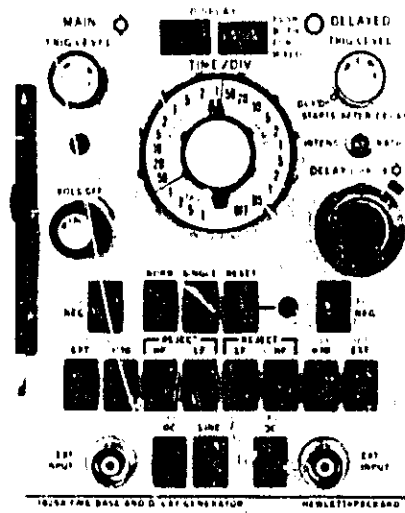


OPERATING AND SERVICE MANUAL

# 1825A TIME BASE AND DELAY GENERATOR



HEWLETT **hp** PACKARD

## 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 MERCHANTABILITY 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 1825A  
TIME BASE AND DELAY GENERATOR**

**SERIAL NUMBERS**

This manual applies directly to instruments with serial numbers prefixed 1514A.

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 1206A through 1348A.

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

Manual Part Number 01825-9090-4  
Microfiche Part Number 01825-9080-4

PRINTED: SEPT 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.

### **DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.**

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

### **DANGEROUS PROCEDURE WARNINGS.**

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

#### **WARNING**

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

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**MAIN TIME BASE****Sweep**

**Ranges:** 0.05  $\mu$ s/div to 1 s/div (23 positions) in 1, 2, 5 sequence.  $\pm 3\%$  accuracy with vernier in calibrated position.

**Vernier:** continuously variable between ranges, extends slowest sweep to at least 2.5 s/div. Front panel light indicates when vernier is not in CAL position.

**Magnifier:** (on mainframe) expands fastest sweep to 5 ns/div, accuracy  $\pm 5\%$ .

**Sweep mode**

**Normal:** sweep is triggered by an internal, external, or power line signal.

**Automatic:** bright baseline displayed in absence of trigger signal. Triggering is same as Normal except low frequency limit is 40 Hz.

**Single:** in Normal, sweep occurs once with same triggering as Normal; reset pushbutton arms sweep and lights indicator; in Auto, sweep occurs once each time reset pushbutton is pressed.

**DELAYED TIME BASE**

Delayed time base sweeps after a time delay set by Main time base and Delay controls. Delayed time base is triggered on first trigger pulse after set delay or automatically triggers after set delay when delayed level control is in detent position.

**Sweep**

**Ranges:** 0.05  $\mu$ s/div to 20 ms/div (18 positions) in 1, 2, 5 sequence.  $\pm 3\%$  accuracy.

**Magnifier:** (on mainframe) expands fastest sweep to 5 ns/div, accuracy  $\pm 5\%$ .

**Delay (before start of delay sweep).**

**Time:** continuously variable from 50 ns to 10 s.

**Accuracy:**  $\pm 0.75\%$  of differential delay  $\pm 2$  minor divisions of delay dial.

**Time jitter:** 0.002% (1 part in 50,000) of maximum delay on each range.

**TRIGGERING**

**Internal:** refer to vertical amplifier plug-in specifications.

**External:** dc to 50 MHz on signals 50 mV p-p or more increasing to 100 mV p-p at 100 MHz and 150 mV p-p at 150 MHz.

**Line:** power line frequency signal. (Main only.)

**Level**

**Internal:** at any point on the vertical waveform displayed.

**External:** continuously variable from +2 V to -2 V on either slope of trigger signal, from +20 V to -20 V in +10 setting.

**Slope:** pushbutton selects either positive or negative slope of trigger signal.

**Coupling:** front panel selection of AC, DC, HF Reject, or LF Reject.

**AC:** attenuates signals below approx. 20 Hz.

**LF reject:** attenuates signals below approx. 15 kHz.

**HF reject:** attenuates signals above approx. 15 kHz.

**Trigger holdoff:** time between sweeps continuously variable, exceeding one full sweep on all ranges. (Main only.)

**TRACE INTENSIFICATION**

In Main sweep mode intensifies that part of main time base to be expanded to full screen in delayed time base mode. Rotating time base switch from OFF position activates intensified mode.

**CALIBRATED MIXED SWEEP**

Combines Main and Delayed sweeps into one display. Sweep is started by the Main time base and is completed by the faster Delayed time base. Delayed sweep start is aligned with start of intensified marker.

**GENERAL****OPERATING ENVIRONMENT**

**Temperature:** 0 to +55°C.

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

**Altitude:** to 4600 m (15 000 ft).

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

**WEIGHT:** net, 1.8 kg (4 lb); shipping 2.7 kg (6 lb).



## SECTION I

### GENERAL INFORMATION

#### 1-1. INTRODUCTION.

1-2. The Hewlett-Packard Model 1825A time base and delay generator is designed for use in HP 180-series mainframes and provides sweep speeds ranging from 0.05  $\mu$ s/div to 1 s/div in 23 ranges. Delay times are continuously variable from 50 nanoseconds to 10 seconds and are accurate to 0.75% with extremely low jitter of 1 part in 50,000. Also, a calibrated mixed sweep mode is provided. A mainframe X10 magnifier increases sweep-speed capability to 5 ns/div with 5% accuracy.

1-3. This manual contains installation and operating instructions, as well as maintenance information for the 1825A. Instrument specification and procedures for verifying proper operation are included. Procedures are also included for adjusting the instrument to its performance specifications. Schematic diagrams, the theory of operation, and troubleshooting information are provided for use in maintaining the instrument.

1-4. This section of the manual contains the performance specifications for the 1825A and instrument and manual identification information.

#### 1-5. SPECIFICATIONS.

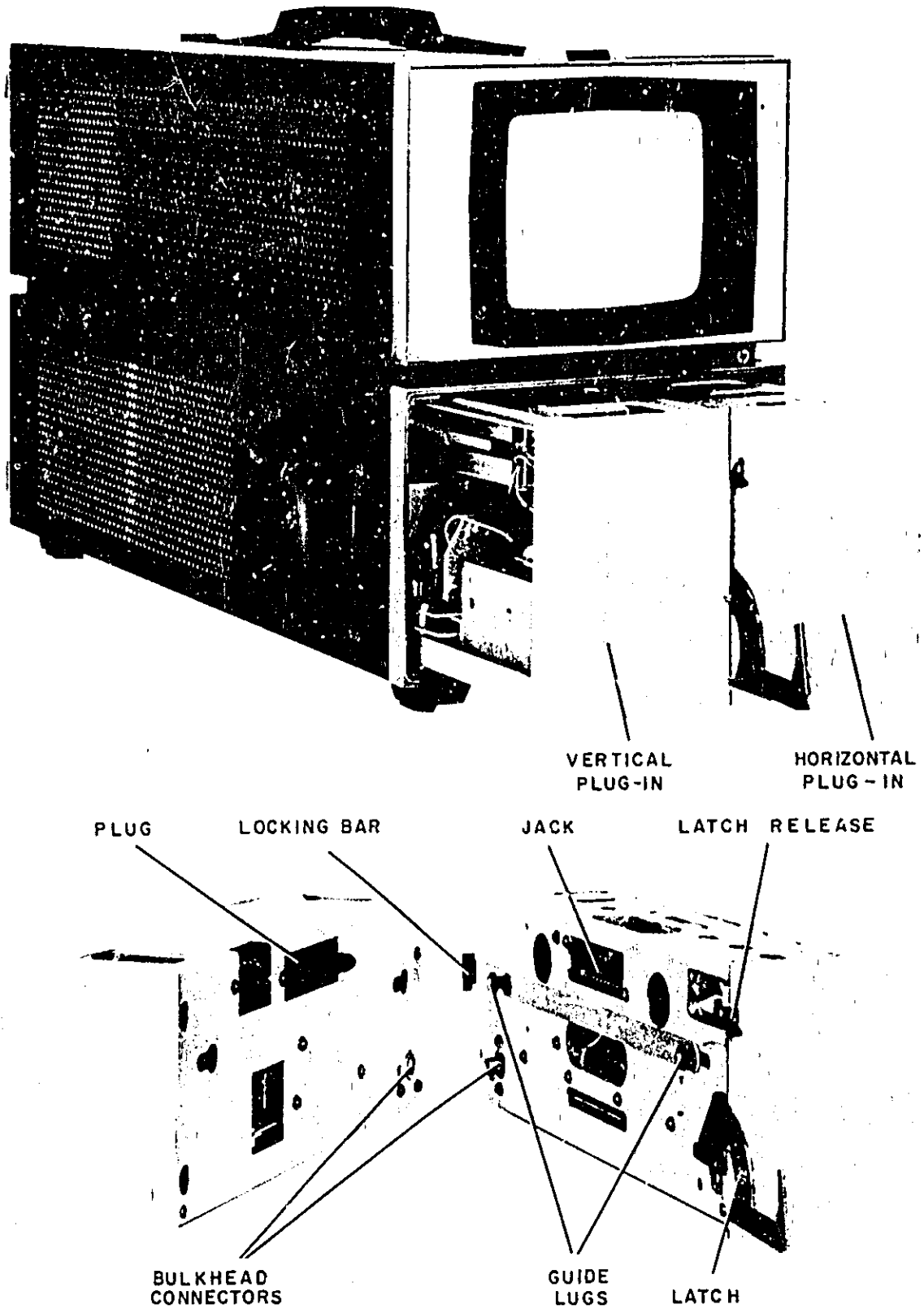
1-6. Table 1-1 is a complete list of the 1825A critical specifications that are controlled by tolerances. Any

changes in specifications due to manufacturing, design, or traceability to the U.S. National Bureau of Standards are included in table 1-1 or on a manual change sheet included with this manual. The manual and manual change sheet (if any) supercedes all previous information concerning specifications of the 1825A.

#### 1-7. INSTRUMENT AND MANUAL IDENTIFICATION.

1-8. Instrument identification by serial number is located on the rear panel. Hewlett-Packard uses a two-section serial number consisting of a four-digit prefix and a five-digit suffix, separated by a letter designating the country in which the instrument was manufactured. (A = U.S.A.; G = West Germany; J = Japan; U = United Kingdom.)

1-9. This manual applies to instruments with a serial prefix number as shown on the title page. If changes have been made in the instrument since this manual was printed, a "Manual Changes" supplement supplied with the manual will define these changes. Be sure to record these changes in your manual. Back-dating information in Section VII adapts the manual to instruments with serial numbers lower than that shown on the title page. Part numbers for the manual and the microfiche copy of the manual are also shown on the title page.



7000-A-23A

Figure 2-1. Plug-in Mating

## SECTION II INSTALLATION

### 2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for installing and interfacing the Model 1825A. Included are initial inspection procedures, 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 marks 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, file a claim with the carrier. Check 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.

### 2-5. PREPARATION FOR USE.

**WARNING**

Read the safety summary at the front of the manual before installing or operating the instrument.

2-6. The 1825A and the vertical plug-in unit must be locked together before installing them into a 180-series oscilloscope mainframe. This procedure is explained below. Power for the 1825A is supplied by the oscilloscope mainframe.

### NOTE

The 1825A will mate with any vertical plug-in of the 180-series and will operate in any mainframe of the series.

2-7. Install plug-ins as follows:

- a. Move locking bar to rear (figure 2-1).
- b. Fit vertical plug-in plug into horizontal plug-in jack, making certain bulkhead connectors and guide lugs are aligned. Press plug-ins firmly together.
- c. After aligning front and rear panels, push locking bar forward.
- d. Lift up latch release and rotate latch downward. Insert plug-ins into oscilloscope.
- e. Rotate latch upward and push forward to lock.

### 2-8. REPACKING FOR SHIPMENT.

2-9. 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.

2-10. Use the original shipping carton and packing material. If the original packing material is not available, the Hewlett-Packard Sales/Service Office will provide information and recommendations on materials to be used.

1. DISPLAY. Selects sweep display mode: MAIN, MIXED, or DELAYED.
2. Delayed TIME/DIV. Selects sweep speed of delayed time base in 18 ranges. Has an OFF position.
3. Delayed TRIG LEVEL. Selects point on delayed trigger signal that starts sweep. Also selects DELY'D STARTS AFTER DELAY.
4. INTENS RATIO. Adjusts intensity difference between main and delayed sweep when DISPLAY is set to MAIN and delayed TIME/DIV is not OFF.
5. DELAY. Selects time delay between start of main sweep and start of delayed sweep.
6. Delayed POS/NEG. Determines whether positive or negative slope of trigger signal starts delayed sweep.
7. Delayed LF REJECT. Attenuates delayed trigger signals below 15 kHz.
8. Delayed HF REJECT. Attenuates delayed trigger signals above 15 kHz.
9. Delayed +1/+10. Selects attenuated or unattenuated delayed trigger signal.
10. Delayed INT/EXT. Selects trigger signal from vertical plug-in or from delayed EXT INPUT connector.
11. Delayed EXT INPUT. BNC connector for applying delayed trigger signal.
12. Delayed AC/DC. Selects direct or capacitive coupling for delayed trigger signal.
13. LINE. Selects line triggering for main sweep.
14. Main AC/DC. Selects direct or capacitive coupling for main trigger signal.
15. Main EXT INPUT. BNC connector for applying main trigger signal.
16. Main LF REJECT. Attenuates main trigger signals below 15 kHz.
17. Main HF REJECT. Attenuates main trigger signals above 15 kHz.
18. Main +1/+10. Selects attenuated or unattenuated main trigger signals.
19. Main INT/EXT. Selects trigger signal from vertical plug-in or from main EXT INPUT connector.
20. Main POS/NEG. Determines whether positive or negative slope of trigger signal starts main sweep.
21. AUTO/NORM. Selects automatic sweep start or triggered sweep start for main sweep.
22. SINGLE. Selects single sweep operation for main sweep.
23. RESET. Rearms sweep after single sweep operation.
24. HOLDOFF. Adjusts time between end of one main sweep and arming of next.
25. VERNIER. Permits selection of sweep speeds between calibrated ranges of main TIME/DIV switch.
26. RESET lamp. Indicator lights when main sweep is armed.
27. UNCAL lamp. Indicator lights when main sweep is rotated out of calibrated position.
28. Main TRIG LEVEL. Selects point of trigger signal that starts main sweep.
29. Main TIME/DIV. Selects sweep speed of main sweep in 23 ranges.

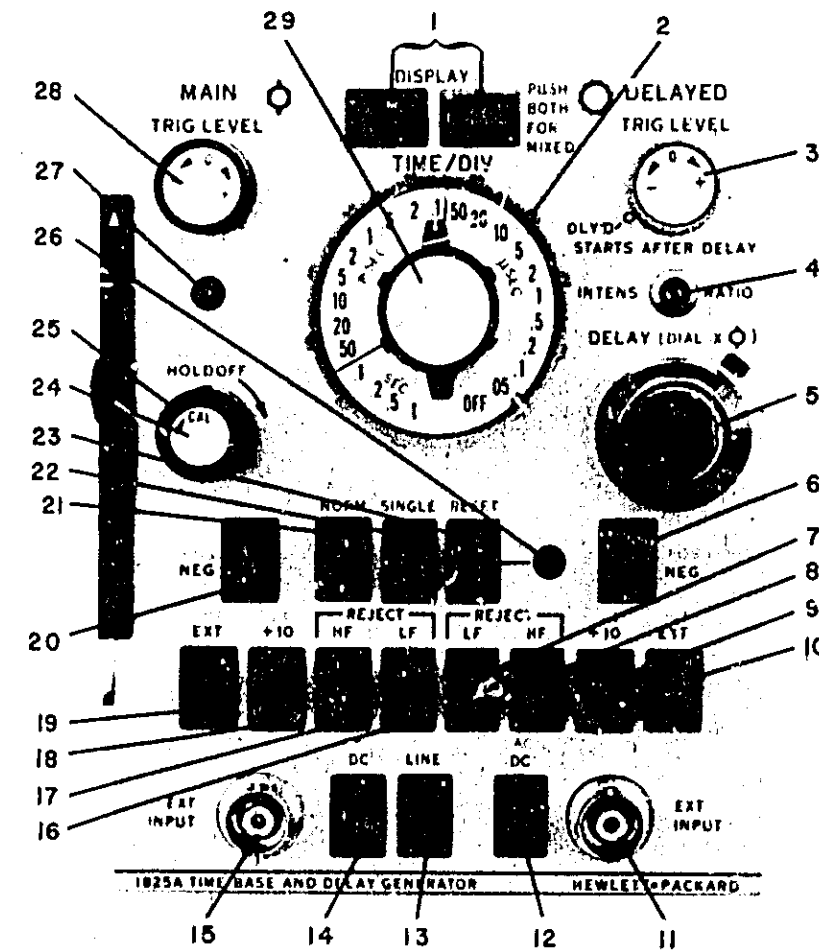


Figure 3-1.  
Front Panel Controls and Connectors  
3-0

### SECTION III OPERATION

#### 3-1. INTRODUCTION.

3-2. This section provides general operating instructions and applications information for Model 1825A. Included are power and warmup information, functional identification of all controls and connectors, and applications information.

#### 3-3. INSTRUMENT CAPABILITIES.

3-4. The 1825A provides a time base with sweep speeds ranging from 0.05  $\mu$ s/div to 1 s/div. Stable, accurate time displays are provided in main, delayed, and mixed modes with external trigger capabilities varying from 50 mV (at 50 MHz) to 150 mV (at 150 MHz).

3-5. Trigger level controls on main and delayed sweeps allow selection of the triggering point on the desired portion of the signal for almost every measurement application. Also, the +10 function provides a wide dynamic range of triggering in both external and internal modes of operation.

3-6. External trigger sensitivity of 50 mV for both main and delayed sweeps allows a 10:1 divider probe to be used to reduce circuit loading at the trigger pick-off point.

#### 3-7. GENERAL OPERATING INSTRUCTIONS.

3-8. Figure 3-1 shows the instrument front panel and provides functional descriptions of operating controls, indicators, and connectors. Trigger signal requirements are listed in table 3-1.

3-9. **INITIAL TURN-ON PROCEDURE.** To place the 1825A into operation, perform the following steps:

- a. Install 1825A and vertical plug-in unit into oscilloscope mainframe (refer to Section II).
- b. Set mainframe INTENSITY control fully counterclockwise.
- c. Set mainframe magnifier to X1.
- d. Set mainframe DISPLAY control to internal position.
- e. Set 1825A controls as follows:

TIME/DIV (main) ..... 1 ms  
 AUTO/NORM ..... AUTO

TRIG LEVEL (delayed) ... DLY'D STARTS AFTER DELAY  
 INT/EXT (main) ..... INT  
 HOLDOFF ..... fully cw  
 AC/DC (main) ..... DC  
 POS/NEG (main) ..... POS

f. Apply power to mainframe oscilloscope and allow 30-minute warmup period.

g. Adjust mainframe INTENSITY and FOCUS controls for sharp, just visible trace.

#### 3-10. OPERATING INFORMATION.

3-11. **AUTO VERSUS NORM.** In AUTO operation, the sweep free-runs in the absence of a trigger signal, displaying a bright baseline. A trigger of 40 Hz or higher overrides AUTO operation and produces a stable presentation. (Adjustment of the main TRIG LEVEL control may be necessary for a stable display.) If the trigger signal is less than 40 Hz or exceeds 25 milliseconds, NORM operation must be used. A trigger signal is always needed in NORM operation to generate a sweep.

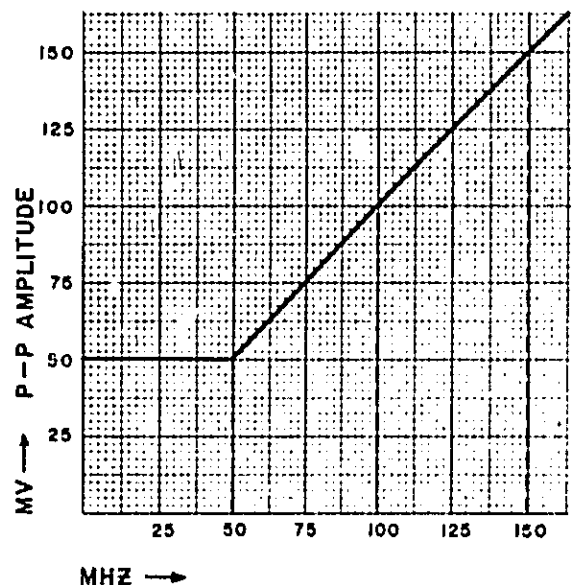


Figure 3-2. External Trigger Requirements

3-12. **AC VERSUS DC.** AC coupling removes the dc level of trigger signals and attenuates signals below approximately 20 Hz. The main LF REJECT switch

Table 3-1 Trigger Signal Requirements

|                                 | SWEEP MODE               | TRIGGER SOURCE                                      | TRIGGER COUPLING   | MINIMUM TRIGGER AMPLITUDE                       | LEVEL                                      |   | SLOPE  |
|---------------------------------|--------------------------|---|--|---|--|---|--|
| M<br>A<br>I<br>N                | NORM                     | LINE  |  | FIXED   | In +1<br>Adjustable<br><br>+2 V to<br>-2 V | In +10<br>Adjustable<br><br>+20 V to<br>-20 V | S<br>E<br>L<br>E<br>C<br>T<br>A<br>B<br>L<br>E<br><br>+<br><br>or<br><br>- |
|                                 |                          | INT   | DC: dc to 150 MHz.<br>AC: 20 Hz to 150 MHz                 | 20 Hz — 100 MHz >1/2 div of vertical deflection |  |   |  |
|                                 |                          | EXT   | REJECT LF: 15 kHz to 150 MHz<br>REJECT HF: dc to 30 kHz    | See figure 3-2                                  |  |   |  |
| M<br>A<br>I<br>N                | AUTO                     | LINE  |  | FIXED   | In +1<br>Adjustable<br><br>+2 V to<br>-2 V | In +10<br>Adjustable<br><br>+20 V to<br>-20 V | S<br>E<br>L<br>E<br>C<br>T<br>A<br>B<br>L<br>E<br><br>+<br><br>or<br><br>- |
|                                 |                          | INT   | DC: 40 Hz to 150 MHz<br>AC: 40 Hz to 150 MHz               | 40 Hz — 100 MHz >1/2 div of vertical deflection |  |   |  |
|                                 |                          | EXT   | REJECT LF: 15 kHz to 150 MHz<br>REJECT HF: 40 Hz to 30 kHz | See figure 3-2                                  |  |   |  |
|                                 | SINGLE                   | Single may be selected after setting up any display |  |   |  |   |  |
| D<br>E<br>L<br>A<br>Y<br>E<br>D | NORM                     | INT   | DC: dc to 150 MHz<br>AC: 20 Hz to 150 MHz                  | See Vert MANUAL                                 | In +1                                      | In +10  | S<br>E<br>L<br>E<br>C<br>T<br>A<br>B<br>L<br>E<br><br>+<br><br>or<br><br>- |
|                                 |                          | EXT   | REJECT LF: 15 kHz to 150 MHz<br>REJECT HF: dc to 30 kHz    | See figure 3-2                                  | +20 V to<br>-20 V                          | +2 V to<br>-2 V                               |  |
|                                 | DLY'D STARTS AFTER DELAY | No Function   |  | Automatically triggered at end of delay         | No Function                                |   |  |

attenuates signals below approximately 15 kHz and can be used to prevent power line frequency ripple from triggering the sweep. The main HF REJECT switch attenuates signal above approximately 15 kHz and can be used to prevent high frequency noise from triggering the sweep.

**3-13. INTENSITY RATIO.** A convenient front-panel control is provided so that the user can adjust the intensity ratio between the main and the delayed sweep. To adjust the intensity ratio proceed as follows:

- a. Accomplish paragraph 3-9.
- b. Set vertical plug-in channel A VOLTS/DIV control to 2 V/div.
- c. Connect mainframe 10 V calibrator signal to vertical plug-in channel A INPUT connector.
- d. Set 1825A AC/DC controls to DC position.
- e. Set main TIME/DIV control for desired display.
- f. Adjust main TRIG LEVEL control for stable display.
- g. Set delayed TIME/DIV control and DELAY control to intensify points of interest.
- h. Adjust INTEN RATIO screwdriver adjustment for desired ratio of intensity between main and delayed sweep.

### 3-14. APPLICATION.

**3-15. TIME DIFFERENCE MEASUREMENTS.** To measure the time difference between two points of interest, proceed as follows:

- a. Accomplish paragraph 3-9.
- b. Connect signal of interest to vertical INPUT connector.
- c. Adjust vertical controls and time base controls for stable display.
- d. Set time base DELAY control to 0.5.
- e. Set delayed TIME/DIV control to intensify desired portion of display.
- f. Adjust DELAY control to intensify first point of interest.
- g. Set time base DISPLAY control to DELAYED position.
- h. Adjust DELAY control to set point of interest on selected vertical graticule line.
- i. Note DELAY control setting.
- j. Set time base DISPLAY control to MAIN position.
- k. Adjust DELAY control to intensify second point of interest.
- l. Set time base DISPLAY control to DELAYED position.
- m. Adjust DELAY control to set second point of interest on same vertical graticule selected in step h.
- n. Note DELAY control setting.
- o. To determine time difference between first and second point of interest multiply main TIME/DIV setting by difference between DELAY settings recorded in steps i and n.

## SECTION IV

### PRINCIPLES OF OPERATION

#### 4-1. INTRODUCTION.

4-2. This section contains functional descriptions keyed to an overall block diagram. A detailed explanation of circuit functions, keyed to the schematics, is provided after the block diagram discussion. Following this, complete cycles of operation (for various modes) will be discussed. The block diagram and the schematics are located in Section VIII.

#### 4-3. MAIN SWEEP BLOCK DIAGRAM.

4-4. **MAIN TRIGGER CONDITIONER.** The main trigger conditioner group contains the switching circuitry required to select the shape of the main trigger.

4-5. **MAIN IMPEDANCE CONVERTERS.** Two impedance converters are employed to provide a means of removing an interfering component from the main trigger signal. The main HF impedance converter attenuates frequencies below approximately 15 kHz. The main LF impedance converter attenuates frequencies above approximately 15 kHz. An interfering signal component can be removed by disabling one of the impedance converters.

4-6. **MAIN TRIGGER AMPLIFIER AND POLARITY SWITCH.** The main trigger amplifier and polarity switch group provides a means of amplifying and switching the polarity of the main trigger signals. Switching is required to permit triggering on either the positive or negative slope of the displayed signal.

4-7. **MAIN DUAL SCHMITT.** The main dual Schmitt inhibits the trigger signal during a main sweep cycle and permits triggering of a new sweep only after termination of a sweep cycle.

4-8. **MAIN INTEGRATOR GATE.** The main integrator gate is a dual input Schmitt trigger that provides a gating pulse to the main integrator. It also provides gating pulses to a rear panel connector on the oscilloscope mainframe. In NORM, the main integrator gate prohibits the sweep from free-running in the absence of a trigger signal. In AUTO, sweep free-running is permitted, providing a baseline display on the oscilloscope CRT in the absence of a trigger signal.

4-9. **MAIN 10 V SCHMITT.** The main 10 V Schmitt controls the main dual Schmitt and the auto and look-out groups, ensuring the start of the main sweep at the proper time and prohibiting further triggering during the sweep cycle.

4-10. **MAIN INTEGRATOR.** The main integrator contains a Miller integrator and the gating circuitry required to clamp and unclamp the integrator, as required. When unclamped, the integrator generates a linear ramp that is used as the main time base for the oscilloscope. The main ramp is also provided to a rear panel connector on the oscilloscope mainframe.

4-11. **HOLDOFF DRIVER AND READER.** The holdoff driver and reader function as impedance matching devices. The driver matches the output of the integrator to the holdoff charging circuit. The reader matches the holdoff charging circuit to the input of the main 10 V Schmitt.

4-12. **AUTO AND LOCKOUT.** The auto and lockout group permits the main 10 V Schmitt to trigger the sweep in the absence of a trigger from one of the trigger inputs.

4-13. **MAIN SWEEP SWITCH AND VERNIER.** The main sweep switch selects the required integrating capacitors and resistors for each range (TIME/DIV). The vernier provides a variable charging voltage to the integrator to permit selection of sweep frequencies between the calibrated ranges.

4-14. **INTERNAL TRIGGER PICKOFF.** The internal trigger pickoff group connects sync signals from the vertical plug-in to the trigger conditioners. Isolation between the two trigger conditioners is also provided.

4-15. **DISPLAY SWITCH.** The display switch group, consisting of the MAIN and DELAYED DISPLAY switches, connects the main ramp, the delayed ramp, or both to the oscilloscope mainframe. The display switch group also provides control voltage to the gate Schmitt and intensify group.

4-16. **GATE SCHMITT AND INTENSIFY.** The gate Schmitt and intensify group takes the main integrator gate, the delayed integrator gate and a dc voltage selected by the INTENS RATIO control and combines them into a composite gate to control the intensity of the oscilloscope CRT.

4-17. **DELAYED SWEEP BLOCK DIAGRAM.** The delayed sweep circuit groups function identically as those of the main sweep circuit groups, except as explained in the following paragraph.

4-18. **COMPARATOR.** In the comparator, the main ramp is compared with a voltage selected by the cali-



brated DELAY control. This makes possible the precise selection of either the arming point (triggered mode) or the starting point (delayed starts after delay mode) of the delayed ramp.

**4-19. DELAYED STARTS AFTER DELAY.** When the DELAYED TRIG LEVEL control is set to DLY'D STARTS AFTER DELAY, the delayed starts after delay group permits the delayed control Schmitt to trigger the delayed dual Schmitt. This provides a trigger for the delayed integrator in the absence of a delayed trigger signal.

#### 4-20. THEORY OF OPERATION.

4-21. The circuits of Model 1825A are diagrammed on schematics located at the rear of this manual. Each explanation will be keyed to one or more of these schematics.

**4-22. MAIN TRIGGER CONDITIONER.** The main trigger conditioner circuits (schematic 1) consist of A1S1A, A1S1B, A1S2A, A1S2B, A1S4A, A1S4B, and associated components. Line, external, and internal triggers are brought in on lines (1), (2), and (3) respectively. The outputs are on lines (4) and (5).

4-23. The main INT/EXT switch selects a trigger from oscilloscope vertical plug-in or from some external device connected to the main EXT INPUT connector.

4-24. The main +1/+10 switch connects the selected input directly or through a 10:1 divider to the impedance converter.

4-25. The main HF REJECT switch applies a bias to the gate of A1Q1, disabling the HF impedance converter.

4-26. The main AC/DC switch connects the selected input directly or capacitively to the LF impedance converter. The HF impedance converter is always capacitively coupled through A1C2.

4-27. The main LF REJECT switch grounds the input to the LF impedance converter (A2U1).

4-28. The LINE switch connects a 60-Hz signal from the oscilloscope mainframe by way of line (1) to the LF impedance converter. It also applies a disabling bias to the HF impedance converter.

**4-29. MAIN IMPEDANCE CONVERTERS.** The main HF impedance converter is a high-impedance input, low-impedance output, noninverting amplifier con-

sisting of FET amplifier A1Q1 and grounded collector amplifier A1Q2. Its input is on line (5) and its output is on line (8). The amplifier can be disabled by applying -12.6 volts to the gate of A1Q1 by way of A1S2B, A1S2A, and A1R6 or by way of A1S4B.

4-30. The main LF impedance converter is a high-impedance input, low-impedance output, inverting amplifier consisting of operational amplifier A2U1 and emitter follower A2Q1. Its input is on line (4) and its output is on line (7). The amplifier is disabled by grounding its input through switches A1S2B and A1S4B.

**4-31. MAIN TRIGGER AMPLIFIER AND POLARITY SWITCH.** The main trigger amplifier is a two-section differential amplifier with the polarity switch between the two sections. The input section consists of differential amplifier A1U1Q1/A1U1Q2 and current source A1U1Q3. Inputs are from the main impedance converter lines (7) and (8). Outputs are to the polarity switch on lines (11) and (12).

4-32. The polarity switch consists of two common-base amplifiers with common inputs and cross-coupled outputs. One amplifier (A1Q3 and A1Q6) is turned on when the POS/NEG switch is set to POS. The other amplifier (A1Q4 and A1Q5) is turned on when the POS/NEG switch is set to NEG.

4-33. The output section consists of differential amplifier A1U1Q4/A1U1Q5 and current source A1U1Q6. Resistor A1R25 adjusts the main trigger sensitivity and its setting is critical for proper operation of the main dual Schmitt.

**4-34. MAIN DUAL SCHMITT.** The main dual Schmitt (schematic 2) consists of gates A1U2A and A1U2B, with associated biasing and feedback circuitry. The main dual Schmitt is controlled by signals on lines (15) and (16) from the main trigger amplifier and on line (18) from the main 10 V Schmitt.

4-35. In the quiescent state, the voltage on line (18) is low and, assuming the main POS/NEG switch is set to POS, line (15) is high and line (16) is low. As long as one of three lines ((15), (16), or (18)) is high, line (21) (main dual Schmitt output) will be high.

4-36. The output of A1U2A will go low when the trigger pulse causes line (15) to go low. Because of feedback through A1R35 and current limitations in

the output of the trigger amplifier, the output of A1U2A will remain low as long as line (18) is low. With line (16) low, all three lines to A1U2B are low causing line (21) to go low. This condition will remain until line (18) goes high (at the end of the sweep cycle).

**4-37. MAIN INTEGRATOR GATE.** The main integrator gate is a Schmitt trigger consisting of A1Q10 on one side and paralleled A1Q8 and A1Q9 on the other side. The two inputs are on line (21) from the main dual Schmitt to the base of A1Q9 and on line (23) from the auto and lockout circuit to the base of A1Q8.

4-38. When the main AUTO/NORM switch is set to NORM, +15 volts on line (23) disables A1Q8. When line (21) goes high, the outputs of the main integrator gate (lines (24), (25), and (25A)) go more positive.

4-39. When the AUTO/NORM switch is set to AUTO, A1Q8 is enabled and line (23) from the auto and lockout circuit controls the gate. Thus the outputs of the main integrator gate on lines (24), (25), and (25A) can be controlled by inputs on either lines (21) or (23).

**4-40. MAIN 10 V SCHMITT.** The main 10 V Schmitt consists of Schmitt trigger A7Q3/A7Q4, current source A7Q5, emitter follower A7Q2, and lamp driver A7Q1. In the quiescent state the output on line (18) is low. When the main sweep starts, the output from the integrator rises and eventually causes the 10 V Schmitt to change states and line (18) (driven by A7Q2) goes high. As long as line (18) is high, further triggering is prevented.

4-41. When the output of A7Q3 is low, A7Q1 conducts and RESET lamp DS1 lights. When the output of A7Q3 is high, A7Q1 is turned off and DS1 goes out.

**4-42. MAIN INTEGRATOR.** The main integrator consists of A9Q1 through A9Q7. The circuit is made up of a standard Miller integrator (A9Q4 and A9Q5) with a current source (A9Q6), an operational amplifier (A9U3) for drift control, a reset control (A9Q2A and A9Q2B), current switch (A9Q1 and A9Q3), and an emitter follower (A9Q7).

4-43. Assume the circuit to be in the quiescent state with A9Q1 off and A9Q3 on. All the current from the integrating resistor is flowing in A9Q3. A trigger causes line (25) to go low and A9Q1 turns on. This

causes A9Q3 to turn off, permitting the integrating capacitor to start charging toward the negative charging voltage. The ramp at the output of A9Q5 starts rising (positively).

4-44. As the ramp rises, it drives A9Q2B toward cutoff and the decreasing current in A9Q2B causes the current in A9Q2A to increase. At a time determined by the upper threshold of the main 10 V Schmitt, line (25) returns to the high state and A9Q1 turns off while A9Q3 turns on. The integrating capacitor starts discharging through A9Q3. This causes the ramp at the collector of A9Q5 to start falling. As the ramp falls, the current in A9Q2B increases while the current in A9Q2A decreases. This change continues until the integrating capacitor has discharged to the point where only (and all of) the current from the integrating resistor is flowing in A9Q3, establishing a condition of equilibrium in A9Q2B and A9Q2A.

4-45. The design of the circuit is such that equilibrium is established when the base voltages of A9Q2B and A9Q2A are equal. Because the base of A9Q2A is tied to ground, equilibrium is established at 0 volt.

4-46. The voltage follower A9U3 is an operational amplifier with the base-emitter junction of A9Q5 in its feedback path. It sets the emitter of A9Q5 to approximately -6 volts. The input voltage to the integrator is a function of the -100-volt power supply. The output voltage of A9U3 is also a function of the -100-volt power supply. This relationship is used to cancel drift from the -100-volt supply.

**4-47. HOLDOFF DRIVER AND READER.** The holdoff driver (A7Q8 and A7Q9) and the holdoff reader (A7Q6 and A7Q7) function as impedance matching devices for the holdoff circuit. The holdoff charging circuit consists of the front panel HOLDOFF control R2, A7R17, and the selected holdoff capacitor on A8.

**4-48. AUTO AND LOCKOUT.** The auto and lockout circuit consists of A1Q7, A1CR5, and A1CR6. When AUTO/NORM switch is set to NORM, the line (23) input to the main integrator gate is disabled because A1Q8 is back biased by +15 volts applied through A1CR6. When AUTO/NORM switch is set to AUTO, A1CR6 is back biased. However, as long as A1Q7 is turned on, +15 volts is applied through A1CR5 and A1Q8 remains back biased.

4-49. In the quiescent state, the NOR output of A1U2B (line 20) is low. Incoming trigger pulses cause A1U2B to change states and line 20 goes high, charging A1C6. Because the NOR output of A1U2B has no pulldown resistor, A1C6 cannot discharge rapidly. As long as trigger pulses (40 Hz or greater) are present, A1C6 does not discharge enough to allow A1Q7 to turn off. If trigger pulses are removed, A1C6 will finally discharge to the point where A1Q7 turns off. Now, the next pulse from the 10 V Schmitt will turn A1Q8 on and the resultant pulse on line 25 will initiate a sweep. In this manner, a free-running baseline is displayed in the absence of trigger pulses.

4-50. **MAIN SWEEP SWITCH AND VERNIER.** The main sweep switch (schematic 7) is a four-section rotary switch, A8S1. The vernier circuit consists of A8U1 and front-panel VERNIER control R3. Switch section A8S1A switches calibration resistors. The integrating resistors are switched by A8S1B. The integrating capacitors are switched by A8S1C. The holdoff capacitors are switched by A8S1D. A fixed voltage reference point for the integrating circuit is provided by A8U1 when the VERNIER control is in detent. It provides a variable (uncalibrated) voltage reference source when the VERNIER control is out of detent.

4-51. **DELAYED TRIGGER CONDITIONER.** The delayed trigger conditioner circuits (schematic 3) consist of A1S2C, A1S2D, A1S3A, A1S3B, A1S5, and associated components. External and internal triggers are brought in on lines 34 and 35 respectively. The outputs are on lines 36 and 37.

4-52. The delayed INT/EXT switch selects a trigger from the oscilloscope vertical plug-in, or from some external device connected to the delayed EXT INPUT connector.

4-53. The delayed +1/+10 switch connects the selected input directly or through a resistive 10:1 divider to the impedance converters.

4-54. The delayed HF REJECT switch applies a bias to the gate of A1Q11 to disable the HF impedance converter.

4-55. The delayed AC/DC switch connects the selected input directly or capacitively to the LF impedance converter. The HF impedance converter is always capacitively coupled through A1C7.

4-56. The delayed LF REJECT switch grounds the input to the LF impedance converter.

4-57. **DELAYED IMPEDANCE CONVERTERS.** The delayed HF impedance converter is a high-impedance input, low-impedance output, noninverting amplifier consisting of FET amplifier A1Q11 and grounded collector amplifier A1Q12. Its input is on line 36 and its output is on line 39. The amplifier can be disabled by applying -12.6 volts to the gate of A1Q11 by way of A1S2C, A1S2D, A1R54 and A1R55.

4-58. The delayed LF impedance converter is a high-impedance input, low-impedance output, inverting amplifier consisting of operational amplifier A2U2 and emitter follower A2Q2. Its input is on line 37 and its output is on line 40.

4-59. **DELAYED TRIGGER AMPLIFIER AND POLARITY SWITCH.** The delayed trigger amplifier is a two-section differential amplifier with the polarity switch between the two sections. The input consists of differential amplifier A1U3Q1/A1U3Q2 and current source A1U3Q3. Inputs are from the delayed impedance converters on lines 39 and 40. Outputs are to the polarity switch on lines 41 and 42.

4-60. The polarity switch consists of two common-base amplifiers with common inputs and cross-coupled outputs. A1Q13 and A1Q16 are one amplifier pair. A1Q14 and A1Q15 are the other pair. Depending on the position of the delayed POS/NEG switch, one amplifier is enabled and the other is disabled.

4-61. The output section consists of differential amplifier A1U3Q5/A1U3Q6 and current source A1U3Q4. Resistor A1R68 adjusts the delayed trigger sensitivity and its setting is critical for proper operation of the delayed dual Schmitt.

4-62. **DELAYED DUAL SCHMITT.** The delayed dual Schmitt (schematic 4) consists of OR gates A1U5A and A1U5B with biasing and feedback to cause them to function as Schmitt triggers. The delayed dual Schmitt is controlled by pulses on lines 47 and 48 from the delayed trigger amplifier and on line 50 from the delayed control Schmitt.

4-63. In the quiescent state, the voltage on line 50 is low and, assuming delayed POS/NEG is set to POS, line 47 is high and line 48 is low. As long as one of three lines (47, 48, and 50) is high, line 51 (delayed dual Schmitt output) will be high.

4-64. The output of A1U5A will go low when a positive-going trigger pulse causes line (47) to go low. Because of feed back through A1R81 and deliberate current limitations in the output of the trigger amplifier, the output of A1U5B will remain low as long as line (50) is low. When line (48) goes low, both lines to A1U4B are low so line (51) goes low. This condition will remain until line (57) goes high at the end of the delayed sweep cycle.

**4-65. DELAYED INTEGRATOR GATE.** The delayed integrator gate is a Schmitt trigger consisting of A1Q17 and A1Q18. Pulses on line (51) control the state of the circuit. Its output pulse on line (54) initiates the delayed sweep.

**4-66. DELAYED 10 V SCHMITT AND DELAYED CONTROL SCHMITT.** The delayed 10 V Schmitt trigger consists of A5Q1 and A5Q2. In the quiescent state, the output on line (57) is low. When the delayed sweep starts, the output from the integrator rises and eventually crosses the threshold of the delayed 10 V Schmitt, causing it to change states and line (57) goes high. Line (51) also goes high. As long as line (57) is high, further triggering is prevented.

4-67. Integrated circuit A1U4 functions as the delayed control Schmitt. Its purpose is to prevent triggering of the delayed integrator until after the coincident pulse is received from the comparator on line (61). At the end of each sweep cycle, line (57) goes high and line (50) follows. Because of feedback through A1R79, lines (61) and (50) are held high even after line (57) returns to the low state. As long as line (50) is high, line (51) is held high. At a time determined by the setting of the DELAY control, the comparator initiates a pulse and line (61) goes low. Both inputs to A1U4 being low, line (50) goes low. The next trigger pulse after the coincident pulse operates the dual Schmitt as described in paragraph 4-62.

**4-68. DELAYED INTEGRATOR.** The delayed integrator consists of A5Q3 through A5Q11. The circuit is made up of a standard Miller integrator (A5Q8 and A5Q9) with current source (A5Q4) a reset control (A5Q6 and A5Q7), a current switch (A5Q10 and A5Q11), and two emitter followers (A5Q3 and A5Q5).

4-69. Assume the circuit to be in the quiescent state with A5Q11 off and A5Q10 on. All the current from the integrating resistor is flowing in A5Q10. A

trigger causes line (54) to go low and A5Q11 turns on. This causes A5Q10 to turn off, permitting the integrating capacitor to start charging toward the negative charging voltage. The ramp at the output of A5Q8 starts rising (positively).

4-70. As the ramp rises, it drives A5Q6 toward cut-off and the decreasing current in A5Q6 causes the current in A5Q7 to increase. At a time determined by the upper threshold of the delayed 10 V Schmitt, line (54) returns to the high state and A9R11 turns off while A5Q10 turns on. The integrating capacitor starts discharging through A5Q10. This causes the ramp at the collector of A5Q8 to start falling. As the ramp falls, the current in A5Q6 increases while the current in A5Q7 decreases. This change continues until the integrating capacitor has discharged to the point where only (and all of) the current from the integrating resistor is flowing in A5Q10, establishing a condition of equilibrium in A5Q6 and A5Q7.

4-71. The design of the circuit is such that equilibrium is established when the base voltages of A5Q6 and A5Q7 are equal. In all display modes except mixed, the reference voltage at the base of A1Q7 is zero (ground). Because the base of A5Q7 is grounded, equilibrium is established at 0 volt.

4-72. In mixed mode, the main ramp from the main integrator is applied to the base of A5Q7 via line (66). The main ramp becomes the reference voltage to which the delayed integrator resets, making the mixed display possible.

