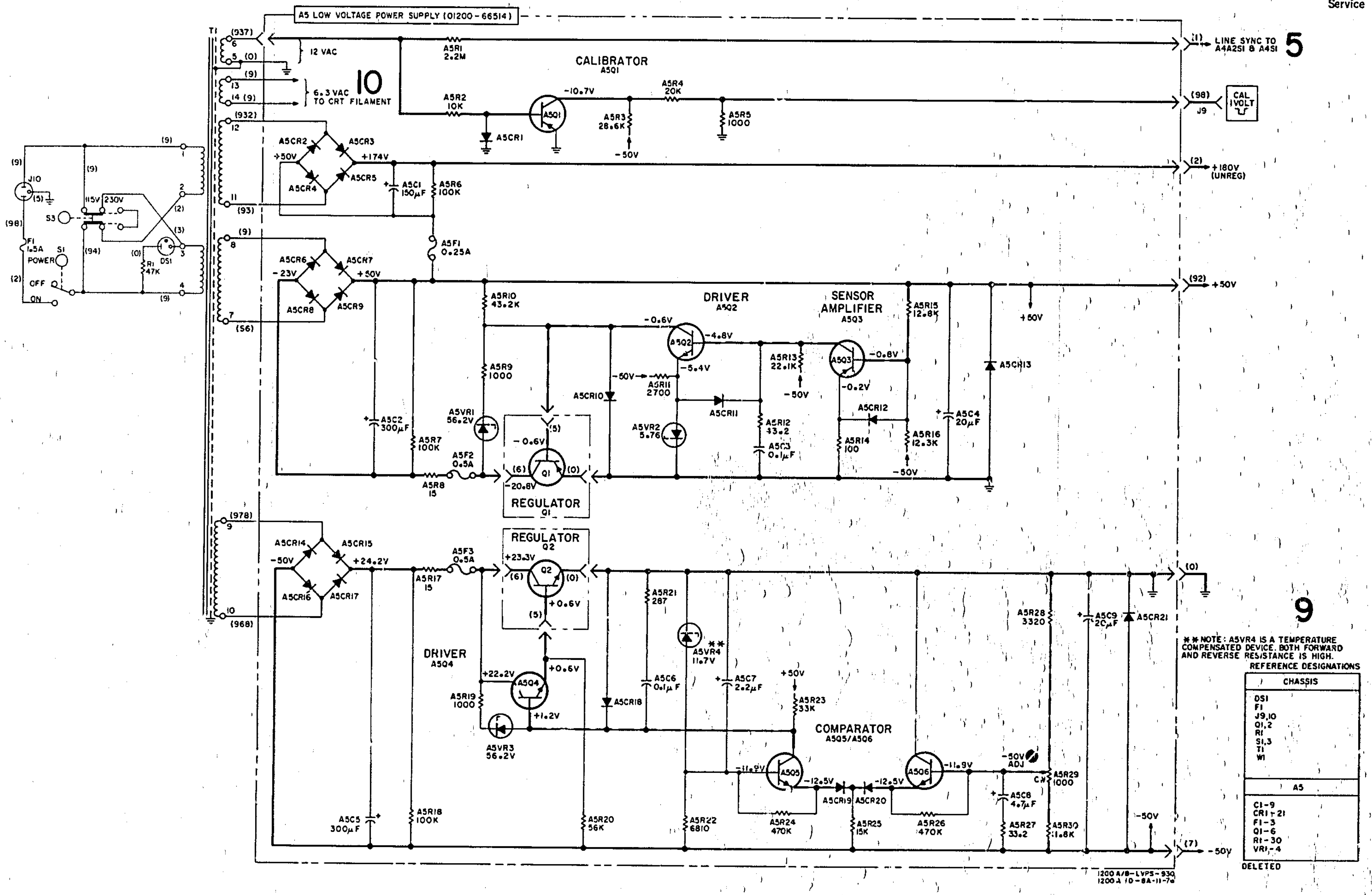


Figure 8-42. Low