



045-0150-00

M63569, M63570, M63584  
M63971, M65168, M65517  
M65726, M65851, M65980  
M66172, M66294, M66492  
M66574

### RELIABILITY IMPROVEMENTS

For the following TEKTRONIX<sup>®</sup> instruments:

11401 Serial Numbers B010100 - B019999

This kit contains parts and instructions that will improve the oscilloscope's reliability. This kit includes a new firmware upgrade version 3.

## KIT PARTS LIST:

Ckt. Number	Quantity	Part Number	Description
	1 ea	020-1576-XX	Component, kit: EPROM's, firmware version 3
	1 ea	070-5791-01	Manual, tech: Users, Reference 11401
	1 ea	070-6255-00	Operators, 11401/11402: Pocket reference
A5U1040	1 ea	155-0320-01	Microckt, linear: Strobe driver
A6U295	1 ea	160-4526-01	Microckt, dgtl: STTL, hi-speed 16 input
A5U1200	2 ea	165-2065-02	Microckt, hybrid: Time interpolator
A5U1220			
A8C430	1 ea	+281-0773-00	Cap, fxd, cer di: 0.01 $\mu$ F, 10%, 100V
A5C1753	2 ea	+281-0812-00	Cap, fxd, cer di: 1000pF, 10%, 100V
A5C1940			
A5C1572	1 ea	+281-0826-00	Cap, fxd, cer di: 2200pF, 10%, 100V
A5C1062			
A5C1262			
A5C1264	6 ea	+285-1300-01	Cap, fxd, mtlzd: 0.1 $\mu$ F, 10%, 63V
A5C1266			
A5C1270			
A5C1570			
A8C323	1 ea	290-0804-00	Cap, fxd, elctlt: 10 $\mu$ F, +50-10%, 25V
A8C620	1 ea	290-0919-00	Cap, fxd, elctlt: 470 $\mu$ F, +50-20%, 35V
A8C221	1 ea	290-0942-00	Cap, fxd, elctlt: 100 $\mu$ F, +100-10%, 25V
A8R230	1 ea	+307-0059-00	Res, fxd, film: 6.2 $\Omega$ , 5%, 5W
A8R330	1 ea	+303-0241-00	Res, fxd, film: 240 $\Omega$ , 5%, 0.075W
A8R1877	1 ea	307-1252-00	Res, ntwrk, fxd, film: (3) 9k $\Omega$ , (2) 6k $\Omega$ , (2) 1.1k $\Omega$ , (1) 12k $\Omega$ , (1) 1k $\Omega$
A8R331	1 ea	+308-0767-00	Res, fxd, ww: 1.1 $\Omega$ , 5%, 1W
A5R1987	1 ea	+313-1201-00	Res, fxd, film: 200 $\Omega$ , 5%, 0.25W
A5R546	1 ea	+313-1241-00	Res, fxd, film: 240 $\Omega$ , 5%, 0.2W
A5R1639			
A5R1641	3 ea	+313-1510-00	Res, fxd, film: 51 $\Omega$ , 5%, 0.2W
A5R1756			
A8R521	1 ea	+315-0120-00	Res, fxd, film: 12 $\Omega$ , 5%, 0.25W
A9R703	1 ea	+315-0566-00	Res, fxd, film: 56M $\Omega$ , 5%, 0.25W
A5R1802	2 ea	+321-0099-00	Res, fxd, film: 105 $\Omega$ , 1%, 0.125W
A5R1804			
A5R1803	2 ea	+321-0215-00	Res, fxd, film: 1.69k $\Omega$ , 1%, 0.12W
A5R1805			

Ckt. Number	Quantity	Part Number	Description
A8R633	1 ea	+321-0418-00	Res. fxd, film: 221k $\Omega$ , 1%, 0.125W
A5R1606	1 ea	+322-3105-00	Res. fxd, film: 121 $\Omega$ , 1%, 0.2W
A5R1605	1 ea	+322-3117-00	Res. fxd, film: 162 $\Omega$ , 1%, 0.2W
A5R1940	2 ea	+322-3126-00	Res. fxd, film: 200 $\Omega$ , 1%, 0.2W
A5R1941			
A19	1 ea	671-0828-00	Ckt bd assy: Trigger Enhancement
	1 ea	174-1355-00	Cable, sp, elec: 26 awg, ribbon, 8 cond
	1 ea	196-3227-00	Lead, electrical: 26 awg, 3.0 l, brown
	3 ea	210-0551-00	Nut, plain, hex: 4-40 x 0.25, st, cd pl
	0.667 ft	-----	Wire, electrical: Solid, 30 awg, blue
	1 ea	-----	Label: 045-kit
	1 ea	-----	Marker: marked Tektronix (cal-label)

**INSTRUCTIONS:**

**WARNING**

*Dangerous shock hazards may be exposed when the instrument covers are removed. Before proceeding, ensure the mainframe power switch is in the off position. Then, disconnect the instrument from the power source. Disassembly should only be attempted by qualified service personnel.*

**CAUTION**

*Many components within the 11401 Digitizing Oscilloscope are extremely susceptible to static-discharge damage. Service the instrument only in a static-free environment. Observe standard handling precautions for static-sensitive devices while installing this kit. Always wear a grounded wrist strap.*

**NOTE**

*These instructions assume a familiarity with the instrument. If additional assembly or disassembly details are required, refer to the 11401 Service Reference Manual.*

**The Following Instructions Are Divided Into Six Sections:**

- Section A.** EPROM microcircuit (firmware) replacement.
- Section B.** R1877 Resistor Network replacement.
- Section C.** Acquisition & Time Base ckt bd modifications.
- Section D.** CRT Driver circuit board A8 modifications.
- Section E.** Touch Panel circuit board A10 modifications.
- Section F.** Checks and Adjustments.

**NOTE**

*Turn the instrument on. If error codes are displayed on the screen, correct the problems before starting this modification upgrade.*

**Section A. EPROM microcircuit (firmware) replacement.**

Ckt. Number	Quantity	Part Number	Description
	1 ea	020-1576-XX	<b>Component, kit: EPROM's, firmware, Consisting of:</b>
U281	1 ea	160-3941-XX	Microckt, dgtl: EPROM, (A6)
U283	1 ea	160-3942-XX	Microckt, dgtl: EPROM, (A6)
U602	1 ea	160-3716-XX	Microckt, dgtl: EPROM, (A7)
U612	1 ea	160-3717-XX	Microckt, dgtl: EPROM, (A7)
U240	1 ea	160-3748-XX	Microckt, dgtl: EPROM, (A17)
U250	1 ea	160-3749-XX	Microckt, dgtl: EPROM, (A17)
U630	1 ea	160-3740-XX	Microckt, dgtl: EPROM, (A18)
U730	1 ea	160-3741-XX	Microckt, dgtl: EPROM, (A18)
U620	1 ea	160-3742-XX	Microckt, dgtl: EPROM, (A18)
U720	1 ea	160-3743-XX	Microckt, dgtl: EPROM, (A18)
U612	1 ea	160-3744-XX	Microckt, dgtl: EPROM, (A18)
U712	1 ea	160-3745-XX	Microckt, dgtl: EPROM, (A18)
U600	1 ea	160-3746-XX	Microckt, dgtl: EPROM, (A18)
U700	1 ea	160-3747-XX	Microckt, dgtl: EPROM, (A18)

**NOTE**

*Disgard the 11401/11402 Firmware Upgrade instructions that is included with the 020-1576-xx component kit and use the following instructions.*

- ( ) 1. Turn the slotted fasteners on the top and bottom dust covers one quarter turn counterwise, then remove the dust covers by lifting away from the instruments.
- ( ) 2. Remove both nylon circuit board guides from the top of the card cage. The guides are retained by two small catches located in the two holes in the left bracket of the card cage. Both ends of the guides can be pried loose for removal.
- ( ) 3. Remove the two screws that secure the card cage retainer, then remove the retainer from the instrument.

**NOTE**

*When installing the new EPROM microcircuits be certain pin 1 is position correctly and all component pins are properly seated.*

- ( ) 4. Remove the Memory circuit board A18 from the card cage. The Memory circuit board is located near the outside of the instrument. Replace the following microcircuits with the new microcircuits provided in this kit: (refer to Figure 2 for component locations).

U600	160-3746-XX
U612	160-3744-XX
U620	160-3742-XX
U630	160-3740-XX
U700	160-3747-XX
U712	160-3745-XX
U720	160-3743-XX
U730	160-3741-XX

- ( ) 5. Replace the Memory circuit board A18 former location in the card cage.
- ( ) 6. Remove the Main Processor circuit board A17 form the card cage. The Main Processor circuit board is located next to the Memory circuit board. J77 cable connector must be removed before the Main Processor circuit board can be removed from the card cage. Note the positions of the cable connector index marks for later reassembly.
- ( ) 7. Replace U240 and U250, microcircuits with the new microcircuits provided in this kit, U240, pn 160-3748-XX, and U250, pn 160-3749-XX. (refer to Figure 3 for component locations).
- ( ) 8. Replace the Main Processor circuit board A17 former location in the card cage.
- ( ) 9. Replace J77 cable connectors removed in the step 6.
- ( ) 10. Remove U602 and U612, microcircuits, located on the Display Controller circuit board A7, and replace with the new microcircuits U602, pn 160-3716-XX, and U612, pn 160-3717-XX, provided in this kit. (refer to Figure 4 for component locations).
- ( ) 11. Position the instrument with the bottom facing the installer. The Time Base circuit board A6 is located towards the front of the instrument. Remove U281 and U283, microcircuits, located on the Time Base circuit board, and replace with the new microcircuits U281, pn 160-3941-XX and U283, pn 160-3942-XX, provided in this kit. (refer to Figure 5 for component locations).
- ( ) 12. Turn the instrument on. Make sure the instrument runs through the self-test routine. Disregard error codes displayed on the screen. However, if the instrument locks-up and will not respond to any of the controls, recheck installed microcircuits: proper microcircuit locations, correct pin orientation or seated firmly into the sockets.
- ( ) 13. Replace the card cage retainer with the two screws, then replace the two nylon circuit board guides.
- ( ) 14. Connect the instrument to a terminal and enter the MCALCONSTANT 134 number that is noted on Acquisition circuit board label.

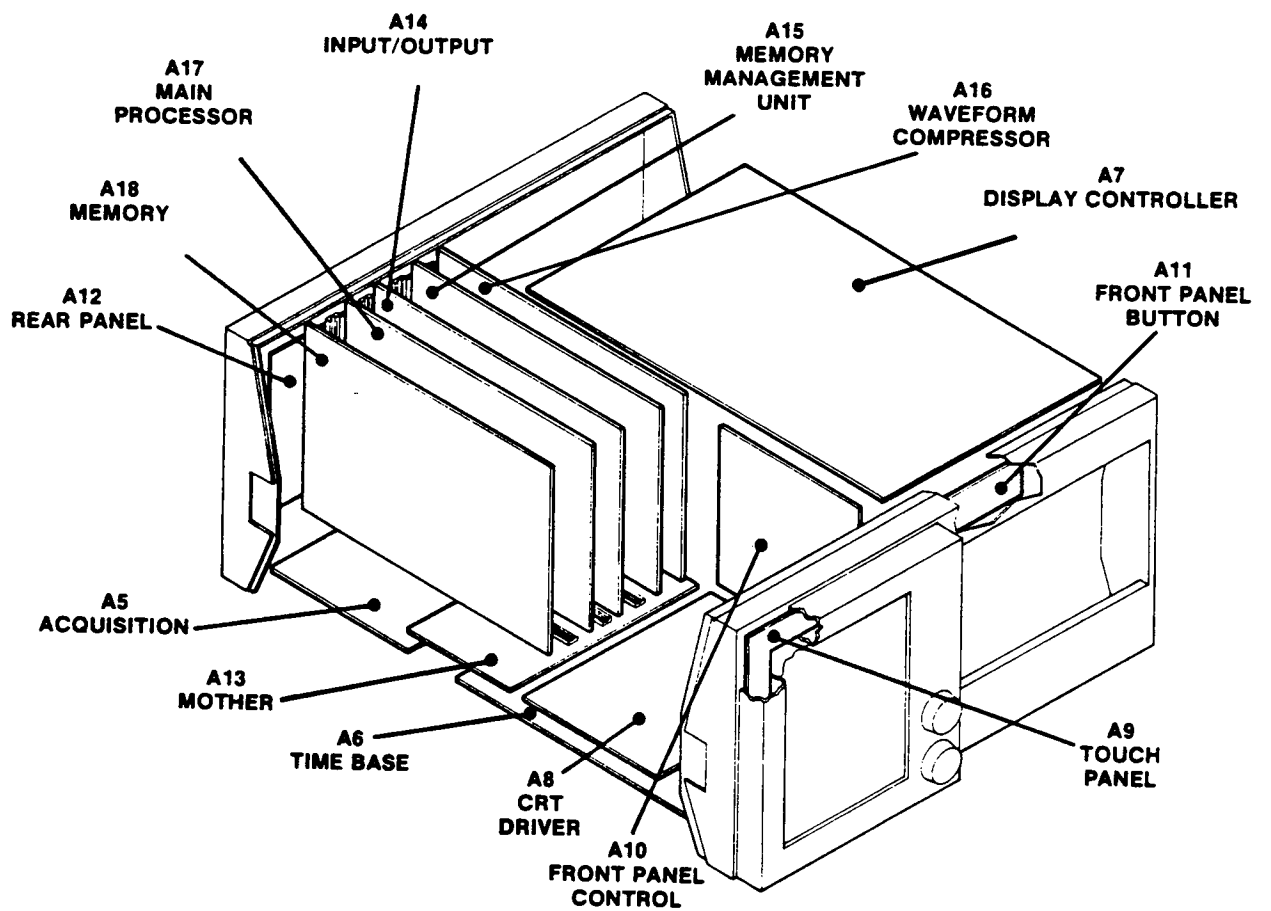


Figure 1 - 11401 Circuit Board Locations.