**4-73. DELAYED STARTS AFTER DELAY.** The delayed starts after delay circuit consists of S1 (ganged with the delayed TRIG LEVEL control), A1CR12 and A1CR13. The circuit permits the delayed sweep to be enabled by the output of the comparator in the absence of a delayed trigger. It does this by applying ground through S6 and A1CR12 to line (47) and through S6 and A1CR13 to line (48). This holds both lines low. When line (50) goes low, line (51) goes low and the delayed integrator gate changes states to initiate the delayed sweep.

**4-74. DELAYED SWEEP SWITCH.** The delayed sweep switch circuit (schematic 7) contains a rotary switch and a voltage reference source. The rotary switch has four sections. The calibrating resistors are switched by A4S1A, the integrating resistors by A4S1B, and the integrating capacitors by A4S1C. Section A3S1D

disables the delayed sweep in the OFF position of the delayed TIME/DIV control.

**4-75. INTERNAL TRIGGER PICKOFF.** The internal trigger pickoff circuits (schematic 5) provide a compensated attenuator between the trigger output and main and delayed trigger conditioners. Isolation between the two trigger conditioners is also provided by emitter followers A2Q3 and A2Q4. The resistor/capacitor network in the base of A2Q3 forms the attenuator.

4-76. The input from the vertical plug-in is on line (59). The input to the main trigger conditioner is on line (3). The input to the delayed trigger conditioner is on line (35).

**4-77. COMPARATOR.** The comparator circuitry (schematic 6) is made up of operational amplifier A9U1, comparator A9U2A and A9U2B, Schmitt trigger A9U2C and A9U2D, and emitter follower A9U2E.

4-78. Operational amplifier A9U1 has the DELAY control in its feedback path. Its output voltage is a function of the setting of the DELAY control and of the -100-volt power supply. Drift in the -100-volt power supply causes drift in the main ramp and a change in the IR drop across A9R38. The change in IR drop across A9R38 caused by power supply drift is inverted at the output of A9U1, cancelling the drift in the main sweep ramp. The amount of delay is selected by setting the voltage on the base of A9U2A with calibrated DELAY control R7. The main ramp is applied on line (32) to the base of A9U2B. When the voltage of the ramp rises to equal the voltage selected by the DELAY control, a pulse is generated at the output of the comparator. The pulse is shaped by Schmitt trigger A9U2C and A9U2D. Emitter follower A9U2E serves as isolation between the comparator and the output line (61) to the delayed control Schmitt.

**4-79. DISPLAY SWITCH.** Integrator outputs and control voltages are selected by the display switch to set up the sweep modes. The display switch circuitry consists of two 3-section pushbutton switches and a potentiometer. Section A3S1A, B, and C is the MAIN DISPLAY switch and A3S1D, E, and F is the DELAYED DISPLAY switch.

4-80. Inputs to the switch are: -12.6 volts, the main ramp on line (33), and the delayed ramp on line (55). Outputs are: main gate enable voltage (-12.6 volts) on line (64), delayed gate enable voltage (-12.6 volts)

on line (65), delayed reset reference voltage (main ramp or ground) on line (66), and selected ramp output on line (68).

4-81. When neither switch is pressed, the sweep mode is in main. Switch sections A3S1D and A3S1A connect -12.6 volts to line (64) to enable the main gate. The main ramp is connected through A3S1E and A3R1 to line (68) and to the oscilloscope mainframe. The delayed reset reference line (line (66)) is grounded through A3S1F.

4-82. When only the MAIN DISPLAY switch is pressed, the sweep mode is also in main. Switch section A3S1A connects -12.6 volts to line (64) to enable the main gate. All other connections are the same as in paragraph 4-81.

4-83. When only the DELAYED DISPLAY switch is pressed, the sweep mode is in delayed. Switch section A3S1D connects -12.6 volts to line (65) to enable the delayed gate. The output of the main integrator, line (33), is disconnected by A3S1E. The output of the delayed integrator, line (55), is connected through A3S1F and A3R1 to line (68) and to the oscilloscope mainframe. The delayed reset reference line (line (66)) is grounded through A3S1F and A3S1C.

4-84. When both switches are pressed, the sweep mode is in mixed. Switch section A3S1A connects -12.6 volts to line (64) to enable the main gate. Switch section A3S1D connects -12.6 volts to line (65) to enable the delayed gate. The output of the delayed integrator (line (55)) is connected through A3S1F and A3R1 to line (68) and the oscilloscope mainframe. The main ramp (line (33)) is connected by A3S1C and A3S1F to the delayed reset reference line (line (66)).

**4-85. GATE SCHMITT AND INTENSIFY.** The gate Schmitt and intensify circuits (schematic 5) form a composite gate to control the grid of the oscilloscope CRT. The circuits consist of a Schmitt trigger (A1Q21 and A1Q22), an enable gate for the Schmitt trigger (A1Q20), a differential amplifier (A1Q24 and A1Q25), and two emitter follower switches (A1Q19 and A1Q23).

4-86. With no sweep (either main or delayed), both A1Q22 and A1Q25 are turned off and the output on line (63) (composite gate) is high, turning off the CRT. When either A1Q22 or A1Q25 turns on, the voltage decreases on line (63) and turns the CRT on. Turning both A1Q22 and A1Q25 on together will turn the CRT on harder (intensified).

4-87. In the quiescent state, A1Q22 is turned off. A1Q20 and A1Q21 are turned on. The circuit has been designed so that a pulse (square wave) from the main integrator to the base of A1Q20 will set the circuit midway between the upper and lower hysteresis limits. The Schmitt trigger is enabled and a small differentiated pulse on the base of A1Q21 will cause it to change states. The sequence of events for main mode is illustrated in figure 4-1. A1Q19 has been activated by  $-12.6$  volts applied to the emitter. At time  $t_1$ , a pulse arrives on line (25A) from the main integrator gate. The leading edge of the pulse is differentiated in the emitter circuit of A1Q19 and applied to the base of A1Q21. Since both conditions required to activate the Schmitt trigger are present simultaneously, the Schmitt trigger changes states and the composite gate on line (63) falls, turning on the CRT.

4-88. Removing the main integrator gate pulse from the base of A1Q20, or applying a positive-going pulse to the base of A1Q21 will reset the Schmitt. At the time  $t_2$  (figure 4-1) the main integrator pulse is removed. The trailing edge is differentiated in the emitter circuit. Since two conditions are present, either of which will reset the Schmitt trigger, the Schmitt trigger resets and the composite gate is terminated, turning off the CRT.

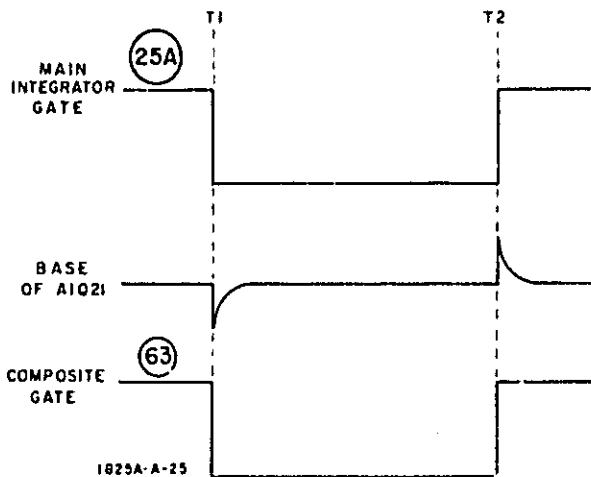


Figure 4-1. Sequence of Events, Main Mode Gate

4-89. In delayed mode, A1Q19 is disabled by removal of  $-12.6$  volts from line (64). A1Q23 is enabled by  $-12.6$  volts on line (65). The sequence of events for delayed mode is shown in figure 4-2. At  $t_1$ , the main integrator gate is applied to the base of A1Q20 on line (25A), enabling the Schmitt trigger. Following time  $t_1$ , the main ramp is compared with a selected

voltage in the comparator. At time  $t_2$ , the selected voltage and the main ramp coincide and the comparator output pulse initiates an output for the delayed integrator gate. The delayed integrator gate pulse on line (52) is applied to the base of A1Q23. The pulse is differentiated and applied to the base of A1Q21. The Schmitt trigger now changes states. The composite gate falls, turning on the CRT. Also at time  $t_2$ , A1Q24 turns off and A1Q25 turns on. This action further increases the composite gate, giving the added brightness to the CRT display required by the faster delayed sweep. At time  $t_3$ , the delayed integrator gate terminates. Its trailing edge is differentiated in the emitter circuit of A1Q23 and applied to the base of A1Q21. This resets the Schmitt trigger and the differential amplifier, terminating the composite gate and turning off the CRT. The sequence of events between  $t_3$  and  $t_4$  continue to take place but, because the CRT has been turned off, they are not displayed.

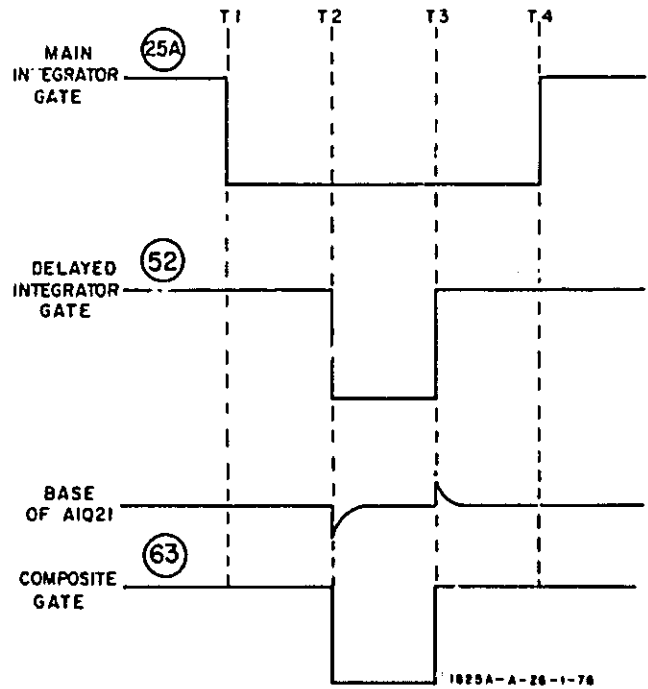


Figure 4-2. Sequence of Events, Delayed Mode Gate

4-90 In mixed mode, both A1Q19 and A1Q23 are activated by application of  $-12.6$  volts on lines (64) and (65). The sequence of events for mixed modes is illustrated in figure 4-3. At time  $t_1$ , the main integrator gate on line (25A) is applied to the base of A1Q19, enabling the Schmitt trigger. The leading edge of the main integrator gate pulse is differentiated in the emitter circuit of A1Q23 and applied to the base of A1Q21, causing the Schmitt trigger to change states. The composite gate falls and the CRT turns on.

Following time  $t_1$ , the main ramp is compared with a selected voltage in the comparator. At time  $t_2$ , the selected voltage and the main ramp coincide and the comparator output pulse initiates an output from the delayed integrator gate. The delayed integrator gate on line (52) is applied to the base of A1Q23. Since the Schmitt trigger is already set, the differentiated pulse on the base of A1Q21 has no effect, however the delayed integrator gate on line (52) turns A1Q24 off and A1Q25 on. This action increases the composite gate and the brightness (intensification) of the CRT. At time  $t_3$ , the delayed integrator gate terminates. The trailing edge is differentiated in the emitter circuit of A1Q23 and applied to the base of A1Q21. The Schmitt trigger resets, terminating the composite gate and turning off the CRT. The sequence of events between  $t_3$  and  $t_4$  continue to take place but, because the CRT is turned off, the events are not displayed.

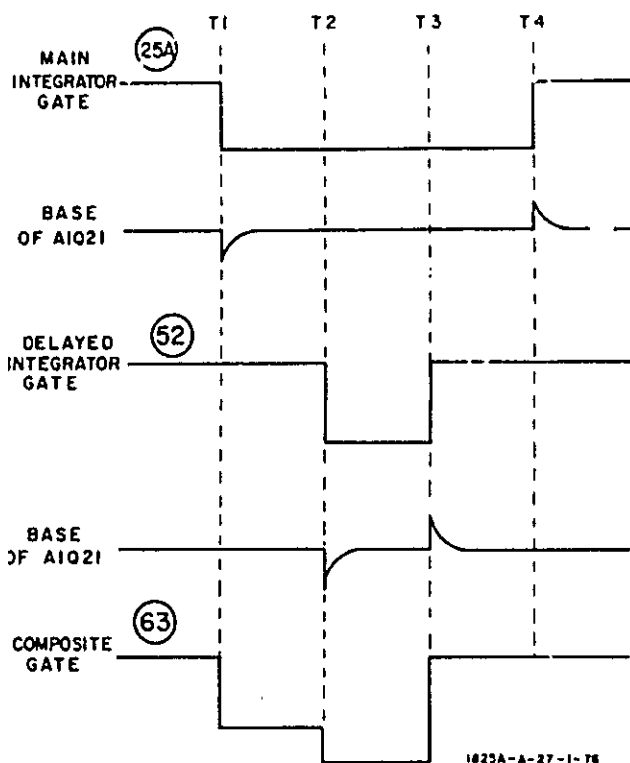


Figure 4-3. Sequence of Events, Mixed Mode Gate

#### 4-91. CIRCUIT OPERATION.

4-92. The information in the following paragraphs is provided in order to tie together all the information presented previously in this section. This is accomplished by following certain functions through a complete cycle of operation.

**4-93. MAIN INTEGRATOR OPERATION IN NORM.** This discussion can be followed on schematic 2 and, in less detail, on the block diagram.

4-94. Setting the main AUTO/NORM switch to NORM disables line (23) input to the main integrator gate (base of A1Q8). Assume all circuits to be in the quiescent state. Lines (15) and (18) are low. Line (16) is high.

4-95. A positive-going trigger pulse is received, causing line (16) to go low. Because all three inputs (lines (15), and (16), and (18)) are now low, the output (line (21)) goes low. The main integrator gate changes states and line (25) goes low. The low condition on line (25) turns A9Q1 on. A9Q1 takes the current formerly flowing into A9Q3, unclamping the integrator and allowing the main sweep ramp to start.

4-96. As the ramp rises, it is connected through holdoff driver (A7Q8 and A7Q9) and holdoff reader (A7Q6 and A7Q7) to the main 10 V Schmitt, causing it to change states. Line (18) goes high, causing line (21) to go high. The main integrator gate changes states and line (25) goes high. A9Q1 turns off and the integrating capacitor discharges through A9Q3, terminating the ramp.

4-97. The trigger holdoff timing circuit keeps the output of the holdoff reader high for a length of time determined by setting of HOLDOFF control R2. During this time, the main 10 V Schmitt remains in its set state. The high condition on line (18) keeps the main dual Schmitt disabled, and retriggering of the sweep is prevented.

4-98. Finally, the holdoff timing circuit discharges to the point where the output of the holdoff reader passes through the lower threshold of the main 10 V Schmitt. The main 10 V Schmitt resets, and line (18) returns to its low state. The next positive-going trigger transition will operate the main dual Schmitt and the entire cycle will repeat.

#### 4-99. FREE-RUN MAIN INTEGRATOR OPERATION.

The purpose of free-run operation is to provide a visible trace on the oscilloscope CRT in the absence of trigger pulses. To start this discussion, assume that the main AUTO/NORM switch is set to AUTO, the sweep has just been triggered, but there are no further incoming trigger pulses. Follow this discussion on schematic 2.

4-100. All inputs to the main dual Schmitt are low, so the NOR output of A1U2B (line 20) is high. The auto and lockout (A1Q7) is turned on and applying a disabling bias to the main integrator gate (base of A1Q8). The ramp rises and causes the main 10 V Schmitt to change states. Line 18 goes high. The NOR output of A1U2B has no pulldown resistor so line 20 cannot go low immediately. At the end of the holdoff period, the main 10 V Schmitt resets and line 18 goes low. The output of the auto and lockout ramps downward on line 23, finally crossing the threshold of the main integrator gate and causing line 25 to go low. This again starts the ramp. As long as no trigger pulses occur, line 20 cannot go high and the main 10 V Schmitt will trigger the main integrator gate.

**4-101. TRIGGERED MAIN INTEGRATOR OPERATION IN AUTO.** Assume that the circuit is free-running as described in paragraph 4-99. An incoming trigger causes all inputs to the main dual Schmitt to go low and consequently, line 20 goes high. When line 20 is high, the auto and lockout disables the line 23 input to the main integrator gate and free-running cannot occur. When one or more inputs to the main dual Schmitt goes high, line 20 cannot go low for about 25 milliseconds because the capacitor (A1C6) must discharge through a finite resistance. As long as trigger pulses continue to arrive, the auto and lockout will keep the line 23 input to the main integrator gate disabled. The discharge time of the auto lockout charging circuit is such that trigger pulse frequencies above approximately 40 Hz will retrigger the sweep before A1C6 can discharge.

**4-102. SINGLE SWEEP.** Normally the main 10 V Schmitt is set by the main ramp and reset at the end of the holdoff time. When the SINGLE switch is pressed, the lower hysteresis limit of the Schmitt is shifted. It will set normally upon application of the ramp but will not reset at the end of the holdoff time. Pushing the RESET button will momentarily restore the original lower hysteresis limit and permit the main 10 V Schmitt to reset.

**4-103. DELAYED INTEGRATOR OPERATION IN DELAYED MODE.** The discussion can be followed on schematic 4 and in less detail, on the block diagram.

4-104. Assume all circuits to be in the quiescent state. Lines 57 and 47 are low. Lines 61, 50,

and 48 are high. At a time determined by the setting of the DELAY control, a pulse is received on line 61 from the comparator. Because both inputs to A1U4 have gone low, its output (line 50) goes low. Both inputs to A1U5A are now low, so its output goes low. When a trigger pulse arrives, line 48 goes low. Both inputs to A1U5B are now low so its output (line 51) goes low. This sets the delayed integrator gate and line 54 goes low, turning on A5Q11. Transistor A5Q11 draws the current formerly drawn through A5Q10. This action unclamps the integrator and the ramp starts.

4-105. As the ramp rises, it crosses the lower threshold (on line 67) of the delayed 10 V Schmitt, causing it to set. Line 57 goes high and resets all Schmitts in the path to line 54. As the ramp falls, the delayed 10 V Schmitt resets and line 57 goes low. This condition will remain until another comparator pulse arrives, followed by a trigger pulse. If the delayed TRIG LEVEL control has been set to **DELAYD STARTS AFTER DELAY**, lines 47 and 48 are hold low by a ground through A1CR12, A1CR13, and S6. In that case, no trigger pulses are required and the circuit is activated solely by the coincident pulse on line 61 from the comparator.

**4-106. MIXED MODE SWEEP OPERATION.** This discussion can be followed on schematics 2, 4, 5, and 6. The sequence of events is illustrated in figure 4-4.

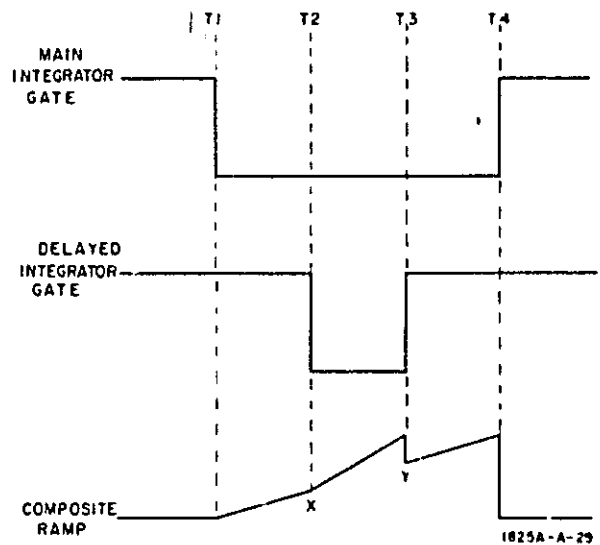


Figure 4-4. Sequence of Events, Mixed Mode Sweep Operation

4-107. Because the delayed integrator is able to function both as a voltage follower (linear amplifier



with a gain of 1) and as an integrator, it is possible to take the composite ramp from the output of the delayed integrator. The action starts with the generation of the main integrator gate. At time  $t_1$ , the output of the main integrator gate circuit (line 25 on schematic 2) falls and initiates the main ramp. The main ramp is routed on line 33 (schematic 6) through the display switch and then on line 66 to the base of A5Q7 (schematic 4). At this time the delayed integrator is clamped and will operate as a voltage follower. The main ramp on the base of A5Q7 appears on the composite ramp line (line 55).

4-108. At time  $t_2$ , the coincident pulse from the comparator triggers the delayed integrator gate which unclamps the delayed integrator. At this time, the reference voltage for the delayed integrator is point X (figure 4-4) on the main ramp. Therefore the delayed ramp starts rising from that point. At time  $t_3$ , the delayed sweep terminates but can fall only to the delayed reference point which, at this time, is point Y on the main ramp. The events between  $t_3$  and  $t_4$  continue but, because the oscilloscope CRT turns off at the termination of the delayed integrator gate they are not displayed.

Table 5-1. Recommended Test Equipment

| Type                      | Model                          | Characteristics               | For                                  |
|---------------------------|--------------------------------|-------------------------------|--------------------------------------|
| Oscilloscope<br>Mainframe | HP 180-series                  | No substitute                 | Performance Check<br>and Adjustments |
| Oscilloscope<br>Vertical  | HP Model 1805A                 | Dual channel, 100 MHz         | Performance Check<br>and Adjustments |
| Monitor<br>Oscilloscope   | HP 180-series<br>with plug-ins | General purpose, 100 MHz      | Performance Check                    |
| Oscillator                | HP Model 200C/D                | 40 Hz to 300 kHz              | Performance Check<br>and Adjustments |
| VHF Oscillator            | HP Model 3200B                 | 150 MHz                       | Performance Check                    |
| Attenuator                | HP Model 8491A                 | 20 dB, 150 MHz                | Performance Check<br>and Adjustments |
| Sampling<br>Voltmeter     | HP Model 3406A                 | 50 mV, 50 kHz to 150 MHz      | Performance Check                    |
| Time-mark<br>Generator    | HP Model 226A                  | 50-ns to 1-sec time marks     | Performance Check<br>and Adjustments |
| Power Divider             | HP 11549A                      | 50-ohm, 150 MHz               | Performance Check                    |
| Sampling Tee              | HP 11063A                      | Accommodate sampling probe    | Performance Check                    |
| 50-ohm<br>Termination     | HP 10100C                      | 50 ohms, 150 MHz              | Performance Check                    |
| 9-in. BNC<br>Cable (2)    | HP 10502A                      | 50 ohms, BNC male to BNC male | Performance Check<br>and Adjustments |
| 44-in. BNC<br>Cable (2)   | HP 10501A                      | 50 ohms, BNC male to BNC male | Performance Check<br>and Adjustments |
| BNC Tee                   | HP 1250-0781                   | 50 ohms                       | Performance Check<br>and Adjustments |

## SECTION V PERFORMANCE CHECK AND ADJUSTMENTS

### 5-1. INTRODUCTION.

**WARNING**

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

5-2. This section contains step-by-step procedures for checking instrument performance and for making all internal adjustments. Performance checks should be made in numerical sequence for best results. Also included are test setup illustrations and a list of recommended test equipment.

### 5-3. EQUIPMENT REQUIRED.

5-4. A complete list of required test equipment and accessories is given in table 5-1. Test equipment equivalent to that recommended may be substituted, provided it meets the required characteristics listed. For best results, use recently calibrated test equipment.

### 5-5. PERFORMANCE CHECKS.

5-6. The performance checks given in this section are suitable for incoming inspections, preventive maintenance, and troubleshooting. The checks are designed to verify the published instrument specifications. Perform the checks in the order given, and record the measured information on the performance check record at the end of this section.

### 5-7. ADJUSTMENTS.

5-8. The adjustment procedures are arranged in a recommended sequence. While most adjustments may be made independently, it is recommended that adjustments be made sequentially as a number of adjustments are directly related to preceding or following adjustments.

### 5-9. PERFORMANCE CHECK RECORD.

5-10. Each measurement point in the performance check is repeated in the performance check record. The pages may be removed for filing. The first time the performance check is made, enter the results on the performance check record and file it for future reference.

### 5-11. FRONT-PANEL CONTROL SETTINGS.

5-12. The control settings listed below are to be used for each performance check and adjustment procedure. If a control is to be set to another position, it will be listed in the procedure. After the completion of each performance check or adjustment procedure, return controls to the initial settings.

| Control                     | Position           |
|-----------------------------|--------------------|
| TIME/DIV (main) .....       | .5 mSEC            |
| TIME/DIV (delayed).....     | OFF                |
| DELAY (dial).....           | 0.00               |
| AUTO/NORM.....              | AUTO               |
| TRIG LEVEL (main).....      | midrange           |
| TRIG LEVEL (delayed).....   | DLY'D              |
|                             | STARTS AFTER DELAY |
| INT/EXT (main).....         | INT                |
| DISPLAY.....                | MAIN               |
| All other pushbuttons ..... | out position       |

### 5-13. PERFORMANCE CHECK PROCEDURES.

5-14. INITIAL PERFORMANCE CHECK. Accomplish initial performance check as follows:

- a. Install 1825A with vertical plug-in into oscilloscope mainframe.
- b. Turn on mainframe power and allow 30 minutes warm-up for stabilization.

**NOTE**

Set oscilloscope and vertical plug-in controls for a suitable trace on CRT.

- c. Rotate main TIME/DIV control through all positions. Trace shall be visible at all sweep speeds.
- d. Release main DISPLAY switch.
- e. Engage delayed DISPLAY switch.
- f. Rotate delayed TIME/DIV control through all positions. Trace shall be visible at all sweep speeds.
- g. Release delayed DISPLAY switch; engage main DISPLAY switch.

h. Set 1825A controls as follows:

TIME/DIV (main) ..... 50  $\mu$ SEC  
 TIME/DIV (delayed)..... 5  $\mu$ SEC

i. Rotate DELAY dial from ccw position to cw position. Intensified line (approximately 1-division long) shall move from left to right on trace.

j. Set 1825A controls as follows:

TIME/DIV (main) ..... .1 mSEC  
 TIME/DIV (delayed)..... 20  $\mu$ SEC

k. Using DELAY dial, move start of intensified portion of trace to center graticule line.

l. Engage both main and delayed DISPLAY switches. Left half of CRT display shall be at main sweep speed and right half of CRT display shall be at delayed sweep speed.

m. Release delayed DISPLAY switch.

n. Turn INTENS RATIO fully ccw. There shall be no visible trace.

o. Readjust INTENS RATIO for desired contrast.

p. Rotate VERNIER control out of detent. UNCAL lamp shall light.

q. Turn VERNIER control to detent position.

r. Set 1825A controls as follows:

TIME/DIV (main) ..... 50 mSEC  
 SINGLE..... engaged

a. Press RESET switch. One sweep shall occur and RESET lamp shall light during sweep.

t. Set 1825A front-panel controls to initial settings.

**5-15. MAIN TRIGGER LEVEL BALANCE.** Main triggering shall be stable for both polarities with 100-mV p-p signal.

**Equipment Required:**

- Oscillator
- Attenuator
- 44-in. BNC cable
- Two 9-in. BNC cables
- BNC tee

5-16. Check main trigger level balance as follows:

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

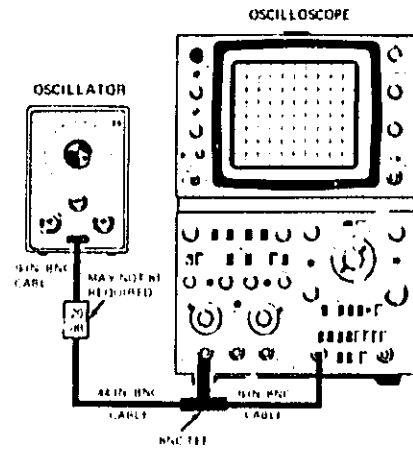


Figure 5-1. Main Trigger Test Setup

b. Set vertical channel A VOLTS/DIV control to 0.1 V/div.

c. Set 1825A main INT/EXT trigger switch to EXT.

d. Adjust oscillator for 1-kHz, 1-division display.

e. Adjust vertical position control to center display.

f. Check triggering stability in both positions of main POS/NEG switch.

g. Disconnect test equipment.

h. Set 1825A front-panel controls to initial settings.

**5-17. MAIN LOW-FREQUENCY REJECT.** A 750-Hz signal shall be attenuated below triggering level when the main LF REJECT switch is engaged.

**Equipment Required:**

- Oscillator
- Attenuator
- 44-in. BNC cable
- Two 9-in. BNC cables
- BNC tee

5-18. Check main low-frequency rejection as follows:

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

b. Set vertical plug-in controls as follows:

Display ..... chan A  
 Sync source ..... chan A  
 Sensitivity (chan A)..... 0.02 V/div

c. Set 1825A controls as follows:

AUTO/NORM ..... NORM  
 INT/EXT (main) ..... EXT

- d. Adjust oscillator for 750-Hz, 3-div display.
- e. Adjust main TRIG LEVEL control for stable display.
- f. Engage main LF REJECT switch.
- g. Triggering shall not occur while varying main TRIG LEVEL control.
- h. Disconnect test equipment.
- i. Set 1825A front-panel controls to initial settings.

**5-19. MAIN HIGH-FREQUENCY REJECT.** A 300-kHz signal shall be attenuated below triggering level when the main HF REJECT switch is engaged.

**Equipment Required:**

Oscillator  
 Attenuator  
 44-in. BNC cable  
 Two 9-in. BNC cables  
 BNC tee

**5-20.** Check main high-frequency rejection as follows:

- a. Connect equipment as shown in figure 5-1.
- b. Set vertical plug-in controls as follows:
 

|                            |            |
|----------------------------|------------|
| Display .....              | chan A     |
| Sync source .....          | chan A     |
| Sensitivity (chan A) ..... | 0.02 V/div |
- c. Set 1825A controls as follows:
 

|                       |        |
|-----------------------|--------|
| TIME/DIV (main) ..... | 1 μSEC |
| AUTO/NORM .....       | NORM   |
| INT/EXT (main) .....  | EXT    |
- d. Adjust oscillator for 300-kHz, 3-div display.
- e. Adjust main TRIG LEVEL control for stable display.
- f. Engage main HF REJECT switch.
- g. Trigger shall not occur while varying main TRIG LEVEL control.
- h. Disconnect test equipment.
- i. Set 1825A controls to initial settings.

**5-21. MAIN RANGE AND POLARITY.** In MAIN (+), triggering point shall adjust smoothly to both positive

and negative extremes of a 4-V, p-p waveform. Trigger shall occur on appropriate slope as indicated by main POS/NEG switch. In MAIN (+10), the p-p trigger point shall occur over a 40-V, p-p waveform.

**Equipment Required:**

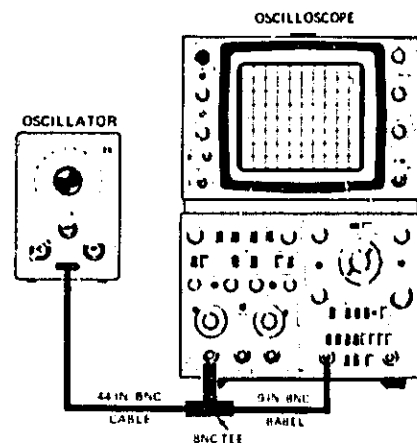
Oscillator  
 44-in. BNC cable  
 9-in. BNC cable  
 BNC tee

**5-22** Check main range and polarity as follows:

- a. Connect equipment as shown in figure 5-2.
- b. Set vertical plug-in controls as follows:
 

|                            |         |
|----------------------------|---------|
| Display .....              | chan A  |
| Sync source .....          | chan A  |
| Sensitivity (chan A) ..... | 1 V/div |
- c. Set 1825A controls as follows:
 

|                       |        |
|-----------------------|--------|
| TIME/DIV (main) ..... | 2 mSEC |
| AUTO/NORM .....       | NORM   |
| INT/EXT (main) .....  | EXT    |
| POS/NEG (main) .....  | NEG    |
- d. Adjust oscillator for 1-kHz, 4-div display.
- e. Rotate main TRIG LEVEL control. Trigger point shall adjust smoothly along entire negative slope of waveform.
- f. Set main POS/NEG switch to POS.
- g. Rotate main TRIG LEVEL control. Trigger point shall adjust smoothly along entire positive slope of waveform.



1825A-003-1-76

Figure 5-2. Main Trigger Range Test Setup

- h. Set main +1/+10 switch to +10.

**CAUTION**

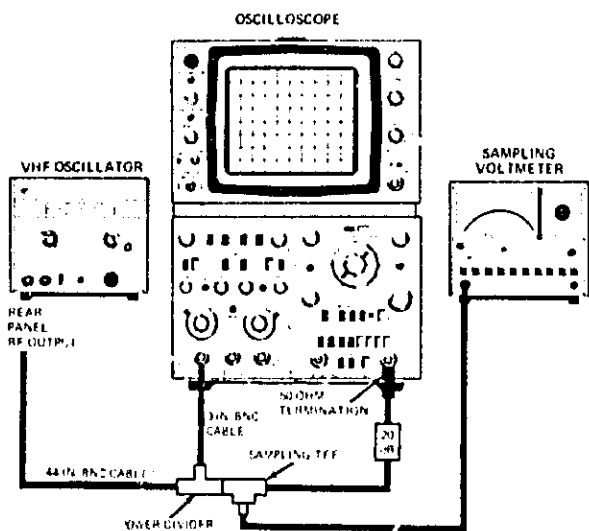
Before proceeding to next step, ensure that maximum permissible input to vertical plug-in is at least 40 V. If not, install attenuator between BNC tee and vertical input.

- i. Adjust oscillator for 40-V, p-p output.
- j. Rotate main TRIG LEVEL control. Trigger point shall adjust smoothly along entire positive slope of waveform.
- k. Disconnect test equipment.
- l. Set 1825A front-panel controls to initial settings.

**5-23. MAIN HIGH-FREQUENCY TRIGGERING.** In main INT, trigger shall be stable for an input of 0.5 division or greater between dc and 100 MHz. In main EXT, triggering shall be stable on 50 mV, p-p signals up to 50 MHz, increasing to 100 mV at 100 MHz, and increasing to 150 mV at 150 MHz.

**Equipment Required:**

- VHF oscillator
- Sampling voltmeter
- Attenuator
- 50-ohm termination
- Power divider
- Sampling tee
- 9-in. BNC cable
- 44-in. BNC cable



1825A-004-1-76

Figure 5-3. High Frequency Triggering Test Setup

5-24. Check main high-frequency triggering as follows:

- a. Connect equipment as shown in figure 5-3.
- b. Set vertical plug-in controls as follows:
 

|                            |         |
|----------------------------|---------|
| Display .....              | chan A  |
| Sync source .....          | chan A  |
| Sensitivity (chan A) ..... | 1 V/div |
- c. Set 1825A controls as follows:
 

|                        |          |
|------------------------|----------|
| TIME/DIV (main) .....  | .05 μSEC |
| AUTO/NORM .....        | NORM     |
| LF REJECT (main) ..... | engaged  |
- d. Set mainframe oscilloscope MAGNIFIER control to X10.

**NOTE**

If upper bandwidth limit of vertical plug-in is less than 100 MHz, reduce frequency appropriately for INT trigger check.

- e. Adjust vhf oscillator for 100-MHz, 0.5-division display.
- f. Adjust main TRIG LEVEL control for stable display. Stable display indicates proper triggering.
- g. Set main INT/EXT switch to EXT.
- h. Set vhf oscillator for 50-MHz output.
- i. Adjust vhf oscillator output amplitude for 180-mV rms (50-mV p-p at EXT INPUT) as indicated on sampling voltmeter.
- j. Adjust main TRIG LEVEL control for stable display. Stable display indicates proper triggering.
- k. Set vhf oscillator for 100-MHz output.
- l. Adjust vhf oscillator output for amplitude of 360-mV rms (100-mV p-p at EXT INPUT) as indicated on sampling voltmeter.
- m. Adjust main TRIG LEVEL control for stable display. Stable display indicates proper triggering.
- n. Set vhf oscillator for 150-MHz output.
- o. Adjust vhf oscillator output for amplitude of 530-mV rms (150-mV p-p at EXT INPUT) as indicated on sampling voltmeter.
- p. Adjust main TRIG LEVEL control for stable display. Stable display indicates proper triggering.
- q. Disconnect test equipment.

r. Set 1825A front-panel controls to initial settings.

**5-25. DELAYED TRIGGER LEVEL BALANCE.** Delayed triggering shall be stable in both polarities with 100-mV p-p signal.

**Equipment Required:**

- Oscillator
- Attenuator
- Two 9-in. BNC cables
- 44-in. BNC cable
- BNC tee

5-26. Check delayed trigger level balance as follows:

- a. Connect equipment as shown in figure 5-4.
- b. Set vertical plug-in controls as follows:

Display ..... chan A  
 Sync source ..... chan A  
 Sensitivity (chan A) ..... 0.02 V/div

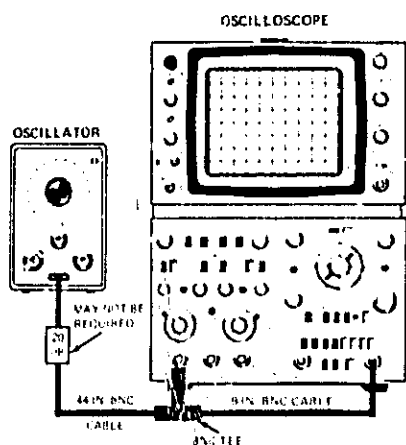
c. Set 1825A controls as follows:

DISPLAY ..... DELAYED  
 TIME/DIV (delayed) ..... .2 mSEC  
 INT/EXT (delayed) ..... EXT  
 TRIG LEVEL (main) ..... midrange  
 DELAY (dial) ..... 0.30

- d. Adjust oscillator for 1-kHz, 1-div display.
- e. Center display using vertical plug-in channel A position control.

f. Check stability of triggering in both positions of delayed POS/NEG switch.

g. Disconnect test equipment.



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Figure 5-4. Delayed Trigger Test Setup

h. Set 1825A front-panel controls to initial settings.

**5-27. DELAYED LOW-FREQUENCY REJECT.** A 750-Hz signal shall be attenuated below triggering level when the delayed LF REJECT switch is engaged.

**Equipment Required:**

- Oscillator
- Attenuator
- Two 9-in. BNC cables
- 44-in. BNC cable
- BNC tee

5-28. Check delayed low-frequency rejection as follows:

- a. Connect equipment as shown in figure 5-4.
- b. Set vertical plug-in controls as follows:

Display ..... chan A  
 Sync source ..... chan A  
 Sensitivity (chan A) ..... 0.02 V/div

c. Set 1825A controls as follows:

DISPLAY ..... DELAYED  
 TIME/DIV (delayed) ..... .2 mSEC  
 INT/EXT (delayed) ..... EXT  
 TRIG LEVEL (main) ..... midrange  
 DELAY (dial) ..... 0.30

- d. Adjust oscillator for 750-Hz, 3-div display.
- e. Adjust delay TRIG LEVEL for stable display.
- f. Engage delayed LF REJECT switch.

g. Triggering shall not occur while varying delayed TRIG LEVEL control.

h. Disconnect test equipment.

i. Set 1825A front-panel controls to initial settings.

**5-29. DELAYED HIGH-FREQUENCY REJECT.** A 300-kHz signal shall be attenuated below triggering level when the delayed HF REJECT switch is engaged.

**Equipment Required:**

- Oscillator
- Attenuator
- Two 9-in. BNC cables
- 44-in. BNC cable
- BNC tee

5-30. Check delayed high-frequency rejection as follows:

- a. Connect equipment as shown in figure 5-4.
- b. Set vertical plug-in controls as follows:
 

|                            |            |
|----------------------------|------------|
| Display .....              | chan A     |
| Sync source .....          | chan A     |
| Sensitivity (chan A) ..... | 0.02 V/div |
- c. Set 1825A controls as follows:
 

|                          |             |
|--------------------------|-------------|
| DISPLAY .....            | DELAYED     |
| TIME/DIV (main) .....    | 2 $\mu$ SEC |
| TIME/DIV (delayed) ..... | 1 $\mu$ SEC |
| INT/EXT (delayed) .....  | EXT         |
| TRIG LEVEL (main) .....  | midrange    |
- d. Adjust oscillator for 300-kHz, 3-div display.
- e. Adjust delayed TRIG LEVEL control for stable display.
- f. Engage delayed HF REJECT switch.
- g. Triggering shall not occur while varying delayed TRIG LEVEL control.
- h. Disconnect test equipment.
- i. Set 1825A front-panel controls to initial settings.

5-31. **DELAYED RANGE AND POLARITY.** In DELAYED (+1), triggering point shall adjust smoothly to both positive and negative extremes of a 4-V, p-p waveform. Triggering shall occur on appropriate slope as indicated by delayed POS/NEG switch. In DELAYED (+10), the p-p trigger point shall occur only over the center 30 degrees of the delayed TRIG LEVEL control.

**Equipment Required:**

- Oscillator
- 44-in. BNC cable
- 9-in. BNC cable
- BNC tee

5-32. Check delayed range and polarity as follows:

- a. Connect equipment as shown in figure 5-5.
- b. Set vertical plug-in controls as follows:
 

|                            |         |
|----------------------------|---------|
| Display .....              | chan A  |
| Sync source .....          | chan A  |
| Sensitivity (chan A) ..... | 1 V/div |
- c. Set 1825A controls as follows:

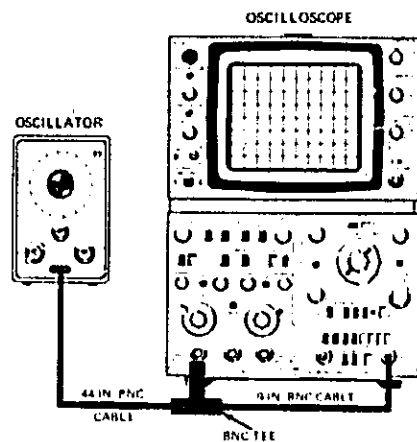
- |                          |          |
|--------------------------|----------|
| DISPLAY .....            | DELAYED  |
| TIME/DIV (delayed) ..... | .2 mSEC  |
| INT/EXT (delayed) .....  | EXT      |
| TRIG LEVEL (main) .....  | midrange |
| POS/NEG (delayed) .....  | NEG      |
| DELAY (dial) .....       | 0.30     |

- d. Adjust oscillator for 1-kHz, 4-div display.
- e. Rotate delayed TRIG LEVEL control. Trigger point shall adjust smoothly along entire negative slope of waveform.
- f. Set delayed POS/NEG switch to POS.
- g. Rotate delayed TRIG LEVEL control. Trigger point shall adjust smoothly along entire positive slope of waveform.
- h. Set delayed +1/+10 to +10.

**CAUTION**

Before proceeding to next step, ensure that maximum permissible input to vertical plug-in is at least 40 V. If not, install attenuator between BNC tee and vertical input.

- i. Adjust oscillator for 40-V, p-p output.
- j. Rotate delayed TRIG LEVEL control. Trigger point shall adjust smoothly over center 30 degrees of waveform.
- k. Disconnect test equipment.
- l. Set 1825A front-panel controls to initial settings.



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Figure 5-5. Delayed Trigger Range Test Setup



**5-33. DELAYED HIGH-FREQUENCY TRIGGERING.** In delayed INT, triggering shall be stable for an input of 0.5 division or greater between dc and 100 MHz. In delayed EXT, triggering shall be stable on 50-mV, p-p signals up to 50 MHz, increasing to 100 mV at 100 MHz, and increasing to 150 mV at 150 MHz.

**Equipment Required:**

- VHF oscillator
- Sampling voltmeter
- Attenuator
- Power divider
- Sampling tee
- 50-ohm termination
- Two 44-in. BNC cables
- 9-in. BNC cable

5-34. Check delayed high-frequency triggering as follows:

- a. Connect equipment as shown in figure 5-3.
- b. Set vertical plug-in controls as follows:
 

|                           |         |
|---------------------------|---------|
| Display .....             | chan A  |
| Sync source .....         | chan A  |
| Sensitivity (chan A)..... | 1 V/div |

c. Set 1825A controls as follows:

- |                         |          |
|-------------------------|----------|
| TIME/DIV (main) .....   | .05 μSEC |
| TIME/DIV (delayed)..... | .05 μSEC |
| AUTO/NORM .....         | NORM     |
| DELAY (dial).....       | 0.30     |

d. Set mainframe oscilloscope MAGNIFIER control to X10.

**NOTE**

If upper bandwidth limit of vertical plug-in is less than 100 MHz, reduce frequency appropriately for INT trigger check.

