

**Tektronix**<sup>®</sup>  
COMMITTED TO EXCELLENCE

**7B80  
TIME BASE  
WITH OPTIONS**

INSTRUCTION MANUAL

## **BEFORE READING**

*PLEASE CHECK FOR CHANGE INFORMATION  
AT THE REAR OF THIS MANUAL.*

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# **TEKTRONIX®**

**7B80  
TIME BASE  
WITH OPTIONS**

## **INSTRUCTION MANUAL**

Tektronix, Inc.  
P.O. Box 500  
Beaverton, Oregon 97077

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



## WARRANTY

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## WARNING

THE REMAINING SECTIONS OF THIS MANUAL CONTAIN SERVICING INSTRUCTIONS. THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRICAL SHOCK, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CALLED OUT IN THE OPERATING INSTRUCTIONS UNLESS QUALIFIED TO DO SO.

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# SAFETY SUMMARY

This manual contains safety information which the user must follow to ensure safe operation of this instrument. WARNING information is intended to protect the operator; CAUTION information is intended to protect the instrument. The following are general safety precautions that must be observed during all phases of operation and maintenance.

## WARNING

### Ground the Instrument

*To reduce electrical-shock hazard, the mainframe (oscilloscope) chassis must be properly grounded. Refer to the mainframe manual for grounding information.*

### Do Not Operate in Explosive Atmosphere

*Do not operate this instrument in an area where flammable gases or fumes are present. Such operation could cause an explosion.*

### Avoid Live Circuits

*Electrical-shock hazards are present in this instrument. The protective instrument covers must not be removed by operating personnel. Component replacement and internal adjustments must be referred to qualified service personnel.*

### Do Not Service or Adjust Alone

*Do not service or make internal adjustments to this instrument unless another person, capable of giving first aid and resuscitation, is present.*

## WARNING

### Warning Statements

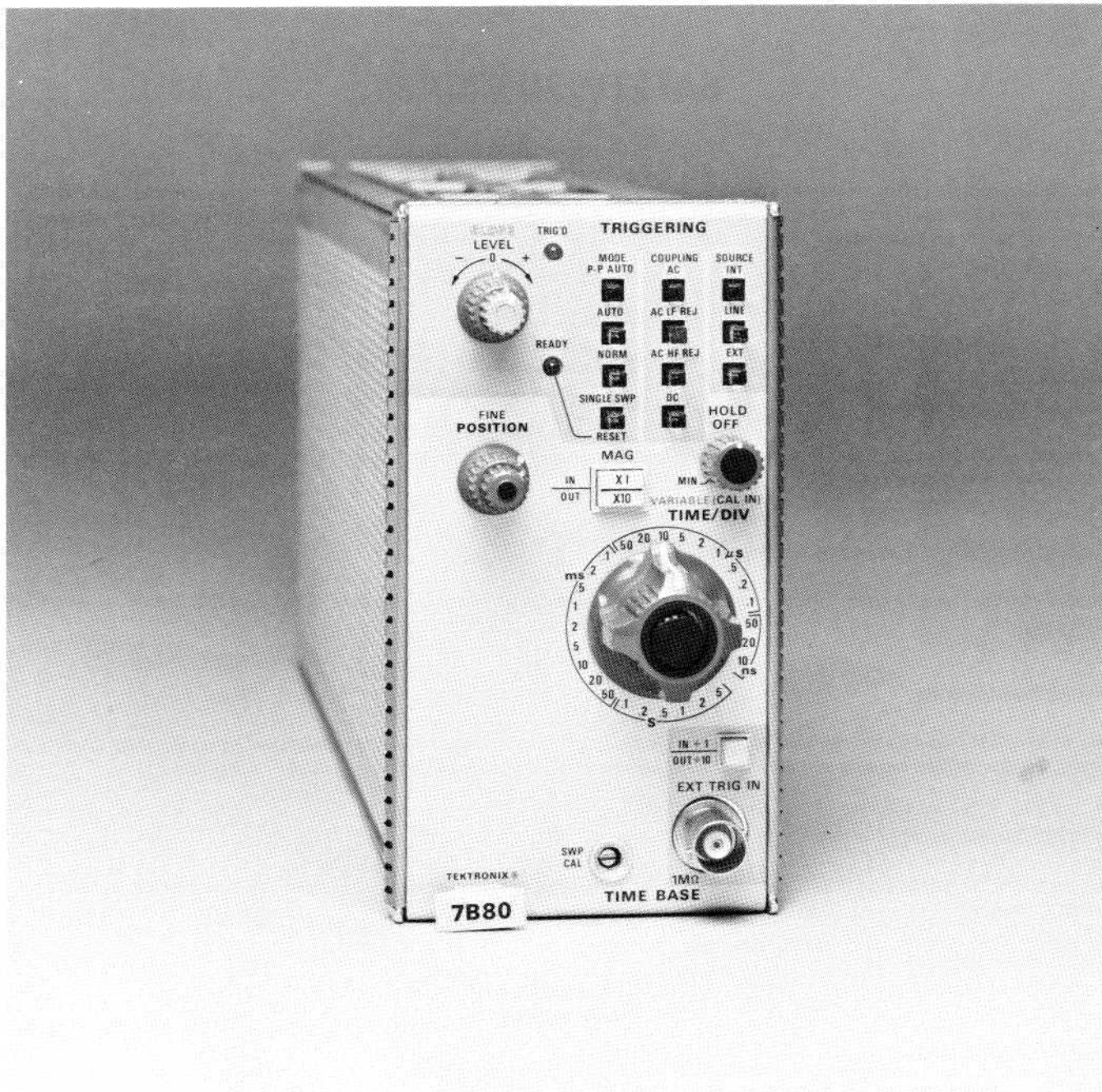
Warning statements accompany potentially dangerous procedures in this manual. The following warnings appear in this manual and are listed here for additional emphasis.

*To avoid electrical shock, disconnect the instrument from the power source before soldering.*

*To avoid electrical shock, disconnect the instrument from the power source before replacing components.*

*Handle silicone grease with care. Avoid getting silicone grease in eyes. Wash hands thoroughly after use.*





### 7B80 Features

The 7B80 Time-Base unit provides calibrated sweep rates from 5 seconds to 10 nanoseconds and triggering to 400 megahertz for 7700-, 7800-, and 7900-series oscilloscopes. A X10 Magnifier increases each sweep rate by a factor of 10 and a VARIABLE TIME/DIV control provides continuously variable sweep rates between calibrated steps. Variable hold off and alphanumeric readout are provided. Also, when operating in the AUTO TRIGGERING MODE, a bright baseline trace is displayed in the absence of a trigger signal. The 7B80 can be operated as an independent time base or as a delayed-sweep unit with a companion delaying time-base unit.

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# OPERATING INSTRUCTIONS

The 7B80 Time-Base unit operates with a Tektronix 7700-, 7800-, and 7900-series oscilloscope mainframes and a 7A-series amplifier unit to form a complete oscilloscope system. This section describes the operation of the front-panel controls and connectors, provides general operating information, a functional check procedure, and basic applications for this instrument.

## INSTALLATION

The time-base unit is designed to operate in the horizontal plug-in compartment of the mainframe. This instrument can also be installed in a vertical plug-in compartment to provide a vertical sweep on the crt. However, when used in this manner, there are no internal triggering or retrace blanking provisions, and the unit may not meet the specifications given in Section 2.

To install the unit in a plug-in compartment, push it in until it fits firmly into the compartment. The front panel of the unit should be flush with the front panel of the mainframe. Even though the gain of the mainframe is standardized, the sweep calibration of the unit should be checked when installed. The procedure for checking the unit is given under Sweep Functions in the Functional Check procedure in this section.

To remove the unit, pull the release latch (see Figure 1-1) to disengage the unit from the mainframe, and pull it out of the plug-in compartment.

## CONTROLS, CONNECTORS, AND INDICATORS

All controls, connectors, and indicators required for the operation of the time-base unit are located on the front panel. Figure 1-2 shows and provides a brief description of all front-panel controls, connectors, and indicators. More detailed information is given in the General Operating Instructions.

## FUNCTIONAL CHECK

The following procedures are provided for checking basic instrument functions. Refer to the description of the controls, connectors, and indicators while performing this procedure. If performing the functional check procedure reveals a malfunction or possible improper adjustment, first check the operation of the associated plug-in units, then refer to the instruction manual for maintenance and adjustment procedures.

### Setup Procedure

1. Install the time-base unit being checked in the A horizontal compartment of the mainframe.

2. Install an amplifier plug-in unit in a vertical compartment.

3. Set the time-base unit controls as follows:

SLOPE	(+)
MODE	P-P AUTO
COUPLING	AC
SOURCE	INT
POSITION	Midrange
TIME/DIV	1 ms
VARIABLE (CAL IN)	Calibrated (Pushed in)
HOLD OFF	MIN (fully counter-clockwise)
MAG	X1 (pushed in)

4. Turn on the mainframe and allow at least 20 minutes warmup.

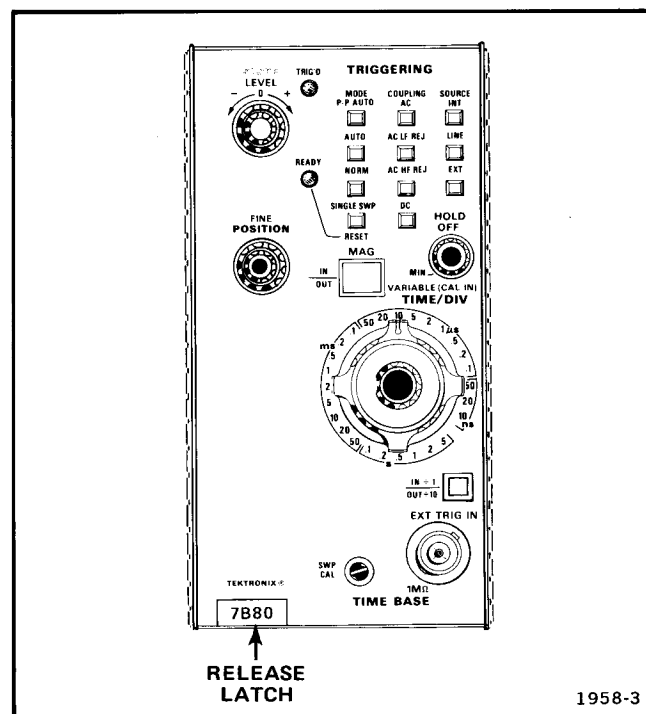


Fig. 1-1. Location of release latch.

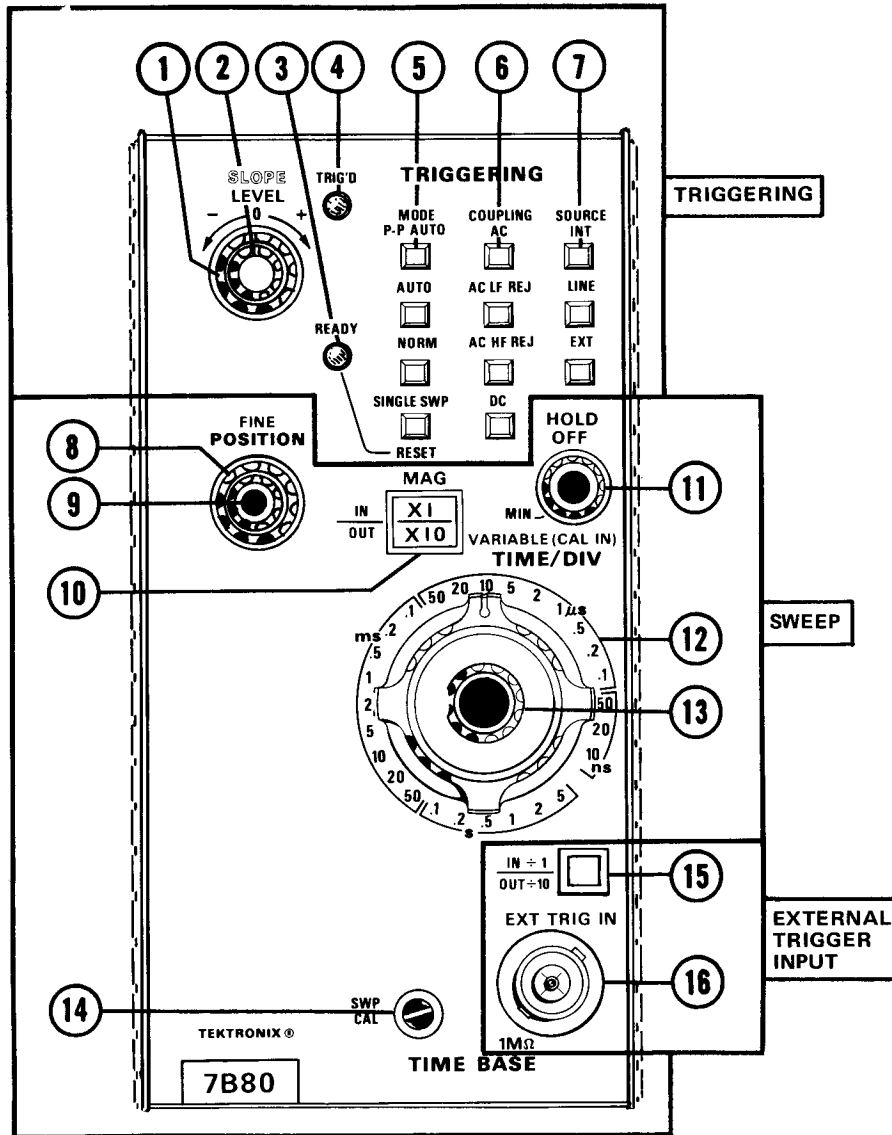


Fig. 1-2. Front-panel controls, connectors, and indicators.

## TRIGGERING

- ① LEVEL Control—Selects a point on the trigger signal where triggering occurs.
- ② SLOPE Switch—Permits sweep to be triggered on negative or positive-going portions of the trigger signal.
- ③ READY Indicator—Illuminates when sweep circuit is armed (SINGLE SWEEP Mode).
- ④ TRIG'D Indicator—Illuminates when the display is triggered.
- ⑤ MODE Pushbuttons—Selects the operating mode of the triggering circuit.
- ⑥ COUPLING Pushbuttons—Selects the method of coupling the trigger signal to triggering circuit.
- ⑦ SOURCE Pushbuttons—Selects source of the trigger signal.

## SWEEP

- ⑧ POSITION Control—Provides horizontal positioning.
- ⑨ FINE Control—Provides precise horizontal positioning.
- ⑩ MAG Pushbutton—Selects magnified X10 or unmagnified sweep.
- ⑪ HOLD OFF Control—Permits hold off period to be varied to improve trigger stability on repetitive complex waveforms.
- ⑫ TIME/DIV Selector—Selects the sweep rate of the sweep generator.
- ⑬ VARIABLE Control and CAL Switch—Selects calibrated or uncalibrated sweep rates. Uncalibrated sweep rates can be continuously reduced to at least the sweep rate of the next slower position.
- ⑭ SWP CAL Adjustment—Compensates for basic timing changes due to the differences in sensitivity of mainframes

## EXTERNAL TRIGGER INPUT

- ⑮ EXT TRIG ATTENUATOR—Selects attenuation factor for external trigger signals.
- ⑯ EXT TRIG IN Connector—Connector (BNC type) provides input for external trigger signals.

Fig. 1-2. Front-panel controls, connectors, and indicators (cont.).

## Operating Instructions—7B80

5. Set the mainframe vertical and horizontal modes to display the plug-in units used and adjust the intensity and focus for a well-defined display. See the oscilloscope mainframe and amplifier unit instruction manuals for detailed operating instructions.

### Sweep Functions

**NORMAL SWEEP.** Perform the following procedure to obtain a normal sweep and to demonstrate the function of the related controls:

1. Perform the preceding Setup Procedure.
2. Connect a 0.4-volt, 1-kilohertz signal from the mainframe calibrator to the amplifier unit input.
3. Set the amplifier unit deflection factor for 4 divisions of display.
4. Adjust the LEVEL control for a stable display.
5. Turn the POSITION control and note that the trace moves horizontally.
6. Turn the FINE control and note that the display can be precisely positioned horizontally.
7. Check the display for one complete cycle per division. If necessary, adjust the front-panel SWP CAL screwdriver adjustment for one complete cycle per division over the center 8 graticule divisions. Be sure that the timing of the mainframe calibrator signal is accurate to within 0.25% (+20 to +30° C).
8. Press to release the VARIABLE (CAL IN) control. Turn the VARIABLE (CAL IN) control fully counterclockwise and note that the displayed sweep rate changes to at least the next slower TIME/DIV switch setting (i.e., 2 milliseconds/division). Press the VARIABLE (CAL IN) knob in to the calibrated position.

**MAGNIFIED SWEEP.** Perform the following procedure to obtain a X10 magnified display and to demonstrate the function of the related controls:

1. Obtain a one cycle per division display as described in the preceding Normal Sweep procedure.

2. Press to release the MAG button (X10). Note that the unmagnified display within the center division of the graticule is magnified to about 10 divisions.

3. Press the MAG button (X1).

### Triggering Functions

Perform the following procedure to obtain a triggered sweep and to demonstrate the functions of the related controls:

1. Obtain a display as described in the preceding Normal Sweep procedure.
2. Press the AUTO MODE button and turn the LEVEL control fully counterclockwise to obtain a free-running sweep.
3. Slowly turn the HOLD OFF control clockwise and note that a stable display can be obtained at several positions of the HOLD OFF control. Return the HOLD OFF control to the fully counterclockwise (MIN) position.

#### NOTE

*The HOLD OFF control varies the sweep hold-off time which effectively changes the repetition-rate of the horizontal sweep signal. However, its primary function is to obtain a stable display of complex waveforms which are otherwise difficult to trigger.*

4. Press the AC, AC HF REJ, and DC COUPLING buttons for both the + and – positions of the SLOPE switch and check for a stable display (LEVEL control may be adjusted, if necessary, to obtain a stable display).
5. Apply the 0.4-volt, 1 kilohertz signal from the mainframe calibrator to the amplifier unit and to the EXT TRIG IN connector.
6. Press the EXT SOURCE button and set the amplifier unit deflection factor for a 4-division display.
7. Press the AC, AC HF REJ, and DC COUPLING buttons for both the + and – positions of the SLOPE switch and check for a stable display (LEVEL control may be adjusted, if necessary, for a stable display).

8. Press the AC COUPLING, INT SOURCE, and NORM MODE buttons. Adjust the LEVEL control for a stable display.

9. Press the AUTO MODE button and adjust the LEVEL control for a free-running display.

10. Press the NORM MODE button and check for no display.

11. Adjust the LEVEL control for a stable display and press the SINGLE SWP MODE button.

12. Note that one trace occurs when the RESET MODE button is pressed.

13. Disconnect the mainframe calibrator signal from the amplifier unit input and press the RESET MODE button. Check for no display and note that the READY indicator is lit.

14. Note that one trace occurs and that the READY indicator extinguishes when the mainframe calibrator signal is reconnected to the amplifier unit input.

## GENERAL OPERATING INFORMATION

### Triggering Switch Logic

The MODE, COUPLING, and SOURCE push buttons of the TRIGGERING switches are arranged in a sequence which places the most-often used position at the top of each series of push buttons. With this arrangement, a stable display can usually be obtained by pressing the top push buttons: P-P AUTO, AC, INT. When an adequate trigger signal is applied and the LEVEL control is correctly set, the unit is triggered as indicated by the illuminated TRIG'D light. If the TRIG'D light is not on, the LEVEL control is either at a setting outside the range of the trigger signal applied to this unit from the vertical unit, the trigger signal amplitude is inadequate, or its frequency is below the lower frequency limit of the AC COUPLING switch position. If the desired display is not obtained with these buttons pushed in, other selections must be made. Refer to the following discussions or the instruction manuals for the associated oscilloscope mainframe and vertical unit(s) for more information.

### Triggering Modes

The MODE push-button switches select the mode in which the sweep is triggered.

**P-P AUTO.** The P-P AUTO MODE provides a triggered display at any setting of the LEVEL control whenever an adequate trigger signal is applied. The range of the LEVEL control in the P-P AUTO MODE is between approximately 10% and 90% of the peak-to-peak amplitude of the trigger signal. The LEVEL control can be set so that the displayed waveform starts at any point within this range on either slope. The trigger circuits automatically compensate for a change in trigger-signal amplitude. Therefore, if the LEVEL control is set to start the waveform display at a certain percentage point on the leading edge of a low-amplitude signal, it triggers at the same percentage point on the leading edge of a high-amplitude signal if the LEVEL control is not changed. When the trigger repetition rate is outside the parameter given in the Specification section, or when the trigger signal is inadequate, the sweep free runs at the rate indicated by the TIME/DIV switch to produce a bright base-line reference trace (TRIG'D light off). When an adequate trigger signal is again applied, the free-running condition ends and a triggered display is presented.

The P-P AUTO MODE is particularly useful when observing a series of waveforms, since it is not necessary to reset the LEVEL control for each observation. The P-P AUTO MODE is used for most applications because of the ease of obtaining a triggered display. The AUTO, NORM, and SINGLE-SWP MODE settings may be used for special applications.

**AUTO.** The AUTO MODE provides a triggered display with the correct setting of the LEVEL control whenever an adequate trigger signal is applied (see Trigger Level discussions). The TRIG'D light indicates when the display is triggered.

When the trigger repetition rate is outside the frequency range selected by the COUPLING switch or the trigger signal is inadequate, the sweep free runs at the rate indicated by the TIME/DIV switch (TRIG'D indicator off). An adequate trigger signal ends the free-running condition and a triggered display is presented. The sweep also free runs at the rate indicated by the TIME/DIV switch when the LEVEL control is at a setting outside the amplitude range of the trigger signal. This type of free-running display is useful when it is desired to measure only the peak-to-peak amplitude of a signal without observing the waveshape (such as bandwidth measurements).

**NORMAL.** The NORM MODE provides a triggered display with the correct setting of the LEVEL control whenever an adequate trigger signal is applied. The TRIG'D light indicates when the display is triggered.

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The normal trigger mode must be used to produce triggered displays with trigger repetition rates below about 30 hertz. When the TRIG'D light is off, no trace is displayed.

**SINGLE SWEEP.** When the signal to be displayed is not repetitive or varies in amplitude, waveshape, or repetition rate, a conventional repetitive type display may produce an unstable presentation. Under these circumstances, a stable display can often be obtained by using the single-sweep feature of this unit. The single-sweep mode is also useful to photograph non-repetitive or unstable displays.

To obtain a single-sweep display of a repetitive signal, first obtain the best possible display in the NORM MODE. Then, without changing the other TRIGGERING controls, press the SINGLE SWP RESET button. A single trace is presented each time this button is pressed. Further sweeps cannot be presented until the SINGLE SWP RESET button is pressed again. If the displayed signal is a complex waveform composed of varying amplitude pulses, successive single-sweep displays may not start at the same point on the waveform. To avoid confusion due to the crt persistence, allow the display to disappear before pressing the SINGLE SWP RESET button again. At fast sweep rates, it may be difficult to view the single-sweep display. The apparent trace intensity can be increased by reducing the ambient light level or by using a viewing hood as recommended in the mainframe instruction manual.

When using the single-sweep mode to photograph waveforms, the graticule may have to be photographed separately in the normal manner to prevent over exposing the film. Be sure the camera system is well protected against stray light, or operate the system in a darkened room. For repetitive waveforms, press the SINGLE SWP RESET button only once for each waveform unless the signal is completely symmetrical. Otherwise, multiple waveforms may appear on the film. For random signals, the lens can be left open until the signal triggers the unit. Further information on photographic techniques is given in the appropriate camera instruction manual.

### Trigger Coupling

The TRIGGERING COUPLING push buttons select the method in which the trigger signal is connected to the trigger circuits. Each position permits selection or rejection of some frequency components of the signal which triggers the sweep.

**AC.** AC COUPLING blocks the dc component of the trigger signal. Signals with low-frequency components below about 30 hertz are attenuated. In general, AC COUPLING can be used for most applications. However, if the signal

contains unwanted frequency components or if the sweep is to be triggered at a low repetition rate or dc level, one of the other COUPLING switch positions will provide a better display.

**AC LF REJ.** AC LF REJ COUPLING rejects dc, and attenuates low-frequency trigger signals below about 30 kilohertz. Therefore, the sweep is triggered only by the higher-frequency components of the trigger signal. This position is particularly useful for providing stable triggering if the trigger signal contains line-frequency components. Also, the AC LF REJ position provides the best alternate-mode vertical displays at fast sweep rates when comparing two or more unrelated signals.

**AC HF REJ.** AC HF REJ COUPLING passes all low-frequency signals between about 30 hertz and 50 kilohertz. Dc is rejected and signals outside the above range are attenuated. When triggering from complex waveforms, this position is useful to provide a stable display of the low-frequency components.

**DC.** DC COUPLING can be used to provide stable triggering from low-frequency signals which would be attenuated in the other COUPLING switch positions. DC COUPLING can be used to trigger the sweep when the trigger signal reaches a dc level set by the LEVEL control. When using internal triggering, the setting of the vertical unit position control affects the triggering point.

### Trigger Source

The TRIGGERING SOURCE push buttons select the source of the trigger signal which is connected to the trigger circuits.

**INTERNAL.** The INT position connects the trigger signal from the vertical plug-in unit. Further selection of the internal trigger signal may be provided by the vertical plug-in unit or by the mainframe; see the instruction manuals for these instruments for more information. For most applications, the internal source can be used. However, some applications require special triggering which cannot be obtained in the INT position. In such cases, the LINE or EXT positions of the SOURCE switches must be used.

**LINE.** The LINE position connects a sample of the power-line voltage from the mainframe to the trigger circuit. Line triggering is useful when the input signal is time-related (multiple or submultiple) to the line frequency. It is also useful for providing a stable display of a line-frequency component in a complex waveform.

**EXTERNAL.** The EXT position connects the signal from the EXT TRIG IN connector to the trigger circuit. The external signal must be time-related to the displayed waveform for a stable display. An external trigger signal can be used to provide a triggered display when the internal signal is either too low in amplitude for correct triggering or contains signal components on which triggering is not desired. It is also useful when signal tracing in amplifiers, phase-shift networks, wave-shaping circuits, etc. The signal from a single point in the circuit can be connected to the EXT TRIG IN connector through a probe or cable. The sweep is then triggered by the same signal at all times and allows amplitude, time relationship, or waveshape changes of signals at various points in the circuit to be examined without re-setting the TRIGGERING controls.

The  $\div 10$  push button attenuates the external trigger signal by a factor of 10. Attenuation of high amplitude external trigger signals is desirable to increase the effective range of the LEVEL control.

### Trigger Slope

The TRIGGERING SLOPE switch (concentric with the TRIGGERING LEVEL control) determines whether the trigger circuit responds on the positive- or negative-going portion of the trigger signal. When the SLOPE switch is in the (+) (positive-going) position, the display starts on the positive-going portion of the waveform (see Figure 1-3). When several cycles of a signal appear in the display, the setting of the SLOPE switch is often unimportant. However, if only a certain portion of a cycle is to be displayed, correct setting of the SLOPE switch is important to provide a display that starts on the desired slope of the input signal.

### Trigger Level

The TRIGGERING LEVEL control determines the voltage level on the trigger signal at which the sweep is triggered. When the LEVEL control is set in the + region, the trigger circuit responds at a more positive point on the trigger signal. When the LEVEL control is set in the - region, the trigger circuit responds at a more negative point on the trigger signal. Figure 1-3 illustrates this effect with different settings of the SLOPE switch.

To set the LEVEL control, first select the TRIGGERING MODE, COUPLING, SOURCE, and SLOPE. Then set the LEVEL control fully counterclockwise and rotate it clockwise until the display starts at the desired point.

### Horizontal Sweep Rates

The TIME/DIV switch provides calibrated sweep rates from 5 seconds/division to 10 nanoseconds/division in a 1-2-5

sequence. The VARIABLE TIME/DIV control must be in the calibrated position and the MAG switch set to X1 to obtain the sweep rate indicated by the TIME/DIV switch. However, the mainframe crt readout will display the appropriate sweep rate.

The VARIABLE TIME/DIV control includes a two-position switch to determine if the sweep rate is calibrated, or uncalibrated. When the VARIABLE control is pressed in, it is inoperative and the sweep rate is calibrated. When pressed and released outward, the VARIABLE control is activated for uncalibrated sweep rates, to at least the sweep rate of the next slower position.

A calibrated sweep rate can be obtained in any position of the VARIABLE control by pressing in the VARIABLE control. This feature is particularly useful when a specific uncalibrated sweep rate has been obtained and it is desired to switch between calibrated and uncalibrated displays.

### Time Measurement

When making time measurements from the graticule, the area between the second and tenth vertical lines of the graticule provides the most linear time measurements (see Figure 1-4). Position the start of the timing area to the second vertical line and adjust the TIME/DIV switch so the end of the timing area falls between the second and tenth vertical lines.

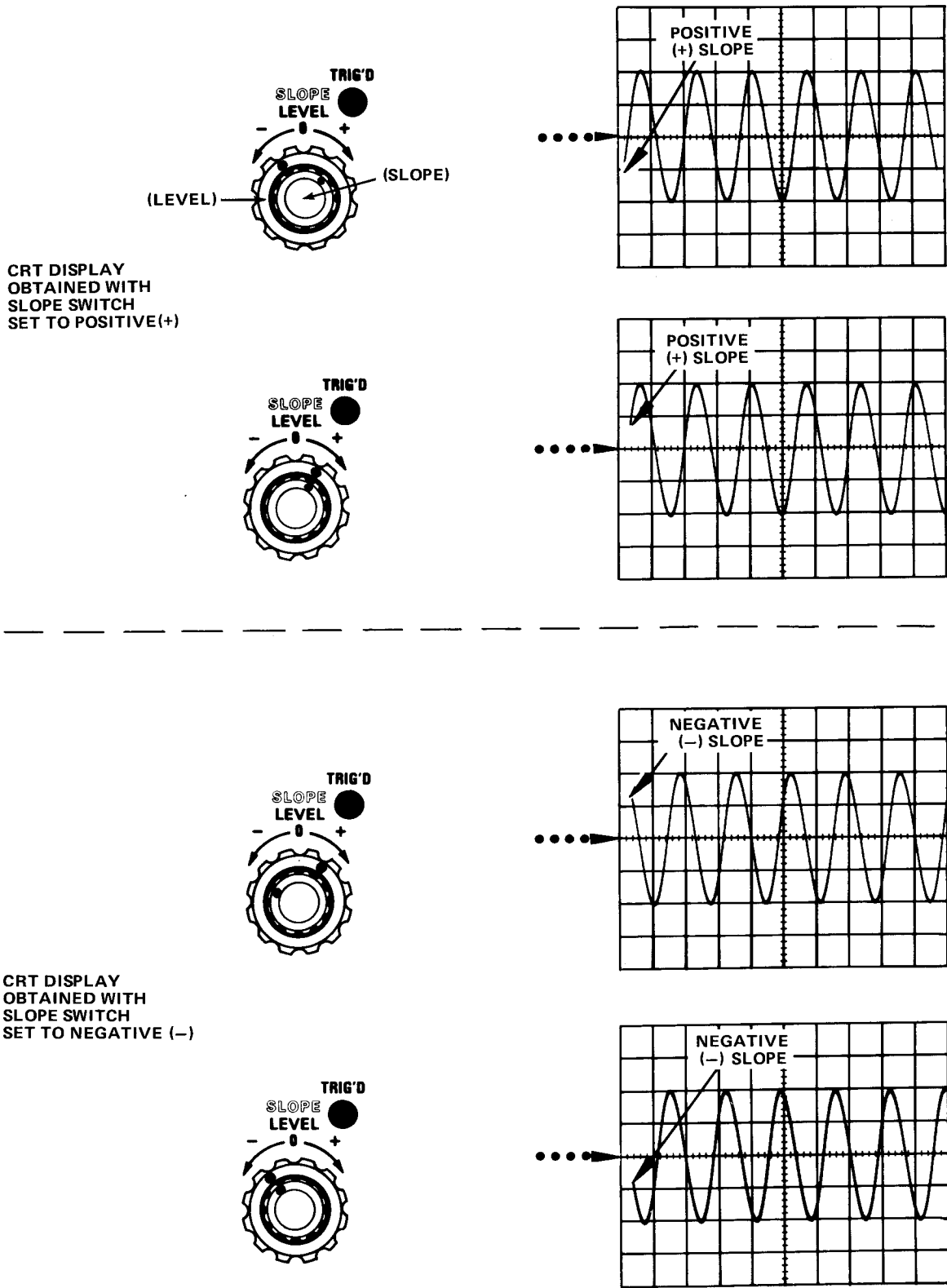
### Sweep Magnification

The sweep magnifier can be used to expand the display by a factor of 10. The center division of the unmagnified display is the portion visible on the crt in the magnified form (see Figure 1-5). The equivalent length of the magnified sweep is more than 100 divisions; any 10 division portion can be viewed by adjusting the POSITION and FINE POSITION controls to bring the desired portion into the viewing area. When the MAG switch is set to X10 (OUT) the equivalent magnified sweep rate can be determined by dividing the TIME/DIV setting by 10; the equivalent magnified sweep rate is displayed on the crt readout.

### Variable Hold Off

The HOLD OFF control improves triggering stability on repetitive complex waveforms by effectively changing the repetition rate of the horizontal sweep signal. The HOLD OFF control should normally be set to its minimum setting. When a stable display cannot be obtained with the TRIGGERING LEVEL control, the HOLD OFF control can be varied for an improved display. If a stable display cannot be obtained at any setting of the LEVEL and HOLD OFF controls, check the TRIGGERING COUPLING and SOURCE switch settings.





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Fig. 1-3. Effect of LEVEL control and SLOPE switch on crt display.

### Mainframe Operating Modes

The time-base unit can be operated either as an independent time base in any Tektronix 7700-, 7800-, or 7900-series oscilloscope mainframe, or as a delayed-sweep unit in those mainframes that have two horizontal compartments. A companion delaying time-base unit is required for delayed-sweep operation. Refer to the delaying time-base unit instruction manual for additional information.

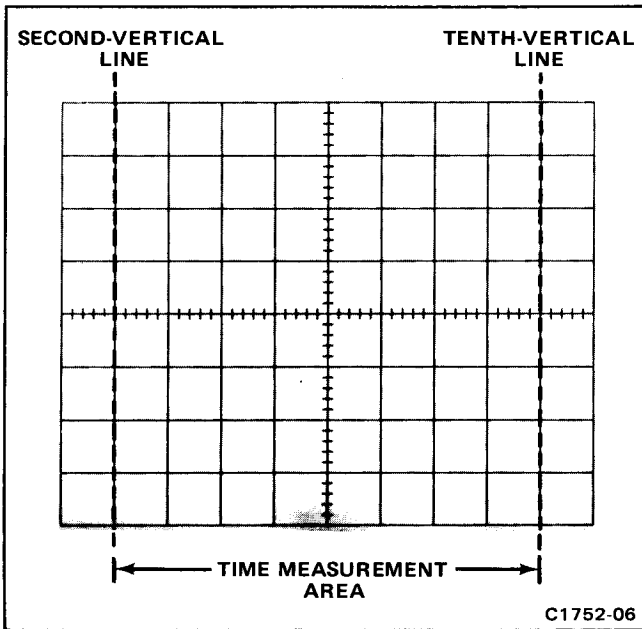


Fig. 1-4. Area of graticule used for most accurate time measurements.

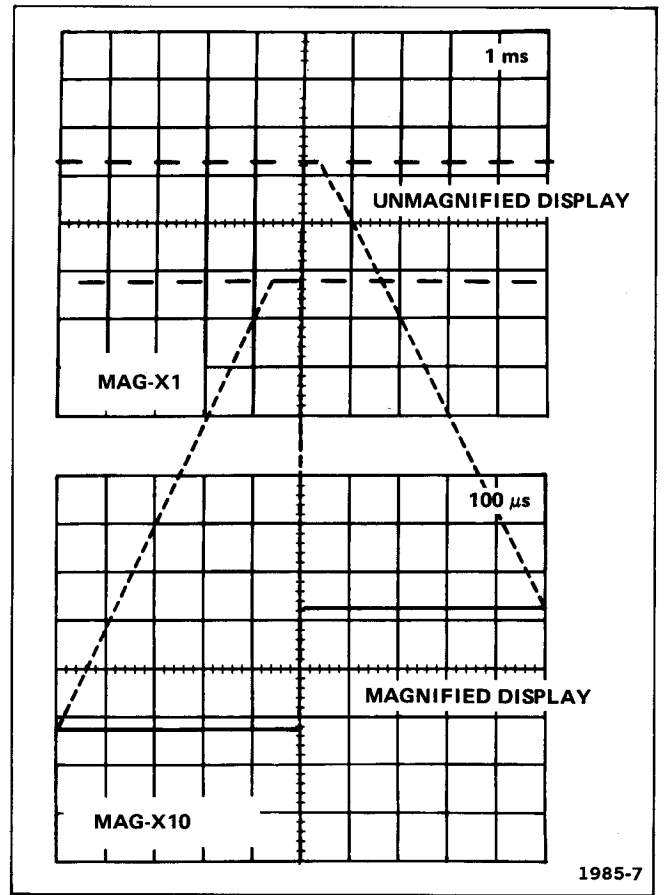


Fig. 1-5. Operation of sweep magnifier.

## APPLICATIONS

The following information describes procedures and techniques for making basic time measurements with the time-base unit installed in a Tektronix 7700-, 7800-, or 7900-series oscilloscope. These procedures provide enough detail to enable the operator to adapt them to other related time measurements. Contact your Tektronix Field Office or representative for assistance in making measurements that are not described in this manual.

### TIME-INTERVAL MEASUREMENTS

Since time is a function of the sweep rate and the horizontal distance (in divisions) that the sweep travels across the graticule in a calibrated-sweep oscilloscope system, the time interval between any two points on a waveform can be accurately measured. The following procedures provide methods to measure some of the more common time-related definable characteristics of a waveform such as period, frequency, rise time, fall time, and pulse width. The procedure for each of these measurements is essentially the same, except for the points between which the measurements are made. The time interval between any two selected points on a displayed waveform can be measured with basically the same technique.

#### Period and Frequency Measurements

Perform the following procedure to measure the period and determine the frequency of a displayed waveform:

1. Install the time-base unit in a mainframe horizontal compartment (either A or B horizontal in a four-compartment mainframe).
2. Connect the signal to be measured to the vertical unit input.
3. Set the mainframe horizontal- and vertical-mode switches to display the time base and vertical units. (Check that the time base VARIABLE (CAL IN) control is pushed in and the HOLD OFF control is in the MIN position.)
4. Set the TRIGGERING switches and LEVEL control for a stable display (see General Operating Information for selecting proper triggering).
5. Set the vertical deflection factor and position control for about a 5-division display, vertically centered on the graticule.
6. Set the TIME/DIV switch and POSITION control for 1 complete cycle displayed within the center 8 graticule divisions as shown in Figure 1-6.

7. Measure the horizontal distance in divisions over 1 complete cycle of the displayed waveform (see Figure 1-6).

8. Multiply the horizontal distance measured in Step 7 by the TIME/DIV switch setting. (Divide the answer by 10 if sweep magnification is used.)

Example: Assume that the horizontal distance over 1 complete cycle is 7 divisions, and the TIME/DIV switch setting is .1 ms (see Figure 1-6).

Using the formula:

$$\text{Period} = \frac{\text{Horizontal distance} \times \text{TIME/DIV setting}}{\text{Magnification}}$$

Substituting values:

$$\text{Period} = \frac{7 \times 0.1 \text{ ms}}{1} = 0.7 \text{ millisecond}$$

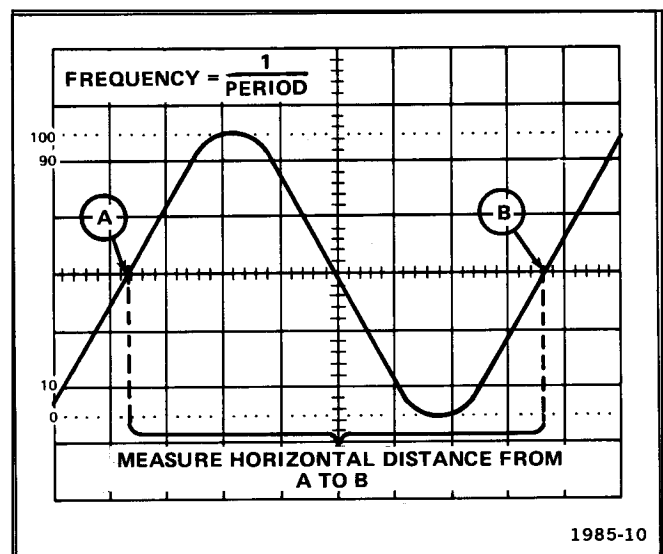


Fig. 1-6. Measuring the period and determining the frequency of a displayed waveform.

9. Determine the frequency of the displayed waveform obtained in steps 1 through 8 by taking the reciprocal of the period of 1 cycle.

Example: Assume that the period of the displayed waveform is 0.7 millisecond.

Using the formula:

$$\text{Frequency} = \frac{1}{\text{Period}}$$

Substituting values:

$$\text{Frequency} = \frac{1}{0.7 \text{ ms}} = 1.43 \text{ kilohertz}$$

### Rise-Time and Fall-Time Measurements

Perform the following procedure to measure the rise time and fall time of a displayed waveform:

1. Install the time-base unit in a mainframe horizontal compartment (either A or B horizontal in a four-compartment mainframe).
2. Connect the signal to be measured to the vertical unit input.
3. Set the mainframe horizontal- and vertical-mode switches to display the time base and the vertical unit. (Check that the time base VARIABLE (CAL IN) control is pushed in and the HOLD OFF control is in the MIN position.)
4. Set the TRIGGERING switches and LEVEL control for a stable display (see General Operating Information for selecting proper triggering).
5. Set the vertical deflection factor and position control for a vertically-centered display with an exact number of divisions of amplitude.
6. Set the TIME/DIV switch and POSITION control to display the rising or falling portion of the waveform within the center 8 graticule divisions as shown in Figure 1-7 (see General Operating Information in this section for discussion of timing measurement accuracy).
7. Determine rise time or fall time by measuring the horizontal distance in divisions between the point on the rising

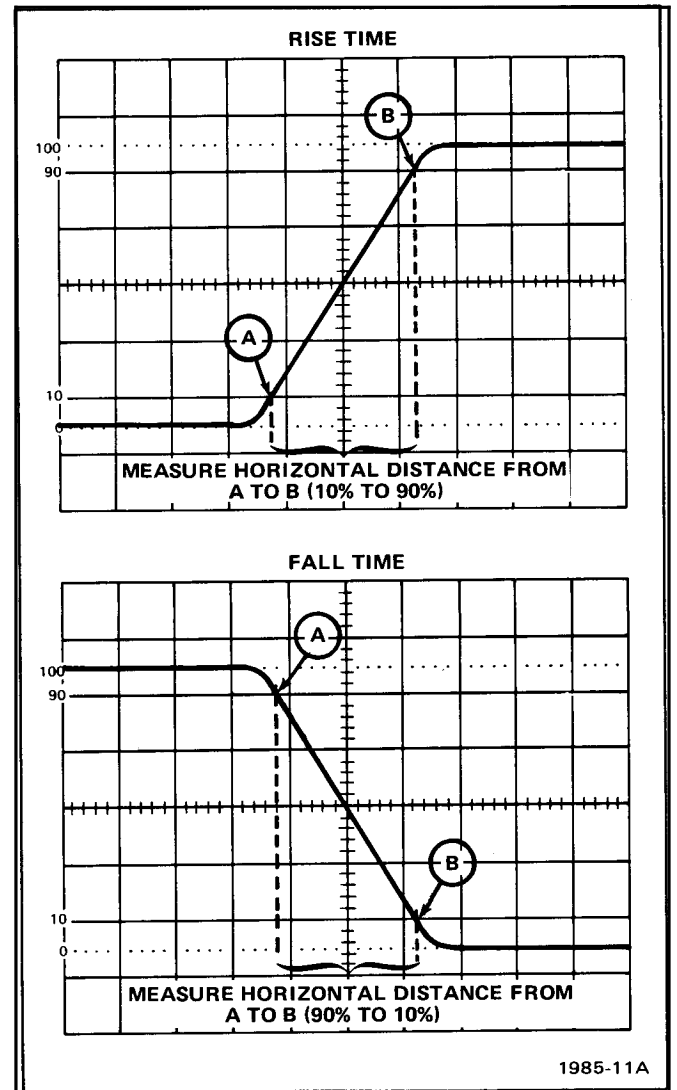


Fig. 1-7. Measuring the rise time and fall time of a displayed waveform.

or falling portion of the waveform that is 10% and the point that is 90% of the total display amplitude (see Figure 1-7).

#### NOTE

The left edge of the oscilloscope graticule is scribed with 0, 10, 90, and 100% lines for convenience when measuring rise time or fall time. To use this feature, adjust the vertical deflection factor and position control to fit the display between the 0 and 100% graticule lines. Then measure the horizontal distance between the points where the waveform crosses the 10% and 90% graticule lines.

## Operating Instructions—7B80

8. Multiply the horizontal distance measured in step 7 by the TIME/DIV switch setting. (Divide the answer by 10 if sweep magnification is used.)

Example: Assume that the horizontal distance from the 10 to 90% points is 2.5 divisions and the TIME/DIV switch setting is .1  $\mu$ s (see Figure 1-7).

Using the formula:

$$\text{Rise Time} = \frac{\text{Horizontal distance (divisions)} \times \text{TIME/DIV setting}}{\text{Magnification}}$$

Substituting values:

$$\text{Rise Time} = \frac{2.5 \times 0.1 \mu\text{s}}{1} = 0.25 \text{ microsecond}$$

### Pulse Width Measurements

Perform the following procedure to measure the pulse width of a displayed waveform:

1. Install the time-base unit in a mainframe horizontal compartment (either A or B horizontal in a four-compartment mainframe).
2. Connect the signal to be measured to the vertical unit input.
3. Set the mainframe horizontal- and vertical-mode switches to display the time base and vertical unit. (Check that the time base VARIABLE (CAL IN) control is pushed in and the HOLD OFF control is in the MIN position.)
4. Set the TRIGGERING switches and LEVEL control for a stable display (see General Operating Information for selecting proper triggering).
5. Set the vertical deflection factor and position control for about a 5-division pulse vertically centered on the graticule.
6. Set the TIME/DIV switch and POSITION control for 1 complete pulse displayed within the center 8 graticule divisions as shown in Figure 1-8.
7. Measure the horizontal distance in divisions between the 50% amplitude points of the displayed pulse (see Figure 1-8).

8. Multiply the horizontal distance measured in step 7 by the TIME/DIV switch setting. (Divide the answer by 10 if sweep magnification is used.)

Example: Assume that the horizontal distance between the 50% amplitude points is 3 divisions, and the TIME/DIV switch setting is .1 ms (see Figure 1-8).

Using the formula:

$$\text{Pulse Width} = \frac{\text{Horizontal distance} \times \text{TIME/DIV setting}}{\text{Magnification}}$$

Substituting values:

$$\text{Pulse Width} = \frac{3 \times 0.1 \text{ ms}}{1} = 0.3 \text{ millisecond}$$

### DELAYED-SWEEP MEASUREMENTS

The time-base unit may be used with a delaying time-base unit in a mainframe with two horizontal compartments to make delayed-sweep measurements. See the Tektronix Products Catalog for compatible delaying time-base plug-in units. If a compatible delaying time-base unit is available, refer to the instruction manual for that unit for detailed delayed-sweep measurement procedures.

### X-Y PHASE MEASUREMENTS

The phase difference between two signals with the same frequency can be measured with a 7B80 Option 2 and amplifier plug-in units. Refer to the Instrument Options section of this manual for detailed procedures.

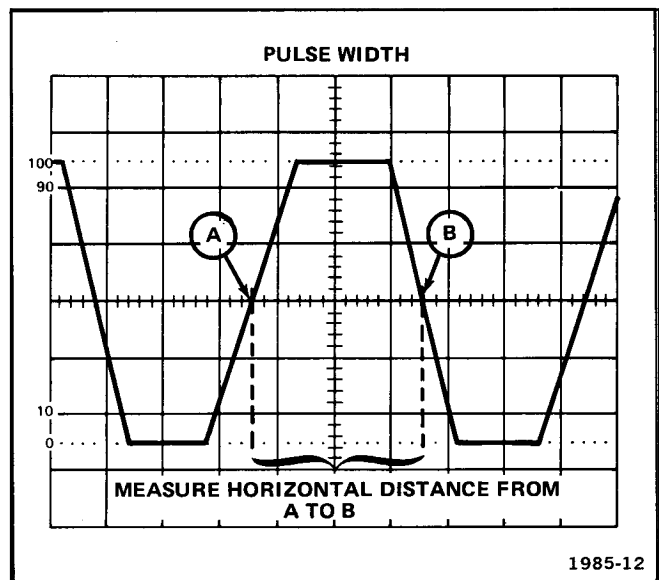


Fig. 1-8. Measuring the pulse width of a displayed waveform.

# SPECIFICATION

This instrument will meet the electrical characteristics listed in Table 2-1, following complete adjustment. The following electrical characteristics apply over an ambient temperature range of 0° to +50° C, except as otherwise indicated. Warmup time for given accuracy is 20 minutes.

**TABLE 2-1**  
**Electrical Characteristics**

Characteristic	Performance Requirement																				
<b>SWEEP GENERATOR</b>																					
Sweep Rates																					
Calibrated Range	5 s/div to 10 ns/div in 27 steps. X10 Magnifier extends fastest calibrated sweep rate to 1 ns/div.																				
Variable Range	Continuously variable uncalibrated sweep rate to at least 2.5 times the calibrated sweep rate setting.																				
Sweep Accuracy <sup>1</sup> (With 7700, 7800, or 7900-Series Mainframes)	With SWP CAL adjusted at 1 ms/div within the temperature range of +20° to +30° C to a timing reference of 0.25% or better.																				
Over Center 8 Div	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="width: 50%; text-align: center;">+15° to +35° C</th> <th colspan="2" style="width: 50%; text-align: center;">0° to +50° C</th> </tr> <tr> <th style="width: 25%; text-align: center;">Unmag</th> <th style="width: 25%; text-align: center;">Mag</th> <th style="width: 25%; text-align: center;">Unmag</th> <th style="width: 25%; text-align: center;">Mag</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">5 s/Div to 1 s/Div</td> <td style="text-align: center;">4.0%</td> <td style="text-align: center;">5.0%</td> <td style="text-align: center;">6.0%</td> </tr> <tr> <td style="text-align: center;">0.5 s/Div to 0.1 μs/Div</td> <td style="text-align: center;">1.5%</td> <td style="text-align: center;">2.5%</td> <td style="text-align: center;">3.5%</td> </tr> <tr> <td style="text-align: center;">50 ns/Div to 10 ns/Div</td> <td style="text-align: center;">2.5%</td> <td style="text-align: center;">4.0%</td> <td style="text-align: center;">5.0%</td> </tr> </tbody> </table>	+15° to +35° C		0° to +50° C		Unmag	Mag	Unmag	Mag	5 s/Div to 1 s/Div	4.0%	5.0%	6.0%	0.5 s/Div to 0.1 μs/Div	1.5%	2.5%	3.5%	50 ns/Div to 10 ns/Div	2.5%	4.0%	5.0%
+15° to +35° C		0° to +50° C																			
Unmag	Mag	Unmag	Mag																		
5 s/Div to 1 s/Div	4.0%	5.0%	6.0%																		
0.5 s/Div to 0.1 μs/Div	1.5%	2.5%	3.5%																		
50 ns/Div to 10 ns/Div	2.5%	4.0%	5.0%																		
Excluded Portions of Sweep																					
Start of Sweep	First 10 ns in 7800, 7900-series mainframes. First 20 ns in 7700-series mainframes. First 50 ns in all other 7000-series mainframes.																				
End of Sweep	Beyond 10th div unmagnified. Beyond 100th div magnified.																				
Sweep Length (Unmagnified)	At least 10.2 div at all sweep rates.																				
MAG Registration	0.5 div or less from graticule center when changing from MAG X10 to MAG X1.																				
Position Range																					
POSITION Controls Fully Clockwise	Start of sweep must be to the right of graticule center at 1 ms/div.																				
POSITION Controls Fully Counterclockwise	End of sweep must be to the left of graticule center at 1 ms/div.																				

<sup>1</sup> The fastest calibrated sweep rate is limited by some mainframes.