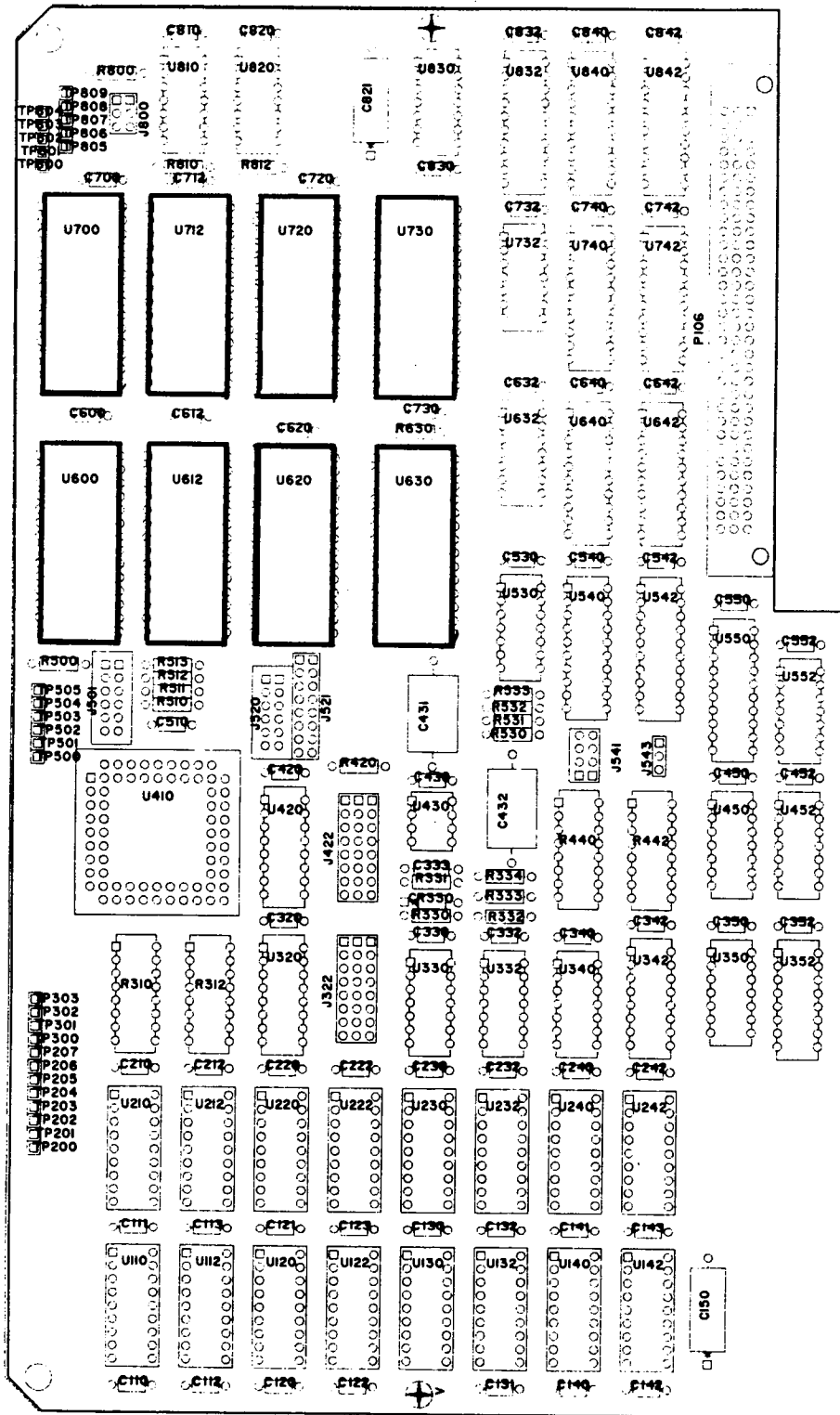


Figure 2 - Memory Circuit Board A18.



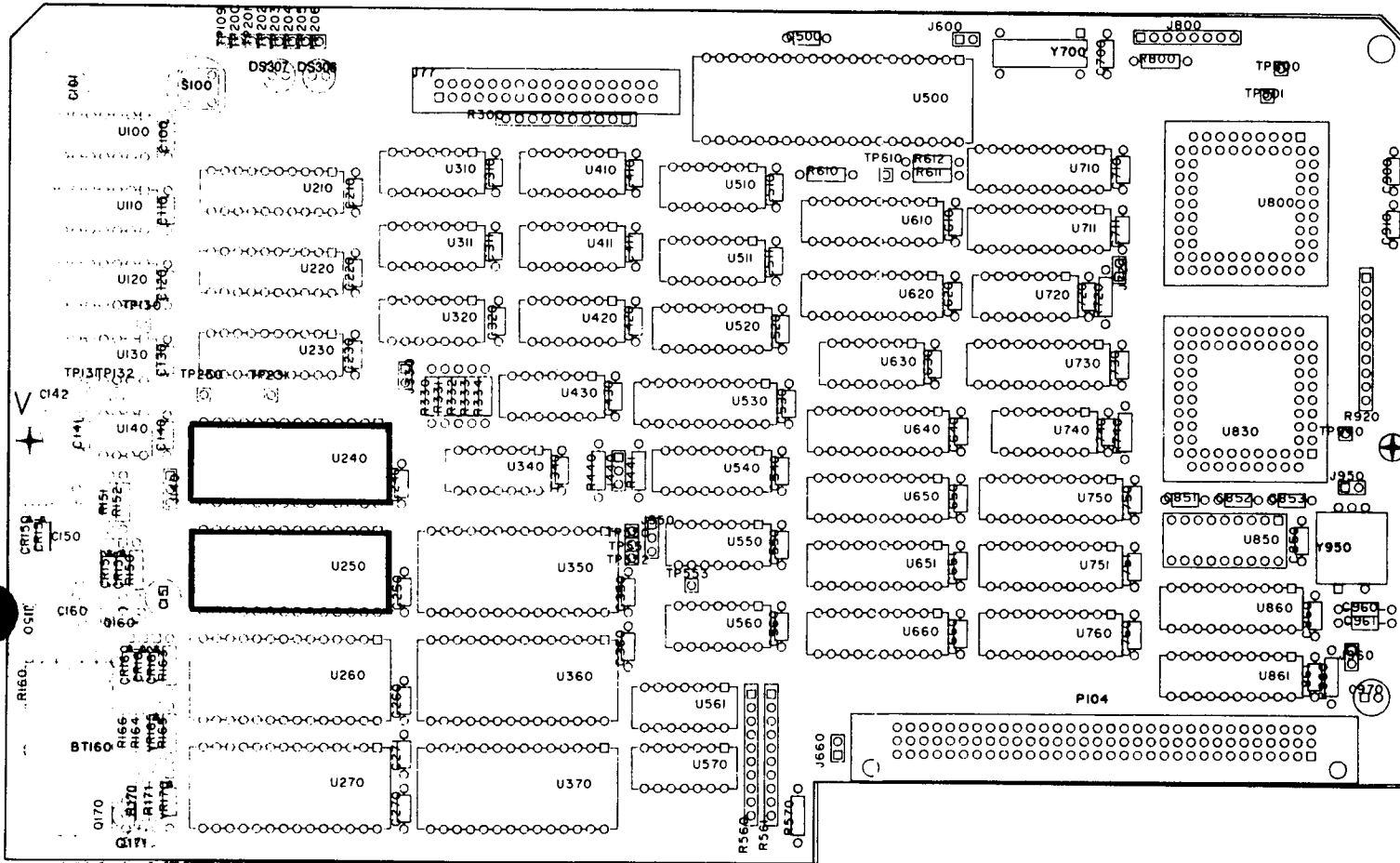


Figure 3 - Main Processor Circuit Board A17.

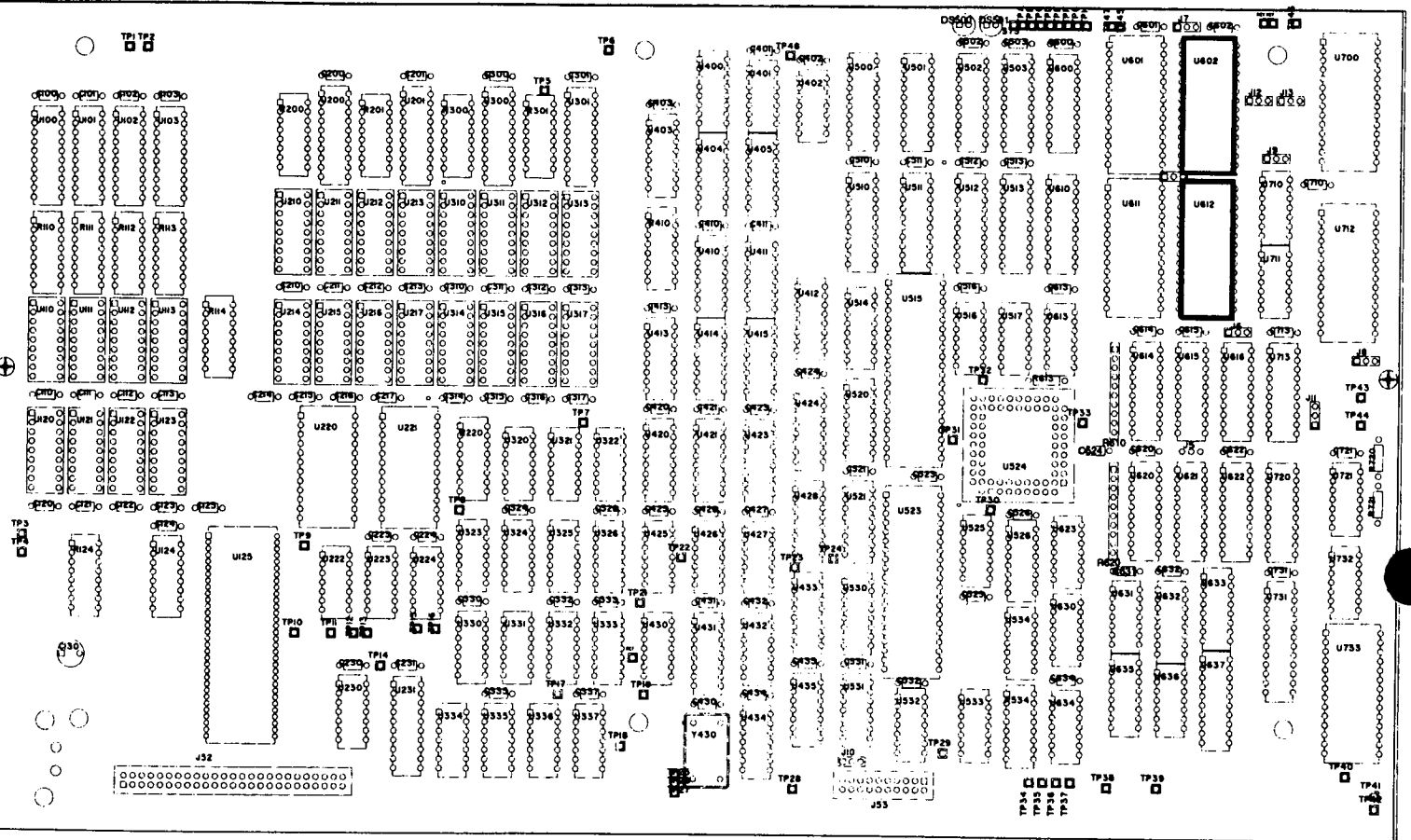


Figure 4 - Display Controller Circuit Board A7.

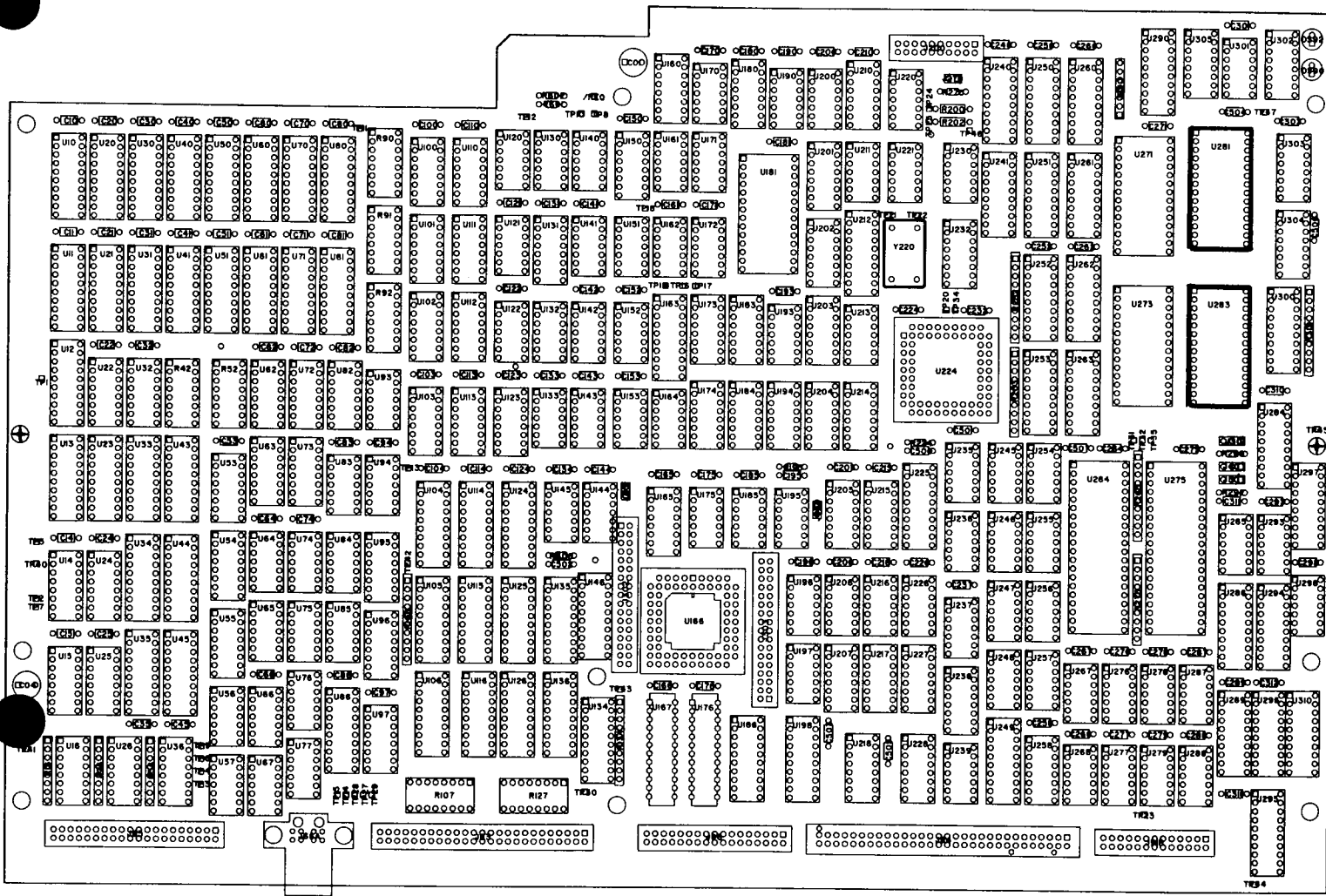


Figure 5 - Time Base Circuit Board A6.