- e. Adjust vhf oscillator for 100-MHz, 0.5-division display.
- f. Adjust main TRIG LEVEL control for stable display.
- g. Set DISPLAY to DELAYED.
- h. Adjust delayed TRIG LEVEL control for stable display.
- i. Set delayed INT/EXT to EXT.
- j. Adjust vhf oscillator output amplitude for 180-mV rms (50-mV p-p at EXT INPUT) as indicated on sampling voltmeter.
- k. Set DISPLAY to MAIN.

l. Adjust main TRIG LEVEL control for stable display.

m. Set DISPLAY to DELAYED.

n. Adjust delayed TRIG LEVEL control for stable display. Stable display indicates proper triggering.

o. Set vhf oscillator for 100-MHz output.

p. Adjust vhf oscillator output for amplitude of 360-mV rms (100-mV p-p at EXT INPUT) as indicated on sampling voltmeter.

q. Set DISPLAY to MAIN.

r. Adjust main TRIG LEVEL control for stable display.

s. Set DISPLAY to DELAYED.

t. Adjust delayed TRIG LEVEL control for stable display. Stable display indicates proper triggering.

u. Set vhf oscillator for 150-MHz output.

v. Adjust vhf oscillator output for amplitude of 530-mV rms (150-mV p-p at EXT INPUT) as indicated on sampling voltmeter.

w. Set DISPLAY to MAIN.

x. Adjust main TRIG LEVEL control for stable display.

y. Set DISPLAY to DELAYED.

z. Adjust delayed TRIG LEVEL control for stable display. Stable display indicates proper triggering.

aa. Disconnect test equipment.

ab. Set 1825A front-panel controls to initial settings.

**5-35. AUTO TRIGGERING.** Frequency cutoff for automatic triggering shall be no greater than 40 Hz.

**Equipment Required:**

- Oscillator
- 44-in. BNC cable
- 9-in. BNC cable
- BNC tee

5-36. Check auto triggering limit as follows:

- a. Connect the equipment as shown in figure 5-2.
- b. Set vertical plug-in controls as follows:

Display ..... chan A  
 Sync source ..... chan A  
 Sensitivity (chan A) ..... 1 V/div

c. Set 1825A controls as follows:

TIME/DIV (main) ..... 20 mSEC  
 AUTO/NORM ..... NORM

d. Adjust oscillator for 40-Hz, 6-div display.

e. Adjust main TRIG LEVEL control for stable display.

f. Set AUTO/NORM switch to AUTO. Display shall remain stable.

g. Disconnect test equipment.

h. Set 1825A front-panel controls to initial settings.

**5-37. SWEEP HOLDOFF.** Sweep holdoff shall be variable to greater than 80 milliseconds.

**Equipment Required:**

Monitor oscilloscope  
 44-in. BNC cable

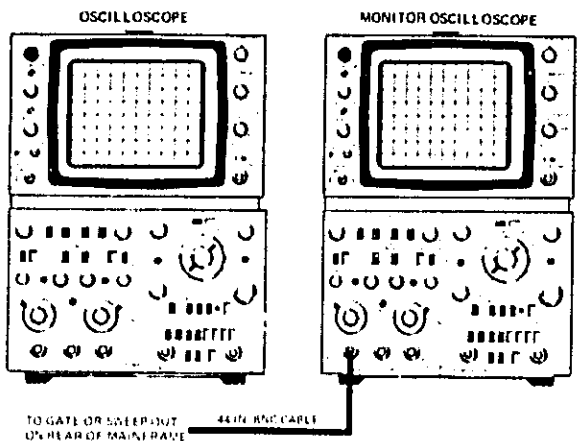
5-38. Check sweep holdoff as follows:

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

b. Set 1825A main TIME/DIV control to 1 mSEC.

c. Adjust monitor oscilloscope controls and observe time between end of one sweep and beginning of next.

d. Rotate trigger HOLDOFF control fully clockwise. Holdoff time between sweeps shall increase to 80 milliseconds or greater.



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Figure 5-6. Sweep Holdoff Test Setup

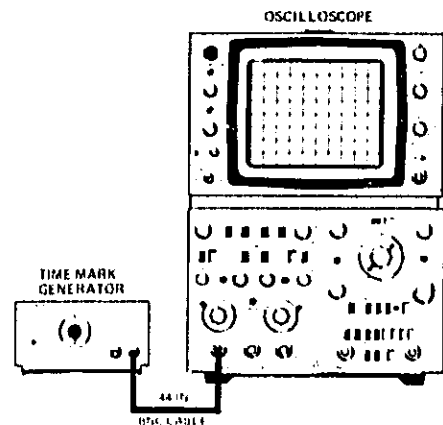
e. Disconnect test equipment.

f. Set 1825A front-panel controls to initial settings.

**5-39. MAIN SWEEP TIME.** All main sweep ranges shall be accurate to  $\pm 3\%$ .

**Equipment Required:**

Time-mark generator  
 44-in. BNC cable



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Figure 5-7. Sweep Calibration Test Setup

5-40. Check main sweep time accuracy as follows:

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

b. Set vertical plug-in controls as follows:

Display ..... chan A  
 Sync source ..... chan A  
 Sensitivity (chan A) ..... 1 V/div

c. Set 1825A main TIME/DIV control to .05  $\mu$ SEC.

d. Set time-mark generator for 50-ns marks.

e. Adjust oscilloscope position controls so that first time mark is positioned exactly on left edge of graticule. Eleventh time mark shall fall on right edge of graticule  $\pm 1.5$  minor divisions.

f. This completes step 1 of table 5-2. Complete remaining steps in table.

g. Disconnect test equipment.

h. Set 1825A front-panel controls to initial settings.

**5-41. SWEEP VERNIER.** Vernier shall reduce the distance between adjacent pulses at least 2.5 times.

**Equipment Required:**

- Time-mark generator
- 44-in. BNC cable

5-42. Check main sweep time vernier as follows:

- a. Connect equipment as shown in figure 5-7.
- b. Set vertical plug-in controls as follows:

Display ..... chan A  
 Sync source ..... chan A  
 Sensitivity (chan A) ..... 1 V/div

c. Set 1825A main TIME/DIV control to 1 mSEC.

d. Set time-mark generator for 10-ms marks.

e. Turn sweep VERNIER fully ccw. Distances between adjacent pulses shall be less than 4 divisions.

f. Disconnect test equipment.

g. Set 1825A front-panel controls to initial settings.

**5-43. DELAY ACCURACY.** The differential delay between two events, as indicated on the DELAY dial shall be accurate  $\pm 0.75\%$ ,  $\pm 0.4$  division of the DELAY dial.

**Equipment Required:**

- Time-mark generator
- 44-in. BNC cable

5-44. Check DELAY dial accuracy as follows:

- a. Connect equipment as shown in figure 5-7.
- b. Set vertical plug-in controls as follows:

Display ..... chan A  
 Sync source ..... chan A  
 Sensitivity (chan A) ..... 1 V/div

c. Set 1825A controls as follows:

DISPLAY ..... DELAYED  
 TIME/DIV (main) ..... .05  $\mu$ SEC  
 TIME/DIV (delayed) ..... .05  $\mu$ SEC  
 DELAY (dial) ..... 1.00

d. Set mainframe oscilloscope MAGNIFIER control X10.

*Table 5-2. Main Sweep Time Checks*

| Step | Time Marks | Main TIME/DIV |
|------|------------|---------------|
| 1    | 50 ns      | .05 $\mu$ SEC |
| 2    | .1 $\mu$ s | .1 $\mu$ SEC  |
| 3    | .2 $\mu$ s | .2 $\mu$ SEC  |
| 4    | .5 $\mu$ s | .5 $\mu$ SEC  |
| 5    | 1 $\mu$ s  | 1 $\mu$ SEC   |
| 6    | 2 $\mu$ s  | 2 $\mu$ SEC   |
| 7    | 5 $\mu$ s  | 5 $\mu$ SEC   |
| 8    | 10 $\mu$ s | 10 $\mu$ SEC  |
| 9    | 20 $\mu$ s | 20 $\mu$ SEC  |
| 10   | 50 $\mu$ s | 50 $\mu$ SEC  |
| 11   | .1 ms      | .1 mSEC       |
| 12   | .2 ms      | .2 mSEC       |
| 13   | .5 ms      | .5 mSEC       |
| 14   | 1 ms       | 1 mSEC        |
| 15   | 2 ms       | 2 mSEC        |
| 16   | 5 ms       | 5 mSEC        |
| 17   | 10 ms      | 10 mSEC       |
| 18   | 20 ms      | 20 mSEC       |
| *19  | 50 ms      | 50 mSEC       |
| *20  | .1 s       | .1 SEC        |
| *21  | .2 s       | .2 SEC        |
| *22  | .5 s       | .5 SEC        |
| *23  | 1 s        | 1 SEC         |

\*Set AUTO/NORM to NORM for these steps

*Table 5-3. Delay Accuracy Checks*

| Step | Markers     | Main TIME/DIV | Delayed TIME/DIV |
|------|-------------|---------------|------------------|
| 1    | 50 ns       | .05 $\mu$ SEC | .05 $\mu$ SEC    |
| 2    | 0.1 $\mu$ s | .1 $\mu$ SEC  | .05 $\mu$ SEC    |
| 3    | 0.2 $\mu$ s | .2 $\mu$ SEC  | .05 $\mu$ SEC    |
| 4    | 0.5 $\mu$ s | .5 $\mu$ SEC  | .05 $\mu$ SEC    |
| 5    | 1 $\mu$ s   | 1 $\mu$ SEC   | .1 $\mu$ SEC     |
| 6    | 2 $\mu$ s   | 2 $\mu$ SEC   | .2 $\mu$ SEC     |
| 7    | 5 $\mu$ s   | 5 $\mu$ SEC   | .5 $\mu$ SEC     |
| 8    | 10 $\mu$ s  | 10 $\mu$ SEC  | 1 $\mu$ SEC      |
| 9    | 20 $\mu$ s  | 20 $\mu$ SEC  | 2 $\mu$ SEC      |
| 10   | 50 $\mu$ s  | 50 $\mu$ SEC  | 5 $\mu$ SEC      |
| 11   | 0.1 ms      | .1 mSEC       | 10 $\mu$ SEC     |
| 12   | 0.2 ms      | .2 mSEC       | 20 $\mu$ SEC     |
| 13   | 0.5 ms      | .5 mSEC       | 50 $\mu$ SEC     |
| 14   | 1 ms        | 1 mSEC        | .1 mSEC          |
| 15   | 2 ms        | 2 mSEC        | .2 mSEC          |
| 16   | 5 ms        | 5 mSEC        | .5 mSEC          |
| 17   | 10 ms       | 10 mSEC       | 1 mSEC           |
| 18   | 20 ms       | 20 mSEC       | 2 mSEC           |
| 19   | 50 ms       | 50 mSEC       | 5 mSEC           |
| 20   | 0.1 s       | .1 SEC        | 10 mSEC          |
| 21   | 0.2 s       | .2 SEC        | 20 mSEC          |
| *22  | 0.5 s       | .5 SEC        | 20 mSEC          |
| **23 | 1 s         | 1 SEC         | 10 mSEC          |

\*Change magnifier on mainframe to X5

\*\*Change magnifier on mainframe to X1

- e. Set time-mark generator for 50-ns marks.
- f. Using horizontal position control, set time mark on horizontal center of graticule.
- g. Turn DELAY dial to 9:00 and locate marker.
- h. Using DELAY dial, set marker precisely on horizontal center of graticule. DELAY dial shall be between 8.92 and 9.08.
- i. This completes step 1 in table 5-3. Complete remaining steps in table.
- j. Disconnect test equipment.
- k. Set 1825A front-panel controls to initial settings.

**5-45. DELAYED SWEEP TIME.** Delayed sweep ranges shall be accurate to  $\pm 3\%$ .

**Equipment Required:**

- Time-mark generator
- 44-in. BNC cable

5-46. Check delayed sweep time accuracy as follows:

- a. Connect equipment as shown in figure 5-7.
- b. Set vertical plug-in controls as follows:

Display ..... chan A  
 Sync source ..... chan A  
 Sensitivity (chan A) ..... 1 V/div

- c. Set 1825A controls as follows:

DISPLAY ..... DELAYED  
 TIME/DIV (delayed) ..... .05  $\mu$ SEC  
 DELAY (dial) ..... 1.00

- d. Set time-mark generator for 50-ns marks.

e. Adjust oscilloscope position controls so that first time mark is positioned exactly on left edge of graticule. Eleventh time mark shall fall on right edge of graticule  $\pm 1.5$  minor divisions.

f. This completes step 1 in table 5-4. Complete remaining steps in table.

- g. Disconnect test equipment.

h. Set 1825A front-panel controls to initial settings.

Table 5-4. Delayed Sweep Time Checks

| Step | Time Marks | Delayed TIME/DIV |
|------|------------|------------------|
| 1    | 50 ns      | .05 $\mu$ SEC    |
| 2    | .1 $\mu$ s | .1 $\mu$ SEC     |
| 3    | .2 $\mu$ s | .2 $\mu$ SEC     |
| 4    | .5 $\mu$ s | .5 $\mu$ SEC     |
| 5    | 1 $\mu$ s  | 1 $\mu$ SEC      |
| 6    | 2 $\mu$ s  | 2 $\mu$ SEC      |
| 7    | 5 $\mu$ s  | 5 $\mu$ SEC      |
| 8    | 10 $\mu$ s | 10 $\mu$ SEC     |
| 9    | 20 $\mu$ s | 20 $\mu$ SEC     |
| 10   | 50 $\mu$ s | 50 $\mu$ SEC     |
| 11   | .1 ms      | .1 mSEC          |
| 12   | .2 ms      | .2 mSEC          |
| 13   | .5 ms      | .5 mSEC          |
| 14   | 1 ms       | 1 mSEC           |
| 15   | 2 ms       | 2 mSEC           |
| 16   | 5 ms       | 5 mSEC           |
| 17   | 10 ms      | 10 mSEC          |
| 18   | 20 ms      | 20 mSEC          |

**5-47. DELAY TIME JITTER.** Delay time jitter shall not exceed 0.002% of the maximum delay on each range.

**Equipment Required:**

- Time-mark generator
- 44-in. BNC cable

5-48. Check delay time jitter as follows:

- a. Connect equipment as shown in figure 5-7.
- b. Set vertical plug-in controls as follows:

Display ..... chan A  
 Sync source ..... chan A  
 Sensitivity (chan A) ..... 1 V/div

- c. Set 1825A controls as follows:

DISPLAY ..... DELAYED  
 TIME/DIV (main) ..... 50  $\mu$ SEC  
 TIME/DIV (delayed) ..... 1  $\mu$ SEC  
 DELAY (dial) ..... 9.00

- d. Set mainframe oscilloscope MAGNIFIER control X10.

- e. Set time-mark generator for 50- $\mu$ s marks.

- f. Locate time mark with DELAY (dial) control.

g. Observe jitter on leading edge. Horizontal jitte: shall not exceed 1 division.

- h. Disconnect test equipment.

i. Set 1825A front-panel controls to initial settings.

**5-49. ADJUSTMENTS.**

**WARNING**

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

5-50. Remove mainframe oscilloscope covers before installing 1825A in the mainframe. Apply input power to the instrument and allow 30-minute warmup. After adjustments are completed, check instrument performance by accomplishing the performance checks described earlier in this section. Adjustment locations are shown in figure 5-9 located at the end of this section.

**5-51. MAIN TRIGGER RECOGNITION THRESHOLD.** Adjust main trigger recognition threshold as follows:

a. Connect equipment as shown in figure 5-8.

b. Set 1825A controls as follows:

TIME/DIV (main) ..... 1 mSEC  
 INT/EXT (main)..... EXT  
 AUTO/NORM ..... NORM

c. Set vhf oscillator for 10-MHz, 50-mV rms output.

d. Adjust main trigger sensitivity control A1R25 fully clockwise.

e. Adjust A1R25 slowly ccw while rotating main TRIG LEVEL control back and forth through 0. Continue adjusting A1R25 until one sweep occurs when main TRIG LEVEL control is rotated in either direction.

f. Reduce output amplitude of vhf oscillator to 42-mV rms.

g. Rotate main TRIG LEVEL back and forth through 0. Sweep shall occur in only one direction of rotation.

h. If step g is not accomplished, adjust A1R25 slowly clockwise until sweep occurs in only one direction of main TRIG LEVEL rotation.

i. Disconnect test equipment.

j. Set 1825A front-panel controls to initial settings.

**5-52. DELAYED TRIGGER RECOGNITION THRESHOLD.** Adjust delayed trigger recognition threshold as follows:

a. Connect equipment as shown in figure 5-8 except connect input signal to delayed EXT INPUT connector.

b. Set 1825A controls as follows:

DISPLAY ..... DELAYED  
 TIME/DIV (delayed) ..... .1 mSEC  
 INT/EXT (delayed) ..... EXT  
 AUTO/NORM (delayed) ..... NORM  
 AUTO/NORM (MAIN) ..... AUTO

c. Set vhf oscillator for 10-MHz, 50-mV rms output.

d. Adjust delayed trigger sensitivity control A1R68 fully clockwise.

e. Adjust A1R68 slowly ccw while rotating delayed TRIG LEVEL control back and forth through 0. Continue adjusting A1R68 until one sweep occurs when delayed TRIG LEVEL control is rotated in either direction.

f. Reduce output amplitude of vhf oscillator to 42-mV rms.

g. Rotate delayed TRIG LEVEL back and forth through 0. Partial sweep should occur in only one direction of rotation.

h. If step g cannot be accomplished, adjust A1R68 clockwise until partial sweep occurs in only one direction of rotation of delayed TRIG LEVEL control.

i. Disconnect test equipment.

j. Set 1825A front-panel controls to initial settings.

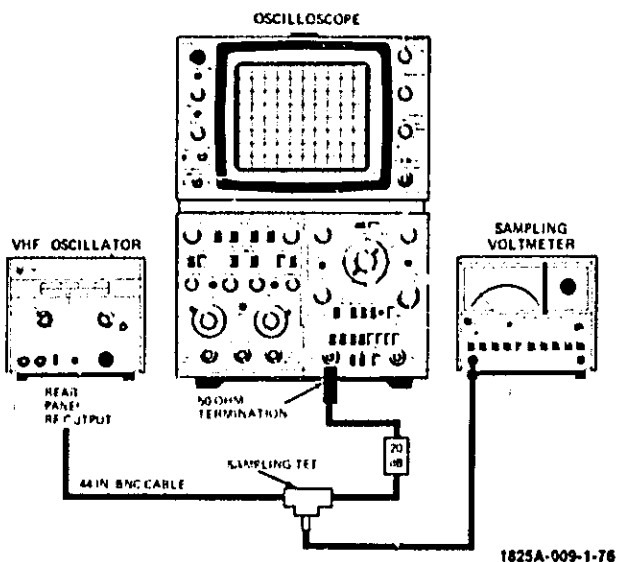


Figure 5-8. Trigger Recognition Threshold Adjustment Setup

**5-53. SWEEP INTERFACE ADJUSTMENT.** Adjust sweep interface as follows:

- a. Set 1825A front-panel controls as follows:

TIME/DIV (main) ..... 50  $\mu$ SEC  
 TIME/DIV (delayed)..... 0.1  $\mu$ SEC  
 DELAY (dial)..... 1.00  
 AUTO/NORM..... NORM

- b. Using horizontal position control, set intensified spot one division from left edge of graticule.
- c. Set DELAY (dial) to 9.00.
- d. Adjust sweep interface adjust A3R1 to place start of intensified portion of sweep one division from right edge of graticule.
- e. Set 1825A front-panel controls to initial settings.

**5-54. PRELIMINARY MAIN SWEEP ADJUSTMENT.** Make preliminary main sweep adjustments as follows:

- a. Connect equipment as shown in figure 5-7.
- b. Set vertical plug-in controls as follows:  
 Display ..... chan A  
 Sync source ..... chan A  
 Sensitivity (chan A) ..... 1 V/div
- c. Set 1825A main TIME/DIV control to 0.1  $\mu$ SEC.
- d. Set time-mark generator for 0.1- $\mu$ s marks.
- e. Using horizontal position control, set first time mark to left edge of graticule.
- f. Adjust A8C3 to place eleventh time mark on right edge of graticule.
- g. This completes step 1 in table 5-5. Complete remaining steps in table.
- h. Disconnect test equipment.
- i. Set 1825A front-panel controls to initial settings.

Table 5-5. Preliminary Sweep Adjustment

| Step | Time Marks  | Main TIME/DIV | Adjust |
|------|-------------|---------------|--------|
| 1    | 0.1 $\mu$ s | .1 $\mu$ SEC  | A8C3   |
| 2    | 1 $\mu$ s   | 1 $\mu$ SEC   | A8R16  |
| 3    | 50 $\mu$ s  | 50 $\mu$ SEC  | A8R4   |
| 4    | 5 ms        | 5 mSEC        | A8R3   |
| 5    | 0.5 s       | .5 SEC        | A8R1   |

**5-55. MAIN SWEEP ADJUSTMENT.** Adjust main sweep as follows:

- a. Connect equipment as shown in figure 5-7.
- b. Set vertical plug-in controls as follows:  
 Display ..... chan A  
 Sync source ..... chan A  
 Sensitivity (chan A)..... 0.2 V/div
- c. Set 1825A controls as follows:  
 DISPLAY..... DELAYED  
 TIME/DIV (main) ..... .1  $\mu$ SEC  
 TIME/DIV (delayed)..... .05  $\mu$ SEC
- d. Set time-mark generator for 0.1- $\mu$ s marks.
- e. Set DELAY (dial) to 1.00.
- f. Center pulse vertically on graticule.
- g. Using horizontal position control, set leading edge of first pulse to horizontal center of graticule.
- h. Set mainframe oscilloscope MAGNIFIER control to X10.
- i. Set DELAY (dial) to 9.00.
- j. Adjusting A8C3, set leading edge of pulse to horizontal center of graticule.
- k. Repeat steps f through j until leading edge of pulse can be set to horizontal center of graticule with DELAY dial set between 8.96 and 9.04.
- l. Set main TIME/DIV control to .2  $\mu$ SEC.
- m. Set time-mark generator for 0.2- $\mu$ s marks.
- n. Set DELAY (dial) to 1.00.
- o. Using horizontal position control, set leading edge of pulse to horizontal center of graticule.
- p. Set DELAY (dial) near 9.00. Verify that leading edge of pulse can be centered with DELAY (dial) set between 8.96 and 9.04.
- q. If step p is not accomplished, make compromise adjustment of A8C3 that will satisfy requirement in step p and still satisfy requirement in step k.
- r. Set main TIME/DIV control to .05  $\mu$ SEC.
- s. Set DELAY (dial) to 1.00.
- t. Using horizontal position control, set leading edge of pulse to horizontal center of graticule.

Table 5-6. Main Sweep Calibration

| Step | Time Marks  | Main TIME/DIV | Delayed TIME/DIV | Adjust          |
|------|-------------|---------------|------------------|-----------------|
| 1    | 0.2 $\mu$ s | .2 $\mu$ SEC  | .05 $\mu$ SEC    | A8C3            |
| 2    | .1 $\mu$ s  | .1 $\mu$ SEC  | .05 $\mu$ SEC    | Check 8.96-9.04 |
| 3    | 50 ns       | .05 $\mu$ SEC | .05 $\mu$ SEC    | Check 8.96-9.04 |
| 4    | 0.5 $\mu$ s | .5 $\mu$ SEC  | .05 $\mu$ SEC    | A8R16           |
| 5    | 1 $\mu$ s   | 1 $\mu$ SEC   | .1 $\mu$ SEC     | Check 8.92-9.02 |
| 6    | 2 $\mu$ s   | 2 $\mu$ SEC   | .2 $\mu$ SEC     | Check 8.92-9.02 |
| 7    | 5 $\mu$ s   | 5 $\mu$ SEC   | .5 $\mu$ SEC     | A8R4 8.92-9.02  |
| 8    | 10 $\mu$ s  | 10 $\mu$ SEC  | 1 $\mu$ SEC      | Check 8.92-9.02 |
| 9    | 20 $\mu$ s  | 20 $\mu$ SEC  | 2 $\mu$ SEC      | Check 8.92-9.02 |
| 10   | 50 $\mu$ s  | 50 $\mu$ SEC  | 5 $\mu$ SEC      | Check 8.92-9.02 |
| 11   | 0.1 ms      | .1 mSEC       | 10 $\mu$ SEC     | Check 8.92-9.02 |
| 12   | 0.2 ms      | .2 mSEC       | 20 $\mu$ SEC     | Check 8.92-9.02 |
| 13   | 0.5 ms      | .5 mSEC       | 50 $\mu$ SEC     | A8R3            |
| 14   | 1 ms        | 1 mSEC        | .1 mSEC          | Check 8.92-9.02 |
| 15   | 2 ms        | 2 mSEC        | .2 mSEC          | Check 8.92-9.02 |
| 16   | 5 ms        | 5 mSEC        | .5 mSEC          | Check 8.92-9.02 |
| 17   | 10 ms       | 10 mSEC       | 1 mSEC           | Check 8.92-9.02 |
| 18   | 20 ms       | 20 mSEC       | 2 mSEC           | Check 8.92-9.02 |
| 19   | 50 ms       | 50 mSEC       | 5 mSEC           | A8R1            |
| 20   | 0.1 s       | .1 SEC        | 10 mSEC          | Check 8.92-9.02 |
| 21   | 0.2 s       | .2 SEC        | 20 mSEC          | Check 8.92-9.02 |
| *21  | 0.2 s       | .2 SEC        | 20 mSEC          | Check 8.92-9.02 |
| *23  | s           | 1 SEC         | 20 mSEC          | Check 8.96-9.04 |

\*Note  
For last two steps, change magnifier on mainframe to X5.

u. Set DELAY (dial) near 9.00. Verify that leading edge of pulse can be centered with DELAY (dial) set between 8.96 and 9.04.

v. If step u cannot be accomplished, make compromise adjustment of A8C3 that will satisfy requirement in step u and still satisfy requirements of steps k and p.

w. This completes steps 1 through 3 in table 5-6. Complete remaining steps in table. Note calibration tolerances are different for three fastest speeds and two slowest speeds.

5-56. SWEEP GAIN. Adjust sweep gain as follows:

- a. Connect equipment as shown in figure 5-7.
- b. Set vertical plug-in controls as follows:  
 Display ..... chan A  
 Sync source ..... chan A  
 Sensitivity (chan A) ..... 1 V/div

c. Set 1825A main TIME/DIV control to 10  $\mu$ SEC.

d. Set time-mark generator for 10- $\mu$ s marks.

e. Using horizontal position control, set first time mark on left edge of graticule.

f. Adjust sweep interface adjust A3R1 to set eleventh time mark on right edge of graticule.

g. Disconnect test equipment.

h. Set 1825A front-panel controls to initial settings.

5-57. DELAYED SWEEP TIMING. Adjust delayed sweep as follows:

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

b. Set vertical plug-in controls as follows:

Display ..... chan A  
 Sync source ..... chan A  
 Sensitivity (chan A) ..... 1 V/div

c. Set 1825A controls as follows:

DISPLAY ..... DELAYED  
 TIME/DIV (main) ..... .1  $\mu$ SEC  
 TIME/DIV (delayed) ..... .05  $\mu$ SEC  
 DELAY (dial) ..... 0.30

Table 5-7. Delayed Sweep Calibration

| Step | Time Marks   | Main TIME/DIV | Delayed TIME/DIV | Adjust |
|------|--------------|---------------|------------------|--------|
| 1    | 0.05 $\mu$ s | .1 $\mu$ SEC  | .05 $\mu$ SEC    | A4C3   |
| 2    | 0.1 $\mu$ s  | .2 $\mu$ SEC  | .1 $\mu$ SEC     | Check  |
| 3    | 0.2 $\mu$ s  | .5 $\mu$ SEC  | .2 $\mu$ SEC     | Check  |
| 4    | 0.5 $\mu$ s  | 1 $\mu$ SEC   | .5 $\mu$ SEC     | Check  |
| 5    | 1 $\mu$ s    | 2 $\mu$ SEC   | 1 $\mu$ SEC      | Check  |
| 6    | 2 $\mu$ s    | 5 $\mu$ SEC   | 2 $\mu$ SEC      | Check  |
| 7    | 5 $\mu$ s    | 10 $\mu$ SEC  | 5 $\mu$ SEC      | A4R4   |
| 8    | 10 $\mu$ s   | 20 $\mu$ SEC  | 10 $\mu$ SEC     | Check  |
| 9    | 20 $\mu$ s   | 50 $\mu$ SEC  | 20 $\mu$ SEC     | Check  |
| 10   | 0.1 ms       | .2 mSEC       | .1 mSEC          | Check  |
| 11   | 0.2 ms       | .5 mSEC       | .2 mSEC          | Check  |
| 12   | 0.5 ms       | 1 mSEC        | .5 mSEC          | A4R2   |
| 13   | 1 ms         | 2 mSEC        | 1 mSEC           | Check  |
| 14   | 2 ms         | 5 mSEC        | 2 mSEC           | Check  |
| 15   | 5 ms         | 10 mSEC       | 5 mSEC           | Check  |
| 16   | 10 ms        | 20 mSEC       | 10 mSEC          | Check  |
| 17   | 20 ms        | 50 mSEC       | 20 mSEC          | Check  |

d. Set time-mark generator for 0.05- $\mu$ s marks.

e. Using horizontal position control, set first time mark on left edge of graticule.

f. Adjusting A4C3, set eleventh time mark on right edge of graticule.

g. Using conditions listed in table 5-7, steps 2 through 6, check accuracy of next five ranges.

Eleventh time mark must fall on right edge of graticule  $\pm 1$  minor division.

h. If step g cannot be accomplished, make compromise adjustment of A4C3 so that requirements of all six ranges are met.

i. This completes steps 1 through 6 in table 5-7. Complete remaining steps in table.



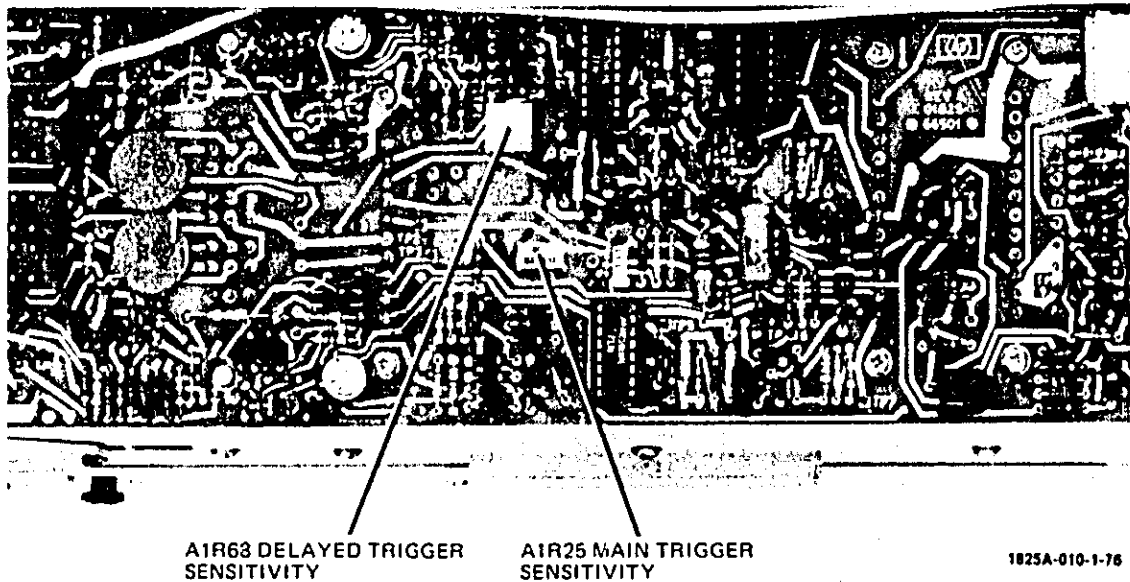
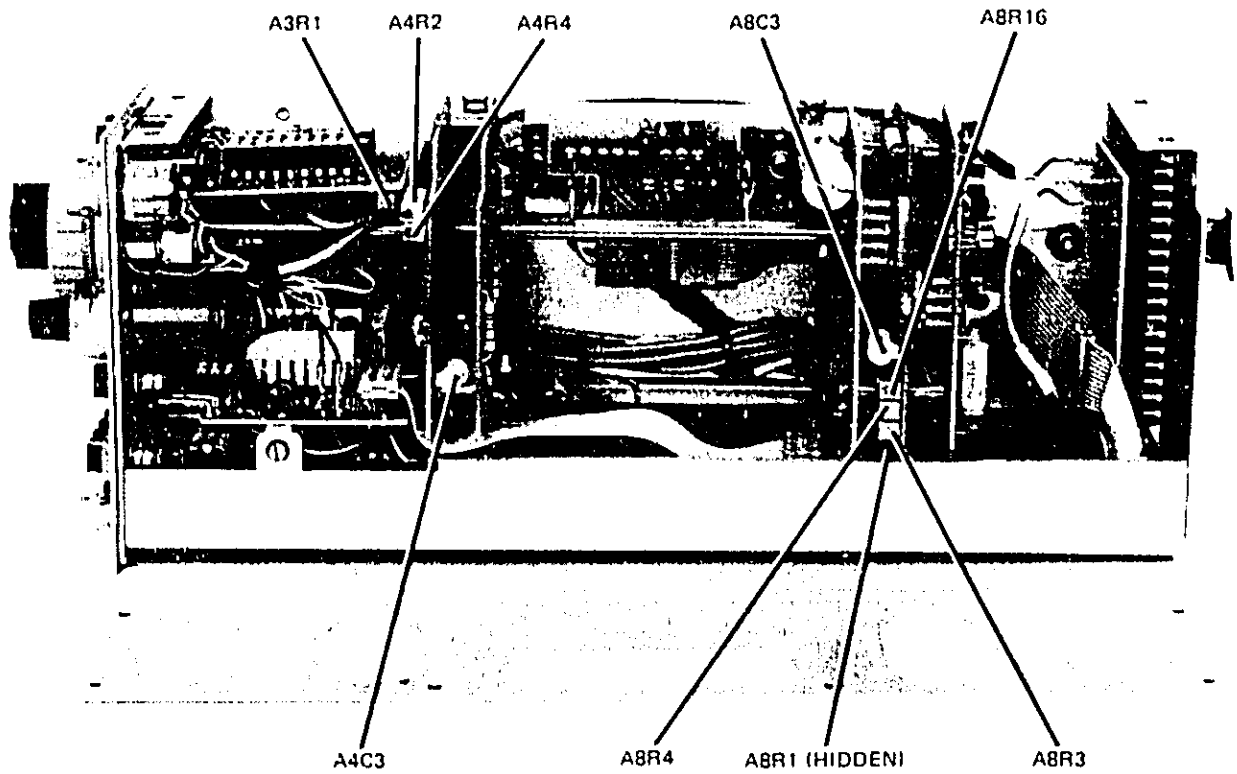


Figure 5-9. Model 1825A Adjustment Controls

**PERFORMANCE CHECK RECORD**  
Model 1825A

Instrument Serial Number \_\_\_\_\_

Date \_\_\_\_\_

| Check  | Specification  | Measured  |
|--|--|---|
| <p><b>PRELIMINARY OPERATIONAL CHECKS</b></p> <p>Main Sweep Ranges<br/>Delayed Sweep Ranges<br/>Intensification<br/>Delay<br/>Intensity ratio</p> <p>UNCAL Indicator<br/>Single Sweep</p> | <p>Sweeps, all ranges<br/>Sweeps, all ranges<br/>1 div intensified<br/>Half trace intensified<br/>INTENS RATIO<br/>controls intensity<br/>Lamp lights<br/>One sweep, lamp lights</p> | <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> |
| <p><b>MAIN TRIGGER LEVEL BALANCE</b></p> <p>Positive</p> <p>Negative</p>   | <p>Stable display<br/>at 100 mV</p> <p>Stable display<br/>at 100 mV</p>  | <p>_____</p> <p>_____</p>   |
| <p><b>MAIN LOW FREQUENCY REJECT</b></p>  | <p>No triggering<br/>at 750 Hz</p>   | <p>_____</p>  |
| <p><b>MAIN HIGH FREQUENCY REJECT</b></p>   | <p>No triggering<br/>at 300 kHz</p>  | <p>_____</p>  |
| <p><b>MAIN RANGE AND POLARITY</b></p> <p>+1<br/>+10</p>  | <p>4 V p-p<br/>40 V p-p</p>  | <p>_____</p> <p>_____</p>   |
| <p><b>MAIN HIGH FREQUENCY TRIGGERING</b></p> <p>INT</p> <p>EXT 50 MHz<br/>100 MHz<br/>150 MHz</p>  | <p>Stable display<br/>at 1/2 div</p> <p>50 mV p-p<br/>100 mV p-p<br/>150 mV p-p</p>  | <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>                           |
| <p><b>DELAYED TRIGGER LEVEL BALANCE</b></p> <p>Positive</p> <p>Negative</p>  | <p>Stable display<br/>at 100 mV</p> <p>Stable display<br/>at 100 mV</p>  | <p>_____</p> <p>_____</p>   |
| <p><b>DELAYED LOW FREQUENCY REJECT</b></p>   | <p>No triggering<br/>at 750 Hz</p>   | <p>_____</p>  |
| <p><b>DELAYED HIGH FREQUENCY REJECT</b></p>  | <p>No triggering<br/>at 300 kHz</p>  | <p>_____</p>  |





## SECTION VI REPLACEABLE PARTS

### 6-1. INTRODUCTION.

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

### 6-3. ORDERING INFORMATION.

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

- a. Instrument model and serial number.
- b. HP part number of item(s).
- c. Quantity of part(s) desired.
- d. Reference designation of part(s).

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

- a. Instrument model and serial number.
- b. Description of the part, including function and location in the instrument.
- c. Quantity desired.

Table 6-1. Abbreviations for Replaceable Parts List

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

Table 6-2 Replaceable Parts

| Reference Designation | HP Part Number | Qty | Description                                     | Mfr Code | Mfr Part Number  |
|-----------------------|----------------|-----|---|----------|------------------|
| CHASSIS PARTS         |                |     |   |          |                  |
| A1                    | 01825 66512    |     | ASSY: MAIN                                      | 28480    | 01825 66512      |
| A2                    | 01825 66502    |     | ASSY: MODE                                      | 28480    | 01825 66502      |
| A3                    | 01825 66503    |     | ASSY: DISPLAY SWITCH                            | 28480    | 01825 66503      |
| A4                    | 01825 66511    |     | ASSY: DELAYED SWITCH                            | 28480    | 01825 66511      |
| A5                    | 01825 66506    |     | ASSY: DELAYED SWEEP COMPONENTS                  | 28480    | 01825 66506      |
| A6                    | 01824 66513    |     | ASSY: VERTICAL CONNECTOR                        | 28480    | 01824 66513      |
| A7                    | 01825 66507    |     | ASSY: MAIN SWEEP COMPONENTS 1                   | 28480    | 01825 66507      |
| AE                    | 01825 66508    |     | ASSY: MAIN SWITCH                               | 28480    | 01825 66508      |
| A9                    | 01825 66509    |     | ASSY: MAIN SWEEP COMPONENTS 2                   | 28480    | 01825 66509      |
| A10                   | 01824 66515    |     | ASSY: MAIN FRAME CONNECTOR                      | 28480    | 01824 66515      |
| DS1                   | 2140 0053      | 1   | LAMP: INCANDESCENT 10 0V 0.014A                 | 06806    | 16890            |
| D 2                   | 1140 0018      | 1   | LAMP: GLOW TUBE MA 0.1W                         | 08906    | AGA C (INE 2E11) |
| H1                    | 0360 0043      | 1   | NUT: HEX DBL CHAM 1/4 32 THD .375 THK           | 28480    | 0690 0043        |
| H2                    | 0360 0040      | 2   | TERMINAL: SLDR LUG, 1/4 SCR, .25/093            | 73734    | 1958             |
| H3                    | 2190 0084      | 2   | WASHER: LK INTL T NO. 1/4 256 IN ID .408 IN OD  | 73739    | KAUTLINK         |
| H4                    | 2950 0072      | 3   | NUT: HEX DBL CHAM 1/4 32 THD .062 THK           | 82389    | P 1975           |
| H5                    | 3050 0028      | 1   | WASHER: FL MTLC NO. 12 .25 IN ID .438 IN OD     | 28480    | 3050 0028        |
| H6                    | 2950 0043      | 3   | NUT: HEX DBL CHAM 3/8 32 THD .064 THK           | 73734    | 2X 28200         |
| H7                    | 2190 0016      | 2   | WASHER: LK INTL T NO. 3/8 .377 IN ID .507 IN OD | 78189    | 1870 02          |
| H8                    | 0360 1117      | 1   | TERMINAL: STRIP 3 TERM PHEN                     | 28480    | 0360 1117        |
| H9                    | 2190 0019      | 7   | WASHER: LK INTL T NO. 4 .115 IN ID .226 IN OD   | 28480    | 2190 0019        |
| H10                   | 2200 0147      | 7   | SCREW: MACH 4 40 .5 IN LG PAN HD POZI           | 28480    | 2200 0147        |
| H11                   | 2200 0170      | 2   | SCREW: MACH 4 40 .625 IN LG HZ DEG FL HD        | 28480    | 2200 0170        |
| H 2                   | 0360 0022      | 2   | SPACER: RND .375 LG .28 ID .19 OD STL           | 76854    | 3457 424         |
| H13                   | 2190 0469      | 2   | WASHER: LK INTL T NO. 4 .116 IN ID .265 IN OD   | 78189    | 1704 00 00 4102  |
| H14                   | 2260 0002      | 2   | NUT: HEX DBL CHAM 4 40 THD .062 THK             | 28480    | 2260 0002        |
| H15                   | 2200 0030      | 14  | SCREW: MACH 4 40 .25 IN LG PAN HD SLT REC       | 28480    | 2200 0030        |
| H16                   | 2200 0078      | 8   | SCREW: MACH 4 40 .188 IN LG PAN HD              | 73734    | 17041            |
| H17                   | 2200 0103      | 2   | SCREW: MACH 4 40 .25 IN LG PAN HD               | 28480    | 2200 0103        |
| H18                   | 3050 0285      | 1   | WASHER: FL MTLC NO. 5/16 .313 IN ID .5 IN OD    | 28480    | 3050 0285        |
| H19                   | 2190 0727      | 1   | WASHER: FL MTLC NO. 5/16 .32 IN ID .406 IN OD   | 28480    | 2190 0727        |
| H20                   | 0360 1489      | 1   | TERMINAL: SLDR LUG, 5/16 SCR, .315/062          | 70963    | 660              |
| H21                   | 2200 0143      | 2   | SCREW: MACH 4 40 .375 IN LG PAN HD              | 28480    | 2200 0143        |
| H22                   | 2260 0003      | 2   | NUT: HEX PLSTC LKG 4 40 THD .141 THK            | 72962    | 87NM40           |
| H23                   | 2200 0165      | 1   | SCREW: MACH 4 40 .25 IN LG 82 DEG FL HD         | 28480    | 2200 0165        |
| H24                   | 2360 0115      | 2   | SCREW: MACH 6 32 .312 IN LG PAN HD              | 28480    | 2360 0115        |
| H25                   | 2360 0236      | 2   | SCREW: MACH 6 32 .812 IN LG PAN HD              | 28480    | 2360 0236        |
| H26                   | 2190 0007      | 2   | WASHER: LK INTL T NO. 6 .141 IN ID .288 IN OD   | 78189    | 1905 00          |
| J1                    | 1250 0118      | 2   | CONNECTOR: BNC                                  | 24931    | 28JR 128 1       |
| J2                    | 1250 0118      |     | CONNECTOR: BNC                                  | 24931    | 28IR 128 1       |
| J3                    | 1250 0898      | 1   | CONNECTOR: RF 75 OHM SUB MINIAT                 | 98291    | 52 146 0000      |
| MP1                   | 0370 0348      | 1   | KNOB: RND BLK 0.640" DIA                        | 28480    | 0370 0348        |
| MP2                   | 01821 67401    | 1   | KNOB WITH ARROWS +/0/-                          | 28480    | 01821 67401      |
| MP3                   | 01825 67401    | 1   | KNOB: VERNIER                                   | 28480    | 01825 67401      |
| MP4                   | 01841 27401    | 1   | KNOB: DELAYED TIME/DIV                          | 28480    | 01841 27401      |
| MP5                   | 01841 67401    | 1   | KNOB ASSY: DLYD SWP                             | 28480    | 01841 67401      |
| MP6                   | 01841 67403    | 1   | KNOB ASSY: DELAYED LEVEL                        | 28480    | 01841 67403      |
| MP7                   | 1140 0036      | 1   | DIAL: TURNS COUNTING                            | 28480    | 1140 0036        |
| MPJ                   | 01821 01205    | 2   | BRACKET: SWEEP DIAL                             | 28480    | 01821 01205      |
| MP9                   | 01825 04001    | 1   | DIAL: SWEEP                                     | 28480    | 01825 04001      |
| MP10                  | 0370 0451      | 11  | BEZEL: PUSHBUTTON KNOB BLK NYLON                | 28480    | 0370 0451        |
| MP11                  | 0370 0938      | 7   | BEZEL: PUSHBUTTON KNOB GRAY                     | 28480    | 0370 0938        |
| MP12                  | 01841 64701    | 1   | KNOB ASSY: MAIN SWP                             | 28480    | 01841 64701      |
| MP13                  | 01825 23901    | 4   | SHAFT: REJECT SWITCHES                          | 28480    | 01825 23901      |
| MP14                  | 01830 23201    | 4   | COUPLER: BAL SHAFT                              | 28480    | 01830 23201      |
| MP15                  | 01841 23702    | 1   | SHAFT: DELAYED SWEEP                            | 28480    | 01841 23702      |
| MP16                  | 01841 63702    | 1   | SHAFT: MAIN SWEEP                               | 28480    | 01841 63702      |
| MP17                  | 01841 63704    | 1   | SHAFT ASSY: MODE                                | 28480    | 01841 63704      |
| MP18                  | 1490 0948      | 1   | BUSHING: POTENTIOMETER 1/4 32 EXT THRD          | 00000    | 080              |
| MP19                  | 01821 01205    | 1   | BRACKET: SWEEP DIAL                             | 28480    | 01821 01205      |
| MP20                  | 00183 67406    | 11  | PUSHBUTTON ASSY: BLACK FRONT                    | 28480    | 00183 67406      |
| MP21                  | 01841 67404    | 7   | PUSHBUTTON ASSY: GRAY FRONT                     | 28480    | 01841 67404      |
| MP22                  | 3130 0339      | 2   | ROTOR ASSY: MALE                                | 28480    | 3130 0339        |
| MP23                  | 3130 0339      | 1   | ROTOR ASSY: MALE                                | 28480    | 3130 0339        |
| MP24                  | 3130 0401      | 1   | ROTOR ASSY: FEMALE                              | 28480    | 3130 0401        |
| MP25                  | 3130 0340      | 1   | ROTOR ASSY: FEMALE                              | 28480    | 3130 0340        |
| MP26                  | 0510 1101      | 2   | SPRING: RETAINER (PC SWITCH)                    | 28480    | 0510 1101        |
| MP27                  | 0610 1101      | 1   | SPRING: RETAINER (PC SWITCH)                    | 28480    | 0610 1101        |
| MP28                  | 01821 04101    | 1   | BRACKET: PLUG                                   | 28480    | 01821 04101      |
| MP29                  | 01821 43101    | 1   | GUIDE: LATCH                                    | 28480    | 01821 43101      |
| MP30                  | 01824 00203    | 1   | PANEL: REAR                                     | 28480    | 01824 00203      |
| MP31                  | 01824 61201    | 1   | BRACKET ASSY                                    | 28480    | 01824 61201      |
| MP32                  | 01825 00201    | 1   | PANEL: FRONT                                    | 28480    | 01825 00201      |
| MP33                  | 01825 00203    | 1   | PANEL: SUB                                      | 28480    | 01825 00203      |
| MP34                  | 01825 01201    | 1   | BRACKET: RIGHT                                  | 28480    | 01825 01201      |