**TABLE 2-1 (CONT.)  
Electrical Characteristics**

Characteristic	Performance Requirement
Trigger Holdoff Time	
Minimum Holdoff Setting	
5 s/Div to 1 $\mu$ s/Div	2 times TIME/DIV setting or less.
0.5 $\mu$ s/Div to 10 ns/Div	2.0 $\mu$ s or less.
Variable Holdoff Range	Extends holdoff time through at least 2 sweep lengths for sweep rates of 20 ms/div or faster.

**TRIGGERING**

Triggering Sensitivity from Repetitive Signal (Auto, Norm and Single Sweep Modes)	Triggering Frequency Range <sup>2</sup>	Minimum Triggering Signal Required	
		Internal	External
Coupling			
AC	30 Hz to 50 MHz 50 MHz to 400 MHz	0.3 div 1.5 div	50 mV 250 mV
AC LF REJ <sup>3</sup>	30 kHz to 50 MHz 50 MHz to 400 MHz	0.3 div 1.5 div	50 mV 250 mV
AC HF REJ	30 Hz to 50 kHz	0.3 div	50 mV
DC <sup>4</sup>	Dc to 50 MHz 50 MHz to 400 MHz	0.3 div 1.5 div	50 mV 250 mV
Internal Trigger Jitter	0.1 ns or less at 400 MHz.		
External Trigger Input			
Maximum Input Voltage	250 V (dc plus peak ac).		
Input R and C	1 M $\Omega$ within 5%, 20 pF within 10%.		
Level Range (Excluding P-P AUTO)	(Checked on 1 kHz sine wave.)		
EXT $\div$ 1	At least + and -1.5 volts.		
EXT $\div$ 10	At least + and -15 volts.		
P-P AUTO Operation Sensitivity (Ac or Dc Coupling)	Triggering Frequency Range	Minimum Triggering Signal Required	
		Internal	External
	200 Hz to 50 MHz	0.5 div	125 mV
	50 MHz to 400 MHz	1.5 div	375 mV
Low Frequency Response	At least 50 Hz	2.0 div	500 mV

<sup>2</sup> The triggering frequency ranges given here are limited to the -3 dB frequency of the oscilloscope vertical system (mainframe and amplifier unit) when operating from an internal source.

<sup>3</sup> Will not trigger on sine waves at or below 60 Hz when amplitudes are less than 8 divisions internal or 3 volts external.

<sup>4</sup> The Triggering Frequency Range for DC COUPLING applies to frequencies above 30 Hz when operating in the AUTO TRIGGERING MODE.

**TABLE 2-2**  
Environmental Characteristics

Refer to the Specification section of the associated mainframe manual.
------------------------------------------------------------------------

**TABLE 2-3**  
Physical Characteristics

Net Weight	Approximately 2.1 pounds (1 kilogram).
Dimensions	See Figure 2-1, dimensional drawing.

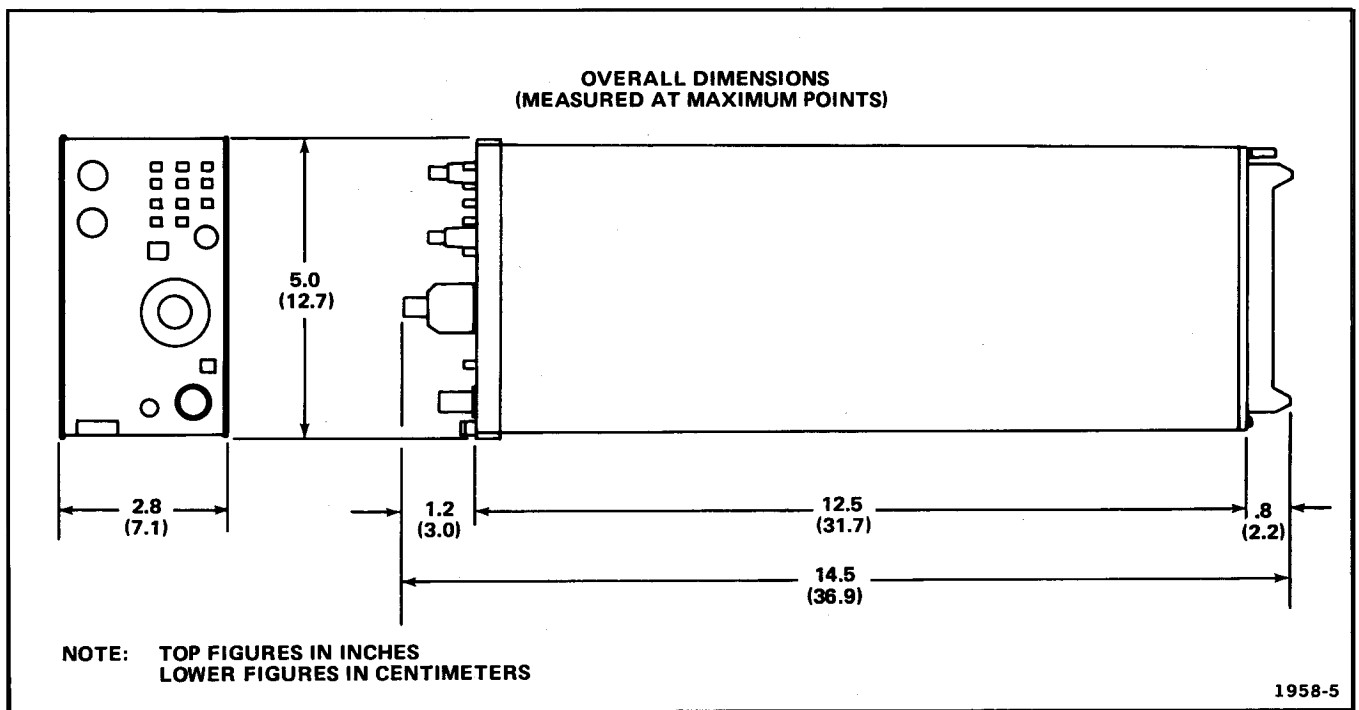


Fig. 2-1. 7B80 dimensional drawing.

**STANDARD ACCESSORIES**

- 1 ea ..... Operators Manual
- 1 ea ..... Instruction Manual



# THEORY OF OPERATION

This section of the manual describes the circuitry used in the 7B80 Time-Base unit. The description begins with a discussion of the instrument, using the block diagram shown in Figure 3-1. Next, each circuit is described in detail with a block diagram provided to show the major interconnections between circuits, and the relationship of the front-panel controls to each circuit. Detailed schematic diagrams of each circuit are located in the diagrams foldout section at the back of this manual. Refer to these diagrams throughout the following discussions for specific electrical values and relationships.

## BLOCK DIAGRAM DESCRIPTION

The following discussion is provided to aid in understanding the overall concept of the time-base unit before the individual circuits are discussed in detail. A basic block diagram is shown in Figure 3-1. The numbered diamond in each block refers to the corresponding circuit diagram at the rear of this manual.

### TRIGGER GENERATOR

The Trigger Generator ensures a stable crt display by starting each sweep at the same point on the waveform. Circuitry is included for selection of trigger mode, coupling, and source. The output of the Trigger Generator is a fast-rise gate which enables the Sweep Generator.

rate of change (slope) of the sawtooth signal is determined by the TIME/DIV switch setting. The sawtooth signal provides horizontal deflection for the mainframe (oscilloscope). The Sweep Generator also generates a Sweep Gate pulse which unblanks the crt in the mainframe.

### SWEEP GENERATOR

The sweep sawtooth signal is initiated when the Trigger Generator output is applied to the Sweep Generator. The

The Logic circuits control the sweep modes and associated functions of the time-base unit (e.g., auto sweep, single sweep, hold off, etc.). The Logic circuits also generate the control signals for the mainframe.

### LOGIC

## DETAILED CIRCUIT DESCRIPTION

The operation of circuits unique to this instrument is described in detail in this discussion. Circuits commonly used in the electronics industry are not described in detail.

The following circuit analysis, with supporting illustrations, gives the names of individual stages, and shows how they are connected to form major circuits. These illustrations show the inputs and outputs for each circuit and the relationship of the front-panel controls to the individual stages. The detailed circuit diagrams from which the illustrations are derived are shown in the diagrams foldout section.

### LOGIC FUNDAMENTALS

Digital logic techniques are used to perform many functions within this instrument. The function and operation of the logic circuits are described using logic symbology and terminology. This portion of the manual is provided to be an aid in the understanding of these symbols and logic concepts, not a comprehensive discussion of the subject.

#### Symbols

The symbols used to describe digital circuits in this instrument are based on ANSI standard Y32.14-1973. Table 3-1 provides a basic reference for the logic devices used within this instrument. Any deviations from the standard symbology, or devices not defined by the standard, are described in the circuit description for the applicable device.

### NOTE

*Logic symbols used on the diagrams depict the logic function as used in this instrument, and may differ from the manufacturer's data.*

#### Logic Polarity

All logic functions are described using the positive logic convention. Positive logic is a system of notation where the more positive of two levels (HI) is called the true or 1-state; the more negative level (LO) is called the false or 0-state. The HI-LO method of notation is used in this description. The specific voltages that constitute a HI or LO state may vary between individual devices. Wherever possible, the input and output lines are named to indicate the function performed when at the HI (true) state.

Input/Output Tables

Input/Output (truth) tables are used to show the input combinations important to a particular function, along with the resultant output conditions. This table may be given either for an individual device or for a complete logic stage. For examples of input/output tables for individual devices, see Table 3-1.

NON-DIGITAL DEVICES

Not all of the integrated circuits in this instrument are digital logic devices. The function of nondigital devices is described individually, using operating waveforms or other techniques to illustrate the function.

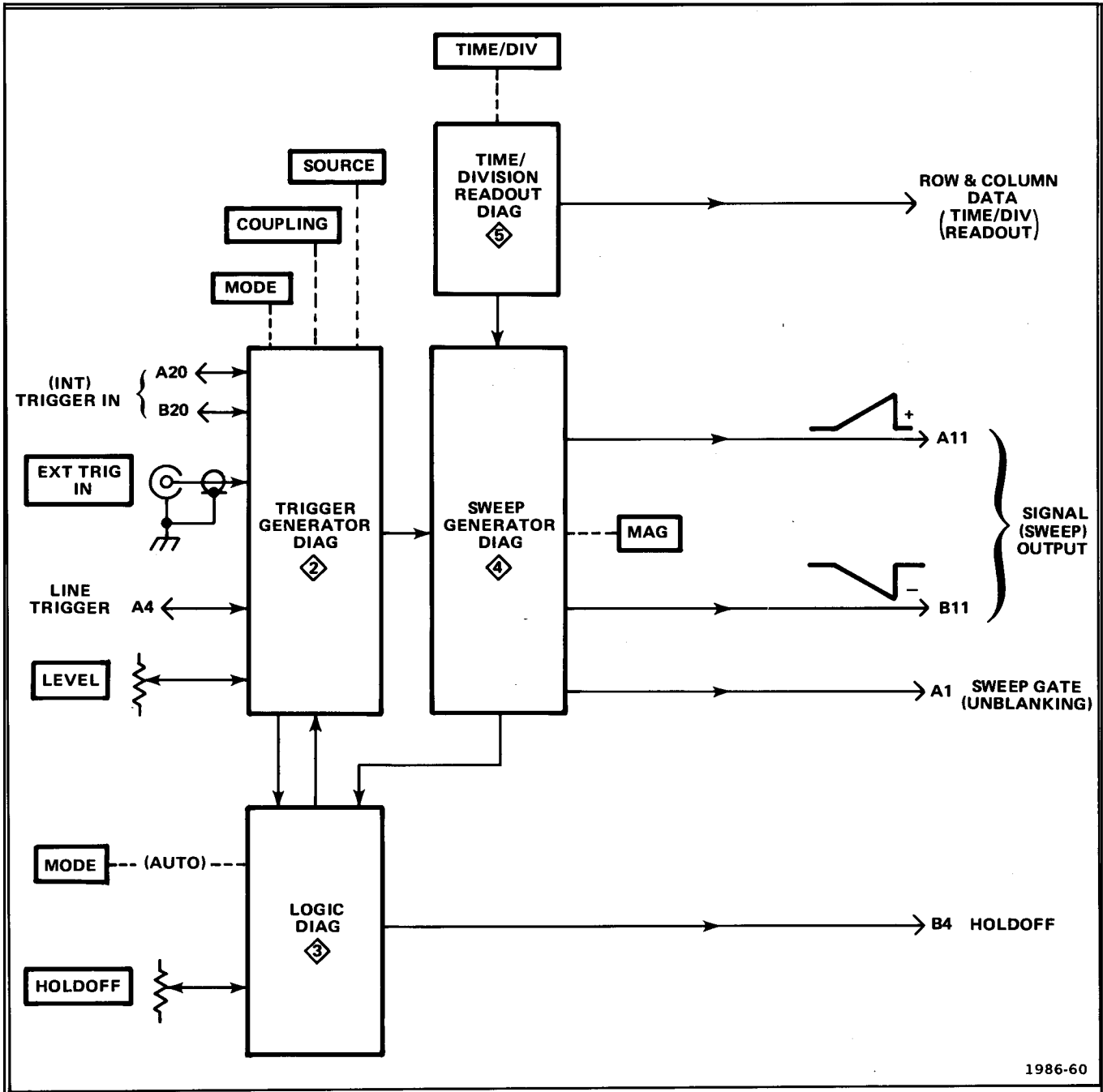


Fig. 3-1. Basic block diagram of the 7B80 Time-Base Unit.

**TABLE 3-1**  
**Basic Logic Reference**

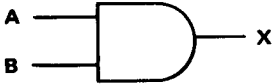



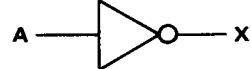
Device	Symbol	Description	Input/Output Table																		
AND gate		A device with two or more inputs and one output. The output of the AND gate is HI if and only if all of the inputs are at the HI state.	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>LO</td> <td>LO</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>HI</td> <td>HI</td> </tr> </tbody> </table>	Input		Output	A	B	X	LO	LO	LO	LO	HI	LO	HI	LO	LO	HI	HI	HI
Input		Output																			
A	B	X																			
LO	LO	LO																			
LO	HI	LO																			
HI	LO	LO																			
HI	HI	HI																			
NAND gate		A device with two or more inputs and one output. The output of the NAND gate is LO if and only if all of the inputs are at the HI state.	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>HI</td> <td>LO</td> </tr> </tbody> </table>	Input		Output	A	B	X	LO	LO	HI	LO	HI	HI	HI	LO	HI	HI	HI	LO
Input		Output																			
A	B	X																			
LO	LO	HI																			
LO	HI	HI																			
HI	LO	HI																			
HI	HI	LO																			
OR gate		A device with two or more inputs and one output. The output of the OR gate is HI if one or more of the inputs are at the HI state.	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>LO</td> <td>LO</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>HI</td> <td>HI</td> </tr> </tbody> </table>	Input		Output	A	B	X	LO	LO	LO	LO	HI	HI	HI	LO	HI	HI	HI	HI
Input		Output																			
A	B	X																			
LO	LO	LO																			
LO	HI	HI																			
HI	LO	HI																			
HI	HI	HI																			
NOR gate		A device with two or more inputs and one output. The output of the NOR gate is LO if one or more of the inputs are at the HI state.	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>HI</td> <td>LO</td> </tr> </tbody> </table>	Input		Output	A	B	X	LO	LO	HI	LO	HI	LO	HI	LO	LO	HI	HI	LO
Input		Output																			
A	B	X																			
LO	LO	HI																			
LO	HI	LO																			
HI	LO	LO																			
HI	HI	LO																			
Inverter		A device with one input and one output. The output state is always opposite to the input state.	<table border="1"> <thead> <tr> <th>Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>LO</td> </tr> </tbody> </table>	Input	Output	A	X	LO	HI	HI	LO										
Input	Output																				
A	X																				
LO	HI																				
HI	LO																				

TABLE 3-1 (cont)


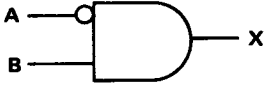

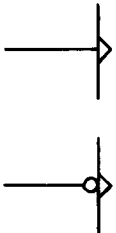
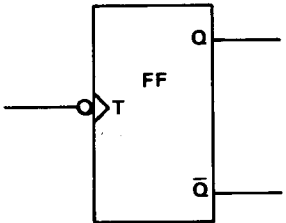
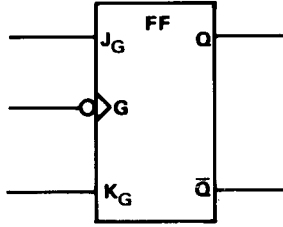
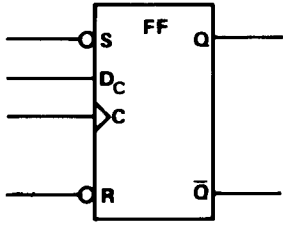
Device	Symbol	Description	Input/Output Table																				
LO-state indicator		<p>A small circle at the input or output of a symbol indicates that the LO state is the significant state. Absence of the circle indicates that the HI state is the significant state. Two examples follow:</p>																					
		<p>AND gate with LO-state indicator at the A input.</p> <p>The output of this gate is HI if and only if the A input is LO and the B input is HI.</p>	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>LO</td> <td>LO</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>HI</td> <td>LO</td> </tr> </tbody> </table>	Input		Output	A	B	X	LO	LO	LO	LO	HI	HI	HI	LO	LO	HI	HI	LO		
Input		Output																					
A	B	X																					
LO	LO	LO																					
LO	HI	HI																					
HI	LO	LO																					
HI	HI	LO																					
		<p>OR gate with LO-state indicator at the A input:</p> <p>The output of this gate is HI if either the A input is LO or the B input is HI.</p>	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th>Output</th> </tr> <tr> <th>A</th> <th>B</th> <th>X</th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>HI</td> <td>HI</td> </tr> </tbody> </table>	Input		Output	A	B	X	LO	LO	HI	LO	HI	HI	HI	LO	LO	HI	HI	HI		
Input		Output																					
A	B	X																					
LO	LO	HI																					
LO	HI	HI																					
HI	LO	LO																					
HI	HI	HI																					
Dynamic Indicator		<p>Indicates that this input (usually the trigger input of a flip-flop) responds to the indicated transition of the applied signal.</p>																					
Triggered (toggle) Flip-Flop		<p>A bistable device with one input and two outputs (either or both outputs may be used). When triggered, the outputs change from one stable state to the other stable state with each trigger. The outputs are complementary (i.e., when one output is HI the other is LO). The dynamic indicator on the trigger (T) input may be of either polarity depending on the device.</p>	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th colspan="2">Output</th> </tr> <tr> <th>Condition before trigger pulse</th> <th>Condition after trigger pulse</th> <th>Q</th> <th><math>\bar{Q}</math></th> </tr> </thead> <tbody> <tr> <td>Q</td> <td><math>\bar{Q}</math></td> <td>Q</td> <td><math>\bar{Q}</math></td> </tr> <tr> <td>LO</td> <td>HI</td> <td>HI</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>LO</td> <td>HI</td> </tr> </tbody> </table>	Input		Output		Condition before trigger pulse	Condition after trigger pulse	Q	$\bar{Q}$	Q	$\bar{Q}$	Q	$\bar{Q}$	LO	HI	HI	LO	HI	LO	LO	HI
Input		Output																					
Condition before trigger pulse	Condition after trigger pulse	Q	$\bar{Q}$																				
Q	$\bar{Q}$	Q	$\bar{Q}$																				
LO	HI	HI	LO																				
HI	LO	LO	HI																				

TABLE 3-1 (cont)

Device	Symbol	Description	Input/Output Table																																						
<p>Triggered Set-Clear (J-K) Flip-Flop</p>		<p>A bistable device with three or more inputs and two outputs (either or both outputs may be used). When gated, the outputs change state in response to the states at the inputs prior to the trigger. The outputs are complementary (i.e., when one output is HI the other is LO). The dynamic indicator on the gate (G) input may be of either polarity depending on the device.</p>	<table border="1"> <thead> <tr> <th colspan="2">Input</th> <th colspan="2">Output</th> </tr> <tr> <th>J</th> <th>K</th> <th>Q</th> <th><math>\bar{Q}</math></th> </tr> </thead> <tbody> <tr> <td>LO</td> <td>LO</td> <td colspan="2">No change</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>HI</td> <td>LO</td> <td>HI</td> <td>LO</td> </tr> <tr> <td>HI</td> <td>HI</td> <td colspan="2">Changes state</td> </tr> </tbody> </table> <p>Output conditions shown after gate pulse.</p>	Input		Output		J	K	Q	$\bar{Q}$	LO	LO	No change		LO	HI	LO	HI	HI	LO	HI	LO	HI	HI	Changes state															
Input		Output																																							
J	K	Q	$\bar{Q}$																																						
LO	LO	No change																																							
LO	HI	LO	HI																																						
HI	LO	HI	LO																																						
HI	HI	Changes state																																							
<p>D (data) Type Flip-Flop with Direct Inputs</p> <p>(Direct Inputs may be applied to all triggered flip-flops)</p>		<p>A bistable device with two inputs and two outputs (either or both outputs may be used). When clocked, the state of the Q output changes to the state at the data (D) input. The outputs are complementary (e.g., when one output is HI the other is LO). The dynamic indicator on the clock input may be of either polarity, depending upon the device.</p> <p>For devices with set (S) or reset (R) inputs, the indicated state at either of these inputs overrides all other inputs to the states shown in the Input/Output Table.</p>	<p>Set (S) and reset (R) inputs override data (D) and clock (C) inputs.</p> <table border="1"> <thead> <tr> <th colspan="2">Input</th> <th colspan="2">Output</th> </tr> <tr> <th>S</th> <th>R</th> <th>Q</th> <th><math>\bar{Q}</math></th> </tr> </thead> <tbody> <tr> <td>HI</td> <td>LO</td> <td>LO</td> <td>HI</td> </tr> <tr> <td>LO</td> <td>LO</td> <td colspan="2">Undefined</td> </tr> <tr> <td>HI</td> <td>HI</td> <td colspan="2">No Effect</td> </tr> <tr> <td>LO</td> <td>HI</td> <td>HI</td> <td>LO</td> </tr> </tbody> </table> <p>Set (S) and Reset (R) inputs both high.</p> <table border="1"> <thead> <tr> <th rowspan="2">Condition before clock pulse</th> <th colspan="2">Output</th> </tr> <tr> <th>Condition after clock pulse</th> <th></th> </tr> <tr> <td>D</td> <td>Q</td> <td><math>\bar{Q}</math></td> </tr> <tr> <td>HI</td> <td>HI</td> <td>LO</td> </tr> <tr> <td>LO</td> <td>LO</td> <td>HI</td> </tr> </thead></table>	Input		Output		S	R	Q	$\bar{Q}$	HI	LO	LO	HI	LO	LO	Undefined		HI	HI	No Effect		LO	HI	HI	LO	Condition before clock pulse	Output		Condition after clock pulse		D	Q	$\bar{Q}$	HI	HI	LO	LO	LO	HI
Input		Output																																							
S	R	Q	$\bar{Q}$																																						
HI	LO	LO	HI																																						
LO	LO	Undefined																																							
HI	HI	No Effect																																							
LO	HI	HI	LO																																						
Condition before clock pulse	Output																																								
	Condition after clock pulse																																								
D	Q	$\bar{Q}$																																							
HI	HI	LO																																							
LO	LO	HI																																							

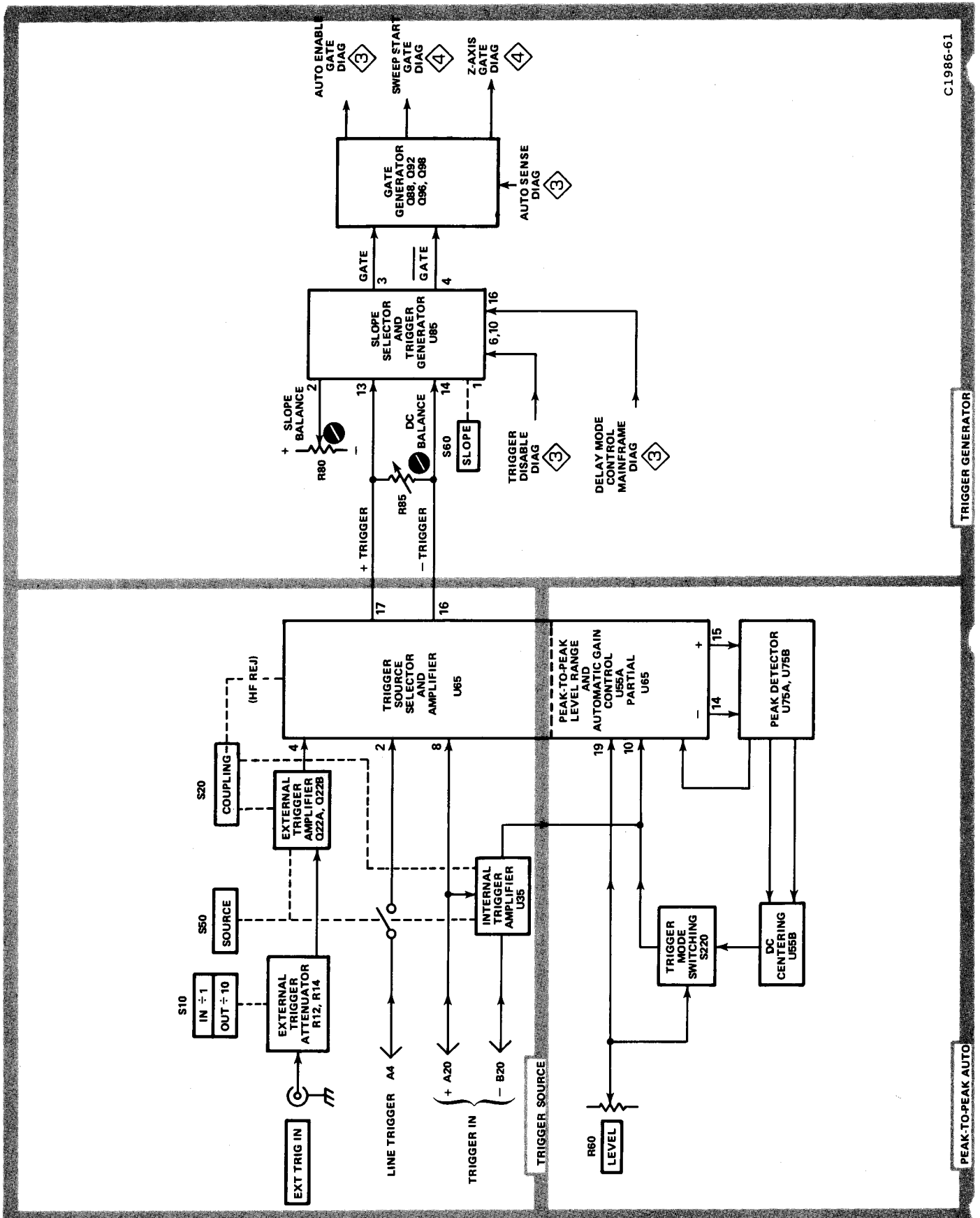


Fig. 3-2. Detailed block diagram of Trigger Generator.

C1986-61

TRIGGER GENERATOR

PEAK-TO-PEAK AUTO

## FRONT-PANEL DISTRIBUTION

The Front-Panel Distribution diagram shows the interconnections between front-panel functions (controls, connectors, and indicators) and circuit boards within this instrument.

## TRIGGER GENERATOR

The Trigger Generator provides a stable display by starting the Sweep Generator (diagram 4) at a selected point on the input waveform. The triggering point can be varied by the LEVEL control and may be on either the positive or negative slope of the waveform. The triggering signal source may be from either the signal being displayed (INT), a signal from an external source (EXT), or a sample of the power-line voltage (LINE). A block diagram of the Trigger Generator is shown in Figure 3-2.

### External Source

The external trigger signal is connected to the Trigger Generator through EXT TRIG IN connector J12. Push-button switch S10 provides 10 times attenuation of the external trigger input signal.

When SOURCE switch (S50) is set to EXT, external signals below approximately 16 kilohertz are coupled through R15 and R20 to External Trigger Amplifier Q22. Ac coupling is provided by C15. Triggering signals above 16 kilohertz are coupled through C20 to the gate of Q22A.

Field-effect transistors Q22A and Q22B form a unity-gain source follower, which couples the external trigger signal to the Trigger Source Selector and Amplifier stage (U65-pin 4). Diodes CR23 and CR24 provide input protection by clamping the input within a diode drop of ground (approximately 0.7 volt).

### Internal and Line Source

The internal trigger signal from the vertical channel of the mainframe is connected to the Internal Trigger Amplifier stage (U35) differentially via interface connector pins A20 and B20.

Internal trigger signals with frequencies above 16 kilohertz are coupled through C37 directly into the Trigger Source Selector and Amplifier stage (U65-pin 8). Internal trigger signals with frequencies below 16 kilohertz are coupled differentially through R31 and R33 to U35-pins 2 and 3. The single-ended output at U35-pin 6 is coupled, along with the offset from LEVEL control R60, to U65-pin 10. Ac coupling is provided by C43.

A sample of the line voltage is connected to the trigger circuits via interface connector pin A4. The line signal is connected to the Trigger Source Selector and Amplifier stage at U65-pin 2.

### Trigger Source Selector and Amplifier

The Trigger Source Selector and Amplifier stage (partial U65) determines whether the triggering signal source is from the signal being displayed (INT), a signal from an external source (EXT), or a sample of the power line voltage (LINE).

The trigger source is selected by SOURCE switch S50 by connecting the most positive voltage to the source input of U65 (refer to Figure 3-3). The voltage offset from LEVEL control R60 is coupled to U65-pin 10. The differential trigger output signal from U65-pins 16 and 17 is coupled to the Slope Selector and Trigger Generator stage (U85).

High-frequency reject coupling is provided in the Trigger Source Selector stage. When the AC HF REJ push button is pressed, C68 and components internal to U65-pin 9 form a high-frequency rejection filter. Only low-frequency ac triggering signals are accepted.

### Peak-to-Peak Auto

The Peak-to-Peak Auto function can be divided into 3 distinct blocks. First, the Peak Detector determines signal size and dc positioning. Second, a DC Centering loop centers the peak-detected output regardless of the dc input and offset voltages. Third, the Peak-to-Peak Level Range output voltage is automatically adjusted until the trigger output reaches the clamp level set by the Automatic Gain Control to achieve full level range (refer to the Specification section in this manual for level range parameters).

**PEAK DETECTOR.** The peak detector outputs from U65-pins 14 and 15, rectified within U65, are externally filtered by C73 and C74. Secondary stages of peak detection for the positive and negative detector signals are provided by U75A-CR71-C72 and U75B-CR75-C76. Outputs from the Peak Detector stage are coupled to the Peak-to-Peak Level Range and DC Centering stages.

**DC CENTERING.** Operational amplifier U55B adjusts the input level at U65-pin 10 to null the dc input voltage and accumulated dc offsets. This allows the trigger outputs at U65-pins 16 and 17 to balance when LEVEL control R60 is set to zero. DC Balance adjustment R85 provides centering for offset voltages due to circuitry external to U65-pins 16 and 17 (e.g., U85).

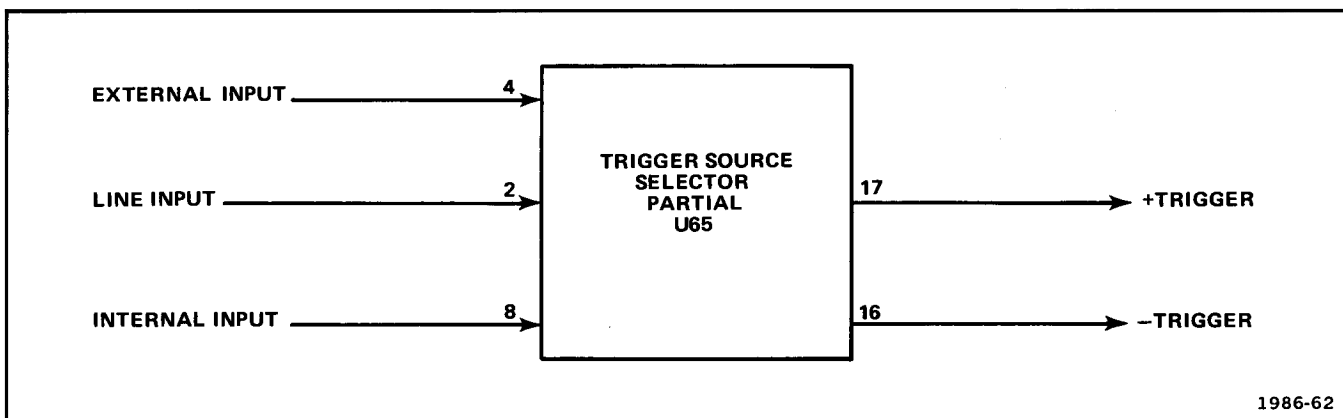


Fig. 3-3. Functional diagram of Trigger Source Selector.

**PEAK-TO-PEAK LEVEL RANGE.** The Peak-to-Peak Level Range stage amplifies the peak Detector signals to provide constant amplitude trigger signals and to determine the range of the front-panel LEVEL control. Peak Detector signal amplitude is dependent on triggering (input) signal amplitude.

Peak Detector signals from R58-R59 are coupled to U55A-pin 3 of the Peak-to-Peak Level Range stage. The gain of the feedback amplifier (consisting of U55A and pins 1 and 20 of U65) increases as the Peak Detector signal amplitude is reduced, thereby producing a constant trigger signal level at U65-pins 16 and 17.

The range of the front-panel LEVEL control is zero at minimum triggering signal amplitude. The LEVEL range increases as triggering signal amplitude increases, until it reaches maximum level range at the Automatic Gain Control threshold. Refer to the Specification section in this manual for triggering sensitivity and triggering LEVEL range parameters.

**Automatic Gain Control.** The Automatic Gain Control stage limits the trigger signal amplitude to approximately 450 millivolts peak-to-peak (at U65-pins 16 and 17) regardless of the trigger input signal amplitude. The level of the peak detected signal from R58-R59 is sensed by a feedback amplifier stage (U55A and pins 1 and 20 of U65). When the peak detected signal is above the Automatic Gain Control threshold (resulting from approximately 2 divisions of internal trigger signal or approximately 50 millivolts external trigger signal), the Automatic Gain Control stage limits the output trigger signal amplitude at U65-pins 16 and 17. Current into U65-pin 3 (established by R51) determines the current reference that sets the Automatic Gain Control threshold.

### Slope Selector and Trigger Generator

Integrated circuit U85 converts the differential trigger signal from the Trigger Source Selector and Amplifier block to a differential gate waveform for use by the Gate Generator stage.

SLOPE switch S60 is connected to U85-pin 1 to determine whether the display is triggered on the positive-going or negative-going slope. When the SLOPE switch is set to +, a positive-going signal on pin 13 produces a positive-going gate on pin 3 and a negative-going gate on pin 4. When the SLOPE switch is set to -, a negative-going signal on pin 13 produces a positive-going gate on pin 3 and a negative-going gate on pin 4. Slope Balance adjustment R80 provides optimum input balance for both + and - SLOPE operation.

The delay mode control signal into U85-pin 16 is functional only when the unit is operating as a delayed sweep unit in the B Horizontal compartment of a mainframe with 2 horizontal compartments. When the unit is operating in the independent or triggerable after delay time modes (as determined by the delaying sweep time-base unit in the A horizontal compartment), there is no effect on the Trigger Generator circuits. However, when the unit is operating in the B starts after delay time mode, a HI level at U85-pin 16 supplies a trigger gate pulse to U85-pins 3 and 4 in the absence of a trigger disable pulse at pins 6 and 10.

At the end of each sweep, the Logic circuits (diagram 3) supply a trigger disable pulse through Q242 to U85-pins 6 and 10. A HI level disables the Trigger Generator to allow enough time for the sweep generator to stabilize before another trigger pulse starts the next sweep.



**Gate Generator**

The Gate Generator stage provides an auto enable gate to the Logic circuits (diagram 3), and a sweep start gate and Z-axis gate (unblanking) to the Sweep Generator circuit (diagram 4). Refer to Figure 3-4 for a timing diagram of the Gate Generator functions.

When an adequate trigger signal is applied to U85-pins 13 and 14, a HI level is produced at U85-pin 3 and a LO level is produced at U85-pin 4.

The HI level from U85-pin 3 is coupled through emitter follower Q88 and J200-2 into the Logic circuit (diagram 3) to indicate that a triggering signal has been received. The Logic circuit (diagram 3) sets the auto sense at J200-3 HI, turning off Q98. Simultaneously, the LO level at U85-pin 4 gates comparator Q96-Q92. The collector of Q92 rises HI to provide a sweep start gate at J200-5 and the collector of Q96 falls LO to provide a Z-axis gate (unblanking) at J200-4.

In the absence of a trigger output at U85-pins 13 and 14, pin 3 is set LO and pin 4 is set HI. The LO level from U85-pin 3 is coupled through J200-2 to the Logic circuit (diagram 3) to indicate the lack of a triggering signal. The Logic circuit provides a LO-level auto sense pulse through J200-3 to the base of Q98. This LO level gates the comparator (Q98 and Q96). The collector of Q98 rises high to provide a sweep start gate and the collector of Q96 falls LO to provide a Z-axis gate (unblanking) at J200-4.

**LOGIC** 3

The Logic circuit controls the sweep modes and associated functions of the time-base unit (e.g., sweep display, hold off, auto sweep, single sweep, etc.). The Logic circuit also generates control signals for the mainframe. A block diagram for the Logic circuit is shown in Figure 3-5.

**Sweep Modes**

Integrated circuit U220 controls the NORM, AUTO, and SINGLE SWEEP MODES and also generates control signals used in the 7B80. P-P AUTO operation is described in the Trigger Generator circuit description (diagram 2).

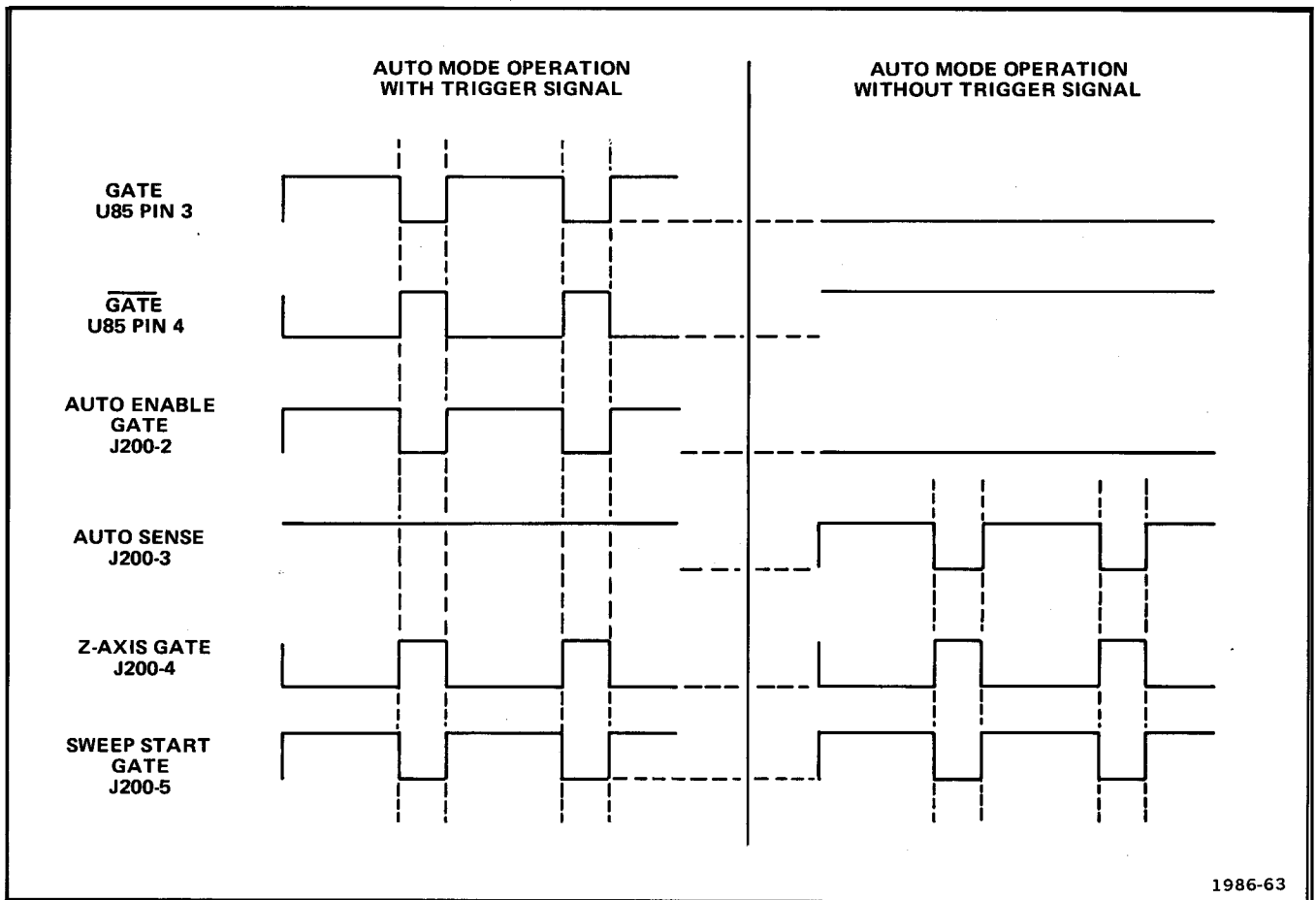


Fig. 3-4. Timing diagram for Gate Generator stage (Q92, Q96, Q98).

## Theory of Operation—7B80

**NORMAL MODE.** The NORM MODE is provided when U220-pin 12 is LO. In the NORM MODE, only an appropriate trigger signal can initiate a sweep gate to the Sweep Generator (diagram 4). Sweep Control integrated circuit U220 controls sweep lockout and hold off functions.

**AUTO MODE.** The Auto Control stage produces a free-running reference trace (bright base line) in the absence of a trigger signal.

A HI level from MODE switch S230 is inverted by Q230 to U220-pin 19 LO, which selects AUTO MODE operation. In the presence of a trigger pulse from the Trigger Generator (diagram 2), a HI level at U220-pin 1 discharges the auto stage which inhibits the auto sense signal from U220-pin 3. In the absence of a trigger pulse, the LO level at U220-pin 1 an auto sense signal is initiated from U220-pin 3 to the Trigger Generator (diagram 2).

**SINGLE SWEEP MODE.** SINGLE SWEEP operation provides display of only one sweep. After one sweep has run, all other sweeps are inhibited until the SINGLE SWP-RESET push button is pressed. The READY light indicates when the sweep is ready to accept a trigger.

After completion of one sweep, the hold off start pulse at U220-pin 16 causes the sweep disable out at pin 17 to rise HI. A HI level at U220-pin 12 initiates single sweep operation and holds the sweep disable out at U220-pin 17 HI after completion of the sweep. Momentary contact of the RESET push button places a LO at U220-pins 14 and 15, which removes the sweep disable out from pin 17 and allows the Sweep Generator (diagram 4) to accept a trigger. Interface connector B15 provides a remote single-sweep reset input from compatible mainframes.

### Hold Off Timing

The hold off stages prevent the Sweep Generator (diagram 4) from being retriggered until the sweep timing capacitors are discharged.

At the end of each sawtooth waveform from the Sweep Generator (diagram 4), a sweep stop comparator pulse (HI) is coupled to U220-pin 16. This pulse enables the hold off timing circuits at U220-pin 8, which sets the sweep disable out at U220-pin 17 HI and the hold off signal at pin 10 LO for the duration of the hold off cycle. Hold off timing (U220-pin 8) is provided by capacitors C212 through C215, and resistors R212 through R214. Transistors Q203 and

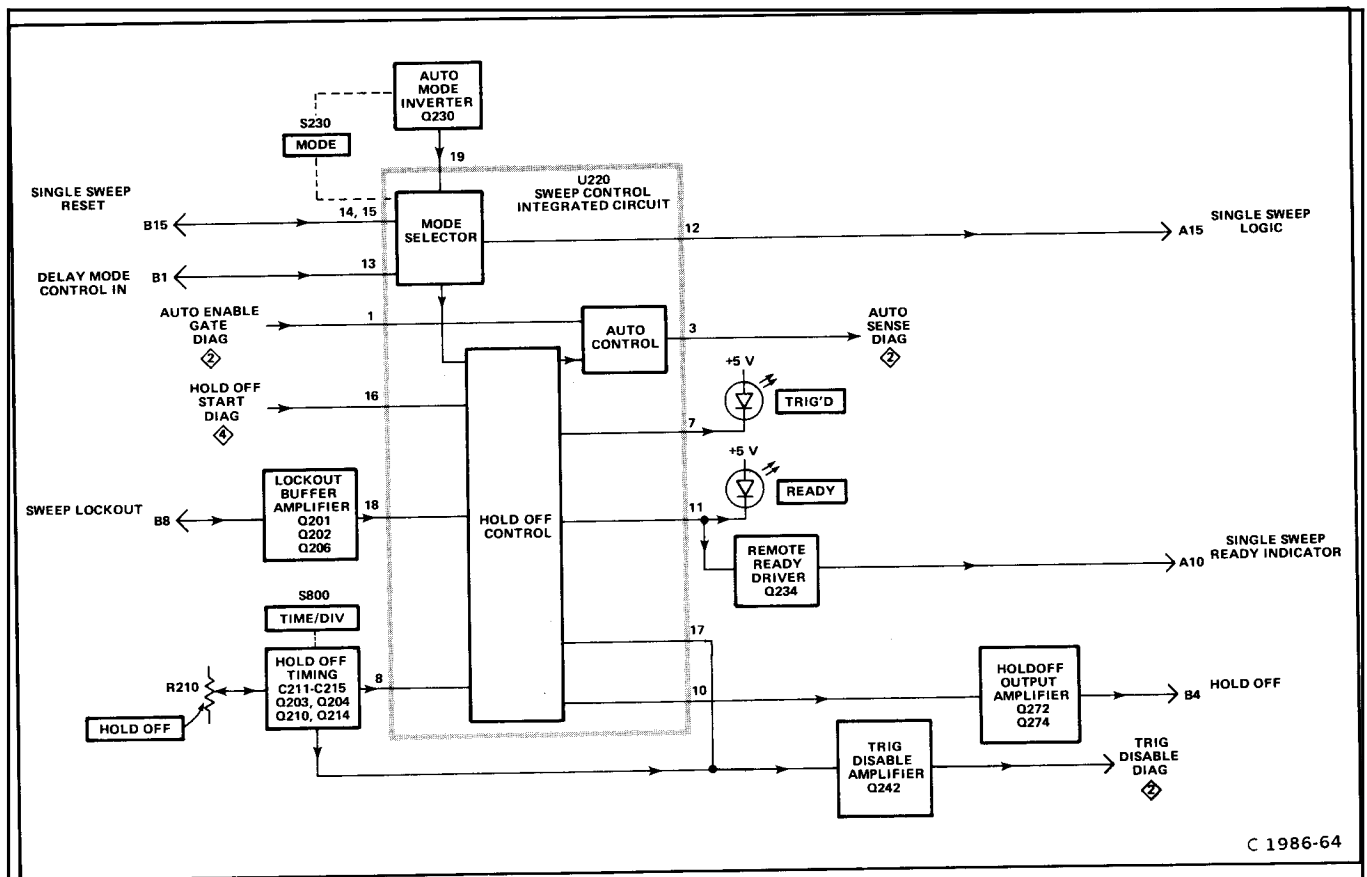


Fig. 3-5. Detailed block diagram of Logic circuit.

Q204 prevent the sweep disable out pulse at U220-pin 17 from falling LO until the timing capacitors have discharged. Transistors Q212 and Q214 and front-panel HOLD OFF control R210 provide variable current to the timing components to change the hold off time period.

### Lockout Buffer Amplifier

A lockout pulse (HI) may be initiated at interface connector pin B8 by mainframe switching functions. A HI level, coupled from interface connector B8 through the Lockout Buffer Amplifier (Q201, Q202, and Q206) to the lockout input at U220-pin 18, initiates a sweep disable pulse at U220-pin 17 thereby disabling the sweep. The lockout pulse (HI) is also applied through Q358 (diagram 4) to the hold off start input at U220-pin 16 to enable the hold off cycle.

### Hold Off Output Amplifier

The Hold Off Output Amplifier inverts and amplifies the hold off signal from U220-pin 10 for use by the mainframe.

Transistor Q272 inverts the hold off signal from U220-pin 10 to provide a HI level when hold off is present. The inverted signal is coupled through emitter follower Q274 to interface connector B4.

## SWEEP GENERATOR

The Sweep Generator produces a linear ramp waveform for the mainframe when gated by the Trigger Generator. A sweep gate (unblanking) is also generated in this circuit block.

The linear sweep ramp waveform is produced by charging a capacitor from a constant current source. The slope of the ramp determines the sweep rate of the displayed trace. A block diagram of the Sweep Generator is shown in Figure 3-6.

### Timing Current Source

The Timing Current Source stages generate a constant current for the Ramp Generator stages (see Figure 3-6). A Reference Voltage Source is established by the +50 volt supply and R710, R711, R717, and R705 (front-panel SWP CAL adjustment).

The reference voltage is applied to the Source Current Generator stage. Operational amplifier U722 provides unity voltage gain and low output impedance. The output of U722 is connected through the base-emitter junction of Q732 to the Timing Resistors (R741 through R749). Timing current is the result of the voltage drop across the

Timing Resistors and flows through the collector of Q732 to the Ramp Generator stages.

### Ramp Generator

The Ramp Generator stages produce a linear positive-going ramp for the Output Preamp and Sweep Gate Generator stages. Refer to Figure 3-6.

Upon the arrival of a HI-level sweep start gate at the Current Switch stage, Q322 turns on and Q324 turns off. The source current from Q732 charges the Timing Capacitors (C332, C334, C336) in a positive ramp. Field effect transistors Q334A, Q334B, and transistor Q338 form a unity-gain Ramp Voltage Follower for the sweep ramp. The output of Q338 is connected to the Horizontal Preamp, Sweep Stop Comparator, and Baseline Stabilizer stages.

When the sweep start gate is LO, Q322 turns off and Q324 turns on causing the Timing Capacitors (C332, C334, and C336) to discharge. The Baseline Stabilizer stage (Q304, Q314) maintains a constant level from which the ramp begins. The output of Q338 is compared (by way of Q304A) with the reference level at the base of Q304B. If the output of Q338 is less than the reference, Q314 will charge the timing capacitors through CR323 until the output and reference voltages are equal. If the output of Q338 is greater than the reference, Q314 conducts more and CR323 conducts less causing the Timing Capacitors to discharge through Q324 and R322. When the output and reference voltages are equal, the current through CR323 and Q732 equals the current through Q423.

### Output Preamp

The Output Preamp stages connect the differential sweep signal to the mainframe and provide an offset voltage for trace positioning. Provisions are made in these stages for sweep magnification, and a negative-going sawtooth signal is supplied to the mainframe for sawtooth output and special plug-in unit functions. Refer to Figure 3-6.

The sweep ramp voltage from Q338 is coupled to the Horizontal Preamp stage at the base of Q424. Transistors Q424 and Q434 form a single-ended to push-pull converter with Q428 and Q438 as current follower stages for the push-pull signal. Output drivers Q448 and Q458 provide final amplification and connect the sweep signal to the mainframe.

The MAG switch, S435, increases the Horizontal Preamp gain ten times by connecting R431 and R430 in parallel with R442.