**Section B. R1877 Resistor Network replacement.**

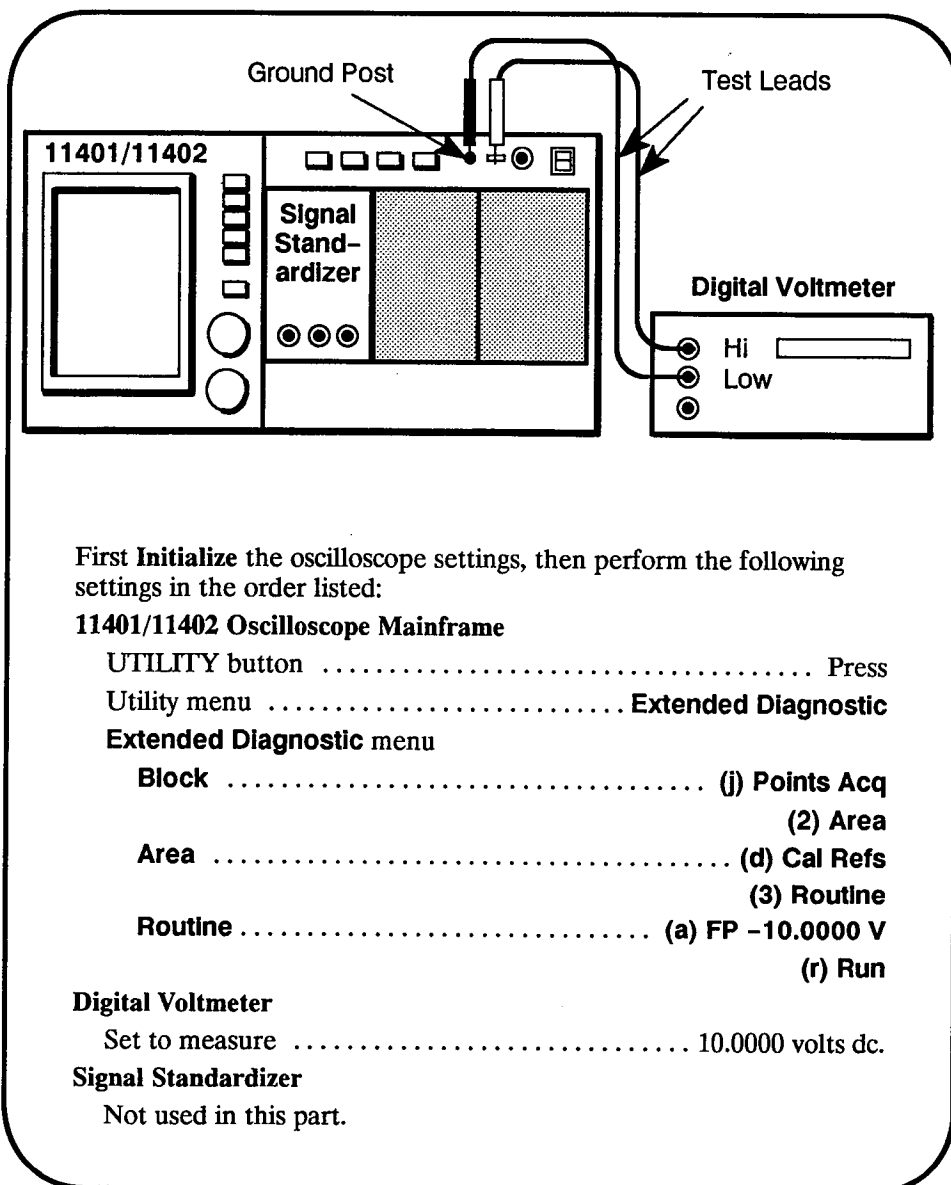
**NOTE**

*R1877 resistor network is located on the Aquisition circuit board A5, refer to Figure 6.*

**Description.** The extended diagnostics are set to apply (selected voltages) to the front panel connector which is then measured with a digital voltmeter.

**Specification.** Attenuator Ratios  $\pm 0.04\%$ .

**Setup**



**Procedure**

- a. Record the minus voltage. Recorded voltage \_\_\_\_\_
- b. Select the **Exit(E)** label.
- c. Select **(k)FP + 9.9951 V** from the **Routine** menu.
- d. Select the **(r)Run** label in the menu/status area. Recorded voltage \_\_\_\_\_
- e. Add the absolute value of the voltage recorded in step a to the absolute value recorded in step d. Recorded Voltage \_\_\_\_\_
- f. Select the **Exit(E)** label.
- g. Select **(b)FP -5.0000 V** from the **Routine** menu.
- h. Select the **(r)Run** label in the menu/status area.
- i. Push the offset button on the DVM.
- j. Select the **Exit(E)** label.
- k. Select **(j)FP + 4.9976 V** from the **Routine** menu.
- l. Select the **(r)Run** label in the menu/status area.
- m. Record the voltage reading on the DVM and multiply 2. (Refer to Step m Voltage in Table 2-2 for selecting voltages for the 2nd, 3rd, and 4th repetitions.) Recorded Voltage \_\_\_\_\_
- n. **EXAMINE**—that the difference between the voltages recorded in steps e and m is  $\leq \pm 0.008$  V.
- o. Push the offset button on the DVM so that the DVM is off.
- p. Repeat Steps g through o using the voltages supplied in Table 2-2 for Steps g, k, and m on repetitions 2, 3, and 4.

} ± 6 mV

**TABLE 2-2**  
**Voltages for Checking Attenuator Ratios**

Repetition	Step g Voltage	Step k Voltage	Step m Voltage	Recorded Voltages
2	FP -2.5000 V	FP + 2.4988 V	multiply by 4	_____
3	FP -1.000 V	FP + 999.51 mV	multiply by 10	_____
4	FP -100.00 mV	FP + 99.951 mV	multiply by 100	_____

- ( ) 1. Replace R1877, resistor network only when the attenuator ratios exceed the specification,  $\pm 0.04\%$ .

Scan by Zenith

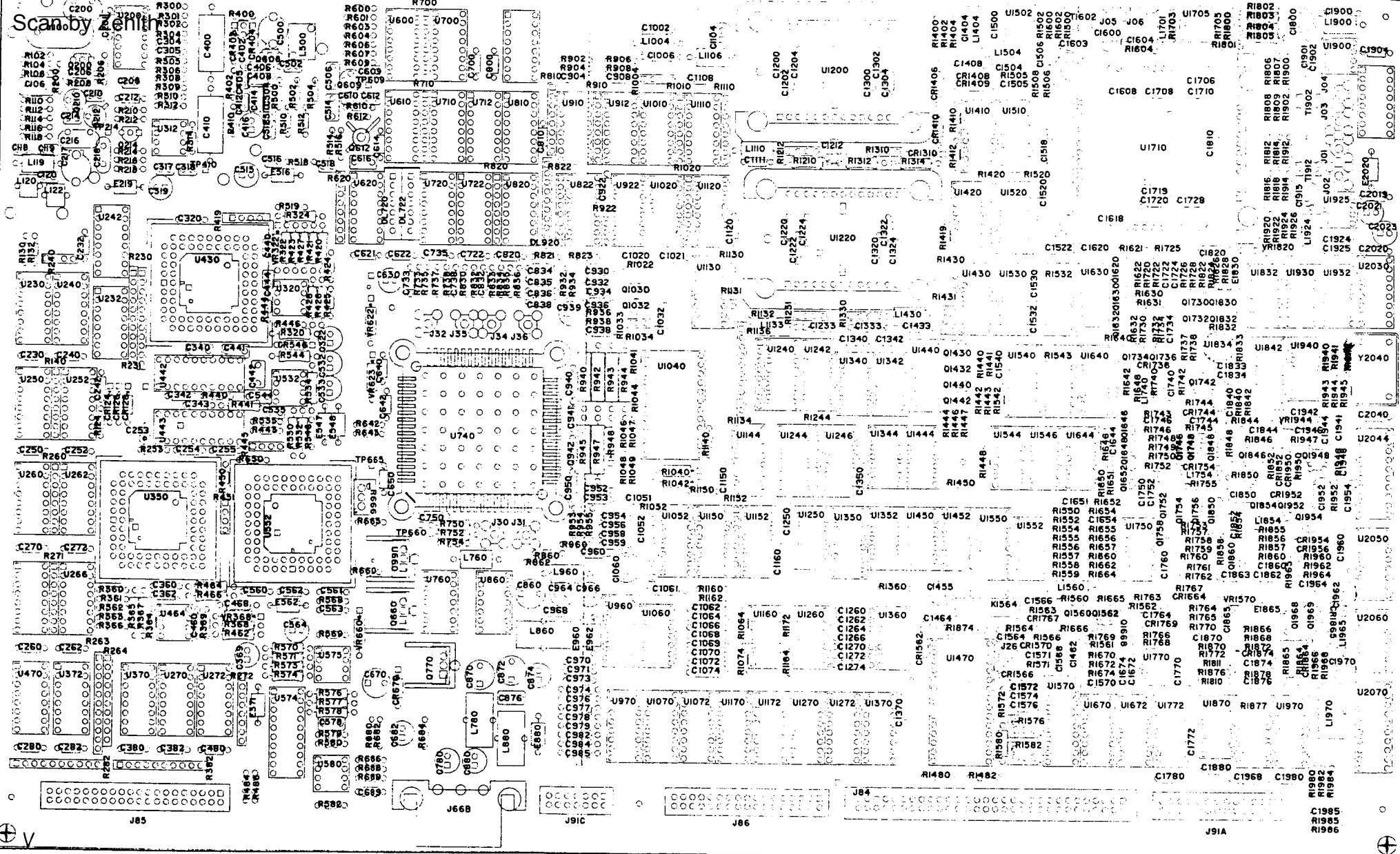


Figure 6. - Acquisition circuit board A5.

**Section C. Acquisition & Time Base ckt bd modifications.****NOTE**

*Before proceeding with the following modifications examine the Acquisition & Time Base circuit boards to determine if any or all these modification have already been installed. Make sure to examine each component change, partial modifications may have been installed at the factory. Perform only the modifications that have not been installed.*

*While performing the modifications on the Acquisition circuit board refer to Figures 6, component locations.*

- ( ) 1. Remove the hardware that secures the Acquisition circuit board A5 (bottom circuit board) to the instrument, then remove the circuit board from the instrument.
- ( ) 2. Disconnect the coaxial and cable connectors from the Acquisition circuit board A5, noting locations for later reassembly.
- ( ) 3. Unsolder and remove C1062, C1262, C1264, C1266, C1270 and C1570, 0.1 $\mu$ F, 50V, ceramic capacitors, and replace with 0.1 $\mu$ F, 63V, metalized capacitors, pn 285-1300-01, that are provided in this kit.
- ( ) 4. Unsolder and remove C1572, 0.1 $\mu$ F, ceramic capacitor and replace with 2200pF, capacitor, pn 281-0826-00, that is provided in this kit.
- ( ) 5. Unsolder and remove R546, a 390 $\Omega$ , resistor and replace with a 240 $\Omega$ , resistor, pn 313-1241-00, that is provided in this kit.
- ( ) 6. Remove U1040, microcircuit from the circuit board. Remove the hardware that secures the heatsink to the microcircuit. Then separate the heatsink and microcircuit.
- ( ) 7. Secure the heatsink to U1040, new microcircuit, pn 155-0320-01, provided in this kit, using the hardware removed in previous step. Install the new microcircuit into the circuit board.
- ( ) 8. Unsolder the collector of Q1562 transistor, from the circuit board pad, located nearest to R1666. Solder one lead of R1987, pn 313-1201-00, to the collector lead of Q1562 and solder the remaining lead to the circuit board pad from which the collector was removed, refer to Figure 7.
- ( ) 9. Remove U1705, microcircuit.
- ( ) 10. Remove R1703 and R1800, 10k $\Omega$ , resistors.
- ( ) 11. Remove R1705 and R1801, 47 $\Omega$ , resistors.

- ( ) 12. Remove R1803 and R1805, 17k $\Omega$ , resistors, and replace with 1.69k $\Omega$ , resistors, pn 321-0215-00, that is provided in this kit.
- ( ) 13. Remove R1802 and R1804, 1.05k $\Omega$ , resistors, and replace with 105 $\Omega$ , resistors, pn 321-0099-00, that is provided in this kit.
- ( ) 14. Remove the 1/4-inch nuts that secures U1200 and U1220, microcircuits. Replace U1200 and U1220, microcircuits with the new microcircuits, pn 165-2065-02, and secure them with the hardware removed in this step. Be certain that pin 1 is positioned correctly, pin 1 index mark is indicated with a beveled corner on the heatsink.
- ( ) 15. Examine U350, U430 and U552 for possible microcircuit replacement. Looking down towards microcircuits inspect the color of each substrate (the substrate is visible near the heatsink tabs under the retaining clips). If the substrate is black, the microcircuit does not need to be replaced. **If any of the microcircuit substrates are white they must be replaced with the following modification kits:**

**U350 or U552**, order modification kit pn 045-0152-00. This kit contains two (2) microcircuits.

**U430**, order modification kit pn 045-0153-00.

#### NOTE

*The next three (3) steps are to be performed on the front (component) side of the circuit board.*

- ( ) 16. Add a length of 30 blue AWG wire to the circuit board pad from which R1705 was removed, nearest U1710. Solder the remaining end of the wire to the circuit board pad common to R1805, 1.69k $\Omega$ , resistor, nearest L1701, refer to Figure 8.
- ( ) 17. Add a length of 30 blue AWG wire to the circuit board pad from which R1801 was removed, nearest to the outer edge of the circuit board. Solder the remaining end of the wire to the circuit board pad common to R1803, 1.69k $\Omega$ , resistor, nearest to L1701, refer to Figure 8.
- ( ) 18. Solder a length of blue 30 AWG wire connecting U1452, microcircuit pin 8 to R1543, resistor network pin 12, refer to Figure 9.
- ( ) 19. On the back (solder) side of the circuit board cut and remove a section of the circuit board run connecting U1544, pin 8 to R1543, pin 12, located between pins 6 and 11 of U1540, refer to Figure 10.