See introduction to this section for ordering information

Table 6-2 Replaceable Parts (Cont'd)

| Reference Designation  | HP Part Number | Qty | Description  | Mfr Code | Mfr Part Number |
|------------------------|----------------|-----|--|----------|-----------------|
| CHASSIS PARTS (CONT'D) |                |     |  |          |                 |
| MP35                   | 01841 01202    | 1   | BRACKET, LEFT                                      | 28480    | 01841 01202     |
| MP36                   | 01841 01205    | 1   | BRACKET, TOP                                       | 28480    | 01841 01205     |
| MP37                   | 5060 0451      | 2   | LIGHT ASSY, IND                                    | 28480    | 5060 0451       |
| MP38                   | 5060 0458      | 2   | HEADER ASSY, LAMP                                  | 28480    | 5060 0458       |
| R1                     | 2100 2635      | 1   | R VAR COMP 50K OHM 20% LIN 1/2W                    | 28480    | 2100 2635       |
| R2                     | 2100 3220      | 2   | R VAR COMP 15K OHM 10% 1/2W                        | 28480    | 2100 3220       |
| R3                     | 2100 3220      | 1   | R VAR COMP 15K OHM 10% 1/2W                        | 28480    | 2100 3220       |
| R4                     | 0687 8221      | 1   | R FXD COMP 8200 OHM 10% 1/2W                       | 01121    | EB 8221         |
| R5                     | 2100 3233      | 1   |  |          |                 |
| R6                     | 2100 2063      | 1   | R VAR COMP 1K OHM 10% LIN 1/2W                     | 28480    | 2100 2063       |
| R7                     | 2 00 1443      | 1   | R VAR WW 50K OHM 3% 2W                             | 28480    | 2100 1443       |
| R8                     | 0697 3931      | 1   | R FXD COMP 39K OHM 10% 1/2W                        | 01121    | EB 3931         |
| S1                     |                |     | S NSR P/O R5                                       |          |                 |
| S2                     |                |     | S NSR P/O R3                                       |          |                 |
| W1                     | 01825 61614    | 1   | CABLE ASSY A3 TO FRONT PANEL                       | 28480    | 01825 61616     |
| W2                     | 01825 61611    | 1   | CABLE ASSY RIBBON A1 TO A3                         | 28480    | 01825 61611     |
| W3                     | 01825 61604    | 1   | CABLE COAX REAR PANEL MAIN GATE                    | 28480    | 01825 61604     |
| W4                     |                |     | NOT ASSIGNED                                       |          |                 |
| W5                     | 01825 61606    | 1   | CABLE COAX REAR PANEL DELAYED RAMP                 | 28480    | 01825 61606     |
| W6                     | 01825 61610    | 1   | CABLE COAX DELAYED RAMP TO DISPLAY SW              | 28480    | 01825 61610     |
| W7                     | 01825 61609    | 1   | CABLE COAX DELAYED RESET REFERENCE                 | 28480    | 01825 61609     |
| W8                     | 01824 61610    | 1   | CABLE ASSY   | 28480    | 01824 61610     |
| W9                     | 01825 61602    | 1   | CABLE COAX GATE OUT                                | 28480    | 01825 61602     |
| W10                    | 01825 61601    | 1   | CABLE COAX RAMP OUT                                | 28480    | 01825 61601     |
| W11                    | 01841 61620    | 1   | CABLE FLEX   | 28480    | 01841 61620     |
| W12                    | 01825 61613    | 1   | CABLE COAX DELAY POT                               | 28480    | 01825 61613     |
| W13                    | 01825 61607    | 1   | CABLE COAX LINE SYNC                               | 28480    | 01825 61607     |
| W14                    | 01825 61608    | 1   | CABLE COAX COAX MAIN RAMP TO DISPLAY SW            | 28480    | 01825 61608     |
| W15                    | 01824 61608    | 1   | CABLE POWER  | 28480    | 01824 61608     |
| W16                    | 01825 61618    | 1   | CABLE MAIN (INC DES W3, W5, W7, W8, W12, W14, W15) | 28480    | 01825 61618     |

See Introduction to this section for ordering information

Table 6-2 Replaceable Parts (Cont'd)

| Reference Designation | HP Part Number | Qty | Description                           | Mfr Code | Mfr Part Number        |
|-----------------------|----------------|-----|---------------------------------------|----------|------------------------|
| A1                    | 01825 66512    | 1   | ASSY MAIN                             | 28480    | 01825 66512            |
| A1C1                  | 0150 0024      | 2   | C.FXD CER 002 UF +80-20% 600VDCW      | 71590    | TYPE DD 203            |
| A1C2                  | 0160 3443      | 2   | C.FXD CER 220 PF 10% 1KVDCW           | 56289    | C016B102F 221K 25 CDH  |
| A1C3                  | 0160 0155      | 1   | C.FXD MY 0.0033 UF 10% 200VDCW        | 56289    | 192P23292 P1           |
| A1C4                  | 0180 0291      | 2   | C.FXD ELECT 1.0 UF 10% 35VDCW         | 56289    | 150D105X9035A2 DYS     |
| A1C5                  | 0160 0197      | 10  | C.FXD ELECT 2.2 UF 10% 20VDCW         | 56289    | 150D125X9020A2 DYS     |
| A1C6                  | 0160 0168      | 4   | C.FXD MY 0.1 UF 10% 200VDCW           | 56289    | 192P10492 P15          |
| A1C7                  | 0160 3446      |     | C.FXD CER 220 PF 10% 1KVDCW           | 56289    | C016B102F 221K 25 CDH  |
| A1C8                  | 0150 0024      |     | C.FXD CER 002 UF +80-20% 600VDCW      | 71590    | TYPE DD 203            |
| A1C9                  | 0160 0300      | 1   | C.FXD MY 0.0027 UF 200VDCW            | 56289    | 192P27292 P15          |
| A1C10                 | 0180 0291      |     | C.FXD ELECT 1.0 UF 10% 35VDCW         | 56289    | 150D105X9035A2 DYS     |
| A1C11                 | 0160 3451      | 1   | C.FXD CER 001 UF +80-20% 100VDCW      | 56289    | C023B101F 103Z525 CD   |
| A1C12                 | 0160 3466      | 2   | C.FXD CER 100 PF 10% 250VDCW          | 56289    | C157F 251F 101K522 CDH |
| A1C13                 | 0160 3466      |     | C.FXD CER 100 PF 10% 250VDCW          | 56289    | C157F 251F 101K522 CDH |
| A1C14                 | 0160 0197      |     | C.FXD ELECT 2.2 UF 10% 20VDCW         | 56289    | 150D225X9020A2 DYS     |
| A1C15                 | 0160 2257      | 3   | C.FXD CER 10 PF 5% 500VDCW            | 72982    | 301 000 C0H0 100J      |
| A1C16                 | 0160 3451      | 25  | C.FXD CER 001 UF +80-20% 100VDCW      | 56289    | C023B101F 103Z525 CDH  |
| A1C17                 | 0160 3557      | 9   | C.FXD CER 001 UF 20% 200VDCW          | 28480    | 0160 3557              |
| A1C18                 | 0160 3451      |     | C.FXD CER 001 UF +80-20% 100VDCW      | 56289    | C023B101F 103Z525 CDH  |
| A1C19                 | 0160 3451      |     | C.FXD CER 001 UF +80-20% 100VDCW      | 56289    | C023B101F 103Z525 CDH  |
| A1C20                 | 0160 3451      |     | C.FXD CER 001 UF +80-20% 100VDCW      | 56289    | C023B101F 103Z525 CDH  |
| A1C21                 | 0160 3451      |     | C.FXD CER 001 UF +80-20% 100VDCW      | 56289    | C023B101F 103Z525 CDH  |
| A1C22                 | 0160 3451      |     | C.FXD CER 0.1 UF +80-20% 100VDCW      | 56289    | C023B101F 103Z525 CDH  |
| A1C23                 | 0160 3451      |     | C.FXD CER 001 UF +80-20% 100VDCW      | 56289    | C023B101F 103Z525 CDH  |
| A1C24                 | 0160 3451      |     | C.FXD CER 001 UF +80-20% 100VDCW      | 56289    | C023B101F 103Z525 CDH  |
| A1C25                 | 0160 3451      |     | C.FXD CER 001 UF +80-20% 100VDCW      | 56289    | C023B101F 103Z525 CDH  |
| A1C26                 |                |     | DELETED                               |          |                        |
| A1C27                 |                |     | DELETED                               |          |                        |
| A1C28                 | 0160 3461      |     | C.FXD CER 001 UF +80-20% 100VDCW      | 56289    | C023B101F 103Z525 CDH  |
| A1C29                 | 0180 0197      |     | C.FXD ELECT 2.2 UF 10% 20VDCW         | 56289    | 150D225X9020A2 DYS     |
| A1C30                 | 0160 3451      |     | C.FXD CER 001 UF +80-20% 100VDCW      | 56289    | C023B101F 103Z525 CDH  |
| A1C31                 | 0160 3451      |     | C.FXD CER 001 UF +80-20% 100VDCW      | 56289    | C023B101F 103Z525 CDH  |
| A1C32                 | 0180 0197      |     | C.FXD ELECT 2.2 UF 10% 20VDCW         | 56289    | 150D225X9020A2 DYS     |
| A1C33                 |                |     | DELETED                               |          |                        |
| A1C34                 | 0160 3557      |     | C.FXD CER 001 UF 20% 200VDCW          | 28480    | 0160 3557              |
| A1C35                 | 0160 3557      |     | C.FXD CER 001 UF 20% 200VDCW          | 28480    | 0160 3557              |
| A1C36                 | 0160 3451      | 1   | C.FXD CER 001 UF +80-20% 100VDCW      | 56289    | C023B101F 103Z525 CD   |
| A1C37                 | 0160 2240      |     | C.FXD CER 2.0 PF 500VDCW              | 72982    | 301 000 C0K0 200C      |
| A1C38                 | 0160 2201      | 2   | C.FXD MICA 51 PF 5%                   | 72136    | ROM15E51011C           |
| A1C39                 | 0160 2201      |     | C.FXD MICA 51 PF 5%                   | 72136    | ROM15E51011C           |
| A1C40                 | 0160 3451      |     | C.FXD CER 001 UF +80-20% 100VDCW      | 56289    | C023B101F 103Z525 CD   |
| A1C41                 |                |     | DELETED                               |          |                        |
| A1C42                 | 0160 2150      | 24  | C.FXD MICA 33 PF 500                  | 28480    | 0160 2150              |
| A1CR1                 | 1901 0047      | 1   | DIODE JUNCTION SILICON 20PIV          | 28480    | 1901 0047              |
| A1CR2                 | 1901 0047      |     | DIODE JUNCTION SILICON 20PIV          | 28480    | 1901 0047              |
| A1CR3                 | 1901 0047      |     | DIODE JUNCTION SILICON 20PIV          | 28480    | 1901 0047              |
| A1CR4                 | 1501 0040      | 25  | DIODE SILICON 30 MA 30 WV             | 07263    | FDG 1088               |
| A1CR5                 | 1501 0016      | 1   | DIODE GERMANIUM 100 MA/0.85V 60PIV    | 03332    | 02361                  |
| A1CR6                 | 1901 0040      |     | DIODE SILICON 30 MA 30 WV             | 07263    | FDG 1088               |
| A1CR7                 |                |     | NOT ASSIGNED                          |          |                        |
| A1CR8                 | 1901 0047      |     | DIODE JUNCTION SILICON 20PIV          | 28480    | 1901 0047              |
| A1CR9                 | 1901 0047      |     | DIODE JUNCTION SILICON 20PIV          | 28480    | 1901 0047              |
| A1CR10                | 1901 0047      |     | DIODE JUNCTION SILICON 20PIV          | 28480    | 1901 0047              |
| A1CR11                | 1901 0040      |     | DIODE SILICON 30MA 30 WV              | 07262    | FDG 1088               |
| A1CR12                | 1901 0047      |     | DIODE JUNCTION SILICON 20PIV          | 28480    | 1901 0047              |
| A1CR13                | 1901 0047      |     | DIODE JUNCTION SILICON 20PIV          | 28480    | 1901 0047              |
| A1J1                  | 1251 1968      |     | CONNECTOR PC 10 TUNING FORK TYPE CONT | 02660    | 143 010 07 1158        |
| A1J2                  | 1200 0441      | 4   | SOCKET IC 14 PIN MINIATURE            | 28480    | 1200 0441              |
| A1J3                  | 1251 0477      |     | CONNECTOR PC 12 FORK TYPE CONTACT     | 95354    | 91 6912 1700 00        |
| A1J4                  | 1251 0477      |     | CONNECTOR PC 12 FORK TYPE CONTACT     | 95354    | 91 6912 1700 00        |
| A1J5                  | 1200 0441      | 3   | SOCKET IC 14 PIN MINIATURE            | 28480    | 1200 0441              |
| A1L1                  | 9100 2247      | 4   | COIL FXD RF 0.10 UH 10%               | 28480    | 9100 2247              |
| A1L2                  | 9100 2247      |     | COIL FXD RF 0.10 UH 10%               | 28480    | 9100 2247              |
| A1L3                  | 9100 2247      |     | COIL FXD RF 0.10 UH 10%               | 28480    | 9100 2247              |
| A1L4                  | 9100 2247      |     | COIL FXD RF 0.10 UH 10%               | 28480    | 9100 2247              |
| A1L5                  | 9140 0115      | 4   | COIL FXD RF 22 UH 10%                 | 99800    | 2150 32                |
| A1L6                  | 9140 0115      |     | COIL FXD RF 22 UH 10%                 | 99800    | 2150 32                |
| A1L7                  | 9170 0029      | 4   | CORE FERRITE BEAD                     | 02114    | 56 590 65/38           |
| A1L8                  | 9170 0029      |     | CORE FERRITE BEAD                     | 02114    | 56 590 65/38           |
| A1Q1                  | 1855 0081      | 2   | TSTR SI FET                           | 80131    | 2N5245                 |
| A1Q2                  | 1853 0203      | 2   | TSTR SI PNP                           | 28480    | 1853 0203              |
| A1Q3                  | 1854 0092      | 10  | TSTR SI NPN                           | 80131    | 2N3563                 |
| A1Q4                  | 1854 0092      |     | TSTR SI NPN                           | 80131    | 2N3563                 |
| A1Q5                  | 1854 0092      |     | TSTR SI NPN                           | 80131    | 2N3563                 |
| A1Q6                  | 1854 0092      |     | TSTR SI NPN                           | 80131    | 2N3563                 |
| A1Q7                  | 1854 0071      | 20  | TSTR SI NPN                           | 28480    | 1854 0071              |
| A1Q8                  | 1853 0286      | 13  | TSTR SI PNP                           | 80131    | 2N5087                 |
| A1Q9                  | 1853 0086      |     | TSTR SI PNP                           | 80131    | 2N5087                 |
| A1Q10                 | 1853 0086      |     | TSTR SI PNP                           | 80131    | 2N5087                 |
| A1Q11                 | 1855 0081      |     | TSTR SI FET                           | 80131    | 2N5245                 |

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Table 6-2 Replaceable Parts (Cont'a)

| Reference Designation | HP Part Number | Qty | Description                        | Mfr Code | Mfr Part Number |
|-----------------------|----------------|-----|------------------------------------|----------|-----------------|
| A1Q12                 | 1853 0203      |     | TSTR SI NPN                        | 28480    | 1853 0203       |
| A1Q13                 | 1854 0092      |     | TSTR SI NPN                        | 80131    | 2N3563          |
| A1Q14                 | 1854 0092      |     | TSTR SI NPN                        | 80131    | 2N3563          |
| A1Q15                 | 1854 0092      |     | TSTR SI NPN                        | 80131    | 2N3563          |
| A1Q16                 | 1854 0092      |     | TSTR SI NPN                        | 80131    | 2N3563          |
| A1Q17                 | 1853 0086      |     | TSTR SI NPN                        | 80131    | 2N5087          |
| A1Q18                 | 1853 0086      |     | TSTR SI NPN                        | 80131    | 2N5087          |
| A1Q19                 | 1854 0215      | 10  | TSTR SI NPN                        | 80131    | 2N3904          |
| A1Q20                 | 1854 0215      |     | TSTR SI NPN                        | 80131    | 2N3904          |
| A1Q21                 | 1854 0215      |     | TSTR SI NPN                        | 80131    | 2N3904          |
| A1Q22                 | 1854 0215      |     | TSTR SI NPN                        | 80131    | 2N3904          |
| A1Q23                 | 1854 0215      |     | TSTR SI NPN                        | 80131    | 2N3904          |
| A1Q24                 | 1854 0215      |     | TSTR SI NPN                        | 80131    | 2N3904          |
| A1Q25                 | 1854 0215      |     | TSTR SI NPN                        | 80131    | 2N3904          |
| A1R1                  | 0684 2201      | 7   | R FXD COMP 22 OHM 10% 1/4W         | 01121    | CB 2201         |
| A1R2                  | 0757 0488      | 4   | R FXD MET FLM 900K OHM 1% 1/8W     | 28480    | 0757 0488       |
| A1R3                  | 0757 0466      | 3   | R FXD MET FLM 100K OHM 1% 1/8W     | 28480    | 0757 0466       |
| A1R4                  | 0684 1061      | 3   | R FXD COMP 10 MEGOHM 10% 1/4W      | 01121    | CB 1061         |
| A1R5                  | 0683 1056      | 2   | R FXD COMP 1 MEGOHM 5% 1/4W        | 01121    | CB 1056         |
| A1R6                  | 0684 1031      | 5   | R FXD COMP 10K OHM 10% 1/4W        | 01121    | CB 1031         |
| A1R7                  | 0757 0488      |     | R FXD MET FLM 900K OHM 1% 1/8W     | 28480    | 0757 0488       |
| A1R8                  | 0757 0471      | 2   | R FXD MET FLM 182K OHM 1% 1/8W     | 28480    | 0757 0471       |
| A1R9                  | 0684 5601      | 2   | R FXD COMP 56 OHM 10% 1/4W         | 01121    | CB 5601         |
| A1R10                 | 0684 3321      | 2   | R FXD COMP 3300 OHM 10% 1/4W       | 01121    | CB 3321         |
| A1R11                 | 0698 3159      | 1   | R FXD MET FLM 26.1K OHM 1% 1/8W    | 28480    | 0698 3159       |
| A1R12                 | 0757 0290      | 3   | R FXD MET FLM 6.19K OHM 1% 1/8W    | 28480    | 0757 0290       |
| A1R13                 | 0698 3153      | 2   | R FXD MET FLM 3.83K OHM 1% 1/8W    | 28480    | 0698 3153       |
| A1R14                 | 0757 0280      | 9   | R FXD MET FLM 1K OHM 1% 1/8W       | 28480    | 0757 0280       |
| A1R15                 | 0757 0283      | 11  | R FXD MET FLM 2.00K OHM 1% 1/8W    | 28480    | 0757 0283       |
| A1R16                 | 0757 0419      | 2   | R FXD MET FLM 681 OHM 1% 1/8W      | 28480    | 0757 0419       |
| A1R17                 | 0757 0283      |     | R FXD MET FLM 2.00K OHM 1% 1/8W    | 28480    | 0757 0283       |
| A1R18                 | 0675 1011      | 10  | R FXD COMP 100 OHM 10% 1/8W        | 01121    | BB 1011         |
| A1R19                 | 0675 1011      |     | R FXD COMP 100 OHM 10% 1/8W        | 01121    | BB 1011         |
| A1R20                 | 0698 3430      | 4   | R FXD MET FLM 21.5 OHM 1% 1/8W     | 28480    | 0698 3430       |
| A1R21                 | 0698 7212      |     | R FXD FLM 100 OHM 2% 1/8W          | 28480    | 0698 7212       |
| A1R22                 | 0684 5611      | 2   | R FXD COMP 560 OHM 10% 1/4W        | 01121    | CB 5611         |
| A1R23                 | 0684 2201      | 2   | R FXD COMP 22 OHM 10% 1/4W         | 01121    | CB 2201         |
| A1R24                 | 0757 0174      | 4   | R FXD MET FLM 39.2K OHM 1% 1/8W    | 28480    | 0757 0174       |
| A1R25                 | 2100 3175      | 2   | R VAR CERMET 100K OHM 10% LIN 1/2W | 28480    | 2100 3175       |
| A1R26                 | 0757 0280      |     | R FXD MET FLM 1K OHM 1% 1/8W       | 28480    | 0757 0280       |
| A1R27                 | 0757 0273      | 4   | R FXD MET FLM 3.01K OHM 1% 1/8W    | 28480    | 0757 0273       |
| A2R28                 | 0757 0280      |     | R FXD MET FLM 1K OHM 1% 1/8W       | 28480    | 0757 0280       |
| A1R29                 | 0757 0420      | 4   | R FXD MET FLM 75C OHM 1% 1/8W      | 28480    | 0757 0420       |
| A1R30                 | 0675 1011      |     | R FXD COMP 100 OHM 10% 1/8W        | 01121    | BB 1011         |
| A1R31                 | 0675 1011      |     | R FXD COMP 100 OHM 10% 1/8W        | 01121    | BB 1011         |
| A1R32                 | 0698 3430      |     | R FXD MET FLM 21.5 OHM 1% 1/8W     | 28480    | 0698 3430       |
| A1R33                 | 0757 0174      |     | R FXD MET FLM 39.2K OHM 1% 1/8W    | 28480    | 0757 0174       |
| A1R34                 | 0684 2201      |     | R FXD COMP 22 OHM 10% 1/4W         | 01121    | CB 2201         |
| A1R35                 | 0757 0398      | 4   | R FXD MET FLM 75 OHM 1% 1/8W       | 28480    | 0757 0398       |
| A1R36                 | 0684 2221      |     | R FXD COMP 2200 OHM 10% 1/4W       | 01121    | CB 2221         |
| A1R37                 | 0757 0398      |     | R FXD MET FLM 75 OHM 1% 1/8W       | 28480    | 0757 0398       |
| A1R38                 | 0684 2221      |     | R FXD COMP 2200 OHM 10% 1/4W       | 01121    | CB 2221         |
| A1R39                 | 0684 4711      | 1   | R FXD COMP 470 OHM 10% 1/4W        | 01121    | CB 4711         |
| A1R40                 | 0757 0487      | 3   | R FXD MET FLM 825K OHM 1% 1/8W     | 28480    | 0757 0487       |
| A1R41                 | 0757 0415      | 4   | R FXD MET FLM 475 OHM 1% 1/8W      | 28480    | 0757 0415       |
| A1R42                 | 0698 8139      | 2   | R FXD MET OX 10K OHM 20% 1.0W      | 28480    | 0698 8139       |
| A1R43                 | 0757 0412      | 2   | R FXD MET FLM 365 OHM 1% 1/8W      | 28480    | 0757 0412       |
| A1R44                 | 0757 0427      | 2   | R FXD MET FLM 1.5K OHM 1% 1/8W     | 28480    | 0757 0427       |
| A1R45                 | 0757 0199      | 2   | R FXD MET FLM 21.5K OHM 1% 1/8W    | 28480    | 0757 0199       |
| A1R46                 | 0757 0438      | 6   | R FXD MET FLM 5.11K OHM 1% 1/8W    | 28480    | 0757 0438       |
| A1R47                 | 0757 0416      | 4   | R FXD MET FLM 511 OHM 1% 1/8W      | 28480    | 0757 0416       |
| A1R48                 | 0683 1055      |     | R FXD COMP 1 MEGOHM 5% 1/4W        | 01121    | CB 1055         |
| A1R49                 | 0757 0488      |     | R FXD MET FLM 900K OHM 1% 1/8W     | 28480    | 0757 0488       |
| A1R50                 | 0757 0471      |     | R FXD MET FLM 182K OHM 1% 1/8W     | 28480    | 0757 0471       |
| A1R51                 | 0684 2201      |     | R FXD COMP 22 OHM 10% 1/4W         | 01121    | CB 2201         |
| A1R52                 | 0757 0488      |     | R FXD MET FLM 900K OHM 1% 1/8W     | 28480    | 0757 0488       |
| A1R53                 | 0757 0466      |     | R FXD MET FLM 100K OHM 1% 1/8W     | 28480    | 0757 0466       |
| A1R54                 | 0684 5601      |     | R FXD COMP 56 OHM 10% 1/4W         | 01121    | CB 5601         |
| A1R55                 | 0684 1061      |     | R FXD COMP 10 MEGOHM 10% 1/4W      | 01121    | CB 1061         |
| A1R56                 | 0684 3321      |     | R FXD COMP 3300 OHM 10% 1/4W       | 01121    | CB 3321         |
| A1R57                 | 0757 0290      |     | R FXD MET FLM 6.19K OHM 1% 1/8W    | 28480    | 0757 0290       |
| A1R58                 | 0698 3153      |     | R FXD MET FLM 3.83K OHM 1% 1/8W    | 28480    | 0698 3153       |
| A1R59                 | 0757 0280      |     | R FXD MET FLM 1K OHM 1% 1/8W       | 28480    | 0757 0280       |
| A1R60                 | 0757 0283      |     | R FXD MET FLM 2.00K OHM 1% 1/8W    | 28480    | 0757 0283       |
| A1R61                 | 0757 0419      |     | R FXD MET FLM 681 OHM 1% 1/8W      | 28480    | 0757 0419       |
| A1R62                 | 0757 0283      |     | R FXD MET FLM 2.00K OHM 1% 1/8W    | 28480    | 0757 0283       |
| A1R63                 | 0675 1011      |     | R FXD COMP 100 OHM 10% 1/8W        | 01121    | BB 1011         |
| A1R64                 | 0675 1011      |     | R FXD COMP 100 OHM 10% 1/8W        | 01121    | BB 1011         |
| A1R65                 | 0698 3430      |     | R FXD MET FLM 21.5 OHM 1% 1/8W     | 28480    | 0698 3430       |
| A1R66                 | 0684 2201      |     | R FXD COMP 22 OHM 10% 1/4W         | 01121    | CB 2201         |

See introduction to this section for ordering information

Table 6-2 Replaceable Parts (Cont'd)

| Reference Designation | HP Part Number | Qty | Description                              | Mfr Code | Mfr Part Number |
|-----------------------|----------------|-----|--|----------|-----------------|
| A1R67                 | 0757 0124      |     | R: FXD MET FLM 39.2K OHM 1% 1/8W         | 28480    | 0757 0124       |
| A1R68                 | 2100 3175      |     | R: VAR CERMET 100K OHM 10% LIN 1/2W      | 28480    | 2100 3175       |
| A1R69                 | 0757 0280      |     | R: FXD MET FLM 1K OHM 1% 1/8W            | 28480    | 0757 0280       |
| A1R70                 | 0757 0280      |     | R: FXD MET FLM 1K OHM 1% 1/8W            | 28480    | 0757 0280       |
| A1R71                 | 0757 0273      |     | R: FXD MET FLM 3.01K OHM 1% 1/8W         | 28480    | 0757 0273       |
| A1R72                 | 0757 0420      |     | R: FXD MET FLM 750 OHM 1% 1/8W           | 28480    | 0757 0420       |
| A1R73                 | 0675 1011      |     | R: FXD COMP 100 OHM 10% 1/8W             | 01121    | BB 1011         |
| A1R74                 | 0675 1011      |     | R: FXD COMP 100 OHM 10% 1/8W             | 01121    | BB 1011         |
| A1R75                 | 0684 5611      |     | R: FXD COMP 560 OHM 10% 1/4W             | 01121    | CB 5611         |
| A1R76                 | 0698 3430      |     | R: FXD MET FLM 21.5 OHM 1% 1/8W          | 28480    | 0698 3430       |
| A1R77                 | 0757 0124      |     | R: FXD MET FLM 39.2K OHM 1% 1/8W         | 28480    | 0757 0124       |
| A1R78                 | 0684 2201      |     | R: FXD COMP 22 OHM 10% 1/4W              | 01121    | CB 2201         |
| A1R79                 | 0757 0410      |     | R: FXD MET FLM 231 OHM 1% 1/8W           | 28480    | 0757 0410       |
| A1R80                 | 0757 0424      |     | R: FXD MET FLM 1.10K OHM 1% 1/8W         | 28480    | 0757 0424       |
| A1R81                 | 0757 0398      |     | R: FXD MET FLM 75 OHM 1% 1/8W            | 28480    | 0757 0398       |
| A1R82                 | 0684 1031      |     | R: FXD COMP 10K OHM 10% 1/4W             | 01121    | CB 1031         |
| A1R83                 | 0684 2221      |     | R: FXD COMP 2200 OHM 10% 1/4W            | 01121    | CB 2221         |
| A1R84                 | 0757 0398      |     | R: FXD MET FLM 75 OHM 1% 1/8W            | 28480    | 0757 0398       |
| A1R85                 | 0684 2221      |     | R: FXD COMP 2200 OHM 10% 1/4W            | 01121    | CB 2221         |
| A1R86                 | 0757 0415      |     | R: FXD MET FLM 475 OHM 1% 1/8W           | 28480    | 0757 0415       |
| A1R87                 | 0693 8139      |     | R: FXD MET OX 10K OHM 20% 1.0W           | 28480    | 0698 8139       |
| A1R88                 | 0757 0412      |     | R: FXD MET FLM 365 OHM 1% 1/8W           | 28480    | 0757 0412       |
| A1R89                 | 0757 0199      |     | R: FXD MET FLM 21.5K OHM 1% 1/8W         | 28480    | 0757 0199       |
| A1R90                 | 0757 0427      |     | R: FXD MET FLM 1.5K OHM 1% 1/8W          | 28480    | 0757 0427       |
| A1R91                 | 0757 0438      |     | R: FXD MET FLM 5.11K OHM 1% 1/8W         | 28480    | 0757 0438       |
| A1R92                 | 0757 0416      | 38  | R: FXD MET FLM 511 OHM 1% 1/8W           | 28480    | 0757 0416       |
| A1R93                 | 0684 1011      |     | R: FXD COMP 100 OHM 10% 1/4W             | 01121    | CB 1011         |
| A1R94                 | 0684 1011      |     | R: FXD COMP 100 OHM 10% 1/4W             | 01121    | CB 1011         |
| A1R95                 | 0684 1521      | 2   | R: FXD COMP 1500 OHM 10% 1/4W            | 01121    | CB 1521         |
| A1R96                 | 0684 1011      |     | R: FXD COMP 100 OHM 10% 1/4W             | 01121    | CB 1011         |
| A1R97                 | 0757 0437      | 3   | R: FXD MET FLM 4750 OHM 1% 1/8W          | 28480    | 0757 0437       |
| A1R98                 | 0757 0273      |     | R: FXD MET FLM 3.01K OHM 1% 1/8W         | 28480    | 0757 0273       |
| A1R99                 | 0684 1011      |     | R: FXD COMP 100 OHM 10% 1/4W             | 01121    | CB 1011         |
| A1R100                | 0757 0281      | 1   | R: FXD MET FLM 2.74K OHM 1% 1/8W         | 28480    | 0757 0281       |
| A1R101                | 0764 0044      | 1   | R: FXD MET OX 8.2K OHM 5% 2W             | 28480    | 0764 0044       |
| A1R102                | 0757 0408      | 2   | R: FXD MET FLM 243 OHM 1% 1/8W           | 28480    | 0757 0408       |
| A1R103                | 0757 0280      |     | R: FXD MET FLM 1K OHM 1% 1/8W            | 28480    | 0757 0280       |
| A1R104                | 0698 3150      | 1   | R: FXD MET FLM 2.37K OHM 1% 1/8W         | 28480    | 0698 3150       |
| A1R105                | 0757 0422      | 3   | R: FXD MET FLM 909 OHM 1% 1/8W           | 28480    | 0757 0422       |
| A1R106                | 0757 0440      | 1   | R: FXD MET FLM 7.50K OHM 1% 1/8W         | 28480    | 0757 0440       |
| A1R107                | 0684 1011      |     | R: FXD COMP 100 OHM 10% 1/4W             | 01121    | CB 1011         |
| A1R108                | 0684 1011      |     | R: FXD COMP 100 OHM 10% 1/4W             | 01121    | CB 1011         |
| A1R109                | 0684 1011      |     | R: FXD COMP 100 OHM 10% 1/4W             | 01121    | CB 1011         |
| A1R110                | 0684 1521      |     | R: FXD COMP 1500 OHM 10% 1/4W            | 01121    | CB 1521         |
| A1R111                | 0684 2721      | 3   | R: FXD COMP 2700 OHM 10% 1/4W            | 01121    | CB 2721         |
| A1R112                | 0683 5115      |     | R: FXD COMP 510 OHM 5% 1/4W              | 01121    | CB 5115         |
| A1R113                | 0757 0288      | 2   | R: FXD MET FLM 9.09K OHM 1% 1/8W         | 28480    | 0757 0288       |
| A1R114                | 0757 0273      |     | R: FXD MET FLM 3.01K OHM 1% 1/8W         | 28480    | 0757 0273       |
| A1R115                | 0757 0417      | 3   | R: FXD MET FLM 562 OHM 1% 1/8W           | 28480    | 0757 0417       |
| A1R116                | 0684 1011      |     | R: FXD COMP 100 OHM 10% 1/4W             | 01121    | CB 1011         |
| A1R117                | 0684 5601      |     | R: FXD COMP 56 OHM 10% 1/4W              | 01121    | CB 5601         |
| A1R118                | 0684 1011      |     | R: FXD COMP 100 OHM 10% 1/4W             | 01121    | CB 1011         |
| A1R119                | 0684 5601      |     | R: FXD COMP 56 OHM 10% 1/4W              | 01121    | CB 5601         |
| A1R120                | 0757 0417      |     | R: FXD MET FLM 562 OHM 1% 1/8W           | 28480    | 0757 0417       |
| A1R121                | 0684 1011      |     | R: FXD COMP 100 OHM 10% 1/4W             | 01121    | CB 1011         |
| A1R122                |                |     | DELETED                                  |          |                 |
| A1R123                | 0684 3901      | 4   | R: FXD COMP 39 OHM 10% 1/4W              | 01121    | CB 3901         |
| A1R124                | 0684 0271      | 2   | R: FXD COMP 2.7 OHM 10% 1/4W             | 01121    | CB 27G1         |
| A1R125                | 0684 1011      |     | R: FXD COMP 100 OHM 10% 1/4W             | 01121    | CB 1011         |
| A1R126                | 0684 1011      |     | R: FXD COMP 100 OHM 10% 1/4W             | 01121    | CB 1011         |
| A1R127                | 0684 0271      |     | R: FXD COMP 2.7 OHM 10% 1/4W             | 01121    | CB 27G1         |
| A1R128                |                |     | DELETED                                  |          |                 |
| A1R129                | 0684 1011      |     | R: FXD COMP 100 OHM 10% 1/4W             | 01121    | CB 1011         |
| A1R130                | 0684 1011      |     | R: FXD COMP 100 OHM 10% 1/4W             | 01121    | CB 1011         |
| A1R131                | 0698 3159      |     | R: FXD MET FLM 26.1 OHM 1% 1/8W          | 28480    | 0698 3159       |
| A1R132                | 0698 7212      |     | R: FXD FLM 100 OHM 2% 1/8W               | 28480    | 0698 7212       |
| A1R133                | 0757 0441      |     | R: FXD MET FLM 8250 OHM 1% 1/8W          | 28480    | 0757 0441       |
| A1R134                | 0757 0416      |     | R: FXD MET FLM 511 OHM 1% 1/8W           | 28480    | 0757 0416       |
| A1S1                  | 3101-1662      | 3   | SWITCH: PUSHBUTTON 2 STATION EA. DPDT    | 28480    | 3101-1662       |
| A1S2                  | 3101-1665      | 1   | SWITCH: PUSHBUTTON 4 STATION EA. DPDT    | 28480    | 3101-1665       |
| A1S3                  | 3101-1662      |     | SWITCH: PUSHBUTTON 2 STATION EA. DPDT    | 28480    | 3101-1662       |
| A1S4                  | 3101-1663      | 1   | SWITCH: PUSHBUTTON 2 STATION EA. DPDT    | 71590    | PB 10           |
| A1S5                  | 3101-1664      |     | SWITCH: PUSHBUTTON SINGLE STATION DPDT   | 71590    | PB-1            |
| A1U1                  | 1858 0004      | 2   | TSTR ARRAY: SI NPN DUAL DIFF. AMPL.      | 28480    | 1858 0004       |
| A1U2                  | 1820 0806      | 2   | IC                                       | 28480    | 1820 0806       |
| A1U3                  | 1858 0004      |     | TSTR ARRAY: SI NPN DUAL DIFF. AMPL.      | 28480    | 1858 0004       |
| A1U4                  | 1820-0142      | 1   | INTEGRATED CIRCUIT: 4 INPUT 2 DR./NOR IC | 04713    | MC 1004P        |
| A1U5                  | 1820 0806      |     | IC                                       | 28480    | 1820 0806       |
| A1VR1                 | 1902 3002      | 2   | DIODE BREAKDOWN: 2.37V 5%                | 28480    | 1902-3002       |
| A1VR2                 | 1902 3094      | 3   | DIODE BREAKDOWN: 5.11V 2% 400MW          | 15818    | CD35622         |