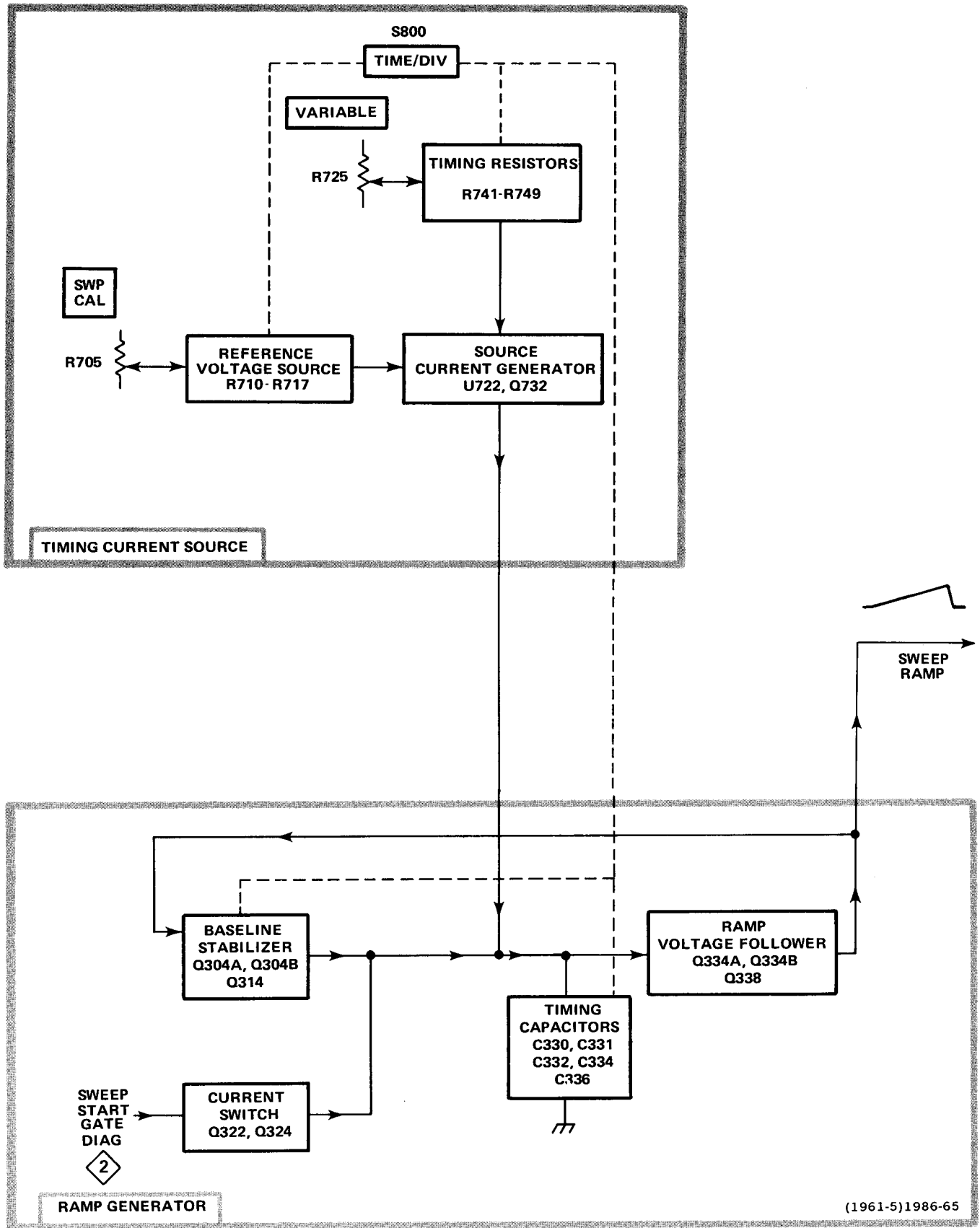


Fig. 3-6. Detailed block diagram of Sweep Generator.

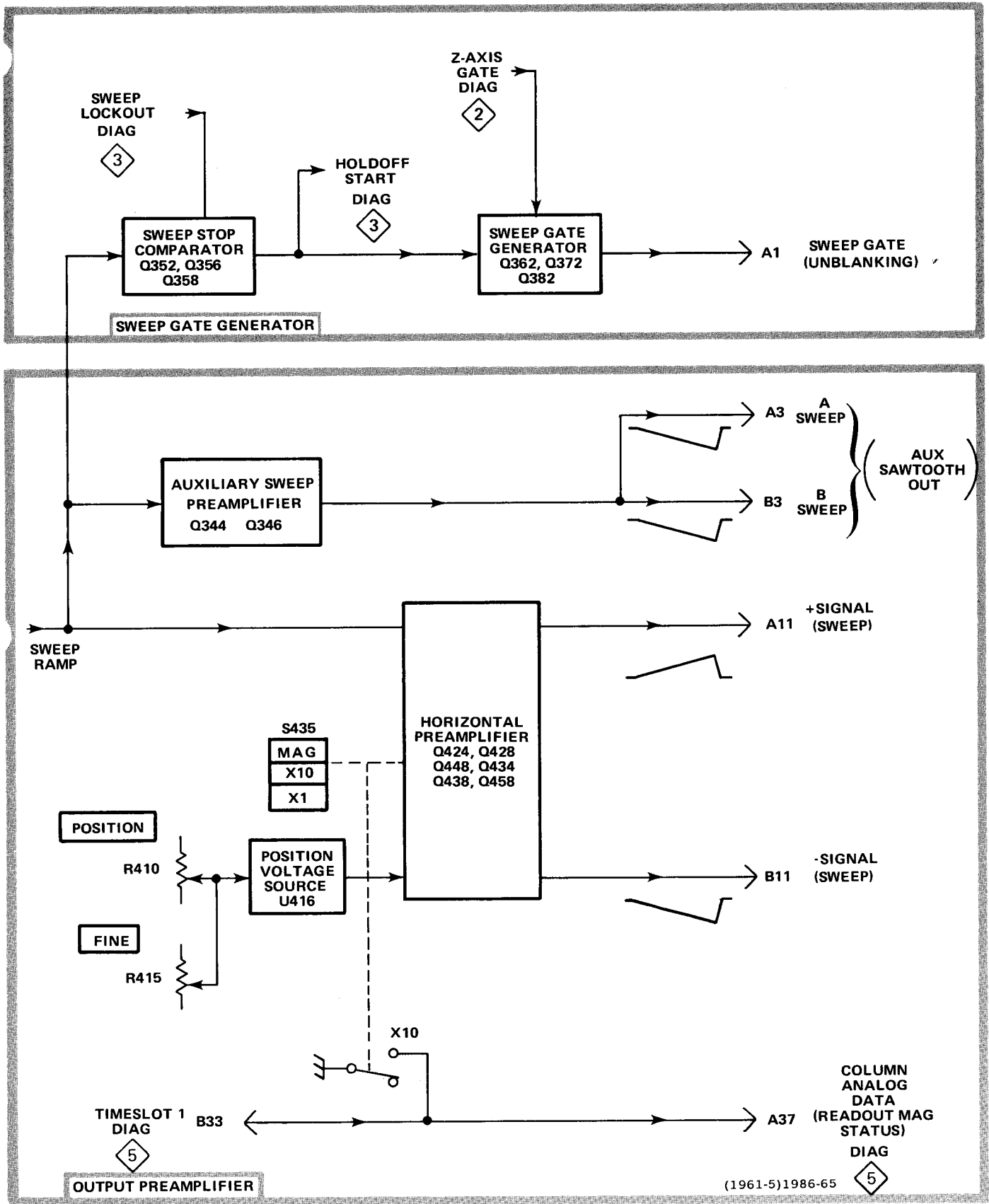


Fig. 3-6. Detailed block diagram of Sweep Generator (cont.).

The Position Voltage Source stage combines the dc voltages of the FINE and POSITION controls for a position voltage level at the output of operational amplifier U416. This voltage level on the base of Q434 provides a ramp waveform offset voltage to horizontally position the displayed trace.

The Auxiliary Sweep Preamplifier stage provides a negative-going sweep ramp to the mainframe (via interface connector pins-A3 and B3) for sawtooth output and special plug-in unit functions. Transistors Q344 and Q346 form a unity-gain inverting amplifier for the sawtooth signal from the Ramp Voltage Follower stage. Diode CR344 provides emitter-base compensation.

### Sweep Gate Generator

The Sweep Gate Generator produces an unblanking gate for the Z-axis system of the mainframe. When the sweep is displayed, the crt is unblanked (gate level LO). The sweep is blanked (gate level HI) between sweeps. Refer to Figure 3-6.

The sweep ramp is applied to the Sweep Stop Comparator stage. A comparison voltage is set at the base of Q356. When the ramp voltage exceeds the comparison voltage, Q352 turns off and Q356 couples a HI level through common-base transistor Q358. The Sweep Stop Comparator output is coupled to the Sweep Gate Generator stage and to the Logic circuit (diagram 3) to initiate hold off.

The Z-axis gate from the Trigger Generator circuit (diagram 2) is LO at the start of the sweep. This LO level turns off Q372. The resultant HI-level sweep gate pulse at the collector of Q372 is coupled through emitter follower Q382 to the mainframe for sweep unblanking. At the end of the sweep, the HI level from the Sweep Stop Comparator stage turns Q362 off and Q372 on. The resultant LO is coupled through emitter follower Q382 to the mainframe for sweep blanking.

## TIME/DIVISION READOUT

The Readout circuits provide information to the mainframe readout system. Readout circuitry is shown on the Time/Division Readout (diagram 5) at the rear of this manual.

### Basic Readout System

The readout system in 7000-series mainframes provides alpha-numeric display of information encoded by the plug-in units. This display is presented on the crt, and is written by the crt beam on a time-shared basis with the analog waveform display.

The readout system produces a pulse train consisting of ten negative-going pulses called time-slots. Each pulse represents a possible character in a readout word, and is assigned a time-slot number corresponding to its position in the word. Each time-slot pulse is directed to one of ten output lines, labeled TS 1 through TS 10 (time slots one through ten), which are connected to the vertical and horizontal plug-in compartments. Two output lines, row and column, are connected from each channel (two channels per plug-in compartment) back to the readout system.

Data is encoded on these output lines either by connecting resistors between them and the time-slot input lines or by generating equivalent currents. The resultant output is a sequence of analog current levels on the row and column output lines. The row and column current levels are decoded by the readout system to address a character matrix during each time slot, thus selecting a character to be displayed or a special instruction to be followed.

## INTERFACE CONNECTORS AND POWER SUPPLY

The Interface Connectors provide interconnection for control signals and power supply voltages between the mainframe and the time-base unit.

The Power Supply derives supply voltages from the mainframe supplies for power requirements unique to this instrument. Additional voltage regulation is also provided.

**TABLE 3-2**  
**Readout Character Selection**

Characters	Time-Slot	Description	Encoded By
Decimal	TS-1	Determines decimal magnitude (number of zeros displayed or prefix change information).	R751, R752 R756
Uncalibrated (>)	TS-3	Indicates calibrated or uncalibrated sweep rates and delay times.	R761, R764
1, 2, 5	TS-4	Scaling (TIME/DIV).	R771 R772, R773
m, $\mu$ , n	TS-8	Defines the prefix which modifies the units of measurement.	R781, R782 R783, R784
s (seconds)	TS-9	Defines the unit of measurement.	R793, R794

# MAINTENANCE

This section of the manual contains information for performing preventive maintenance, troubleshooting, and corrective maintenance for this instrument.

## PREVENTIVE MAINTENANCE

Preventive maintenance consists of cleaning, visual inspection, lubrication, etc. Preventive maintenance performed on a regular basis may prevent instrument breakdown and will improve the reliability of the instrument. The severity of the environment to which this instrument is subjected determines the frequency of maintenance. A convenient time to perform preventive maintenance is preceding adjustment of the instrument.

### CLEANING

This instrument should be cleaned as often as operating conditions require. Accumulation of dirt on components acts as an insulating blanket and prevents efficient heat dissipation which can cause overheating and component breakdown.

#### CAUTION

*Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. In particular, avoid chemicals that contain benzene, toluene, xylene, acetone, or similar solvents.*

#### Exterior

Loose dust accumulated on the front panel can be removed with a soft cloth or small brush. Dirt that remains can be removed with a soft cloth dampened with a mild detergent and water solution. Abrasive cleaners should not be used.

#### Interior

Dust in the interior of the instrument should be removed occasionally due to its electrical conductivity under high-humidity conditions. The best way to clean the interior is to blow off the accumulated dust with dry, low-pressure air. Remove any dirt which remains with a soft brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces.

### Switch Contacts

Switch contacts and pads are designed to operate dry for the life of the switch. However, as the switches are not sealed, dust attracted to the contact area may cause switch contacts to become electrically noisy. Cleaning may be accomplished by flushing the contact area with isopropyl alcohol or kelite (1 part kelite to 20 parts water). Do not use chemical cleaning agents that leave a film or that might damage plastic parts. Do not use cotton swabs or similar applicators to apply cleaning agents, as they tend to snag and leave strands of cotton on switch contacts. Should it become necessary to remove a switch for replacement or cleaning, refer to Component Removal and Replacement in this section.

### VISUAL INSPECTION

This instrument should be inspected occasionally for such defects as broken connections, improperly seated semiconductors, damaged circuit boards, and heat-damaged parts.

The corrective procedure for most visible defects is obvious; however, particular care must be taken if heat-damaged components are found. Overheating usually indicates other trouble in the instrument; therefore, it is important that the cause of overheating be corrected to prevent recurrence of the damage.

### LUBRICATION

Generally, there are no components in this instrument that require a regular lubrication program during the life of the instrument.



### Cam Switch Lubrication

In most cases, factory lubrication should be adequate for the life of the instrument. However, if the switch has been disassembled for replacement of switch sub-parts, a lubrication kit containing the necessary lubricating materials and instructions is available through any Tektronix Field Office. Order Tektronix Part 003-0342-01. General Electric Versilube<sup>®</sup> silicone grease should be applied sparingly so that the lubricant does not get on the contacts. Refer to Figure 4-1 for lubrication instructions.

### SEMICONDUCTOR CHECKS

Periodic checks of the semiconductors in this instrument are not recommended. The best check of semiconductor performance is actual operation in the instrument. More details on checking semiconductor operation are given under Troubleshooting.

### ADJUSTMENT AFTER REPAIR

After any electrical component has been replaced, the adjustment of that particular circuit should be checked, as well as the adjustment of other closely related circuits. The Performance Check and Adjustment procedure in this manual provides a quick and convenient means of checking instrument operation. In some cases, minor troubles may be revealed or corrected by adjustment.

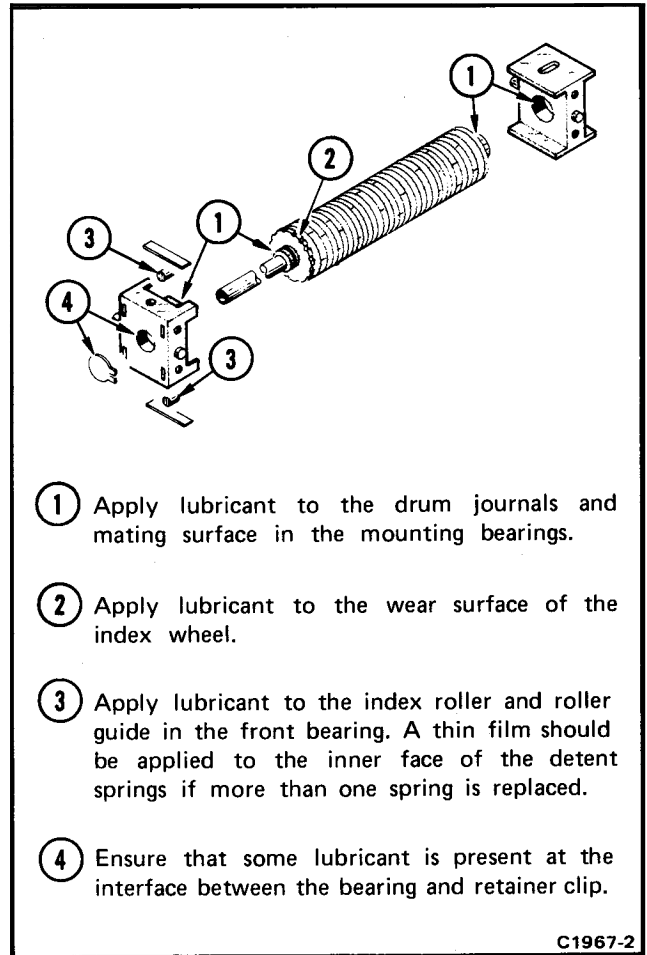


Fig. 4-1. Lubrication procedure for a typical cam switch.

## TROUBLESHOOTING

The following information is provided to help troubleshoot this instrument. Information contained in other sections of this manual should be used along with the following information to aid in locating the defective component. An understanding of the circuit operation is very helpful in locating troubles, particularly where integrated circuits are used.

### TROUBLESHOOTING AIDS

#### Diagrams

Circuit diagrams are given on foldout pages in Section 8. The component number and electrical value of each component in this instrument is shown on the diagrams. Components that are mounted on circuit boards are outlined on the diagrams with a heavy black line.

#### Voltages and Waveforms

Typical operating voltages are shown on the diagrams. Voltage Conditions given on the diagram page indicate the test equipment used and the front-panel control status necessary to obtain the given voltages.

Typical operating waveforms are shown next to the diagram where they were measured. Each waveform is numbered to locate on the diagram the point where the waveform was taken. Waveform Conditions given on the diagram page list the test equipment used and the front-panel control status necessary to obtain the given waveform.

#### Circuit-Board Illustrations

Circuit-board illustrations are shown on the foldout page preceding the associated diagram. Each board-mounted electrical component is identified by its circuit number, as are interconnecting wires and connectors.

Figure 8-2, in the front of the diagrams section, shows the location and assembly number of each circuit board in this instrument.

#### Switch Cam Identification

Switch cam numbers shown on diagrams indicate the position of each cam in the complete switch assembly. The switch cams are numbered from front to rear.

#### Diode Color Code

The cathode end of each glass-encased diode is indicated by a stripe, a series of stripes, or a dot. The cathode and anode ends of metal-encased diodes are identified by the diode symbol marked on the case. For most silicon or germanium diodes with a series of stripes, the color code identifies the

four significant digits of the JEDEC or vendor number using the resistor color-code system (e.g., a diode color-coded yellow-brown-green-red indicates a 1N-4152 diode).

#### Wiring Color Code

Insulated wire and cable used in this instrument is color-coded to facilitate circuit tracing.

#### Semiconductor Basing

Figure 4-2 illustrates the basing configurations for all semiconductors used in this instrument. Some plastic-case transistors have lead configurations that do not agree with those shown here. If a replacement transistor is made by a different manufacturer than the original, check the manufacturer's basing diagram. All transistor sockets in this instrument are wired for the standard basing used for metal-case transistors.

#### Inter-Board Pin Connector Identification

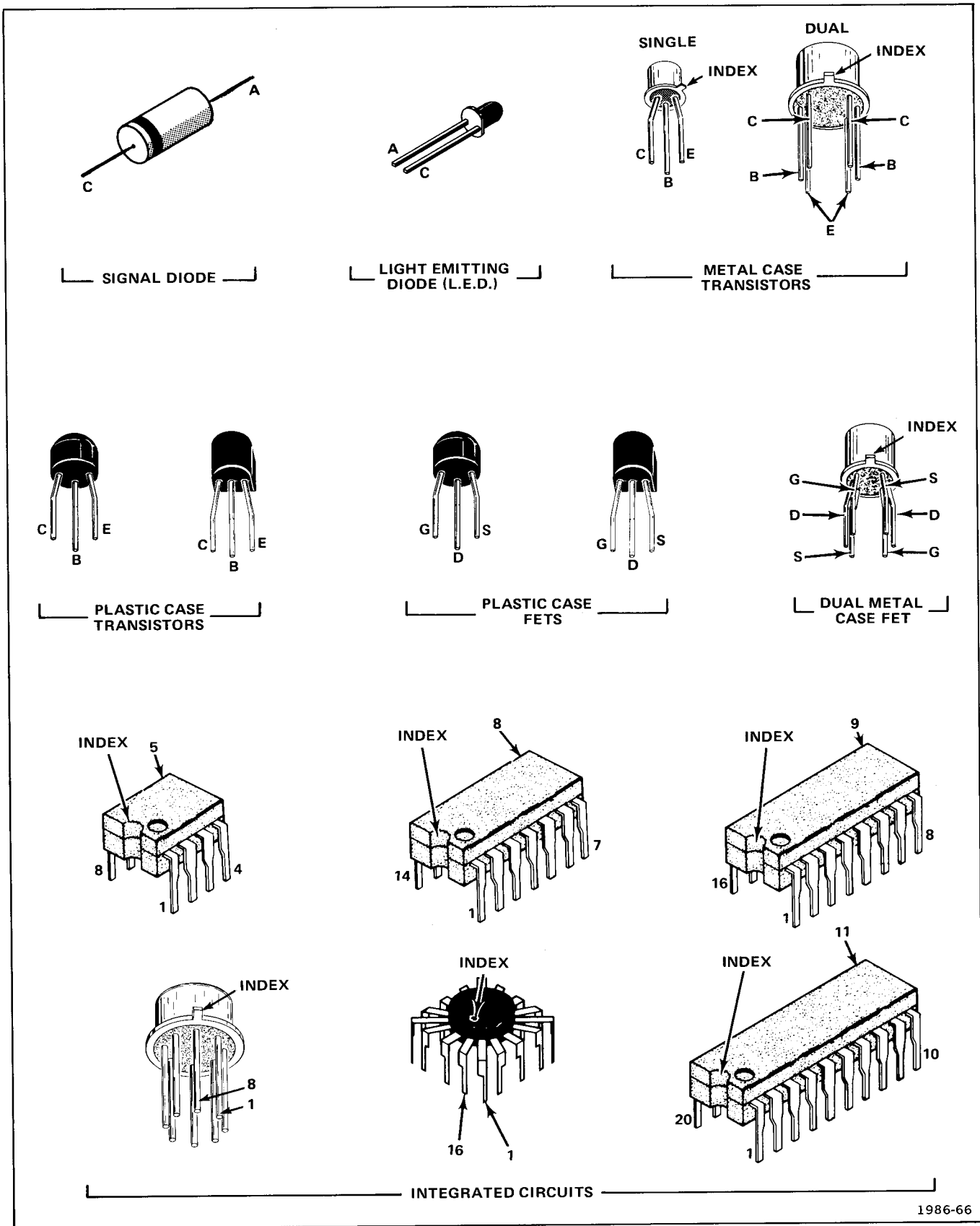
The inter-board pin connector sockets are installed on circuit boards, in groups of 5 sockets (as in Figure 4-3). Socket number 1 is indexed on the circuit board with either a triangular mark or the number 1. Each group of sockets is identified by its J (jack) number etched on the circuit board. The J numbers correlate to the J (jack) and P (plug) circuit numbers on the schematic diagrams.

#### Multi-Pin Connector Identification

Multi-pin connectors mate with groups of pins soldered to circuit boards. Pin number 1 is indexed with a triangular mark on the circuit board and molded on the holder of the multi-pin connector, as shown in Figure 4-4. Each group of pins is identified by its corresponding J number etched on the circuit board. The J numbers, on the circuit boards, correlate to the J and P component numbers on the schematic diagrams.

#### Interface Connector Pin Locations

The Interface circuit board couples the plug-in unit to the associated mainframe (oscilloscope). Figure 4-5 identifies the pins on the interface connector as shown on Interface Connectors and Power Supply diagram 8 in the Diagrams section.



1986-66

Fig. 4-2. Semiconductor lead configuration.

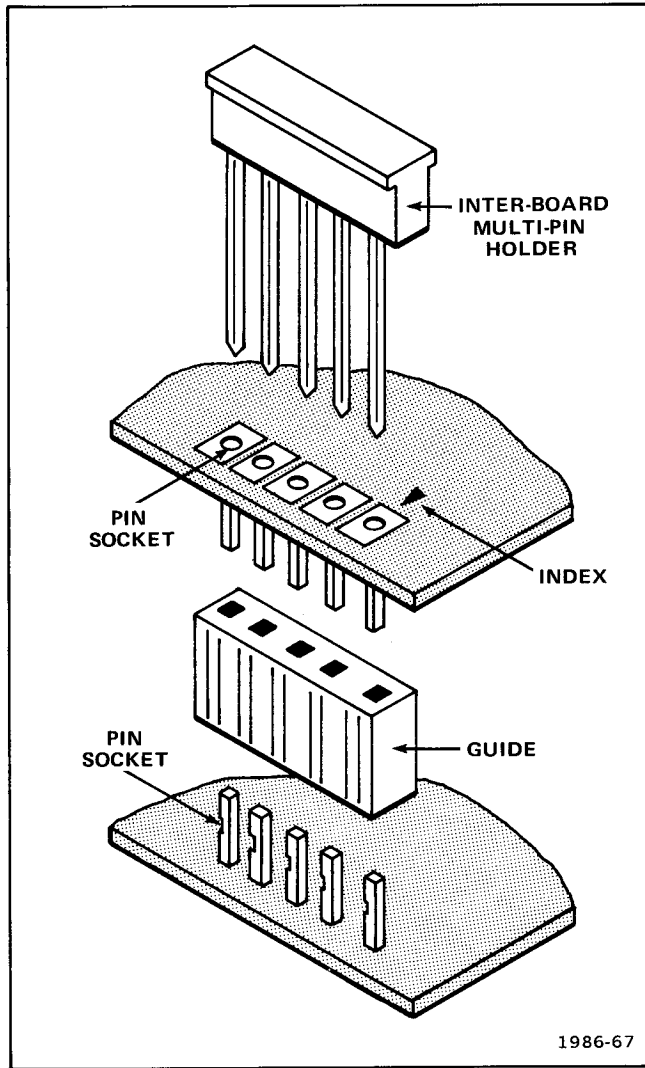


Fig. 4-3. Inter-board multi-pin connector assembly.

**Performance Check and Adjustment**

The Performance Check and Adjustment procedure, given in section 5 of this manual, provides a quick and convenient means of checking instrument operation. In some cases, minor troubles may be revealed or corrected by adjustment.

**TROUBLESHOOTING EQUIPMENT**

The following equipment, in addition to that listed in the Performance Check and Adjustment section, is useful for troubleshooting.

**Transistor Tester**

Description: Dynamic-type tester.

Purpose: Test semiconductors.

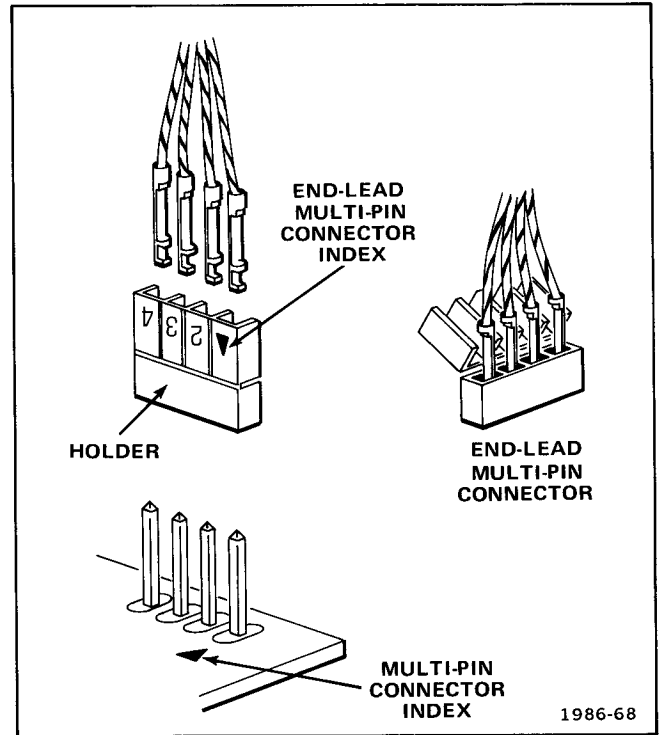


Fig. 4-4. End-lead multi-pin connector assembly.

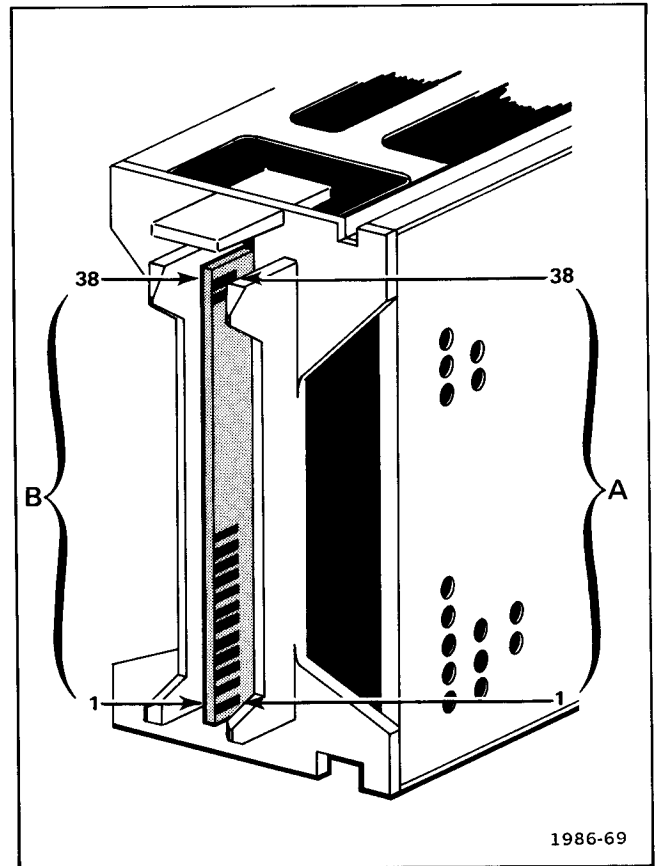


Fig. 4-5. Location of pin numbers on Interface connector.

### Transistor Tester (Cont.)

Recommended Tektronix types: 576 Curve Tracer, 577/177 Curve Tracer system, 7CT1N Curve Tracer unit and a 7000-series oscilloscope system, or a 5CT1N Curve Tracer unit and a 5000-series oscilloscope.

### Multimeter

Description: Voltmeter, 10 megohm input impedance and a range from 0 to at least 50 volts dc; accuracy, within 0.1%. Ohmmeter, 0 to 20 megohms. Test probes should be insulated to prevent accidental shorting.

Purpose: Check voltage and resistance.

### Test Oscilloscope

Description: Frequency response, dc to 100 megahertz minimum; deflection factor, 5 millivolts to 5 volts/division. A 10X, 10 megohm voltage probe should be used to reduce circuit loading.

Purpose: Check operating waveforms.

## TROUBLESHOOTING TECHNIQUES

The following troubleshooting procedure is arranged to check the simple trouble possibilities before proceeding with extensive troubleshooting. The first few checks ensure proper connection, operation, and adjustment. If the trouble is not located by these checks, the remaining steps aid in locating the defective component. When the defective component is located, it should be replaced using the replacement procedure given under Corrective Maintenance.

### Troubleshooting Procedure

**1. CHECK CONTROL SETTINGS.** Incorrect control settings can indicate a trouble that does not exist. If there is any question about the correct function or operation of any control, see the Operating Instructions, section 2.

**2. CHECK ASSOCIATED EQUIPMENT.** Before troubleshooting, check that the equipment used with this instrument is operating correctly. Check that the signal is properly connected and that the interconnecting cables are not defective. Also, check the power source. If the trouble persists, the time-base unit is probably at fault.

**3. VISUAL CHECK.** Visually check the portion of the instrument in which the trouble is located. Many troubles can be located by visible indications such as unsoldered connections, broken wires, damaged circuit boards, damaged components, etc.

**4. CHECK INSTRUMENT ADJUSTMENT.** Check the adjustment of this instrument, or the affected circuit if the trouble appears in one circuit. The apparent trouble may be the result of misadjustment. Complete adjustment instructions are given in the Performance Check and Adjustment, section 5.

**5. ISOLATE TROUBLE TO A CIRCUIT.** To isolate trouble to a circuit, note the trouble symptom. The symptom often identifies the circuit in which the trouble is located. When trouble symptoms appear in more than one circuit, check the affected circuits by taking voltage and waveform readings. Incorrect operation of all circuits often indicates trouble in the power supply. Check first for correct voltages of the individual supplies. However, a defective component elsewhere in the instrument can appear as a power-supply trouble and may also affect the operation of other circuits.

Figure 4-6 provides a guide for locating a defective circuit. Start at the top of the chart and perform the checks given on the left side of the page until a step is found that does not produce the indicated results. Further checks, or the circuit in which the trouble is probably located, are listed to the right of the step. The shaded blocks on the Troubleshooting Chart indicate circuit(s) that may cause instrument malfunction. The circuit(s) listed in shaded blocks are discussed in detail in the Theory of Operation section of this manual. This chart does not include checks for all possible defects; use steps 6 and 7 in such cases.

After the defective circuit has been located, proceed with steps 6 and 7 to locate the defective component(s).

**6. CHECK VOLTAGES AND WAVEFORMS.** Often the defective component can be located by checking for the correct voltages and waveforms in the circuit. Refer to the diagrams section at the rear of the manual for typical voltages and waveforms.

**NOTE**

*Voltages and waveforms given on the diagrams are not absolute and may vary slightly between instruments. To obtain operating conditions similar to those used to take these readings, see the voltage and waveforms page adjacent to each schematic diagram. Note the recommended test equipment, front-panel control settings, voltage and waveform conditions, and test equipment cable connection instructions.*

**7. CHECK INDIVIDUAL COMPONENTS.** The following procedures describe methods for checking individual components. Two-lead components that are soldered in place are best checked by first disconnecting one end. This isolates the measurement from the effects of surrounding circuitry.

**CAUTION**

*To avoid component damage, disconnect the power source before removing or replacing semiconductors.*

**Transistors.** The best check of transistor operation is actual performance under operating conditions. A transistor can be most effectively checked by substituting a new component or one that has been checked previously. However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic tester. Static-type testers are not recommended, since they do not check operation under simulated operating conditions.

**Integrated Circuits.** IC's can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of circuit operation is desirable when troubleshooting circuits using IC's. Use care when checking voltages and waveforms around the IC's so that adjacent leads are not shorted together. A convenient means of clipping a test probe to the 14- and 16-pin IC's is with an IC test clip. This device also serves as an extraction tool. The lead configuration for the semiconductors used in this instrument are shown on a pullout page in the front of the diagrams section.

**CAUTION**

*Do not use an ohmmeter scale that has a high internal current. High currents may damage the diode.*

**Diodes.** A diode can be checked for an open or shorted condition by measuring the resistance between terminals with an ohmmeter scale having a low internal source current, such as the R X 1K scale. The resistance should be very high in one direction and very low when the meter leads are reversed.

The cathode end of each glass-encased diode is indicated by a stripe, a series of stripes, or a dot. The cathode and anode ends of metal-encased diodes are identified by the diode symbol marked on the case. For most silicon or germanium diodes with a series of stripes, the color code identifies the four significant digits of the JEDEC or vendor number using the resistor color-code system (e.g., a diode color-coded yellow-brown-green-red indicates a 1N-4152 diode).

**Resistors.** Check resistors with an ohmmeter. See the Replaceable Electrical Parts list for the tolerance of the resistors used in this instrument. Resistors normally do not need to be replaced unless the measured value varies widely from that specified.

**Inductors.** Check for open inductors by checking continuity with an ohmmeter. Shorted or partially shorted inductors can usually be found by checking the waveform response when high-frequency signals are passed through the circuit. Partial shorting often reduces high-frequency response.

**Capacitors.** A leaky or shorted capacitor can usually be detected by checking resistance with an ohmmeter on the highest scale. Do not exceed the voltage rating of the capacitor. The resistance reading should be high after initial charge of the capacitor. An open capacitor can best be detected with a capacitance meter or by checking that the capacitor passes ac signals.

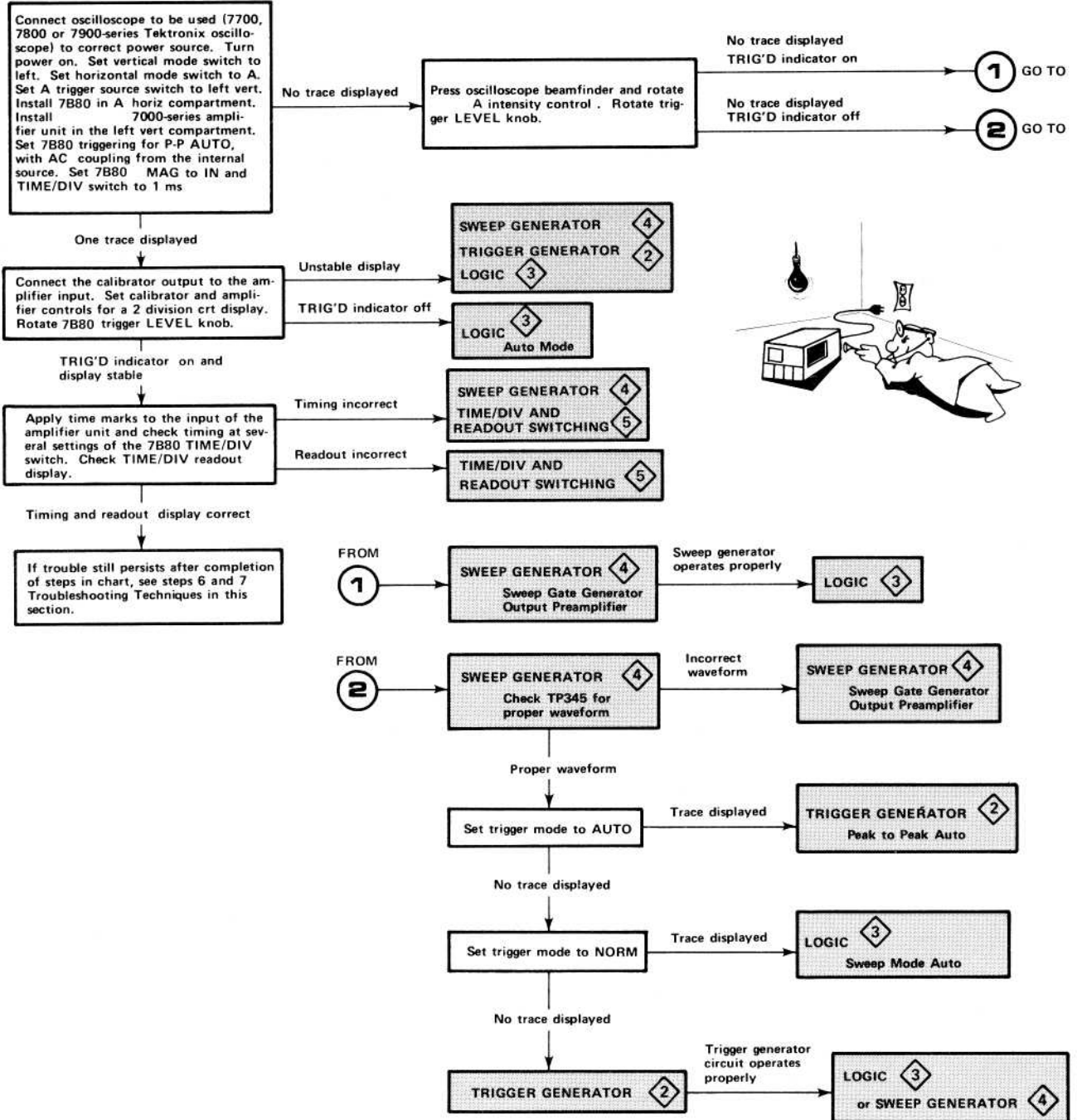
**8. REPAIR AND ADJUSTMENT.** If any defective parts are located, follow the replacement procedures given in Corrective Maintenance. Be sure to check the performance of any circuit that has been repaired or had any electrical components replaced.

**TROUBLESHOOTING CHART INSTRUCTIONS:**

1. Proceed down the left side of chart until the instrument does not perform as indicated. Then proceed to the right as the symptom(s) indicates.
2. Follow the path(s) of symptoms until a shaded block is reached. The shaded block indicates the circuit(s) that may cause instrument malfunction. Refer to the Theory of Operation section for a detailed discussion of the circuit(s).

**NOTE**

The upper case titles in shaded blocks are the same titles as used in the Theory of Operation section and on tabs in the diagrams section.



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Fig. 4-6. 7B80 troubleshooting chart.

## CORRECTIVE MAINTENANCE

Corrective maintenance consists of component replacement and instrument repair. Special techniques required to replace components in this instrument are given here.

### OBTAINING REPLACEMENT PARTS

All electrical and mechanical part replacements can be obtained through your Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order them from Tektronix, Inc. Before purchasing or ordering replacement parts, check the parts list for value, tolerance, rating, and description.

#### NOTE

*When selecting replacement parts, remember that the physical size and shape of a component may affect the performance of the instrument, particularly at high frequencies. All parts should be direct replacements unless a different component will not adversely affect instrument performance.*

Some parts are manufactured or selected by Tektronix, Inc. to satisfy particular requirements, or are manufactured to specifications for Tektronix, Inc. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. To determine the manufacturer of parts, refer to parts list, Cross Index Mfr. Code Number to Manufacturer.

When ordering replacement parts from Tektronix, Inc., include the following information:

1. Instrument type.
2. Instrument serial number.
3. A description of the part (if electrical, include circuit number).
4. Tektronix part number.

### SOLDERING TECHNIQUES

#### WARNING

*To avoid electrical shock, disconnect the instrument from the power source before soldering.*

The reliability and accuracy of this instrument can be maintained only if proper soldering techniques are used when repairing or replacing parts. General soldering techniques, which apply to maintenance of any precision electronic equipment, should be used when working on this instrument. Use only 60/40 rosin-core, electronic-grade solder. The choice of soldering iron is determined by the repair to be made. When soldering on circuit boards, use a 15- to 40-watt pencil-type soldering iron with a 1/8-inch wide, wedge-shaped tip. Keep the tip properly tinned for best heat transfer to the solder joint. A higher wattage soldering iron may separate the wiring from the base material. Avoid excessive heat; apply only enough heat to remove the component or to make a good solder joint. Also, apply only enough solder to make a firm solder joint; do not apply too much solder.

#### CAUTION

*All circuit boards, except the readout circuit board, in this instrument are multilayer type boards with a conductive path(s) laminated between the top and bottom board layers. All soldering on these boards should be done with extreme care to prevent breaking the connections to the center conductor(s); only experienced maintenance personnel should attempt repair of these boards.*

For metal terminals (e.g., switch terminals, potentiometers, etc.), a higher wattage-rating soldering iron may be required. Match the soldering iron to the work being done. For example, if the component is connected to the chassis or other large heat-radiating surface, it will require a 75-watt or larger soldering iron.

The following techniques should be used to replace a component on a circuit board:

1. Grip the component lead with long-nose pliers. Touch the soldering iron to the lead at the solder connection. Do not lay the iron directly on the board, as it may damage the board.



2. When the solder begins to melt, gently pull the lead out. If unable to pull out the lead without using force, try removing the other end of the component as it may be more easily removed.

**NOTE**

*The reason some component leads are troublesome to remove is due to a bend placed on each lead during the manufacturing process. The bent leads hold components in place during a process that solders many components at one time.*

If a component lead is extremely difficult to remove, it may be helpful to straighten the leads on the back side of the board with a small screwdriver or pliers while heating the soldered connection.

Use only enough heat to remove the component lead without removing the solder from the board. If it is desired to remove solder from a circuit-board hole for easier installation of a new component, a solder-removing wick should be used.

3. Bend the leads of the new component to fit the holes in the board. If the component is replaced while the board is mounted in the instrument, cut the leads so they will just protrude through the board. Insert the leads into the holes so the component is firmly seated against the board (or as positioned originally). If it does not seat properly, heat the solder and gently press the component into place.

4. Touch the iron to the connection and apply a small amount of solder to make a firm solder joint. To protect heat-sensitive components, hold the lead between the component body and the solder joint with a pair of long-nose pliers or other heat sink.

5. Clip any excess lead protruding through the board (if not clipped in step 3).

6. Clean the area around the solder connection with a flux-removing solvent. Be careful not to remove information printed on the board.

**COMPONENT REMOVAL AND REPLACEMENT**

**WARNING**

*To avoid electrical shock, disconnect the instrument from the power source before replacing components.*

The exploded-view drawing associated with the Replaceable Mechanical Parts list may be helpful in the removal or disassembly of individual components or subassemblies. Component locations and circuit board locations are shown in the Diagrams section.

**Circuit Boards**

If a circuit board is damaged beyond repair, replace the entire board assembly. Part numbers for completely wired boards are given in the Replaceable Electrical Parts list.

**A3—READOUT CIRCUIT BOARD.** To remove the circuit board, follow the procedure given in Figure 4-7.

**A2—TRIGGER CIRCUIT BOARD.** To remove the circuit board:

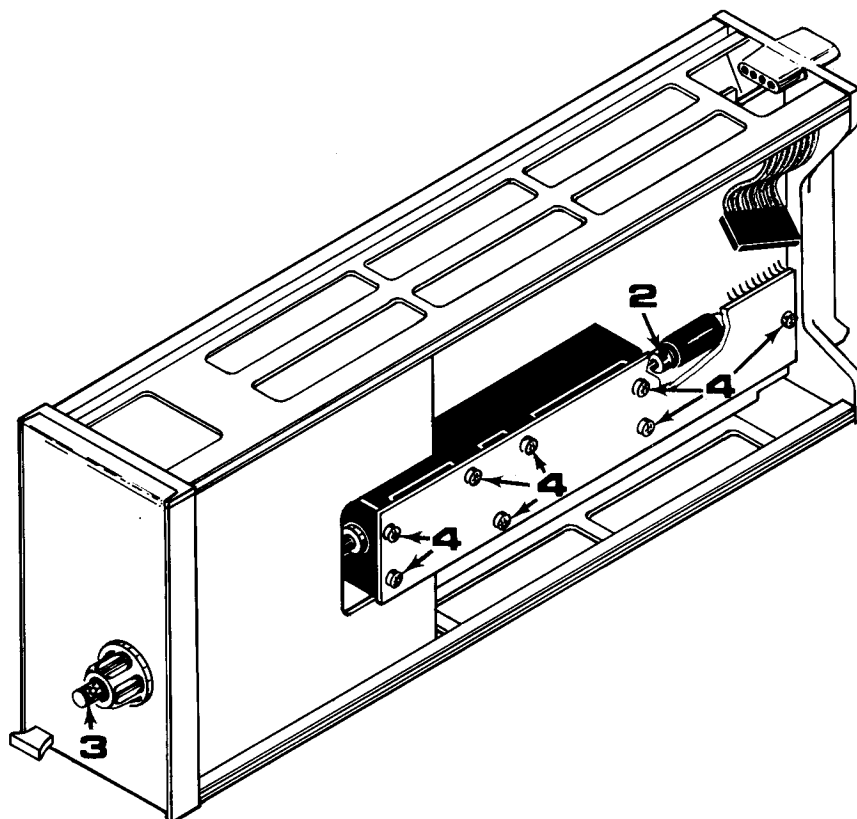
1. Remove 3 inter-board multi-pin connectors (see Figure 4-3 for identification).
2. Remove 2 screws from circuit board.
3. Lift rear of circuit board away from frame and slide board to the rear until push-button switches are clear of the front panel.
4. Note wire color on single-conductor shielded cables (see Figure 4-8 for identification) and connector to which each is attached.

5. Disconnect cables from back of circuit board.

To replace the circuit board, reverse the order of removal.

**A1—INTERFACE CIRCUIT BOARD.** To remove circuit board:

1. Remove Trigger and Digital Voltmeter circuit boards using procedures given previously.
2. Set TIME/DIV knob to 2 ms position and VARIABLE TIME/DIV knob to expose the set screw.
3. With hex-key wrench, loosen set screws in both knobs. Remove knobs from shafts.



**REMOVE READOUT BOARD AS FOLLOWS:**

1. Note index of multi-pin connector attached to board and disconnect cable.
2. Loosen set screw on variable switch assembly.
3. Remove VARIABLE (CAL IN) TIME/DIV knob and attached shaft out the front of the instrument.
4. Remove the 8 securing screws from board.
5. Lift board away from cam switch assembly.

**TO REPLACE READOUT BOARD, REVERSE THE ORDER OF REMOVAL.**

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**Fig. 4-7. Readout board removal procedure.**

4. Note color of multi-pin connectors (see Figure 4-4 for identification) and P numbers to which each connect. Disconnect all multi-pin connectors from board.

5. Remove 4 screws that secure gray plastic rear panel to instrument frame.

6. Remove 6 screws that secure perimeter of board to instrument frame.

7. Remove Interface circuit board through rear of instrument.

To install the Interface circuit board:

1. Guide TIME/DIV switch shaft through hole in front-panel.

2. Install 6 screws that secure perimeter of board to instrument frame.

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3. Install gray plastic rear panel with 4 securing screws.
4. Replace TIME/DIV knob on shaft. Align knob index with 2 ms position; then, tighten 2 set screws on knob.
5. Replace VARIABLE knob and tighten set screw.
6. Replace all cables as noted during removal procedure.
7. Replace Trigger circuit board.

### Switches

Two types of switches are used in this instrument. Contact alignment and spacing are critical to the operation of the push-button and cam switches. Therefore, defective switches should either be replaced as a unit or repaired only by personnel experienced with these types of switches. Your local Tektronix Field Office or representative can provide additional repair information. The following special maintenance information is provided for switch replacement.

**CAM SWITCHES.** Cam switches consist of a rotating cam that mates with contacts on the adjacent circuit board. These contacts are activated by lobes on the cam as the switch is rotated. A cam switch can be disassembled for inspection, cleaning, repair, or replacement; however, it is recommended that the switch be removed and replaced as a unit. Refer to Figure 4-9 for special instructions on cam switch removal.

#### CAUTION

*Repair of a cam switch should be undertaken only by experienced maintenance personnel. Switch alignment and contact spacing must be carefully maintained for proper operation. A cam switch repair kit is available (Tektronix part 040-0541-00) which contains special alignment tools for use in repairing or replacing the switch contacts. For information or assistance on maintenance of cam switches, contact your local Tektronix Field Office or representative.*

**PUSH-BUTTON SWITCHES.** Removal and replacement instructions for push-button switches are shown in Figure 4-10.

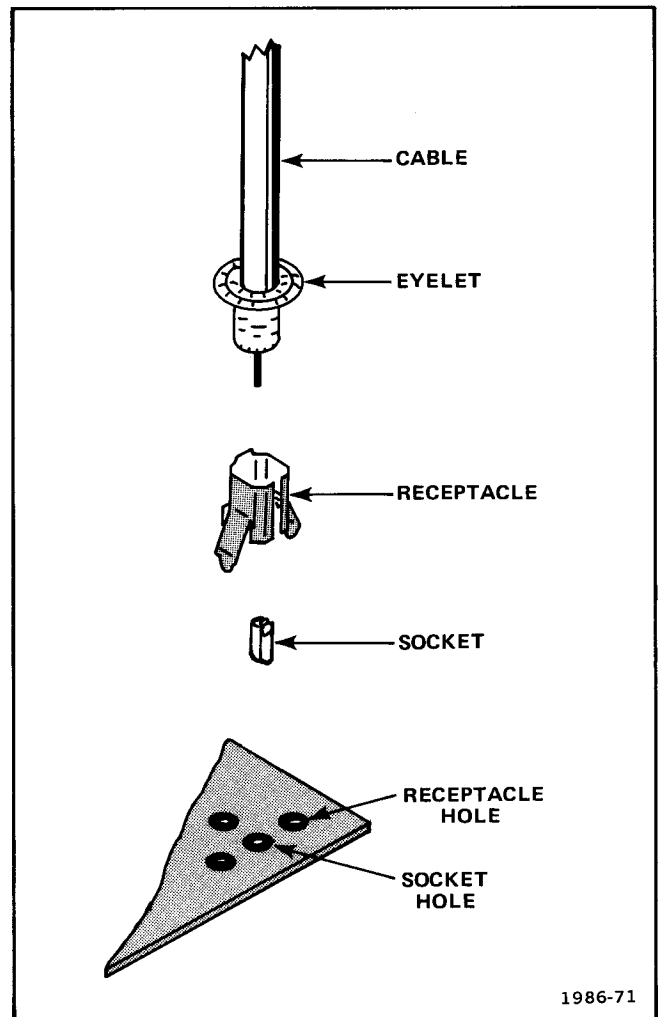


Fig. 4-8. Coaxial end-lead connector assembly.

### Semiconductors

#### CAUTION

*To avoid component damage, power must be turned off before removing or replacing semiconductors.*

Semiconductors should not be replaced unless actually defective. If semiconductors are removed during routine maintenance, return them to their original sockets. Unnecessary replacement of semiconductors may affect the adjustment of this instrument. When semiconductors are replaced, check the operation of that part of the instrument which may be affected.

**WARNING**

*Handle silicone grease with care. Avoid getting silicone grease in eyes. Wash hands thoroughly after use.*

Replacement devices should be of the original type or a direct replacement. Figure 4-2 shows the lead configurations of the semiconductor devices used in this instrument. Some plastic-case transistors have lead configurations that do not agree with those shown here. When replacing, check the manufacturer's basing diagram for correct basing. All transistor sockets in this instrument are wired for the standard basing used for metal-case transistors. Semiconductors that have heat radiators use silicone grease to increase heat transfer. Replace the silicone grease when replacing these semiconductors.

An extraction tool should be used to remove the 14- and 16-pin integrated circuits to prevent damage to the pins. This tool is available from Tektronix, Inc. Order Tektronix part 003-0619-00. If an extraction tool is not available when removing one of these integrated circuits, pull slowly and evenly on both ends of the device. Try to avoid having one end of the integrated circuit disengage from the socket before the other, as the pins may be damaged.