Voltage Power Supply Schematic

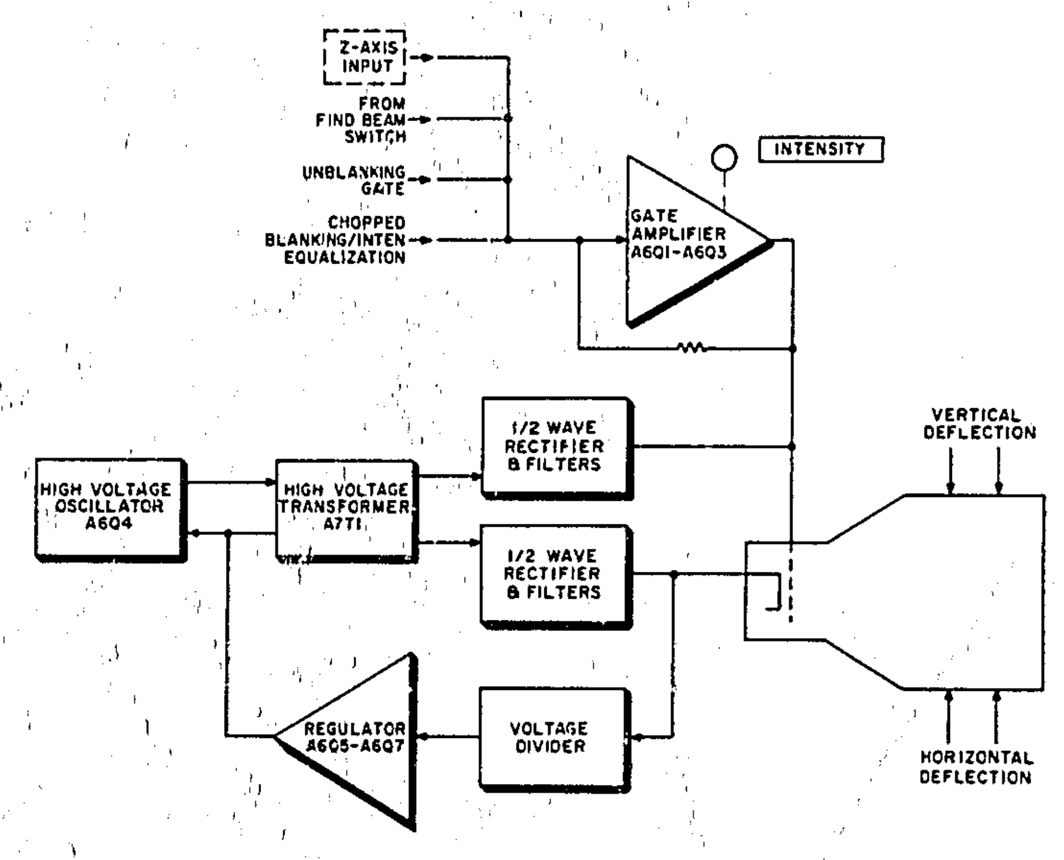