See introduction to this section for ordering information

Table 6-2 Replaceable Parts (Cont'd)

| Reference Designation | HP Part Number | Qty | Description                           | Mfr Code | Mfr Part Number      |
|-----------------------|----------------|-----|---------------------------------------|----------|----------------------|
| A1VR3                 | 1902 3086      | 2   | DIODE BREAKDOWN: 4.75V 2%             | 28480    | 1902 3086            |
| A1VR4                 | 1902 3002      |     | DIODE BREAKDOWN: 2.37V 5%             | 28480    | 1902 3002            |
| A1VR5                 | 1902 3086      |     | DIODE BREAKDOWN: 4.75V 2%             | 28480    | 1902 3086            |
| A1VR6                 | 1902 3094      |     | DIODE BREAKDOWN: 5.11V 2% 400MW       | 15818    | CD35622              |
| A1XU2                 | 1200 0438      | 2   | SOCKET: IC 16 PIN MINIATURE           | 24995    | 583529 1             |
| A1XU4                 | 1200 0441      | 1   | SOCKET: IC 14 PIN MINIATURE           | 24995    | 583527 1             |
| A1XU5                 | 1200 0438      |     | SOCKET: IC 16 PIN MINIATURE           | 24995    | 583529 1             |
| A2                    | 01825 66502    | 1   | ASSY: MODE                            | 28480    | 01825 66502          |
| A2C1                  | 0160 3451      |     | C:FXD CER 0.01 UF +80-20% 100VDCW     | 56289    | C0238101F103Z526 CDH |
| A2C2                  |                |     | DELETED                               |          |                      |
| A2C3                  | 0160 0060      | 1   | C:FXD CER 3.3 0.25 PF 500VDCW         | 72982    | 301 000 C0J0 339C    |
| A2C4                  | 0160 3451      |     | C:FXD ELECT 2.2 UF 10% 20VDCW         | 56289    | C0238101F103Z525 CDH |
| A2C5                  | 0160 2247      | 1   | C:FXD CER 3.0 PF 500VDCW              | 72982    | 301 NPO 3.0 PF       |
| A2C6                  | 0160 3451      |     | C:FXD CER 0.01 UF +80-20% 100VDCW     | 56289    | C0238101F103Z525 CDH |
| A2C7                  | 0160 0134      | 1   | C:FXD MICA 220 PF 5% 300VDCW          | 14655    | HDM16F221J3C         |
| A2C8                  | 0160 2257      |     | C:FXD CER 10 PF 5% 500VDCW            | 72982    | 301 000 C0H0 109J    |
| A2C9                  | 0160 3451      |     | C:FXD CER 0.01 UF +80-20% 100VDCW     | 56289    | C0238101F103Z525 CDH |
| A2C10                 | 0160 3451      |     | C:FXD CER 0.01 UF +80-20% 100VDCW     | 56289    | C0238101F103Z525 CDH |
| A2C11                 | 0160 3451      |     | C:FXD CER 0.01 UF +80-20% 100VDCW     | 56289    | C023P101F103Z525 CD  |
| A2J1                  | 1251 3071      | 1   | 8 FEMALE RECEPTACLE                   | 28480    | 1251 3071            |
| A2P1                  | 1200 0441      |     | SOCKET: IC 14 PIN MINIATURE           | 28480    | 1200 0441            |
| A2Q1                  | 1854 0215      |     | TSTR: Si NPN                          | 80131    | 2N3904               |
| A2Q2                  | 1854 0215      |     | TSTR: Si NPN                          | 80131    | 2N3904               |
| A2Q3                  | 1854 0092      |     | TSTR: Si NPN                          | 80131    | 2N3563               |
| A2Q4                  | 1853 0015      | 1   | TSTR: Si NPN                          | 80131    | 2N3640               |
| A2R1                  | 0757 0437      |     | R:FXD MET FLM 4750 OHM 1% 1/8W        | 28480    | 0757 0437            |
| A2R2                  | 0757 0422      |     | R:FXD MET FLM 909 OHM 1% 1/8W         | 28480    | 075 422              |
| A2R3                  | 0757 0415      |     | R:FXD MET FLM 475 OHM 1% 1/8W         | 28480    | 0757 0415            |
| A2R4                  |                |     | NOT ASSIGNED                          |          |                      |
| A2R5                  | 0757 0487      |     | R:FXD MET FLM 825K OHM 1% 1/8W        | 28480    | 0757 0487            |
| A2R6                  | 0684 4721      | 4   | R:FXD COMP 4700 OHM 10% 1/4W          | 01121    | CB 4721              |
| A2R7                  | 0698 8198      | 2   | R:FXD MET FLM 1.58M OHM 1% 1/8W       | 28480    | 0698 8198            |
| A2R8                  | 0757 0473      | 2   | R:FXD MET FLM 221K OHM 1% 1/8W        | 28480    | 0757 0473            |
| A2R9                  | 0683 1555      | 2   | R:FXD COMP 1.5 MEGOHM 5% 1/4W         | 01121    | CB 1555              |
| A2R10                 |                |     | NOT ASSIGNED                          |          |                      |
| A2R11                 | 0757 0438      |     | R:FXD MET FLM 5.11K OHM 1% 1/8W       | 28480    | 0757 0438            |
| A2R12                 | 0757 0278      | 1   | R:FXD MET FLM 1.78K OHM 1% 1/8W       | 28480    | 0757 0278            |
| A2R13                 | 0684 4721      |     | R:FXD COMP 4700 OHM 10% 1/4W          | 01121    | CB 4721              |
| A2R14                 | 0684 1031      |     | R:FXD COMP 10K OHM 10% 1/4W           | 01121    | CB 1031              |
| A2R15                 | 0698 8198      |     | R:FXD MET FLM 1.58M OHM 1% 1/8W       | 28480    | 0698 8198            |
| A2R16                 | 0684 4721      |     | R:FXD COMP 4700 OHM 10% 1/4W          | 01121    | CB 4721              |
| A2R17                 | 0757 0473      |     | R:FXD MET FLM 221K OHM 1% 1/8W        | 28480    | 0757 0473            |
| A2R18                 | 0757 0487      |     | R:FXD MET FLM 825K OHM 1% 1/8W        | 28480    | 0757 0487            |
| A2R19                 | 0683 1555      |     | R:FXD COMP 1.5 MEGOHM 5% 1/4W         | 01121    | CB 1555              |
| A2R20                 | 0757 0437      |     | R:FXD MET FLM 4750 OHM 1% 1/8W        | 28480    | 0757 0437            |
| A2R21                 | 0757 0415      |     | R:FXD MET FLM 475 OHM 1% 1/8W         | 28480    | 0757 0415            |
| A2R22                 | 0757 0422      |     | R:FXD MET FLM 909 OHM 1% 1/8W         | 28480    | 0757 0422            |
| A2R23                 | 0757 0402      | 1   | R:FXD MET FLM 110 OHM 1% 1/8W         | 28480    | 0757 0402            |
| A2R24                 | 0757 0420      |     | R:FXD MET FLM 750 OHM 1% 1/8W         | 28480    | 0757 0420            |
| A2R25                 | 0675 1011      |     | R:FXD COMP 100 OHM 10% 1/8W           | 01121    | BB 1011              |
| A2R26                 | 0757 0408      |     | R:FXD MET FLM 243 OHM 1% 1/8W         | 28480    | 0757 0408            |
| A2R27                 | 0757 0446      | 1   | R:FXD MET FLM 15.0K OHM 1% 1/8W       | 28480    | 0757 0446            |
| A2R28                 | 0687 4711      | 1   | R:FXD COMP 470 OHM 10% 1/2W           | 01121    | EB 4711              |
| A2R29                 | 0687 2221      | 1   | R:FXD COMP 2200 OHM 10% 1/2W          | 01121    | EB 2221              |
| A2R30                 | 0684 6801      | 1   | R:FXD COMP 68 OHM 10% 1/4W            | 01121    | CB 6801              |
| A2R31                 | 0684 2221      |     | R:FXD COMP 2200 OHM 10% 1/4W          | 01121    | CB 2221              |
| A2R32                 | 0684 1211      | 1   | R:FXD COMP 120 OHM 10% 1/4W           | 01121    | CB 1211              |
| A2R33                 | 0684 6801      |     | R:FXD COMP 68 OHM 10% 1/4W            | 01121    | CB 6801              |
| A2R34                 | 0684 1011      |     | R:FXD COMP 100 OHM 10% 1/4W           | 01121    | CB 1011              |
| A2R35                 | 0684 6801      |     | R:FXD COMP 68 OHM 10% 1/4W            | 01121    | CB 6801              |
| A2S1                  | 3101 0535      | 2   | SWITCH: PUSHBUTTON 2P SINGLE STATION  | 28480    | 3101 0535            |
| A2S2                  | 3101 1516      | 1   | SWITCH: PUSHBUTTON 3 SECTION          | 28480    | 31 31 1516           |
| A2S3                  | 3101 0535      |     | SWITCH: PUSHBUTTON 2P SINGLE STATION  | 28480    | 3101 0535            |
| A2U1                  | 0160 3557      | 2   | IC: LINEAR OP. AMPL.                  | 07263    | U5B7776J33           |
| A2U2                  | 1826 0086      |     | IC: LINEAR OP. AMPL.                  | 07263    | U5B7776J33           |
| A2VR1                 | 1902 3059      | 1   | DIODE BREAKDOWN SILICON 3.83V 5%      | 26480    | 1902 3059            |
| A2VR2                 | 1902 0041      |     | DIODE BREAKDOWN 5.11V 5%              | 04713    | 5210939 98           |
| A2XU1                 | 1200 0763      |     | SOCKET: IC 8 PIN FOR T05 CASE         | 71785    | 133 98 92 061        |
| A2XU2                 | 1200 0763      |     | SOCKET: IC 8 PIN FOR T05 CASE         | 71785    | 133 98 92 061        |
| A3                    | 01825 66503    | 1   | ASSY: DISPLAY SWITCH                  | 28480    | 01825 66503          |
| A3R1                  | 2100 3123      | 1   | R:VAR CERMET 500 OHM 10% TYPE P 3/4W  | 28480    | 2100 3123            |
| A3S1                  | 3101 1666      | 1   | SWITCH: PUSHBUTTON 2 STATION EA. 6PDT | 28480    | 3101 1666            |
| A4                    | 01825 66511    | 1   | ASSY: DELAYED SWITCH                  | 28480    | 01825 66511          |
| A4C1                  | 0160 3557      |     | C:FXD CER 0.01 UF 20% 200VDCW         | 28480    | 0160 3557            |
| A4C2                  | 0160 3987      | 2   | C:FXD MICA 82 PF 5%                   | 28480    | 0160 3987            |
| A4C3                  | 0121 0495      | 2   | C:VAR 18-15.7 PF                      | 74970    | 187 0309 105         |
| A4C4                  | 0160 3541      | 2   | C:FXD POLY 0.01 UF 5% 100VDCW         | 84411    | HEW 192              |
| A4C5                  | 0160 3324      | 2   | C:FXD MET POLY 1.0 UF 5% 100VDCW      | 84411    | HEW 249              |
| A4CR1                 | 1901 0040      |     | DIODE: SILICON 30MA 30WV              | 07263    | FDG1088              |
| A4CR2                 | 1901 0040      |     | DIODE: SILICON 30MA 30WV              | 07263    | FDG1088              |
| A4CR3                 | 1901 0040      |     | DIODE: SILICON 30MA 30WV              | 07263    | FDG1088              |
| A4CR4                 | 1901 0040      |     | DIODE: SILICON 30MA 30WV              | 07263    | FDG1088              |
| A4CR5                 | 1901 0040      |     | DIODE: SILICON 30MA 30WV              | 07263    | FDG1088              |

See Introduction to this section for ordering information

Table 6-2 Replaceable Parts (Cont'd)

| Reference Designation | HP Part Number | Qty | Description   | Mfr Code | Mfr Part Number         |
|-----------------------|----------------|-----|---|----------|-------------------------|
| A4CR6                 | 1901 0040      |     | DIODE SILICON 30MA 30V                                  | 07263    | FDG1088                 |
| A4L1                  | 0170 0029      |     | CORE FERRITE BEAD                                       | 02114    | 56 600 65/30            |
| A4Q1                  | 1853 0036      | 2   | TSTR SI PNP   | 80131    | 2N3906                  |
| A4R1                  | 0684 2211      | 4   | R:FXD COMP 220 OHM 10% 1/4W                             | 01121    | CB 2211                 |
| A4R2                  | 2100 3161      | 5   | R:VAR CERMET 20K OHM 10% TYPE P 3/4W                    | 28480    | 2100 3161               |
| A4R3                  | 0757 0060      | 1   | R:FXD MET FLM 24.3K OHM 1% 1/2W                         | 28480    | 0757 0060               |
| A4R4                  | 2100 3161      |     | R:VAR CERMET 20K OHM 10% TYPE P 3/4W                    | 28480    | 2100 3161               |
| A4R5                  | 0757 0442      | 6   | R:FXD MET FLM 100K OHM 1% 1/8W                          | 28480    | 0757 0442               |
| A4R6                  | 0757 0442      |     | R:FXD MET FLM 100K OHM 1% 1/8W                          | 28480    | 0757 0442               |
| A4R7                  | 0684 2211      |     | R:FXD COMP 220 OHM 10% 1/4W                             | 01121    | CB 2211                 |
| A4R8                  | 0698 8149      | 2   | R:FXD FLM 40K OHM 0.1% 1/4W                             | 28480    | 0698 8149               |
| A4R9                  | 0698 8147      | 2   | R:FXD FLM 80K OHM 0.1% 1/8W                             | 28480    | 0698 8147               |
| A4T10                 | 0698 8146      | 2   | R:FXD FLM 160K OHM 0.1% 1/8W                            | 28480    | 0698 8146               |
| A4R11                 | 0698 5171      | 2   | R:FXD FLM 400K OHM 0.1% 1/8W                            | 28480    | 0698 5171               |
| A4R12                 | 0698 8159      | 2   | R:FXD FLM 800K OHM 0.1% 1/4W                            | 28480    | 0698 8159               |
| A4R13                 | 0698 8141      | 2   | R:FXD MET FLM 1.6MEJOHM 0.1% 1/2W                       | 28480    | 0698 8141               |
| A4R14                 | 0607 1801      | 1   | R:FXD COMP 18 OHM 10% 1/2W                              | 01121    | EB 1801                 |
| A4R15                 | 0757 0093      | 1   | R:FXD COMP 33K OHM 5% 1/2W                              | 01121    | EB 3935                 |
| A4S1                  |                |     | CONSISTS OF MP22, MP24, MP26 AND PLATED CONTACTS ON A4. |          |                         |
| A5                    | 01825 66505    | 1   | ASSY: DELAYED SWEET COMPONENTS                          | 28480    | 01825 66505             |
| A5C1                  |                |     | NOT ASSIGNED  |          |                         |
| A5C2                  | 0160 2261      | 2   | C:FXD CER 15 PF 5% 500VDCW                              | 72982    | 301 NPO 15 PF           |
| A5C3                  | 0160 2204      | 1   | C:FXD MICA 100 PF 5%                                    | 72982    | RDM15F 101JJC           |
| A5C4                  | 0160 3451      |     | C:FXD CER 0.01 UF +80-20% 100VDCW                       | 56289    | C0238 101F 103Z525 CDH  |
| A5C5                  | 0160 0115      | 1   | C:FXD CER 27 PF 10% 500VDCW                             | 72982    | 301 000 U2J0 270K       |
| A5C                   | 0160 2207      |     | C:FXD MICA 300 PF +5% 300VDCW                           | 28480    | 0160 2207               |
| A5C7                  | 0180 0197      |     | C:FXD ELECT 2.2 UF 10% 20VDCW                           | 56289    | 1500 225X0020A2 DYS     |
| A5C8                  | 0180 0197      |     | C:FXD ELECT 2.2 UF 10% 20VDCW                           | 56289    | +C0238 101F 103Z525 CDH |
| A5C9                  | 0160 0168      |     | C:FXD MY 0.1 UF 10% 200VDCW                             | 56289    | 182P10492 P15           |
| A5C10                 | 0160 3557      |     | C:FXD CER 0.01 UF 20% 200VDCW                           | 28480    | 0160 3557               |
| A5C11                 | 0160 3557      |     | C:FXD CER 0.01 UF 20% 200VDCW                           | 28480    | 0160 3557               |
| A5C12                 | 0160 3557      |     | C:FXD CER 0.01 UF 20% 200VDCW                           | 28480    | 0160 3557               |
| A5CR1                 | 1901 0040      |     | DIODE SILICON 30MA 30V                                  | 07263    | FDG 1088                |
| A5CR2                 | 1901 0040      |     | DIODE SILICON 30MA 30V                                  | 07263    | FDG 1088                |
| A5CR3                 | 1901 0040      |     | DIODE SILICON 30MA 30V                                  | 07263    | FDG 1088                |
| A5CR4                 | 1901 0040      |     | DIODE SILICON 30MA 30V                                  | 07263    | FDG 1088                |
| A5CRE                 | 1901 0040      |     | DIODE SILICON 30MA 30V                                  | 07263    | FDG 1088                |
| A5CR6                 | 1901 0040      |     | DIODE SILICON 30MA 30V                                  | 07263    | FDG 1088                |
| A5CR7                 | 1901 0040      |     | DIODE SILICON 30MA 30V                                  | 07263    | FDG 1088                |
| A5L1                  | 0140 0114      |     | COIL:FXD RF CHOKE 10 UH 10%                             | 24226    | 15/102                  |
| A5Q1                  | 1554 0215      |     | TSTR SI NPN   | 80131    | 2N3904                  |
| A5Q2                  | 1554 0215      |     | TSTR SI NPN   | 80131    | 2N3904                  |
| A5Q3                  | 1554 0215      |     | TSTR SI NPN   | 80131    | 2N3904                  |
| A5Q4                  | 1853 0086      | 1   | TSTR SI PNP   | 80131    | 2N5087                  |
| A5Q5                  | 1854 0215      |     | TSTR SI PNP   | 80131    | 2N3904                  |
| A5Q6                  | 1853 0086      |     | TSTR SI PNP   | 80131    | 2N5087                  |
| A5Q7                  | 1853 0086      |     | TSTR SI PNP   | 80131    | 2N5087                  |
| A5Q8                  | 1854 0691      |     | TSTR SI NPN   | 28480    | 1854 0691               |
| A5Q9                  | 1854 0691      |     | TSTR SI NPN   | 28480    | 1854 0691               |
| A5Q10                 | 1853 0244      | 2   | TSTR SI PNP   | 28480    | 1853 0244               |
| A5Q11                 | 1853 0086      |     | TSTR SI PNP   | 80131    | 2N5087                  |
| A5R1                  | 0757 0650      | 1   | R:FXD MET FLM 39.2K OHM 1.0% 1/2W                       | 28480    | 0757 0650               |
| A5R2                  | 0684 1021      | 3   | R:FXD COMP 100K OHM 10% 1/4W                            | 01121    | CB 1021                 |
| A5R3                  | 0757 0283      |     | R:FXD MET FLM 9.09K OHM 1% 1/8W                         | 28480    | 0757 0283               |
| A5R4                  | 0757 0466      | 1   | R:FXD MET FLM 110K OHM 1% 1/8W                          | 28480    | 0757 0466               |
| A5R5                  | 0757 0848      | 1   | R:FXD MET FLM 22.1K OHM 1.0% 1/2W                       | 28480    | 0757 0848               |
| A5R6                  | 0684 4721      |     | R:FXD COMP 4700 OHM 10% 1/4W                            | 01121    | CB 4721                 |
| A5R7                  | 0684 1011      |     | R:FXD COMP 100 OHM 10% 1/4W                             | 01121    | CB 1011                 |
| A5R8                  | 0684 2211      |     | R:FXD COMP 220 OHM 10% 1/4W                             | 01121    | CB 2211                 |
| A5R9                  |                |     | NOT ASSIGNED  |          |                         |
| A5R10                 | 0757 0847      | 1   | R:FXD MET FLM 27.4K OHM 1% 1/2W                         | 28480    | 0757 0847               |
| A5R11                 | 0684 1011      |     | R:FXD COMP 100 OHM 10% 1/4W                             | 01121    | CB 1011                 |
| A5R12                 | 0684 1031      |     | R:FXD COMP 10K OHM 10% 1/4W                             | 01121    | CB 1031                 |
| A5R13                 | 0757 0283      | 4   | R:FXD MET FLM 2.00K OHM 1% 1/8W                         | 28480    | 0757 0283               |
| A5R14                 | 0757 0420      |     | R:FXD MET FLM 750 OHM 1% 1/8W                           | 28480    | 0757 0420               |
| A5R15                 | 0781 0074      | 2   | R:FXD MET OX 15K OHM 5% 1W                              | 28480    | 0781 0074               |
| A5R16                 | 0684 1011      |     | R:FXD COMP 100 OHM 10% 1/4W                             | 01121    | CB 1011                 |
| A5R17                 | 0684 2201      |     | R:FXD COMP 22 OHM 10% 1/4W                              | 01121    | CB 2201                 |
| A5R18                 | 0757 0283      |     | R:FXD MET FLM 2.00K OHM 1% 1/8W                         | 28480    | 0757 0283               |
| A5R19                 | 0757 0416      |     | R:FXD MET FLM 511 OHM 1% 1/8W                           | 28480    | 0757 0416               |
| A5R20                 | 0757 0438      |     | R:FXD MET FLM 5.11K OHM 1% 1/8W                         | 28480    | 0757 0438               |
| A5R21                 | 0684 1011      |     | R:FXD COMP 100 OHM 10% 1/4W                             | 01121    | CB 1011                 |
| A5R22                 | 0684 1011      |     | R:FXD COMP 100 OHM 10% 1/4W                             | 01121    | CB 1011                 |
| A5R23                 | 0684 1001      |     | R:FXD COMP 10 OHM 10% 1/4W                              | 01121    | CB 1001                 |
| A5R24                 | 0684 1001      | 3   | R:FXD COMP 10 OHM 10% 1/4W                              | 01121    | CB 1001                 |
| A5R25                 | 0684 1011      |     | R:FXD COMP 100 OHM 10% 1/4W                             | 01121    | CB 1011                 |
| A5R26                 | 0684 1011      |     | R:FXD COMP 100 OHM 10% 1/4W                             | 01121    | CB 1011                 |
| A5R27                 | 0757 0404      | 1   | R:FXD FLM 130 OHM 1% 1/8W                               | 28480    | 0757 0404               |
| A6                    | 01824 66506    |     | ASSY: VERTICAL CONNECTOR                                | 28480    | 01824 66506             |
| A6C1                  | 0160 3451      |     | C:FXD CER 0.01 UF +80-20% 100VDCW                       | 56289    | C0238 101F 103Z525 CDH  |

See introduction to this section for ordering information

Table 6-2 Replaceable Parts (Cont'd)

| Reference Designation | HP Part Number | Qty | Description                          | Mfr Code | Mfr Part Number      |
|-----------------------|----------------|-----|--------------------------------------|----------|----------------------|
| A6C2                  | 0160 3451      | 1   | C:FXD CER 0.01 UF +80-20% 100VDCW    | 56289    | C0238101F103Z525 CDH |
| A6J1                  | 1251 0954      | 1   | CONNECTOR, FEMALE 24 CONTACT         | 28480    | 1251 0064            |
| A6J2                  | 1200 0441      | 2   | SOCKET, IC 14 PIN MINIATURE          | 28480    | 1200 0441            |
| A6L1                  | 0140 0115      | 1   | COIL:FXD RF 22 UH 10%                | 09800    | 2160 32              |
| A6L2                  | 0140 0115      | 1   | COIL:FXD RF 22 UH 10%                | 09800    | 2160 32              |
| A7                    | 01825 66607    | 2   | ASSY-MAIN SWEEP COMPONENTS 1         | 28480    | 01825 66607          |
| A7C1                  | 0160 3451      | 1   | C:FXD CER 0.01 UF +80-20% 100VDCW    | 56289    | C0238101F103Z525 CDH |
| A7C2                  | 0160 2261      | 1   | C:FXD CER 15 PF 5% 500VDCW           | 72982    | 301 NPO 15 PF        |
| A7C3                  | 0160 2160      | 1   | C:FXD MICA 33 PF 5%                  | 28480    | 0160 2160            |
| A7C4                  | 0160 3567      | 1   | C:FXD CER 0.01 UF 20% 200VDCW        | 28480    | 0160 3567            |
| A7C5                  | 0160 3451      | 1   | C:FXD CER 0.01 UF +80-20% 100VDCW    | 56289    | C0238101F103Z525 CDH |
| A7C6                  | 0160 3451      | 1   | C:FXD CER 0.01 UF +80-20% 100VDCW    | 56289    | C0238101F103Z525 CDH |
| A7C7                  | 0180 0197      | 1   | C:FXD ELECT 2.2 UF 10% 20VDCW        | 56289    | 1500225X0020A2 DYS   |
| A7C8                  | 0180 0197      | 1   | C:FXD ELECT 2.2 UF 10% 20VDCW        | 56289    | 1500225X0020A2 DYS   |
| A7C9                  | 0160 0168      | 1   | C:FXD MY 0.1 UF 10% 200VDCW          | 56289    | 192P10492 PTS        |
| A7C10                 | 0160 3354      | 1   | C:FXD POLY 10 UF +5-15% 100VDCW      | 84411    | HEW 247              |
| A7CR1 thru A7CR4      | 1901 0040      | 1   | DIODE,SILICON 30 MA 30VV             | 07263    | FDG 1088             |
| A7J1                  | 1251 32 ?      | 1   | CONNECTOR, 6 PIN                     |          | 1251 3272            |
| A7Q1                  | 1853 0086      | 1   | TSTR:SI NPN                          | 80131    | 2N5087               |
| A7Q2                  | 1854 0092      | 1   | TSTR:SI NPN                          | 80131    | 2N3563               |
| A7Q3                  | 1854 0215      | 1   | TSTR:SI NPN                          | 80131    | 2N3904               |
| A7Q4                  | 1854 0215      | 1   | TSTR:SI NPN                          | 80131    | 2N3904               |
| A7Q5                  | 1854 0215      | 1   | TSTR:SI NPN                          | 80131    | 2N3904               |
| A7Q6                  | 1854 0215      | 1   | TSTR:SI NPN                          | 80131    | 2N3904               |
| A7Q7                  | 1853 0086      | 1   | TSTR:SI NPN                          | 80131    | 2N5087               |
| A7Q8                  | 1854 0215      | 1   | TSTR:SI NPN                          | 80131    | 2N3904               |
| A7Q9                  | 1853 0086      | 1   | TLTR:SI PNP                          | 80131    | 2N5087               |
| A7R1                  | 0684 3311      | 1   | R:FXD COMP 330 OHM 10% 1/4W          | 01121    | CB 3311              |
| A7R2                  | 0684 2221      | 1   | R:FXD COMP 2200 OHM 10% 1/4W         | 01121    | CB 2221              |
| A7R3                  | 0687 1031      | 1   | R:FXD COMP 10K OHM 10% 1/2W          | 01121    | EB 1031              |
| A7R4                  | 0687 1231      | 1   | R:FXD COMP 12K OHM 10% 1/2W          | 01121    | EB 1231              |
| A7R5                  | 0684 4731      | 1   | R:FXD COMP 47K OHM 10% 1/4W          | 01121    | CB 4731              |
| A7R6                  | 0757 0438      | 1   | R:FXD MET FLM 6.1K OHM 1% 1.8W       | 28480    | 0757 0438            |
| A7R7                  | 0684 1041      | 2   | R:FXD COMP 100K OHM 10% 1/4W         | 01121    | CB 1041              |
| A7R8                  | 0684 1021      | 1   | R:FXD COMP 1000 OHM 10% 1/4W         | 01121    | CB 1021              |
| A7R9                  | 0757 0438      | 1   | R:FXD MET FLM 5.1K OHM 1% 1.8W       | 28480    | 0757 0438            |
| A7R10                 | 0757 0270      | 1   | R:FXD MET FLM 3.16K OHM 1% 1.8W      | 28480    | 0757 0270            |
| A7R11                 | 0698 8140      | 1   | R:FXD MET OX 15K OHM 2.0% 1.0W       | 28480    | 0698 8140            |
| A7R12                 | 0757 0280      | 1   | R:FXD MET FLM 1K OHM 1% 1.8W         | 28480    | 0757 0280            |
| A7R13                 | 0757 0442      | 1   | R:FXD MET FLM 10.0K OHM 1% 1.8W      | 28480    | 0757 0442            |
| A7R14                 | 0761 0076      | 1   | R:FXD MET OX 18K OHM 5% 1W           | 28480    | 0761 0076            |
| A7R15                 | 0683 1825      | 1   | R:FXD COMP 1800 OHM 5% 1/4W          | 01121    | CB 1825              |
| A7R16                 | 0684 4731      | 1   | R:FXD COMP 47K OHM 10% 1/4W          | 01121    | CB 4731              |
| A7R17                 | 0757 0476      | 1   | R:FXD MET FLM 301K OHM 1% 1.8W       | 28480    | 0757 0476            |
| A7R18                 | 0684 3921      | 2   | R:FXD COMP 3900 OHM 10% 1/4W         | 01121    | CB 3921              |
| A7R19                 | 0684 3921      | 1   | R:FXD COMP 3900 OHM 10% 1/4W         | 01121    | CB 1011              |
| A7R20                 | 0684 1011      | 1   | R:FXD COMP 100 OHM 10% 1/4W          | 01121    | CB 1021              |
| A7R21                 | 0684 1021      | 1   | R:FXD COMP 1000 OHM 10% 1/4W         | 01121    | CB 1011              |
| A7R22                 | 0684 2901      | 1   | R:FXD COMP 39 OHM 10% 1/4W           | 01121    | CB 3901              |
| A7R23                 | 0684 1011      | 1   | R:FXD COMP 100 OHM 10% 1/4W          | 01121    | CB 1011              |
| A7R24                 | 0684 3901      | 1   | R:FXD COMP 39 OHM 10% 1/4W           | 01121    | CB 3901              |
| A7R25                 | 0684 1001      | 1   | R:FXD COMP 10 OHM 10% 1/4W           | 01121    | CB 1001              |
| A7R26                 | 0684 3901      | 1   | R:FXD COMP 39 OHM 10% 1/4W           | 01121    | CB 3901              |
| AB                    | 01825 66608    | 1   | ASSY-MAIN SWEEP COMPONENTS 1         | 28480    | 01825 66608          |
| ABC1                  |                | 2   | NOT ASSIGNED                         |          |                      |
| ABC2                  |                | 1   | NOT ASSIGNED                         |          |                      |
| ABC3                  | 0121 3495      | 1   | C:VAR AIR 1.9-15.7 PF                | 74070    | 187 0309 105         |
| ABC4                  | 0140 0193      | 1   | C:FXD MICA 82 PF 5%                  | 28480    | 0140 0193            |
| ABC5                  | 0160 2020      | 1   | C:FXD MICA 810 PF 5% 100VDCW         | 00853    | RDM15F01J15          |
| ABC6                  | 0160 3541      | 1   | C:FXD POLY 0.01 UF 5% 100VDCW        | 84411    | HEW 192              |
| ABC7                  | 0160 3324      | 1   | C:FXD MET POLY 1.0 UF 5% 100VDCW     | 84411    | HEW 249              |
| ABC8                  | 0140 0207      | 1   | C:FXD MICA 330 PF 5%                 | 28480    | 0140 0207            |
| ABC9                  | 0160 0157      | 1   | C:FXD MY 0.0047 UF 10% 200VDCW       | 56289    | 192P47292 PTS        |
| ABC10                 | 0160 0163      | 1   | C:FXD MY 0.033 UF 10% 200VDCW        | 56289    | 192P33392 PTS        |
| ABC11                 | 0180 0195      | 1   | C:FXD ELECT 0.33 UF 20% 35VDCW       | 56289    | 1500334X0035A2 DYS   |
| ABC12                 | 0180 0378      | 1   | C:FXD ELECT 0.47 UF 10% 35VDCW       | 56289    | 1500474X9035A2 DYS   |
| ABC13                 | 0180 0100      | 1   | C:FXD ELECT 4.7 UF 10% 35VDCW        | 56289    | 1500475X9035B2 DYS   |
| ABCR1                 | 0180 0228      | 1   | C:FXD ELECT 22 UF 10% 15VDCW         | 56289    | 1500226X9015B2 DYS   |
| ABCR2                 | 0140 0203      | 1   | C:FXD MICA 30 PF 5%                  | 28480    | 0140 0203            |
| ABCR3                 | 1901 0040      | 1   | DIODE,SILICON 30MA 30VV              | 07263    | FDG 1088             |
| ABCR4                 | 1901 0040      | 1   | DIODE,SILICON 30MA 30VV              | 07263    | FDG 1088             |
| ABCR5                 | 1901 0040      | 1   | DIODE,SILICON 30MA 30VV              | 07263    | FDG 1088             |
| ABCR6                 | 1901 0040      | 1   | DIODE,SILICON 30MA 30VV              | 07263    | FDG 1088             |
| ABCR7                 | 1901 0033      | 1   | DIODE,SILICON 180VW                  | 07263    | FD 3369              |
| ABCR8                 | 1901 0045      | 1   | DIODE,SILICON 0.75A 100PIV           | 04713    | SR 1258 7            |
| ABL1                  | 8170 0029      | 1   | CORE:FERRITE BEAD                    | 07114    | 56 590 65-3B         |
| ABR1                  | 2100 3161      | 1   | R:VAR CERMET 20K OHM 10% TYPE P 1.4W | 28480    | 2100 3161            |
| ABR2                  | 0757 0843      | 1   | R:FXD MET FLM 15.0K OHM 1% 1/2W      | 28480    | 0757 0843            |

See introduction to this section for ordering information

Table 6-2 Replaceable Parts (Cont'd)

| Reference Designation | HP Part Number | Qty | Description  | Mfr Code | Mfr Part Number        |
|-----------------------|----------------|-----|--|----------|------------------------|
| ABR3                  | 2100 3161      |     | R:VAR CERMET 20K OHM 10% TYPE P 3/4W   | 28480    | 2100 3161              |
| ABR4                  | 2100 3161      |     | R:VAR CERMET 20K OHM 10% TYPE P 3/4W   | 28480    | 2100 3161              |
| ABR5                  | 0757 0442      |     | R:FXD MET FLM 100K OHM 1% 1/8W   | 28480    | 0757 0442              |
| ABR6                  | 0757 0442      |     | R:FXD MET FLM 100K OHM 1% 1/8W   | 28480    | 0757 0442              |
| ABR7                  | 0698 P         |     | R:FXD FLM 40K OHM 0.1% 1/4W  | 28480    | 0698 8149              |
| ABR8                  | 0698 8147      |     | R:FXD FLM 60K OHM 0.1% 1/8W  | 28480    | 0698 8147              |
| ABR9                  | 0698 8146      |     | R:FXD FLM 160K OHM 0.1% 1/8W   | 28480    | 0698 8146              |
| ABR10                 | 0698 5171      |     | R:FXD FLM 400K OHM 0.1% 1/8W   | 28480    | 0698 5171              |
| ABR11                 | 0698 8159      |     | R:FXD FLM 800K OHM 0.1% 1/4W   | 28480    | 0698 8159              |
| ABR12                 | 0698 8141      |     | R:FXD MET FLM 1.6 MEGOHM 0.1% 1/2W   | 28480    | 0698 8141              |
| ABR13                 | 0698 8142      | 2   | R:FXD MET FLM 4 MEGOHM 0.25% 1/2W  | 28480    | 0698 8142              |
| ABR14                 | 0698 8142      |     | R:FXD MET FLM 4 MEGOHM 0.25% 1/2W  | 28480    | 0698 8142              |
| ABR15                 | 0687 2231      |     | R:FXD COMP 22K OHM 10% 1/2W  | 01121    | CB 2231                |
| ABR16                 | 2100 3161      |     | R:VAR CERMET 20K OHM 10% TYPE P 3/4W CONSISTS OF MP21, MP25, MP27, AND PLATED CONTACTS ON AB | 28480    | 2100 3161              |
| ABU1                  | 1902 0203      |     | IC:OPERATIONAL AMPLIFIER   | 07263    | SL2740                 |
| ABVR1                 | 1902 0782      | 1   | DIODE: BREAKDOWN 30.1V 1W  | 28480    | 1902 0782              |
| ABVR2                 | 1902 3139      | 2   | DIODE: BREAKDOWN 8.25V 5%  | 04713    | S210930 158            |
| A9                    | 01825 66509    | 1   | ASSY: MAIN SWEEP COMPONENTS 2  | 28480    | 01825 66509            |
| ABC1                  | 0160 2261      | 1   | C:FXD CER 15 PF 5% 500VDCW   | 72902    | 301 NPO 15 PF          |
| ABC2                  | 0160 2207      | 1   | C:FXD MICA 300 PF 5%   | 28480    | 0160 2207              |
| ABC3                  | 0160 3451      |     | C:FXD CER 0.01 UF +80-20% 100VDCW  | 56289    | C0218101F1032525 CDH   |
| ABC4                  | 0180 0374      | 1   | C:FXD TANT. 10 UF 10% 20VDCW   | 56289    | TANT 10UF10%20VDCW DYS |
| ABC5                  | 0160 0168      |     | C:FXD MY 0.1 UF 10% 200VDCW  | 56289    | 1U2P10402 P15          |
| ABC6                  | 0160 3451      |     | C:FXD CER 0.01 UF +80-20% 100VDCW  | 56289    | C0239101F1032525 CDH   |
| ABC7                  | 0180 0049      |     | C:FXD ELECT 20 UF +75-10% 50VLCW   | 56289    | 3200206G060CC2 DSM     |
| ABC8                  | 0180 0059      | 1   | C:FXD ELECT 10 UF +75-10% 25VLCW   | 28480    | 0180 0059              |
| ABC9                  | 0180 0107      |     | C:FXD ELECT 2.2 UF 10% 20VDCW  | 56289    | 1500225X0020A2 DYS     |
| ABC10                 | 0160 3451      |     | C:FXD CER 0.01 UF +80-20% 100VDCW  | 56289    | C0239101F1032525 CDH   |
| ABC11                 | 0160 3567      |     | C:FXD CER 0.01 UF 20% 200VDCW  | 28480    | 0160 3567              |
| ABC12                 | 0180 0091      | 1   | C:FXD ELECT 10 UF +50-10% 100VDCW  | 56289    | 30D106F1000C2 DSM      |
| ABC13                 | 0180 0107      |     | C:FXD TA 2.2 UF 10% 20VDCW   | 56289    | 1500225X0020A2 DYS     |
| ABCR1                 | 1906 0042      | 1   | DIODE: DUAL SI, COMMON ANODE   | 28480    | 1906 0042              |
| ABCR2                 | 1901 0040      |     | DIODE: SILICON 30MA 30MV   | 07263    | FDG 1088               |
| ABCR3                 | 1901 0040      |     | DIODE: SILICON 30MA 30MV   | 07263    | FDG 1088               |
| ABCR4                 | 1901 0613      | 1   | DIODE: SILICON DUAL 100VV  | 04713    | SSD 101                |
| A9Q1                  | 1853 0086      |     | TSTR: SI PNP   | 80131    | 2N5087                 |
| A9Q2                  | 1853 0316      | 1   | TSTR: SI PNP (MATCHED PAIR) N CHANNEL  | 28480    | 1853 0316              |
| A9Q3                  | 1853 0244      |     | TSTR: SI PNP   | 28480    | 1853 0244              |
| A9Q4                  | 1854 C691      |     | TSTR: SI PNP   | 28480    | 1854 0691              |
| A9Q5                  | 1854 0691      |     | TSTR: SI PNP   | 28480    | 1854 0691              |
| A9Q6                  | 1853 0086      |     | TSTR: SI PNP   | 80131    | 2N5087                 |
| A9Q7                  | 1854 0215      |     | TSTR: SI PNP   | 80131    | 2N3904                 |
| A9R1                  | 0761 0074      |     | R:FXD MET OX 15K OHM 5% 1W   | 28480    | 0761 0074              |
| A9R2                  | 0757 0769      |     | R:FXD FLM 51.1 OHM 1% 1/4W   | 28480    | 0757 0769              |
| A9R3                  | 0757 0283      |     | R:FXD MET FLM 2.00K OHM 1% 1/8W  | 28480    | 0757 0283              |
| A9R4                  | 0684 1221      | 1   | R:FXD COMP 1.2K OHM 10% 1/4W   | 01121    | CB 1221                |
| A9R5                  | 0684 1011      |     | R:FXD COMP 100 OHM 10% 1/4W  | 01121    | CB 1011                |
| A9R6                  | 0757 0416      |     | R:FXD MET FLM 511 OHM 1% 1/8W  | 28480    | 0757 0416              |
| A9R7                  | 0757 0283      |     | R:FXD MET FLM 2.00K OHM 1% 1/8W  | 28480    | 0757 0283              |
| A9R8                  | 0684 2201      |     | R:FXD COMP 22 OHM 10% 1/4W   | 01121    | CB 2201                |
| A9R9                  | 0757 0404      | 1   | R:FXD FLM 130 OHM 1% 1/8W  | 28480    | 0757 0404              |
| A9R10                 | 0757 0465      |     | R:FXD MET FLM 100K OHM 1% 1/8W   | 28480    | 0757 0465              |
| A9R11                 | 0757 0290      |     | R:FXD MET FLM 8.19K OHM 1% 1/8W  | 28480    | 0757 0290              |
| A9R12                 | 0684 1061      |     | R:FXD COMP 10 MEGOHM 10% 1/4W  | 01121    | CB 1061                |
| A9R13                 | 0684 1001      |     | R:FXD COMP 10 OHM 10% 1/4W   | 01121    | CB 1001                |
| A9R14                 | 0761 0073      | 1   | R:FXD MET OX 13K OHM 5% 1W   | 28480    | 0761 0073              |
| A9R15                 | 0684 1011      |     | R:FXD COMP 100 OHM 10% 1/4W  | 01121    | CB 1011                |
| A9R16                 | 0684 2721      |     | R:FXD COMP 2700 OHM 10% 1/4W   | 01121    | CB 2721                |
| A9R17                 | 0757 1094      | 1   | R:FXD MET FLM 1.47K OHM 1% 1/8W  | 28480    | 0757 1094              |
| A9R18                 | 0684 4751      | 1   | R:FXD COMP 4.7 MEGOHM 10% 1/4W   | 01121    | CB 4751                |
| A9R19                 | 0684 4731      |     | R:FXD COMP 47K OHM 10% 1/4W  | 01121    | CB 4731                |
| A9R20                 | 0684 1011      |     | R:FXD COMP 100 OHM 10% 1/4W  | 01121    | CB 1011                |
| A9R21                 | 0684 1041      |     | R:FXD COMP 100K OHM 10% 1/4W   | 01121    | CB 1041                |
| A9R22                 | 0757 0769      | 1   | R:FXD FLM 51.1K OHM 1% 1/4W  | 28480    | 0757 0769              |
| A9R23                 | 0757 0280      |     | R:FXD MET FLM 1K OHM 1% 1/8W   | 28480    | 0757 0280              |
| A9R24                 | 0757 0442      |     | R:FXD MET FLM 10K OHM 1% 1/8W  | 28480    | 0757 0442              |
| A9R25                 | 0684 1011      |     | R:FXD COMP 100 OHM 10% 1/4W  | 01121    | CB 1011                |
| A9R26                 | 0757 0401      | 1   | R:FXD MET FLM 100 OHM 1% 1/8W  | 28480    | 0757 0401              |
| A9R27                 | 0757 0429      | 1   | R:FXD MET FLM 1.82K OHM 1% 1/8W  | 28480    | 0757 0429              |
| A9R28                 | 0757 0407      | 1   | R:FXD MET FLM 200 OHM 1% 1/8W  | 28480    | 0757 0407              |
| A9R29                 | 0698 3443      | 1   | R:FXD MET FLM 287 OHM 1% 1/8W  | 28480    | 0698 3443              |
| A9R30                 | 0684 1011      |     | R:FXD COMP 100 OHM 10% 1/4W  | 01121    | CB 1011                |
| A9R31                 | 0696 3419      | 1   | R:FXD MET FLM 31.6K OHM 1% 1/2W  | 28480    | 0696 3419              |
| A9R32                 | 0684 2721      |     | R:FXD COMP 2700 OHM 10% 1/4W   | 01121    | CB 2721                |
| A9R33                 | 0684 3001      |     | R:FXD COMP 30 OHM 10% 1/4W   | 01121    | CB 3001                |
| A9R34                 | 0684 1011      |     | R:FXD COMP 100 OHM 10% 1/4W  | 01121    | CB 1011                |
| A9R35                 | 0684 1011      |     | R:FXD COMP 100 OHM 10% 1/4W  | 01121    | CB 1011                |
| A9R36                 | 0684 1011      |     | R:FXD COMP 100 OHM 10% 1/4W  | 01121    | CB 1011                |
| A9R37                 | 0757 0724      | 1   | R:FXD FLM 392 OHM 1% 1/4W  | 28480    | 0757 0724              |

See introduction to this section for ordering information

Table 6-2 Replaceable Parts (Cont'd)

| Reference Designation                   | HP Part Number  | Qty | Description   | Mfr Code                                  | Mfr Part Number  |
|---|---|-----|---|---|--|
| A9R3R<br>A9R3S<br>A9U1<br>A9U2<br>A9U3  | 0608 4708<br>0684 2211<br>1826 0086<br>1821 0002<br>1820 0203   | 1   | R.FXD MET FLM 487K 1% 1/4W<br>R.FXD COMP 220 OHM 10% 1/4W<br>IC LINEAR OP. AMPL.<br>TRANSISTOR ARRAY: 51 NPN<br>IC OPERATIONAL AMPLIFIER                  | 28480<br>01121<br>02763<br>02735<br>02763 | 0608 4708<br>CB 2211<br>U5B7776.203<br>CA 045<br>SLC3 0                    |
| A10<br>A10C1<br>A10J1<br>A10P1<br>A10R1 | 01824 66607<br>0160 3451<br>1200 0441<br>1251 0135<br>0687 3951 | 1   | ASSY MAINFRAME CONNECTOR<br>C.FXD CER 0.01 UF +80 -20% 100VDCW<br>SOCKET: IC 14 PIN MINIATURE<br>CONNECTOR: 32 PIN MALE<br>R.FXD COMP 3.9 MEGOHM 10% 1/2W | 28480<br>56289<br>28480<br>02660<br>01121 | 01824 66607<br>C0238101F1032526 CDH<br>1200 0441<br>26 4100 32P<br>EB 3951 |
| A10R2                                   | 0608 3152   | 1   | R.FXD MET FLM 3.48K OHM 1% 1.8W   | 28480                                     | 0608 3152  |

Table 6-3. List of Manufacturers' Codes

| MFR NO | MANUFACTURER NAME  | ADDRESS                | ZIP CODE |
|--------|--|------------------------|----------|
| 00000  | U.S.A. COMMON  | ANY SUPPLIER OF U.S.A. |          |
| 00853  | SANGAMO ELECTRIC CO. PICKENS DIV.                        | PICKENS, S.C.          | 29671    |
| 01121  | ALLEN BRADLEY CO.  | MILWAUKEE, WI.         | 53204    |
| 02114  | FERROXCUBE CORP.   | SAUGERTIES, N.Y.       | 12477    |
| 02660  | AMPHENOL CO. CONNECTOR DIV.                              | BROADVIEW, IL.         | 60163    |
| 02735  | RADIO CORP. OF AMERICA, SEMICONDUCTOR AND MATERIALS DIV. | SOMERVILLE, N.J.       | 08876    |
| 04713  | MOTOROLA SEMICONDUCTOR PROD. INC.                        | PHOENIX, AZ.           | 85008    |
| 07263  | FAIRCHILD CAMERA & INST. CORP. SEMICONDUCTOR DIV.        | MOUNTAIN VIEW, CA.     | 94040    |
| 08806  | GENERAL ELECTRIC CO. MINIAT. LAMP DEPT.                  | CLEVELAND, OH.         | 44117    |
| 14657  | CORNELL DUBLIER ELECT. DIV. FEDERAL PACIFIC ELECT. CO.   | NEWARK, N.J.           | 07105    |
| 2487   | SPECIALTY CONNECTOR CO. INC.                             | INDIANAPOLIS, IN.      | 46227    |
| 28480  | HEWLETT PACKARD COMPANY                                  | PALO ALTO, CA.         | 94304    |
| 56289  | SPRAGUE ELECTRIC CO.                                     | N. ADAMS, MA.          | 01247    |
| 71690  | GLOBE UNION INC. CENTRAL LAB DIV.                        | MILWAUKEE, WI.         | 53201    |
| 72136  | ELECTRO MOTIVE MFG. CO. INC.                             | WILLIMANTIC, CT.       | 06276    |
| 72962  | ERIE TECHNOLOGICAL PROD. INC.                            | ERIE, PA.              | 16512    |
| 74970  | JOHNSON E. F. CO.  | WASECA, MN.            | 56093    |
| 80131  | ELECTRONIC INDUSTRIES ASSOCIATION                        | WASHINGTON, D.C.       | 20006    |
| 84411  | TRW CAPACITOR DIV.                                       | OGALLALA, NB.          | 68153    |
| 95354  | METHODE MFG. CO.   | ROLLING MEADOWS, IL.   | 60656    |
| 98291  | SEAELECTRO CORP.   | MAMARONECK, N.Y.       | 10644    |
| 99890  | DELEVAN ELECTRONICS CORP.                                | E. AURORA, N.Y.        | 14052    |

See introduction to this section for ordering information

**SECTION VII  
MANUAL CHANGES**

**7-1. INTRODUCTION.**

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

**7-3. MANUAL CHANGES.**

7-4. This manual applies directly to the instrument having the same serial prefix shown on the manual title page. If the serial prefix of the instrument is not the same as the one on the title page, find your serial prefix in table 7-1 and make the changes to the manual that are listed for that serial prefix. When making changes listed in table 7-1, make the change with the highest number first. Example: if backdating changes 1, 2, and 3 are required for your serial prefix, do change 3 first, then change 2, and finally change 1. If the serial prefix of the instrument is not listed either in the title page or in table 7-1, refer to an 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     |
|---------------|------------------|
| 1206A         | 1, 2, 3, 4, 5, 6 |
| 1211A         | 2, 3, 4, 5, 6    |
| 1228A         | 3, 4, 5, 6       |
| 1309A         | 4, 5, 6          |
| 1322A         | 5, 6             |
| 1348A         | 6                |

**CHANGE 1**

Table 6-2,  
Delete: A5CR7.  
A8CR7: Change to HP Part No. 1901-0040, DIODE: SILICON 30 MA 30 WV, Mfr Code 07263, Mfr Part No FDG 1088.  
Schematic 4,  
Delete: A5CR7.