### Interconnecting Pins

Three methods of interconnection are used to connect the circuit boards with other boards and components. When the interconnection is made with a coaxial cable, a special end-lead connector plugs into a socket on the board (Figure 4-8). When the interconnection is made with a wire lead, an end-lead connector is used which mates with the interconnecting pin soldered into the board (Figure 4-4). When the interconnection is made between adjacent boards, an inter-board multi-pin connector is used (Figure 4-3). The following information provides the removal and replacement procedure for the various types of interconnection methods.

**COAXIAL END-LEAD CONNECTORS.** Replacement of the coaxial-type end-lead connectors requires special tools and techniques; only experienced maintenance personnel should attempt to remove and replace these connectors. It is recommended that the cable be replaced as a unit. For cable part numbers, see the Replaceable Mechanical Parts list. An alternative solution is to refer the replacement of the defective connector to your local Tektronix Field Office or representative.

**END-LEAD PIN CONNECTORS.** The pin connectors used to connect the wires to the interconnecting pins are clamped to the ends of the associated leads. To remove and replace damaged end-lead pin connectors, remove the old pin connector from the end of the lead and clamp the replacement connector to the lead.

Some of the pin connectors are grouped together and mounted in a plastic holder; the overall result is that these connectors are removed and installed as a multi-pin connector (see Figure 4-4). To provide correct orientation of this multi-pin connector when it is replaced, an arrow is marked on the circuit board and a matching arrow is molded into the plastic holder of the multi-pin connector. Be sure these arrows are aligned as the multi-pin connector is replaced. If the individual end-lead pin connectors are removed from the plastic holder, note the color of the individual wires for replacement.

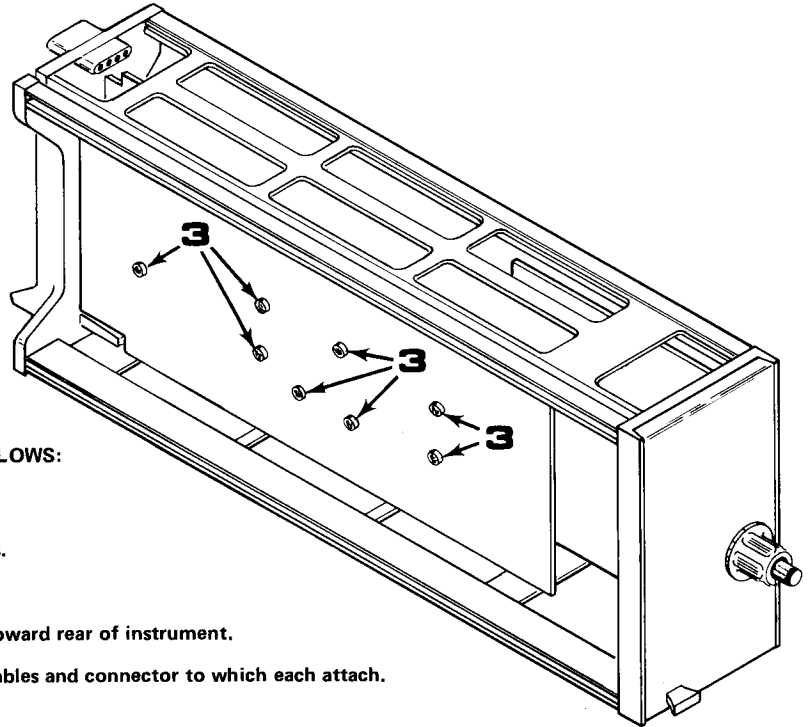
**INTER-BOARD MULTI-PIN CONNECTOR.** The inter-board multi-pin connector pin-holder is not repairable and should be replaced as a unit (see Figure 4-3). Refer to the Replaceable Mechanical Parts list for part number. Inter-board multi-pin connector pin-sockets are soldered to circuit boards (see Figure 4-3). To replace a socket, first remove the guide. Then, remove the old socket using soldering techniques previously described. Solder the new socket in place, making sure it will align properly with the inter-board connector pins.

### CIRCUIT-BOARD PINS.

**CAUTION**

*All circuit boards in this instrument, except the Readout circuit board, are multilayer type boards with a conductive path(s) laminated between the top and bottom board layers. All soldering on these boards should be done with extreme care to prevent breaking the connection to the center conductor(s); only experienced maintenance personnel should attempt repair of these boards.*

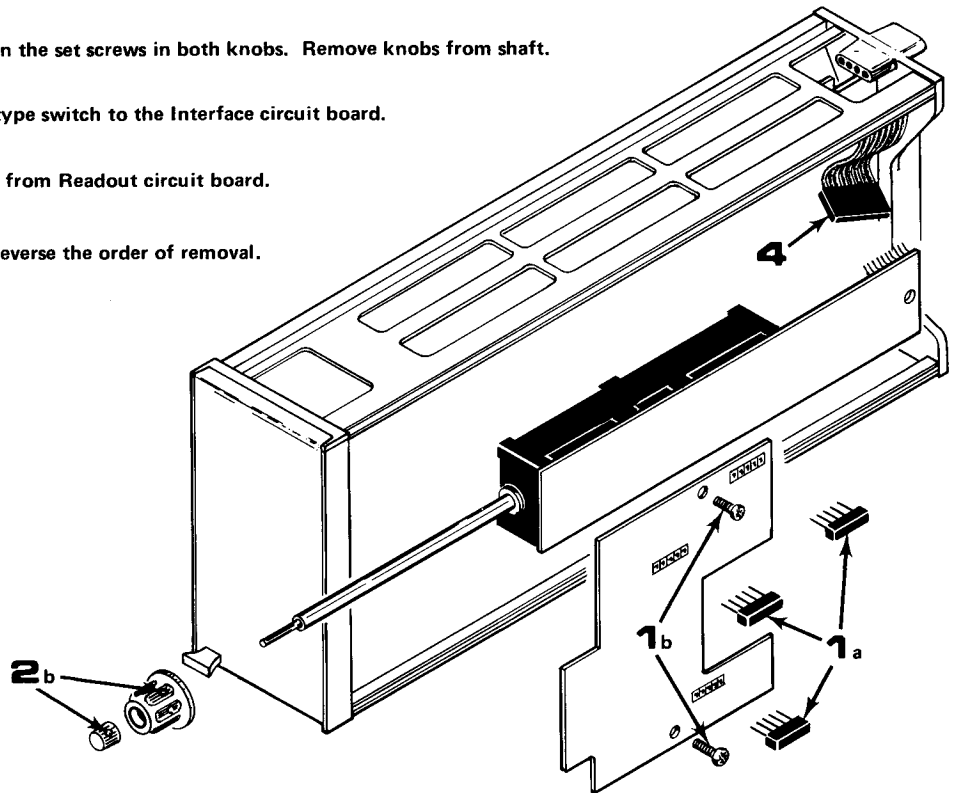
A circuit-board pin replacement kit including the necessary tools, instructions, and replacement pins is available from Tektronix, Inc. Order Tektronix part 040-0542-00. Replacement of circuit-board pins on multi-layer boards is not recommended; refer such repairs to your local Tektronix Field Office or representative.



**REMOVE CAM-TYPE SWITCH ASSEMBLY AS FOLLOWS:**

1. Remove Trigger circuit board as follows:
  - a. Remove the 3 inter-board multi-pin connectors.
  - b. Remove 2 screws from circuit board.
  - c. Lift rear of board away from frame and slide toward rear of instrument.
  - d. Note wire color of single-conductor shielded cables and connector to which each attach. Then, disconnect cables.
  
2. Remove the TIME/DIV and VARIABLE (CAL IN) knobs as follows:
  - a. Set the TIME/DIV switch to the 2 ms position and the VARIABLE (CAL IN) knob out to expose set screw.
  - b. With a hex key wrench loosen the set screws in both knobs. Remove knobs from shaft.
  
3. Remove 8 screws securing cam-type switch to the Interface circuit board.
  
4. Disconnect multi-pin connector from Readout circuit board.

To reinstall the cam-type switch, reverse the order of removal.



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Fig. 4-9. Cam switch removal procedure.

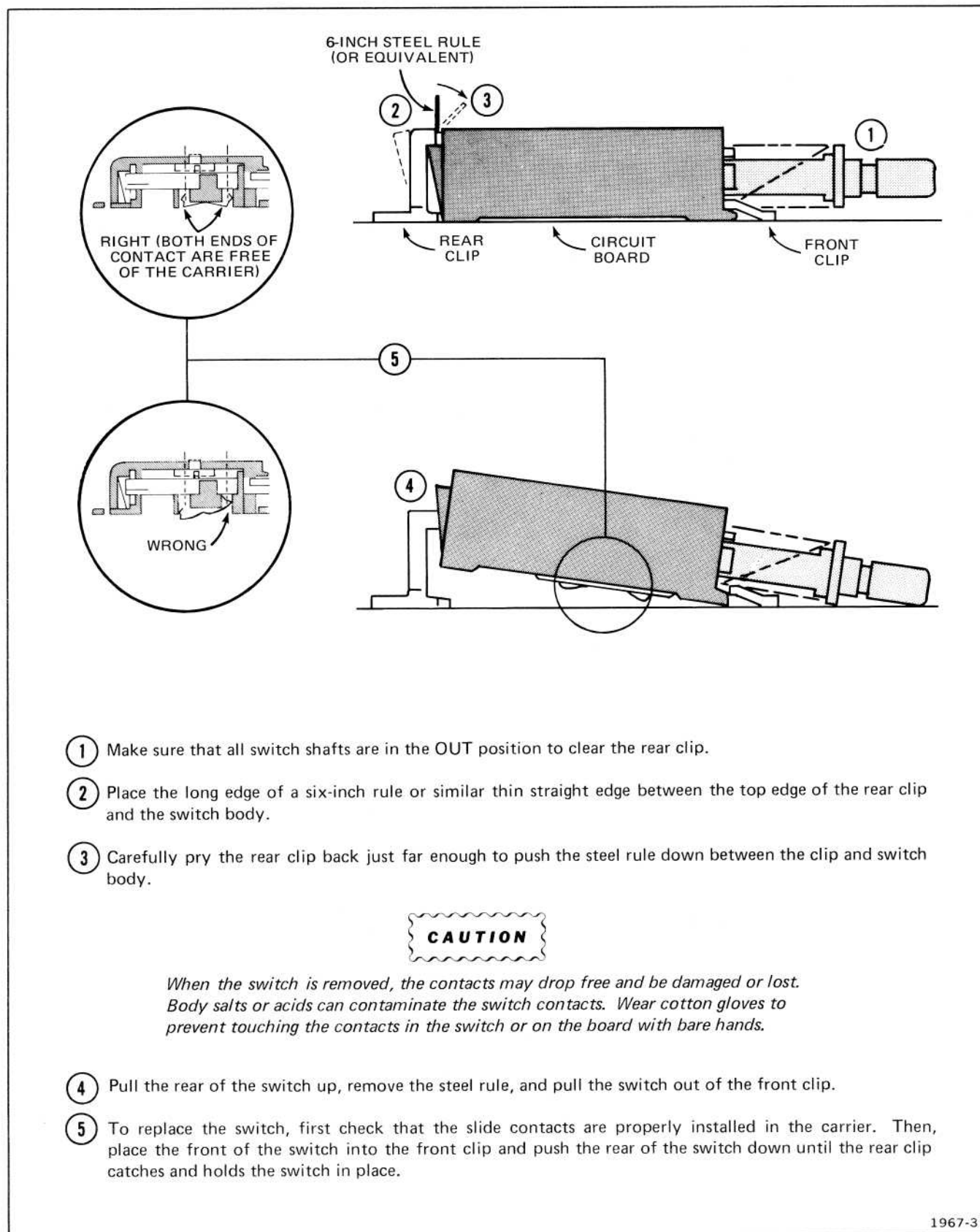


Fig. 4-10. Removal procedure for typical push-button switch.

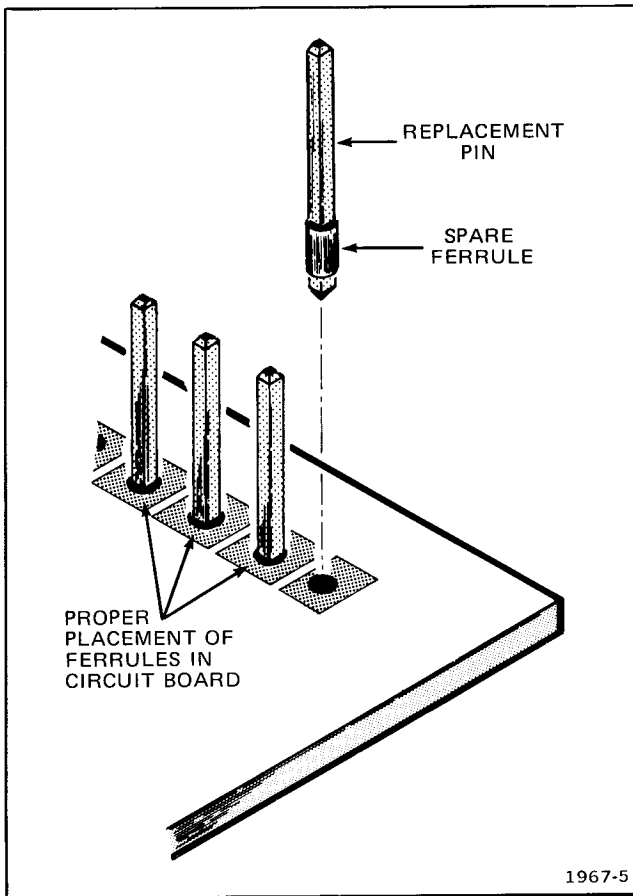


Fig. 4-11. Exploded view of circuit-board pin and ferrule.

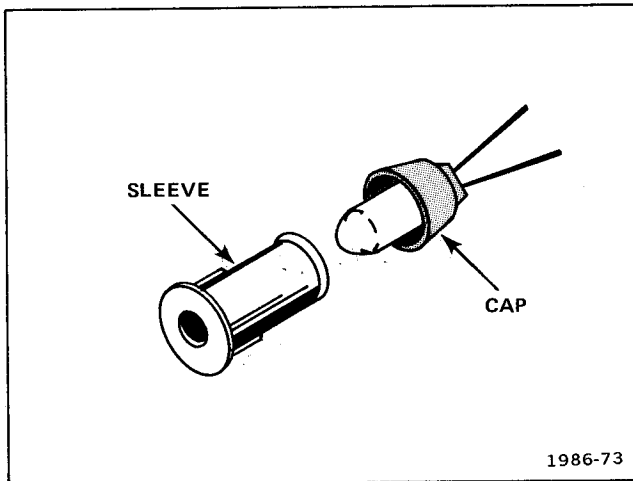


Fig. 4-12. Front-panel light socket assembly.

To replace a damaged pin which is mounted on a single-layer circuit board, first disconnect any pin connectors. Then (using Soldering Techniques given earlier in this section), unsolder the damaged pin and pull it from the board with a pair of pliers, leaving the ferrule (see Figure

4-11) in the hole, if possible. If the ferrule remains in the circuit board, remove the spare ferrule from the replacement pin and press the new pin into the hole in the circuit board. If the ferrule is removed with the damaged pin, clean out the hole using a solder-removing wick and a scribe. Then, press the replacement pin with attached spare ferrule into the hole. Position the replacement pin in the same manner as the damaged pin. Solder the pin to the circuit board on each side of the board. If the old pin was bent at an angle to mate with a connector, carefully bend the new pin to the same angle. Replace the pin connector.

### Front-Panel Lights

This instrument uses LED's (light-emitting diodes) and incandescent lamps for front-panel lights.

LED's are used to illuminate the TRIG'D and SINGLE SWP READY lights. To replace LED's, remove the cap from the sleeve as in Figure 4-12. Note lead wire color coding and LED lead configuration. Unsolder wire leads and remove LED from the cap. Solder the replacement LED and lead wires to the socket cap as noted previously. Install the cap in the sleeve.

Incandescent lamps are used to illuminate the transparent push-button switches. To replace incandescent lamps, unsolder the lead wires from the rear of the cap (see Figure 4-12), pull the cap and bulb out of the sleeve. Solder the replacement lamp and lead wires to the cap. Install the assembly in the sub-panel sleeve.

### ADJUSTMENT AFTER REPAIR

After any electrical component has been replaced, the adjustment of that particular circuit should be checked, as well as other closely related circuits. See Section 5 for a complete adjustment procedure.

### INSTRUMENT REPACKAGING

If the Tektronix instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag showing: owner (with address) and the name of an individual at your firm that can be contacted, complete instrument serial number and a description of the service required.

Save and re-use the package in which your instrument was shipped. If the original packaging is unfit for use or not available, repackage the instrument as follows:

1. Obtain a carton of corrugated cardboard having inside dimensions of no less than six inches more than the instrument dimensions; this will allow for cushioning. The shipping carton test strength for this instrument is 200 lbs.
2. Surround the instrument with polyethylene sheeting to protect the finish of the instrument.
3. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between carton and instrument, allowing three inches on all sides.
4. Seal carton with shipping tape or industrial stapler.

# PERFORMANCE CHECK AND ADJUSTMENT

This section contains information necessary to perform a complete instrument performance check and adjustment. Limits given in the procedure are adjustment guides and should not be interpreted as performance requirements unless preceded by a check mark (✓). Where possible, instrument performance is checked before an adjustment is made.

## PRELIMINARY INFORMATION

### Adjustment Interval

To maintain instrument accuracy, check the performance of the 7B80 every 1000 hours of operation, or every 6 months if used infrequently. Before complete adjustment, thoroughly clean and inspect this instrument as outlined in Section 4, Maintenance.

### Tektronix Field Service

Tektronix Field Service Centers and the Factory Service Center provide instrument repair and adjustment services. Contact your Tektronix Field Office or representative for further information.

### Using This Procedure

This Performance Check and Adjustment procedure can be used either for complete adjustment or as a check of instrument performance. Completion of each step in the procedure ensures that the instrument is correctly adjusted and operating within specified limits. Refer to the following discussion for instructions on a complete or partial check and adjustment.

**INDEX.** An index precedes the procedure to aid in locating Performance Check and Adjustment steps.

**PERFORMANCE CHECK.** Instrument performance can be checked by performing the complete Performance Check and Adjustment procedure and omitting only the ADJUST parts of the steps. A check mark (✓) preceding a CHECK indicates that the limit given is a performance requirement specified in Section 2, Specification.

**ADJUSTMENT.** Completion of each step in the Performance Check and Adjustment procedure ensures that the instrument is correctly adjusted and performing within specified limits. Where possible, instrument performance is checked before an adjustment is made. For best overall performance when performing the complete adjustment procedure, make each adjustment to the exact setting indicated.

**PARTIAL PROCEDURES.** The following procedure is written to completely check and adjust the instrument to the Performance Requirements listed in Section 2, Specification. If the applications for which the instrument is used do not require the full available performance, the procedures and the required equipment list can be shortened accordingly.

A partial performance check and adjustment may be desirable after replacing components, or to touch up the adjustment of a portion of the instrument. To check or adjust only part of the instrument, refer to the Equipment Required list which precedes that portion of the procedure to be performed. To avoid unnecessary adjustment of other parts, adjust only if the tolerance given in each CHECK is not met.

## TEST EQUIPMENT REQUIRED

The test equipment listed in Table 5-1 is required for a complete performance check and adjustment of this instrument. The specifications given in Table 5-1 for test equipment are the minimum required to meet the Performance Requirements listed in Section 2, Specification. Detailed operating instructions for test equipment are omitted in this procedure. Refer to the test equipment instruction manual if more information is needed.

### Special Fixtures

Special fixtures are used only where they facilitate instrument adjustment. These fixtures are available from Tektronix, Inc. Order by part number from Tektronix Field Offices or representatives.

### Test Equipment Alternatives

The test equipment listed in the Examples of Applicable Test Equipment column, Table 5-1, is required to check and adjust this instrument. The Performance Check and Adjustment procedure is based on the first item of equipment given as an example. If other equipment is substituted, control settings or setups may need to be altered. If the exact item of equipment given as an example is not available, refer to the Minimum Specifications column to determine if other equipment may be substituted. Then check the Purpose column. If you determine that your measurement requirements will not be affected, the item and corresponding step(s) can be deleted.



**TABLE 5-1**  
**Test Equipment**

Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
1. Oscilloscope Mainframe	Tektronix 7000-series. Bandwidth, 400 MHz with 2 horizontal plug-in compartments.	Provides a display for unit under test.	a. Tektronix 7904 Oscilloscope System.
2. Amplifier Plug-In Unit	Tektronix 7A-series. Bandwidth, 400 MHz; deflection factor, 10 mV to 0.5 V.	Provides vertical input to oscilloscope mainframe.	a. Tektronix 7A19 Amplifier plug-in unit.
3. High-Frequency Signal Generator	Frequency, 50 MHz to 400 MHz; output amplitude, variable from 50 mV to 0.5 V into 50 $\Omega$ .	High-frequency triggering checks.	a. SG 504 Leveled Sine Wave Generator. b. Wavetek 1002 Sweep/Signal Generator.
4. Time-Mark Generator	Marker outputs, 2 ns to 5 s; accuracy, within 0.1%.	Sweep timing checks and adjustments.	a. Tektronix TG 501 Time-Mark Generator with power module. b. Tektronix 2901 Time-Mark Generator. c. Tektronix 184 Time-Mark Generator.
5. Low-Frequency Sine-Wave Generator	Frequency, 30 Hz to 50 kHz; output amplitude, variable from 50 mV to 3 V into 50 $\Omega$ .	Low-frequency triggering checks and adjustments.	a. Tektronix FG 503 Function Generator with power module. b. General Radio 1310-B Oscillator.
6. Plug-In Extender	Tektronix 7000-series extender.	Provides access to internal adjustments and test points.	a. Tektronix 067-0589-00 Calibration Fixture.
7. Coaxial Cables (2 required)	Impedance, 50 $\Omega$ ; type, RG 58/U; length, 42 and 18 inches; connectors, BNC.	Provides signal interconnections.	a. Tektronix Part 012-0057-01.
8. T Connector	Connectors, BNC.	External trigger checks and adjustments.	a. Tektronix Part 103-0030-00.
9. Termination	Impedance, 50 $\Omega$ ; accuracy, within 2%; connectors, BNC.	Magnified sweep timing check.	a. Tektronix Part 011-0049-01.
10. Screwdriver	3-inch shaft, 3/32-inch bit.	Adjustments.	a. Xcelite R-3323.

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## PRELIMINARY PROCEDURE

1. Install an amplifier unit in the left vertical compartment of the oscilloscope mainframe.
2. Install the 067-0589-00 plug-in extender in the B horizontal compartment of the mainframe. Remove the side covers and install the 7B80 in the plug-in extender.
3. Set the mainframe vertical mode switch to display the left vertical unit and the horizontal mode switch to display the B horizontal unit. Set the mainframe intensity controls fully counterclockwise and set the trigger source switches to vertical mode.
4. Turn on the mainframe and allow at least 20 minutes warmup before beginning the procedure.

### NOTE

*The performance of this instrument can be checked at any ambient temperature within the 0° to +50° C range unless stated otherwise. This instrument must be adjusted at an ambient temperature of +20° to +30° C for quoted accuracy.*

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✓ Performance Requirement check; see introductory information.

## A. TRIGGERING SYSTEM

### Equipment Required

- |                                       |                       |
|---------------------------------------|-----------------------|
| 1. Oscilloscope mainframe.            | 6. 50-ohm cables (2). |
| 2. Amplifier plug-in unit.            | 7. BNC T connector.   |
| 3. Low-frequency sine-wave generator. |                       |
| 4. High-frequency signal generator.   |                       |
| 5. Plug-in extender.                  |                       |

BEFORE YOU BEGIN, see

**TEST POINT AND  
ADJUSTMENT LOCATIONS**

in the Diagrams section.

### Control Settings

Set the 7B80 controls as follows:

#### TRIGGERING

MODE	P-P AUTO
COUPLING	AC
SOURCE	INT

#### SWEEP

POSITION	Midrange
TIME/DIV	20 $\mu$ s
VARIABLE	IN (calibrated)
MAG	X1
HOLD OFF	MIN

f. ADJUST—R85 (DC Balance) for a stable crt display.

g. Set the SLOPE switch to (–) and check for a stable display.

h. ADJUST—R80 (Slope Balance) for a stable display.

i. Check for a stable display when the SLOPE switch is set to (+) and (–).

j. INTERACTION—Repeat the adjustment of R85 (DC Balance) and R80 (Slope Balance) until a stable display is obtained while changing TRIGGERING SLOPE.

### A1. ADJUST DC BALANCE AND SLOPE BALANCE (R85, R80)

- Connect the low-frequency sine-wave generator to the amplifier unit input with a 50-ohm cable.
- Set the oscilloscope mainframe intensity and focus controls for the desired display.
- Set the low-frequency sine-wave generator and the amplifier unit deflection factor for a 0.3-division display at 50 kilohertz. Center the display vertically.
- Set the TRIGGERING LEVEL control to approximately 0 (midrange) and TRIGGERING SLOPE to (+).
- Check for a stable display with TRIG'D light on.

#### NOTE

*If any of the CHECK parts in the following steps cannot be met, repeat step (A) 1.*

### ✓ A2. CHECK TRIGGERING MODES

- Remove the 7B80 and plug-in extender; then install the 7B80 directly into the B horizontal compartment.
- Set the low-frequency sine-wave generator and the amplifier unit deflection factor for approximately a 2-division display.
- ✓ c. CHECK—For a stable display at all LEVEL control settings (P-P AUTO MODE).

✓ Performance Requirement check; see introductory information.

d. Set the TRIGGERING MODE to AUTO.

✓ e. CHECK—Set the TRIGGERING LEVEL control for a stable display (TRIG'D light on).

✓ f. CHECK—For a free-running display with TRIG'D light off when the TRIGGERING LEVEL control is set fully clockwise and fully counterclockwise.

g. Set the TRIGGERING MODE to NORM.

✓ h. CHECK—Set the TRIGGERING LEVEL control for a stable display (TRIG'D light on).

✓ i. CHECK—For no display (TRIG'D light off) when the TRIGGERING LEVEL control is set fully clockwise and fully counterclockwise.

j. Set the TRIGGERING LEVEL control for a stable display (TRIG'D light on).

k. Set the TRIGGERING MODE to SINGLE SWP and the SOURCE to EXT.

✓ l. CHECK—Press the SINGLE SWP RESET push button and check that the READY light is on.

✓ m. CHECK—For one sweep and that the READY light is out after completion of that sweep when the INT SOURCE push button is pressed (oscilloscope intensity may need to be increased to view the single-sweep display).

n. Remove signal connection.

✓ **A3. CHECK EXTERNAL LEVEL RANGE**

a. Connect the low-frequency sine-wave generator to the EXT TRIG IN connector with a 42-inch 50-ohm cable and T connector. Connect the output of the T Connector to the amplifier unit input with an 18-inch 50-ohm cable.

b. Set the TRIGGERING MODE to AUTO, SLOPE to (+), and SOURCE to EXT. Set the TIME/DIV switch to 0.5 ms and the EXT TRIG IN attenuator to  $IN \div 1$ .

c. Set the amplifier unit deflection factor for 0.5 volts/division. Set the low-frequency sine-wave generator for a 6-division display (3 volts) at 1 kilohertz.

✓ d. CHECK—That all levels of the positive slope may be selected for the sweep starting point as the TRIGGERING LEVEL control is rotated throughout its range (indicates an external level range of at least plus and minus 1.5 volts). Check that the display is not triggered at either end of the LEVEL control rotation.

✓ e. CHECK—Change the TRIGGERING SLOPE to (–) and repeat part d for the negative slope of the waveform.

✓ **A4. CHECK EXTERNAL TRIGGERING SENSITIVITY**

a. Set the amplifier unit deflection factor for 10 millivolts/division. Set the low-frequency sine-wave generator for a 5-division display (50 millivolts) at 30 hertz.

b. Set TRIGGERING SLOPE to (+), MODE to NORM, TIME/DIV to 20 ms, and set the LEVEL control for a stable display.

✓ c. CHECK—Set the TRIGGERING MODE to AUTO and check for a stable display (TRIG'D light on) with the COUPLING push button set to:

1. AC
2. AC HF REJ
3. DC

(Set TRIGGERING LEVEL control as necessary).

✓ d. CHECK—Change the TRIGGERING SLOPE to (–) and repeat part c.

e. Set the TRIGGERING MODE to P-P AUTO and COUPLING to AC.

f. Set the amplifier unit deflection factor for a 0.1 volt/division and the low-frequency sine-wave generator for a 5-division display (500 millivolts) at 50 hertz.

✓ g. CHECK—For a stable display (TRIG'D light on) at all settings of the LEVEL control with COUPLING set to:

1. AC
2. DC

✓ Performance Requirement check; see introductory information.

## Performance Check and Adjustment—7B80

- ✓ h. CHECK—Set the SLOPE to (+) and repeat part g.
- i. Set the amplifier unit deflection factor for 50 millivolts/division and the low-frequency sine-wave generator for a 2.5-division display (125 millivolts) at 200 hertz. Set the TIME/DIV switch to 5 ms.
- ✓ j. CHECK—Repeat part g for both the (+) and (–) SLOPE.
- k. Disconnect the low-frequency sine-wave generator from the T connector and connect the high-frequency signal generator to the T connector.
- l. Set the TRIGGERING MODE to AUTO and the SLOPE to (+). Set the TIME/DIV switch to 20 ns.
- m. Set the amplifier unit deflection factor to 10 millivolts/division and the high-frequency signal generator for a 5-division display (50 millivolts) at 50 megahertz.
- ✓ n. CHECK—For a stable display (TRIG'D light on) with the COUPLING switch set to:
1. AC
  2. AC LF REJ
  3. DC
- (Set the LEVEL control as necessary.)
- ✓ o. CHECK—Set the SLOPE switch to (–) and repeat part n.
- p. Set the amplifier unit deflection factor to 50 millivolts/division and set the high-frequency signal generator for a 2.5-division display (125 millivolts).
- ✓ q. CHECK—Set the TRIGGERING MODE to P-P AUTO and check for a stable display (TRIG'D light on) at all settings of the LEVEL control with COUPLING set to:
1. AC
  2. DC
- ✓ r. CHECK—Set the SLOPE to (+) and repeat part q.
- s. Set the high-frequency signal generator for a 7.5-division display (375 millivolts) at 400 megahertz. Set the TIME/DIV switch to 10 ns and the MAG switch to X10.
- ✓ t. CHECK—Set the TRIGGERING MODE to P-P AUTO and check for a stable display (TRIG'D light on) when the LEVEL control setting is within the ends of the arrows on the front panel. Repeat for both the (+) and (–) SLOPE.
- u. Set the high-frequency signal generator for a 5-division display (250 millivolts) at 400 megahertz. Set the TRIGGERING MODE to AUTO and the SLOPE to (+).
- ✓ v. CHECK—For a stable display (TRIG'D light on) with COUPLING set to:
1. AC
  2. AC LF REJ
  3. DC
- (Set LEVEL control as necessary.)
- ✓ w. CHECK—Set the SLOPE to (–) and repeat part v.
- ✓ A5. CHECK INTERNAL TRIGGERING SENSITIVITY
- a. Remove all signal connections, then connect the low-frequency sine-wave generator to the amplifier unit input.
- b. Set the TIME/DIV switch to 20 ms and the MAG switch to X1.
- c. Set the low-frequency sine-wave generator and the amplifier unit deflection factor for a 0.3-division display at 30 hertz.
- d. Set TRIGGERING for (+) SLOPE, NORM MODE, AC COUPLING, INT SOURCE, and set the LEVEL control for a stable display (TRIG'D light on).
- ✓ e. CHECK—Set the TRIGGERING MODE to AUTO and check for a stable display (TRIG'D light on) with COUPLING set to:
1. AC
  2. AC HF REJ
  3. DC
- (Set TRIGGERING LEVEL control as necessary.)
- ✓ f. Change the TRIGGERING SLOPE to (–) and repeat part e.
- g. Set the TRIGGERING MODE to P-P AUTO and COUPLING to AC.

✓ Performance Requirement check; see introductory information.

h. Set the low-frequency sine-wave generator and the amplifier unit deflection factor for a 2-division display at 50 hertz.

✓ i. CHECK—For a stable display (TRIG'D light on) at all settings of the LEVEL control with COUPLING set to:

1. AC
2. DC

✓ j. Set the SLOPE to (+) and repeat part i.

k. Set the low-frequency sine-wave generator and the amplifier unit deflection factor for a 0.5-division display at 200 hertz. Set the TIME/DIV switch to 5 ms.

✓ l. CHECK—Repeat part i for both the (+) and (–) SLOPE.

m. Disconnect the low-frequency sine-wave generator and connect the high-frequency signal generator to the amplifier unit input.

n. Set the TRIGGERING MODE to AUTO and the SLOPE to (+). Set the TIME/DIV switch to 20 ns.

o. Set the high-frequency signal generator and the amplifier unit deflection factor for a 0.3-division display at 50 megahertz.

✓ p. CHECK—For a stable display (TRIG'D light on) with COUPLING set to:

1. AC
2. AC LF REJ
3. DC

(Set LEVEL control as necessary.)

✓ q. CHECK—Set the SLOPE to (–) and repeat part p.

r. Set the high-frequency signal generator and the amplifier unit deflection factor for a 0.5-division display.

✓ s. CHECK—Set the TRIGGERING MODE to P-P AUTO and check for a stable display at all settings of the LEVEL control (TRIG'D light on) with COUPLING set to:

1. AC
2. DC

✓ **Performance Requirement check; see introductory information.**

✓ t. CHECK—Set the SLOPE to (+) and repeat part s.

u. Set the high-frequency signal generator and the amplifier unit deflection factor for a 1.5-division display at 400 megahertz. Set the TIME/DIV switch to 10 ns and the MAG switch to X10.

✓ v. CHECK—Set the TRIGGERING MODE to P-P AUTO and check for a stable display (TRIG'D light on) when the LEVEL control setting is within the ends of the arrows on the front panel. Repeat for both the (+) and (–) SLOPE.

w. Set the TRIGGERING MODE to AUTO and SLOPE to (+).

✓ x. CHECK—For a stable display (TRIG'D light on) with COUPLING set to:

1. AC
2. AC LF REJ
3. DC

(Set LEVEL control as necessary.)

✓ y. CHECK—Set the SLOPE to (–) and repeat part x.

✓ **A6. CHECK INTERNAL TRIGGER JITTER**

a. Set TRIGGERING COUPLING to AC and set the LEVEL control for a stable display (TRIG'D light on).

✓ b. CHECK—For a stable display with no more than 0.1 division (0.1 nanosecond) of jitter.

✓ **A7. CHECK LINE TRIGGERING**

a. Remove all signal connections.

b. Set the TRIGGERING SOURCE to LINE, the TIME/DIV switch to 1 ms, and the MAG switch to X1.

✓ c. CHECK—Set the TRIGGERING LEVEL to approximately midrange and check that the TRIG'D light is on.

✓ d. CHECK—That the display is not triggered (TRIG'D light off) at either end of the LEVEL control rotation.

## B. HORIZONTAL SYSTEM

### Equipment Required

- |                            |                        |
|----------------------------|------------------------|
| 1. Oscilloscope mainframe. | 5. 50-ohm cables (2).  |
| 2. Amplifier plug-in unit. | 6. 50-ohm termination. |
| 3. Time-mark generator.    |                        |
| 4. Plug-in extender.       |                        |

BEFORE YOU BEGIN, see

**TEST POINT AND  
ADJUSTMENT LOCATIONS**

in the Diagrams section.

### Control Settings

Set the 7B80 controls as follows:

#### TRIGGERING

MODE	AUTO
COUPLING	AC
SOURCE	INT

#### SWEEP

POSITION	Midrange
TIME/DIV	1 ms
VARIABLE	IN (calibrated)
MAG	X1
HOLD OFF	MIN

### B1. SET BASIC SWEEP CALIBRATION

- a. Remove the 7B80 from the oscilloscope mainframe and install the plug-in extender in the B horizontal compartment. Then, install the 7B80 in the plug-in extender.
- b. Connect the time-mark generator to the amplifier unit input with a 50-ohm cable. Set the time-mark generator for 1-millisecond markers. Set the mainframe intensity and focus for the desired display.
- c. Set the LEVEL control for a stable display (TRIG'D light on). Set the amplifier unit for approximately a 2-division display centered vertically on the graticule.
- d. Set the front-panel SWP CAL adjustment for exactly 1 marker/division over the center 8 divisions (position as necessary).

### ✓ B2. CHECK SWEEP LENGTH AND POSITIONING RANGE

- a. Horizontally position the display to place the second time marker to the first graticule line.
- ✓ b. CHECK—That the end of sweep is beyond 9.2 graticule divisions (indicates sweep length of at least 10.2 divisions).
- c. Set the POSITION and FINE controls fully clockwise.
- ✓ d. CHECK—The start of sweep must be to the right of graticule center.
- e. Set the POSITION and FINE controls fully counter-clockwise.
- ✓ f. CHECK—The end of sweep must be to the left of graticule center.

### ✓ B3. CHECK/ADJUST MAGNIFIER GAIN AND REGISTRATION (R430, R445).

- a. Set the time-mark generator for 0.1-millisecond markers.
- b. Set the MAG switch to X10 and set the POSITION controls to midrange. Set the mainframe intensity controls for the desired display.
- c. Check for 1 marker/division over the center 8 divisions of display (position as necessary).

✓ Performance Requirement check; see introductory information.

d. ADJUST—R430 (Mag Gain) for 1 marker/division over the center 8 divisions of display.

e. Set the time-mark generator for 5-millisecond markers. Align the center time marker with graticule center.

✓ f. CHECK—Set the MAG switch to X1 and check that the center time marker is at graticule center within 0.5 division.

g. ADJUST—R445 (Mag Reg) to align the center time marker with graticule center.

h. INTERACTION—Set the MAG switch to X10 and repeat parts e, f, and g as necessary.

✓ **B4. CHECK VARIABLE TIME/DIVISION AND VARIABLE HOLD OFF**

a. Press and release the VARIABLE TIME/DIV control for uncalibrated sweep rates. Set the VARIABLE control fully clockwise and note 3 time markers in 10 graticule divisions.

✓ b. CHECK—Set the VARIABLE control fully counterclockwise and check for 2 divisions or less between 5-millisecond markers.

c. Press the VARIABLE control in for calibrated sweep rates.

d. Set the LEVEL control for a free-running display (TRIG'D light off).

e. Set the HOLD OFF control fully counterclockwise.

✓ f. CHECK—Rotate the HOLD OFF control slowly clockwise throughout its range and check that the display (3 time markers in 10 divisions) will stabilize at least 3 times throughout the range of the HOLD OFF control (disregard any slow drift).

g. Set the HOLD OFF control counterclockwise to MIN and set the LEVEL control for a stable display.

**B5. ADJUST SWEEP TIMING (C330, R710, R715)**

a. Set the TIME/DIV switch to 50 ns and set the time mark generator for 50-nanosecond markers.

b. Check for 1 marker/division over the center 8 divisions of display (position as necessary).

c. ADJUST—C330 (50 ns Timing) for 1 marker/division over the center 8 divisions of display (position as necessary).

d. Set the TIME/DIV switch to 10  $\mu$ s and set the time-mark generator for 10-microsecond markers.

e. Check for 1 marker/division over the center 8 divisions of display (position as necessary).

f. ADJUST—R710 (10  $\mu$ s Timing) for 1 marker/division over the center 8 divisions of display (position as necessary).

g. Set the TIME/DIV switch to 10 ms and set the time-mark generator for 10-millisecond markers.

h. CHECK—For 1 marker/division over the center 8 divisions of display (position as necessary).

i. ADJUST—R715 (10 ms Timing) for 1 marker/division over the center 8 divisions of display (position as necessary).

✓ **B6. CHECK SWEEP TIMING**

**NOTE**

*The tolerances given in Table 5-2 are for an ambient temperature range of +15° to +35° C. If outside this range, see the Specification section for applicable tolerances.*

a. Remove the 7B80 and plug-in extender from the mainframe, then install the 7B80 directly into the B horizontal compartment.

✓ **Performance Requirement check; see introductory section.**



**Performance Check and Adjustment—7B80**

b. Set the POSITION controls to midrange and TRIGGERING MODE to NORM.

✓ c. CHECK—Using the TIME/DIV setting and time-mark generator settings from Table 5-2, check sweep accuracy for 1 time mark/division over the center 8 divisions within the tolerance given in Table 5-2. Set the POSITION controls and TRIGGERING LEVEL control as necessary for a stable display aligned with the vertical graticule lines.

**NOTE**

*If the time-mark generator used does not have 1-2-5 sequence markers, apply 1 unit markers in place of 2 unit markers and check for 2 markers/division, over the center eight divisions of display, to the tolerances given in Table 5-2.*

**TABLE 5-2  
Sweep Timing**

TIME/DIV	Time Markers	Tolerance (+15° to +35° C)
10 ns	10 ns	Within 0.2 div
20 ns	20 ns	Within 0.2 div
50 ns	50 ns	Within 0.2 div
.1 μs	.1 μs	Within 0.12 div
.2 μs	.2 μs	Within 0.12 div
.5 μs	.5 μs	Within 0.12 div
1 μs	1 μs	Within 0.12 div
2 μs	2 μs	Within 0.12 div
5 μs	5 μs	Within 0.12 div
10 μs	10 μs	Within 0.12 div
20 μs	20 μs	Within 0.12 div
50 μs	50 μs	Within 0.12 div
.1 ms	.1 ms	Within 0.12 div
.2 ms	.2 ms	Within 0.12 div
.5 ms	.5 ms	Within 0.12 div
1 ms	1 ms	Within 0.12 div
2 ms	2 ms	Within 0.12 div
5 ms	5 ms	Within 0.12 div
10 ms	10 ms	Within 0.12 div
20 ms	20 ms	Within 0.12 div
50 ms	50 ms	Within 0.12 div
.1 s	.1 s	Within 0.12 div
.2 s	.2 s	Within 0.12 div
.5 s	.5 s	Within 0.12 div
1 s	1 s	Within 0.32 div
2 s	2 s	Within 0.32 div
5 s	5 s	Within 0.32 div

✓ **B7. CHECK MAGNIFIED SWEEP TIMING**

**NOTE**

*The tolerances in Table 5-3 are for an ambient temperature range of +15° to +35° C. If outside this range, see the Specification section for applicable tolerances.*

a. Center the display horizontally on the graticule. Set the MAG switch to X10 and the SOURCE switch to EXT.

b. Connect the time-mark generator trigger output to the EXT TRIG IN connector with a 50-ohm cable and 50-ohm termination.

✓ Performance Requirement check; see introductory section.

**TABLE 5-3**  
Magnified Sweep Timing

TIME/DIV	Time Markers	Tolerance (+15° to 35° C)
10 ns	2 ns	<sup>1</sup> Within 0.32 div
20 ns	2 ns	Within 0.32 div
50 ns	5 ns	Within 0.32 div
.1 $\mu$ s	10 ns	Within 0.2 div
.2 $\mu$ s	20 ns	Within 0.2 div
.5 $\mu$ s	50 ns	Within 0.2 div
1 $\mu$ s	.1 $\mu$ s	Within 0.2 div
2 $\mu$ s	.2 $\mu$ s	Within 0.2 div
5 $\mu$ s	.5 $\mu$ s	Within 0.2 div
10 $\mu$ s	1 $\mu$ s	Within 0.2 div
20 $\mu$ s	2 $\mu$ s	Within 0.2 div
50 $\mu$ s	5 $\mu$ s	Within 0.2 div
.1 ms	10 $\mu$ s	Within 0.2 div
.2 ms	20 $\mu$ s	Within 0.2 div
.5 ms	50 $\mu$ s	Within 0.2 div
1 ms	.1 ms	Within 0.2 div
2 ms	.2 ms	Within 0.2 div
5 ms	.5 ms	Within 0.2 div
10 ms	1 ms	Within 0.2 div
20 ms	2 ms	Within 0.2 div
50 ms	5 ms	Within 0.2 div
.1 s	10 ms	Within 0.2 div
.2 s	20 ms	Within 0.2 div
.5 s	50 ms	Within 0.2 div
1 s	.1 s	Within 0.4 div
2 s	.2 s	Within 0.4 div
5 s	.5 s	Within 0.4 div

<sup>1</sup> Check for 1 time-marker in 2 divisions over the center eight divisions.

- ✓ c. CHECK—Using the TIME/DIV settings and time-mark generator settings in Table 5-3, check magnified sweep accuracy for 1 time mark/division, over the center 8 divisions, within the tolerance given in Table 5-3. Set the POSITION controls and TRIGGERING LEVEL control as necessary for a stable display aligned with the vertical graticule lines.

**NOTE**

*The 7B80 may be operated as a delayed sweep unit (B horizontal compartment) with a companion delaying sweep unit (A horizontal compartment). To check 7B80 delayed sweep operation, refer to a delaying sweep checkout procedure in the Operating Instructions or calibration sections of the instruction manual for the delaying sweep unit.*

This completes the Performance Check and Adjustment procedure.

✓ Performance Requirement check; see introductory section.

# REPLACEABLE ELECTRICAL PARTS

## PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

## SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number  
00X Part removed after this serial number

## ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

## ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICON	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MURTL BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD, PO BOX 20923	PHOENIX, AZ 85036
07910	TELEDYNE SEMICONDUCTOR	12515 CHADRON AVE.	HAWTHORNE, CA 90250
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
11237	CTS KEENE, INC.	3230 RIVERSIDE AVE.	PASO ROBLES, CA 93446
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
12969	UNITRODE CORPORATION	580 PLEASANT STREET	WATERTOWN, MA 02172
28480	HEWLETT-PACKARD CO., CORPORATE HQ.	1501 PAGE MILL RD.	PALO ALTO, CA 94304
32293	INTERSIL, INC.	10900 N. TANTAU AVE.	CUPERTINO, CA 95014
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
50434	HEWLETT-PACKARD COMPANY	640 PAGE MILL ROAD	PALO ALTO, CA 94304
53184	XCITON CORPORATION	5 HEMLOCK STREET	LATHAM, NY 12110
56289	SPRAGUE ELECTRIC CO.		NORTH ADAMS, MA 01247
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
72136	ELECTRO MOTIVE CORPORATION, SUB OF INTERNATIONAL ELECTRONICS CORPORATION	SOUTH PARK AND JOHN STREETS	WILLIMANTIC, CT 06226
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
74970	JOHNSON, E. F., CO.	299 10TH AVE. S. W.	WASECA, MN 56093
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
78488	STACKPOLE CARBON CO.		ST. MARYS, PA 15857
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
81483	INTERNATIONAL RECTIFIER CORP.	9220 SUNSET BLVD.	LOS ANGELES, CA 90069
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E WASHINGTON STREET	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P O BOX 372 P. O. BOX 609	COLUMBUS, NE 68601

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A1 <sup>1</sup>	-----			CKT BOARD ASSY:INTERFACE		
A2	670-4181-00	B010100	B049999	CKT BOARD ASSY:TRIGGER	80009	670-4181-00
A2	670-4181-01	B050000		CKT BOARD ASSY:TRIGGER	80009	670-4181-01
A3	670-4182-00			CKT BOARD ASSY:READOUT	80009	670-4182-00
A5	670-4395-00			CKT BOARD ASSY:X-Y SWITCHING (OPTION 2)	80009	670-4395-00
C3	290-0748-00			CAP.,FXD,ELCTLT:10UF,+50-10%,20V	56289	500D149
C5	290-0748-00			CAP.,FXD,ELCTLT:10UF,+50-10%,20V	56289	500D149
C7	290-0748-00			CAP.,FXD,ELCTLT:10UF,+50-10%,20V	56289	500D149
C9	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C12	281-0661-00			CAP.,FXD,CER DI:0.8PF,+/-0.1PF,500V	72982	301-000COK0808B
C14	281-0503-00			CAP.,FXD,CER DI:8PF,+/-0.5PF,500V	72982	301-000COH0809D
C15	283-0005-00			CAP.,FXD,CER DI:0.01UF,+100-0%,250V	72982	8131N300Z5U0103P
C20	281-0505-00			CAP.,FXD,CER DI:12PF,+/-1.2PF,500V	72982	301-012COG0120K
C21	283-0299-00			CAP.,FXD,CER DI:51PF,5%,500V	72982	8121N501COG510J
C22	283-0299-00			CAP.,FXD,CER DI:51PF,5%,500V	72982	8121N501COG510J
C23	281-0812-00	XB050000		CAP.,FXD,CER DI:1000PF,10%,100V	72982	8005H9AADW5R102K
C30	281-0773-00	B010100	B049999	CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C30	281-0813-00	B050000		CAP.,FXD,CER DI:0.047UF,20%,100V	04222	GC705-E-473M
C34	281-0525-00			CAP.,FXD,CER DI:470PF,+/-94PF,500V	04222	7001-1364
C35	281-0551-00			CAP.,FXD,CER DI:390PF,10%,500V	04222	7001-1363
C37	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C43	283-0203-00			CAP.,FXD,CER DI:0.47UF,20%,50V	72982	8131N075 E474M
C46	281-0792-00			CAP.,FXD,CER DI:82PF,10%,100V	72982	8035D2AADCOG820K
C51	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C52	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C53	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C56	283-0010-00	B010100	B039999	CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	273C20
C56	283-0341-00	B040000		CAP.,FXD,CER DI:0.047UF,10%,100V	72982	8131N145X7R0473K
C57	283-0203-00			CAP.,FXD,CER DI:0.47UF,20%,50V	72982	8131N075 E474M
C66	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C67	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C68	283-0195-00			CAP.,FXD,CER DI:680UF,10%,50V	72982	8121N075COG0681J
C69	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C71	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C72	290-0580-00			CAP.,FXD,ELCTLT:0.27UF,20%,50V	56289	196D274X0050HA1
C73	283-0114-00			CAP.,FXD,CER DI:0.0015UF,5%,200V	72982	805-509B152J
C74	283-0114-00			CAP.,FXD,CER DI:0.0015UF,5%,200V	72982	805-509B152J
C75	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C76	290-0580-00			CAP.,FXD,ELCTLT:0.27UF,20%,50V	56289	196D274X0050HA1
C84	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C85	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C88	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C89	281-0786-00			CAP.,FXD,CER DI:150PF,10%,100V	72982	8035D2AADX5P151K
C92	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
C204	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	72982	831-516E102P
C211	283-0672-00			CAP.,FXD,MICA D:200PF,1%,500V	00853	D155F201F0
C212	283-0555-00			CAP.,FXD MICA D:2000PF,1%,500V	72136	CM20D202F
C213	285-0683-00			CAP.,FXD,PLSTC:0.022UF,5%,100V	56289	410P22351
C214	290-0269-00			CAP.,FXD,ELCTLT:0.22UF,5%,35V	56289	162D224X5035BC2
C215	290-0523-00			CAP.,FXD,ELCTLT:2.2UF,20%,20V	56289	196D225X0020HA1
C221	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C225	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C228	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1

<sup>1</sup>Replaceable under 672-0538-XX only.