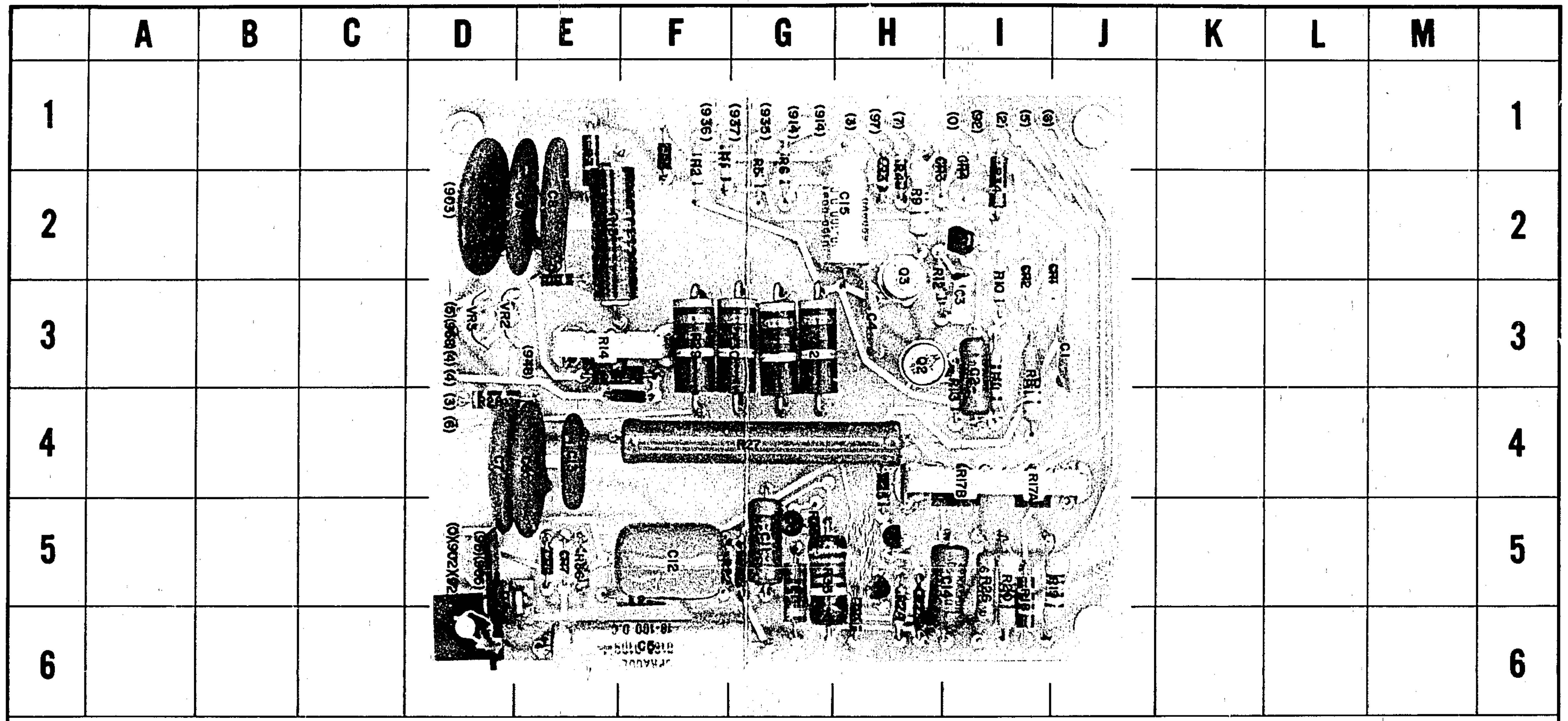