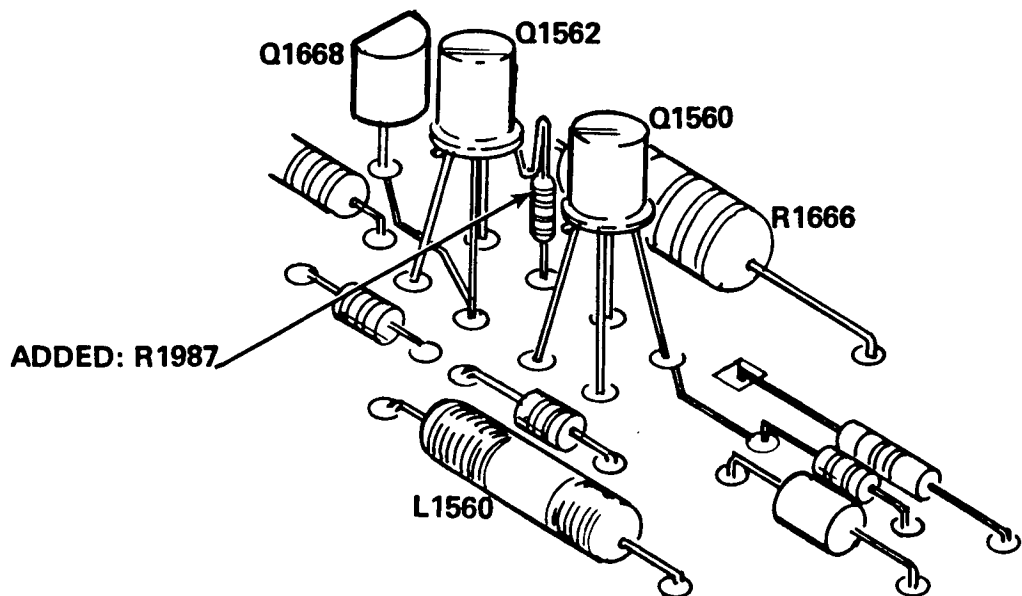


Figure 7. - R1987 and Q1562 configuration.

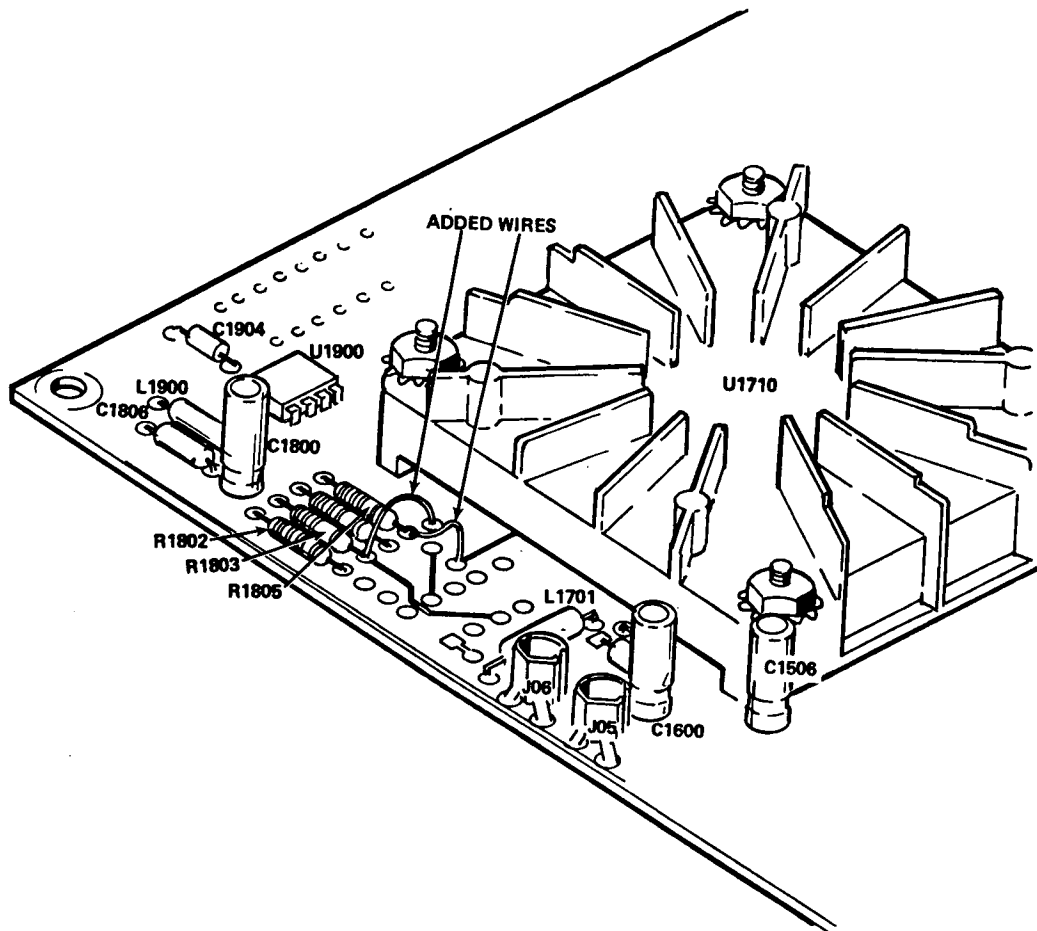


Figure 8. - Partial. Acquisition circuit board.

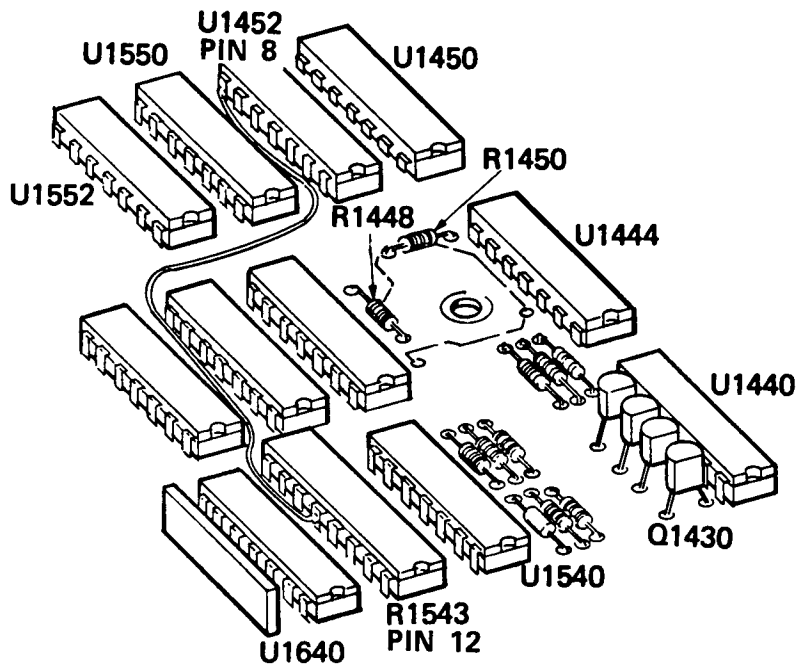


Figure 9. - Partial. Acquisition ckt bd.

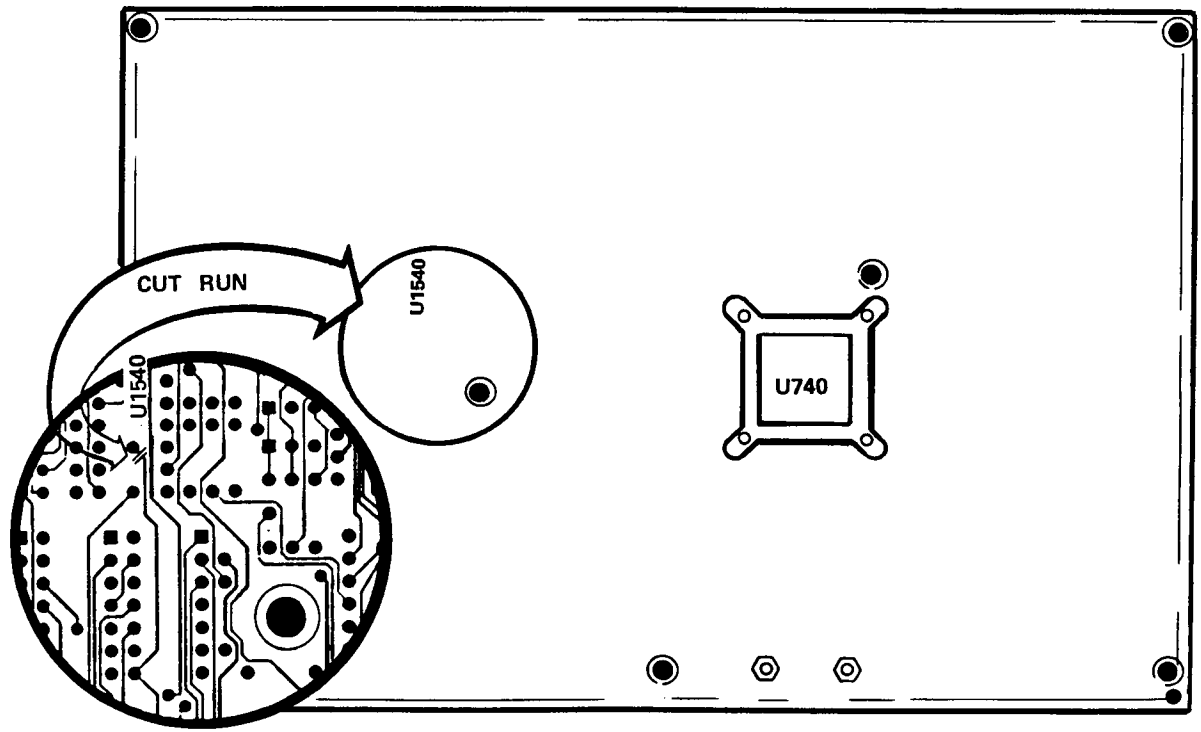


Figure 10. - Partial. (back) solder side Acquisition ckt bd.

## NOTE

*Trigger/Enhancement modification steps 20 through 38.*

- ( ) 20. Remove R1940 and R1941, 10k $\Omega$ , resistors.
- ( ) 21. On the front (component) side of the circuit board remove a section of the circuit board run connecting R1941 to C1941, refer to Figure 11.
- ( ) 22. Install R1940 and R1941, 200 $\Omega$ , resistors, pn 322-3126-00, that are provided in this kit, into the circuit board pads that were occupied with the 10k $\Omega$ , resistors removed in step 20.

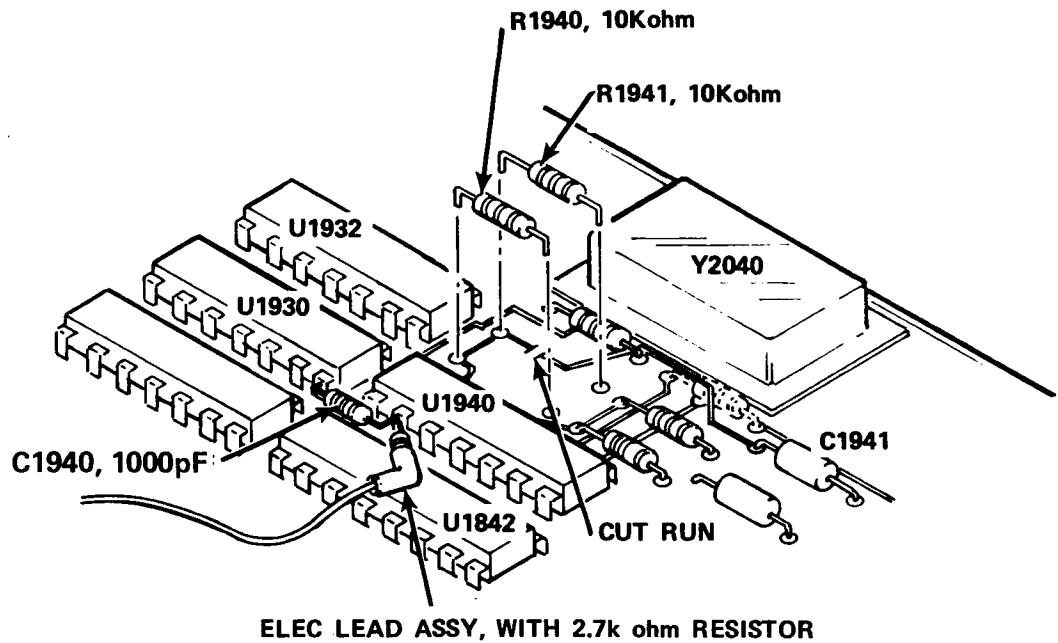


Figure 11. - R1941 & C1941, & cut ckt bd run.

- ( ) 23. Unsolder the base leads of Q1746 & Q1748 transistors from the circuit board, located nearest to CR1754. Solder one lead of R1641 and R1639, pn 313-1510-00, to the base leads of Q1746 & Q1748 respectively. Then solder the remaining leads of R1641 and R1639 to the circuit board pads from which the base leads were removed, refer to Figure 12.

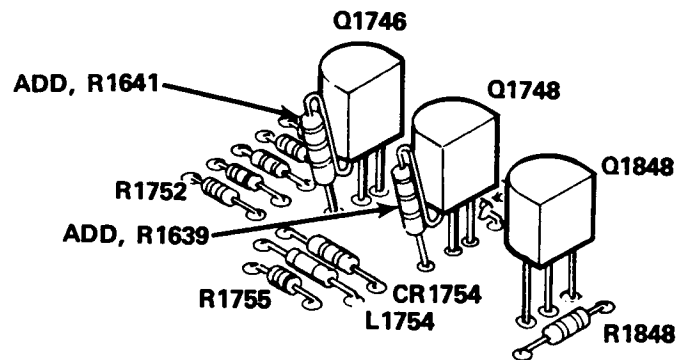


Figure 12. - Q1746 and Q1748 configuration.