Replaceable Electrical Parts—7B80

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C312	283-0691-00			CAP., FXD, MICA D: 650PF, 1%, 300V	72136	DM15FC651FO
C324	283-0111-00			CAP., FXD, CER DI: 0.1UF, 20%, 50V	72982	8121-N088Z5U104M
C330	281-0166-00			CAP., VAR, AIR DI: 1.9-15.7PF, 250V	74970	187-0109-005
C331	283-0633-00			CAP., FXD, MICA D: 77PF, 1%, 100V	00853	D151E770FO
C332	295-0172-00			CAP., SET MTCHD: 10UF, 0.1UF, 898PF, 0.75%	80009	295-0172-00
C333	283-0111-00			CAP., FXD, CER DI: 0.1UF, 20%, 50V	72982	8121-N088Z5U104M
C334	295-0172-00			CAP., SET MTCHD: 10UF, 0.1UF, 898PF, 0.75%	80009	295-0172-00
C335	283-0111-00			CAP., FXD, CER DI: 0.1UF, 20%, 50V	72982	8121-N088Z5U104M
C336	295-0172-00			CAP., SET MTCHD: 10UF, 0.1UF, 898PF, 0.75%	80009	295-0172-00
C356	283-0616-00			CAP., FXD, MICA D: 75PF, 5%, 500V	00853	D155E750JO
C416	283-0003-00			CAP., FXD, CER DI: 0.01UF, +80-20%, 150V	72982	855-558Z5U-103Z
C432	283-0111-00			CAP., FXD, CER DI: 0.1UF, 20%, 50V	72982	8121-N088Z5U104M
C440	281-0616-00			CAP., FXD, CER DI: 6.8PF, +/-0.5PF, 200V	72982	374-001COH0689D
C441	281-0592-00			CAP., FXD, CER DI: 4.7PF, +/-0.5PF, 500V	72982	301-023COH0479D
C515	283-0004-00	B010100	B039999	CAP., FXD, CER DI: 0.02UF, +80-20%, 150V	72982	855-558-Z5V0203Z
C515	283-0111-00	B040000		CAP., FXD, CER DI: 0.1UF, 20%, 50V	72982	8121-N088Z5U104M
C712	290-0420-00			CAP., FXD, ELCTLT: 0.68UF, 20%, 75V	56289	150D684X0075A2
C722	283-0054-00			CAP., FXD, CER DI: 150PF, 5%, 200V	72982	855-535U2J15LJ
C731	283-0204-00			CAP., FXD, CER DI: 0.01UF, 20%, 50V	72982	8121N075Z5U0103M
C810	283-0178-00			CAP., FXD, CER DI: 0.1UF, +80-20%, 100V	72982	8131N145 E 104Z
C820	290-0745-00			CAP., FXD, ELCTLT: 22UF, +50-10%, 25V	56289	502D225
C822	283-0004-00			CAP., FXD, CER DI: 0.02UF, +80-20%, 150V	72982	855-558-Z5V0203Z
C830	290-0745-00			CAP., FXD, ELCTLT: 22UF, +50-10%, 25V	56289	502D225
C840	290-0745-00			CAP., FXD, ELCTLT: 22UF, +50-10%, 25V	56289	502D225
C844	283-0004-00			CAP., FXD, CER DI: 0.02UF, +80-20%, 150V	72982	855-558-Z5V0203Z
CR23	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR24	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR53	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR55	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR71	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR75	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR201	152-0153-00			SEMICONV DEVICE: SILICON, 15V, 50MA	80009	152-0153-00
CR206	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR208	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR220	150-1029-00			LAMP, LED: 2.0V, GREEN	53184	XC209G
CR224	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR225	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR226	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR232	150-1033-00			LAMP, LED: YELLOW, 2.2V	50434	5082-4584
CR273	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR301	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR302	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR314	152-0141-02	XB040000		SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR323	152-0322-00			SEMICONV DEVICE: SILICON, 15V, HOT CARRIER	28480	5082-2672
CR324	152-0242-00	XB040000		SEMICONV DEVICE: SILICON, 225V, 200MA	12969	NDF341
CR334	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR344	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR356	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR362	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR372	152-0322-00			SEMICONV DEVICE: SILICON, 15V, HOT CARRIER	28480	5082-2672
CR382	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR423	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152
CR433	152-0141-02			SEMICONV DEVICE: SILICON, 30V, 150MA	07910	1N4152

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR435	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR717	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR718	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR723	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR724	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR725	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR751	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR752	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR772	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR773	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR782	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR783	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR844	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
CR965 <sup>1</sup>	152-0141-02			SEMICONV DEVICE:SILICON,30V,150MA	07910	1N4152
DS810	150-0048-01			LAMP, INCAND:5V,0.06A,SEL	08806	683AS15
L274	276-0507-00			SHIELDING BEAD,:0.6UH	78488	57-0180-7D 500B
L382	276-0507-00			SHIELDING BEAD,:0.6UH	78488	57-0180-7D 500B
LR3	108-0543-00			COIL,RF:FIXED,1.1UH	80009	108-0543-00
LR5	108-0537-00			COIL,RF:200UH	80009	108-0537-00
LR7	108-0543-00			COIL,RF:FIXED,1.1UH	80009	108-0543-00
LR70	108-0328-00			COIL,RF:0.3UH	80009	108-0328-00
LR75	108-0328-00			COIL,RF:0.3UH	80009	108-0328-00
LR326	108-0271-00			COIL,RF:0.025UH	80009	108-0271-00
LR810	108-0537-00			COIL,RF:200UH	80009	108-0537-00
LR820	108-0537-00			COIL,RF:200UH	80009	108-0537-00
LR830	108-0537-00			COIL,RF:200UH	80009	108-0537-00
LR840	108-0537-00			COIL,RF:200UH	80009	108-0537-00
Q22A,B	151-1042-00			SEMICONV DVC SE:MATCHED PAIR FET	80009	151-1042-00
Q48	151-0190-00	XB050000		TRANSISTOR:SILICON,NPN	80009	151-0190-00
Q88	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q92	151-0271-00			TRANSISTOR:SILICON,PNP	80009	151-0271-00
Q96	151-0271-00			TRANSISTOR:SILICON,PNP	80009	151-0271-00
Q98	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q201	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q202	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q203	151-0220-00	B010100 B029999		TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q203	151-0216-00	B030000		TRANSISTOR:SILICON,PNP	80009	151-0216-00
Q204	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q206	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q210	151-0273-00			TRANSISTOR:SILICON,NPN	80009	151-0273-00
Q214	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q230	151-0302-00			TRANSISTOR:SILICON,NPN	80009	151-0302-00
Q234	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q242	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q272	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q274	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q304A,B	151-0354-00			TRANSISTOR:SILICON,PNP,DUAL	32293	ITS1200A
Q314	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q322	151-0367-00			TRANSISTOR:SILICON,NPN,SEL FROM 3571TP	80009	151-0367-00
Q324	151-0367-00			TRANSISTOR:SILICON,NPN,SEL FROM 3571TP	80009	151-0367-00
Q334	151-1036-00			TRANSISTOR:SILICON,JFE,N-CHANNEL,DUAL	80009	151-1036-00
Q338	151-0437-00			TRANSISTOR:SILICON,NPN,SEL FROM 2N5769	80009	151-0437-00

<sup>1</sup>Option 2 only.

Replaceable Electrical Parts—7B80

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
Q344	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q346	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q352	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q356	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q358	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q362	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q372	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q382	151-0367-00			TRANSISTOR:SILICON,NPN,SEL FROM 3571TP	80009	151-0367-00
Q424	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q428	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q434	151-0220-00			TRANSISTOR:SILICON,PNP	80009	151-0220-00
Q438	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q448	151-0472-00			TRANSISTOR:SILICON,NPN	80009	151-0472-00
Q458	151-0472-00			TRANSISTOR:SILICON,NPN	80009	151-0472-00
Q732	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q844	151-0301-00			TRANSISTOR:SILICON,PNP	04713	2N2907A
Q962 <sup>1</sup>	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
Q972 <sup>1</sup>	151-0223-00			TRANSISTOR:SILICON,NPN	80009	151-0223-00
R8	315-0512-00	B010100	B049999	RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R8	315-0622-00	B050000		RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R9	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R12	315-0915-00			RES.,FXD,CMPSN:9.1M OHM,5%,0.25W	01121	CB9155
R13	317-0470-00	XB050000		RES.,FXD,CMPSN:47 OHM,5%,0.125W	01121	BB4705
R14	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R15	315-0824-00			RES.,FXD,CMPSN:820K OHM,5%,0.25W	01121	CB8245
R16	315-0274-00			RES.,FXD,CMPSN:270K OHM,5%,0.25W	01121	CB2745
R19	315-0274-00			RES.,FXD,CMPSN:270K OHM,5%,0.25W	01121	CB2745
R20	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R21	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R22	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R23	315-0751-00	XB050000		RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R28	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R29	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R30	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R31	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R32	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R33	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R34	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R35	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R36	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R37	315-0560-00			RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
R41	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R42	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R43	315-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.25W	01121	CB7525
R44	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R45	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R47	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R48	315-0682-00	XB050000		RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R49	311-1564-00	XB050000		RES.,VAR,NONWIR:500 OHM,20%,0.50W	73138	91A R500
R50	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R51	321-0274-00			RES.,FXD,FILM:6.98K OHM,1%,0.125W	91637	MFF1816G69800F
R52	321-0431-01			RES.,FXD,FILM:301K OHM,0.5%,0.125W	91637	MFF1816G30102D
R53	315-0124-00			RES.,FXD,CMPSN:120K OHM,5%,0.25W	01121	CB1245

Option 2 only.



Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R54	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R55	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R56	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R57	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R58	321-0443-00			RES.,FXD,FILM:402K OHM,1%,0.125W	91637	MFF1816G40202F
R59	321-0443-00			RES.,FXD,FILM:402K OHM,1%,0.125W	91637	MFF1816G40202F
R60	311-1192-00			RES.,VAR,NONWIR:10K OHM,20%,1W	71590	BA-232-001
R61	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R62	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R63	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R64	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R65	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R67	323-0155-00			RES.,FXD,FILM:402 OHM,1%,0.50W	75042	CECTO-4020F
R68	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R69	315-0131-00	B010100	B049999	RES.,FXD,CMPSN:130 OHM,5%,0.25W	01121	CB1315
R69	315-0820-00	B050000		RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R72	315-0205-00			RES.,FXD,CMPSN:2M OHM,5%,0.25W	01121	CB2055
R73	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R74	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R76	315-0205-00			RES.,FXD,CMPSN:2M OHM,5%,0.25W	01121	CB2055
R80	311-1228-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	32997	3386F-T04-103
R83	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R84	315-0680-00			RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R85	311-1594-00			RES.,VAR,NONWIR:10 OHM,20%,0.50W	73138	91A-R10
R86	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R89	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R90	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R91	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R92	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R93	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R94	321-0202-00			RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	MFF1816G12400F
R95	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R96	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R97	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R98	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R99	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R200	315-0201-00	B010100	B042459X	RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R201	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R202	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R203	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R204	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R205	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R206	321-0219-00			RES.,FXD,FILM:1.87K OHM,1%,0.125W	91637	MFF1816G18700F
R207	321-0173-00			RES.,FXD,FILM:619 OHM,1%,0.125W	91637	MFF1816G6190F
R208	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R209	321-0274-00			RES.,FXD,FILM:6.98K OHM,1%,0.125W	91637	MFF1816G69800F
R210	311-0467-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	11237	300SF-41334
R211	301-0752-00			RES.,FXD,CMPSN:7.5K OHM,5%,0.50W	01121	EB7525
R212	321-0373-00			RES.,FXD,FILM:75K OHM,1%,0.125W	91637	MFF1816G75001F
R213	321-0373-00			RES.,FXD,FILM:75K OHM,1%,0.125W	91637	MFF1816G75001F
R214	321-0327-00			RES.,FXD,FILM:24.9K OHM,1%,0.125W	91637	MFF1816G24901F
R215	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R216	321-0327-00			RES.,FXD,FILM:24.9K OHM,1%,0.125W	91637	MFF1816G24901F

Replaceable Electrical Parts—7B80

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R217	321-0288-00	B010100	B029999	RES.,FXD,FILM:9.76K OHM,1%,0.125W	91637	MFF1816G97600F
R217	321-0291-00	B030000		RES.,FXD,FILM:10.5K OHM,1%,0.125W	91637	MFF1816G10501F
R218	321-0274-00	B010100	B029999	RES.,FXD,FILM:6.98K OHM,1%,0.125W	91637	MFF1816G69800F
R218	321-0267-00	B030000		RES.,FXD,FILM:5.9K OHM,1%,0.125W	91637	MFF1816G59000F
R222	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R224	315-0622-00			RES.,FXD,CMPSN:6.2K OHM,5%,0.25W	01121	CB6225
R226	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R227	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R228	315-0184-00			RES.,FXD,CMPSN:180K OHM,5%,0.25W	01121	CB1845
R231	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R232	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R233	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
R234	315-0430-00			RES.,FXD,CMPSN:43 OHM,5%,0.25W	01121	CB4305
R240	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R242	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R243	315-0821-00			RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R244	315-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.25W	01121	CB4325
R271	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R272	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R274	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R275	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R301	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R303	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R307	321-0301-00			RES.,FXD,FILM:13.3K OHM,1%,0.125W	91637	MFF1816G13301F
R308	321-0275-00			RES.,FXD,FILM:7.15K OHM,1%,0.125W	91637	MFF1816G71500F
R312	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R313	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R314	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R315	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R321	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R322	323-0175-00			RES.,FXD,FILM:649 OHM,1%,0.50W	75042	CECT0-6490F
R323	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R324	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R325	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R326	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R330	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R331	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R332	315-0560-00			RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
R333	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R334	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R335	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R336	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R337	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R338	315-0120-00			RES.,FXD,CMPSN:12 OHM,5%,0.25W	01121	CB1205
R339	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R341	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R342	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R343	321-0263-00			RES.,FXD,FILM:5.36K OHM,1%,0.125W	91637	MFF1816G53600F
R344	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R345	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R346	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R347	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R351	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R352	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R353	321-0222-07			RES.,FXD,FILM:2K OHM,0.1%,0.125W	91637	MFF1816C20000B
R354	321-0196-00			RES.,FXD,FILM:1.07K OHM,1%,0.125W	91637	MFF1816G10700F
R355	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R356	321-0229-00			RES.,FXD,FILM:2.37K OHM,1%,0.125W	91637	MFF1816G23700F
R358	321-0185-00			RES.,FXD,FILM:825 OHM,1%,0.125W	91637	MFF1816G825R0F
R362	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R371	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R372	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R382	315-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.25W	01121	CB2705
R383	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R410	311-1781-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	12697	388CM40913
R412	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R413	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R414	321-0362-00			RES.,FXD,FILM:57.6K OHM,1%,0.125W	91637	MFF1816G57601F
R415	311-1781-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	12697	388CM40913
R416	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R422	315-0101-00	B010100	B029999	RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R422	315-0680-00	B030000		RES.,FXD,CMPSN:68 OHM,5%,0.25W	01121	CB6805
R424	323-0285-00			RES.,FXD,FILM:9.09K OHM,1%,0.50W	75042	CECT0-9091F
R426	315-0180-00			RES.,FXD,CMPSN:18 OHM,5%,0.25W	01121	CB1805
R427	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R428	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R430	311-1423-00			RES.,VAR,NONWIR:20 OHM,20%,0.50W	73138	72PM-01-0-200
R431	321-0122-00			RES.,FXD,FILM:182 OHM,1%,0.125W	91637	MFF1816G182R0F
R432	315-0180-00			RES.,FXD,CMPSN:18 OHM,5%,0.25W	01121	CB1805
R433	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R434	323-0285-00			RES.,FXD,FILM:9.09K OHM,1%,0.50W	75042	CECT0-9091F
R435	321-0400-00			RES.,FXD,FILM:143K OHM,1%,0.125W	91637	MFF1816G14302F
R436	315-0180-00			RES.,FXD,CMPSN:18 OHM,5%,0.25W	01121	CB1805
R437	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R438	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R439	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R440	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R441	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R442	321-0225-06			RES.,FXD,FILM:2.15K OHM,0.25%,0.125	91637	MFF1816C21500C
R444	322-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.25W	75042	CEBT0-1501F
R445	311-1226-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	32997	3386F-T04-252
R446	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R447	321-0928-03			RES.,FXD,FILM:250 OHM,0.25%,0.125W	91637	MFF1816D250R0C
R448	322-0218-00			RES.,FXD,FILM:1.82K OHM,1%,0.25W	75042	CEBT0-1821F
R449	322-0224-00			RES.,FXD,FILM:2.15K OHM,1%,0.25W	75042	CEBT0-2101F
R454	322-0210-00			RES.,FXD,FILM:1.5K OHM,1%,0.25W	75042	CEBT0-1501F
R455	321-0124-00			RES.,FXD,FILM:191 OHM,1%,0.125W	91637	MFF1816G191R0F
R456	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R457	321-0928-03			RES.,FXD,FILM:250 OHM,0.25%,0.125W	91637	MFF1816D250R0C
R458	322-0218-00			RES.,FXD,FILM:1.82K OHM,1%,0.25W	75042	CEBT0-1821F
R459	322-0224-00			RES.,FXD,FILM:2.15K OHM,1%,0.25W	75042	CEBT0-2101F
R705	311-0467-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	11237	300SF-41334
R706	321-0438-00			RES.,FXD,FILM:357K OHM,1%,0.125W	91637	MFF1816G35702F
R710	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T04-503
R711	321-0458-00			RES.,FXD,FILM:576K OHM,1%,0.125W	91637	MFF1816G57602F
R712	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735

Replaceable Electrical Parts—7B80

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R713	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R714	321-0363-00			RES.,FXD,FILM:59K OHM,1%,0.125W	91637	MFF1816G59001F
R715	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T04-503
R717	321-0360-00			RES.,FXD,FILM:54.9K OHM,1%,0.125W	91637	MFF1816G54901F
R721	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R722	321-0225-06			RES.,FXD,FILM:2.15K OHM,0.25%,0.125	91637	MFF1816C21500C
R723	321-0642-00			RES.,FXD,FILM:20.3K OHM,0.25%,0.125W	91637	MFF1816C20301C
R724	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R725	311-1590-00			RES.,VAR,NONWIR:10K OHM,10%,1W	12697	CM40256
R728	301-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.50W	01121	EB3025
R729	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R731	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R732	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R741	323-0810-07			RES.,FXD,FILM:4M OHM,0.1%,0.50W	91637	HFF129C40003B
R742	323-0809-07			RES.,FXD,FILM:2.667M OHM,0.1%,0.50W	91637	HFF129C26673B
R743	323-1500-07			RES.,FXD,FILM:1.6M OHM,0.1%,0.50W	91637	HFF129C16003B
R744	323-0620-07			RES.,FXD,FILM:800K OHM,0.1%,0.50W	91637	MFF1226C80002B
R745	323-0806-07			RES.,FXD,FILM:266.7K OHM,0.1%,0.50W	91637	MFF1226C26672B
R746	323-1404-07			RES.,FXD,FILM:160K OHM,0.1%,0.50W	91637	MFF1226C16002B
R747	323-0805-07			RES.,FXD,FILM:80.0K OHM,0.1%,0.50W	91637	MFF1226C80001B
R748	323-0802-07			RES.,FXD,FILM:26.67K OHM,0.1%,0.50W	91637	MFF1226C26671B
R749	323-1308-07			RES.,FXD,FILM:16.0K OHM,0.1%,0.50W	91637	MFF1226C16001B
R751	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R752	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R754	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R761	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R764	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
R771	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R772	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R773	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R779	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R781	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R782	315-0753-00			RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R783	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R784	321-0356-00			RES.,FXD,FILM:49.9K OHM,1%,0.125W	91637	MFF1816G49901F
R793	321-0344-00			RES.,FXD,FILM:37.4K OHM,1%,0.125W	91637	MFF1816G37401F
R794	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R821	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R841	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R842	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R844	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
R961 <sup>1</sup>	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R962 <sup>1</sup>	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R965 <sup>1</sup>	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R972 <sup>1</sup>	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
S10	263-0010-01			ACTR ASSY,PB:1 PUSH,7.5 MM,1 CONTACT	80009	263-0010-01
S20	263-0016-00			ACTR ASSY,PB:4 LATCHING,7.5 MM,5 CONTACT	80009	263-0016-00
S50	263-0015-00			ACTR ASSY,PB:3 LATCHING,7.5 MM	80009	263-0015-00
S60	311-1192-00			RES.,VAR,NONWIR:10K OHM,20%,1W	71590	BA-232-001
S230	263-0016-01			ACTR ASSY,PB:3 LATCHING,7.5 MM,5 CONTACT	80009	263-0016-01
S435	260-1771-00			SWITCH,PUSH:1 BUTTON,DPDT	71590	2KAB010000
S800	263-1134-00			DRUM ASSY,CAM S:	80009	263-1134-00
S935 <sup>1</sup>	263-0011-00			ACTR ASSY,PB:1 PUSH,10MM	80009	263-0011-00

<sup>1</sup>Option 2 only.

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
S936 <sup>1</sup>	263-0011-06			ACTR ASSY,PB:1 MOMENTARY,10 MM,3 CONTACTS	80009	263-0011-06
T35	120-0444-00			XFMR,TOROID:5 TURNS,BIFILAR	80009	120-0444-00
T935 <sup>1</sup>	120-0444-00			XFMR,TOROID:5 TURNS,BIFILAR	80009	120-0444-00
U35	156-0067-02			MICROCIRCUIT,LI:OPNL AMPLIFIER,SELECTED	80009	156-0067-02
U55	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-00
U65	155-0126-00			MICROCIRCUIT,LI:TRIGGER AMPLIFIER	80009	155-0126-00
U75	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	80009	156-0158-00
U85	155-0109-01			MICROCIRCUIT,LI:MONOLITHIC TRIG	80009	155-0109-01
U220	155-0049-01	B010100	B042459	MICROCIRCUIT,DI:MONOLITHIC,SWEEP CONTROL	80009	155-0049-01
U220	155-0049-02	B042460		MICROCIRCUIT,DI:SWEEP CONTROL,W/LOCKOUT	80009	155-0049-02
U416	156-0067-02			MICROCIRCUIT,LI:OPNL AMPLIFIER,SELECTED	80009	156-0067-02
U722	156-0686-00			MICROCIRCUIT,LI:OPNL AMPL,HIGH IMPEDANCE	02735	CA3130S
U842	156-0067-02			MICROCIRCUIT,LI:OPNL AMPLIFIER,SELECTED	80009	156-0067-02
VR314	152-0168-00			SEMICOND DEVICE:ZENER,0.4W,12V,5%	04713	1N963B
VR728	152-0226-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	81483	69-6584

<sup>1</sup>Option 2 only.

# INSTRUMENT OPTIONS


Your instrument may be equipped with one or more instrument options. A brief description of each option is given in the following discussion.

Conversion kits, for most options, are available and can be installed at a later time. For further information on instrument options, see your Tektronix Catalog or contact your Tektronix Field Office.

## OPTION 2

This option provides an X-Y display feature. Horizontal (X) and vertical (Y) deflection signals are applied to the inputs of either a dual-trace amplifier or two single amplifier units; the horizontal signal is then routed through the amplifier and main-frame trigger paths to the Option 2 instrument. A push-button control (DISPLAY MODE) is provided on the Option 2 instrument front panel to select either normal sweep or X-Y display.

**TABLE 7-1**  
Option Information Locator

Instrument Option	Manual Section	Location of Information
Option 2 (Provides X-Y display)	1 Operating Instructions	Information contained in this section.
	2 Specification	Electrical X bandwidth, X deflection factor accuracy, and phase shift information contained in this section.
	3 Theory of Operation	Description contained in this section. Operation is described with reference to Section 8 diagram numbers 7, 3, and 4.
	6 Replaceable Electrical Parts	Replaceable electrical parts are listed in Section 6 of this manual. Parts unique to the Option 2 Time Base are referenced to the footnote "Option 2 only".
	7 Instrument Options	Option 2 A description of the X-Y display mode, Operating Instructions, Specification, and Theory of Operation is contained in this section.
	8 Diagram and Circuit Board Illustrations	X-Y Switching   All circuitry unique to Option 2 is shown on diagram 7.
	9 Replaceable Mechanical Parts	Instrument Options (see the pull-out page at the rear of this manual) Provides a mechanical parts list and an exploded-view drawing unique to the Option 2 Time Base.

## OPTION 2

This option provides a means to obtain an X-Y display. The horizontal and vertical (X-Y) signals are applied to the inputs of a dual-trace amplifier unit, or two single amplifier units. The horizontal signal is then routed through the amplifier and mainframe trigger paths to the Option 2 instrument. The front-panel DISPLAY MODE switch selects either normal sweep displays or X-Y displays. A functional description of the X-Y display feature will follow.

### OPERATING INSTRUCTIONS

To make full use of the capabilities of this instrument, the operator should be familiar with the use of the front-panel DISPLAY MODE push-button switch. A brief description of the DISPLAY MODE switch is given here. More detailed information is given under the topic General Operating Information (later in this section).

#### DISPLAY MODE CONTROL

Figure 1 shows the location of the front-panel DISPLAY MODE switch relative to the standard front-panel controls. Only the functions of the Option 2 instrument DISPLAY MODE switch are explained here; see Section 1, Operating Instructions in this manual for a description of the standard instrument controls.

#### FUNCTIONAL CHECK

The following procedure checks the basic operation of the X-Y functions and is intended to supplement the Functional Check procedure given in Section 1 of this manual.

#### Setup Procedure

1. Install the Option 2 instrument in a horizontal compartment of the mainframe.
2. Install a dual-trace amplifier unit in the desired vertical compartment, or install single amplifier units in each vertical compartment of the mainframe.
3. Turn on the mainframe power.

#### X-Y Display

1. Set the DISPLAY MODE push button to X-Y. Set the mainframe intensity control for convenient brightness of the displayed spot.
2. Any available vertical channels may be used for the X and Y signal inputs.

**DUAL-TRACE AMPLIFIERS.** Set the vertical display mode controls of both the amplifier and mainframe to select the Y (vertical) signal; set the trigger source controls

of both the amplifier and mainframe to select the X (horizontal) signal.

**SINGLE-TRACE AMPLIFIERS.** Set the vertical display mode of the mainframe to select the Y (vertical) signal. Set the mainframe trigger source to select the X (horizontal) signal.

3. Set each amplifier unit input coupling switch to dc, and set the position controls of the selected X and Y channels for a spot display at graticule center. Notice that the position control of the Y channel controls Y-axis (vertical) spot movement and that the position control of the X channel controls X-axis (horizontal) spot movement.

4. Connect a low-frequency sine-wave signal to the selected X and Y inputs.

5. Adjust the mainframe intensity control until the display is at the desired viewing level. Adjust the signal amplitude for a convenient display size with the X and Y amplifiers set for the same deflection factor.

6. If one signal source is connected to both the X and Y amplifier units, the resultant display should be a diagonal line on the mainframe crt.

7. Disconnect the X and Y signals, set the Option 2 instrument DISPLAY MODE control to TIME BASE, and set the mainframe vertical mode and trigger source for normal sweep operation.

#### GENERAL OPERATING INFORMATION

The following information is provided to aid in fully understanding the functions associated with the DISPLAY MODE control.



### Internal Sweep Operation

When the DISPLAY MODE push button is pressed and latched to the IN: TIME BASE position, all functions and controls of the instrument operate as described (in Section 1—Operating Instructions) for the standard instrument. Operation in an X-Y mode is not possible until the DISPLAY MODE push button is pressed and released to the OUT: X-Y position.

### X-Y Operation

In some applications, it is desirable to display one signal versus another (X-Y), rather than against the internal sweep. When the DISPLAY MODE push button is pressed and released to the OUT: X-Y position, all other front-panel controls, the sweep, and readout functions of the Option 2 instrument are disabled. An X-Y mode of operation is now

provided. An external X signal can now be connected to any vertical amplifier unit and coupled through the internal triggering system of the vertical amplifier unit, the mainframe, and the Option 2 Time Base to provide the horizontal deflection on the mainframe display. The external Y signal is connected to the remaining amplifier channel to provide the vertical deflection on the mainframe display.

The advantages of using the internal triggering system to provide the X signal are:

1. X-Y operation is possible with one dual-trace amplifier in a mainframe vertical compartment.
2. X-Y operation is possible without having to remove a time-base unit from the horizontal compartment of the mainframe to substitute an amplifier unit.

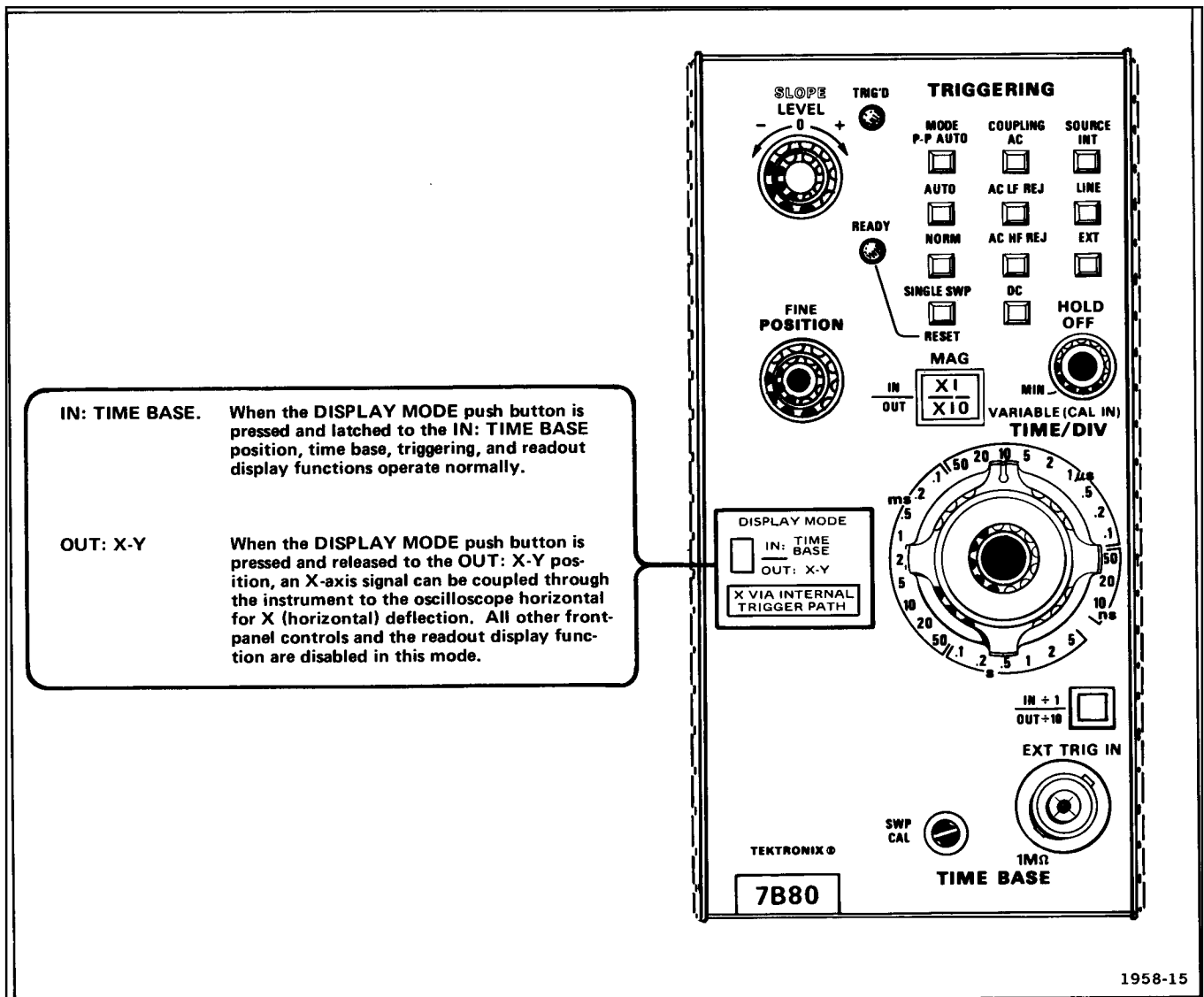


Figure 1. Option 2 Display Mode switch.

3. The attenuator switch of the vertical channel in the horizontal signal path provides many deflection-factor settings to allow full-range amplitude control.

**OPERATION WITH DUAL-TRACE AMPLIFIERS.** When dual-trace amplifier units are based with the Option 2 Time-Base unit, any vertical channel may be used for X or Y signal inputs. Set the display mode controls of both the amplifier and mainframe to select the channel that provides the vertical signal; set the trigger source controls of both the amplifier and mainframe to select the channel that provides the horizontal signal.

**OPERATION WITH SINGLE-TRACE AMPLIFIERS.** If single-trace amplifier units are used with the Option 2 Time-Base unit, set the mainframe trigger source control to select the amplifier unit that provides the horizontal signal; set the mainframe vertical mode control to select the amplifier unit that provides the vertical signal.

## APPLICATIONS

The following information describes a procedure or technique for making X-Y phase measurements with the Option 2 Time-Base unit. The measurements are described in a detailed example, but each user application must be adapted to the requirements of the individual measurement. The following X-Y phase measurement method can be used to measure the phase angle between two signals of the same frequency.

### Preliminary Setup

1. Set the DISPLAY MODE push button to the OUT: X-Y position. Set the mainframe intensity control for convenient brightness of the spot display.

2. Set the controls of the mainframe and the amplifier units as directed in the following setup procedure for the amplifier units to be used.

**DUAL-TRACE AMPLIFIERS.** Set the vertical display mode controls of both the amplifier and mainframe to select the input of the Y (vertical) signal; set the trigger source controls of both the amplifier and mainframe to select the input of the X (horizontal) signal.

**SINGLE-TRACE AMPLIFIERS.** Set the vertical display mode control of the mainframe to select the input of the Y (vertical) signal; set the trigger source control of the mainframe to select the input of the X (horizontal) signal.

3. Set each amplifier unit input coupling switch to dc, and set the position controls of the selected X and Y channels for a spot display at graticule center.

4. Connect low-frequency sine-wave signals of the same frequency to the selected X and Y inputs.

5. Advance the mainframe intensity control until the display is at the desired viewing level. Set the amplifier deflection factors and variable volts/division controls for eight divisions of vertical and horizontal deflection, and set the position controls to center the display on the graticule as shown in Figure 2.

6. Measure and record the overall horizontal deflection (B) and the opening of the Lissajous display (A), measuring horizontally at the graticule horizontal center line (see Figure 2).

7. Divide A by B to obtain the trigonometric sine of the phase angle difference between the two signals. Obtain the phase angle from a trigonometric table to determine the phase angle between the X and Y signals.

Example: Assume that the horizontal distance measured at the center opening of the display (A) is 2.7 divisions (see

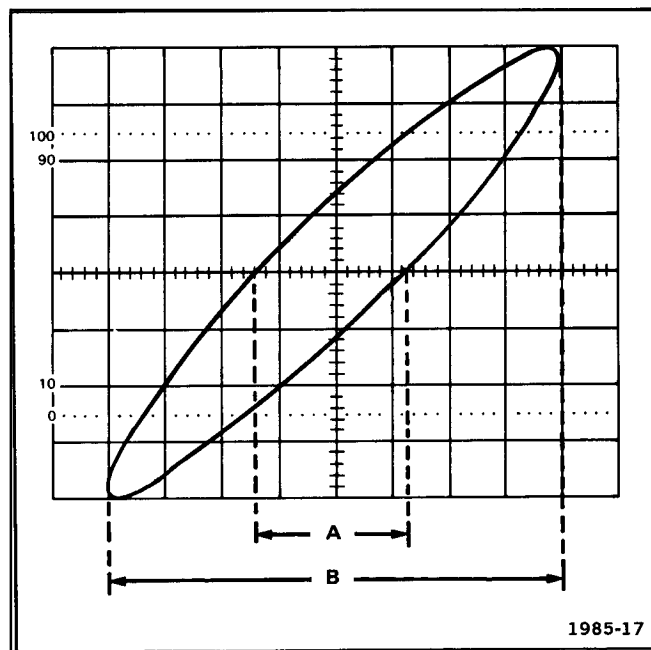


Figure 2. Measurement of phase angle difference from an X-Y display.

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Figure 2) and the overall horizontal distance of the display (B) is eight divisions.

Using the formula:

$$\sin (\text{Phase Angle}) = \frac{\text{center opening distance (A)}}{\text{overall distance (B)}}$$

Substituting values:

$$\sin (\text{Phase Angle}) = \frac{2.7 \text{ divisions}}{8 \text{ divisions}} = 0.3375$$

Obtaining the angle from a trigonometric table:

$$\text{Phase Angle} = \sin^{-1} 0.3375 = 19.7^{\circ}$$

The phase angle difference between the X and Y signals is  $19.7^{\circ}$ .

## SPECIFICATION

The following information applies to the Option 2 Time-Base unit only, operating in the X-Y display mode. Any electrical characteristics listed here apply when the instrument is operating in an oscilloscope system within an ambient temperature range of  $0^{\circ}$  to  $+50^{\circ}$  C. Warmup time of the oscilloscope system must be 20 minutes or more.

### X BANDWIDTH

In most cases, the typical X bandwidth is equal to the horizontal bandwidth of the mainframe alone. (Example: In the Tektronix 7904 mainframe, the horizontal bandwidth is 1 MHz.)

When the amplifier unit in the X-signal path is lower in trigger bandwidth than the horizontal bandwidth of the mainframe (an unusual case), the X bandwidth is this lower value.

### X-Y PHASE SHIFT

X-Y Phase Shift is determined by the circuitry in the mainframe. For mainframes without X-Y horizontal compensation, the mainframe phase shift specification is retained for frequencies of 50 kHz and below. (Example: In the Tektronix 7904 mainframe, the X-Y phase shift specification of  $2^{\circ}$  or less to 35 kHz is retained.)

### Supplemental Information

For mainframes with optional X-Y horizontal compensation, the extra delay of the mainframe trigger path adds to the phase shift error above 50 kHz. (Example: In the Tektronix 7904 Option 2 mainframe, the trigger path adds about  $2^{\circ}$  of error at 1 MHz, which increases its X-Y phase shift specification of  $2^{\circ}$ , to a typical  $4^{\circ}$  error at 1 MHz.)

Refer to the manuals on associated instruments for X-Y phase shift and frequency information. Apply signals to the vertical and horizontal systems within the X-Y frequency range specified for the instruments.

### X DEFLECTION FACTOR ACCURACY

X deflection factor accuracy is determined by the gain accuracy in the trigger paths of the amplifier unit and the mainframe.

### Supplemental Information

The typical X deflection factor is within 20% of the amplifier unit deflection factor.

## THEORY OF OPERATION

The following information provides a description of electrical operation of the Option 2 Time Base X-Y function and is intended to supplement the circuit operation description for the standard instrument as given in Section 3 of this manual. The Option 2 circuitry is described with reference to the schematic diagrams in the Diagrams section at the rear of this manual. Refer to these schematic diagrams throughout the following circuit operation description for specific electrical values and relationships.

### BASIC DESCRIPTION

The following discussion is provided to aid in understanding the overall concept of the additional circuitry unique to the Option 2 Time-Base unit before the circuits are described in detail.

The Option 2 instrument has an additional circuit board (X-Y Switch Board) that is mounted to the rear of the instrument Interface Board. This circuit board contains the DISPLAY MODE switch, and the logic circuitry to control the sweep display, readout display, and X-Y functions unique to the Option 2 instrument. The additional circuitry provides switching of the trigger signal input path to the sweep signal output path for the X-Y display mode of operation. The circuit board also contains logic circuitry to disable the sweep and readout functions, maintain an unblanked crt display, and switch a compensation network into the mainframe horizontal signal path (option 2 mainframes only) for X-Y compensation. A schematic of this circuit, with all of the X-Y Switch Board functions labeled, is shown on diagram 7 in the Diagrams section of this manual.

#### X-Y SWITCHING

The DISPLAY MODE switches S935-S936 select either the normal sweep and internal triggering signal paths for time base operation, or select X-Y operation with the instrument trigger input path connected to the sweep output path for trigger path continuity only. Refer to diagram 7 throughout the following discussion of the time base and X-Y display modes.

##### Time Base Mode

When the DISPLAY MODE button is pressed and latched to the IN: TIME BASE position, all time base electrical operation and functions are the same as described for the standard instrument (see Section 3—Theory of Operation). The Option 2 instrument, however, has the internal trigger and sweep signal paths routed through the X-Y Switch Board. The following description explains the signal paths in more detail.

The internal trigger signal from the mainframe is routed to the X-Y Switch Board, passes through DISPLAY MODE switch contacts S935A and D, then proceeds to the Internal Trigger Amplifier stage, U35 (diagram 2). The sweep output signal from the Output Preamp (diagram 4-Sweep), is routed to the X-Y Switch Board, passes through DISPLAY MODE switch contacts S936A and D, then proceeds from the time-base unit to the mainframe horizontal deflection system.

##### X-Y Mode

When the DISPLAY MODE button is pressed and released to the OUT: X-Y position, the signal paths through the X-Y Switch Board are altered as explained in the following discussion.

The internal trigger signal from the mainframe is disconnected from the usual trigger path and connected to the instrument sweep output path through DISPLAY MODE switch contacts S935A and D-S936A and D. An X-axis signal can now be connected through any vertical unit and coupled through the mainframe trigger path and the Option 2 Time Base to provide the horizontal deflection for the mainframe display. The trigger path to Internal Trigger Amplifier stage U35, and the sweep output path from the Output Preamp (sweep) are open circuits in this mode because those functions are not used.

In the X-Y mode of operation, logic circuitry on the X-Y Switch Board causes the sweep, readout display, and normal crt display Z-axis unblanking functions to be disabled. The following information describes the logic functions controlling the instrument for the input and output logic lines labeled on diagram 7.

**SWEEP LOCKOUT.** The Sweep Lockout current level at interface connector pin B8 is HI (+5-volt supply through DISPLAY MODE switch contact S936B and resistor R961).

## Option 2—7B80

The HI level prevents mainframe switching commands from affecting the X-Y display. This same HI level is coupled through the Lockout Buffer Amplifier (Q201, Q202, and Q206 on diagram 3) to the lockout input at U220-pin 18, to cause a trigger disable level at U220 pin 17 thereby disabling the sweep.

**X-Y LOGIC.** In the X-Y mode, Q962 is turned on and its collector becomes LO. This LO level is applied to the base of Q372 in the Sweep Gate Generator (diagram 4) to turn it off and to maintain the LO state of the generator. The Sweep Gate Generator is thereby effectively disabled in this mode. The resultant HI at the collector of Q372 is coupled through emitter follower Q382 to the mainframe to keep the crt display unblanked at all times.

**READOUT INHIBIT.** In the X-Y mode, the Readout Inhibit level at interface connector A37 is held HI. This prevents the mainframe readout circuitry from producing a readout display from the mainframe plug-in compartment containing the Option 2 Time Base.

**X-Y COMPENSATION.** In the X-Y mode, the X-Y Compensation level at interface connector B10 is held LO. This allows a compensation network to be switched into the mainframe horizontal signal path for X-Y compensation (only if the mainframe contains optional X-Y compensation circuitry).

# DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

## Symbols and Reference Designators

Electrical components shown on the diagrams are in the following units unless noted otherwise:

- Capacitors = Values one or greater are in picofarads (pF).  
Values less than one are in microfarads (μF).
- Resistors = Ohms (Ω).

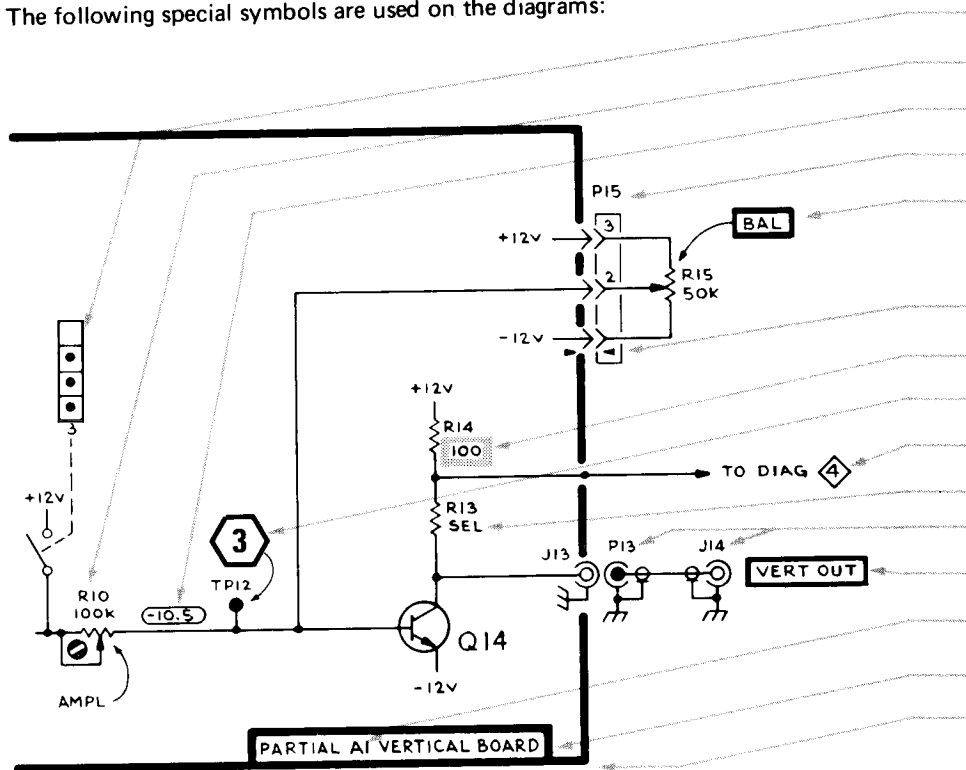
Symbols used on the diagrams are based on ANSI Standard Y32.2-1970.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc.)	H	Heat dissipating device (heat sink, heat radiator, etc.)	RT	Thermistor
AT	Attenuator, fixed or variable	HR	Heater	S	Switch
B	Motor	HY	Hybrid circuit	T	Transformer
BT	Battery	J	Connector, stationary portion	TC	Thermocouple
C	Capacitor, fixed or variable	K	Relay	TP	Test point
CB	Circuit breaker	L	Inductor, fixed or variable	U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	V	Electron tube
DL	Delay line	M	Meter	VR	Voltage regulator (zener diode, etc.)
DS	Indicating device (lamp)	P	Connector, movable portion	Y	Crystal
E	Spark Gap	Q	Transistor or silicon-controlled rectifier	Z	Phase shifter
F	Fuse	R	Resistor, fixed or variable		
FL	Filter				

The following special symbols are used on the diagrams:



- Cam Switch Closure Chart
- Internal Screwdriver Adjustment
- Test Voltage
- Plug to E.C. Board
- Panel Adjustment
- Plug Index
- Modified Component—See Parts List
- Refer to Waveform
- Refer to Diagram Number
- SEL Value Selected at Factory
- Coaxial Connector
- Panel Connector
- Assembly Number
- Board Name
- Etched Circuit Board Outlined in Black
- Schematic Name and Number

VERTICAL AMPLIFIER 2 CMD 12.74



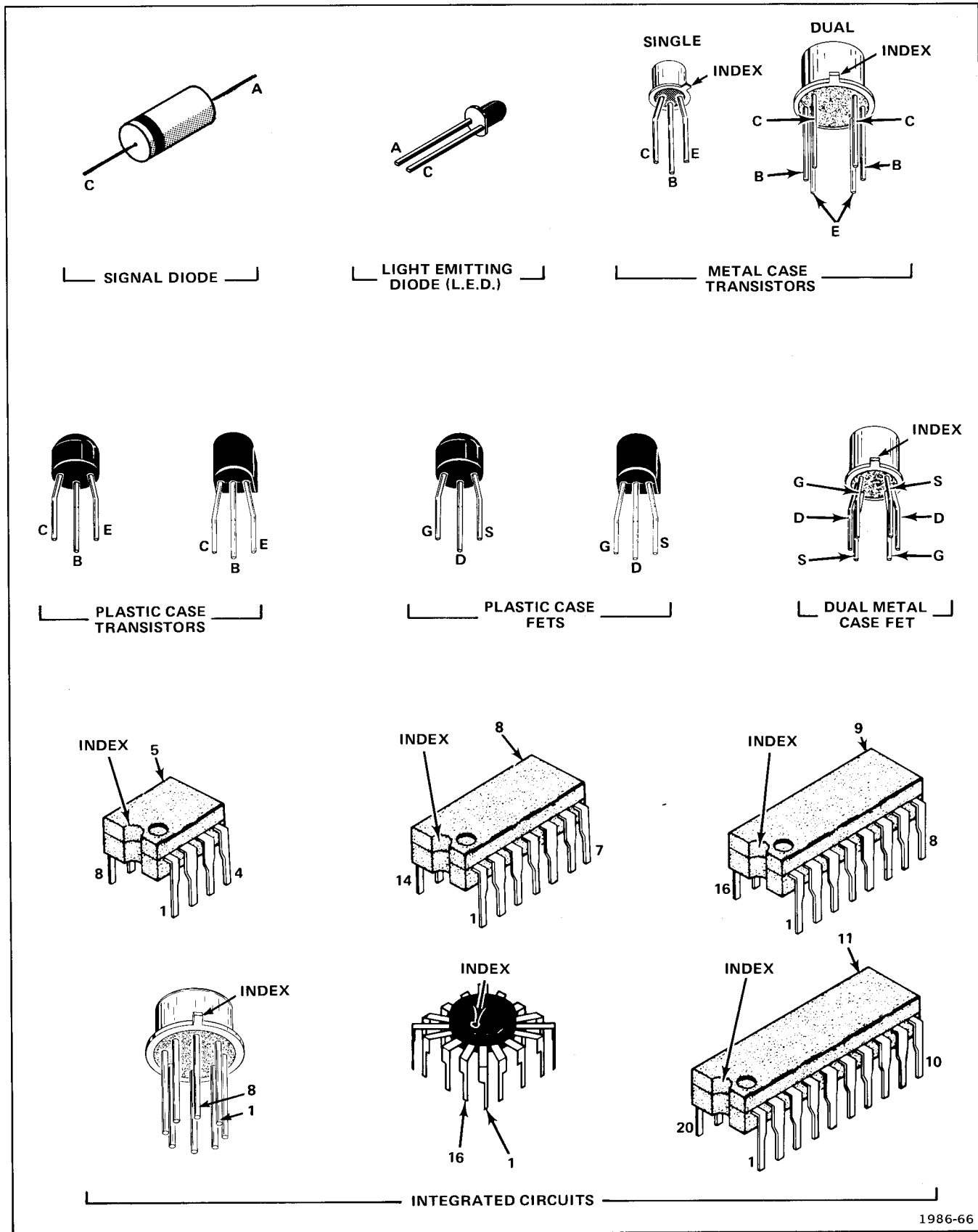


Fig. 8-1. Semiconductor lead configurations.

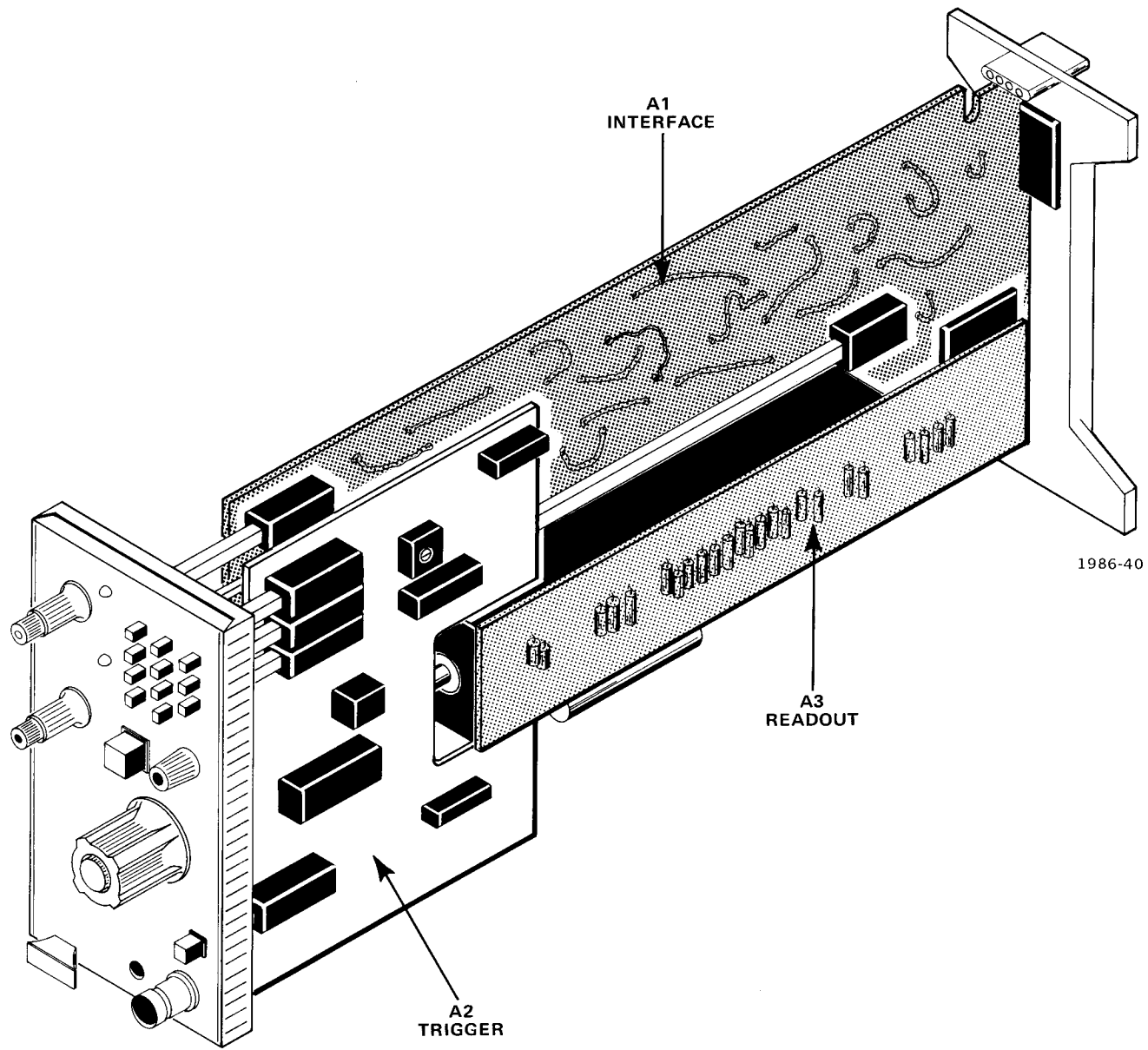


Fig. 8-2. Location of circuit boards in the 7B80.