Figure 8-43. High Voltage Power Supply Block Diagram

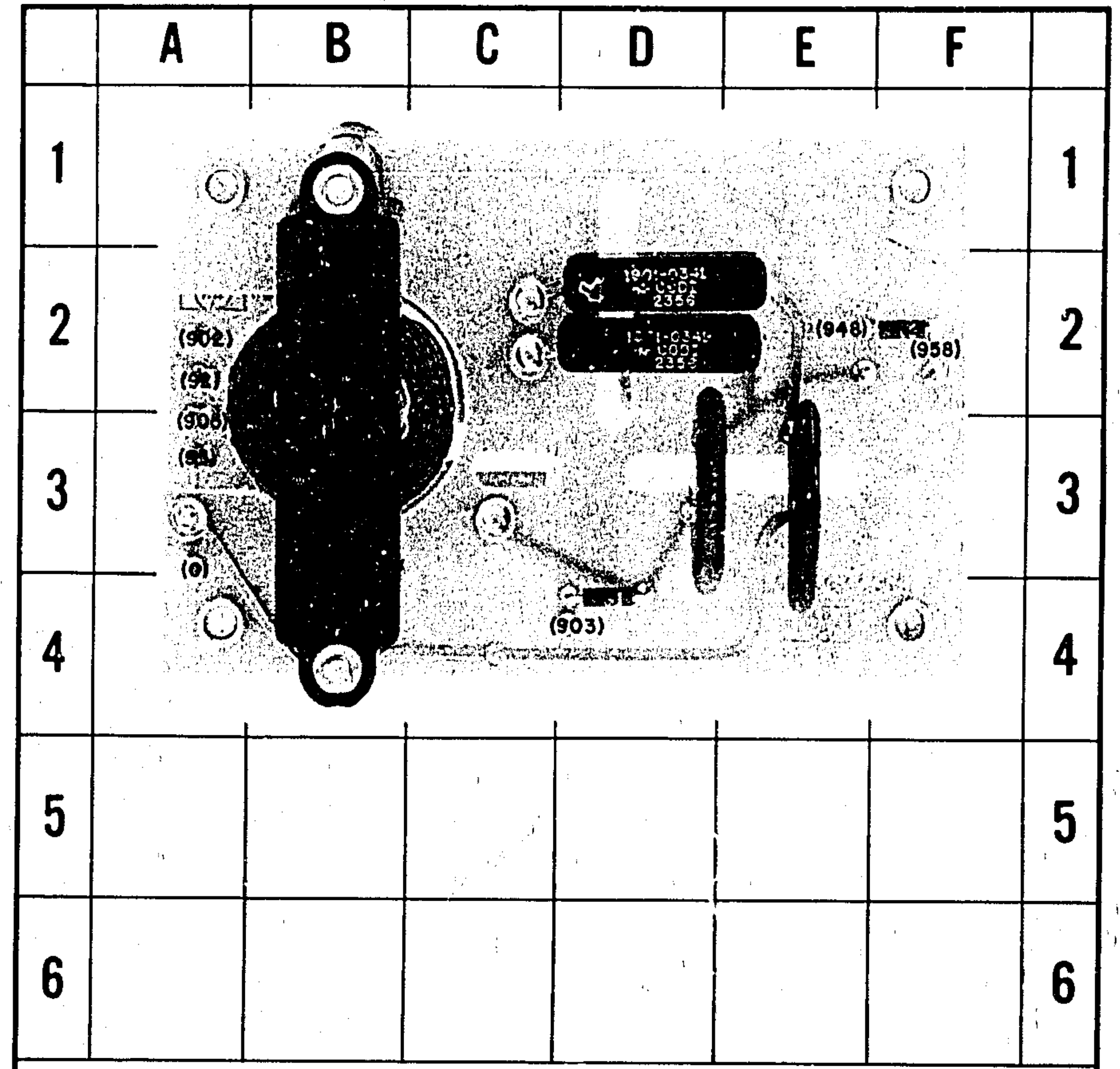


REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C1	J-3	C11	G-5	CR5	F-1	Q6	H-5	R8	I-3	R17A	I-4	R25	H-4	R34	I-2
C2	I-3	C12	F-5	CR6	E-5	Q7	H-5	R9	H-2	R17B	I-4	R26	I-5	R35	G-5
C3	I-3	C13	E-4	CR7	E-5	R1	F-1	R10	I-2	R18	I-5	R27	G-4	R36	E-5
C4	H-3	C14	I-5	CR8	F-4	R2	F-1	R11	I-3	R19	J-5	R28	D-4	R37	E-3
C5	F-6	C15	H-2	Q1	I-2	R3	H-1	R12	H-2	R20	I-5	R29	F-3	L1	G-5
C6	E-4	CR1	J-2	Q2	H-3	R4	H-1	R13	I-3	R21	H-6	R30	G-3	L2	F-5
C7	D-4	CR2	I-2	Q3	H-3	R5	G-1	R14	E-3	R22	F-5	R31	G-3	VR1	G-5
C8	E-2	CR3	I-1	Q4	D-5	R6	G-1	R15	E-2	R23	H-5	R32	G-3	VR2	D-3
C9	E-2	CR4	I-1	Q5	G-5	R7	E-1	R16	E-2	R24	H-5	R33	G-5	VR3	D-3
C10	D-2														

Note: For complete reference designation, prefix component designators with A6.