**CHANGE 2**

Table 6-2,  
Delete A1C42.  
A1: Change HP Part No. and Mfr Part No. to 01825-66501.  
A1R39: Change to HP Part No. 0684-4701, R:FXD COMP 47 OHM 10% 1/4W, Mfr Code 01121, Mfr. Part No. CB 4701.  
A1R112: Change to HP Part No. 0684-1021, R: FXD COMP 1000 OHM 10% 1/4 W, Mfr Code 01121, Mfr Part No. CB 1021.  
A1R117, A1R119: Change to HP Part No. 0684-1011 R:FXD COMP 100 OHM 10% 1/4W, Mfr Code 01121, Mfr Part No. CB 1011.  
A9R24: Change to HP Part No. 0684-1031, R:FXD COMP 10 K OHM 10% 1/W, Mfr Code 01121, Mfr Part No. 0757-0422.  
Schematic 2,  
Delete: A1C42.  
Change value of A1R39 to 47.  
Schematic 5,  
Change value of A1R112 to 1000.  
Schematic 10,  
Change value of A1R117 and A1R119 to 100.

**CHANGE 3**

W1: Change HP Part No. and Mfr Part No. to 01825-61612.

**CHANGE 4**

Table 6-2,  
Delete: A4R15.  
A4: Change HP Part No. and Mfr Part No. to 01825-66504.  
Schematic 7,  
Delete: A4R15.

**CHANGE 5**

Table 6-2,  
Delete: A8CR8.  
A8VR1: Change to HP Part No. 1902-0041, DIODE: BREAKDOWN 5.11 V 5%, Mfr Code 04712, Mfr Part No. SZ10939-98.  
Schematic 7,  
Change schematic 7 as shown in figure 7-1.



## CHANGE 6

## Table 6-2,

A6: Change to HP Part No. 01824-66506; ASSY: VERTICAL CONNECTOR; Mfr Code 28480, Mfr Part No. 01824-66506.

A10: Change to HP Part No. 01824-66507; ASSY: MAINFRAME CONNECTOR; Mfr Code 28480, Mfr Part No. 01824-66507.

W15: Change to HP Part No. 01824-61611; CABLE: POWER; Mfr Code 28480, Mfr Part No. 01824-61611.

W16: Change to HP Part No. 10825-61617; CABLE: MAIN (INCLUDES W3, W5, W7, W8, W12, W14, W15); Mfr Code 28480, Mfr Part No. 01825-61617.

Figure 8-26, schematic 8,

Delete: Connections to J1 pins 11 and 12.

Figure 8-27, schematic 9,

Delete: Connections to P1 pins 10 and 26.

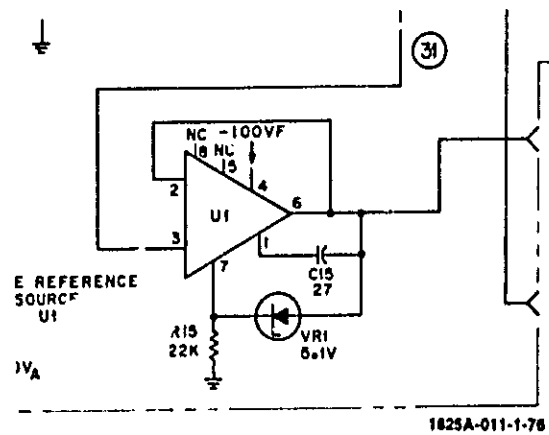


Figure 7-1. Schematic Changes

## SECTION VIII

### SCHEMATICS AND TROUBLESHOOTING

#### 8-1. INTRODUCTION.

8-2. This section contains schematics, repair and replacement information, component-identification illustrations, waveforms, test conditions, troubleshooting procedures and a troubleshooting block diagram.

#### 8-3. SCHEMATICS.

8-4. Schematics are printed on foldout pages for easy reference to the text and figures in other sections. The schematics are drawn to show electronic function of the circuits. Any one schematic may include all or part of several different physical assemblies. Non-MIL-standard symbols and conventions used in the schematics are defined in table 8-1.

8-5. The schematics are numbered in sequence with a bold number at the lower right-hand corner of each page. These numbers are used to cross-reference signal connections between the schematics. At most circuit breaking points, a number in a circle is shown, followed by another number in bold type. The circled number indicates the signal or circuit and the bold number indicates the associated schematic that contains the source or destination of the signal. To find the source or destination of the signal, turn to the indicated schematic and find the circled number (if assigned).

8-6. A table on each schematic lists all components shown on the schematic by reference designation. Component reference designators that have been deleted from the schematic are listed below the table.

8-7. All components within the bordered areas of the schematic are physically located on etched circuit boards. Chassis components (not physically located on etched circuit boards) are shown in the unbordered areas of the schematic.

#### 8-8. REFERENCE DESIGNATIONS.

8-9. The unit system of reference designations used in this manual is in accordance with the provisions of USA Standard Y32.16-1968, "Reference Designations for Electrical and Electronics parts and Equipments", dated March 1, 1968. Minor variations from the standard, due to design and manufacturing practices, may be noted.

8-10. Each electrical component is assigned a class letter and a number. This letter-number combination is the basic reference designation. Components which are part of an assembly have, in addition to the basic

designation, a prefix designation indicating the assembly of which the component is a part. For instance, resistor R23 on assembly A1 is called A1R23.

8-11. Assemblies are numbered consecutively. If an assembly reference designation is assigned and later deleted, that number is not reused.

#### 8-12. COMPONENT LOCATIONS.

8-13. Locations of components on assemblies and sub-assemblies are shown on photographs located adjacent to the schematics. Since schematics are drawn to show function, portions of a particular assembly may appear on several different schematics. The component-location photograph is printed next to the schematic that first shows the assembly.

#### 8-14. PREVENTIVE MAINTENANCE.

8-15. Preventive maintenance consists of periodic performance checks, calibration, mechanical inspection, lubrication, and other services designed to prevent breakdown and failure. Performance checks and calibration are covered in Section V of this manual. The other preventive maintenance services are covered in the following paragraphs.

8-16. **MECHANICAL INSPECTION.** Periodically inspect the instrument for damaged components, excess grease, dirt, and corrosion. Look for loose and misaligned assemblies. Ensure that all screws and fasteners are tight and serviceable.

8-17. Refer to the paragraphs in this section on repair and replacement for instructions on replacing damaged components.

8-18. Painted surfaces can be cleaned with a commercial, spray-type, window cleaner or with a mild soap and water solution. Excess grease can be removed with a degreaser such as M-180 FREON TF DEGREASER produced by Miller-Stevenson Company.

8-19. **SWITCH MAINTENANCE.** The pushbutton switches used in this instrument have been designed for long, trouble-free service. If one of these switches becomes defective, replacement rather than repair is recommended.

8-20. Conventional rotary switches are serviced by cleaning the contacts with a degreaser such as M-180

**FREON TF DEGREASER.** Lubricate contact surfaces with a lubricant comparable to LUBRIPLATE FML produced by Fiske Brothers Refining Company. LUBRIPLATE FML is also available from the Hewlett-Packard Company (HP Part No. 6040-0305).

## 6-21. REPAIR AND REPLACEMENT.

8-22. The following paragraphs provide procedures for removal, repair, and replacement of assemblies, sub-assemblies, and components. Special repair instructions for etched circuit boards are provided in paragraph 8-26. Section VI provides a detailed parts list for use in ordering replacement parts. Figure 8-2 identifies mechanical parts and mounting hardware listed under chassis parts in table 6-2 (refer to Section VI).

8-23. **ASSEMBLY REMOVAL.** Assemblies A1, A2, A3, A6 and A10 can be removed by removing their mounting screws, disconnecting jacks and square pin connectors, and in some instances, unsoldering connecting wires (refer to paragraph 8-24 for removal of other assemblies). Before disconnecting any wires, write down wire color codes and note position of wires on the board.

### CAUTION

Miswiring during reassembly can result in damage to instrument components.

8-24. **TIME/DIV SHAFT REMOVAL.** Assemblies A4, A5, A7, A8, and A9 can be removed only after removal of TIME/DIV switch shaft. Remove TIME/DIV switch shaft as follows:

- a. Loosen setscrew in dial spacer assembly MP12.
- b. Set MAIN TIME/DIV to 1 SEC.
- c. Set DELAYED TIME/DIV to 20  $\mu$ SEC.
- d. Note positions of A5S1 and A8S1.
- e. Pull outward on dial spacer assembly and remove shaft assembly.
- f. A4, A5, A7, A8, and A9 can now be removed by pulling each board upward.

8-25. To reinstall TIME/DIV shaft, proceed as follows:

- a. Reseat A4, A5, A7, A8, and A9.
- b. Ensure that A5S1, and A8S1 are set in positions noted in paragraph 8-24, steps b and c.
- c. Insert shaft through both switches.
- d. Push shaft inward until dial spacer assembly MP12 is firm against front panel. Tighten setscrew.

8-26. **SERVICING ETCHED CIRCUIT BOARDS.** All the etched circuit boards have plated through component holes. This allows components to be removed or replaced by unsoldering or soldering from either side of the board. When removing large components such as potentiometers, rotate the soldering iron tip from lead to lead while applying pressure to the part to lift it from the board. HP Service Note M-20E contains additional information for repair of etched circuit boards.

8-27. **SEMICONDUCTOR REMOVAL AND REPLACEMENT.** Figure 8-1 is included to help identify the leads on the common shapes and sizes of semiconductor devices. When removing a semiconductor, use long-nosed pliers as a heat sink between the device and the soldering iron. When replacing a semiconductor, ensure sufficient lead length to dissipate the soldering heat by using the same length of exposed lead as used for the original part.

## 8-28. INTEGRATED CIRCUIT REMOVAL AND REPLACEMENT.

### CAUTION

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

8-29. The integrated circuits (IC's) in this instrument are of two general configurations, plug-in types, and those soldered in place. Remove a plug-in integrated circuit with a straight pull away from the board. Soldered integrated circuits can be removed with soldering irons which simultaneously heat all connections. These irons are available from various manufacturers. Soldering irons with built-in desoldering tools also facilitate quick removal.

8-30. Use the following procedure for removing an integrated circuit with a standard soldering iron.

- a. Heat lead solder joint. Use small tip such as on Weller No. PT-H7 iron.
- b. When solder is fluid, remove with desoldering tool such as deluxe Model Soldapull manufactured by Edsyn Company of California.
- c. Repeat steps a and b for each lead until all leads are free.
- d. Grasp each lead with long-nosed pliers and check that it is mechanically free from circuit board.
- e. When all leads are free, carefully remove integrated circuit. Dual in-line type can be removed by gently gripping top and bottom with long-nosed pliers and rolling circuit out.

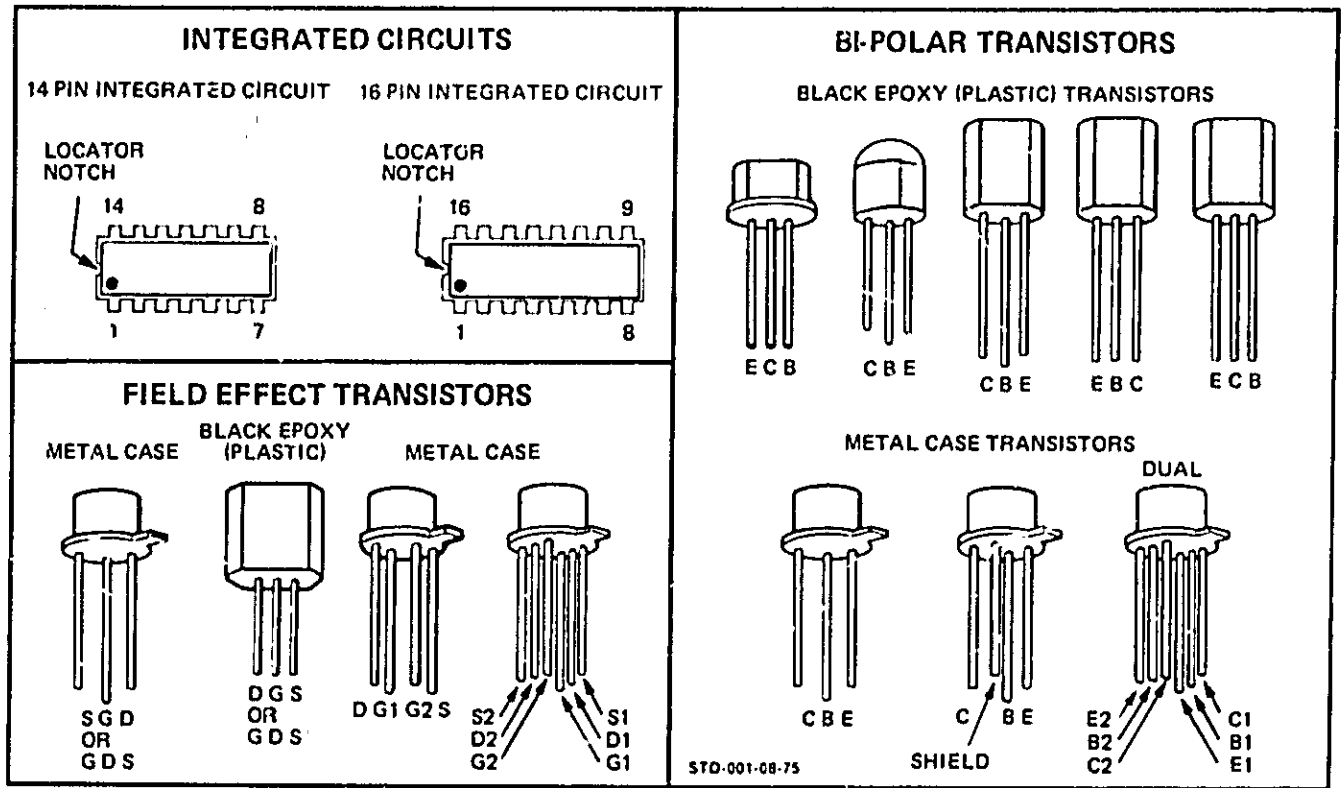


Figure 8-1. Semiconductor Terminal Identification

f. Use desoldering tool or toothpick to remove all remaining solder from circuit board holes.

**CAUTION**

Be careful not to damage the integrated circuit with excessive heat. Work quickly.

g. Insert replacement integrated circuit into circuit board and solder in place.

8-31. When replacing an integrated circuit, note the mark or notch used for orientation. The component-identification photographs and the integrated circuit pin-location diagrams in this manual show the correct orientation.

**8-32. TROUBLESHOOTING.**

**WARNING**

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

8-33. Two important prerequisites for successful troubleshooting are understanding how the instrument is designed to operate and correct use of front-panel controls. Improper control settings or circuit con-

nections can cause apparent malfunctions. Read Section III (operation) for an explanation of controls, connectors, and general operating considerations. Read Section IV (Principles of Operation) for explanation of circuit theory.

8-34. If trouble is suspected, visually inspect the instrument. Look for loose or burned components that may suggest a source of trouble. Verify that all circuit board connections are making good contact and are not shorting to an adjacent circuit. If no obvious trouble is found, check power supply voltages in the instrument; also check external power sources.

8-35. **DC VOLTAGES AND WAVEFORMS.** All numbered points on the troubleshooting block diagram and corresponding points on the schematics show dc voltages and, if appropriate, waveforms. Table 8-3, adjacent to the block diagram, provides the location of the measurement point and conditions under which the measurement must be made. Since the conditions for making these measurements differ from one circuit to another, always check the specific condition for a particular measurement.

8-36. **CHECKING DC VOLTAGES.** DC voltage troubles, especially shorts, may be difficult to trace because of the large number of stages supplied by a particular dc voltage source. Schematic 10 (overleaf from schematic 9) has been included to make troubleshooting of this type easier by providing complete dc voltage distributions on a single schematic.

**8-37. CIRCUIT CHECKING.** The troubleshooting block diagram (figure 8-4) has been provided to enable rapid isolation of a malfunction to a particular circuit group. This is accomplished by making indicated measurements until a block is found whose inputs are normal but whose outputs are abnormal. Once this point is reached, the numbered input and output points are located on the appropriate schematic and progressive troubleshooting techniques (waveform analysis, voltage measurement, resistance measurement, substitution) are employed between the two points to isolate the malfunction to a particular component(s).

8-38. To use the troubleshooting block diagram, proceed as follows:

a. Install 1825A as instructed in Section II and perform initial turn-on (as far as malfunction will permit) as instructed in Section III.

b. Make all measurements possible on mother board or directly on leads of components.

c. Verify auxiliary equipment is operating properly.

d. Verify all power supply voltages are present and within tolerance.

e. Determine effect of all operating controls on output. This will enable logical selection of most direct troubleshooting path to malfunction. If all else fails, inputs and outputs of each block can be tested to find malfunctioning block.

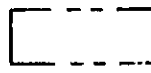

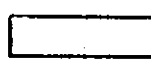

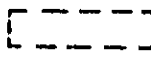

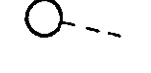




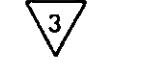

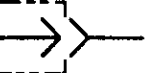
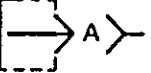
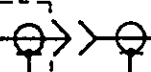

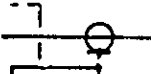
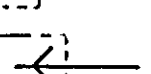


f. After locating desired measurement point on block diagram, refer to corresponding number on adjacent table 8-3. Table 8-3 provides physical location of measurement and test condition for making indicated measurement.

g. Set up 1825A and test equipment as shown in figure 8-3.

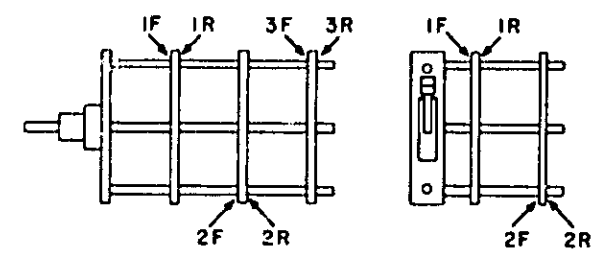
h. Make measurement and compare waveform or voltage on block diagram.

Table 8-1. Schematic Notes

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

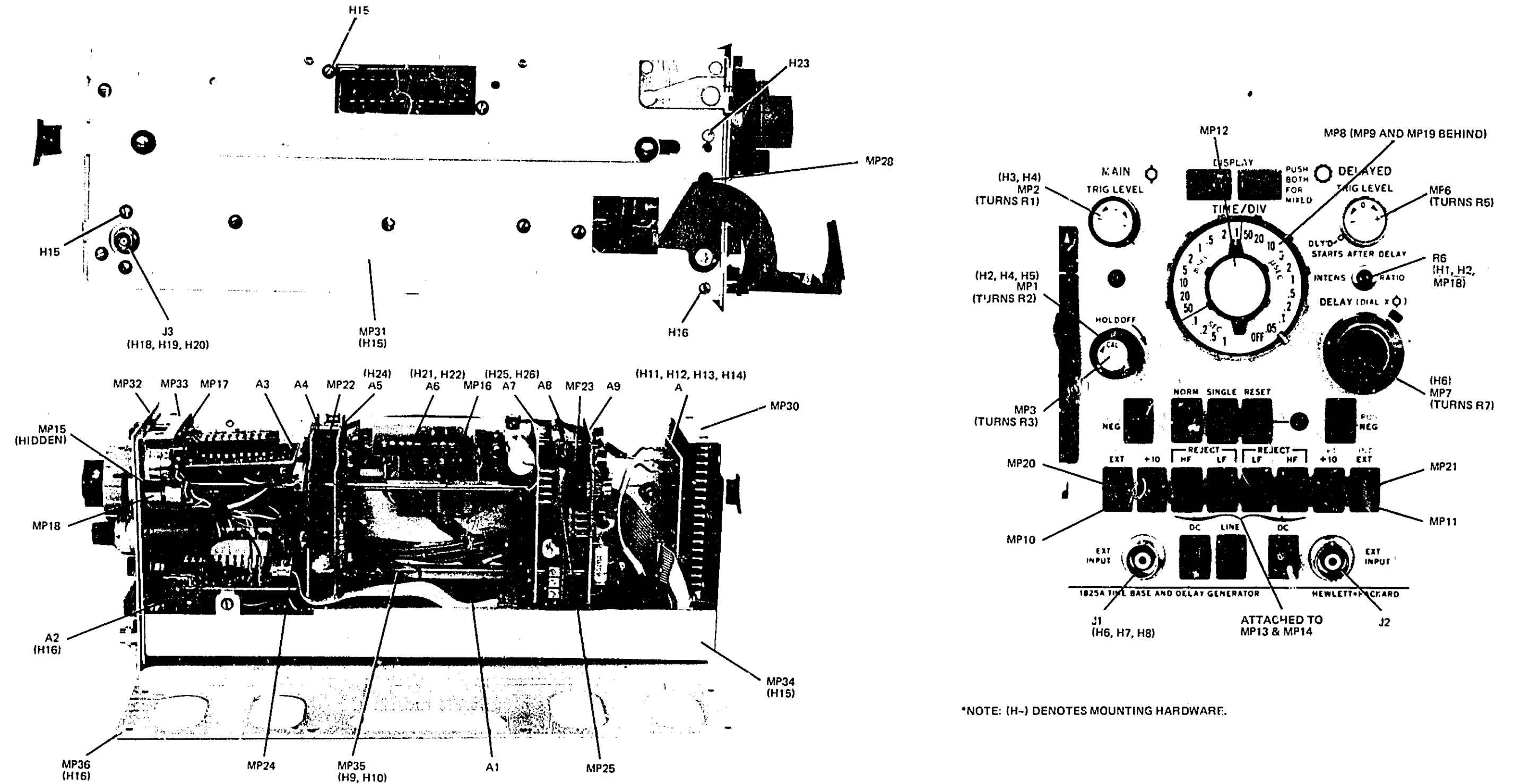
|   |  |   |  |
|---|--|---|--|
|    | = Etched circuit board   |  | = Field-effect transistor (P-type base)  |
|    | = Front-panel marking  |  | = Field-effect transistor (N-type base)  |
|    | = Rear-panel marking   |  | = Breakdown diode (voltage regulator)  |
|    | = Front-panel control  |  | = Tunnel diode   |
|    | = Screwdriver adjustment                                       |  | = Step-recovery diode  |
| P/O   | = Part of  |  | = 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. |
| CW  | = Clockwise enr. of variable resistor                          |   |  |
| NC  | = No connection  |   |  |
|    | = Waveform test point (with number)                            | (925)   | = Wire colors are given by numbers in parentheses using the resistor color code [ (925) is wht-red-grn ]   |
|    | = Common electrical point (with letter) not necessarily ground | 0 - Black   | 5 - Green  |
|   | = Single-pin connector on board                                | 1 - Brown   | 6 - Blue   |
|  | = Pin of a plug-in board (with letter or number)               | 2 - Red   | 7 - Violet   |
|  | = Coaxial cable connected to snap-on jack                      | 3 - Orange  | 8 - Gray   |
|  | = Coaxial cable connected directly to board                    | 4 - Yellow  | 9 - White  |
|  | = Wire connected to pressure-fit socket on board               |   |  |
|  | = Main signal path   |   |  |
|  | = Primary feedback path  |   |  |
|  | = Secondary feedback path                                      |   |  |

Switch wafers are identified as follows:



\* = Optimum value selected at factory, typical value shown; part may have been omitted.

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



\*NOTE: (H-) DENOTES MOUNTING HARDWARE.

1825A-B-1-1-78

Figure 8-2. Chassis Parts Locator

Table 8-2. Troubleshooting Test Conditions

| TEST CONDITION A  | TEST CONDITION J   |
|---|--|
| <p>Connect equipment as shown in figure 8-3.<br/>Set Model 1825A controls as follows:</p> <p>DISPLAY.....MAIN<br/>MAIN TIME/DIV ..... .2 mSEC<br/>DELAYED TIME/DIV..... OFF<br/>MAIN POS/NEG ..... NEG<br/>AUTO/NORM ..... NORM<br/>MAIN INT/EXT ..... EXT<br/>MAIN +1/+10 ..... +10<br/>pushbuttons not mentioned ..... out</p>                              | <p>Connect equipment as shown in figure 8-3.<br/>Set Model 1825A controls as follows:</p> <p>DISPLAY.....DELAYED<br/>MAIN TIME/DIV ..... .2 mSEC<br/>DELAYED TIME/DIV..... .2 mSEC<br/>MAIN POS/NEG ..... NEG<br/>DELAYED POS/NEG ..... NEG<br/>MAIN INT/EXT ..... EXT<br/>DELAYED INT/EXT ..... EXT<br/>MAIN +1/+10 ..... +10<br/>DELAYED +1/+10 ..... +10<br/>DELAY dial ..... ccw<br/>pushbuttons not mentioned ..... out</p> |
| <p><b>TEST CONDITION B</b></p> <p>Same as A except:<br/>MAIN TRIG LEVEL.....centered<br/>all pushbuttons ..... out</p>  | <p><b>TEST CONDITION K</b></p> <p>Same as J except all pushbuttons (except DISPLAY) are out.</p>   |
| <p><b>TEST CONDITION C</b></p> <p>Same as A except:<br/>MAIN INT/EXT ..... INT<br/>MAIN +1/+10 ..... +1</p>   | <p><b>TEST CONDITION L</b></p> <p>Same as J except:<br/>DISPLAY..... MIXED<br/>MAIN TIME/DIV ..... .5 mSEC<br/>Adjust MAIN then DELAYED TRIG LEVEL for triggered display.</p>  |
| <p><b>TEST CONDITION D</b></p> <p>Set Model 1825A controls as follows:</p> <p>DISPLAY.....MAIN<br/>MAIN TIME/DIV ..... .2 mSEC<br/>DELAYED TIME/DIV..... OFF<br/>MAIN TRIG LEVEL..... cw<br/>VERNIER ..... detent<br/>AUTO/NORM ..... NORM<br/>SINGLE ..... in<br/>pushbuttons not mentioned ..... out<br/>Press RESET and observe that RESET lamp is on.</p> | <p><b>TEST CONDITION M</b></p> <p>Set Model 1825A controls as follows:</p> <p>DISPLAY..... DELAYED<br/>MAIN TIME/DIV ..... .2 mSEC<br/>DELAYED TIME/DIV ..... .1 mSEC<br/>MAIN TRIG LEVEL ..... cw<br/>DELAYED TRIG LEVEL..... cw<br/>VERNIER ..... detent<br/>AUTO/NORM ..... NORM<br/>SINGLE ..... in<br/>pushbuttons not mentioned ..... out<br/>Press RESET and observe that RESET lamp is on.</p>                           |
| <p><b>TEST CONDITION E</b></p> <p>Same as A except measurements are taken in both positions of POS/NEG.</p>   | <p><b>TEST CONDITION N</b></p> <p>Same as J except measurements are made in both extremes of DELAYED TRIG LEVEL.</p>   |
| <p><b>TEST CONDITION F</b></p> <p>Same as A except measurements are taken in both positions of single.</p>  | <p><b>TEST CONDITION O</b></p> <p>Same as J except measurements are made in both positions of DELAYED POS/NEG.</p>   |
| <p><b>TEST CONDITION G</b></p> <p>Same as A except measurements are taken in both extremes of HOLDOFF.</p>  | <p><b>TEST CONDITION P</b></p> <p>Same as J except DELAYED TRIG LEVEL is set to DELAYED STARTS AFTER DELAY.</p>  |
| <p><b>TEST CONDITION H</b></p> <p>Same as A except measurements are taken in both extremes of VERNIER.</p>  | <p><b>TEST CONDITION Q</b></p> <p>Same as J except:<br/>DELAY dial ..... 9.00</p>  |
| <p><b>TEST CONDITION I</b></p> <p>Same as A except:<br/>LINE ..... in</p>   |  |

Service

Table 8-3. Block Diagram Test Identifier

Model 1825A

| No. | Signal Name                                    | Test Point            | Test Condition |
|-----|--|-----------------------|----------------|
| 1   | Line trigger                                   | W13                   | I              |
| 2   | Main external trigger                          | J1                    | A              |
| 3   | Main internal trigger                          | Junction-A1R1, A1S1A  | C              |
| 4   | Main trigger input, LF impedance converter     | A2R8                  | A              |
| 5   | Main trigger input, HF impedance converter     | Junction-C2, R9       | A              |
| 6   | Main trigger level voltage                     | R1-center top         | D              |
| 7   | Main trigger output, LF impedance converter    | A1U1-pin 1            | A              |
| 8   | Main trigger output, HF impedance converter    | A1U1-pin 10           | A              |
| 9   | Polarity switch control voltage                | Junction-R15, R19     | E              |
| 10  | Polarity switch control voltage                | Junction-R17, R19     | E              |
| 11  | Main polarity switch input                     | Q3-emitter            | E              |
| 12  | Main polarity switch input                     | Q6-emitter            | E              |
| 13  | Main polarity switch output                    | A1U1-pin 7            | E              |
| 14  | Main polarity switch output                    | A1U1-pin 4            | E              |
| 15  | Main trigger amplifier positive output         | A1U2-pin 6            | A              |
| 16  | Main trigger amplifier negative output         | A1U2-pin 9            | A              |
| 17  | Single sweep control voltage                   | A1P3-pin 10           | F              |
| 18  | Main trigger enable control voltage            | A1TP7                 | A              |
| 19  | Free-run trigger                               | A1Q7-emitter          | B              |
| 20  | Free-run enable voltage                        | A1U2-pin 14           | B              |
| 21  | Main dual Schmitt output                       | A1TP5                 | A              |
| 22  | Auto and lockout output                        | A1J2-pin              | F              |
| 23  | Internal display enable voltage                | A1Q8-base             | B              |
| 24  | Main gate to rear panel                        | W3                    | A              |
| 25  | Main integrator gate                           | A1TP6                 | A              |
| 25A | Main gate to gate Schmitt                      | A1TP6                 | A              |
| 26  | Holdoff control voltage                        | A1J2-pin              | G              |
| 27  | Holdoff ramp                                   | A1Q4-base             | A              |
| 28  | Main feedback ramp                             | Junction-A7R21, A7C10 | A              |
| 29  | Main ramp to rear panel                        | A1TP9                 | A              |
| 30  | Vernier control voltage                        | A1J2-pin              | H              |
| 31  | Main integrator input                          | A9Q4-base             | D              |
| 32  | Main ramp to comparator                        | A9Q5-collector        | A              |
| 33  | Main ramp                                      | A9Q7-collector        | A              |
| 34  | Delayed external trigger                       | J2                    | C              |
| 35  | Delayed internal trigger                       | Square pin-green      | K              |
| 36  | Delayed trigger input, HF impedance converter  | Junction-A1R54        | J              |
| 37  | Delayed trigger input, LF impedance converter  | A1P2-pin              | J              |
| 38  | Delayed trigger level voltage                  | R5-center tap         | N              |
| 39  | Delayed trigger output, HF impedance converter | A1U3-pin 10           | J              |
| 40  | Delayed trigger output, LF impedance converter | A1U3-pin 1            | J              |
| 41  | Delayed polarity switch input                  | A1Q13-emitter         | O              |
| 42  | Delayed polarity switch input                  | A1Q16-emitter         | O              |
| 43  | Delayed polarity switch output                 | A1U3-pin 7            | O              |
| 44  | Delayed polarity switch output                 | A1U3-pin 4            | O              |
| 45  | Delayed polarity switch control voltage        | Junction-A1R60, A1R63 | O              |
| 46  | Delayed polarity switch control voltage        | Junction-A1R62, A1R64 | O              |
| 47  | Delayed trigger amplifier positive output      | A1U5-pin 6            | J              |
| 48  | Delayed trigger amplifier negative output      | A1U5-pin 9            | J              |
| 49  | Delayed starts after delay control line        | A1J2-pin 1            | P              |
| 50  | Delayed trigger enable voltage                 | A1U5-pin              | L              |
| 51  | Delayed dual Schmitt output                    | A1TP4                 | J              |
| 52  | Delayed gate to gate Schmitt                   | A1TP2                 | J              |
| 53  | Delayed gate to rear panel                     | Junction-A1R91, A1R92 | J              |
| 54  | Delayed integrator gate                        | A1TP2                 | J              |
| 55  | Delayed ramp                                   | W6                    | J              |

Table 8-3. Block Diagram Test Identifier (Cont'd)

| No. | Signal Name                            | Test Point      | Test Condition |
|-----|--|-----------------|----------------|
| 56  | Delayed ramp to rear panel             | W5              | J              |
| 57  | Delayed control Schmitt enable voltage | TP1             | L              |
| 58  | Delayed integrator input               | A5P1-pin 3      | G              |
| 59  | Internal trigger input                 | W8              | C              |
| 60  | Delay comparison voltage               | A9U1-pin 6      | L              |
| 61  | Delayed trigger enable voltage         | A1J4-pin 1      | L              |
| 62  | Intensity control voltage              | R6-center tap   | L              |
| 63  | Composite intensified gate             | TP8             | A              |
| 64  | Main gate enable voltage               | A3-wht/yel wire | Q              |
| 65  | Delayed gate enable voltage            | A3-wht/grn wire | Q              |
| 66  | Delayed reset reference voltage        | W7              | A              |
| 67  | Delayed feedback ramp                  | A5Q2-base       | J              |
| 68  | Composite ramp output                  | W10             | L              |

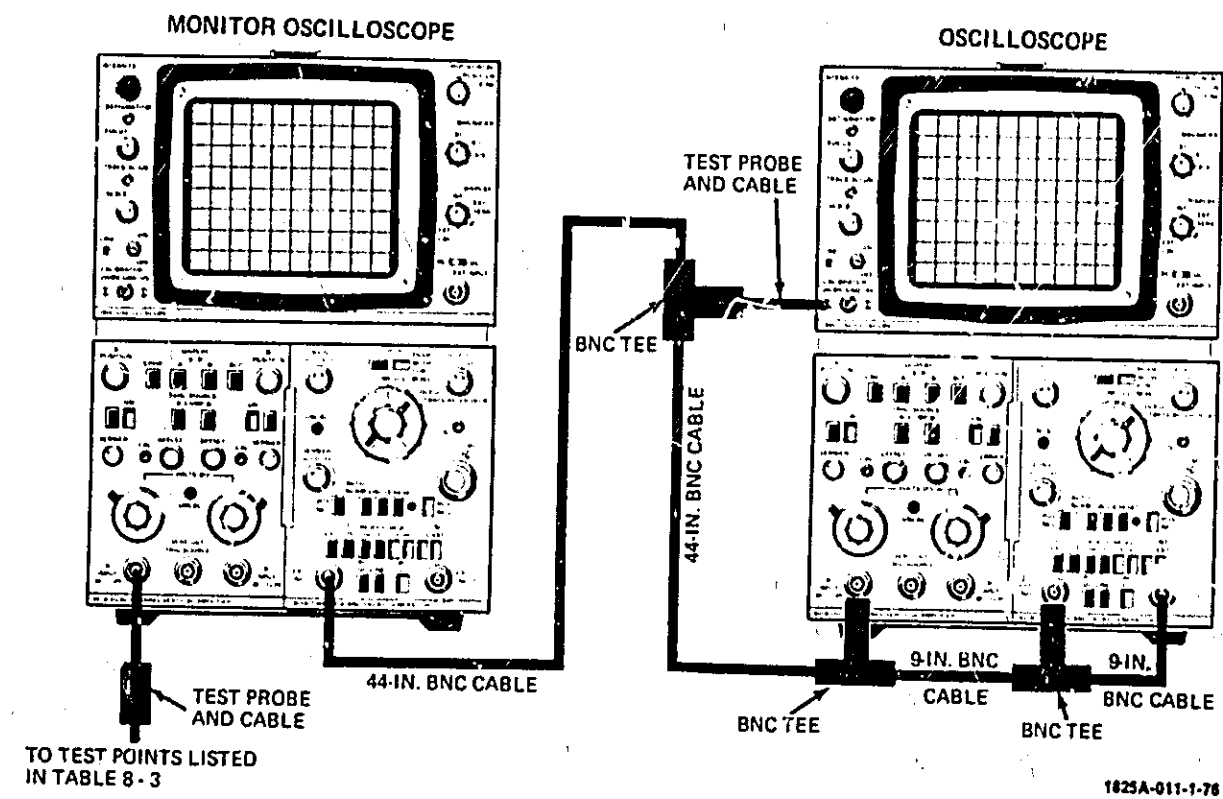


Figure 8-3. Troubleshooting Test Setup

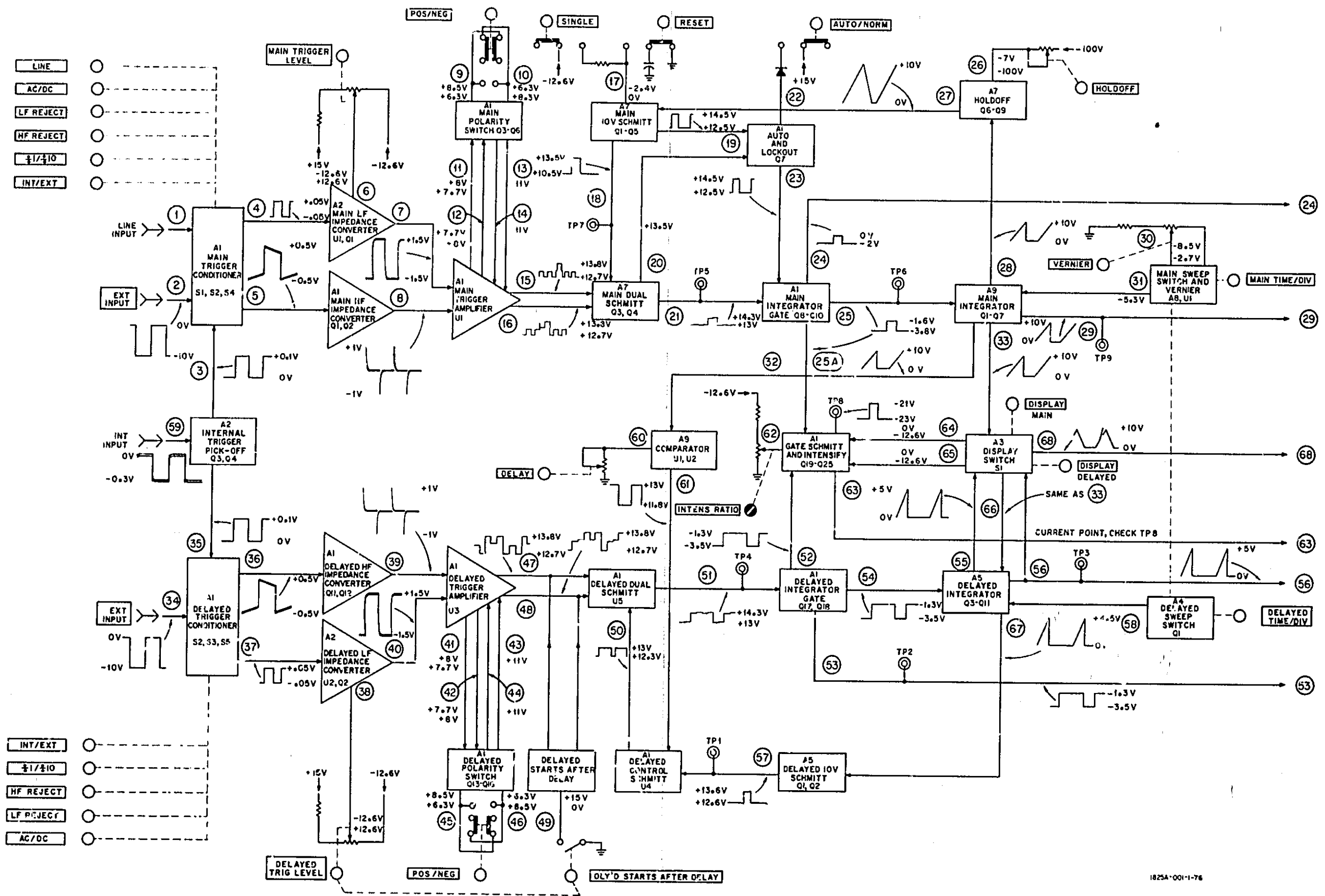


Figure 8-4. Troubleshooting Block Diagram 8-7



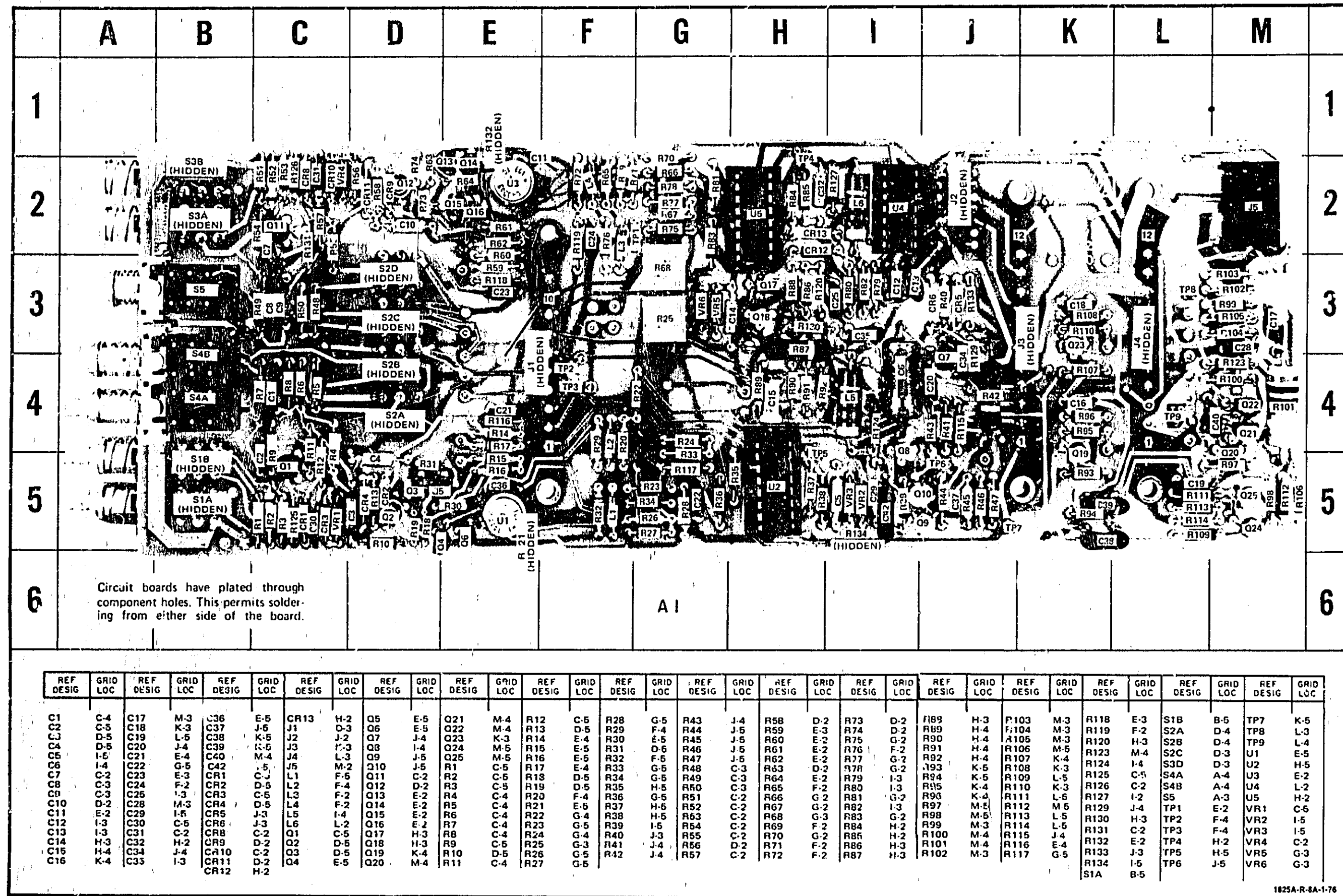


Figure 8-5. A1 Components Locator

**VOLTAGE MEASUREMENT CONDITIONS**

Set Model 1825A controls as follows:

DISPLAY ..... MAIN  
 MAIN TIME/DIV ..... .2 mSEC  
 DELAYED TIME/DIV ..... OFF  
 MAIN TRIG LEVEL ..... cw  
 VERNIER ..... detent  
 AUTO/NORM ..... NORM  
 SINGLE ..... in  
 pushbuttons not mentioned ..... out

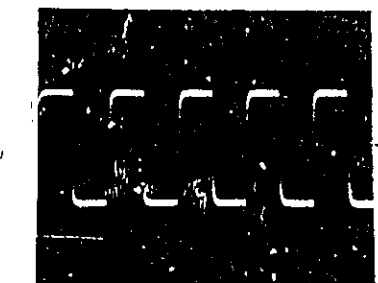
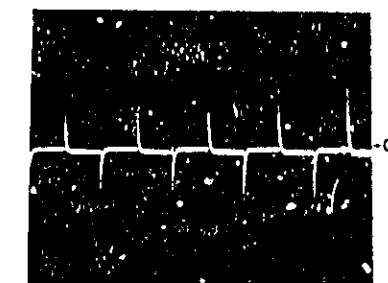
Press RESET and observe that RESET lamp is on.  
 During each test, ensure that RESET lamp is on.