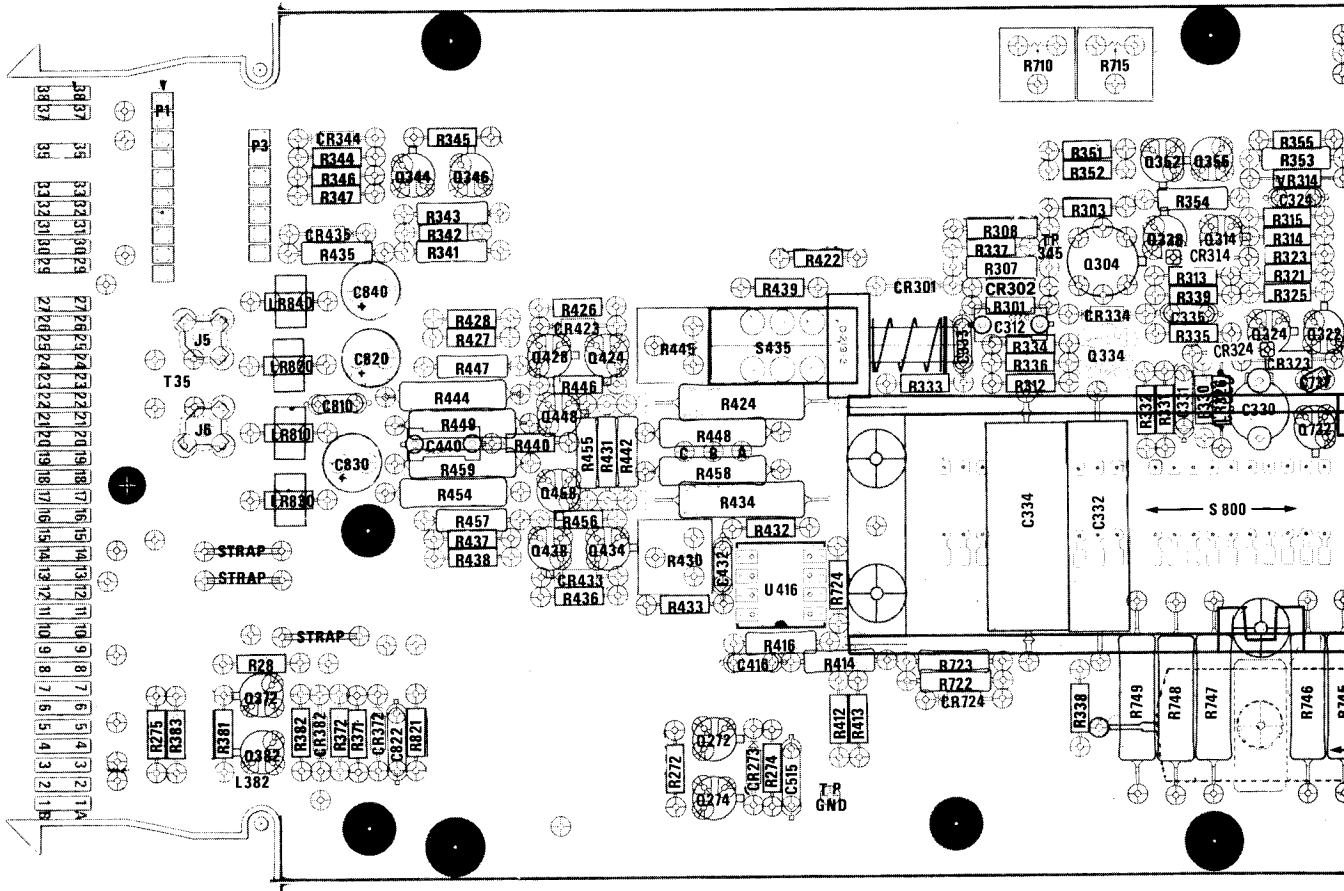


Fig. 8-3. A1-Interface circuit board

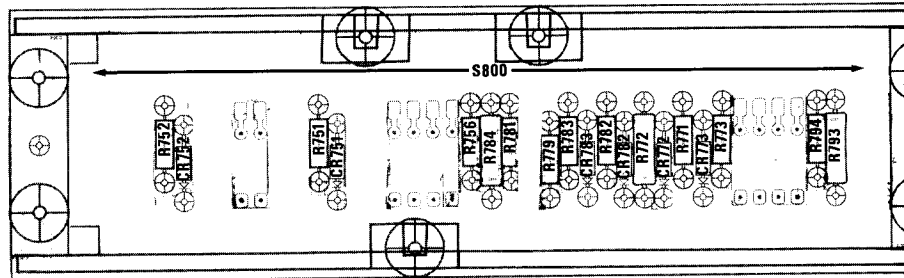
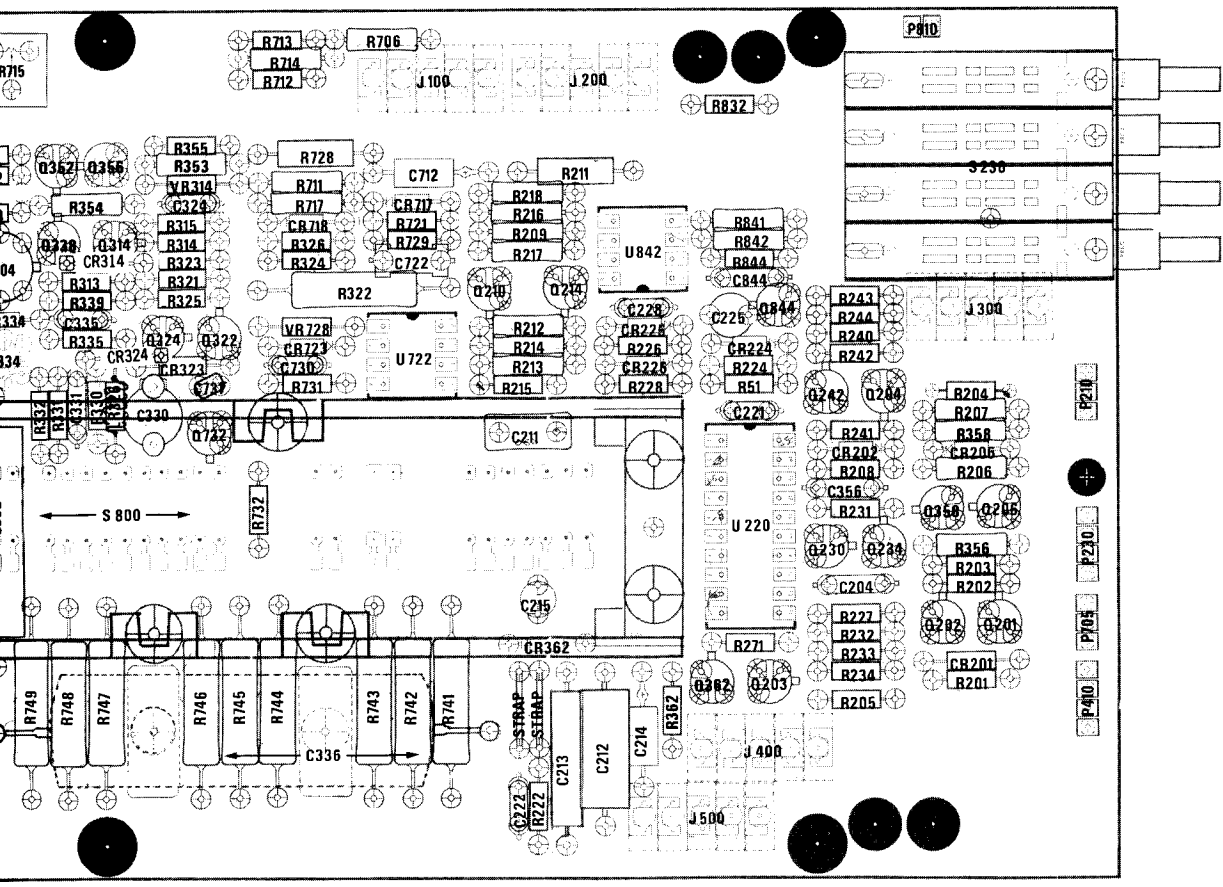


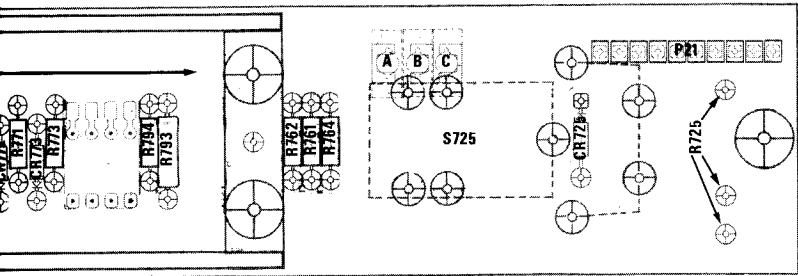
Fig. 8-5. A3-Readout circuit board assembly





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A1—Interface circuit board assembly.



1959-42

Readout circuit board assembly.

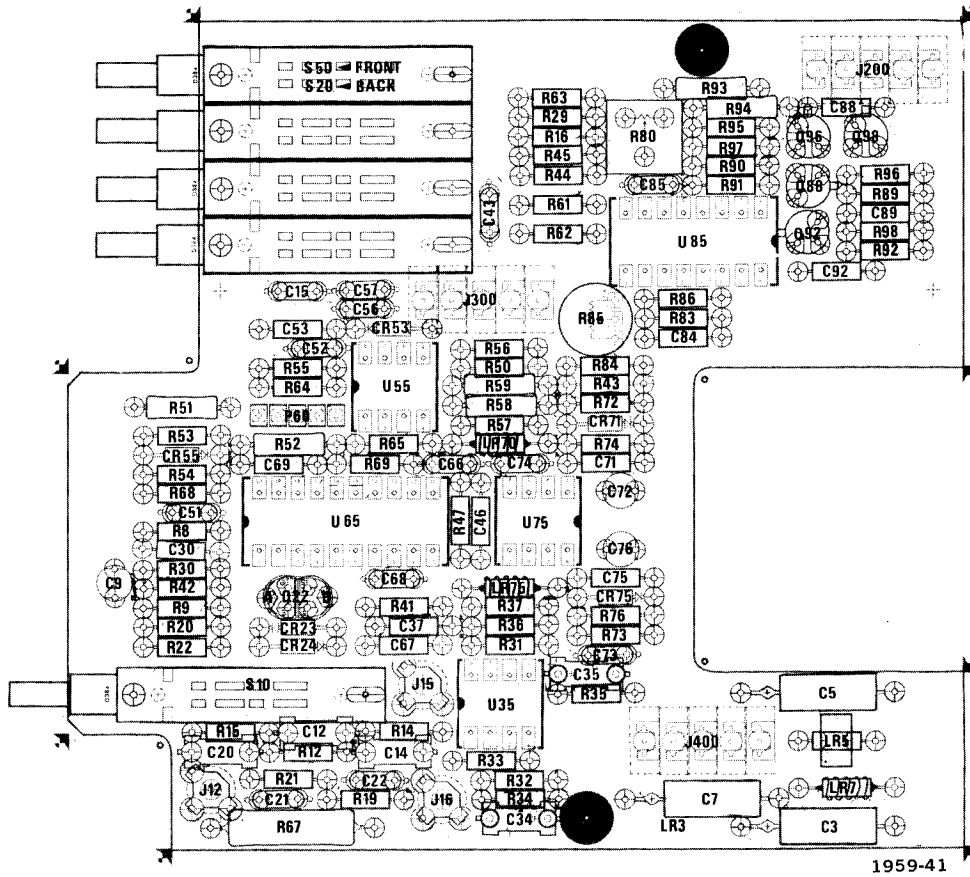
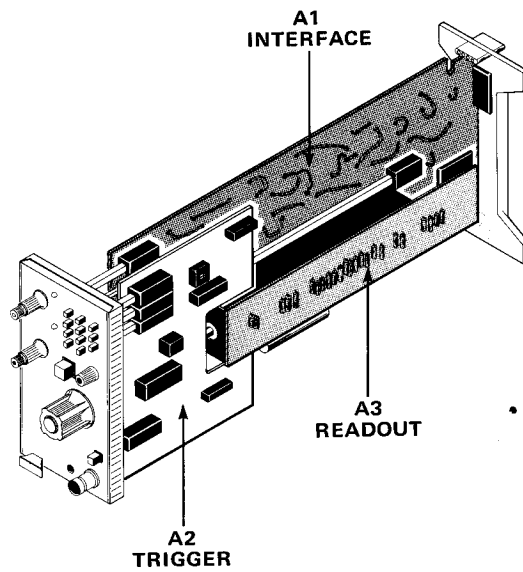
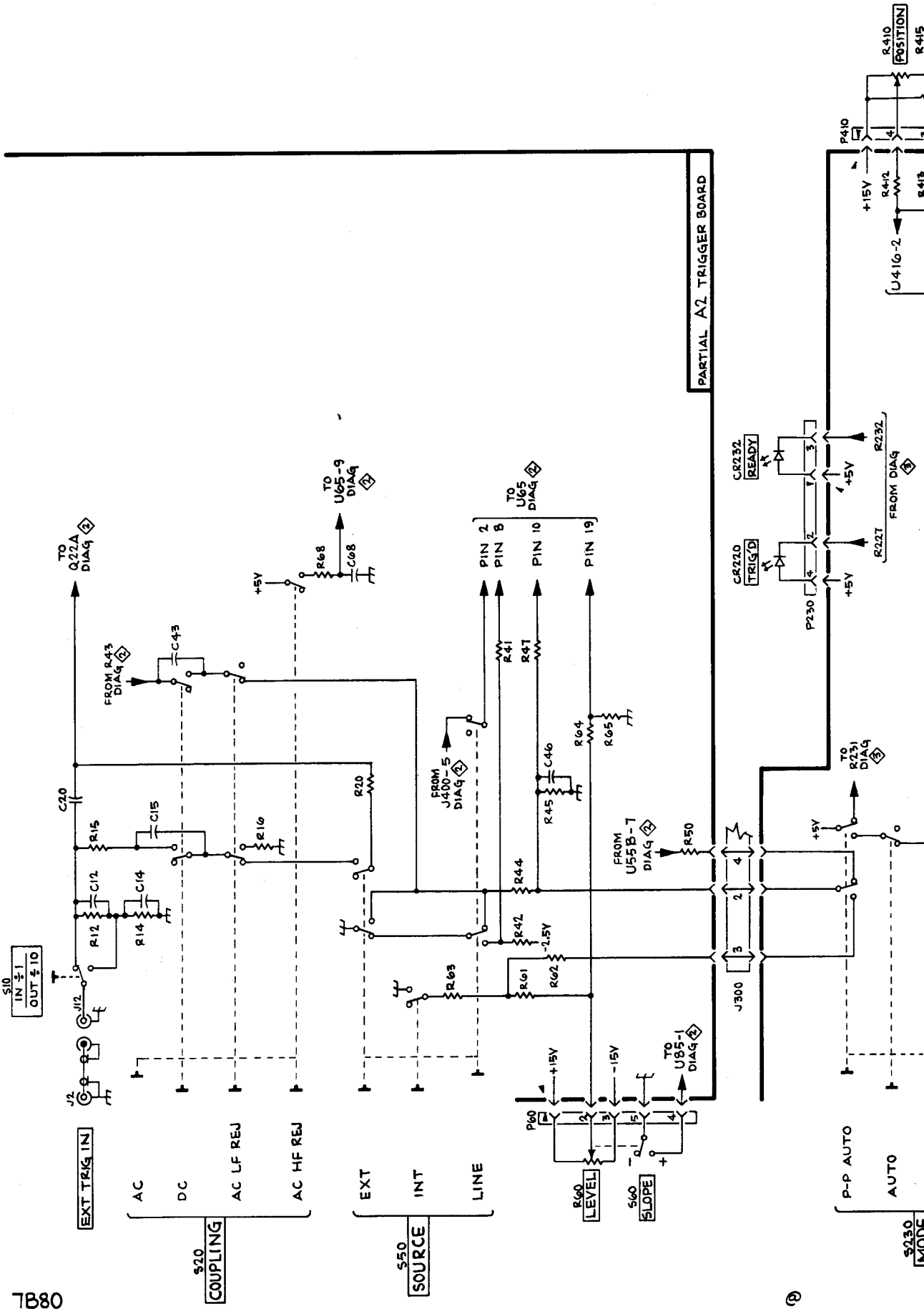
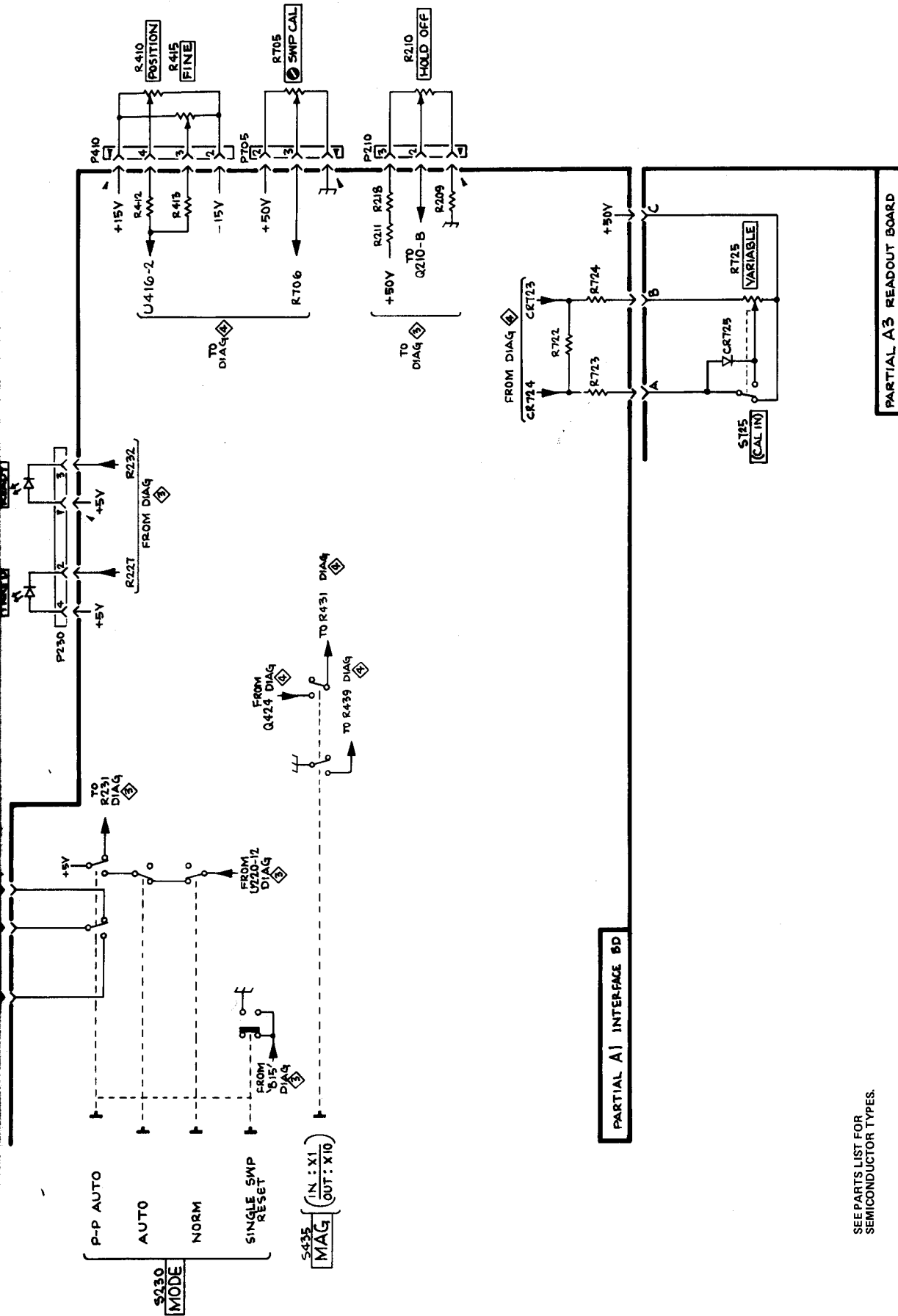


Fig. 8-4. A2-Trigger circuit board assembly.







SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

FRONT-PANEL DISTRIBUTION

FRONT-PANEL DISTRIBUTION



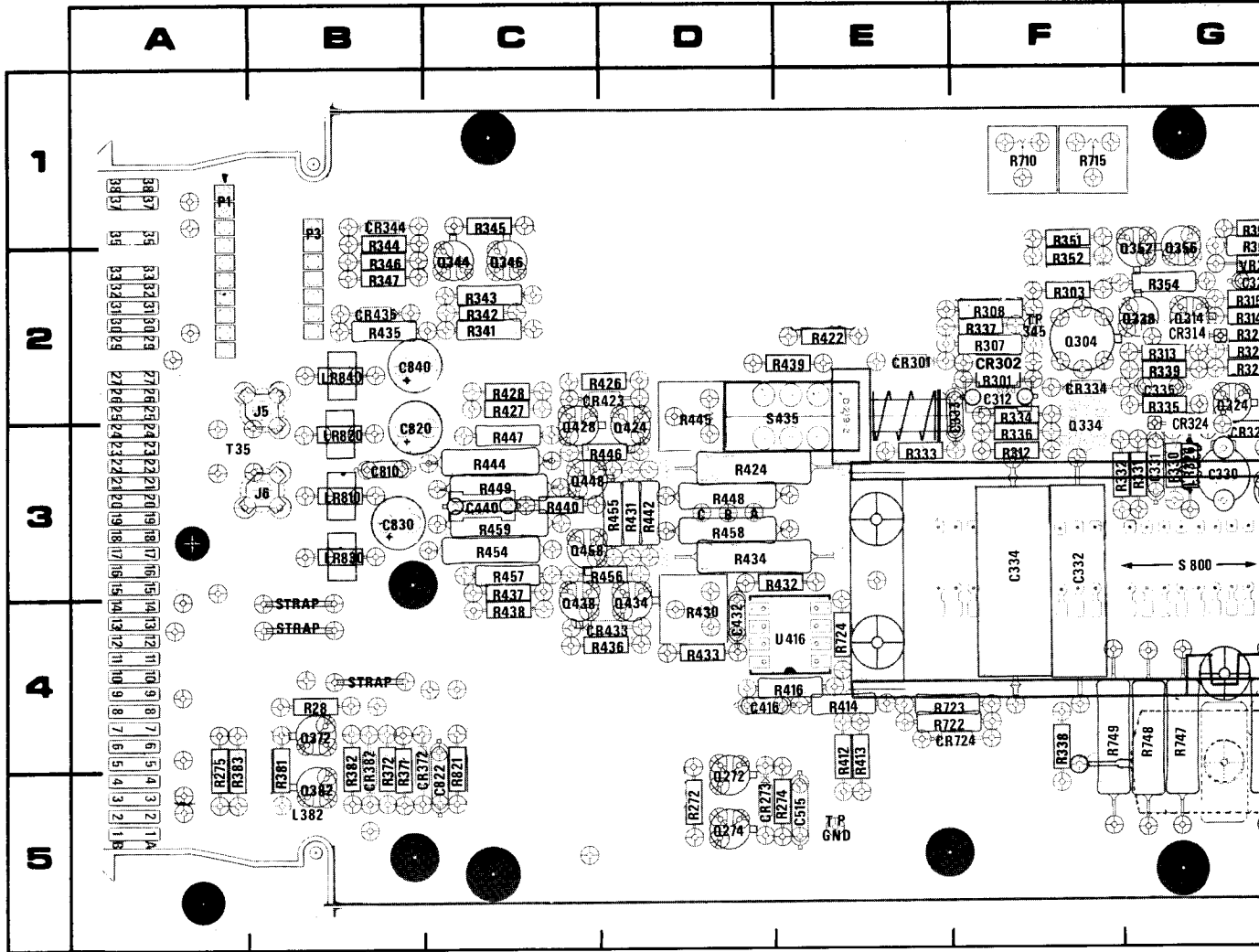
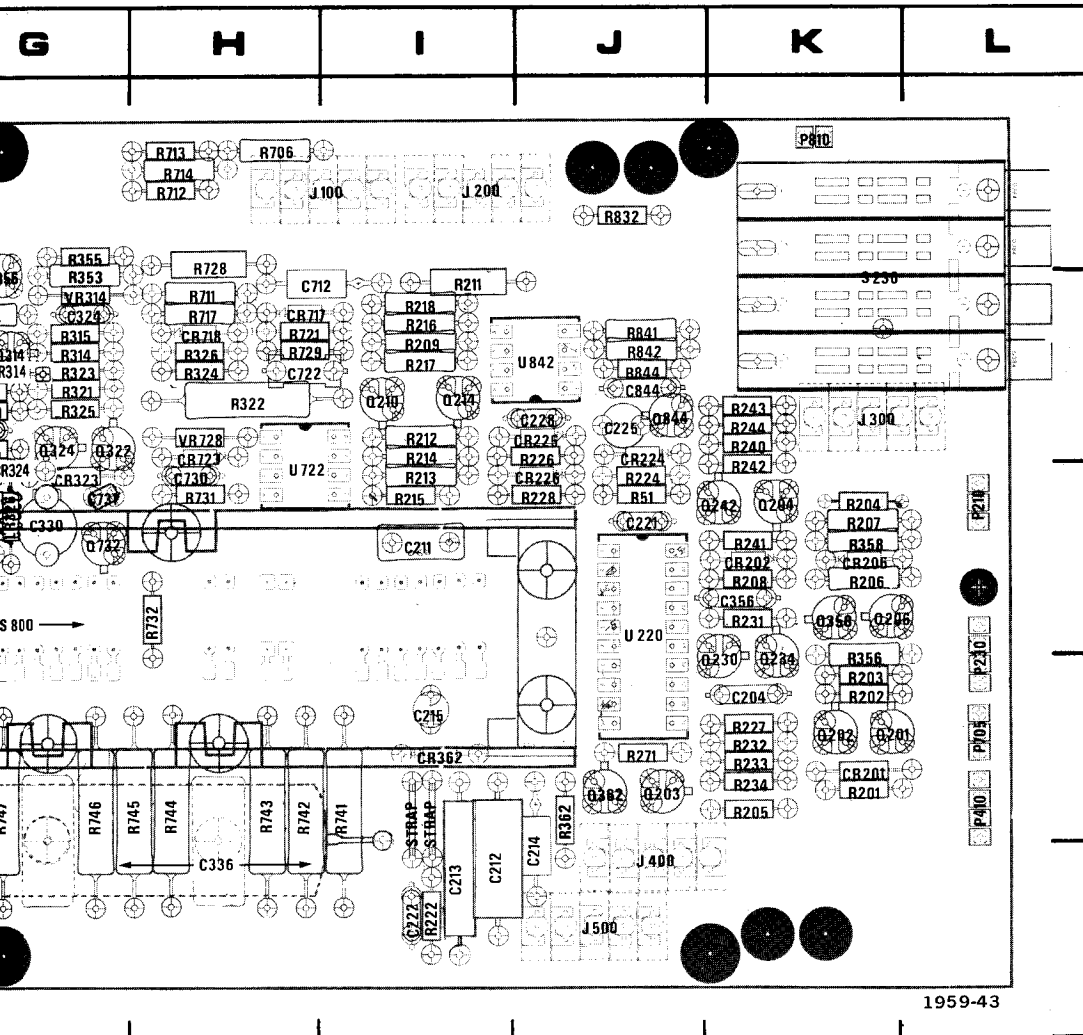


Fig. 8-6. A1—Interface circuit board assembly

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C204	4K	C712	2H	CR372	4B	P1	1A	Q346	2C	R208	3K	R274	5E
C211	3I	C722	2H	CR382	4B	P210	3L	Q352	2G	R209	2I	R275	4A
C212	5I	C730	3H	CR423	2D	P230	4L	Q356	2G	R211	2I	R301	2F
C213	5I	C731	3G	CR433	4D	P410	4L	Q358	3K	R212	2I	R303	2F
C214	5J	C810	3B	CR435	2B	P705	4L	Q362	4J	R213	3I	R307	2F
C215	4I	C820	3B	CR717	2H	P810	1K	Q368	3K	R214	2I	R308	2F
C221	3J	C822	5C	CR718	2H			Q372	4B	R215	3I	R312	3F
C222	5I	C830	3B	CR724	4E	Q201	4K	Q382	5B	R216	2I	R313	2G
C225	2J	C840	2B	CR723	2H	Q202	4K	Q424	3D	R217	2I	R314	2G
C228	2J	C844	2J	J5	2B	Q203	4J	Q428	3C	R218	2I	R315	2G
C312	2F	CR201	4K	J6	3B	Q204	3K	Q434	4D	R222	5I	R321	2G
C324	2G	CR202	3K	J100	1I	Q206	3K	Q438	4C	R224	3J	R322	2H
C330	3G	CR206	3K	J200	1I	Q210	2I	Q448	3C	R226	2J	R323	2G
C331	3G	CR208	3K	J300	2K	Q214	2I	Q458	3C	R227	4K	R324	2H
C332	3F	CR224	2J	J400	5J	Q230	4K	Q732	3G	R228	3J	R325	2G
C333	3F	CR225	2J	J500	5J	Q234	4K	Q844	2J	R231	3K	R326	2H
C334	3F	CR226	3J			Q242	3K			R232	4K	R330	3G
C335	2G	CR273	5D	L274	5A	Q272	5D	R28	4B	R233	4K	R331	3G
C336	5H	CR301	2E	L326	3G	Q274	5D	R99	3J	R234	4K	R332	3F
C356	3K	CR302	2F	L382	5B	Q304	2F	R201	4K	R240	2K	R333	3F
C381	3G	CR314*	2G			Q314	2G	R202	4K	R241	3K	R334	3F
C416	4D	CR323	3G	LR326	3G	Q322	2G	R203	4K	R242	3K	R335	2G
C432	4D	CR324*	3G	LR810	3B	Q324	2G	R204	3K	R243	2K	R336	3F
C440	3C	CR334	2F	LR820	3B	Q334	3F	R205	4K	R244	2K	R337	2F
C515	5E	CR344	1B	LR830	3B	Q338	2G	R206	3K	R271	4J	R338	4I
C571	3G	CR362	4I	LR840	2B	Q344	2C	R207	3K	R272	5D		

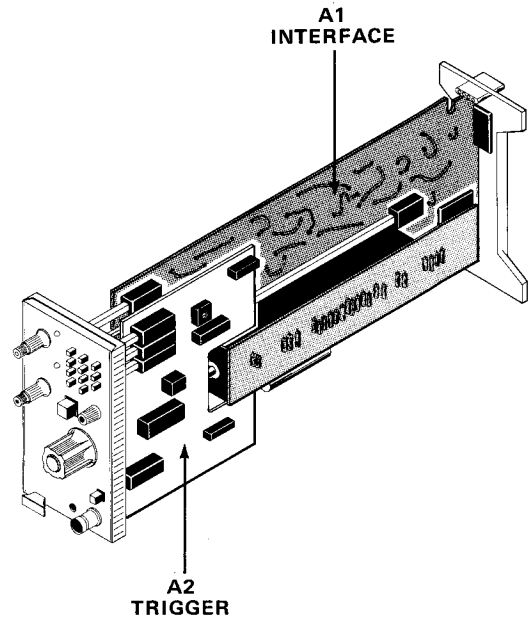




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ard assembly.

CT	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
74	5E	R339	2G	R424	3D	R458	3D	R749	4F
75	4A	R341	2C	R426	2D	R459	3C	R821	5C
01	2F	R342	2C	R427	2C	R706	1H	R832	1J
03	2F	R343	2C	R428	2C	R710	1F	R841	2J
07	2F	R344	1B	R430	4D	R711	2H	R842	2J
08	2F	R345	1C	R431	3D	R712	1H	R844	2J
12	3F	R346	2B	R432	3E	R713	1H		
13	2G	R347	2B	R433	4D	R714	1H	S230	2K
14	2G	R351	1F	R434	3D	R715	1F	S435	2E
15	2G	R352	2F	R435	2B	R717	2H	S800	3G
21	2G	R353	2G	R436	4D	R721	2H		
22	2H	R354	2G	R437	3C	R722	4E	T35	3A
23	2G	R355	1G	R438	4C	R723	4E		
24	2H	R356	4K	R439	2E	R724	4E	TP345	2F
25	2G	R358	3K	R440	3C	R728	1H		
26	2H	R362	4J	R442	3D	R729	2H	U220	3J
30	3G	R371	4B	R444	3C	R731	3H	U416	4E
31	3G	R372	4B	R445	2D	R732	3H	U722	3H
32	3F	R381	4B	R446	3D	R741	4I	U842	2J
33	3E	R382	4B	R447	3C	R742	4H		
34	3F	R383	4A	R448	3D	R743	4H	VR314	2G
35	2G	R412	4E	R449	3C	R744	4H	VR728	2H
36	3F	R413	4E	R454	3C	R745	4H		
37	2F	R414	4E	R455	3D	R746	4G		
38	4F	R416	4E	R456	3D	R747	4G		
		R422	2E	R457	3C	R748	4G		



\*See Parts List for serial number ranges.

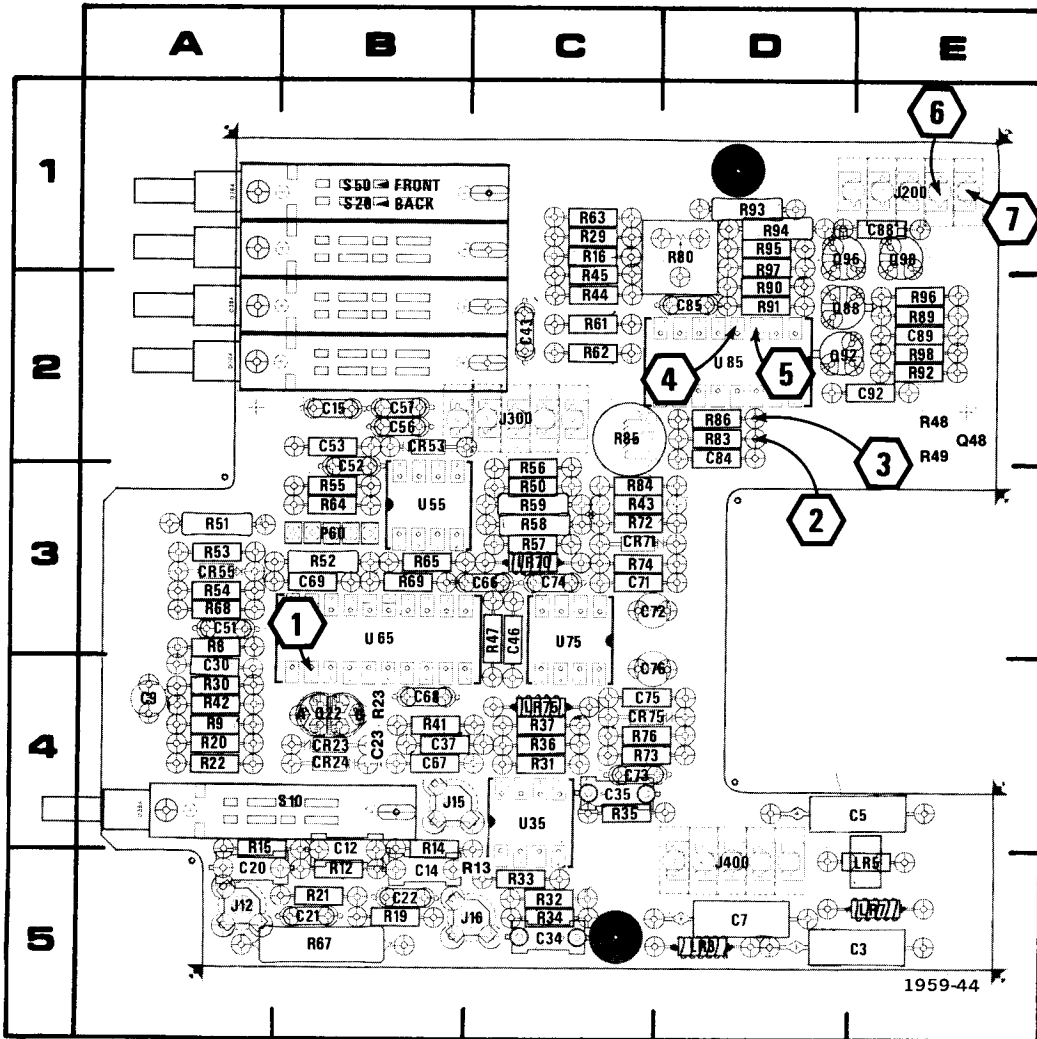


Fig. 8-7. A2-Trigger circuit board assembly.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C3	5E	C77	1E	Q22	4B	R43	3C	R83	2D
C5	4E	C84	2D	Q48*	2E	R44	2C	R84	3C
C7	5D	C85	2D	Q88	2D	R45	2C	R85	2C
C9	4A	C88	1E	Q92	2D	R47	3C	R86	2D
C12	5B	C89	2E	Q96	1D	R48*	2E	R89	2E
C14	5B	C92	2E	Q98	1E	R49*	2E	R90	2D
C15	2B					R50	3C	R91	2D
C20	5A	CR23	4B	R8	3A	R51	3A	R92	2E
C21	5B	CR24	4B	R9	5A	R52	3B	R93	1C
C22	5B	CR53	2B	R12	5B	R53	3A	R94	1D
C23*	4B	CR55	3A	R13*	5C	R54	3A	R95	1D
C30	4A	CR71	3C	R14	5B	R55	3B	R96	2D
C34	5C	CR75	4C	R15	5A	R56	3C	R97	1D
C35	4C			R16	1C	R57	3C	R98	2E
C37	4B	J12	5A	R19	5B	R58	3C		
C43	2C	J15	4B	R20	4A	R59	3C	S10	4B
C46	3C	J16	5C	R21	5B	R61	2C	S20	1B
C51	3A	J200	1E	R22	4A	R62	1C	S50	1B
C52	3B	J300	2C	R23*	2E	R63	1C		
C56	2B	J400	5D	R29	1C	R64	3B	U35	4C
C57	2B			R30	4A	R65	3B	U55	3B
C66	3C	LR3	5D	R31	4C	R66	5B	U65	3B
C68	4B	LR5	5E	R32	5C	R67	3C	U75	3C
C69	3B	LR7	5E	R33	5C	R68	3A	U85	2D
C72	3C	LR70	3C	R34	5C	R69	3B		
C73	4C	LR75	4C	R35	4C	R72	3C		
C74	3C			R36	4C	R73	4C		
C76	4C	P60	3B	R37	4C	R74	3C		
				R41	4B	R76	4C		
				R42	4A	R80	1D		



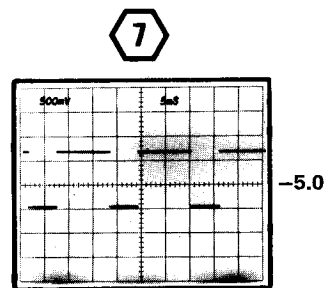
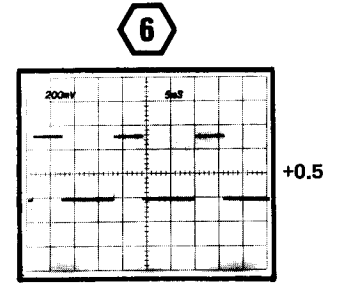
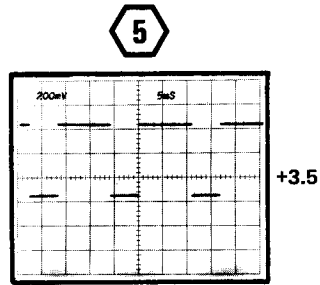
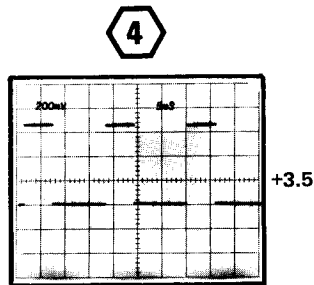
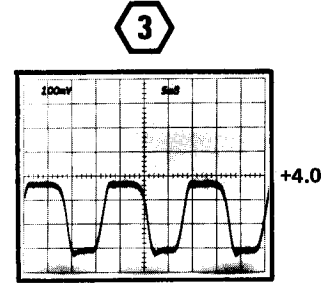
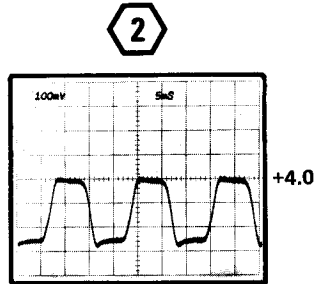
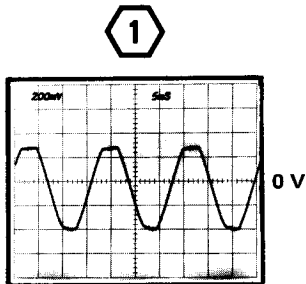
## VOLTAGE AND WAVEFORM CONDITIONS

The voltages and waveforms shown were obtained with the 7B80 controls set as follows:

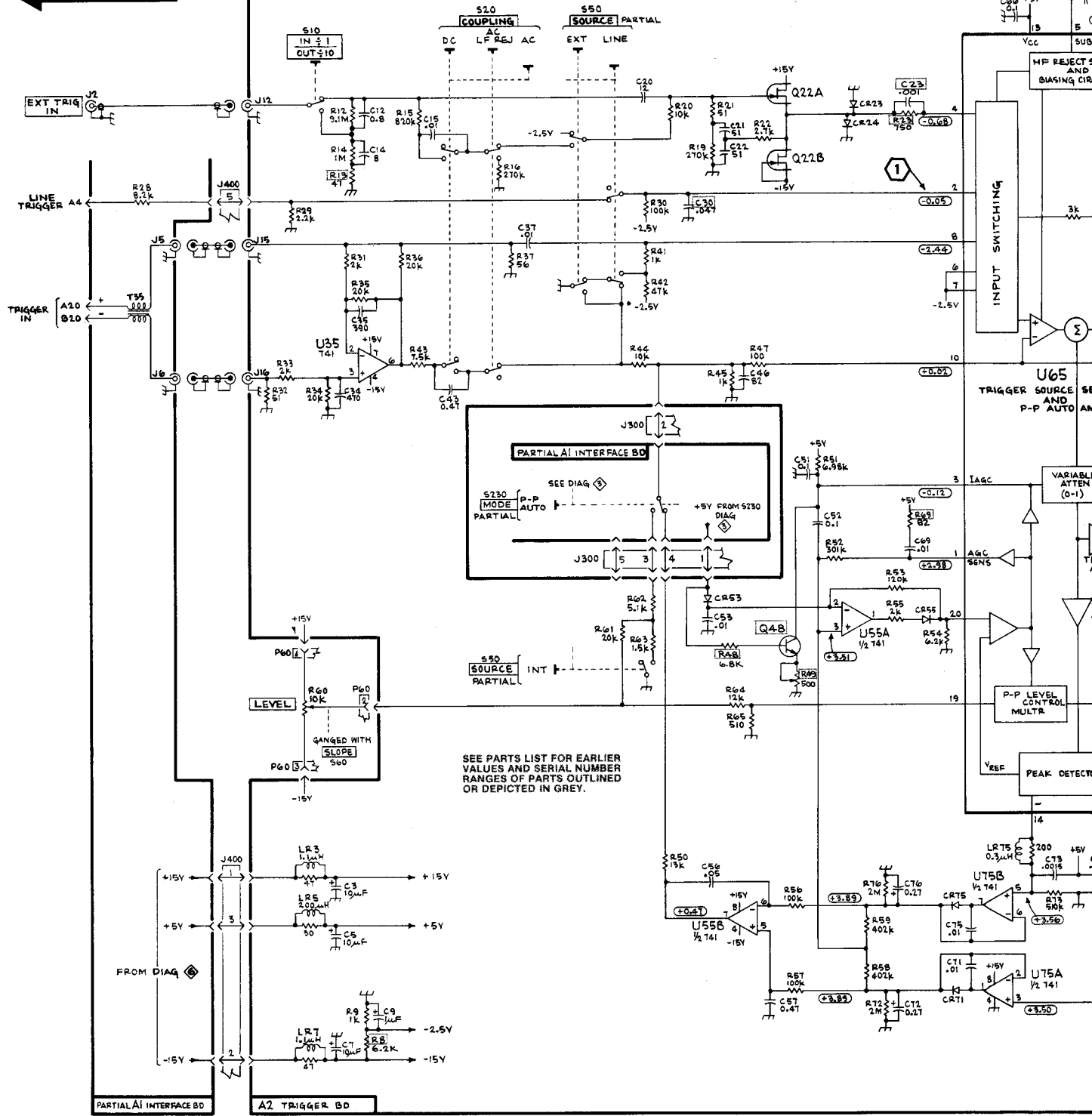
TIME/DIV, 1 ms; VARIABLE (CAL IN), knob in; MAG, X1 (button in); HOLD OFF, fully counterclockwise; SWP CAL, midranged; POSITION, midranged; TRIGGERING: LEVEL, midranged; MODE, P-P AUTO; COUPLING, AC; SOURCE, LINE; SLOPE, +.

**Voltage Conditions.** The voltages shown on the diagram were obtained using a digital multimeter with a 10 M $\Omega$  input impedance (Tektronix DM 501 Digital Multimeter or Tektronix 7D13 Digital Multimeter used with readout equipped, 7000-series oscilloscope).

**Waveform Conditions.** The waveforms shown below were obtained using a test oscilloscope system with 10 M $\Omega$  input impedance and at least 60 MHz bandwidth (Tektronix 7603 Oscilloscope, 7B53A Time Base, and 7A13 Differential Comparator equipped with 10X probe).