1200A-8-12

Figure 8-44. High Voltage Regulator, A6, Component Identification

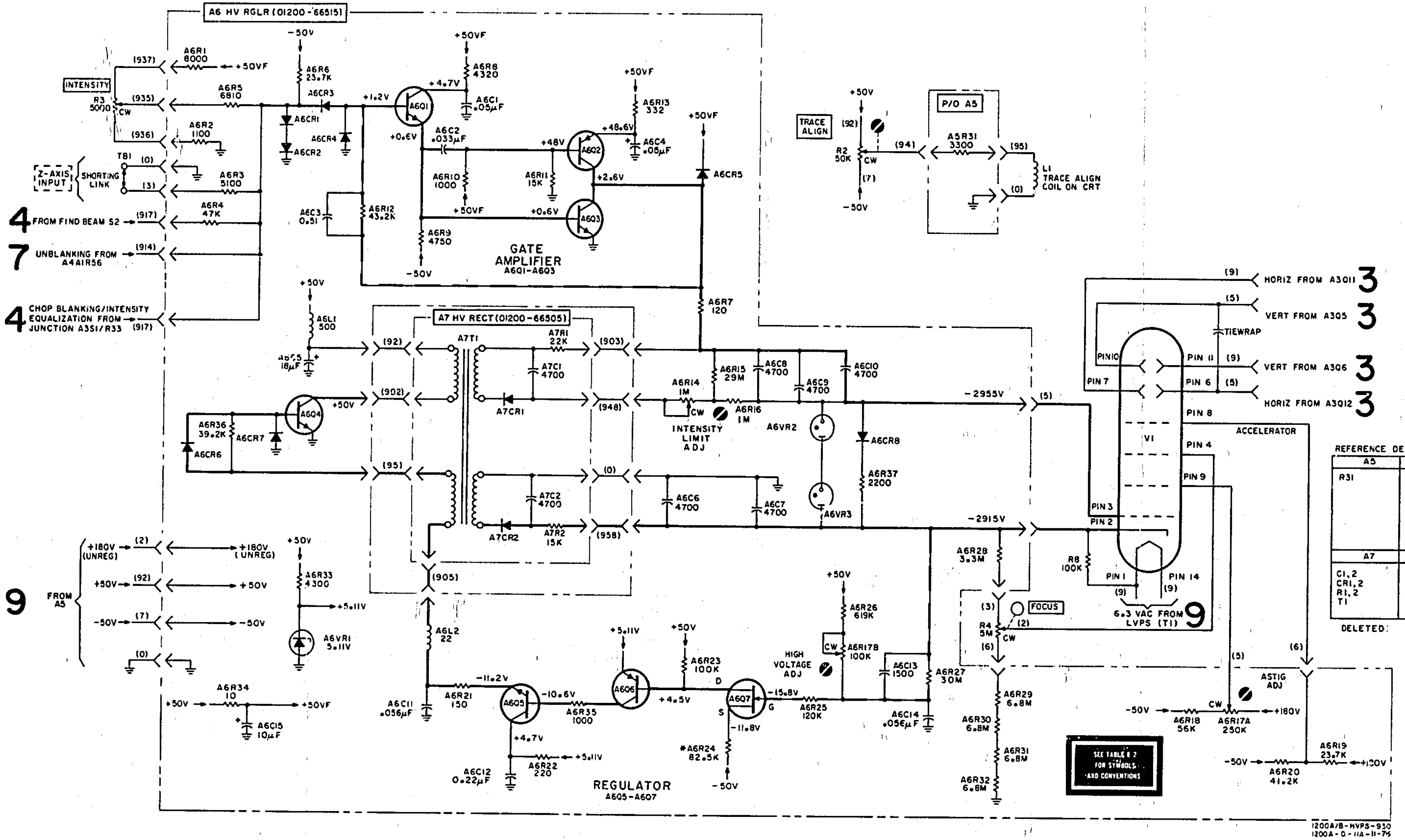


REF DESIG	GRID LOC
C1	D-3
C2	E-3
CR1	D-2
CR2	D-2
R1	D-4
R2	F-2
T1	B-2

Note: For complete reference designation, prefix component designators with A7.