**WAVEFORM MEASUREMENT CONDITIONS**

Connect equipment as shown in figure 8-3.

Set Model 1825A controls as follows:

DISPLAY ..... MAIN  
 MAIN TIME/DIV ..... .2 mSEC  
 DELAYED TIME/DIV ..... OFF  
 MAIN POS/NEG ..... NEG  
 AUTO/NORM ..... NORM  
 MAIN INT/EXT ..... EXT  
 MAIN +1/+10 ..... +10  
 pushbuttons not mentioned ..... out



0.5 V/DIV  
 .5 MS/DIV

0.5 V/DIV  
 .5 MS/DIV

1825A-R-9

Figure 8-6. Schematic 1 and Waveform Measurement Conditions

Table 8-4. Schematic 1 Signal Identifier

| No. | Signal Name                                 |
|-----|---|
| 1   | Line trigger                                |
| 2   | Main external trigger                       |
| 3   | Main internal trigger                       |
| 4   | Main trigger input, LF impedance converter  |
| 5   | Main trigger input, HF impedance converter  |
| 6   | Main trigger level voltage                  |
| 7   | Main trigger output, LF impedance converter |
| 8   | Main trigger output, HF impedance converter |
| 9   | Polarity switch control voltage             |
| 10  | Polarity switch control voltage             |
| 11  | Main polarity switch input                  |
| 12  | Main polarity switch input                  |
| 13  | Main polarity switch output                 |
| 14  | Main polarity switch output                 |
| 15  | Main trigger amplifier positive output      |
| 16  | Main trigger amplifier negative output      |

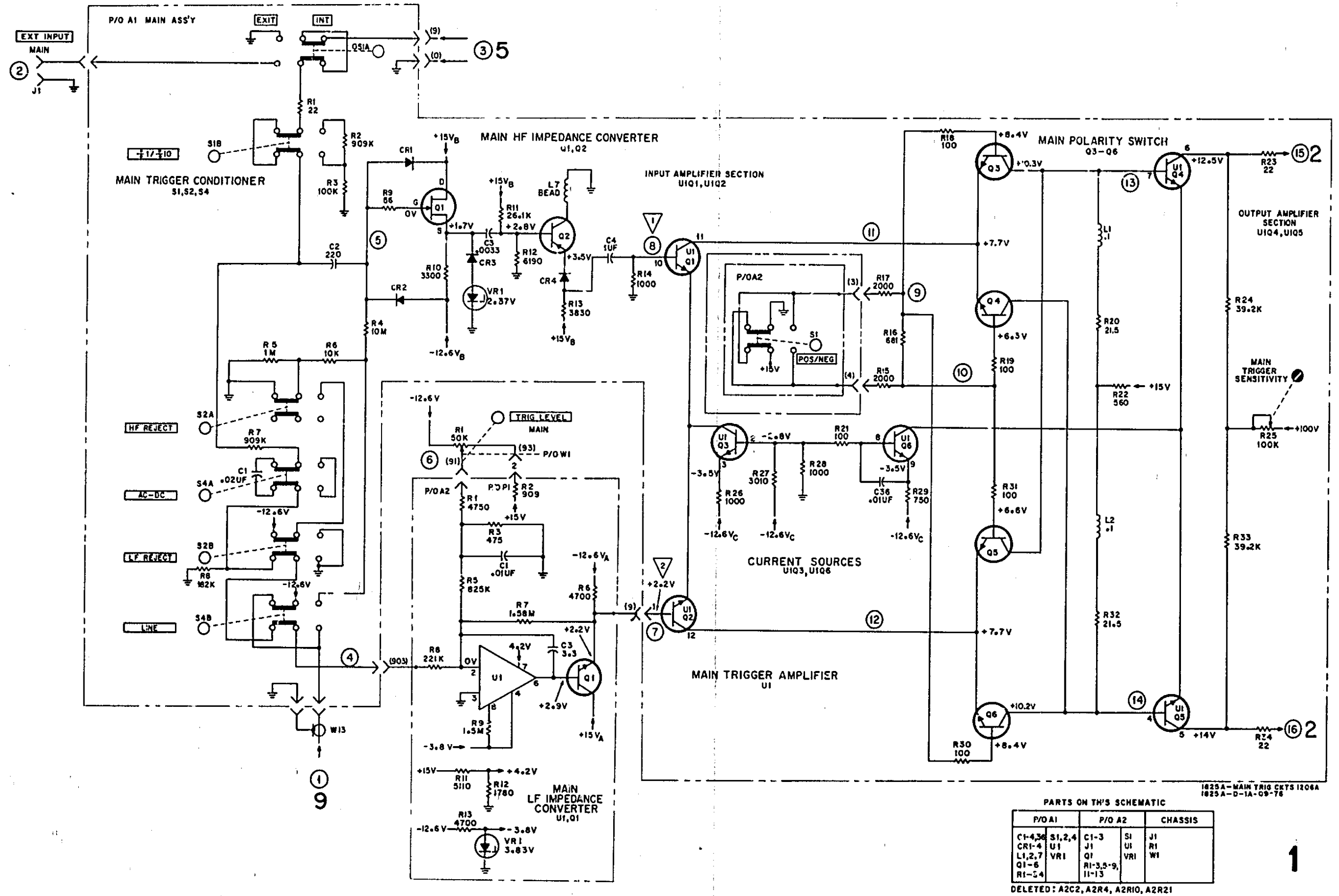


Figure 8-7.  
Schematic, Main Trigger Circuits

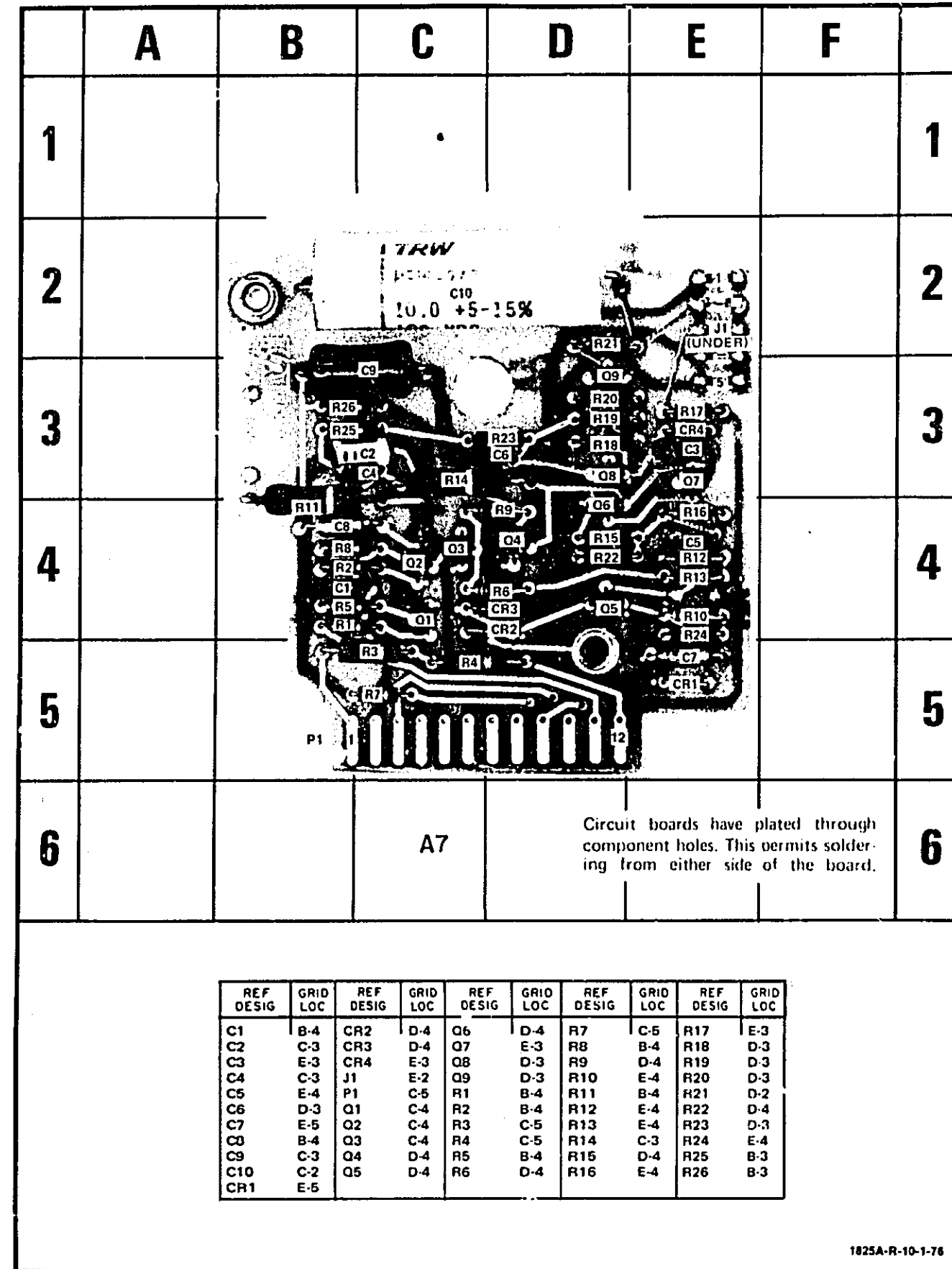


Figure 8-8. A7 Components Locator

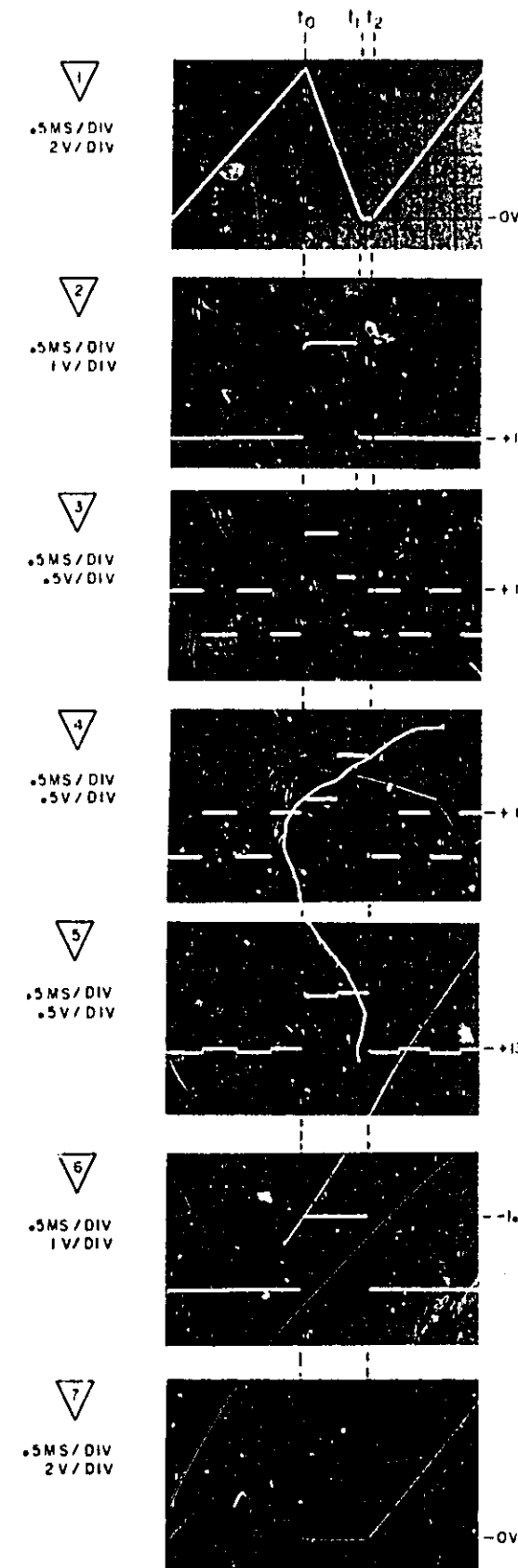


Figure 8-9. Schematic 2 Voltage and Waveform Measurement Conditions

**VOLTAGE MEASUREMENT CONDITIONS**

Set Model 1825A controls as follows:

DISPLAY ..... MAIN  
 MAIN TIME/DIV ..... .2 mSEC  
 DELAYED TIME/DIV ..... OFF  
 MAIN TRIG LEVEL ..... cw  
 VERNIER ..... detent  
 AUTO/NORM ..... NORM  
 SINGLE ..... in  
 pushbuttons not mentioned ..... out

Press RESET and observe that RESET lamp is on. During each test, ensure that RESET lamp is on.

**WAVEFORM MEASUREMENT CONDITIONS**

Connect equipment as shown in figure 8-3.

Set Model 1825A controls as follows:

DISPLAY ..... MAIN  
 MAIN TIME/DIV ..... .2 mSEC  
 DELAYED TIME/DIV ..... OFF  
 MAIN POS/NEG ..... NEG  
 AUTO/NORM ..... NORM  
 MAIN INT/EXT ..... EXT  
 MAIN +1/+10 ..... +10  
 pushbuttons not mentioned ..... out

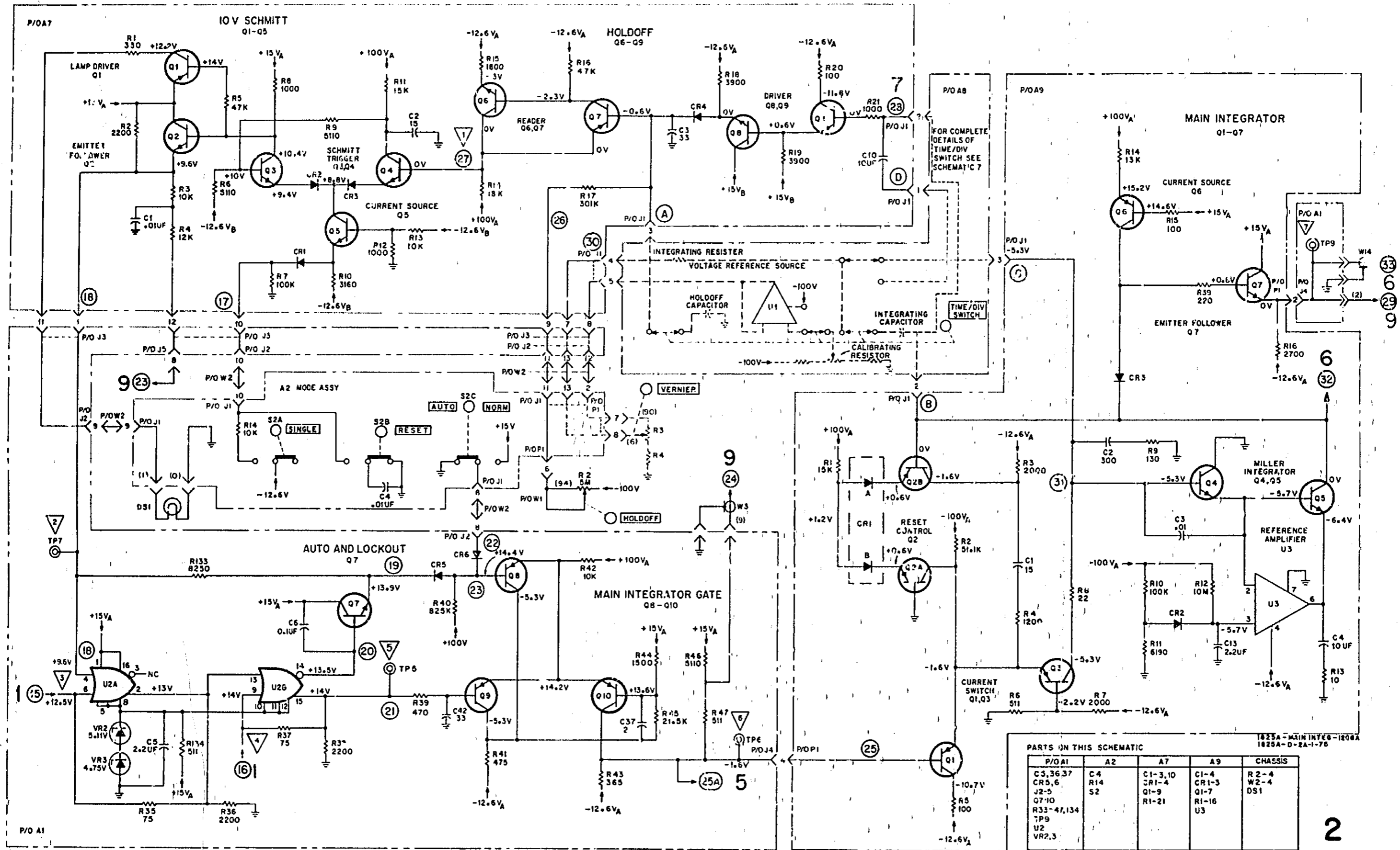
**WAVEFORM NOTES**

At  $t_0$ , sweep ends; holdoff starts; 10V Schmitt sets high.

At  $t_1$ , holdoff ends; 10V Schmitt resets low; dual Schmitt arms.

At  $t_2$ , dual Schmitt output goes low; integrator gate initiates trigger step to integrator; sweep starts.

| No. | Signal Name                            |
|-----|--|
| 15  | Main trigger amplifier positive output |
| 16  | Main trigger amplifier negative output |
| 17  | Single sweep control voltage           |
| 18  | Main trigger enable control voltage    |
| 19  | Free-run trigger                       |
| 20  | Free-run enable voltage                |
| 21  | Main dual Schmitt output               |
| 22  | Auto and lockout output                |
| 23  | Internal display enable voltage        |
| 24  | Main gate to rear panel                |
| 25  | Main integrator gate                   |
| 25A | Main gate to gate Schmitt              |
| 26  | Holdoff control voltage                |
| 27  | Holdoff ramp                           |
| 28  | Main feedback ramp                     |
| 29  | Main ramp to rear panel                |
| 31  | Main integrator input                  |
| 32  | Main ramp to comparator                |
| 33  | Main ramp output                       |

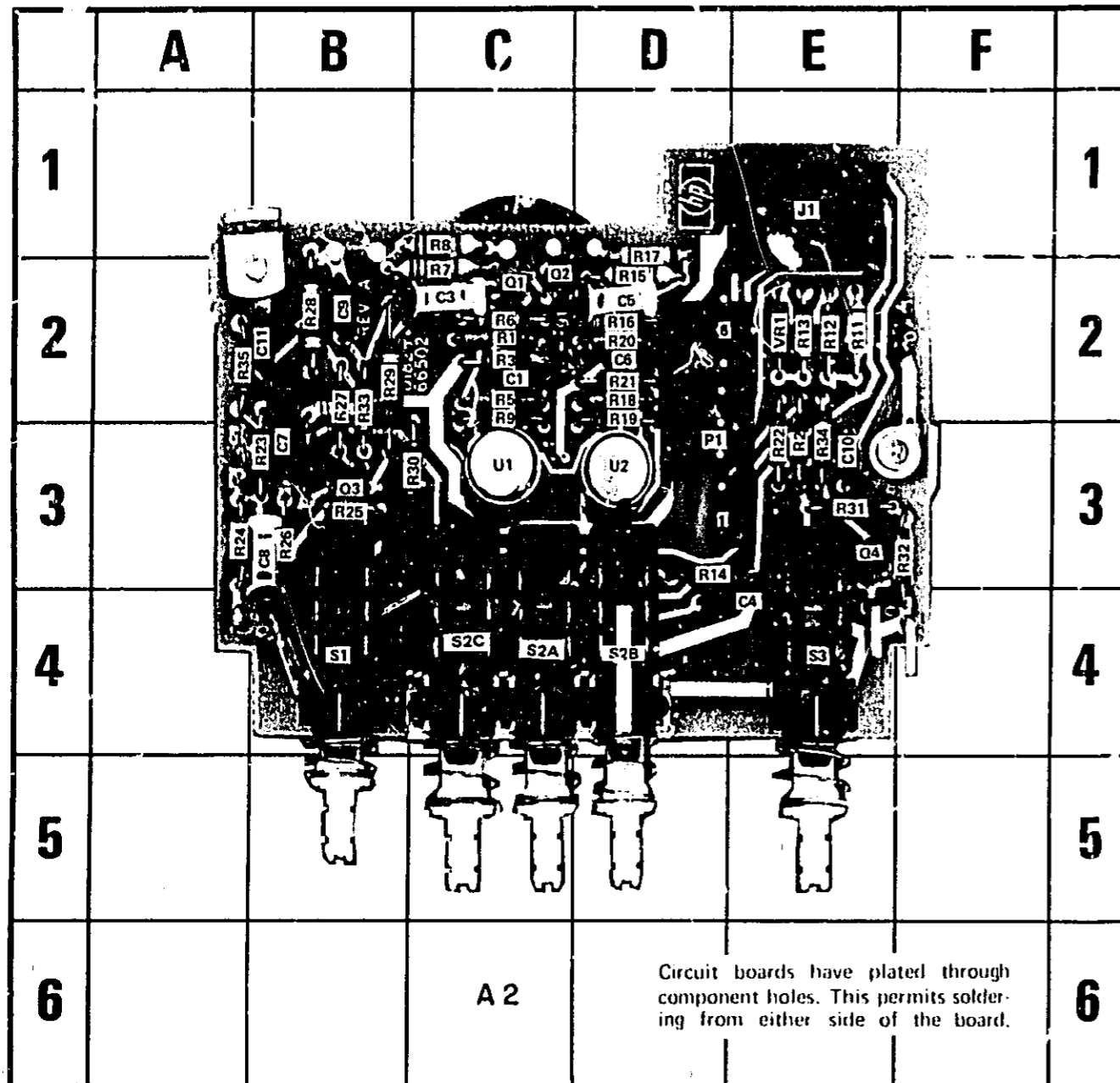


1825A - MAIN INTEGRATOR - 1825A  
1825A-D-2A-1-75

| PARTS ON THIS SCHEMATIC |     |          |       |         |
|-------------------------|-----|----------|-------|---------|
| P/O A1                  | A2  | A7       | A9    | CHASSIS |
| C3, 36, 37              | C4  | C1-3, 10 | C1-4  | R 2-4   |
| CR5, 6                  | R14 | CR1-4    | CR1-3 | W2-4    |
| J2-5                    | S2  | Q1-9     | Q1-7  | DS1     |
| Q7-10                   |     | R1-21    | R1-16 |         |
| R33-47, 134             |     |          | U3    |         |
| TP9                     |     |          |       |         |
| U2                      |     |          |       |         |
| VR2, 3                  |     |          |       |         |

2

Figure 8-10.  
Schematic, Main Integrator  
8-11



Circuit boards have plated through component holes. This permits soldering from either side of the board.

| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|
| C1        | C-2      | Q1        | C-2      | R11       | E-2      | R22       | E-3      | R33       | B-2      |
| C3        | C-2      | Q2        | C-2      | R12       | E-2      | R23       | B-3      | R34       | E-3      |
| C4        | E-4      | Q3        | B-3      | R13       | E-2      | R24       | A-2      | R35       | A-2      |
| C5        | D-2      | Q4        | E-3      | R14       | D-3      | R25       | B-3      | S1        | B-4      |
| C6        | D-2      | R1        | C-2      | R15       | D-2      | R26       | B-3      | S2A       | C-4      |
| C7        | B-3      | R2        | E-3      | R16       | D-2      | R27       | B-2      | S2B       | D-4      |
| C8        | B-3      | R3        | C-2      | R17       | D-1      | R28       | B-2      | S2C       | C-4      |
| C9        | B-2      | R5        | C-2      | R18       | D-2      | R29       | B-2      | S3        | E-4      |
| C10       | E-3      | R6        | C-2      | R19       | D-2      | R30       | C-3      | U1        | C-3      |
| C11       | B-2      | R7        | C-2      | R20       | D-2      | R31       | E-3      | U2        | D-3      |
| J1        | E-1      | R8        | C-1      | R21       | D-2      | R32       | F-3      | VR1       | E-2      |
| P1        | D-3      | R9        | C-2      |           |          |           |          | VR2       | E-2      |

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Figure 8-11. A2 Components Locator

**VOLTAGE MEASUREMENT CONDITIONS**

Set Model 1825A controls as follows:

DISPLAY..... DELAYED  
 MAIN TIME/DIV ..... .2 mSEC  
 DELAYED TIME/DIV..... .1 mSEC  
 MAIN TRIG LEVEL..... cw  
 DELAYED TRIG LEVEL..... cw  
 VERNIER..... detent  
 AUTO/NORM..... NPM  
 SINGLE..... in  
 pushbutton not mentioned ..... out

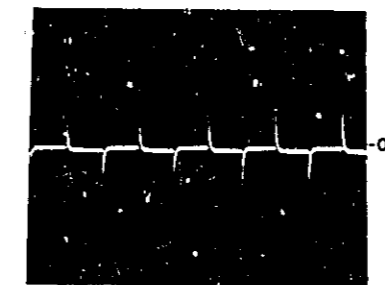
Press RESET and observe that RESET lamp is on. During each test, ensure that RESET lamp is on.

**WAVEFORM MEASUREMENT CONDITIONS**

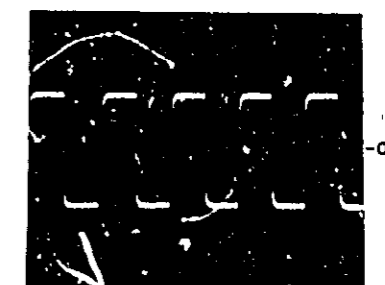
Connect equipment as shown in figure 8-3.

Set Model 1825A controls as follows:

DISPLAY..... DELAYED  
 MAIN TIME/DIV ..... .2 mSEC  
 DELAYED TIME/DIV..... .2 mSEC  
 MAIN POS/NEG ..... NEG  
 DELAYED POS/NEG ..... NEG  
 MAIN INT/EXT..... EXT  
 DELAYED INT/EXT..... EXT  
 MAIN +1/+10 ..... +10  
 DELAYED +1/+10 ..... +10  
 DELAY dial ..... ccw  
 pushbuttons not mentioned ..... out



1 .5V/DIV  
.5MS/DIV



2 .5V/DIV  
.5MS/DIV

1825A-N-9

Figure 8-12. Schematic 3 Voltage and Waveform Measurement Conditions

| No. | Signal Name                                    |
|-----|--|
| 34  | Delayed external trigger                       |
| 35  | Delayed internal trigger                       |
| 36  | Delayed trigger input, HF impedance converter  |
| 37  | Delayed trigger input, LF impedance converter  |
| 38  | Delayed trigger level voltage                  |
| 39  | Delayed trigger output, HF impedance converter |
| 40  | Delayed trigger output, LF impedance converter |
| 41  | Delayed polarity switch input                  |
| 42  | Delayed polarity switch input                  |
| 43  | Delayed polarity switch output                 |
| 44  | Delayed polarity switch output                 |
| 45  | Delayed polarity switch control voltage        |
| 46  | Delayed polarity switch control voltage        |
| 47  | Delayed trigger amplifier, positive output     |
| 48  | Delayed trigger amplifier, negative output     |

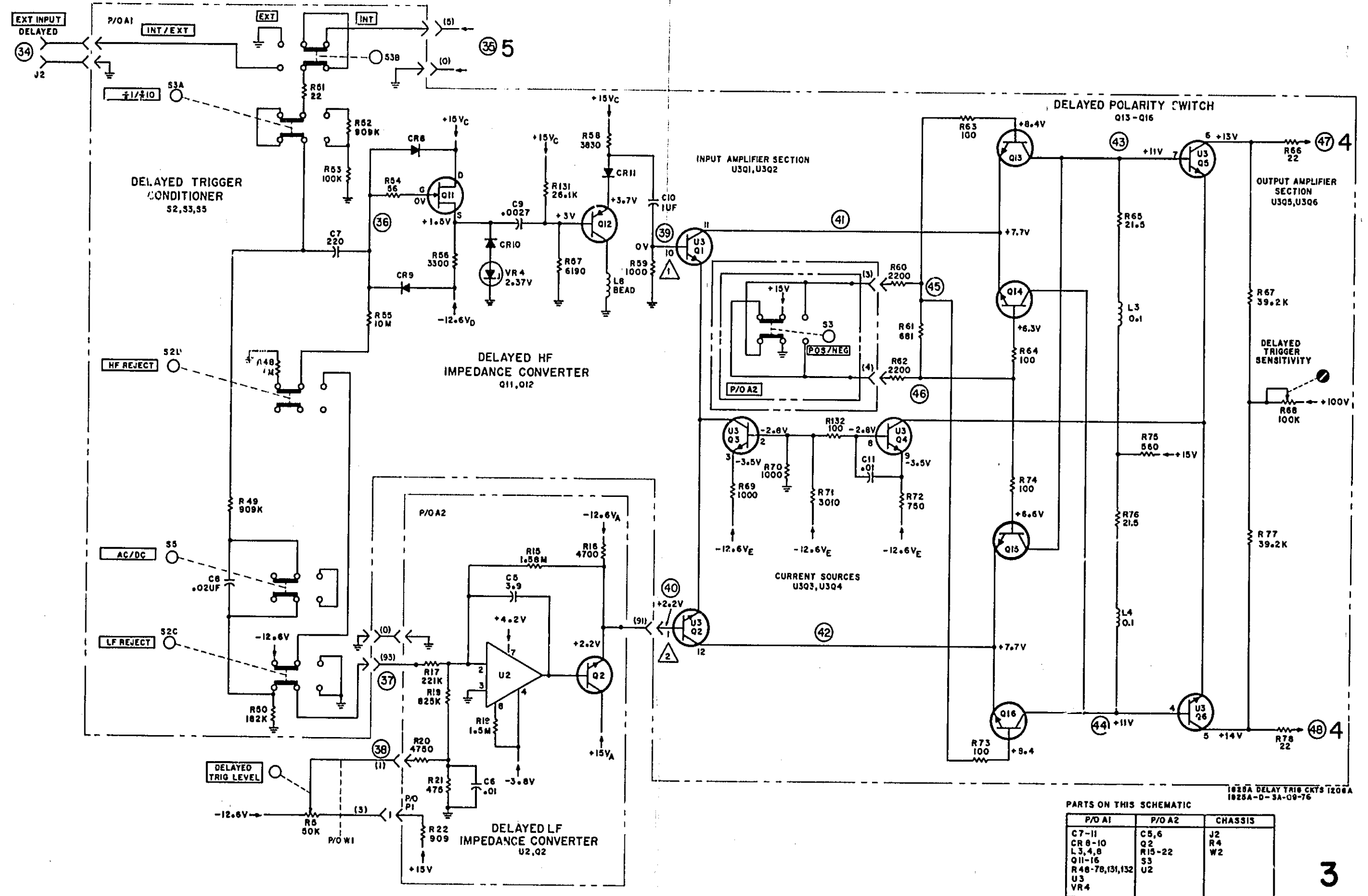
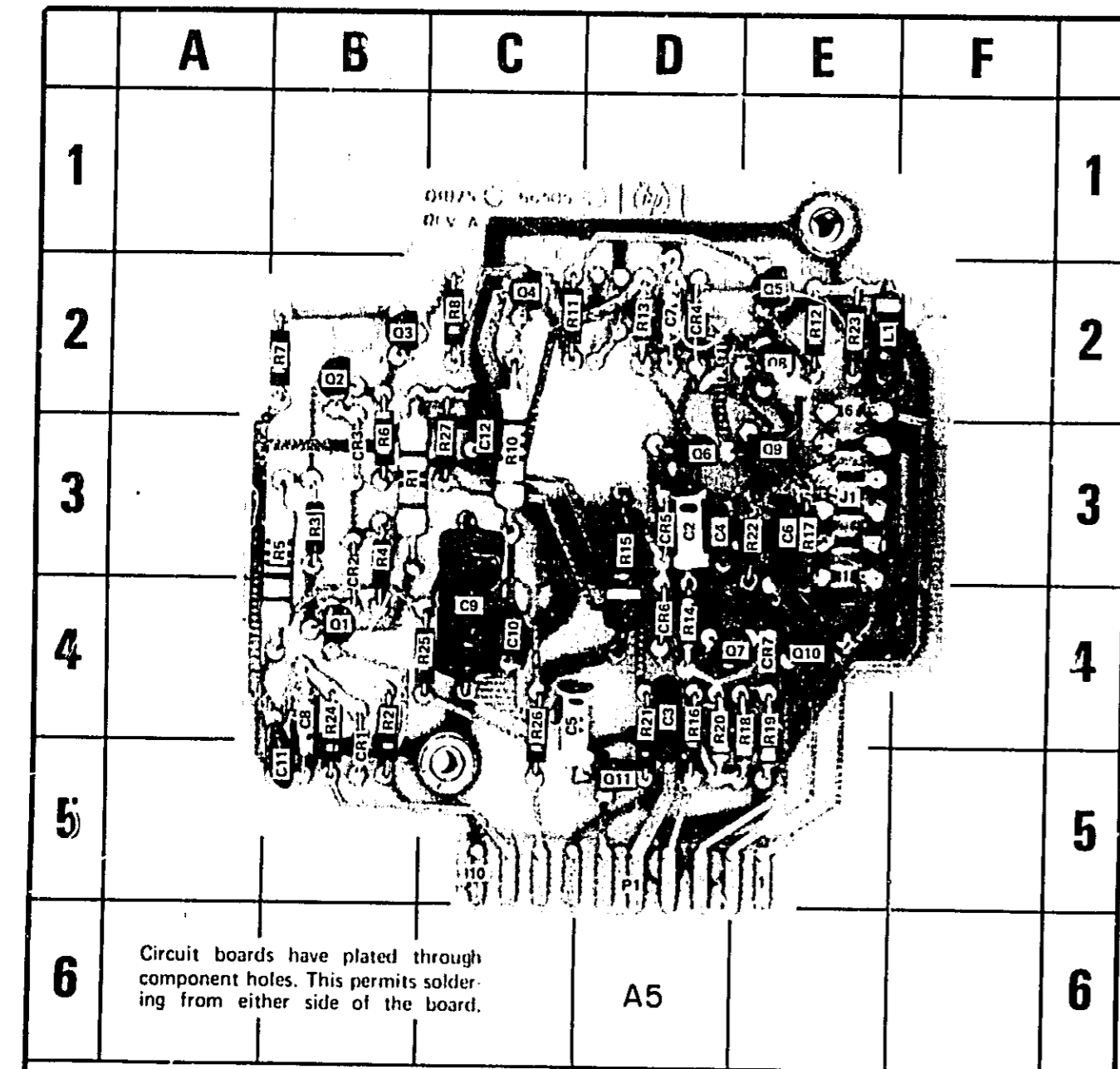


Figure 8-13. Schematic, Delayed Trigger Circuits

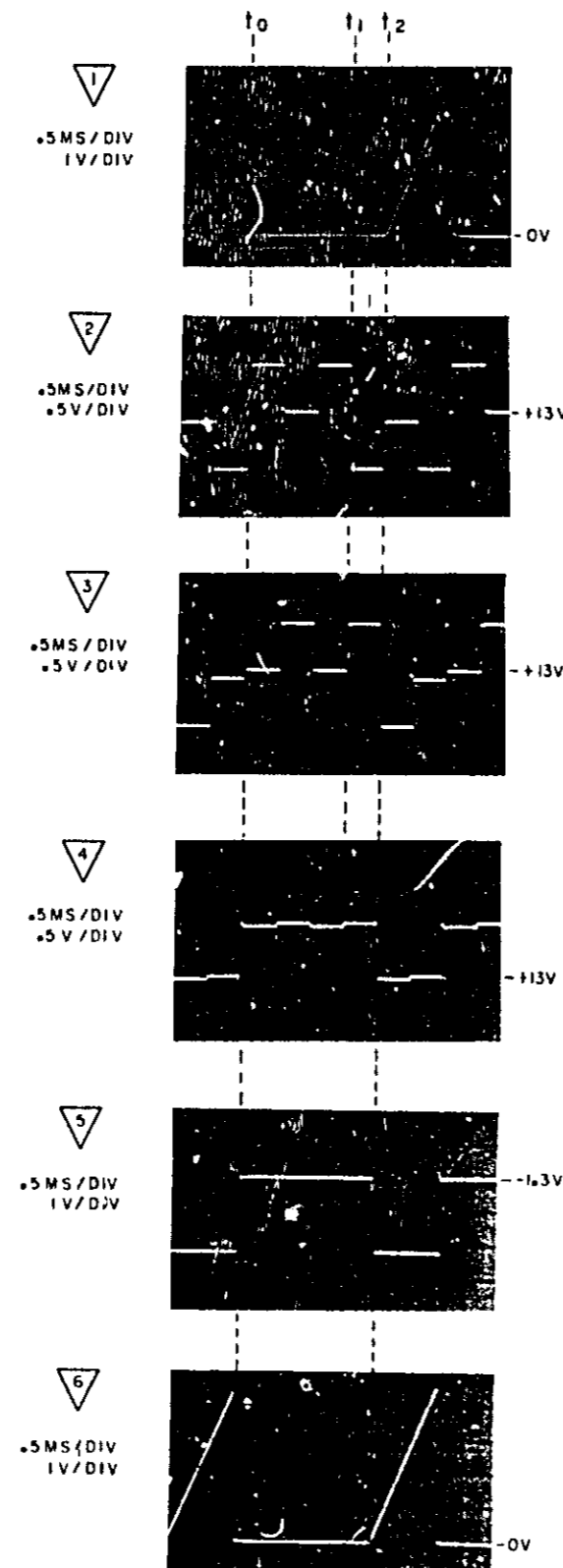
| No. | Signal Name                               |
|-----|---|
| 47  | Delayed trigger amplifier positive output |
| 48  | Delayed trigger amplifier negative output |
| 49  | Delayed starts after delay control line   |
| 50  | Delayed trigger enable voltage            |
| 51  | Delayed dual Schmitt output               |
| 52  | Delayed gate to gate Schmitt              |
| 53  | Delay gate to rear panel                  |
| 54  | Delayed integrator gate                   |
| 55  | Delayed ramp                              |
| 56  | Delayed ramp to rear panel                |
| 57  | Delayed control Schmitt enable voltage    |
| 58  | Delayed integrator input                  |
| 66  | Delayed reset reference voltage           |
| 67  | Delayed feedback ramp                     |



| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|
| C2        | D-3      | CR2       | B-3      | Q4        | C-2      | R5        | B-3      | R17       | E-3      |
| C3        | D-4      | CR3       | B-3      | Q5        | E-2      | R6        | B-3      | R18       | E-4      |
| C4        | D-4      | CR4       | D-2      | Q6        | D-3      | R7        | B-2      | R19       | E-4      |
| C5        | C-4      | CR5       | D-3      | Q7        | E-4      | R8        | C-2      | R20       | D-4      |
| C6        | E-3      | CR6       | D-4      | Q8        | E-2      | R10       | C-3      | R21       | D-4      |
| C7        | D-2      | CR7       | E-4      | Q9        | E-3      | R11       | C-2      | R22       | E-3      |
| C8        | B-4      | J1        | E-3      | Q10       | E-4      | R12       | E-2      | R23       | E-2      |
| C9        | C-4      | P1        | D-5      | Q11       | D-5      | R13       | D-2      | R24       | B-4      |
| C10       | C-4      | L1        | E-2      | R1        | B-3      | R14       | D-4      | R25       | C-4      |
| C11       | B-5      | Q1        | B-4      | R2        | B-4      | R15       | D-3      | R26       | C-4      |
| C12       | C-3      | Q2        | B-2      | R3        | B-3      | R16       | D-4      | R27       | C-3      |
| CR1       | B-5      | Q3        | B-3      | R4        | B-3      |           |          |           |          |

Figure 8-14. A5 Components Locator

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**VOLTAGE MEASUREMENT CONDITIONS**

Set Model 1825A controls as follows:

DISPLAY..... DELAYED  
 MAIN TIME/DIV ..... .2 mSEC  
 DELAYED TIME/DIV..... .1 mSEC  
 MAIN TRIG LEVEL..... cw  
 DELAYED TRIG LEVEL..... cw  
 VERNIER..... detent  
 AUTO/NORM..... NORM  
 SINGLE..... in  
 pushbuttons not mentioned..... out

Press RESET and observe that RESET lamp is on. During each test, ensure that RESET lamp is on.

**WAVEFORM MEASUREMENT CONDITIONS**

Connect equipment as shown in figure 8-3.

Set Model 1825A controls as follows:

DISPLAY..... DELAYED  
 MAIN TIME/DIV ..... .2 mSEC  
 DELAYED TIME/DIV..... .2 mSEC  
 MAIN POS/NEG..... NEG  
 DELAYED POS/NEG..... NEG  
 MAIN INT/EXT..... EXT  
 DELAYED INT/EXT..... EXT  
 MAIN +/-10..... +10  
 DELAYED +/-10..... +10  
 DELAY dial..... cw  
 pushbuttons not mentioned..... out

**WAVEFORM NOTES**

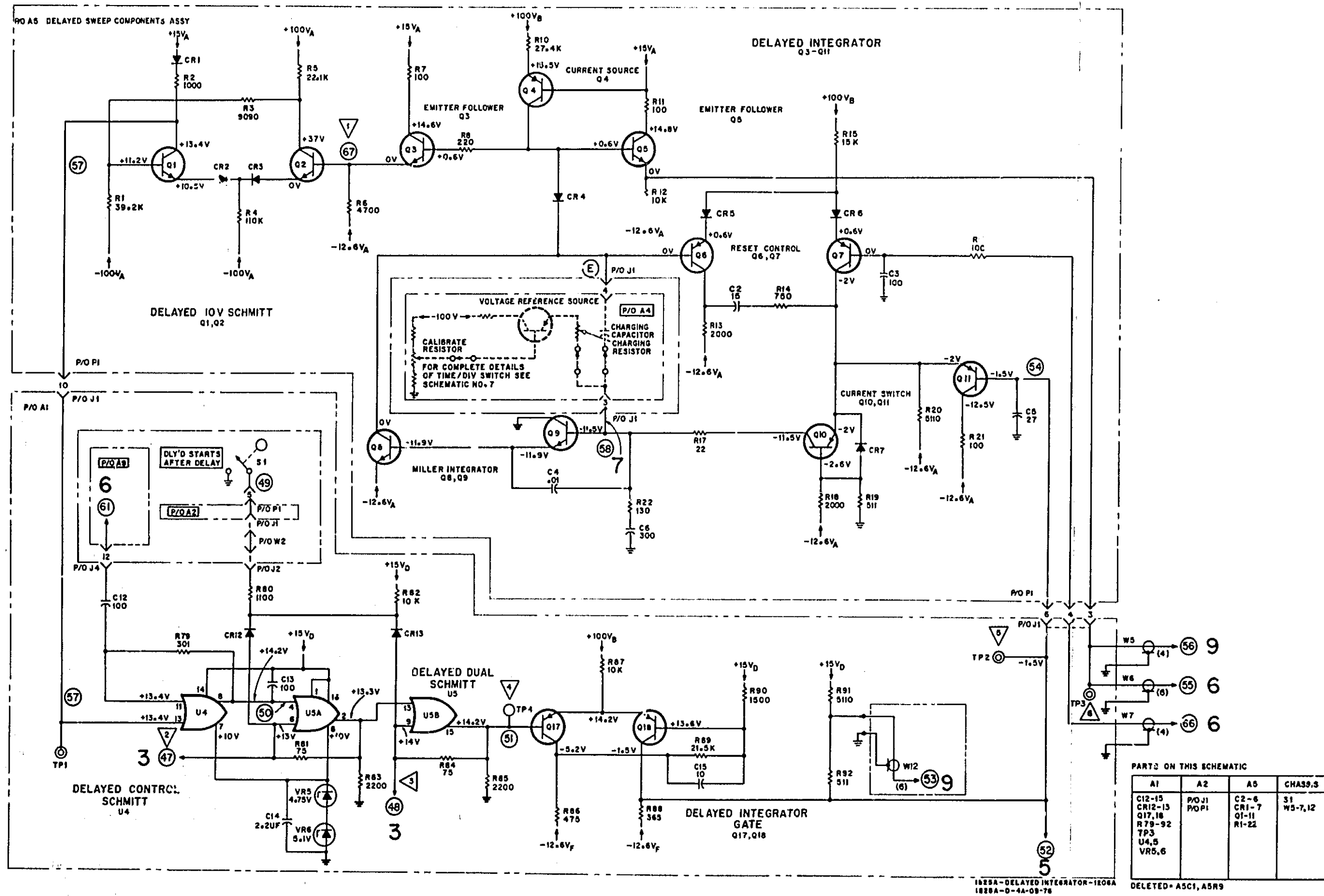
At  $t_0$ , main sweep ends.