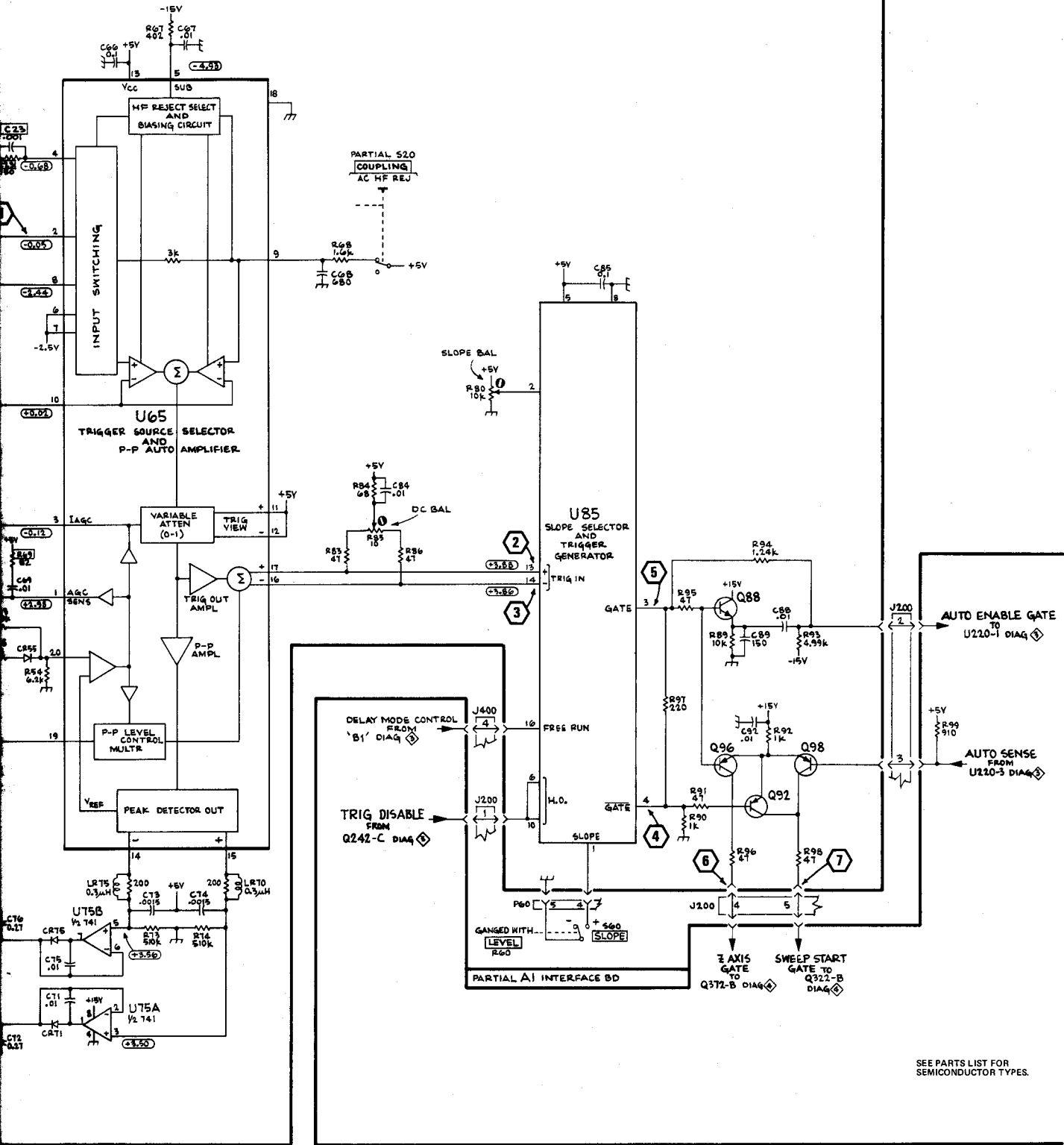


**VOLTAGE & WAVEFORM CONDITIONS**



7B80

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REV. B, MAY 1978



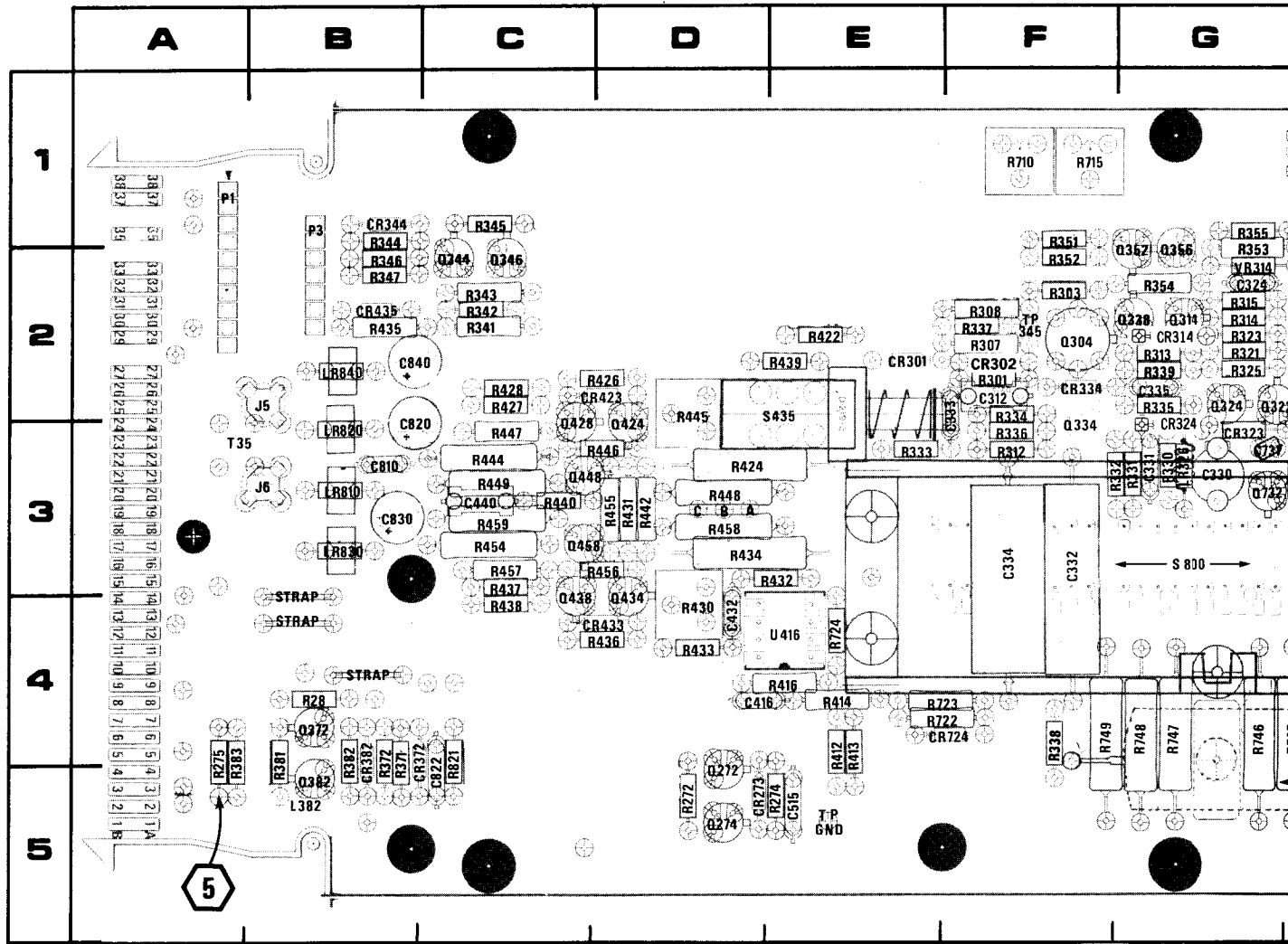
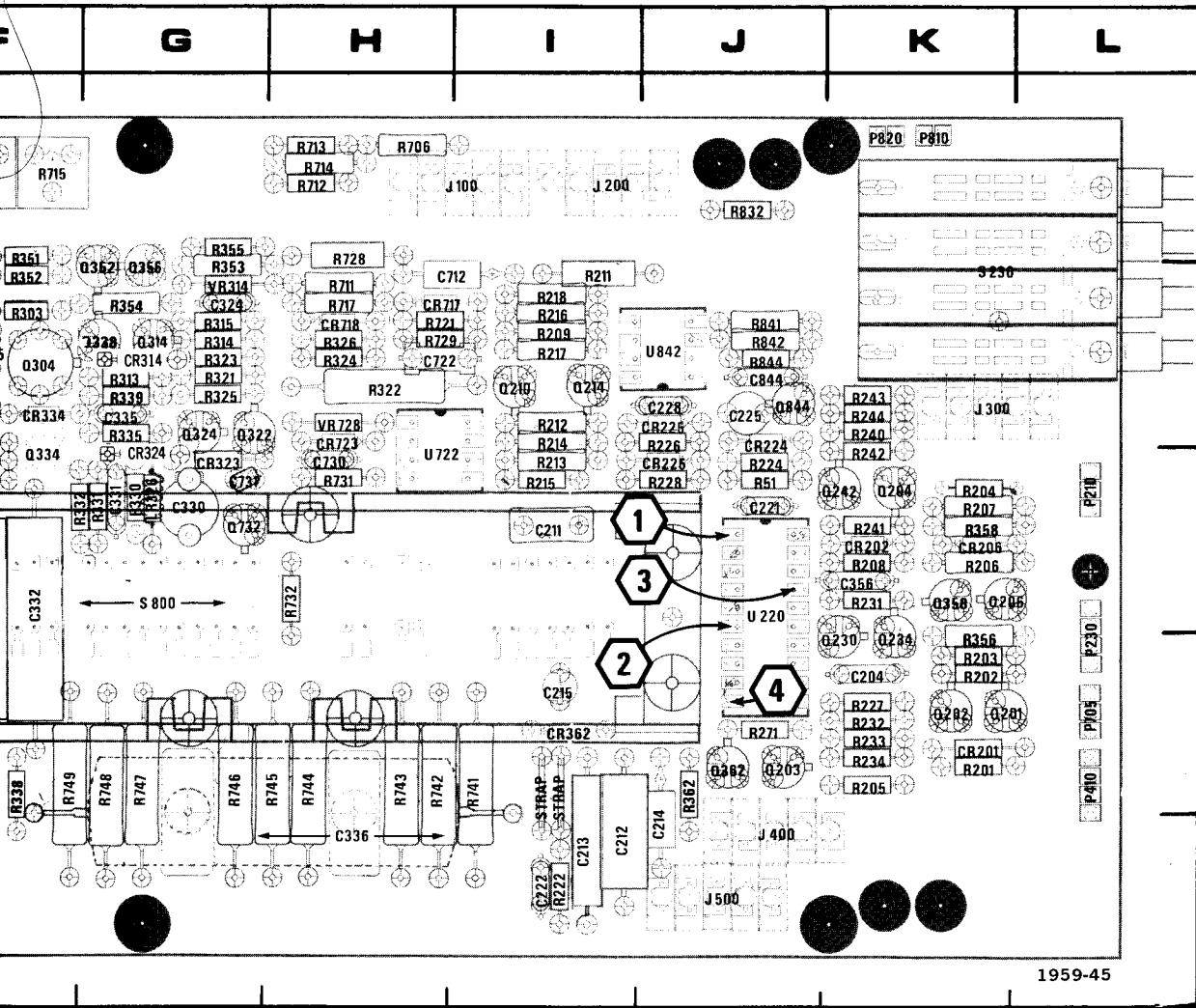


Fig. 8-8. A1—Interface circuit board assembly.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C204	4K	C712	2H	CR372	4B	P1	1A	Q346	2C	R208	3K	R274	5E
C211	3I	C722	2H	CR382	4B	P210	3L	Q352	2G	R209	2I	R275	4A
C212	5I	C730	3H	CR423	2D	P230	4L	Q356	2G	R211	2I	R301	2F
C213	5I	C731	3G	CR433	4D	P410	4L	Q358	3K	R212	2I	R303	2F
C214	5J	C810	3B	CR435	2B	P705	4L	Q362	4J	R213	3I	R307	2F
C215	4I	C820	3B	CR717	2H	P810	1K	Q368	3K	R214	2I	R308	2F
C221	3J	C822	5C	CR718	2H			Q372	4B	R215	3I	R312	3F
C222	5I	C830	3B	CR724	4E	Q201	4K	Q382	5B	R216	2I	R313	2G
C225	2J	C840	2B	CR723	2H	Q202	4K	Q424	3D	R217	2I	R314	2G
C228	2J	C844	2J	J5	2B	Q203	4J	Q428	3C	R218	2I	R315	2G
C312	2F	CR201	4K	J6	3B	Q204	3K	Q434	4D	R222	5I	R321	2G
C324	2G	CR202	3K	J100	1I	Q206	3K	Q438	4C	R224	3J	R322	2H
C330	3G	CR206	3K	J200	1I	Q210	2I	Q448	3C	R226	2J	R323	2G
C331	3G	CR208	3K	J300	2K	Q214	2I	Q458	3C	R227	4K	R324	2H
C332	3F	CR224	2J	J400	5J	Q230	4K	Q732	3G	R228	3J	R325	2G
C333	3F	CR225	2J	J500	5J	Q234	4K	Q844	2J	R231	3K	R326	2H
C334	3F	CR226	3J	L274	5A	Q242	3K	R28	4B	R232	4K	R330	3G
C335	2G	CR273	5D	L326	3G	Q272	5D	R99	3J	R233	4K	R331	3G
C336	5H	CR301	2E	L382	5B	Q274	5D	R201	4K	R234	4K	R332	3F
C356	3K	CR302	2F			Q304	2F	R202	4K	R240	2K	R333	3E
C381	3G	CR314*	2G			Q314	2G	R202	4K	R241	3K	R334	3F
C416	4D	CR323	3G	LR326	3G	Q322	2G	R203	4K	R242	3K	R335	2G
C432	4D	CR324*	3G	LR810	3B	Q324	2G	R204	3K	R243	2K	R336	3F
C440	3C	CR334	2F	LR820	3B	Q334	3F	R205	4K	R244	2K	R337	2F
C515	5E	CR344	1B	LR830	3B	Q338	2G	R206	3K	R271	4J	R338	4F
C571	3G	CR362	4I	LR840	2B	Q344	2C	R207	3K	R272	5D		

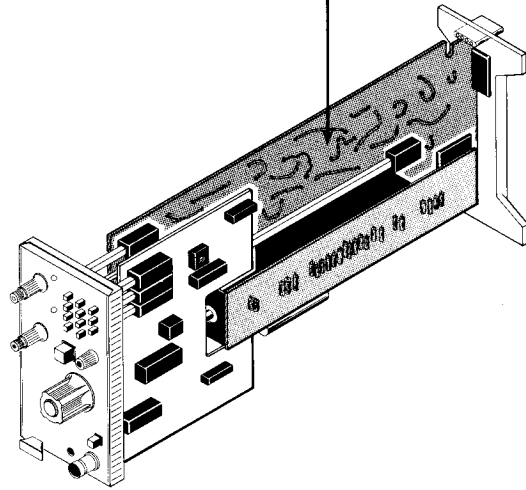


face circuit board assembly.

GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
3K	R274	5E	R339	2G	R424	3D	R458	3D	R749	4F
2I	R275	4A	R341	2C	R426	2D	R459	3C	R821	5C
2I	R301	2F	R342	2C	R427	2C	R706	1H	R832	1J
2I	R303	2F	R343	2C	R428	2C	R710	1F	R841	2J
3I	R307	2F	R344	1B	R430	4D	R711	2H	R842	2J
2I	R308	2F	R345	1C	R431	3D	R712	1H	R844	2J
3I	R312	3F	R346	2B	R432	3E	R713	1H		
2I	R313	2G	R347	2B	R433	4D	R714	1H	S230	2K
2I	R314	2G	R351	1F	R434	3D	R715	1F	S435	2E
5I	R315	2G	R352	2F	R435	2B	R717	2H	S800	3G
2I	R321	2G	R353	2G	R436	4D	R721	2H		
3J	R322	2H	R354	2G	R437	3C	R722	4E	T35	3A
2J	R323	2G	R355	1G	R438	4C	R723	4E		
4K	R324	2H	R356	4K	R439	2E	R724	4E	TP345	2F
3J	R325	2G	R358	3K	R440	3C	R728	1H		
3K	R326	2H	R362	4J	R442	3D	R729	2H	U220	3J
2I	R330	3G	R371	4B	R444	3C	R731	3H	U416	4E
3K	R331	3G	R372	4B	R445	2D	R732	3H	U722	3H
2K	R332	3F	R381	4B	R446	3D	R741	4I	U842	2J
3K	R333	3E	R382	4B	R447	3C	R742	4H		
2I	R334	3F	R383	4A	R448	3D	R743	4H	VR314	2G
3K	R335	2G	R412	4E	R449	3C	R744	4H	VR728	2H
2K	R336	3F	R413	4E	R454	3C	R745	4H		
2K	R337	2F	R414	4E	R455	3D	R746	4G		
4J	R338	4F	R416	4E	R456	3D	R747	4G		
5D			R422	2E	R457	3C	R748	4G		

\*See Parts List for serial number ranges.

A1  
INTERFACE



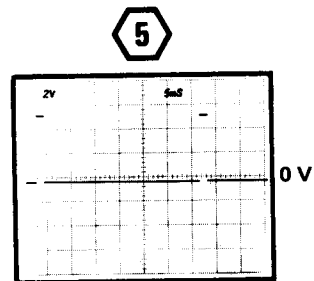
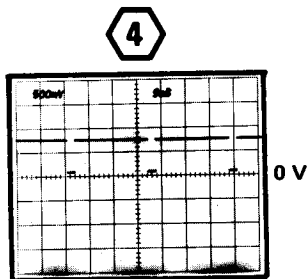
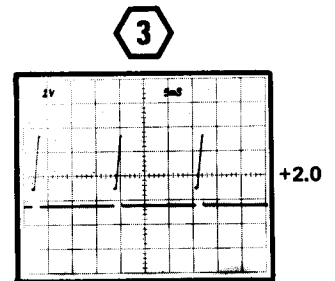
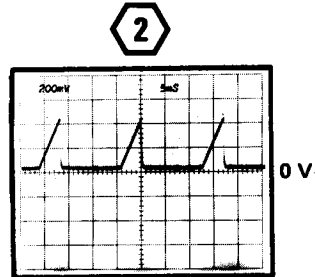
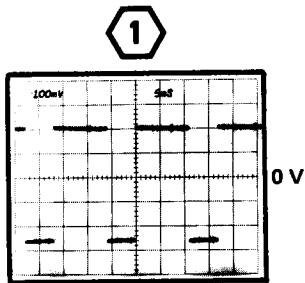
## VOLTAGE AND WAVEFORM CONDITIONS

The voltages and waveforms shown were obtained with the 7B80 controls set as follows:

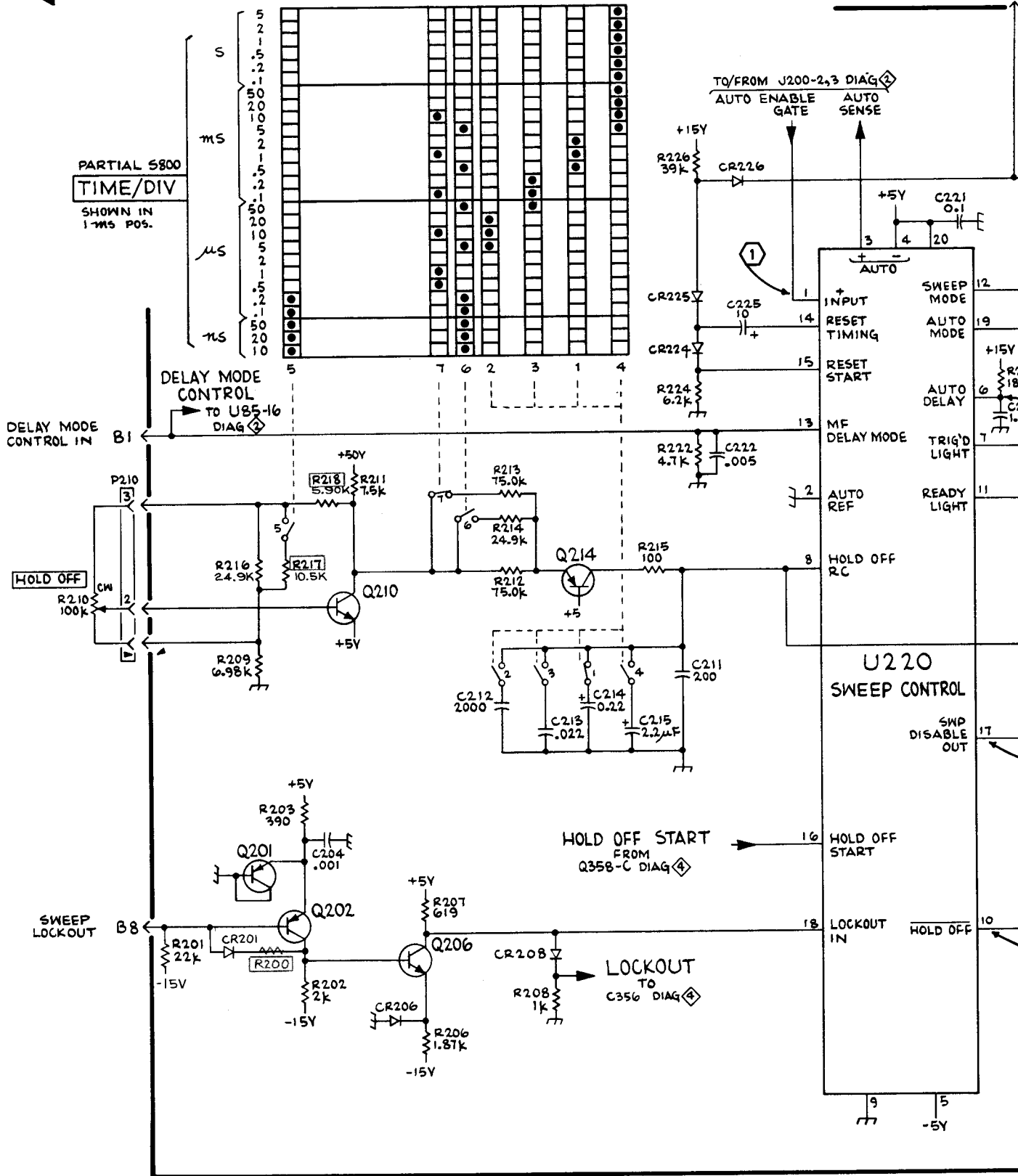
TIME/DIV, 1 ms; VARIABLE (CAL IN), knob in; MAG, X1 (button in); HOLD OFF, fully counterclockwise; SWP CAL, midranged; POSITION, midranged; TRIGGERING: LEVEL, midranged; MODE, P-P AUTO; COUPLING, AC; SOURCE, LINE; SLOPE, +.

**Voltage Conditions.** The voltages shown on the diagram were obtained using a digital multimeter with a 10 M $\Omega$  input impedance (Tektronix DM 501 Digital Multimeter or Tektronix 7D13 Digital Multimeter used with readout equipped, 7000-series oscilloscope).

**Waveform Conditions.** The waveforms shown below were obtained using a test oscilloscope system with 10 M $\Omega$  input impedance and at least 60 MHz bandwidth (Tektronix 7603 Oscilloscope, 7B53A Time Base, and 7A13 Differential Comparator equipped with 10X probe).

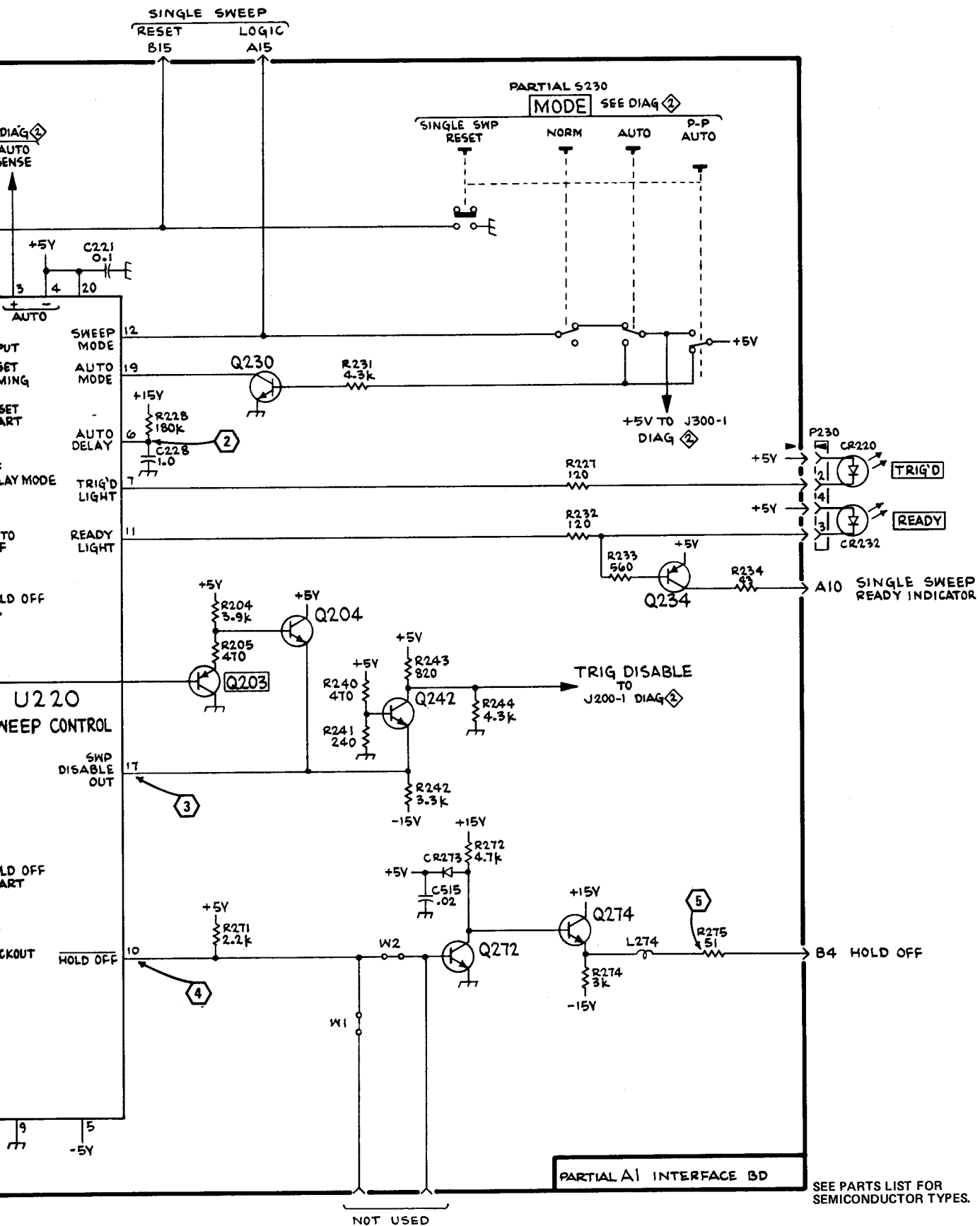


**VOLTAGE & WAVEFORM CONDITIONS**

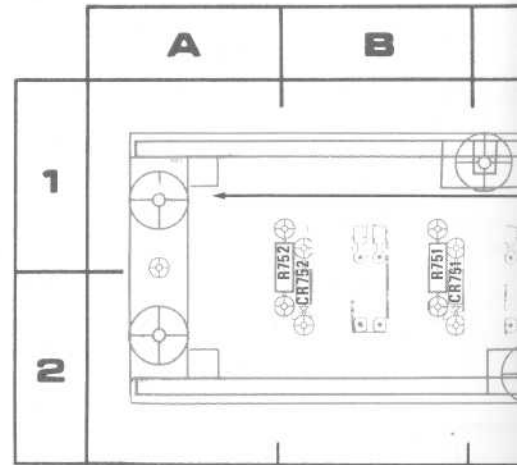
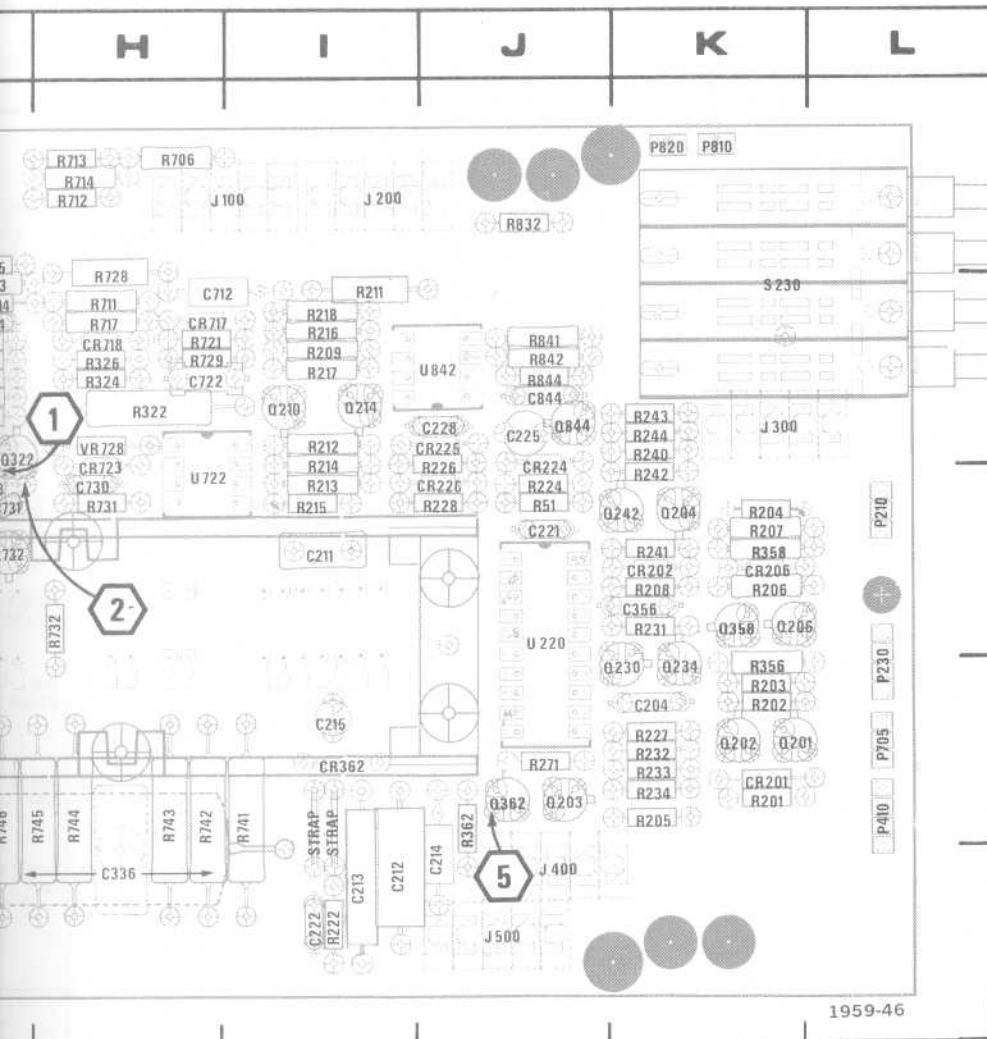


SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

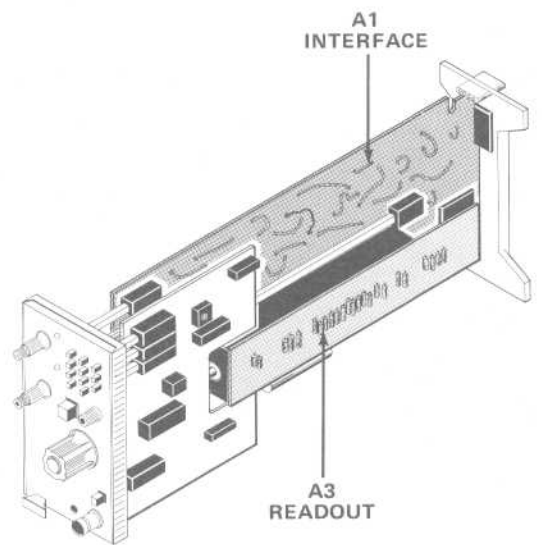








GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
5E	R339	2G	R424	3D	R458	3D	R749	4F
4A	R341	2C	R426	2D	R459	3C	R821	5C
2F	R342	2C	R427	2C	R706	1H	R832	1J
2F	R343	2C	R428	2C	R710	1F	R841	2J
2F	R344	1B	R430	4D	R711	2H	R842	2J
2F	R345	1C	R431	3D	R712	1H	R844	2J
3F	R346	2B	R432	3E	R713	1H		
2G	R347	2B	R433	4D	R714	1H	S230	2K
2G	R351	1F	R434	3D	R715	1F	S435	2E
2G	R352	2F	R435	2B	R717	2H	S800	3G
2G	R353	2G	R436	4D	R721	2H		
2H	R354	2G	R437	3C	R722	4E	T35	3A
2G	R355	1G	R438	4C	R723	4E		
2H	R356	4K	R439	2E	R724	4E	TP345	2F
2G	R358	3K	R440	3C	R728	1H		
2H	R362	4J	R442	3D	R729	2H	U220	3J
3G	R371	4B	R444	3C	R731	3H	U416	4E
3G	R372	4B	R445	2D	R732	3H	U722	3H
3F	R381	4B	R446	3D	R741	4I	U842	2J
3E	R382	4B	R447	3C	R742	4H		
3F	R383	4A	R448	3D	R743	4H	VR314	2G
2G	R412	4E	R449	3C	R744	4H	VR728	2H
3F	R413	4E	R454	3C	R745	4H		
2F	R414	4E	R455	3D	R746	4G		
4F	R416	4E	R456	3D	R747	4G		
	R422	2E	R457	3C	R748	4G		



\*See Parts List for serial number ranges.

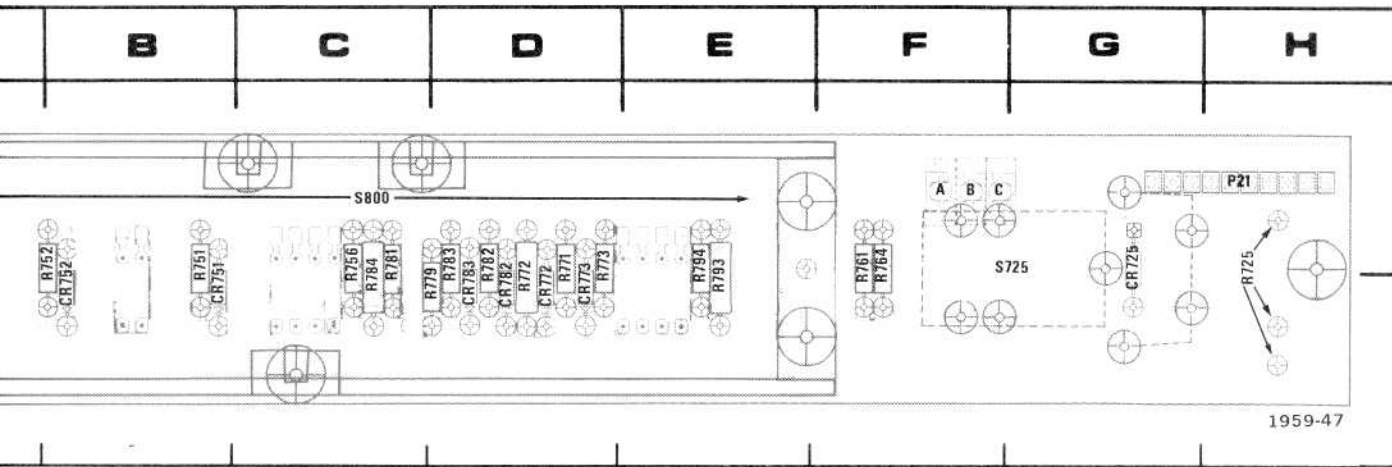
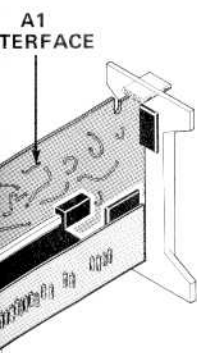


Fig. 8-10. A3-Readout circuit board assembly.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
CR725	1C	R751	2B	R782	2D
CR751	2B	R752	2B	R783	2D
CR752	2B	R756	2C	R784	2C
CR772	2D	R761	2F	R793	2E
CR773	2D	R764	2F	R794	2E
CR782	2D	R771	2D		
CR783	2D	R772	2D	S725	2C
		R773	2D	S800	1C
P21	1H	R779	2D		
		R781	2D		
R725	2H				



3  
OUT

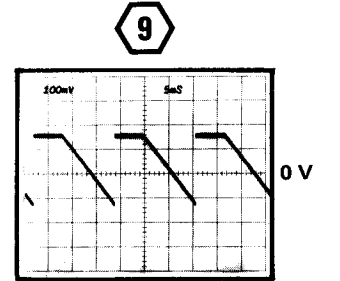
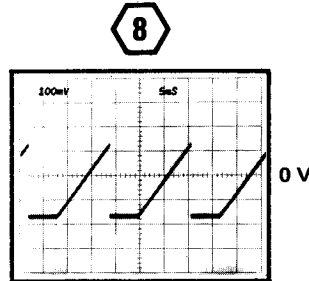
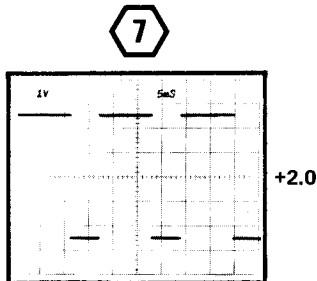
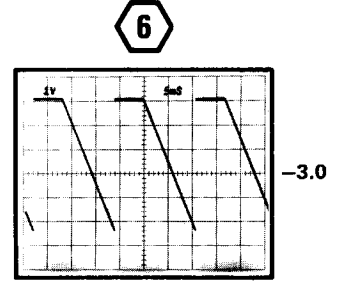
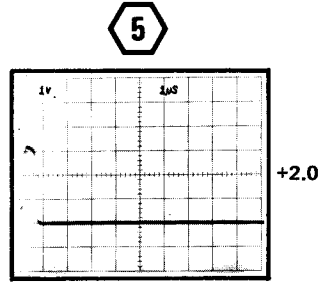
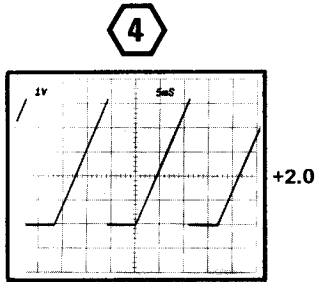
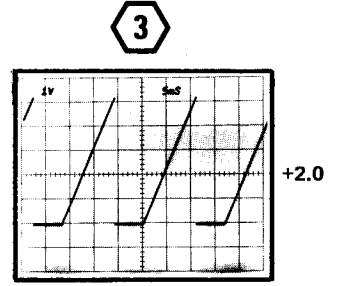
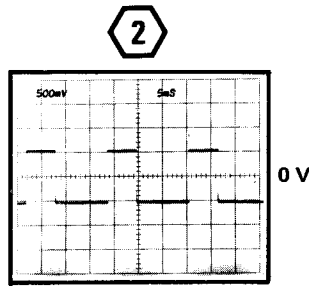
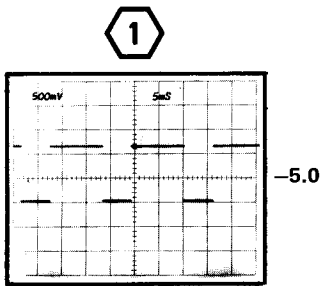
## VOLTAGE AND WAVEFORM CONDITIONS

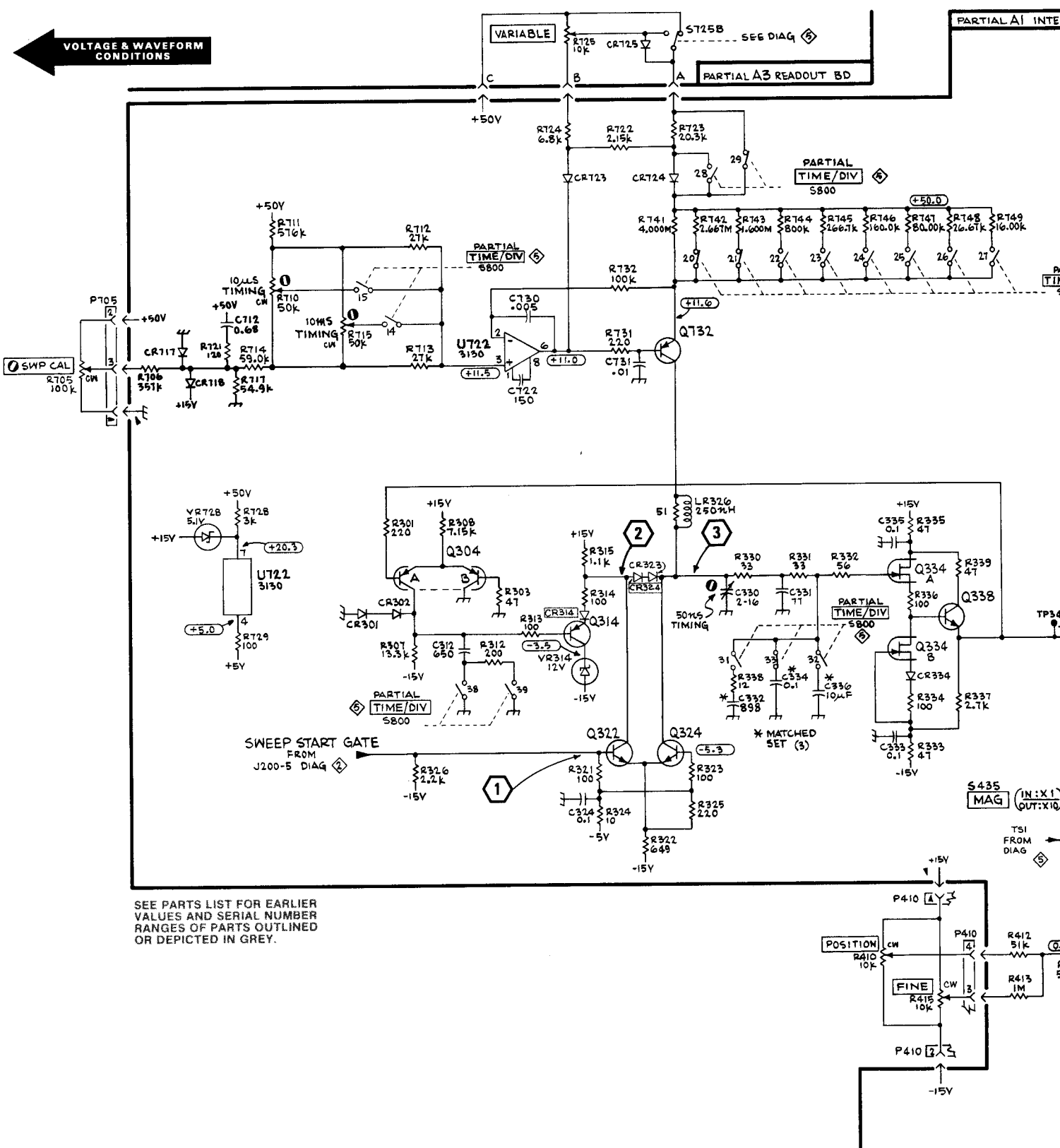
The voltages and waveforms shown were obtained with the 7B80 controls set as follows:

TIME/DIV, 1 ms; VARIABLE (CAL IN), knob in; MAG, X1 (button in); HOLD OFF, fully counterclockwise; SWP CAL, midranged; POSITION, midranged; TRIGGERING: LEVEL, midranged; MODE, P-P AUTO; COUPLING, AC; SOURCE, LINE; SLOPE, +.

**Voltage Conditions.** The voltages shown on the diagram were obtained using a digital multimeter with a  $10\text{ M}\Omega$  input impedance (Tektronix DM 501 Digital Multimeter or Tektronix 7D13 Digital Multimeter used with readout equipped, 7000-series oscilloscope).

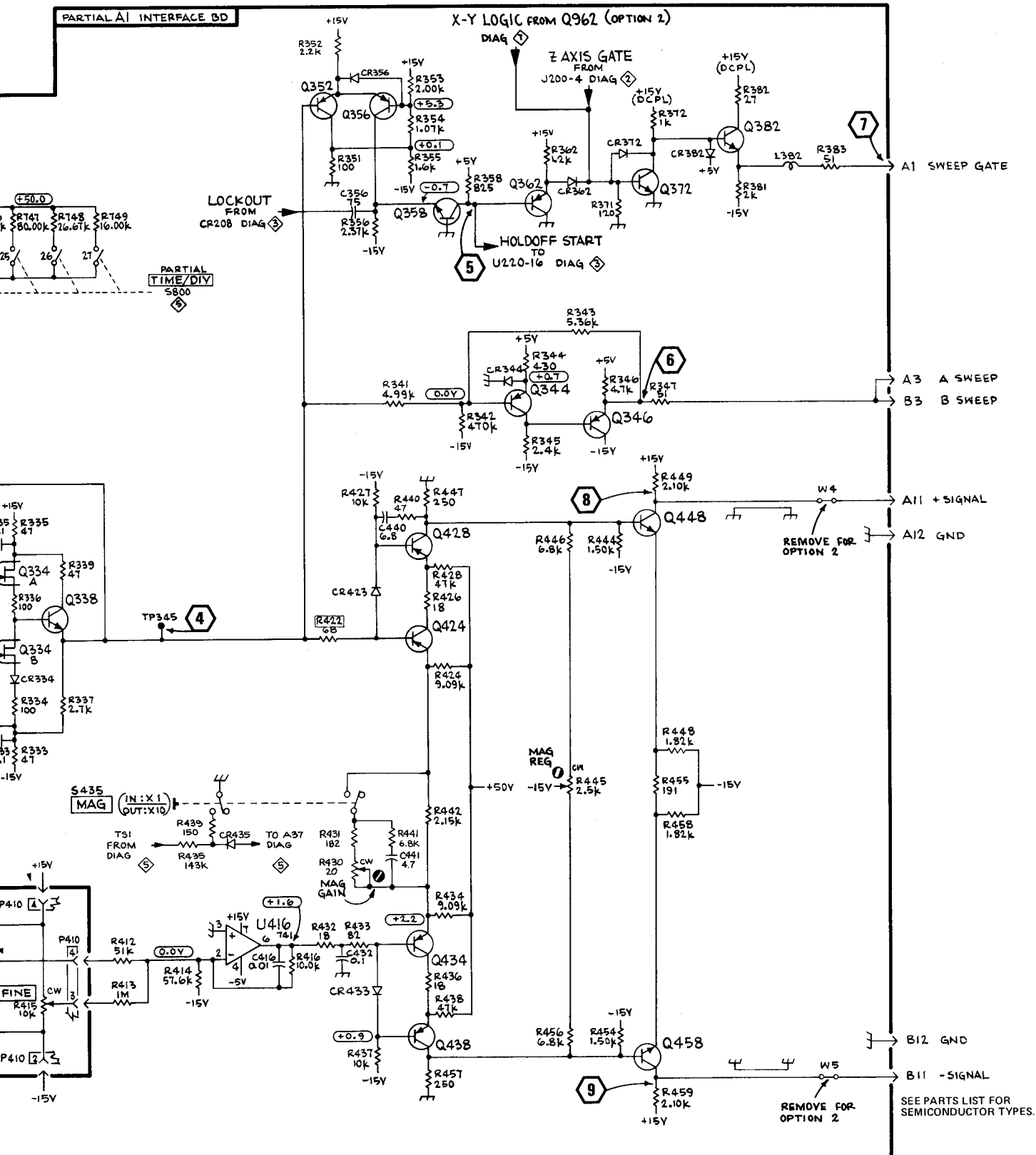
**Waveform Conditions.** The waveforms shown below were obtained using a test oscilloscope system with  $10\text{ M}\Omega$  input impedance and at least 60 MHz bandwidth (Tektronix 7603 Oscilloscope, 7B53A Time Base, and 7A13 Differential Comparator equipped with 10X probe).





VOLTAGE & WAVEFORM CONDITIONS

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.



SWEEP GENERATOR

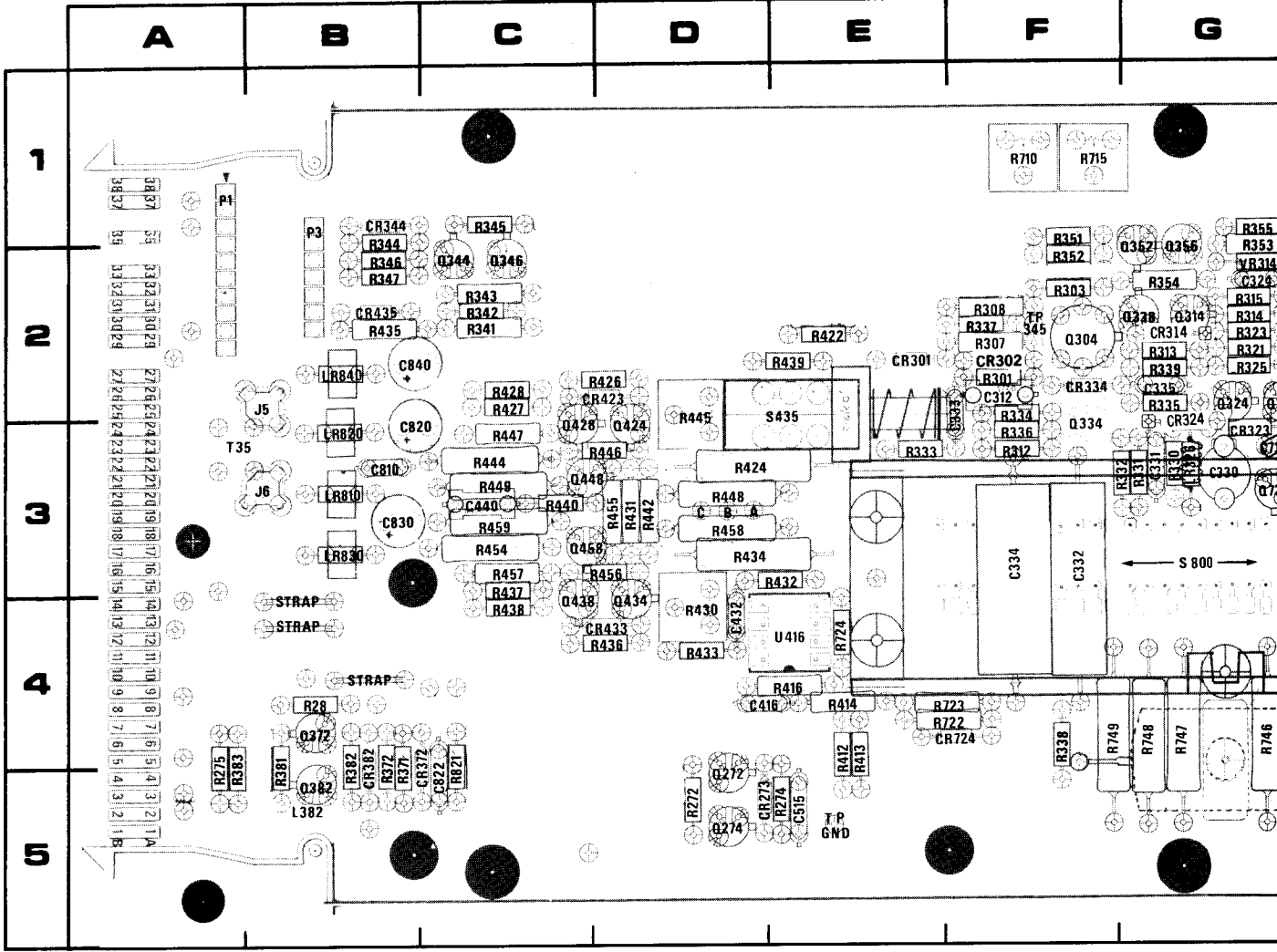


Fig. 8-11. A1—Interface circuit board assembly

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C204	4K	C712	2H	CR372	4B	P1	1A	Q346	2C	R208	3K	R274	5D
C211	3I	C722	2H	CR382	4B	P210	3L	Q352	2G	R209	2I	R275	4D
C212	5I	C730	3H	CR423	2D	P230	4L	Q356	2G	R211	2I	R301	2D
C213	5I	C731	3G	CR433	4D	P410	4L	Q358	3K	R212	2I	R303	2D
C214	5J	C810	3B	CR435	2B	P705	4L	Q362	4J	R213	3I	R307	2D
C215	4I	C820	3B	CR717	2H	P810	1K	Q368	3K	R214	2I	R308	2D
C221	3J	C822	5C	CR718	2H			Q372	4B	R215	3I	R312	3D
C222	5I	C830	3B	CR724	4E			Q382	5B	R216	2I	R313	2D
C225	2J	C840	2B	CR723	2H			Q424	3D	R217	2I	R314	2D
C228	2J	C844	2J	J5	2B			Q428	3C	R218	2I	R315	2D
C312	2F			J6	3B			Q434	4D	R222	5I	R321	2D
C324	2G	CR201	4K	J100	1I			Q438	4C	R224	3J	R322	2D
C330	3G	CR202	3K	J200	1I			Q448	3C	R226	2J	R323	2D
C331	3G	CR206	3K	J300	2K			Q458	3C	R227	4K	R324	2D
C332	3F	CR208	3K	J400	5J			Q732	3G	R228	3J	R325	2D
C333	3F	CR224	2J	J500	5J			Q844	2J	R231	3K	R326	2D
C334	3F	CR225	2J							R232	4K	R330	3D
C335	2G	CR226	3J	L274	5A					R233	4K	R331	3D
C336	5H	CR273	5D	L326	3G			R28	4B	R234	4K	R332	3D
C356	3K	CR301	2E	L382	5B			R99	3J	R240	2K	R333	3D
C381	3G	CR302	2F					R201	4K	R241	3K	R334	3D
C416	4D	CR314*	2G	LR326	3G			R202	4K	R242	3K	R335	2D
C432	4D	CR323	3G	LR810	3B			R203	4K	R243	2K	R336	3D
C440	3C	CR324*	3G	LR820	3B			R204	3K	R244	2K	R337	2D
C515	5E	CR334	2F	LR830	3B			R205	4K	R271	4J	R338	4D
C571	3G	CR344	1B	LR840	2B			R206	3K	R272	5D		
		CR362	4I					R207	3K				







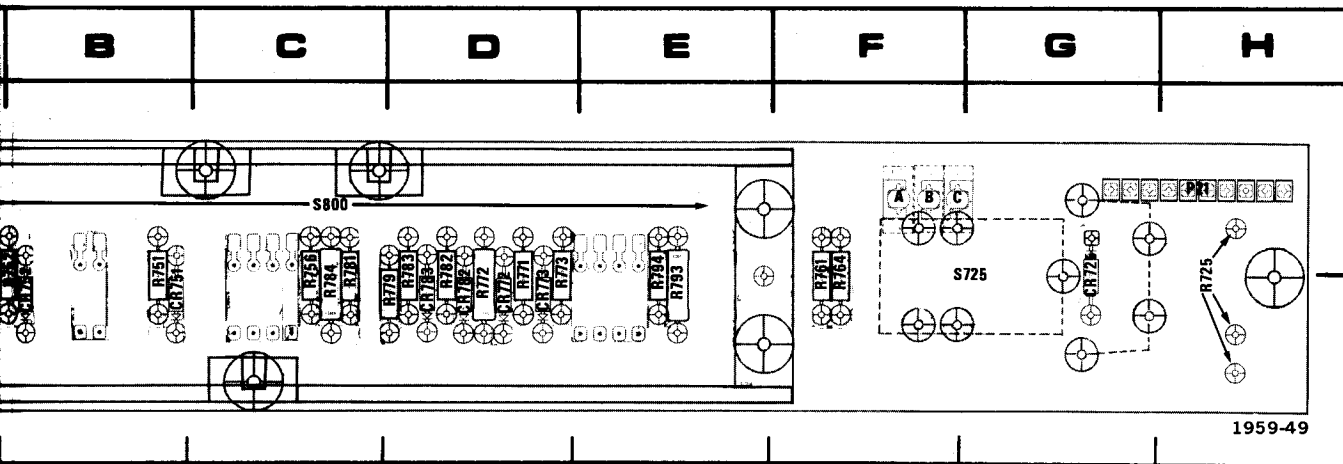
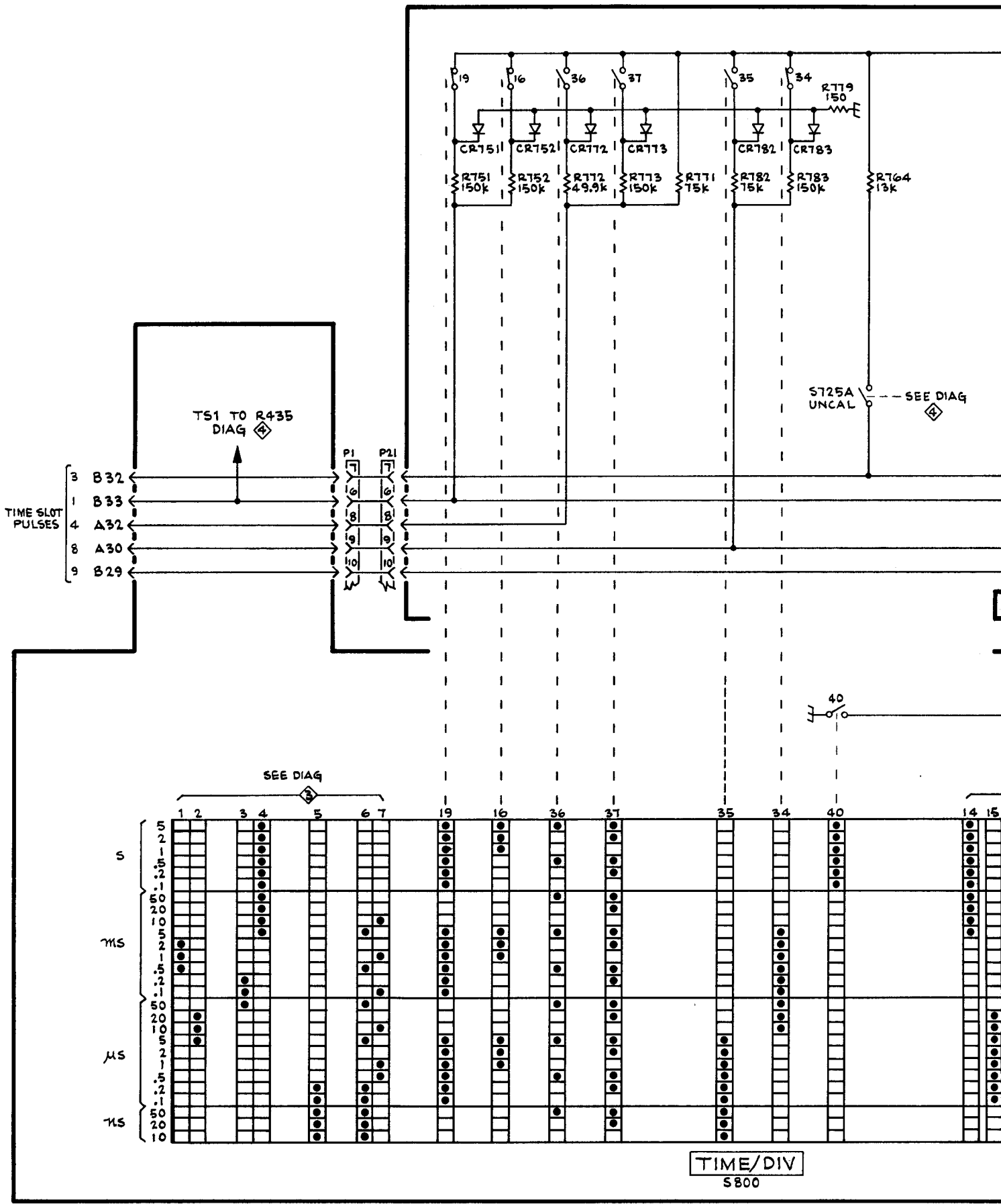