1200A-A-3

Figure 8-45. High Voltage Rectifier, A7, Component Identification



10

Figure 8-46.
High Voltage Power Supply Schematic

MANUAL IDENTIFICATION	
Model Number:	1200A/B
Date Printed:	November 1976
Part Number:	01200-90904

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

To use this supplement:
Make all ERRATA corrections.
Make all appropriate serial number related changes indicated in the tables below.

Serial Prefix or Number	Make Manual Changes
1924S00126 Thru 1924S00183	1
1924S00184 1924S00213	1, 2
1924S00214 Thru 1924S00377	1, 2, 3
1924S00378 Thru 1924S00433	1, 2, 3, 4
1924S00434 Onwards	1, 2, 3, 4, 5
1925S00251 Thru 1925S00470	1

Serial Prefix or Number	Make Manual Changes
1925S00471 Thru 1925S00564	1, 2
1925S00565 Thru 1925S00811	1, 2, 3
1925S00812 Thru 1925S00948	1, 2, 3, 4
1925S00949 Onwards	1, 2, 3, 4, 5

▲ NEW ITEM

NOTE

This Manual Change Sheet is applicable only to manuals with HP Part No. 01200-90904 with wire binding.

▲ ERRATA

Page 5-2, Table 5-1, Recommended Test Equipment.
Replace: Table 5-1 with Table 5-1 in this manual change sheet.

Page 5-8 & 9, paragraph 5-42, HIGH VOLTAGE POWER SUPPLY.
Replace: paragraph 5-42 with paragraph 5-42 below.

5-42. HIGH VOLTAGE POWER SUPPLY.

a. Develop a correction factor for this 1000:1 probe by measuring 200 Vdc from the dc standard using the 1000:1 probe and the dvm. Compare the measured value to the actual voltage to determine the correction factor for a particular probe.

NOTE

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

HEWLETT PACKARD

Printed in U.S.A.

b. Determine what the observed reading will be on the dvm using the 1000:1 probe for the required high voltage of −2915 ±5 Vdc.

Note: This simple ratio will allow you to acquire the correct reading.

$$\frac{-200 \text{ (dc voltage from Voltage standard)}}{\text{Actual measurement observed on dvm using 1000:1 probe when measuring 200 Vdc from the dc source.}} = \frac{-2915}{\text{Actual measurement observed on dvm using 1000:1 probe when measuring HV on the 1200A/B.}}$$

WARNING

Voltages present in the high voltage power supply are dangerous to life.

c. Monitor the high voltage supply (958 wire between A6 and A7) with the dvm and the divider probe. Adjust A6R17 (see Figure 5-2) for the same voltage calculated in step b.

Page 6-2, Table 6-2, Replaceable Parts.
Change: A4 to HP Part No. 01200-63503.
Add: A6, HP Part Number 01200-66519 for options 011 and 611.
Change: MP18 to HP Part No. 01701-04108, Cover CRT.

Page 6-3, Table 6-2, Replaceable Parts.
Change: MP23 to HP Part No. 5001-3569

Page 6-4, Table 6-2, Replaceable Parts.
Change: W1 from HP Part No. 8120-1538 to HP Part No. 8120-1521.
Change: W1 from HP Part No. 8120-1348 to HP Part No. 8120-1378.
Change: XF1 to consist of HP Part No. 2110-0564, Fuseholder Body; 2110-0565, Fuse Carrier; 2110-0569, Nut Mounting.