- ( ) 24. Remove R1604, a 270 $\Omega$ , resistor from the circuit board.
- ( ) 25. Solder one lead of R1605, 162 $\Omega$ , resistor, pn 322-3117-00, to the circuit board pad from which R1604 was removed, nearest to C1600.
- ( ) 26. Solder one lead of R1606, 121 $\Omega$ , resistor, pn 322-3105-00, to the remaining circuit board pad from which R1604 was removed.
- ( ) 27. Solder the remaining leads of R1605 & R1606 together, tepee fashion above the circuit board.
- ( ) 28. Solder one lead of C1940, 1000pF, capacitor, pn 281-0812-00, to pin 7 of U1930. Solder the remaining end of C1940 to pin 2 of U1940, refer to figure 11.
- ( ) 29. Solder the electrical lead, assembly, pn 196-3227-00, that is provided in this kit, to pin 2 of U1940, refer to figure 11.

- See picture*
- ( ) 30. Solder the 8 conductor ribbon cable wires to the following locations: Refer to Figure 14, for the following sub-steps.
    - ( ) a. Solder the brown wire to tepee end of R1605 and R1606.
    - ( ) b. Solder the red wire to the circuit board pad common to C1603, capacitor nearest to C1600.
    - ( ) c. Solder the orange wire to the circuit board pad common to C1505, capacitor nearest to U1710.
    - ( ) d. Solder the yellow wire to the circuit board pad common to CR1409, diode nearest to U1710.
    - ( ) e. Solder the green wire to the circuit board pad common to C1504, capacitor nearest to C1408.
    - ( ) f. Solder the blue wire to the lead common to pin 13, U1410.
    - ( ) g. Solder the violet wire to the lead common to pin 12, U1410.
    - ( ) h. Solder the gray wire to the lead common to the circuit board pad common to C1408, capacitor nearest CR1406.

- See picture*
- ( ) 31. On the back (solder) side of the Acquisition circuit board remove a section of circuit board run connecting the base of Q1758 to U1750D, pin 14, refer to figure 13.
  - ( ) 32. On the back (solder) side of the Acquisition circuit board solder R1756, 51 $\Omega$ , resistor, pn 313-1510-00, to the circuit board pad common to base lead of Q1758 and the circuit board pad common to U1750D, pin 14, refer to figure 13, for component location.
  - ( ) 33. On the back (solder) side of the Acquisition circuit board solder C1753, 1000pF, capacitor, pn 281-0812-00, to the circuit board pad common to base lead of Q1758 and the circuit board pad common to ground, refer to figure 13, for component location.

- ( ) 34. Remove the two nut washer assemblies that secures U1220, microcircuit to the Acquisition circuit board, located nearest U1710. Discard the two nut washer assemblies.
- ( ) 35. Remove one nut washer assembly that secures U1710 to the Acquisition circuit board, located nearest R1532. Discard the nut washer assembly.
- ( ) 36. Install the Trigger Enhancement circuit board A19, pn 671-0828-00, that is provided in this kit, on the U1220 and U1710 mounting screws. Secure the circuit board to the mounting screws using the three (3) 4-40 plain nuts that is provided in this kit, refer to figure 14.

- ( ) 37. Connect the 8-conductor cable connector to the Trigger Enhancement circuit board connector.
- ( ) 38. Connect the 1-conductor lead (brown) connector to the Trigger Enhancement circuit board connector.

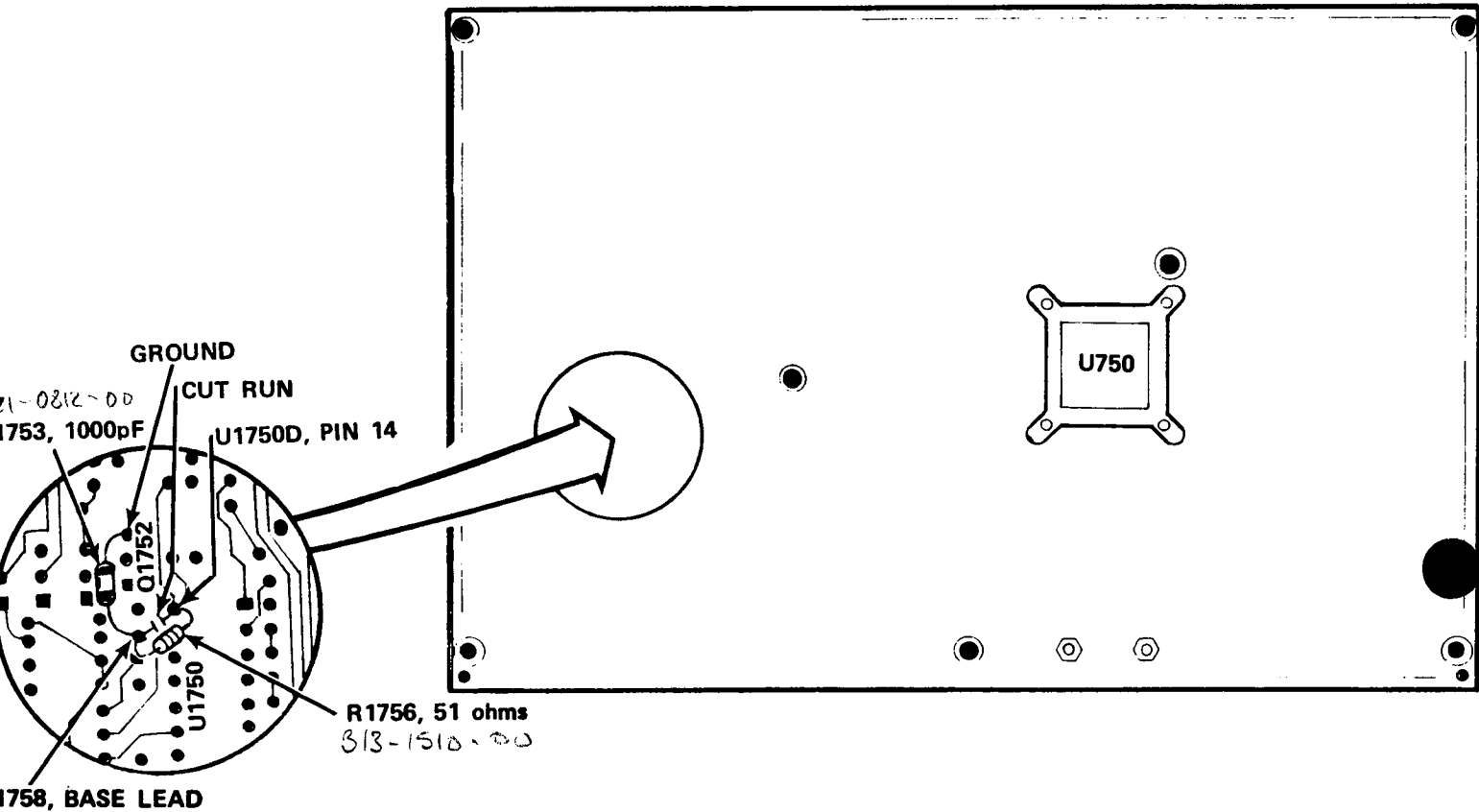


Figure 13. - C1753. R1756 configuration.

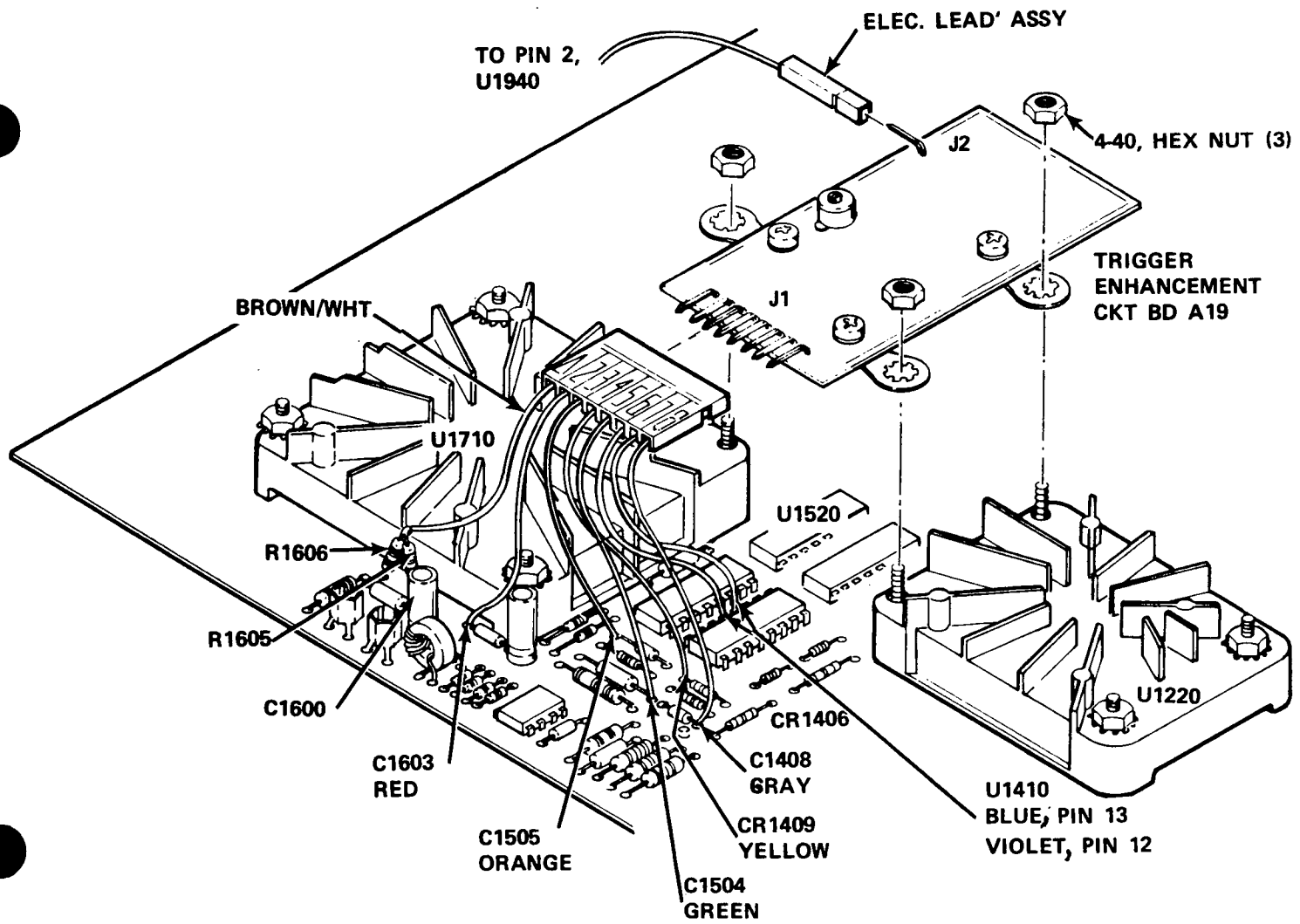
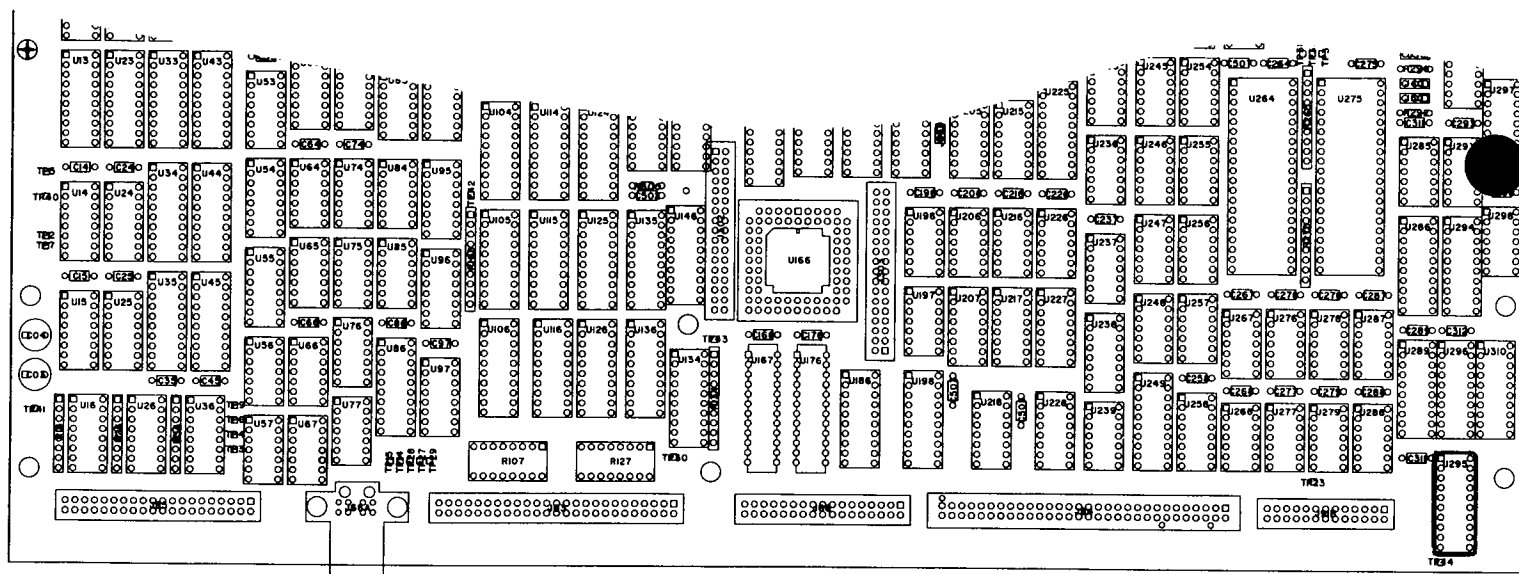


Figure 14. - Trigger Enhancement circuit board A19.

## NOTE

*Some Time Base circuit boards do not have U295, microcircuit. If the circuit board does not have U295, microcircuit, disregard steps 39 through 43.*

- ( ) 39. Remove the cable connectors from the Time Base circuit board A6, noting locations for later reassembly.
- ( ) 40. Remove the hardware that secures the Time Base circuit board to the instrument, then remove the circuit board from the instrument.
- ( ) 41. Remove U295, microcircuit and replace with the new microcircuit, pn 160-4526-01, that is provided in this kit, refer to figure 15, for component location.
- ( ) 42. Replace the Time Base circuit board into the instrument, securing it using the hardware removed in step 40.
- ( ) 43. Connect the cable connectors removed in step 39.



**Figure 15. - Partial, Time Base circuit board A6.**

- ( ) 44. Connect the Acquisition circuit board's coaxial and cable connectors removed in step 2 of this section.
- ( ) 45. Replace the Acquisition circuit board into the instrument, securing it with the hardware removed in step 1 of this section.