At  $t_1$ , comparator coincidence occurs; dual Schmitt arms.

At  $t_2$ , dual Schmitt output goes low; integrator gate initiates trigger step to integrator; delayed sweep starts.

1825A-R-15

Figure 8-15. Schematic 4 Voltage and Waveform Measurement Conditions



4

Figure 8-16.  
Schematic Delay Integrator  
8-15



| No. | Signal Name                  |
|-----|------------------------------|
| 3   | Main internal trigger        |
| 25A | Main gate to gate Schmitt    |
| 35  | Delayed internal trigger     |
| 52  | Delayed gate to gate Schmitt |
| 59  | Internal trigger input       |
| 63  | Composite intensified gate   |
| 64  | Main gate enable voltage     |
| 65  | Delayed gate enable voltage  |

### VOLTAGE MEASUREMENT CONDITIONS

Connect equipment as shown in figure 8-3.

Set Model 1825A controls as follows:

DISPLAY..... DELAYED  
 MAIN/TIME DIV ..... .2 mSEC  
 DELAYED TIME/DIV..... .1 MSEC  
 MAIN TRIG LEVEL..... cw  
 DELAYED TRIG LEVEL..... cw  
 VERNIER ..... detent  
 AUTO/NORM..... NORM  
 SINGLE..... in  
 pushbuttons not mentioned ..... out

Press RESET and observe that RESET lamp is on.  
 During each test, ensure that RESET lamp is on.

*Figure 8-17. Schematic 5 Voltage Measurement Conditions*

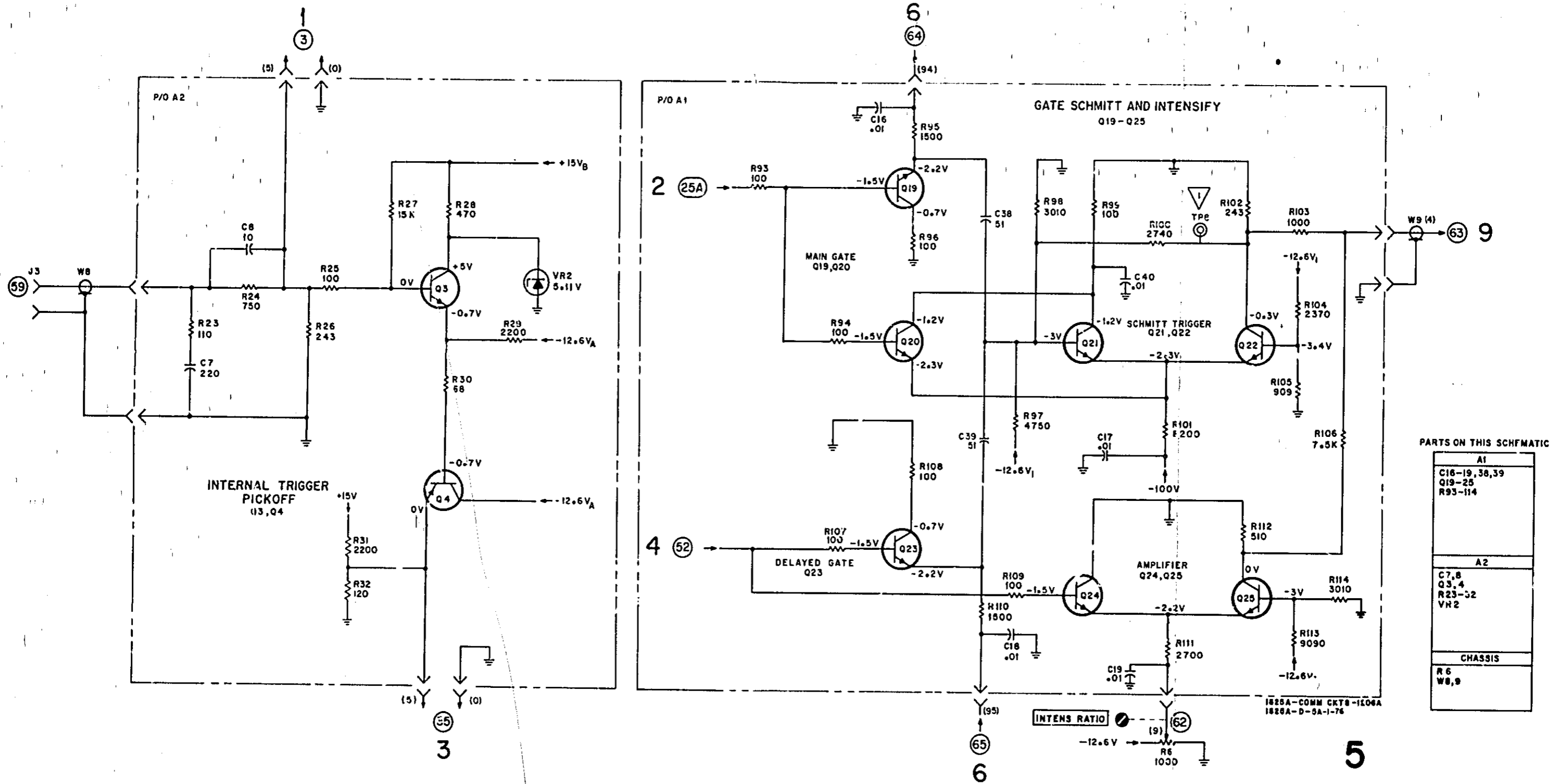


Figure 8-18.  
Schematic, Common Circuits  
8-17

Table 8-9. Schematic 6 Signal Identifier

| No. | Signal Name                     |
|-----|---------------------------------|
| 33  | Main ramp                       |
| 55  | Delayed ramp                    |
| 60  | Delay comparison voltage        |
| 61  | Delayed trigger enable voltage  |
| 64  | Main gate enable voltage        |
| 65  | Delayed gate enable voltage     |
| 66  | Delayed reset reference voltage |
| 68  | Composite ramp output           |
| 69  | Delayed erable voltage          |

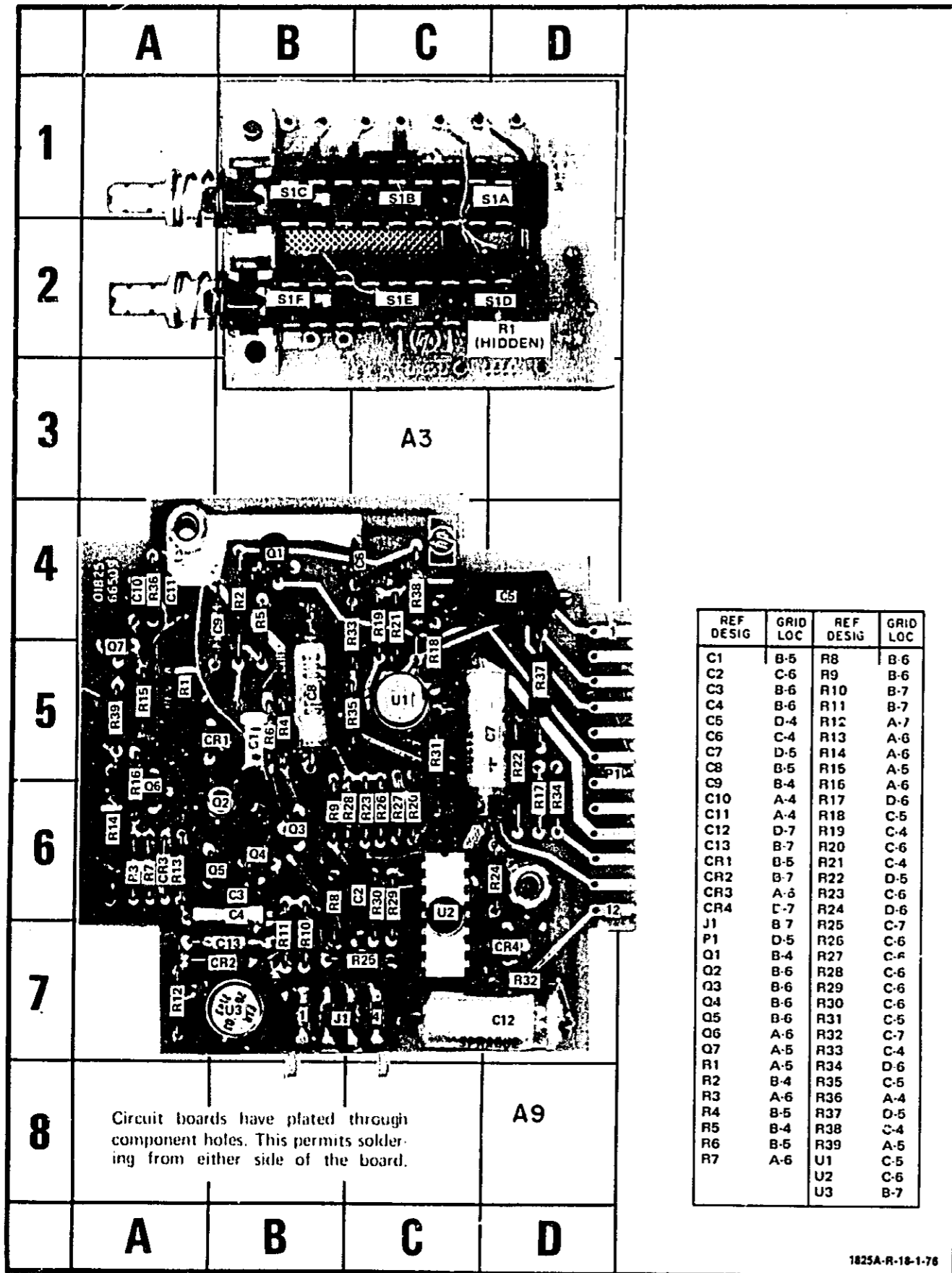


Figure 8-19. A3 and A9 Components Locator

**VOLTAGE MEASUREMENT CONDITIONS**

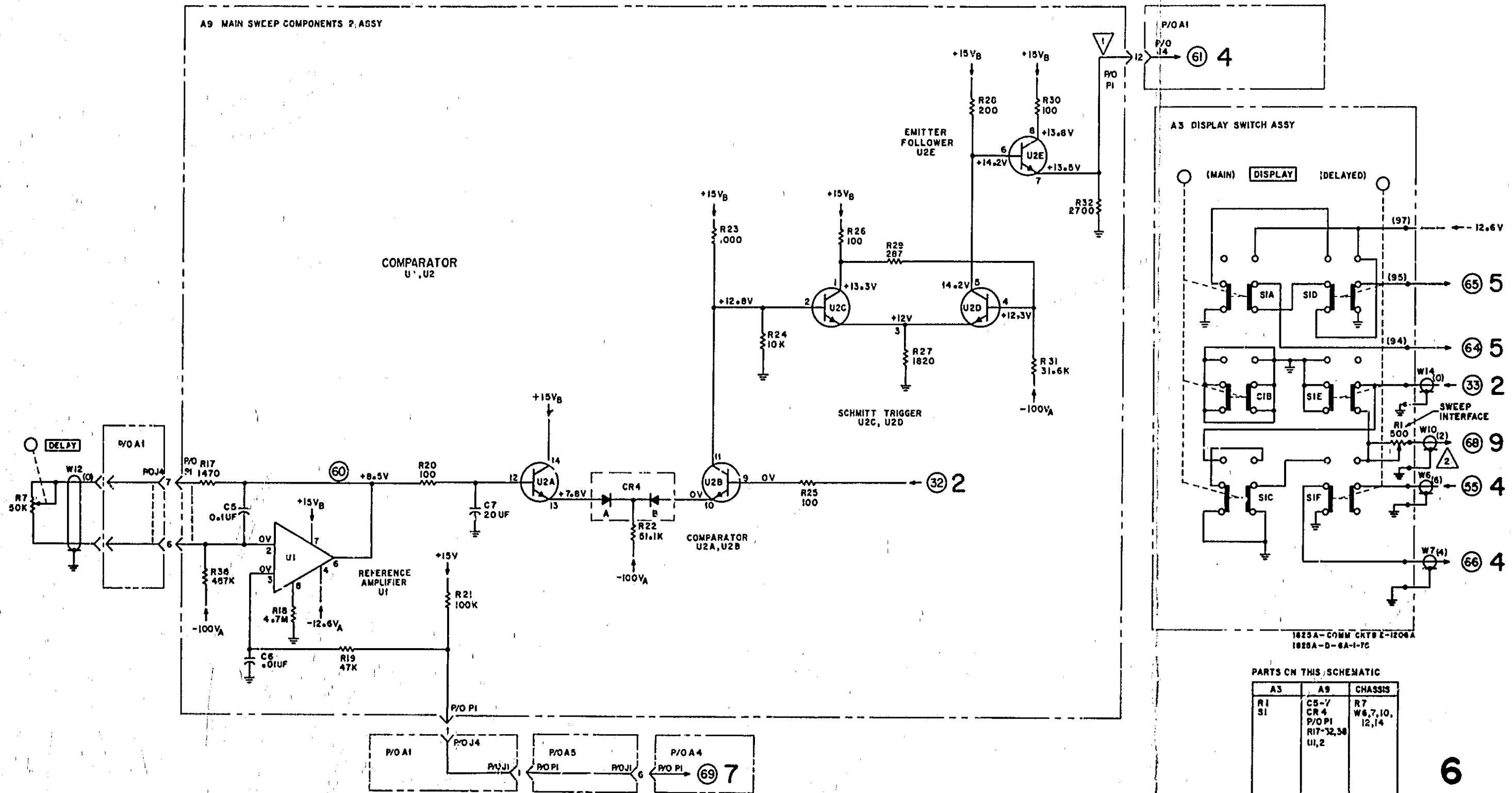
Connect equipment as shown in figure 8-3.

Set Model 1825A controls as follows:

- DISPLAY..... MIXED
- MAIN TIME/DIV ..... .2 mSEC
- DELAYED TIME/DIV..... .1 mSEC
- MAIN TRIG LEVEL..... cw
- DELAYED TRIG LEVEL..... cw
- VERNIER ..... detent
- AUTO/NORM ..... NORM
- SINGLE..... in
- pushbuttons not mentioned ..... out

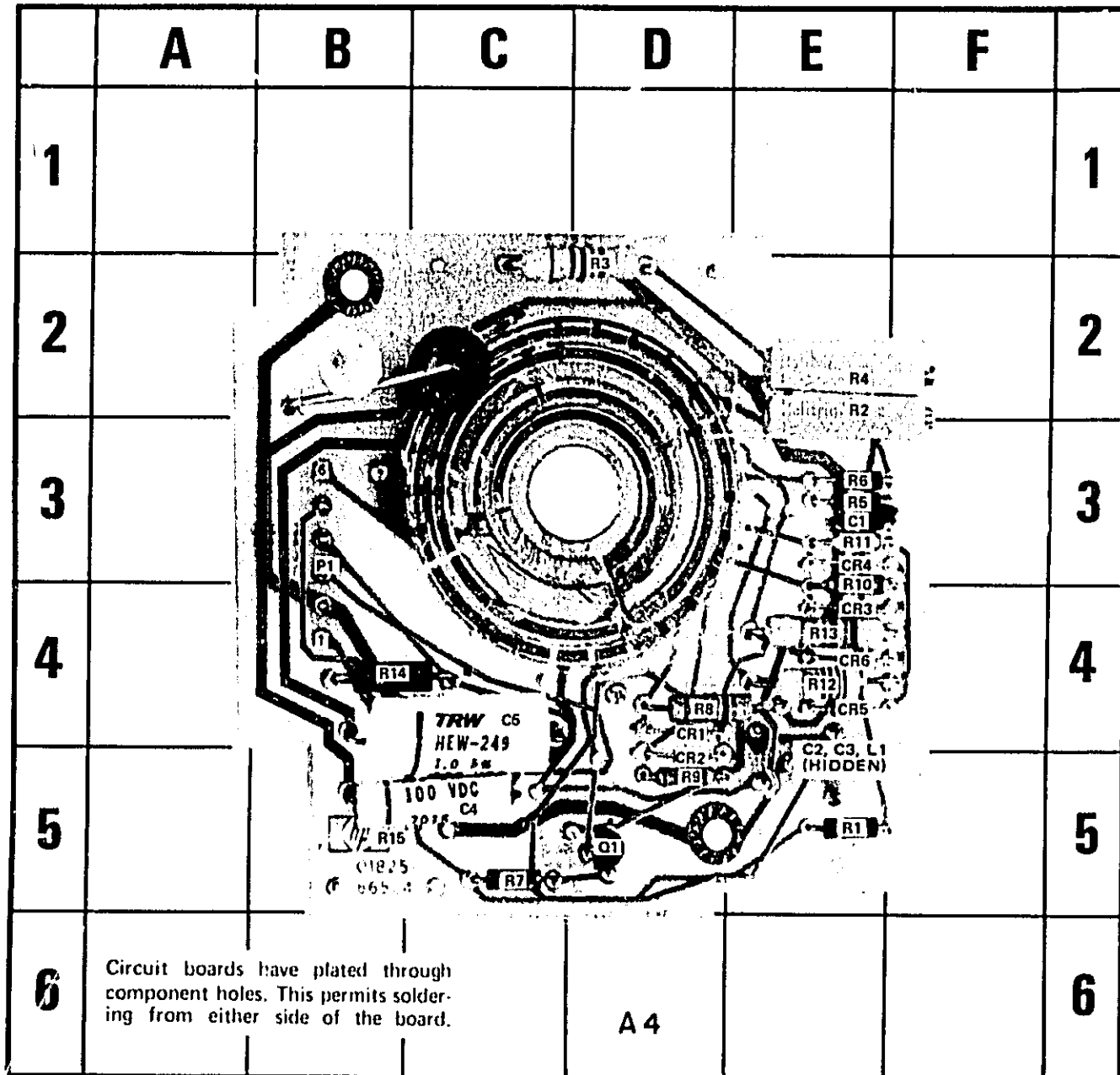
Press RESET and observe that RESET lamp is on. During each test, ensure that RESET lamp is on.

Figure 8-20. Schematic 6 Voltage Measurement Conditions



6

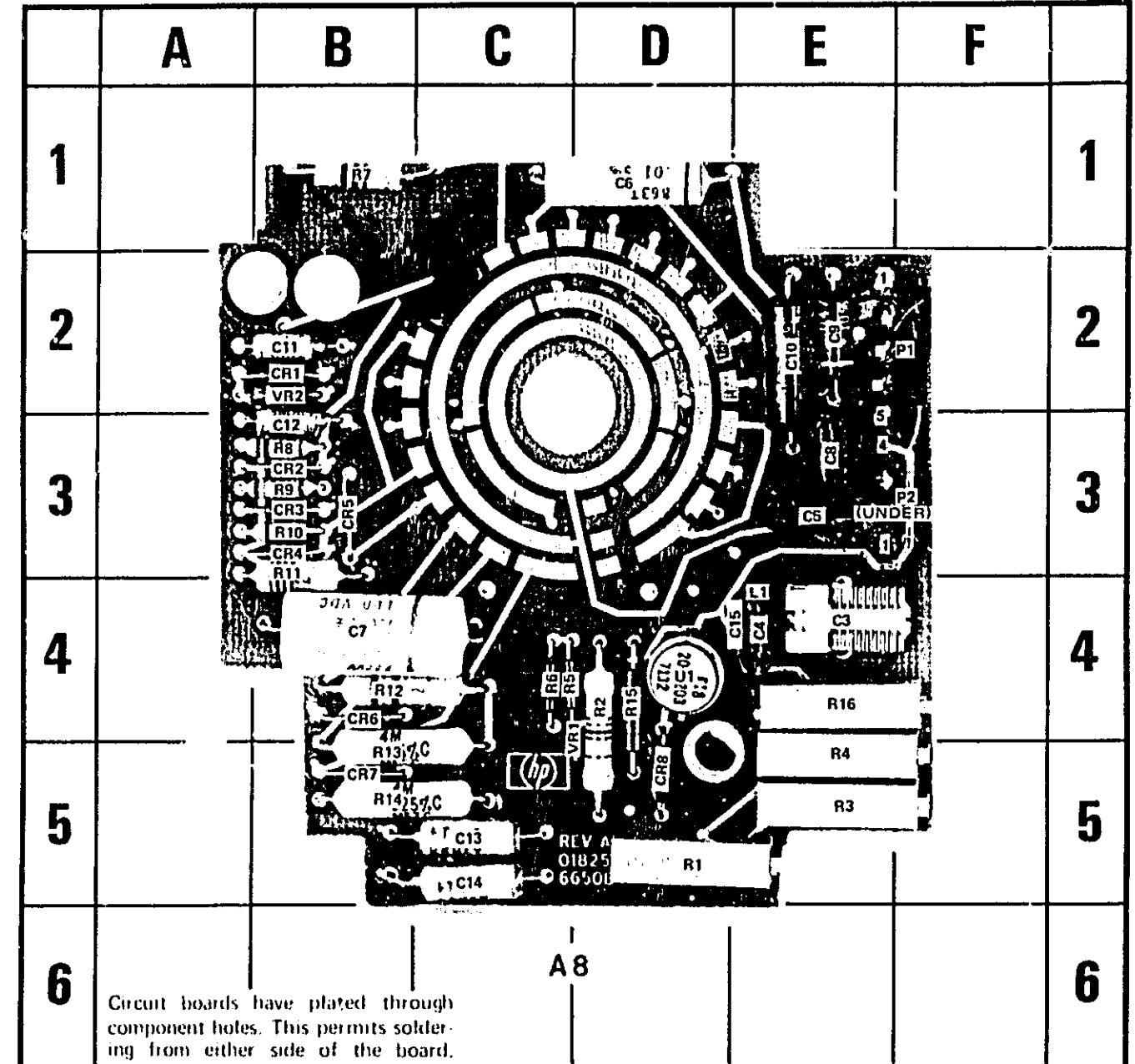
Figure 8-21.  
Schematic, Common Circuits  
8-19



| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|-----------|----------|-----------|----------|-----------|----------|
| C1        | E-3      | CR6       | E-4      | R6        | E-3      |
| C2        | E-5      | L1        | E-5      | R7        | C-6      |
| C3        | E-5      | P1        | B-3      | R8        | D-4      |
| C4        | C-5      | Q1        | D-6      | R9        | D-6      |
| C5        | C-4      | R1        | E-5      | R10       | E-3      |
| CR1       | D-4      | R2        | E-2      | R11       | E-3      |
| CR2       | D-5      | R3        | D-2      | R12       | E-4      |
| CR3       | E-4      | R4        | E-2      | R13       | E-4      |
| CR4       | E-3      | R5        | E-3      | R14       | B-4      |
| CR5       | E-4      |           |          | R15       | B-5      |

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Figure 8-22. A4 Components Locator



| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|-----------|----------|-----------|----------|-----------|----------|-----------|----------|-----------|----------|
| C3        | E-4      | C11       | B-2      | CR4       | B-3      | R2        | D-4      | R11       | B-3      |
| C4        | E-4      | C12       | B-3      | CR5       | B-3      | R3        | E-5      | R12       | B-4      |
| C5        | E-3      | C13       | C-5      | CR6       | B-4      | R4        | E-5      | R13       | B-5      |
| C6        | D-1      | C14       | C-5      | CR7       | B-5      | R5        | C-4      | R14       | B-5      |
| C7        | B-4      | C15       | D-4      | CR8       | D-5      | R6        | C-4      | R15       | D-4      |
| C8        | E-3      | CR1       | B-2      | L1        | E-4      | R7        | B-1      | R15       | E-4      |
| C9        | E-1      | CR2       | B-3      | P1        | F-2      | R8        | B-3      | U1        | D-4      |
| C10       | E-2      | CR3       | B-3      | P2        | F-3      | R9        | B-3      | VF11      | D-5      |
|           |          |           |          | R1        | D-5      | R10       | B-3      | VF12      | B-2      |

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Figure 8-23. A3 Components Locator

Table 8-10. Schematic 7 Signal Identifier

| No. | Signal Name                               |
|-----|---|
| 30  | Vernier control voltage                   |
| 31  | Main integrator input                     |
| 32  | Main ramp to comparator                   |
| 58  | Delayed integrator input                  |
| 69  | Delayed enable voltage                    |
| A   | Holdoff interconnection                   |
| B   | Main integrator output interconnection    |
| C   | Main int-grator input interconnection     |
| D   | Capacitor A7C10 interconnection           |
| E   | Delayed integrator output interconnection |

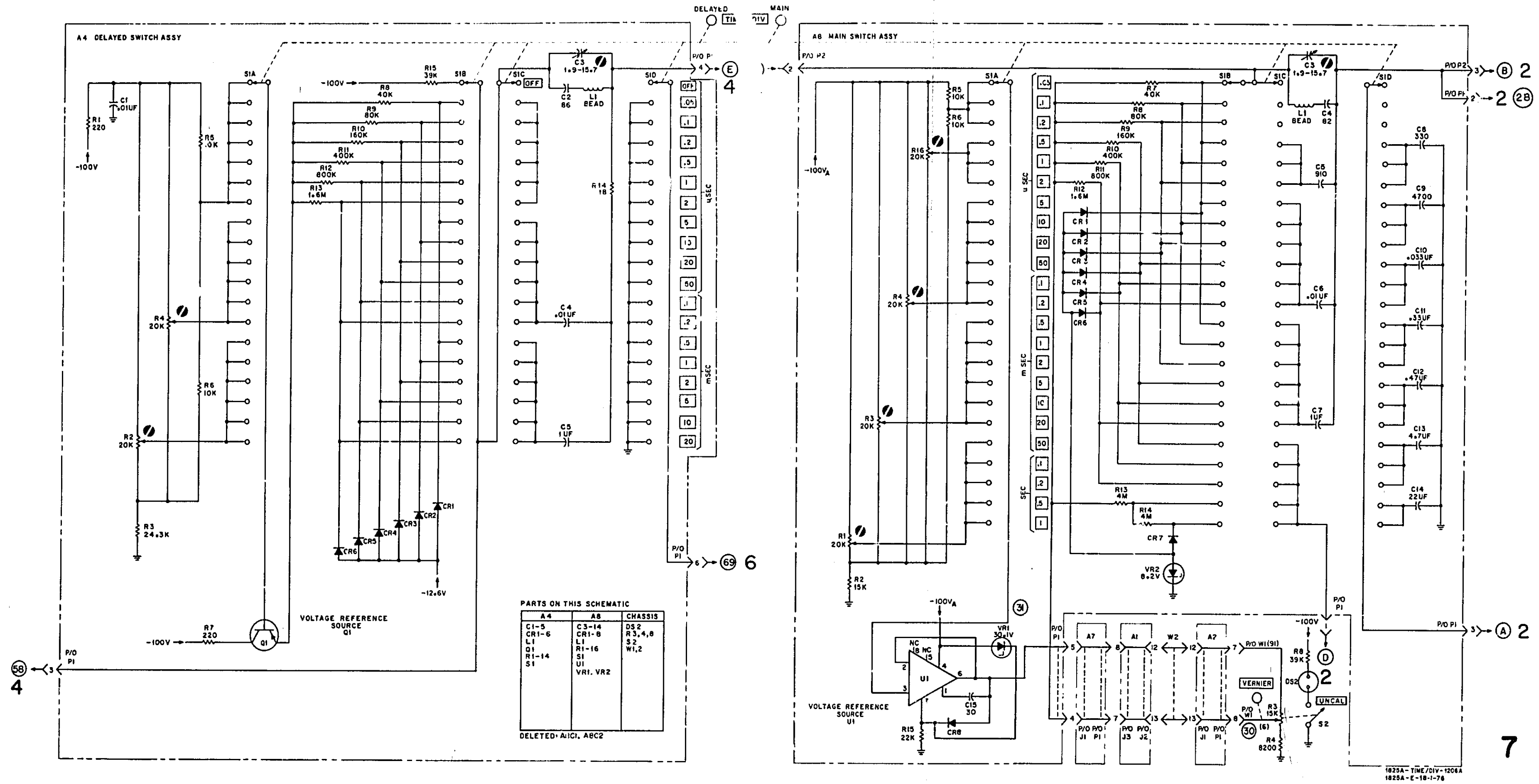
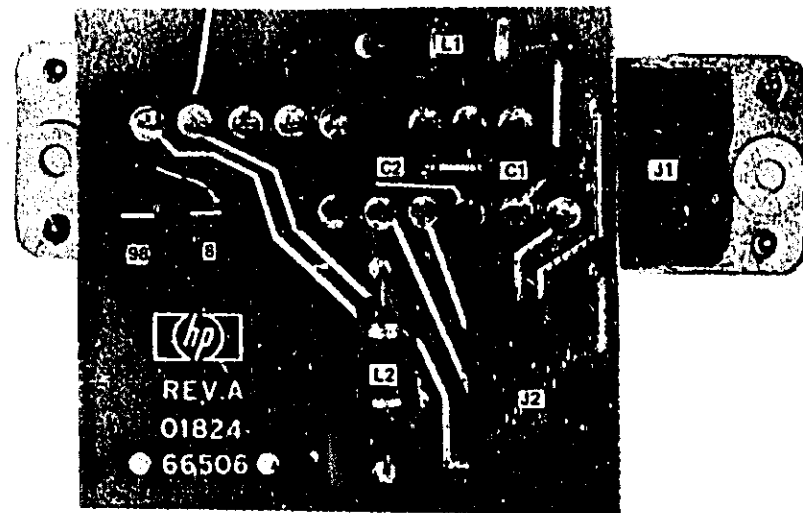


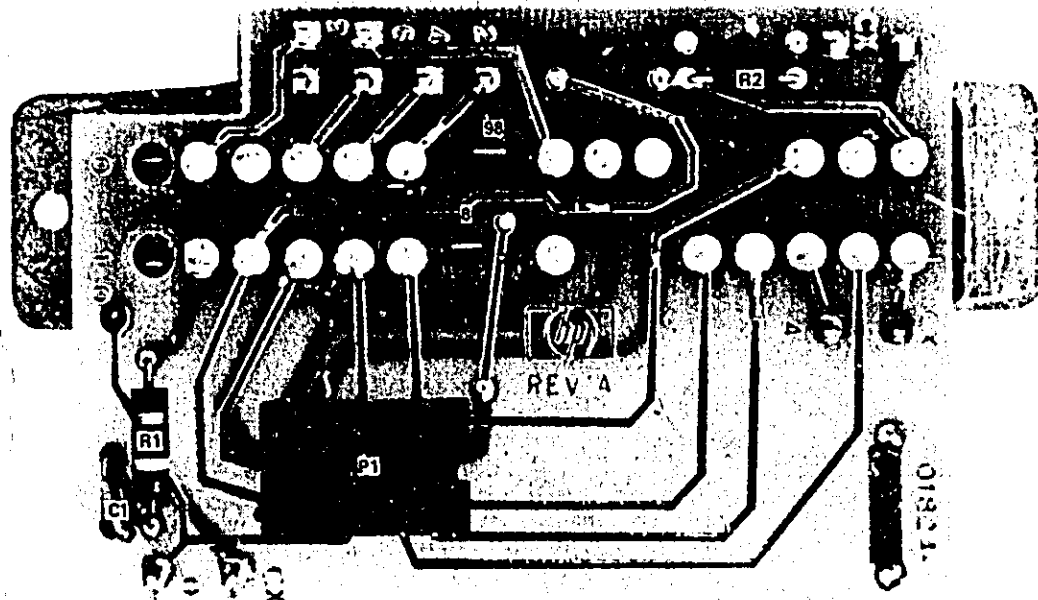
Figure 8-24. Schematic, TIME/DIV Switches 8-21

Table 8-11. Schematic 3 and 9 Signal Identifier

| No. | Signal Name                |
|-----|----------------------------|
| 1   | Line trigger               |
| 24  | Main gate to rear panel    |
| 29  | Main ramp to rear panel    |
| 53  | Delayed gate to rear panel |
| 56  | Delayed ramp to rear panel |
| 63  | Composite intensified gate |
| 68  | Composite ramp output      |
| 70  | Beam finder                |
| 71  | Chopped blanking           |
| 72  | Alternate trigger          |



A 6



A10

Circuit boards have plated through component holes. This permits soldering from either side of the board.

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Figure 8-25. A6 and A10 Components Locator

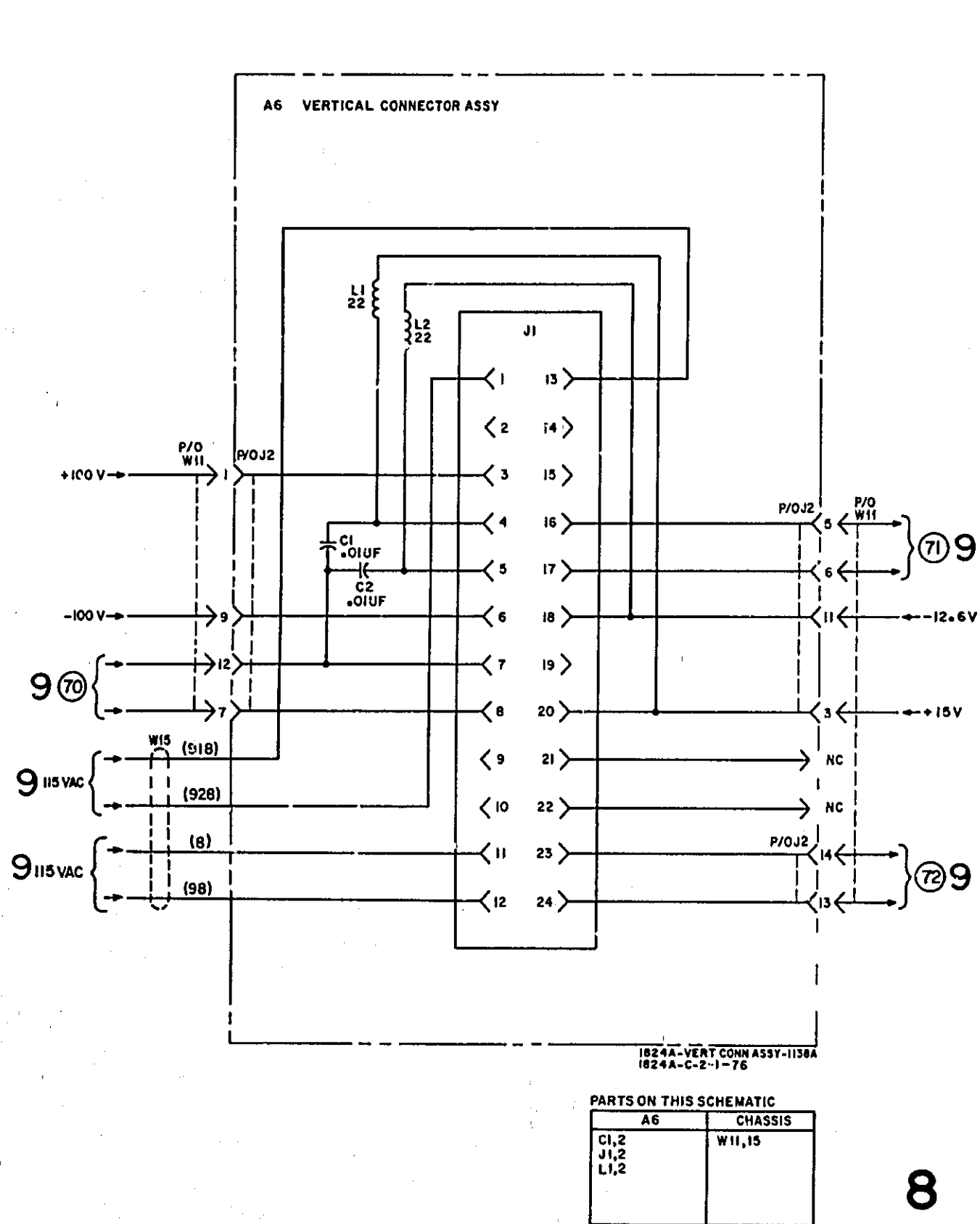


Figure 8-26. Schematic, Vertical Connector Assembly

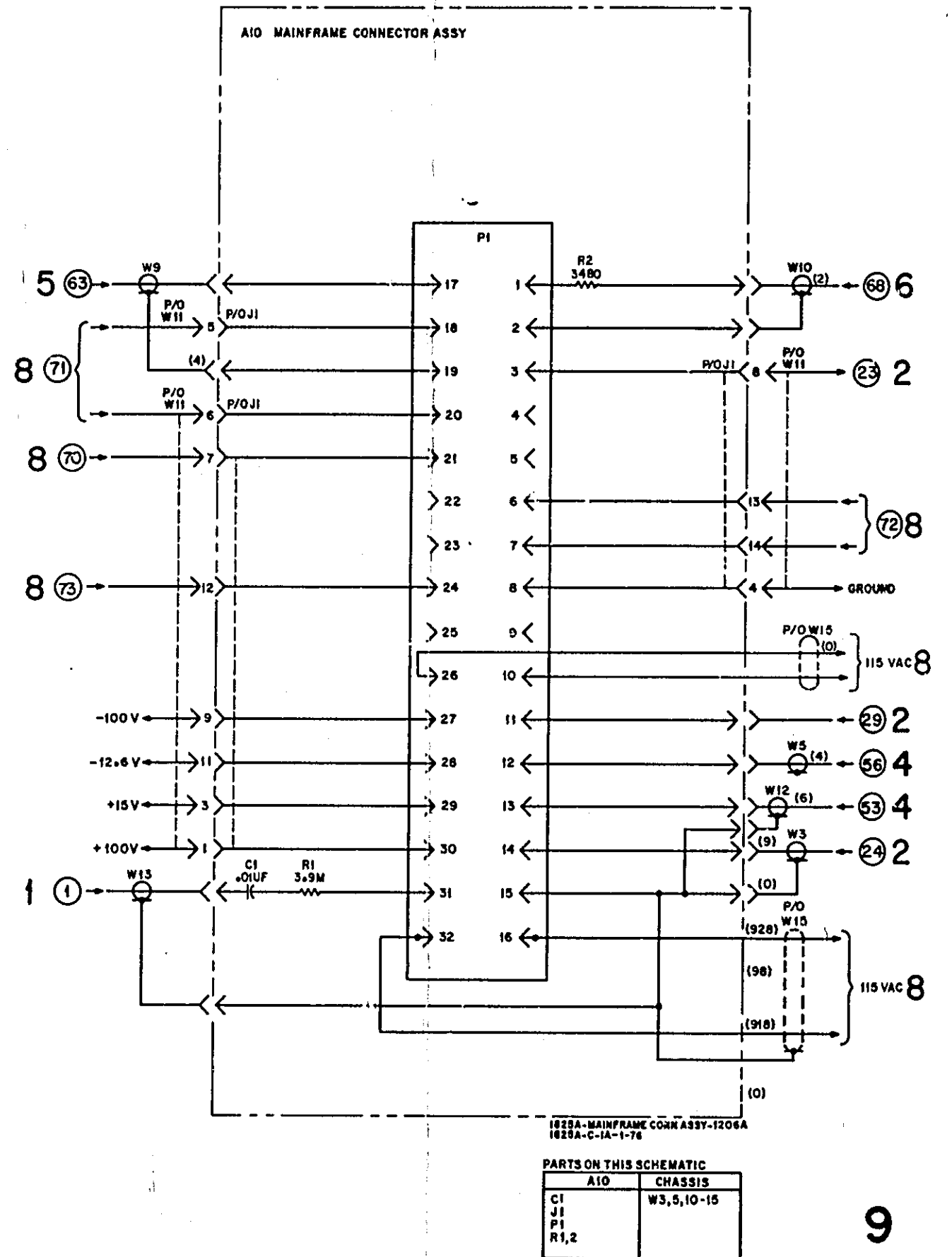
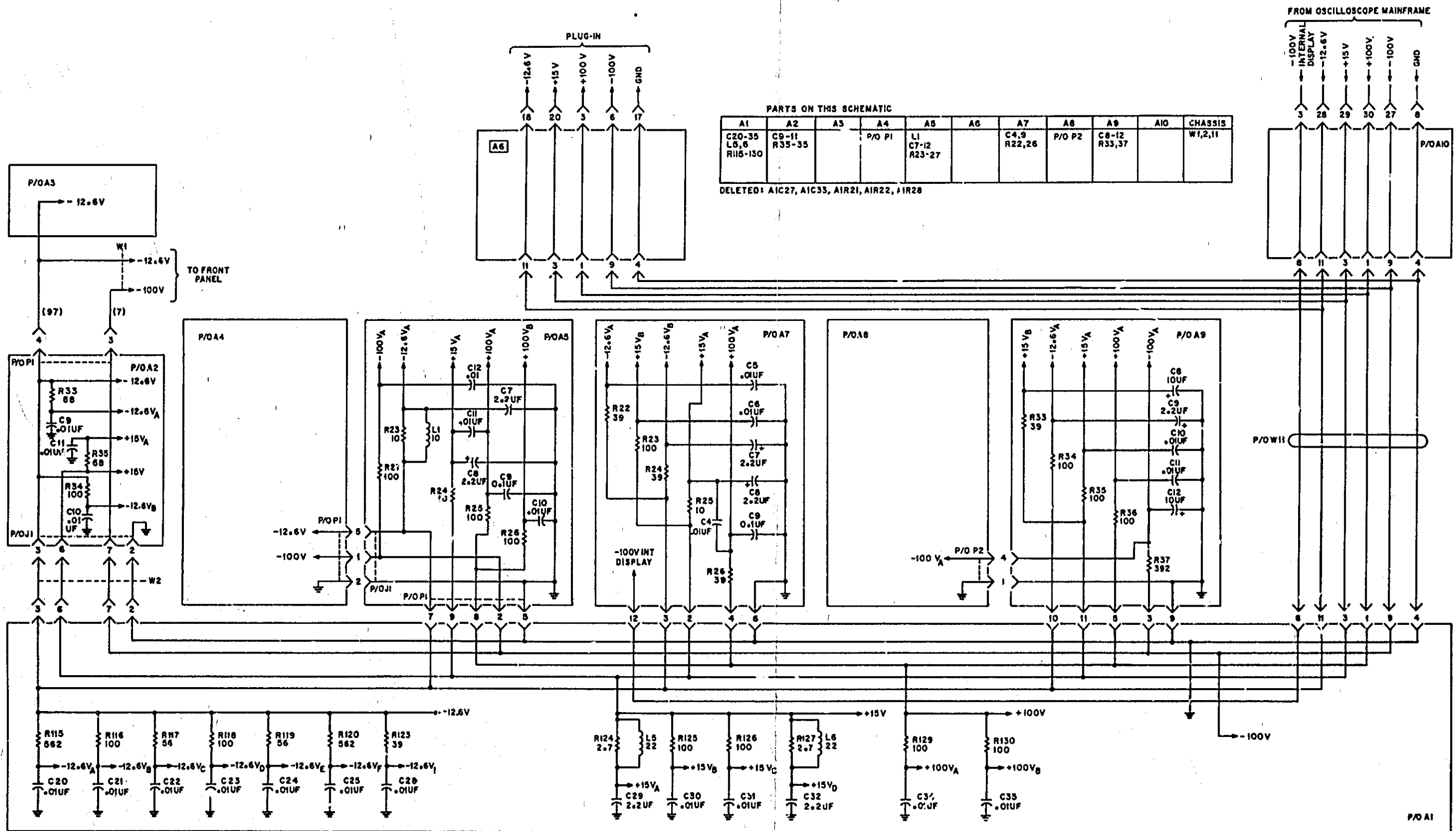


Figure 8-27. Schematic, Mainframe Connector Assembly





PARTS ON THIS SCHEMATIC

| A1                         | A2              | A3 | A4     | A5                    | A6 | A7             | A8     | A9              | A10 | CHASSIS |
|----------------------------|-----------------|----|--------|-----------------------|----|----------------|--------|-----------------|-----|---------|
| C20-35<br>L5,6<br>R115-130 | C9-11<br>R33-35 |    | P/O P1 | L1<br>C7-12<br>R23-27 |    | C4,9<br>R22,26 | P/O P2 | C8-12<br>R33,37 |     | W1,2,11 |

DELETED: AIC27, AIC33, AIR21, AIR22, IR28

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1825A - D-7-1-76

Figure 8-28. Schematic DC Voltage Distribution

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