Page 6-5, Table 6-2, Replaceable Parts.
Change: A1A1C9 to HP Part No. 0160-0084 and 100 wVdc.

Page 6-6, Table 6-2, Replaceable Parts.
Change: A1A1S1 to HP Part No. 3101-0424.

Page 6-7, Table 6-2, Replaceable Parts.
Change: A1A2R1 & A1A2R3 to a matched pair HP Part No. 5081-7646.
Change: A1A2S1 to HP Part No. 3100-2523.

Page 6-9, Table 6-2, Replaceable Parts.
Change: A3R4 to A3R4A,B,C,D HP Part No. 2100-0567.

Page 6-10, Table 6-2, Replaceable Parts.
Change: A3R30 to HP Part No. 0767-0008.

Page 6-11, Table 6-2, Replaceable Parts.
Add: A4L1, HP Part No. 9140-0179, L: fxd 22μH.

Page 6-14, Table 6-2, Replaceable Parts.
Change: A4A1R25 to HP Part No. 0757-5675, R: fxd metflm 22 kilohms 2% 1/8W.
Change: A4A1R29 to HP Part No. 0760-0028, R: fxd metox 1500 ohms 2% 1W.

Page 6-16, Table 6-2, Replaceable Parts.
Change: A4A2R14 to Hp Part No. 0698-5675, R: fxd carflm 30 megohms 1% 1W.

Page 6-19, Table 6-2, Replaceable Parts.
Change: A6Q4 to HP Part No. 5081-7657, Transistor selected.
Change: A6R15 to HP Part No. 0698-8427, R: fxd carflm 29 megohms 10% 1W.

Page 6-20, Table 6-2, Replaceable Parts.
Add: A6R38, HP Part No. 0757-040[illegible], R: fxd metflm 200 ohms 1% 1/8W.

Page 8-16, Figure 8-22.
Change: Voltage to A3L3, A3L4 to +180V.

Page 8-17, Figure 8-26.
Add: A3 in front of R32 at the Emitter Follower A3Q13.
Delete: (917).
Add: (917) to "TO A6R4".

Page 8-21, Figure 8-34.
Change: A4A1R25 value to 22K.

Page 8-23, Figure 8-37.
Add: A4L1 22µH between RESET switch A4S6 wire (92) and +50V.
Delete: +6.15V on gate for A4A1Q16.

Page 8-29, Figure 8-46.
Add: A6R38, 200 ohms between base of A6Q4 and ground.

▲ CHANGE 1

Page 6-5, Table 6-2, Replaceable Parts.
Change: A1A1C3, A1A1C15, A2A1C3 and A2A1C15 to HP Part No 0160-5200, C: fxd polyester 0.047µF 10% 200 wVdc.

▲ CHANGE 2

Page 6-11, Table 6-2, Replaceable Parts.
Change: A4S6 to HP Part No. 3101-2431, S; pushbutton SPST W/LT.

▲ CHANGE 3

Page 6-6, Table 6-2, Replaceable Parts.
Change: A1A1R19 and A2A1R19 to HP Part No. 2100-0554, R: var 500 ohms 10% 1/2W.

Page 6-14, Table 6-2, Replaceable Parts.
Change: A4A1R21 to HP Part No. 2100-0554, R: var 500 ohms 10% 1/2W.
Delete: A4A1R34.
Add: A4A1R34A and A4A1R34B, HP Part No. 2100-0558, R: var 20 kilohms 10% 1/2W.

Page 6-18, Table 6-2, Replaceable Parts.
Change: A6C6 and A6C7 to HP Part No. 0160-5380, C: fxd cer 0.0047µF ±20% 4000 wVdc.
Change: A6C8, A6C9, and A6C10 to HP Part No. 0160-5379, C: fxd cer 0.004µF ±20% 4000 wVdc.