**Section D. CRT Driver circuit board A8 modifications.**

**NOTE**

*Before proceeding with the following modifications examine the CRT Driver circuit board to determine if any or all these modification have already been installed. Perform only the modifications that have not been installed.*

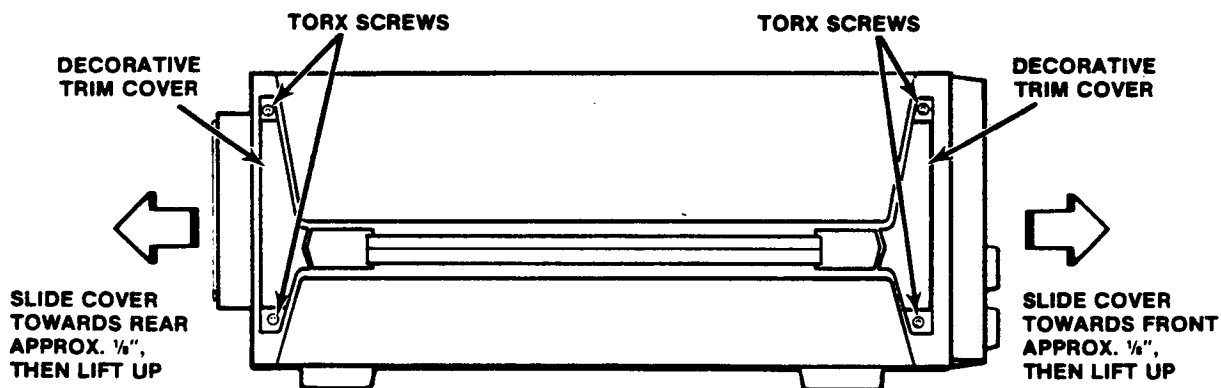
- ( ) 1. Remove the two flathead, torx screws that secures the crt shield to the chassis. (Refer to the 11401 Service Reference Manual).
- ( ) 2. Lift up on the outside of the shield.

**NOTE**

*The inner edge of the shield is held in place by two tabs. Remove the two flathead, torx screws holding the crt shield to the chassis.*

*As the shield is lifted, its bottom will clear the frame behind the instrument's handle. At that point, remove the shield carefully. Don't allow the shield to strike the crt.*

- ( ) 3. Remove all connectors, note locations for later reassembly.
- ( ) 4. Remove the torx screws from the (left side) front and rear decorative trim covers, see figure 16.



**Figure 16. - Removal of the left decorative trim covers.**

### Caution

*Do not lift the trim covers to remove them. They will break. There is a clip on the inside of the trim cover which slides over the end of the side frame section.*

*To remove the trim covers, move each cover towards the end of the instrument where it is located. (The front cover moves forward and rear cover moves backward.) Moving the clip about 1/8-inch will release the cover. Then, the cover can be removed from the instrument.*

- ( ) 5. Remove the trim covers.
- ( ) 6. Remove the single torx screws from the center of the (left side) frame section. Remove the two screws from the ends of the frame sections. Then remove the frame section and handle screws.
- ( ) 7. Remove the torx screws from each corner of the board.
- ( ) 8. Disconnect the anode lead from the crt then remove the CRT Driver circuit board by sliding it under the neck of the crt and out of the left side of the instrument.

### NOTE

*Refer to Figure 18, for CRT Driver circuit board component locations.*

- ( ) 9. Remove C620, a 2200 $\mu$ F, capacitor and replace with a 470 $\mu$ F, capacitor that is provided in this kit.
- ( ) 10. Remove R521, a 2.7 $\Omega$ , resistor and replace with a 12 $\Omega$ , resistor, pn 315-0120-00, that is provided in this kit. Solder one lead of R521 to the circuit board pad from which R521 was removed nearest C620. Solder a length of blue 30 AWG wire to the remaining lead of R521. Solder the remaining end of the wire to the circuit board pad common to R400 nearest to R301, refer to Figure 17.
- ( ) 11. Remove CR130, diode.
- ( ) 12. Remove R230, 1.1 $\Omega$ , resistor and replace with a 6.2 $\Omega$ , resistor, pn 307-0059-00, that is provided in this kit.
- ( ) 13. Remove R330, 100 $\Omega$ , resistor and replace with a 240 $\Omega$ , resistor, pn 303-0241-00, that is provided in this kit.
- ( ) 14. Remove R331, 30 $\Omega$ , resistor, pn 308-0767-00 and replace with a 1.1 $\Omega$ , resistor that is provided in this kit.

- ( ) 15. Remove R633, 191k $\Omega$ , resistor and replace with a 221k $\Omega$ , resistor, pn 321-0418-00, that is provided in this kit.
- ( ) 16. Remove C221, a 47 $\mu$ F, capacitor and replace with a 100 $\mu$ F, capacitor, pn 290-0942-00, that is provided in this kit.
- ( ) 17. Remove C430, 0.1 $\mu$ F, capacitor and replace with a 0.01 $\mu$ F, capacitor, pn 281-0773-00, that is provided in this kit.
- ( ) 18. Add C323, an 10 $\mu$ F, capacitor, provided in this kit, to the CRT Driver circuit board. Solder one lead of C323 to the circuit board pad common to CR320 nearest to R422. Solder the remaining lead to the circuit board pad common to R426 nearest to Q320 and R426 pad.
- ( ) 19. Replace the CRT Driver circuit board by performing step 1 through 7 in reverse order.
- ( ) 20. Replace the crt shield by performing steps 1 and 2 in reverse order. If instrument's serial number is B010450 or above replace crt shield after completing Section E.

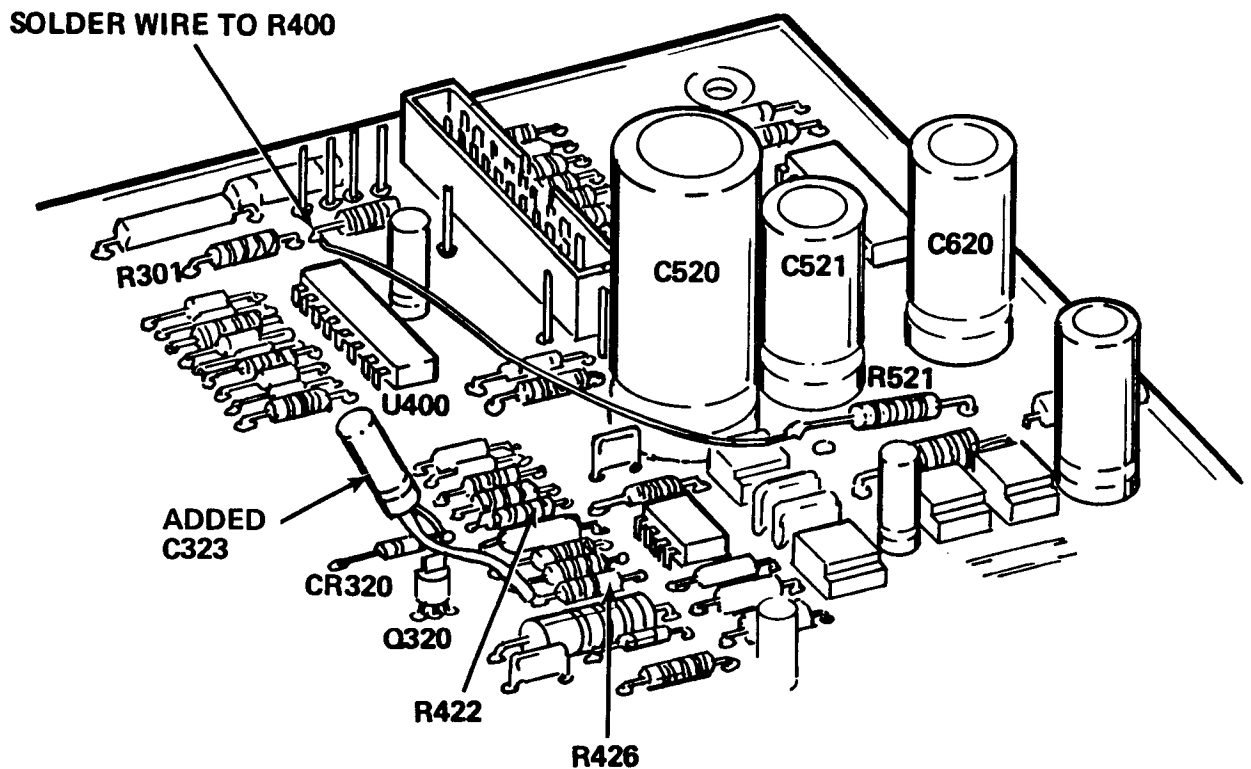


Figure 17. CRT Driver circuit board A8.

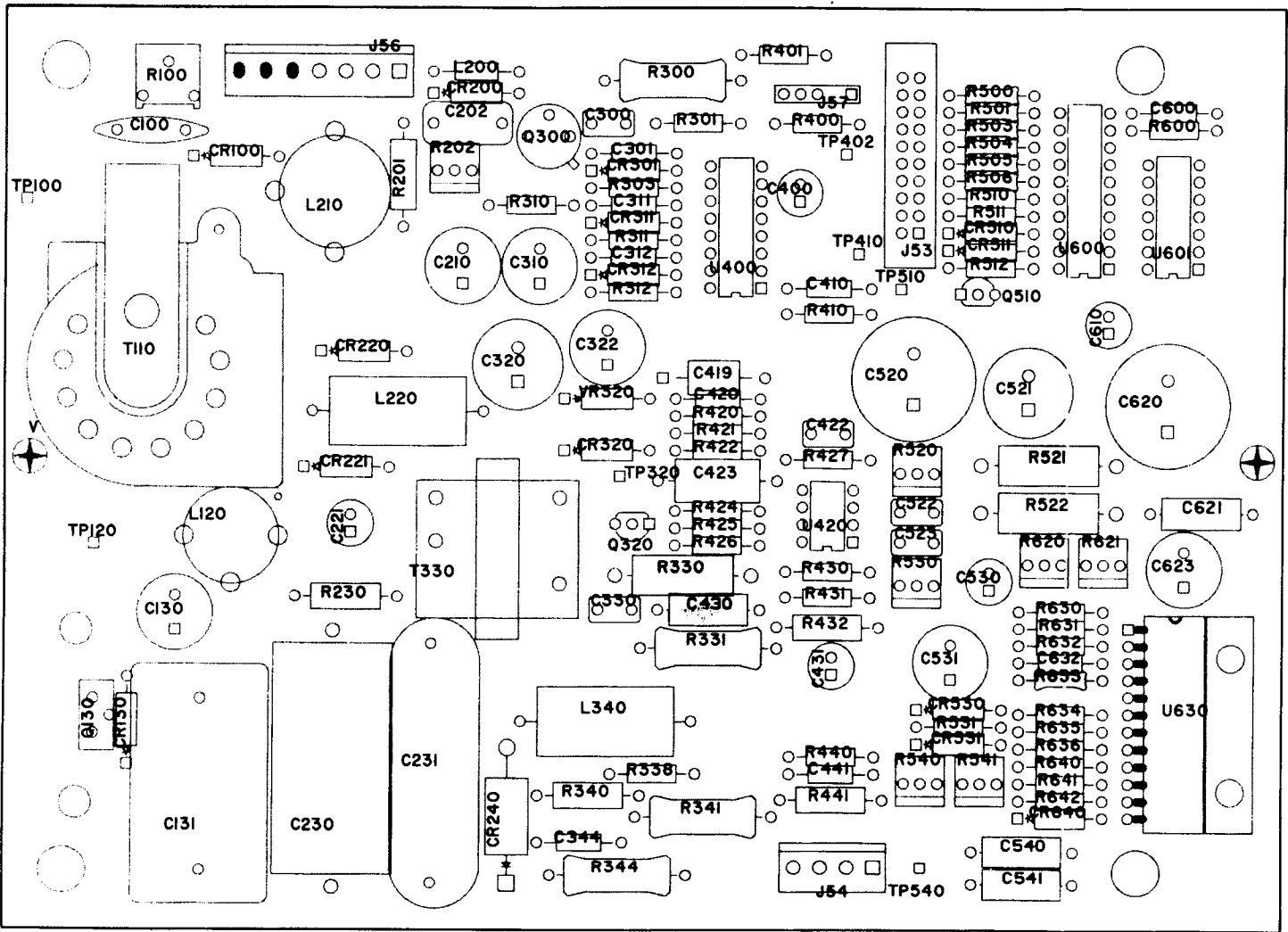


Figure 18. CRT Driver ck bd layout.

**Section E. Touch Panel circuit board A9 modifications.**

**NOTE**

*Disregard this section if the instrument's serial number is B010450 or above.*

- ( ) 1. Remove the front-panel bezel.
  - ( ) a. Remove the two flathead screws from bottom of bezel.
  - ( ) b. Remove the two control knobs from the front of the bezel.
  - ( ) c. Lift up on the bottom of the bezel and swing it outward.
- ( ) 2. Disconnect P73 from the Front Panel circuit board A10. Note the position of the connector index triangles for later reassembly. Then remove the wire cable through the slot provided in the front casting. Disconnect ground wire from front panel.

**NOTE**

*Protect the front of the bezel after it is removed. The plastic exterior may scratch, cover with protective material.*

- ( ) 3. Add R703, a 56M $\Omega$ , resistor, pn 315-0566-00, that is provided in kit, to the Touch Panel circuit board. Solder one lead of R703 resistor to C700 solder pad nearest to S7. Solder the remaining lead of R703 to end of R804 solder pad, nearest to S7, refer to figure 19.
- ( ) 4. To replace the Touch Panel circuit board subassembly, route the P73 wire cable back through the slot in the chassis. Attach the connector to the board after checking index triangles for correct orientation.
- ( ) 5. Replace bezel by using the reverse procedures in step 1, of this section.