Page 6-20, Table 6-2, Replaceable Parts.
Change: A7C2 to HP Part No. 0160-5380, C: fxd cer 0.0047µF ±20% 4000 wVdc.
Change: A7C1 to HP Part No. 0160-5379, C: fxd cer 0.0047µF ±20% 4000 wVdc.

▲ CHANGE 4

Page 6-13, Table 6-2, Replaceable Parts.
Delete: A4A1R10.
Add: A4A1R10A, A4A1R10B, A4A1R10C, and A4A1R10D, HP Part No. 2100-3573, R: var 25 kilohms 10% 1/2W.

Page 6-14, Table 6-2, Replaceable Parts.
Change: A4A1R36 to HP Part No. 2100-3573, R: 25 var kilohms 10% 1/2W.

Page 6-19, Table 6-2, Replaceable Parts.
Delete: A6R17.
Add: A6R17A, HP Part No. 2100-3356, R: var 200 kilohms 10% 1/2W.
Add: A6R17B, HP Part No. 2100-3355, R: var 100 kilohms 10% 1/2W.

Page 8-29, Figure 8-46.
Change: A6R17A value to 200K.

▲ CHANGE 5

Page 6-8, Table 6-2, Replaceable Parts.
Change: A3C6 to HP Part No. 0150-0012, C: fxd cer .01μF ±20% 1000 wVdc.

Page 6-12, Table 6-2, Replaceable Parts.
Change: A4A1C25 and A4A1C31 to HP Part No. 0150-0012, C: fxd cer .01μF ±20% 1000 wVdc.

Table 5-1. Recommended Test Equipment

Recommended Instrument		Required Characteristics	Used For:
Type	Model		
DC Standard	Ballantine Model 6125C	0.5 mV to 100 V ±0.2%	Calibrator Check Vert. Ampl. Gain Check Vert. Vernier Check Trig. Point & Slope Check Horiz. Ampl. Gain Check Horiz. Vernier Check Horiz. Ampl. Gain Adj. Output Ampl. Gain Adj.
Oscillator	HP Model 3311A	50 Hz to 500 kHz; up to 8.0 V peak-to-peak at 500 kHz; 20 V peak-to-peak at 10 kHz.	Vert. Positioning Check Vert. Bandwidth Check CMR Check A vs B Phase Shift Check Channel Isolation Check Trig. Amplitude Check Trig. Point & Slope Check Horiz. Bandwidth Check CMRR Bal. Adj.
Time-mark Generator	Ballantine Model 6125C	Markers from 1 μsec to 5 sec.	Sweep Time Check Sweep Varnier Check Mag. Sweep Check Single Sweep Check Sweep Time Adj.
Digital DC Voltmeter	HP Model 3435A, 3466A	±50 V; ±0.05% ±165 V; ±0.05%	L.V.P.S. Adj. H.V.P.S. Adj.
High Voltage 1000:1 Divider Probe	HP Model 34111A	-3 kV dc	H.V.P.S. Adj.
C Meter	Any compatible capacitance measurement device	45 pF ±3%	Input Cap Adj. Atten. Comp. Adj.
Square Wave Generator	HP Model 3311A	4.5 V peak-to-peak at 1 kHz; rise time approx 0.5 μs	Horiz. Atten. Comp. Adj. Input Cap Adj. Atten. Comp. Adj.
Frequency Compensated Divider Probe	HP Model 10001A	10:1; dc to 30 MHz; 10 megohms; 10 pF; 2% 600 V.	L.V.P.S. Adj. H.V.P.S. Adj.
Test Oscilloscope	HP Model 1200A/B	100 mV sensitivity; 100 kHz bandwidth	L.V.P.S. Adj. H.V.P.S. Adj.
AC Voltmeter	HP Model 3400A	10 V; +2% accurate 50 kHz to 500 kHz	Vert. Bandwidth Check Horiz. Bandwidth Check
BNC-to-binding-post adapter quantity: 2	HP Model 10111A	Shielded	Channel Isolation Check