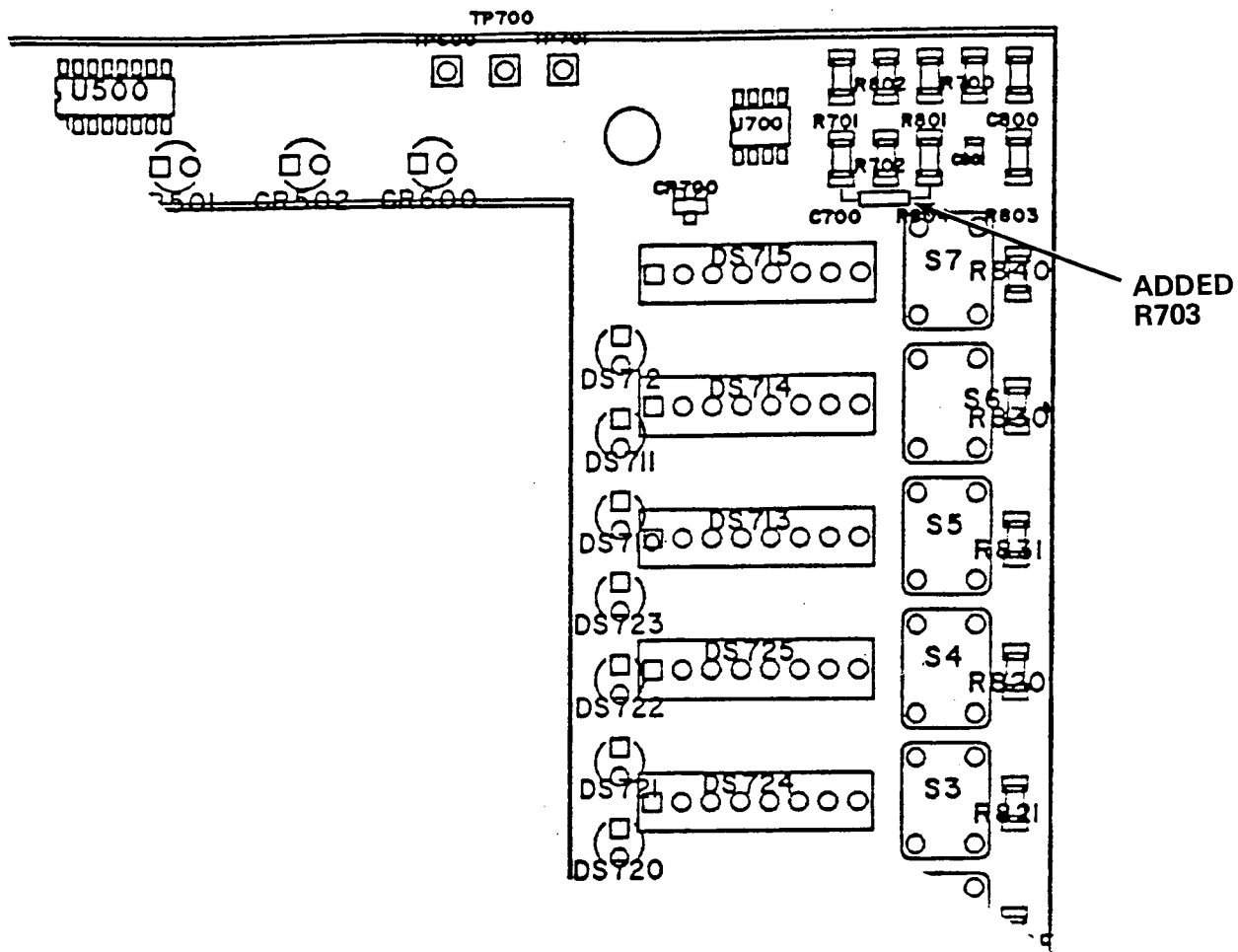


Figure 18. - Touch Panel circuit board A9.

**Section F. Checks and Adjustments.**

- ( ) 1. Refer to Section 2, Checks and Adjustments, in the 11401/11402 Service Reference Manual, and perform the following checks and adjustments.
  - ( ) a. Part 1 - Power-up Diagnostics.
  - ( ) b. Part 2 - Extended Diagnostics.
  - ( ) c. Part 3 - Enhanced Accuracy.

**NOTE**

*Perform the next check and adjustment only if CRT Driver circuit board modifications were installed.*

- ( ) d. Part 5 - Display.
- ( ) e. Part 6 - Calibration Output Accuracy.
- ( ) f. Part ~~10~~<sub>9</sub> - Sampler and Digitizer.

**NOTE**

*As the result of the Checks and Adjustments, the MCALCONSTANTS 134:XXXX number displayed on the screen will not match the number on the Cal-label, located on the Acquisition circuit board A5. Remove the Cal-Label from the circuit board and replace with the new Cal-Label that is provided in this kit. Record the new MCALCONSTANT number, displayed on the screen, on the new Cal-Label.*

- ( ) g. Part 16 - Time Base. Check Window Position Accuracy.
- ( ) h. Continue with the following Checks and Adjustments, Parts 19 & 20.

# Part 19—Trigger Enhancement Adjustment

## Description

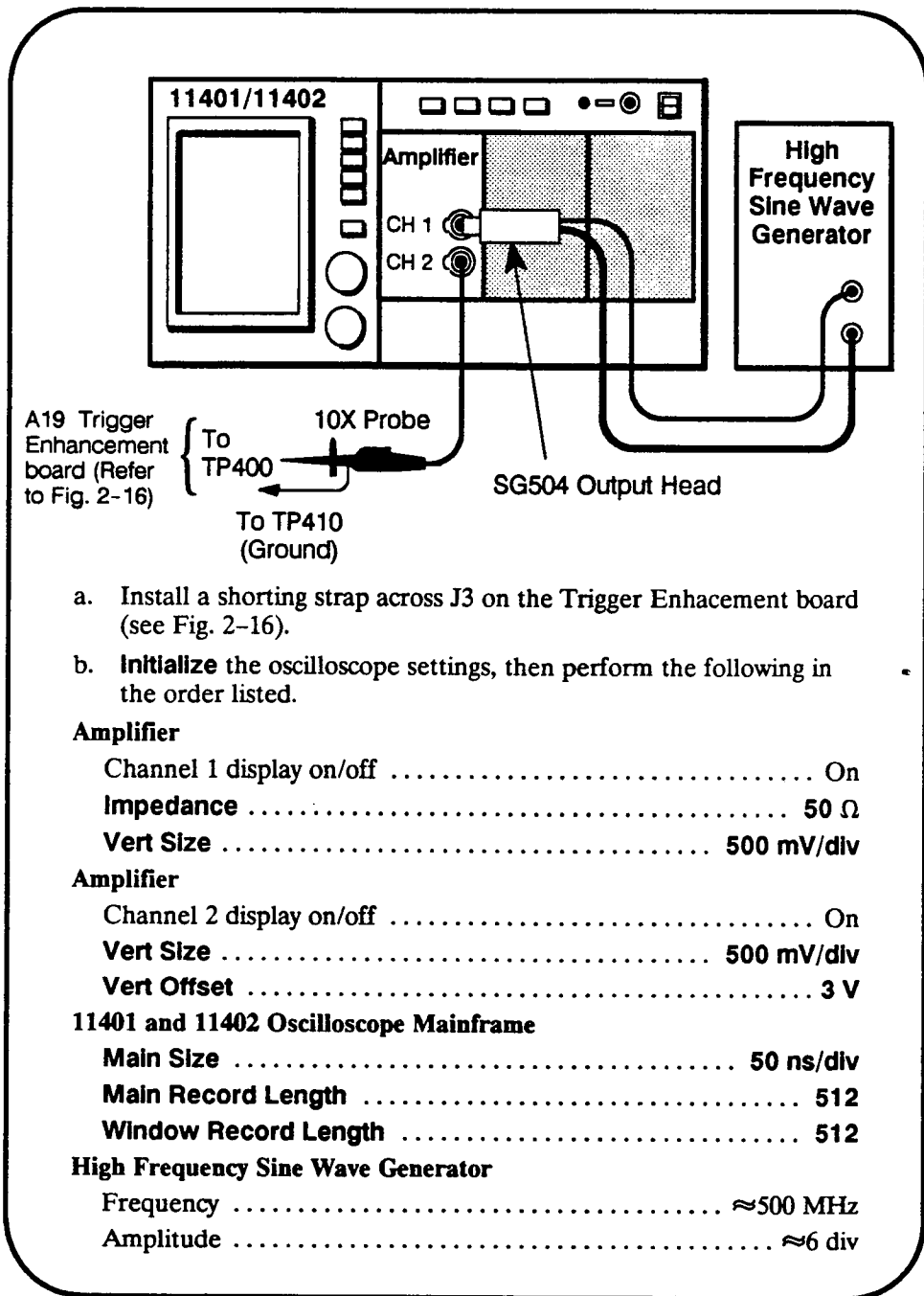
The Trigger Enhancement circuit is adjusted to avoid spikes on the waveform when the end of holdoff and the triggering signal coincides.

## Measurement Limit

Delay limit is 400 ps,  $\pm 80$  ps.

## Setup

File





## Procedure

- a. Select the Channel 1 trace.
- b. Select the **Window1** label.
- c. Set the **Window1 Pos** knob to 400 ns.
- d. Set the **Window1 Size** knob to 500 ps/div.
- e. Set the HF Sine Wave Generator (**Fine**) frequency knob to a setting that displays spikes on the sine wave, then maximize the number of spikes displayed.

### NOTE

*The maximum number of spikes are achieved when the Channel 2 trace (main display) has the maximum number of transitions displayed.*

- f. Select the **Window1** cursors label.
- g. Select the **Vertical Bar** cursors and **Fine** knob resolution.
- h. Position the Cursor 1 Vertical Bar to the first rising zero crossing point on the sine wave.
- i. Rotate the HF Sine Wave Generator (**Fine**) frequency knob counterclockwise (lowers frequency) through a null of the channel 2 transitions to the next maximum number of displayed transitions.
- j. Set Cursor 2 Vertical Bar to the position on the sine wave that was previously occupied by Cursor 1.
- k. **EXAMINE**—that the Cursor  $\Delta t$  readout on the screen is 400 ps, within the limits of 320 ps and 480 ps.



**DO NOT** attempt to optimize the adjustment setting if the Cursor  $\Delta t$  readout is within the stated limits. Remove Shorting strap and probe. Proceed to Part 20—Triggering.

- l. Set the **Window1 Pos** knob to 0 s.
- m. Set the **Main Holdoff** knob to 490.5 ns.
- n. Set the HF Sine Wave Generator (**Fine**) frequency knob to a setting that displays spikes on the sine wave, then maximize the number of spikes displayed.
- o. Set **Main Holdoff** to 490 ns.
- p. **ADJUST**—**C200** to obtain the most transitions between the high and low logic level on the CH 2 signal (this display is not triggered).
- q. Set **Main Holdoff** to 490.5 ns.
- r. Set the HF Sine Wave Generator (**Fine**) frequency to obtain the most transitions on the Channel 2 signal.
- s. Set **Main Holdoff** to 490 ns.

## Part 19 Trigger Enhancement Adjustment

- t. **ADJUST**— C200 slightly to obtain the most transitions on the Channel 2 signal.
- u. Remove the shorting strap and 10X probe.
- v. Set the HF Sine Wave Generator (**Fine**) frequency knob from end to end and observe that no spikes appear on the sine wave.

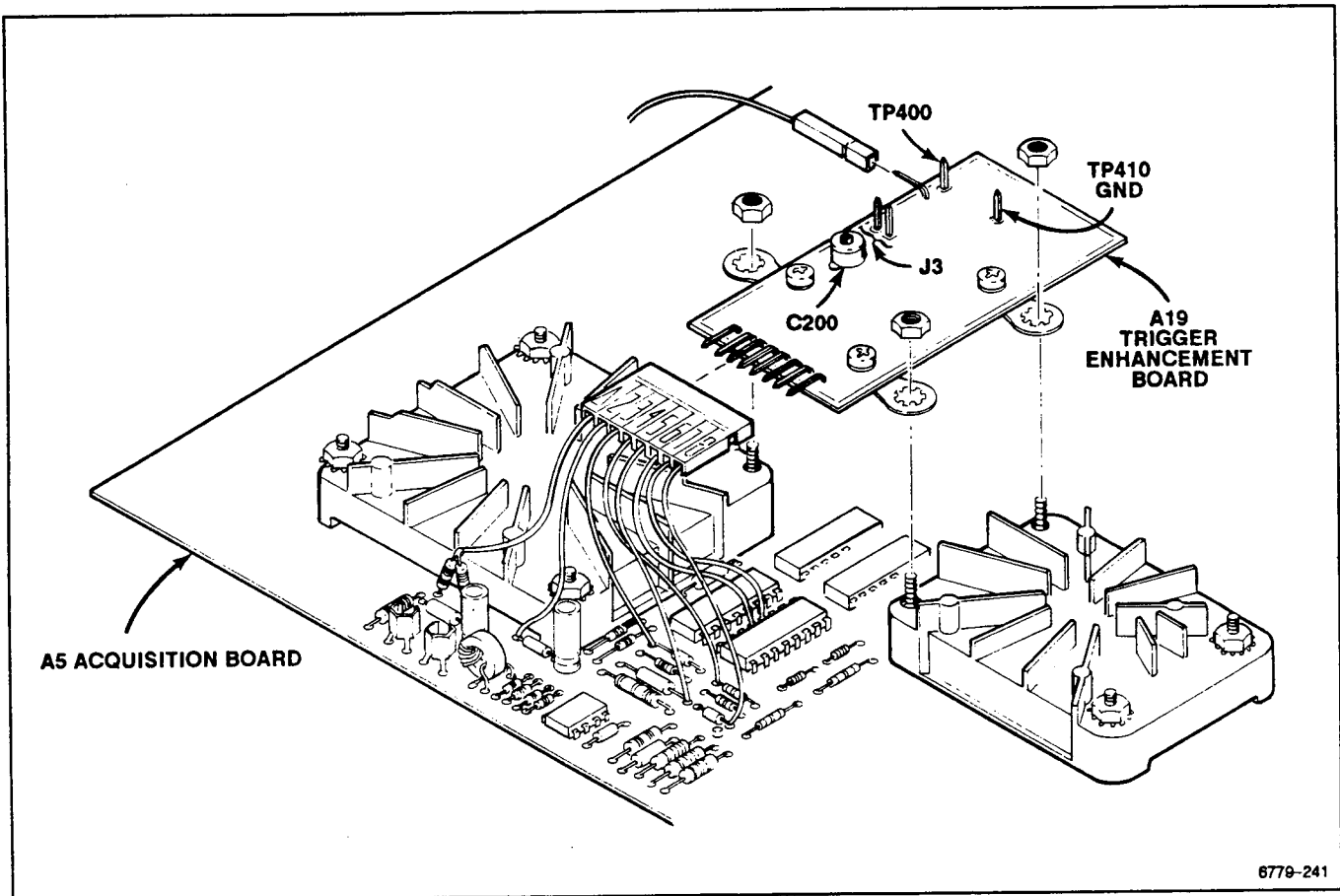
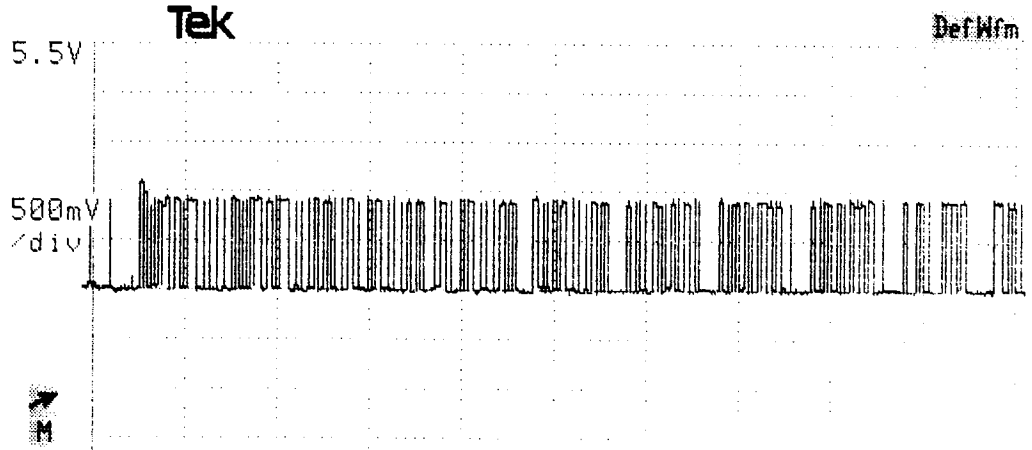


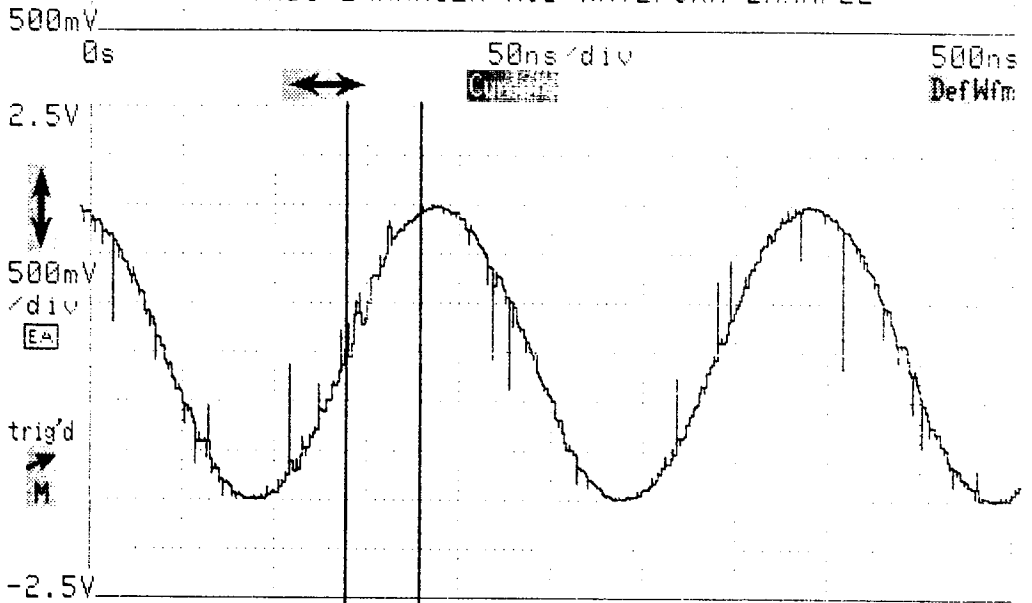
Figure 2-16. A19 Trigger Enhancement board test point and adjustment locations.

11402 DIGITIZING OSCILLOSCOPE  
 date: 27-APR-88 time: 8:12:36

(exp:3.2,dig:3.4,dsy:3.3)  
 Instrument ID# B010464



\*\*\*TRIG ENHANCER MOD WAVEFORM EXAMPLE\*\*\*



400.06ns	500ps/div	405.06ns
Cursor Type	t1= 401.4ns	Cursor 1
Vertical Bars	t2= 401.9ns	401.4ns
	$\Delta t = 400.0ps$	Cursor 2
	$1/\Delta t = 2.500GHz$	401.9ns
		Remove Wfm 3
		L1
		Window 1

---

## Part 20—Triggering

---

### Description

The trigger voltage is set to various values and is checked using the cursors readout on the screen.

### Specification

Trigger level dc accuracy within 2% of full scale (20 LSBs).

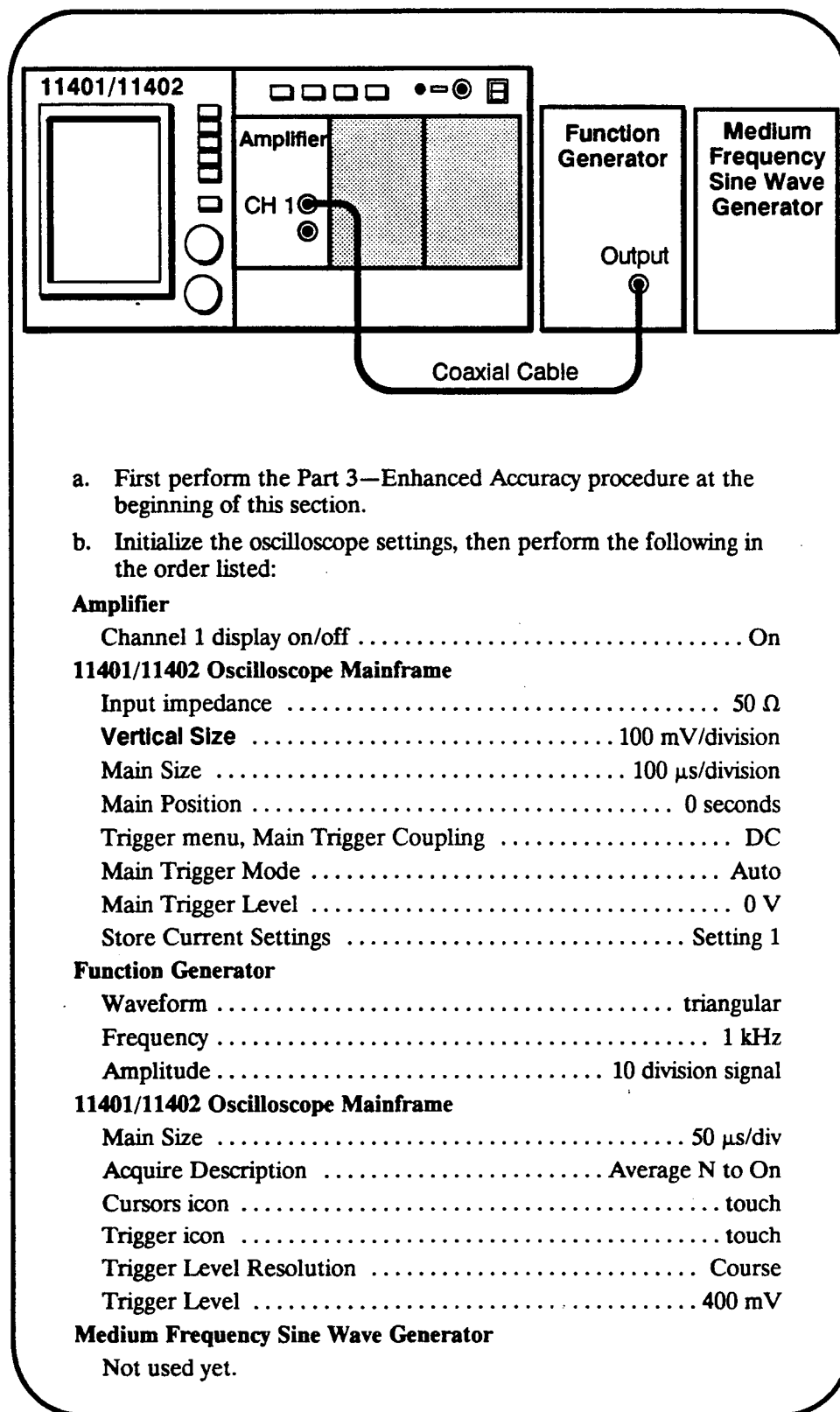
AC and DC noise-reject coupled—1.2 divisions or less from dc to 50 MHz, increasing to 3 divisions at 500 MHz.

AC coupled—0.5 divisions from 60 Hz to 50 MHz, increasing to 1.5 divisions at 500 MHz. Attenuates signals below 60 Hz.

AC & DC HF reject coupled—0.65 divisions from dc to 30 kHz.

LF reject coupled—0.65 division from 80 kHz to 50 MHz, increasing to 1.5 divisions at 500 MHz.

**Setup**



- a. First perform the Part 3—Enhanced Accuracy procedure at the beginning of this section.
- b. Initialize the oscilloscope settings, then perform the following in the order listed:

**Amplifier**

Channel 1 display on/off ..... On

**11401/11402 Oscilloscope Mainframe**

Input impedance ..... 50  $\Omega$

**Vertical Size** ..... 100 mV/division

Main Size ..... 100  $\mu$ s/division

Main Position ..... 0 seconds

Trigger menu, Main Trigger Coupling ..... DC

Main Trigger Mode ..... Auto

Main Trigger Level ..... 0 V

Store Current Settings ..... Setting 1

**Function Generator**

Waveform ..... triangular

Frequency ..... 1 kHz

Amplitude ..... 10 division signal

**11401/11402 Oscilloscope Mainframe**

Main Size ..... 50  $\mu$ s/div

Acquire Description ..... Average N to On

Cursors icon ..... touch

Trigger icon ..... touch

Trigger Level Resolution ..... Course

Trigger Level ..... 400 mV

**Medium Frequency Sine Wave Generator**

Not used yet.

## Check Trigger Level DC Accuracy

### Measurement Limit

- a. *CHECK*—that the cursor readout is  $V1 = 400 \text{ mV}, \pm 20 \text{ mV}$ .
- b. Set the Trigger Level to  $-400 \text{ mV}$ .
- c. *CHECK*—that the cursor readout is  $V1 = -400 \text{ mV}, \pm 20 \text{ mV}$ .
- d. Set the Main Size to  $100 \mu\text{s/division}$ .
- e. Select the Window 1 label, then set the Window 1 Pos to 0 seconds.
- f. Set the Window Holdoff Mode to Holdoff by Time Triggered from Window.
- g. Touch the Trigger Select label to select the Window trigger.
- h. Set the Window Trigger Coupling to DC.
- i. Select the Cursors label.
- j. Select the Trigger Icon, then set the Window 1 Trigger level to  $400 \text{ mV}$ .
- k. *CHECK*—that the Cursor readout is  $V1 = 400 \text{ mV}, \pm 20 \text{ mV}$ .
- l. Set the Window 1 Trigger Level to  $-400 \text{ mV}$ .
- m. *CHECK*—that the Cursor readout is  $V1 = -400 \text{ mV}, \pm 20 \text{ mV}$ .

→

## Check 50 MHz Sensitivity

### Measurement Limit

- a. Connect the MF Sine Wave Generator through a 5X attenuator to the CH 1 input connector.
- b. Set the MF Sine Wave Generator frequency to 50 MHz.
- c. Recall the stored Setting 1 (stored in the Setup at the beginning of this part).
- d. Set the Main Size to  $10 \text{ ns/division}$ .
- e. Adjust the generator output for a Peak–Peak measurement of  $50 \text{ mV}$ .
- f. *CHECK*—that you can adjust the Trigger Level and achieve a stable display (use **Fine Resolution**).
- g. Select the window 1 label.
- h. Set Window Size to  $10 \text{ ns/division}$ .
- i. Set the Window Holdoff Mode to Holdoff by Time Triggered from Window.
- j. Touch the Trigger Select label to select the Window trigger.
- k. *CHECK*—that you can adjust the Window Trigger Level and achieve a stable display.

→

## Check DC Noise Reject

### Measurement Limit

- a. Adjust the generator output for a Peak-Peak measurement of 120 mV.
- b. Select the Window Trigger, then set its coupling to DC Noise Reject.
- c. **CHECK**—that you can adjust the Window Trigger Level and achieve a stable display.
- d. Select the Main Trigger, then set its coupling to DC Noise Reject.
- e. **CHECK**—that you can adjust the Main Trigger Level and achieve a stable display.

## Check DC Coupling

### Measurement Limit

- a. Connect the coaxial cable from the Amplifier CH 1 input to the mainframe CALIBRATOR output connector.
- b. Select the UTILITY button.
- c. Select the Probes menu, then select L1 (this deskews the system).
- d. Recall the stored Setting 1 (stored in the Setup at the beginning of this part).
- e. Set the MF Sine Wave Generator output to its 50 kHz Reference frequency.
- f. Adjust the generator Output Amplitude for a Peak-Peak measurement of 600 mV.
- g. Set the Main Size to 2  $\mu$ s/division.
- h. Adjust the Main Position to position the trigger indicator (arrow) to the center vertical graticule line (-10.2  $\mu$ s readout).
- i. **CHECK**—that the rising portion of the sine wave crosses the center of the screen,  $\pm 0.2$  divisions.
- j. Adjust the Vertical Offset to move the waveform above and below its original position and **CHECK** that the trigger indicator (arrow) remains at the same level, at the center of the screen.
- k. Set the Vertical Offset control for 0 V readout.

## Check DC HF Reject

- Measurement Limit**
- a. Set the Trigger Coupling to DC HF Reject.
  - b. *CHECK*—that the waveform moved left of the trigger indicator (arrow) between 0.5 and 2.0 divisions.

## Check AC LF Reject

- Measurement Limit**
- a. Set the trigger Coupling to AC LF Reject.
  - b. *CHECK*—that the trigger indicator (arrow) disappears and that the zero crossing of the positive-going edge of the waveform now appears between 0.5 and 2.0 divisions to the right of the center vertical graticule line.

## Check AC Coupling

- Measurement Limit**
- a. Set the Trigger Coupling to AC.
  - b. Adjust the Vertical Offset and note the waveform remains triggered at the same point regardless of the vertical offset.

- ( ) 2. Reinstall the covers removed in section A.
- ( ) 3. Remove the protective backing from the 045-kit label, provided with this kit and place it on a clean, dry area on the rear panel. The label indicates the kit has been installed.