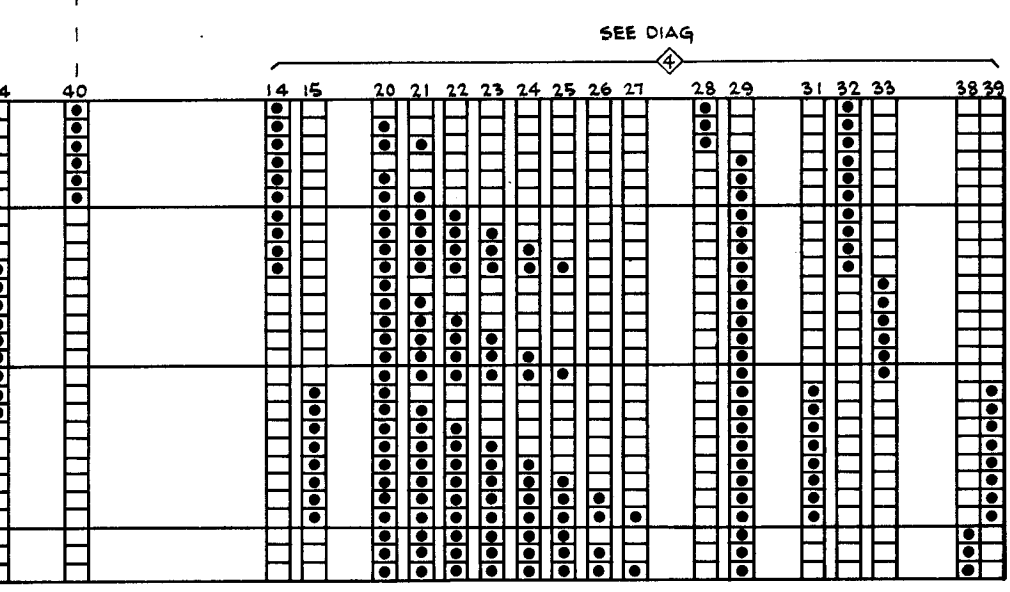
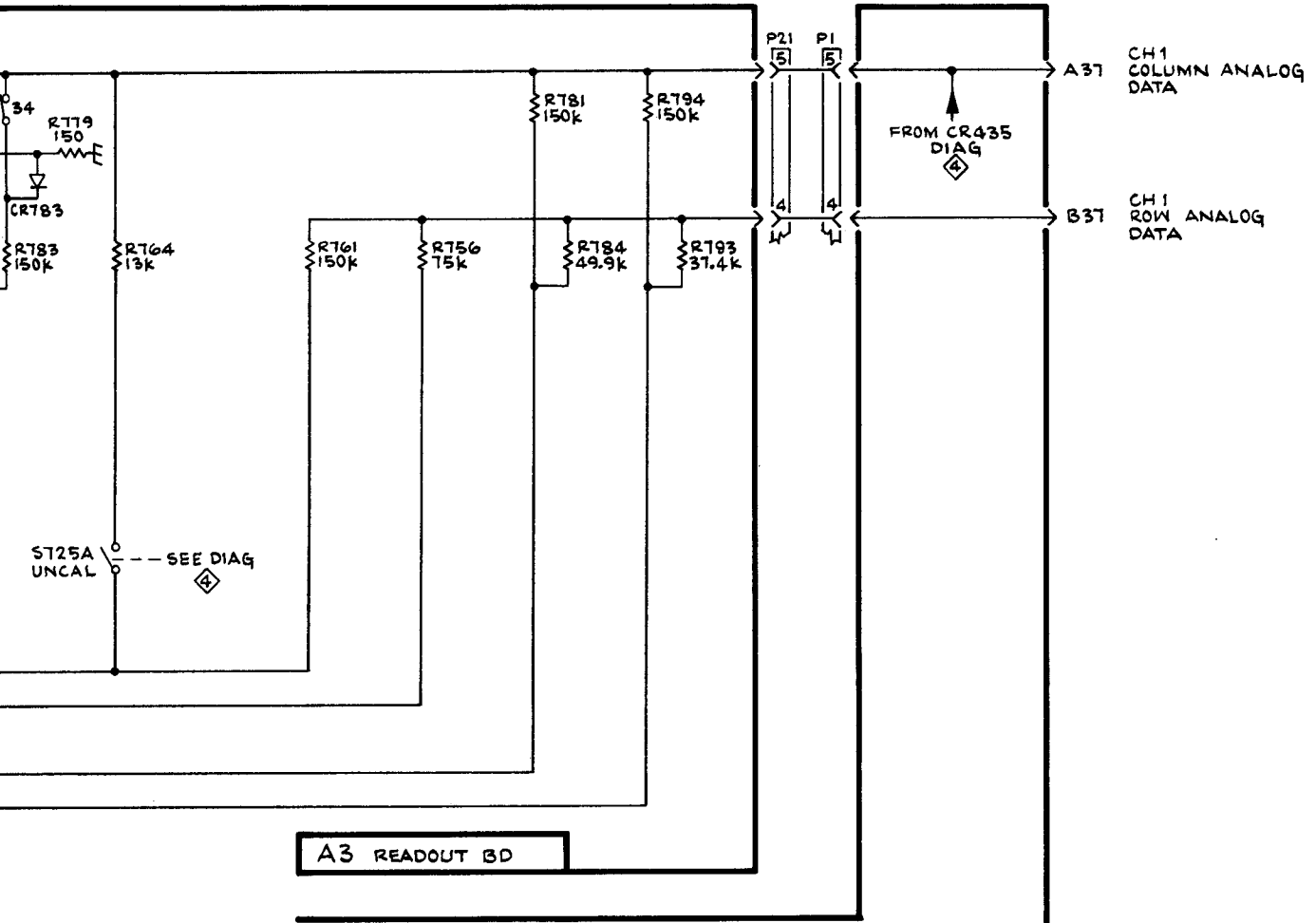
Fig. 8-12. A3-Readout circuit board assembly.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
CR725	1C	R751	2B	R782	2D
CR751	2B	R752	2B	R783	2D
CR752	2B	R756	2C	R784	2C
CR772	2D	R761	2F	R793	2E
CR773	2D	R764	2F	R794	2E
CR782	2D	R771	2D		
CR783	2D	R772	2D	S725	2C
		R773	2D	S800	1C
P21	1H	R779	2D		
R725	2H	R781	2D		



7B80

@



SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

PARTIAL A2 INTERFACE BOARD

L. I. C.  
B24 P10

TIME/DIVISION AND READOUT SWITCHING

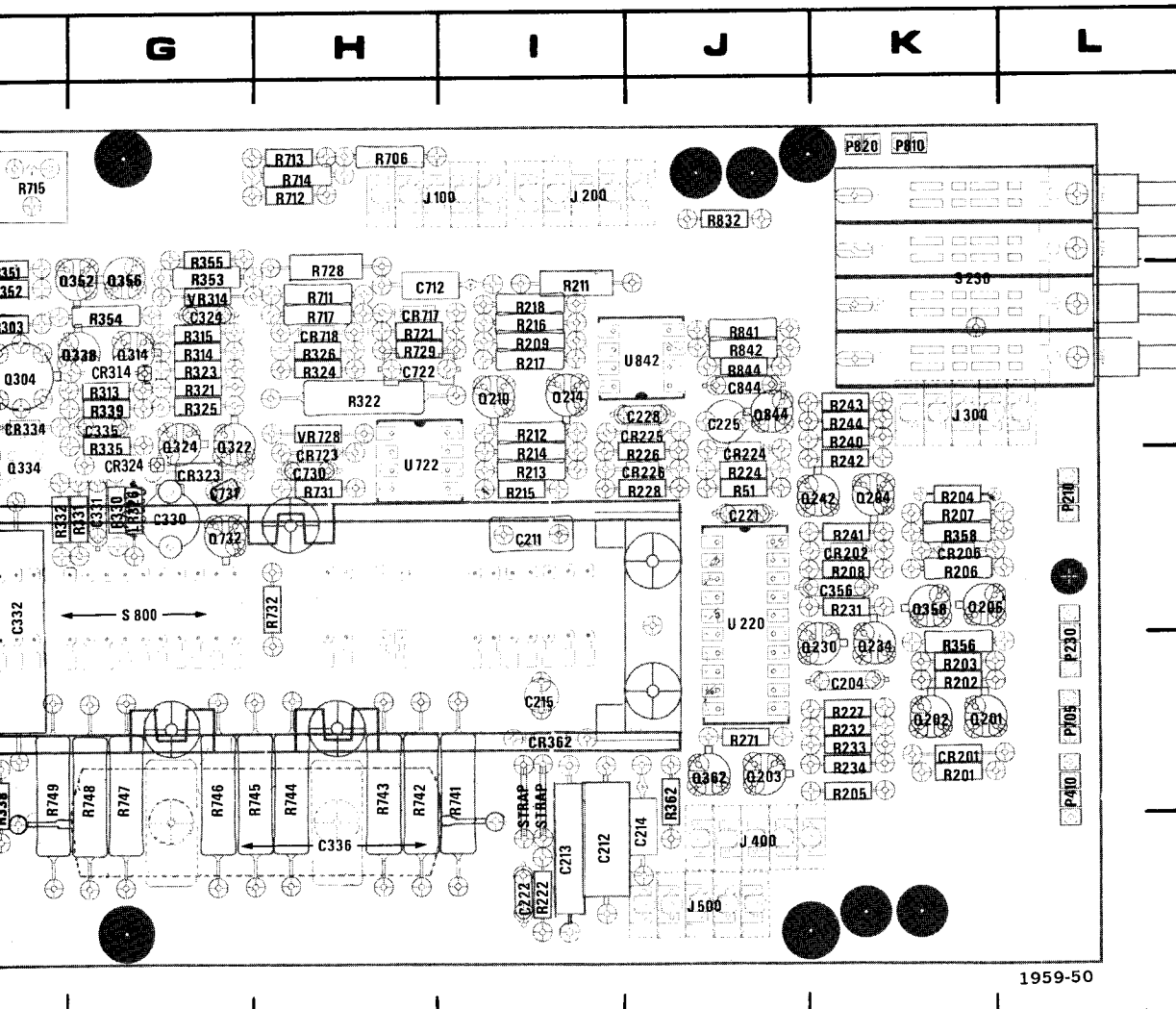
5

TIME/DIVISION AND READOUT SWITCHING

5

@

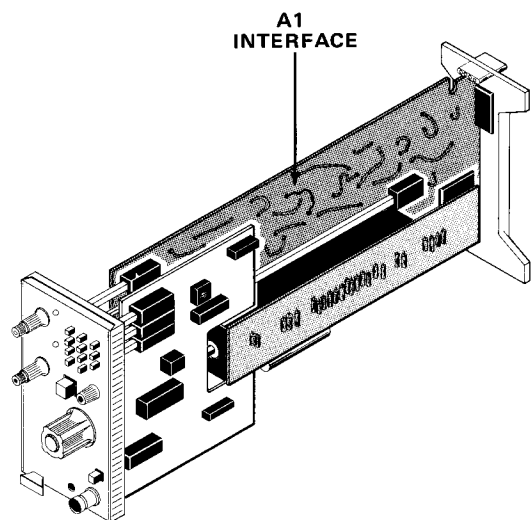


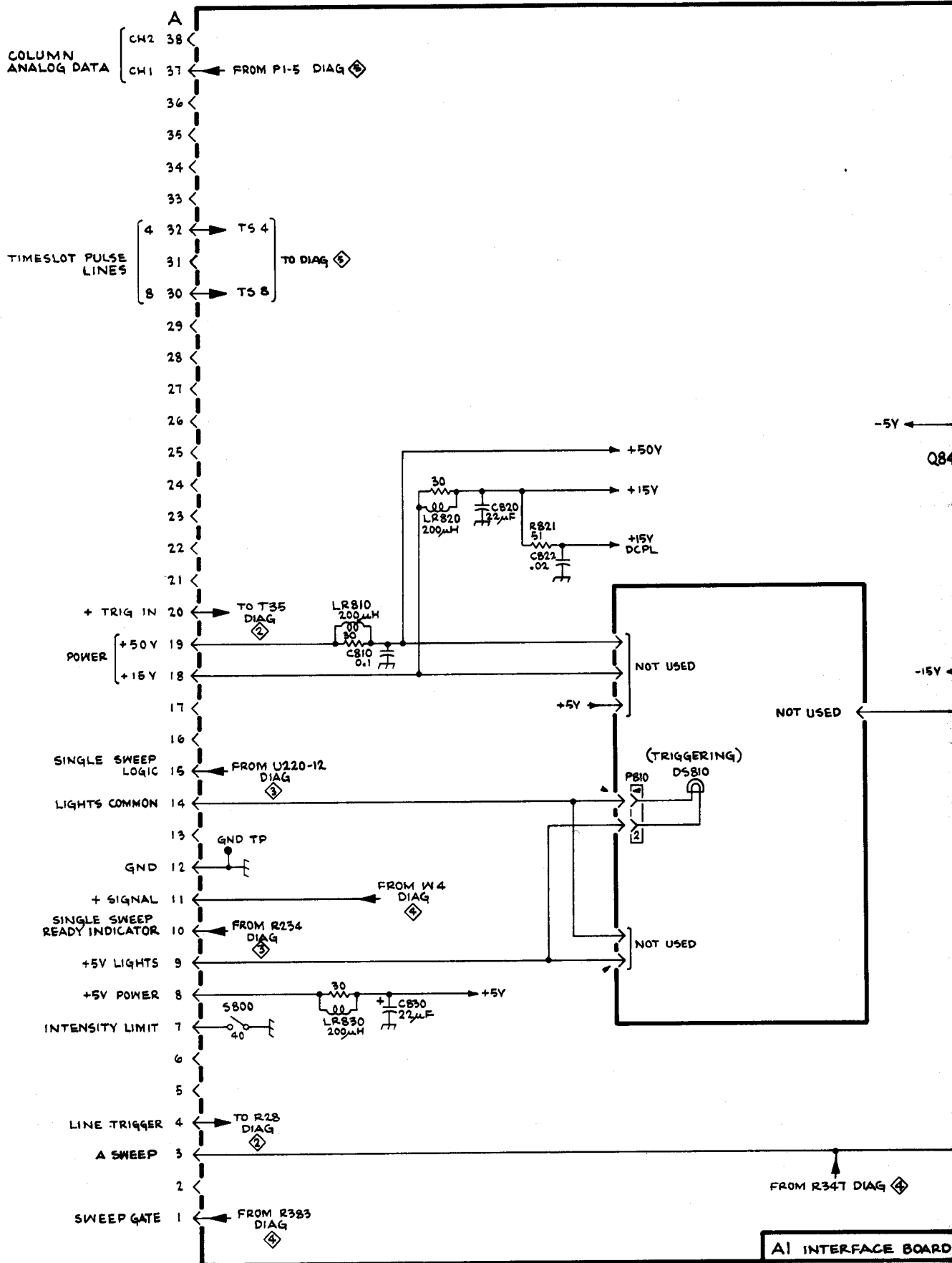


circuit board assembly.

	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
8	3K	R274	5E	R339	2G	R424	3D	R458	3D	R749	4F
9	2I	R275	4A	R341	2C	R426	2D	R459	3C	R821	5C
1	2I	R301	2F	R342	2C	R427	2C	R706	1H	R832	1J
2	2I	R303	2F	R343	2C	R428	2C	R710	1F	R841	2J
3	3I	R307	2F	R344	1B	R430	4D	R711	2H	R842	2J
4	2I	R308	2F	R345	1C	R431	3D	R712	1H	R844	2J
5	3I	R312	3F	R346	2B	R432	3E	R713	1H		
6	2I	R313	2G	R347	2B	R433	4D	R714	1H	S230	2K
7	2I	R314	2G	R351	1F	R434	3D	R715	1F	S435	2E
8	2I	R315	2G	R352	2F	R435	2B	R717	2H	S800	3G
2	5I	R321	2G	R353	2G	R436	4D	R721	2H		
4	3J	R322	2H	R354	2G	R437	3C	R722	4E	T35	3A
6	2J	R323	2G	R355	1G	R438	4C	R723	4E		
7	4K	R324	2H	R356	4K	R439	2E	R724	4E	TP345	2F
8	3J	R325	2G	R358	3K	R440	3C	R728	1H		
1	3K	R326	2H	R362	4J	R442	3D	R729	2H	U220	3J
2	4K	R330	3G	R371	4B	R444	3C	R731	3H	U416	4E
3	4K	R331	3G	R372	4B	R445	2D	R732	3H	U722	3H
4	4K	R332	3F	R381	4B	R446	3D	R741	4I	U842	2J
0	2K	R333	3E	R382	4B	R447	3C	R742	4H		
1	3K	R334	3F	R383	4A	R448	3D	R743	4H	VR314	2G
2	3K	R335	2G	R412	4E	R449	3C	R744	4H	VR728	2H
3	2K	R336	3F	R413	4E	R454	3C	R745	4H		
4	2K	R337	2F	R414	4E	R455	3D	R746	4G		
1	4J	R338	4F	R416	4E	R456	3D	R747	4G		
2	5D			R422	2E	R457	3C	R748	4G		

\*See Parts List for serial number ranges.

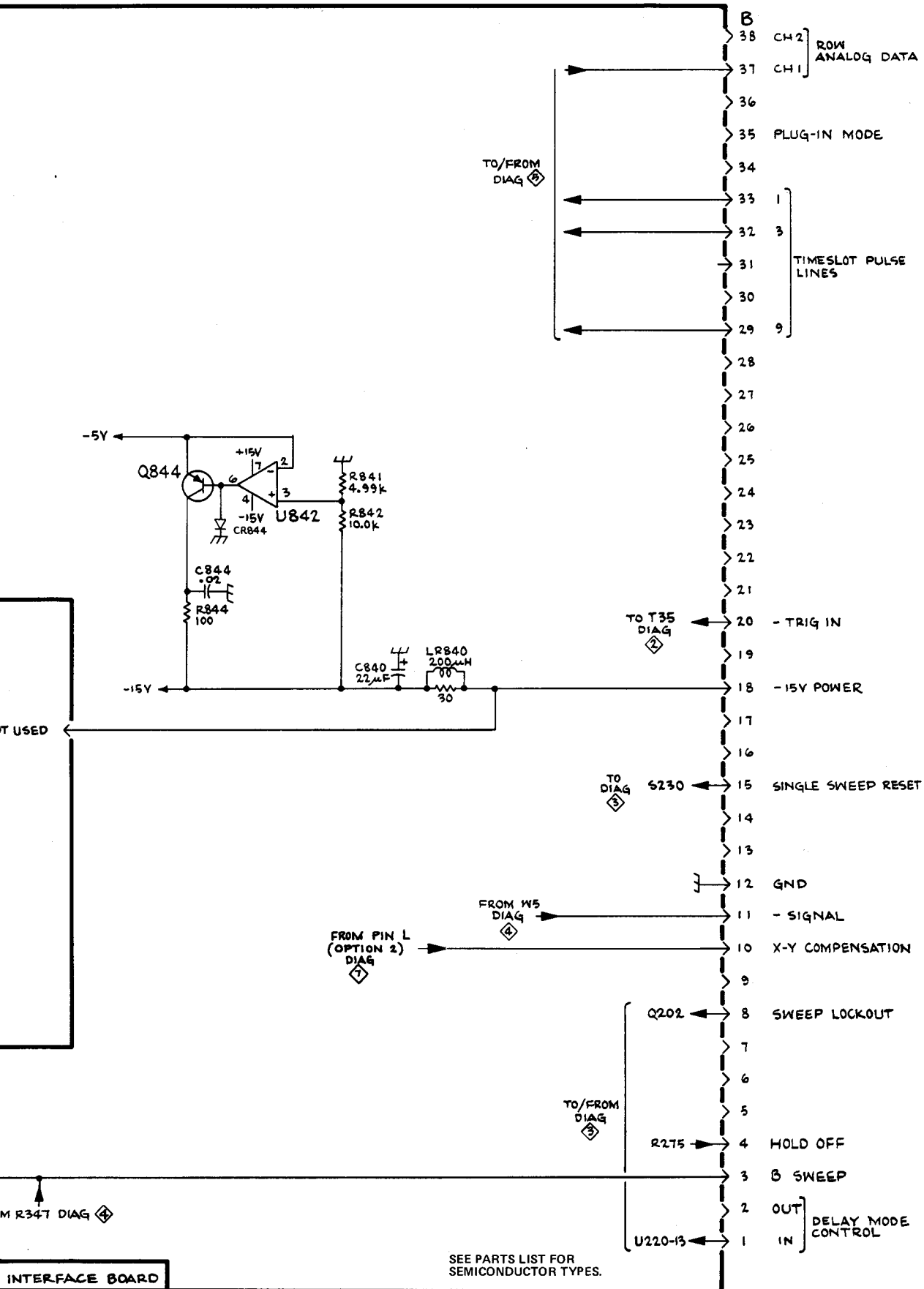




7B80

1959-69  
REV. A, APR. 1976





INTERFACE CONNECTORS AND POWER SUPPLY

6

INTERFACE BOARD

SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

INTERFACE CONNECTORS AND POWER SUPPLY

6

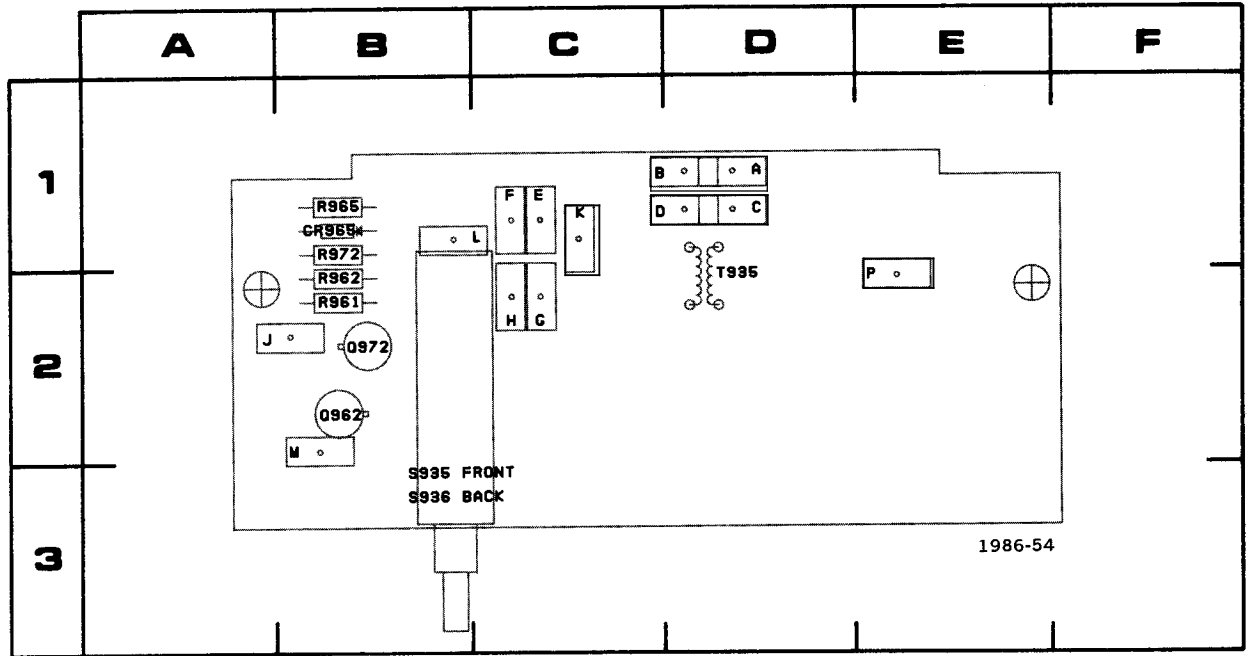
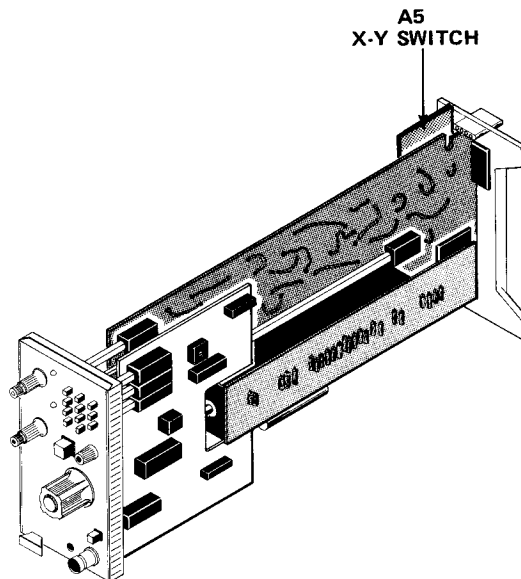
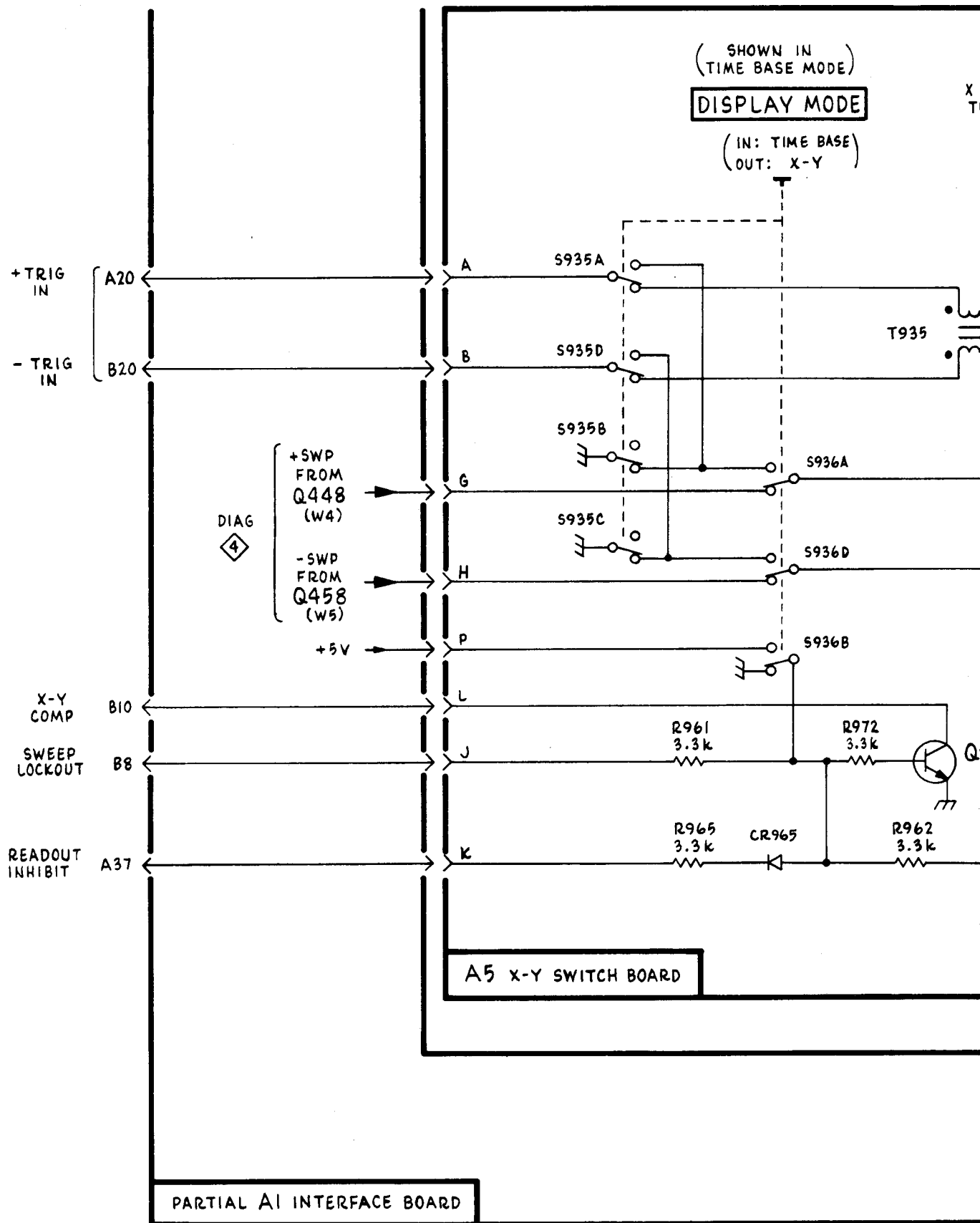


Fig. 8-14. A5-X-Y Switch circuit board assembly.

CKT NO	GRID COORD	CKT NO	GRID COORD
CR965	1B	S935	3B
		S936	3B
R961	2B		
R962	2B	T935	2D
R965	1B		
R972	1B		

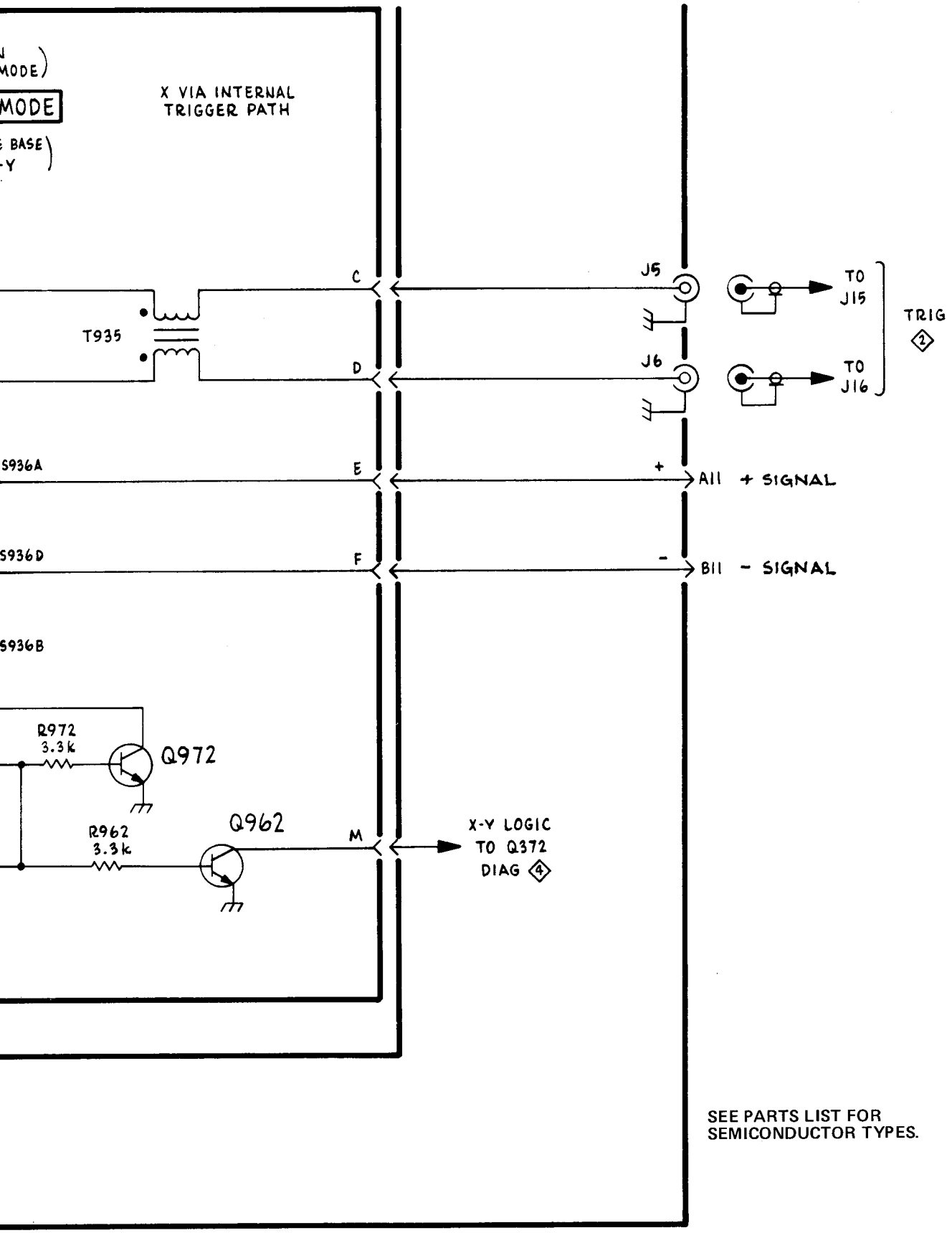
ASSEMBLY A5





1959-70  
 REV. A, APR. 1976

7B80



(OPTION 2)  
X-Y SWITCHING 7

(OPTION 2) X-Y SWITCHING

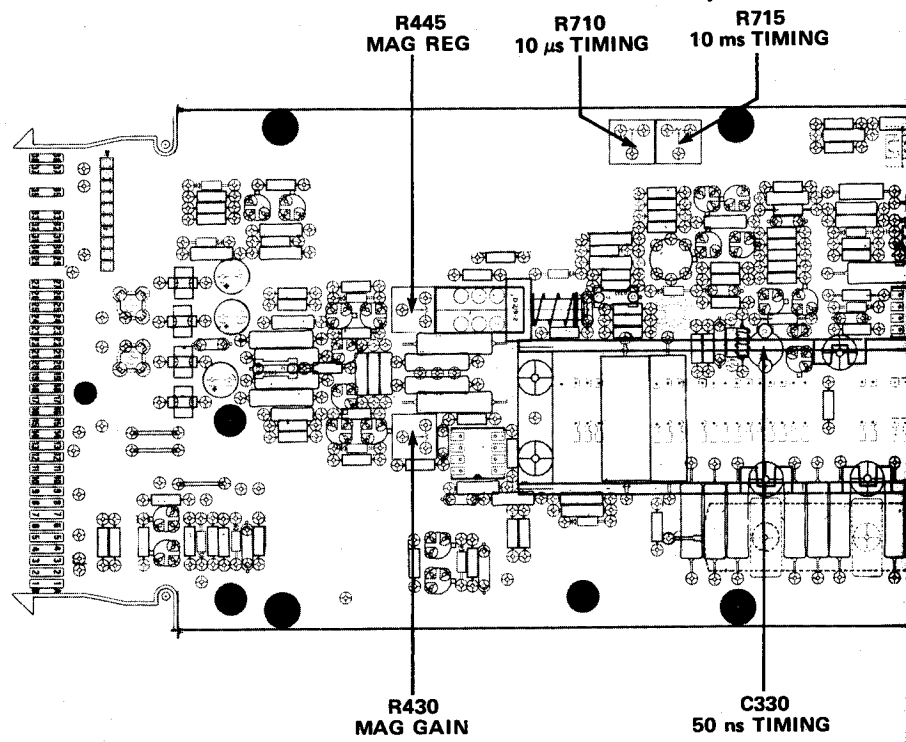


Fig. 8-15. Location of Sweep Timing adjustments.

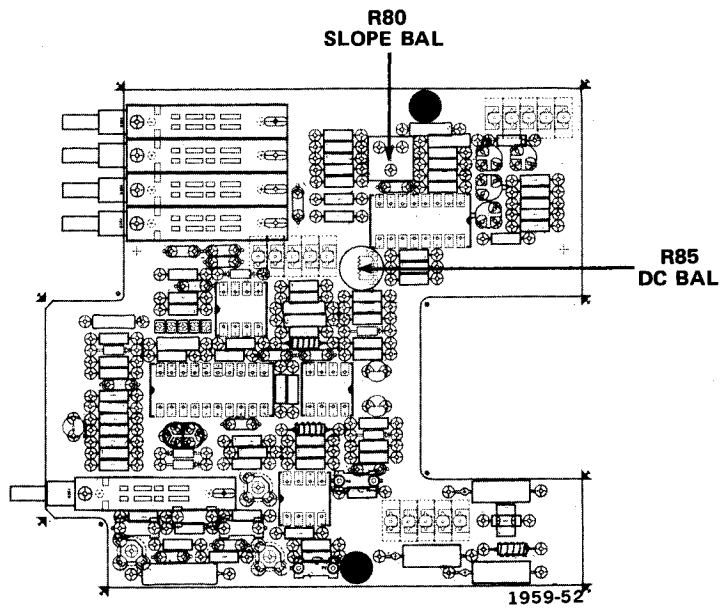
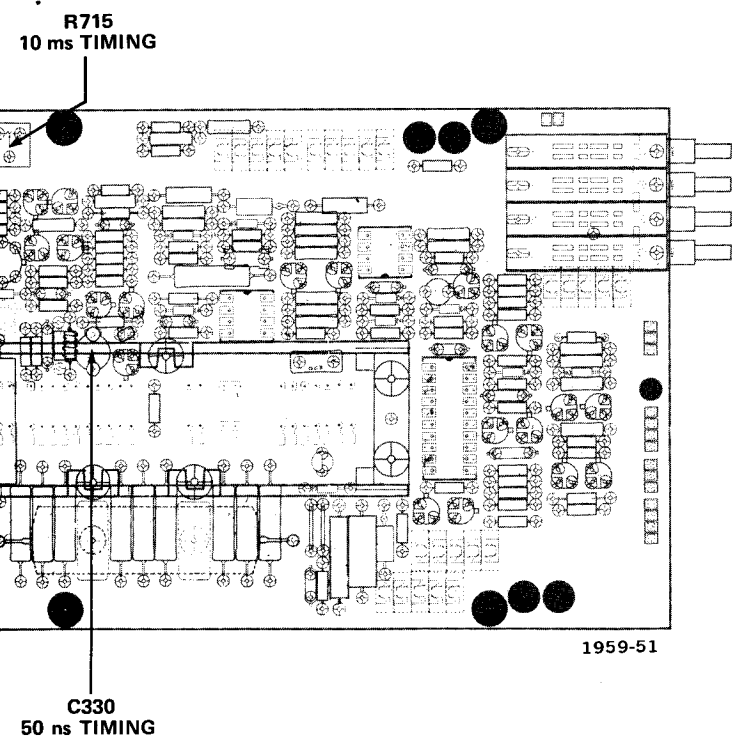
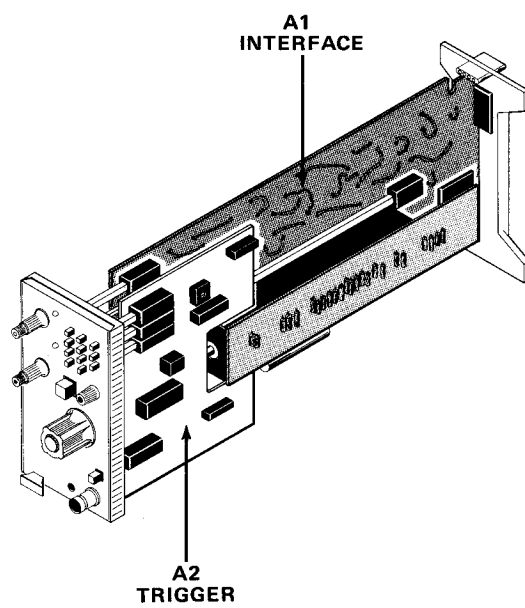
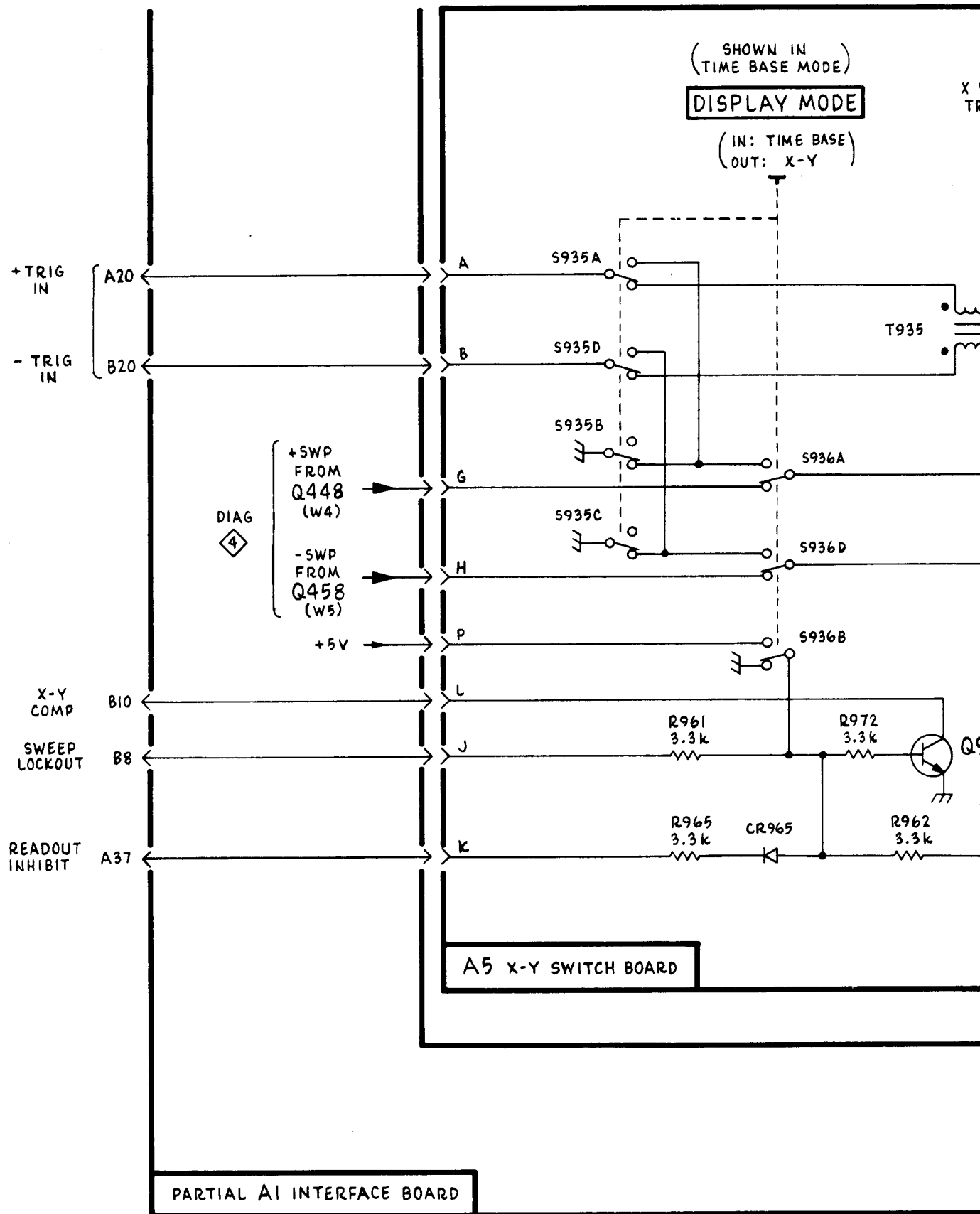


Fig. 8-16. Location of Triggering adjustments.



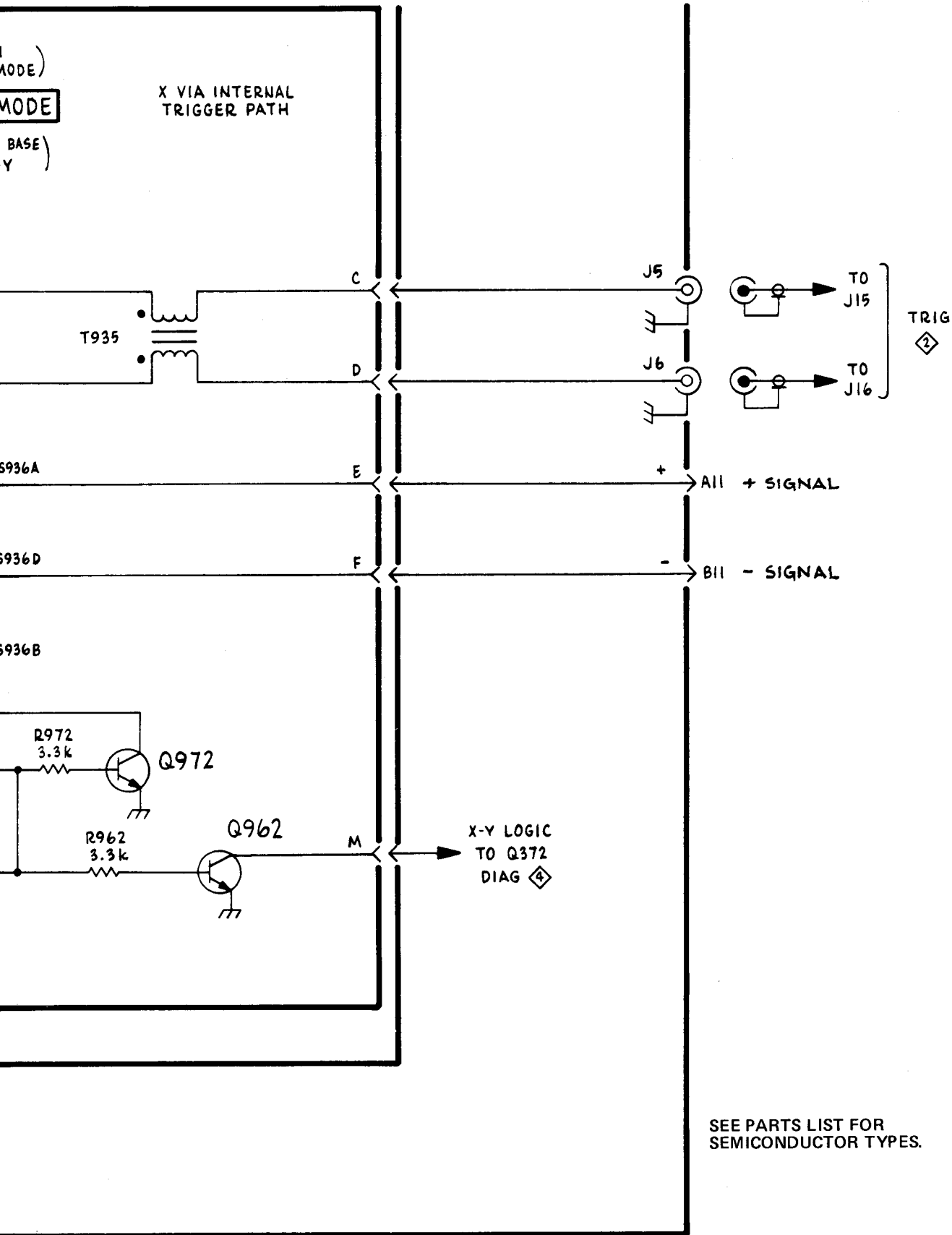
Sweep Timing adjustments.





1959-70  
REV. A, APR. 1976

7B80



(OPTION 2)  
X-Y SWITCHING





# REPLACEABLE MECHANICAL PARTS

## PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

## SPECIAL NOTES AND SYMBOLS

X000 Part first added at this serial number  
00X Part removed after this serial number

## FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

## INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

```

1 2 3 4 5      Name & Description
Assembly and/or Component
Attaching parts for Assembly and/or Component
-----*-----
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
-----*-----
Parts of Detail Part
Attaching parts for Parts of Detail Part
-----*-----

```

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol --- \* --- indicates the end of attaching parts.

**Attaching parts must be purchased separately, unless otherwise specified.**

## ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

## ABBREVIATIONS

"	INCH	ELCTRN	ELECTRON	IN	INCH	SE	SINGLE END
#	NUMBER SIZE	ELEC	ELECTRICAL	INCAND	INCANDESCENT	SECT	SECTION
ACTR	ACTUATOR	ELCTLT	ELECTROLYTIC	INSUL	INSULATOR	SEMICON	SEMICONDUCTOR
ADPTR	ADAPTER	ELEM	ELEMENT	INTL	INTERNAL	SHLD	SHIELD
ALIGN	ALIGNMENT	EPL	ELECTRICAL PARTS LIST	LPHLDR	LAMPHOLDER	SHLDR	SHOULDERED
AL	ALUMINUM	EQPT	EQUIPMENT	MACH	MACHINE	SKT	SOCKET
ASSEM	ASSEMBLED	EXT	EXTERNAL	MECH	MECHANICAL	SL	SLIDE
ASSY	ASSEMBLY	FIL	FILLISTER HEAD	MTG	MOUNTING	SLFLKG	SELF-LOCKING
ATTEN	ATTENUATOR	FLEX	FLEXIBLE	NIP	NIPPLE	SLVG	SLEEVEING
AWG	AMERICAN WIRE GAGE	FLH	FLAT HEAD	NON WIRE	NOT WIRE WOUND	SPR	SPRING
BD	BOARD	FLTR	FILTER	OBD	ORDER BY DESCRIPTION	SQ	SQUARE
BRKT	BRACKET	FR	FRAME or FRONT	OD	OUTSIDE DIAMETER	SST	STAINLESS STEEL
BRS	BRASS	FSTNR	FASTENER	OVH	OVAL HEAD	STL	STEEL
BRZ	BRONZE	FOOT	FOOT	PH BRZ	PHOSPHOR BRONZE	SW	SWITCH
BSHG	BUSHING	FXD	FIXED	PL	PLAIN or PLATE	T	TUBE
CAB	CABINET	GSKT	GASKET	PLSTC	PLASTIC	TERM	TERMINAL
CAP	CAPACITOR	HDL	HANDLE	PN	PART NUMBER	THD	THREAD
CER	CERAMIC	HEX	HEXAGON	PNH	PAN HEAD	THK	THICK
CHAS	CHASSIS	HEX HD	HEXAGONAL HEAD	PWR	POWER	TNSN	TENSION
CKT	CIRCUIT	HEX SOC	HEXAGONAL SOCKET	RCPT	RECEPTACLE	TPG	TAPPING
COMP	COMPOSITION	HLCPS	HELICAL COMPRESSION	RES	RESISTOR	TRH	TRUSS HEAD
CONN	CONNECTOR	HLEXT	HELICAL EXTENSION	RGD	RIGID	V	VOLTAGE
COV	COVER	HV	HIGH VOLTAGE	RLF	RELIEF	VAR	VARIABLE
CPLG	COUPLING	IC	INTEGRATED CIRCUIT	RTNR	RETAINER	W/	WITH
CRT	CATHODE RAY TUBE	ID	INSIDE DIAMETER	SCH	SOCKET HEAD	WSHR	WASHER
DEG	DEGREE	IDENT	IDENTIFICATION	SCOPE	OSCILLOSCOPE	XFMR	TRANSFORMER
DWR	DRAWER	IMPLR	IMPELLER	SCR	SCREW	XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
07707	USM CORP., USM FASTENER DIV.	510 RIVER RD.	SHELTON, CT 06484
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
13257	AMERACE, LTD.	10 ESNA PARK DRIVE	MARKHAM, ONTARIO, CANADA
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
24931	SPECIALTY CONNECTOR CO., INC.	3560 MADISON AVE.	INDIANAPOLIS, IN 46227
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
56878	STANDARD PRESSED STEEL COMPANY	BENSON EAST	JENKINTOWN, PA 19046
71159	BRISTOL SOCKET SCREW, DIV. OF AMERICAN CHAIN AND CABLE CO., INC.	P O BOX 2244, 40 BRISTOL ST.	WATERBURY, CT 06720
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
73803	TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV.	34 FOREST STREET	ATTLEBORO, MA 02703
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
79136	WALDES, KOHINOOR, INC.	47-16 AUSTEL PLACE	LONG ISLAND CITY, NY 11101
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
82647	TEXAS INSTRUMENTS, INC., CONTROL PRODUCTS DIV.	34 FOREST ST.	ATTLEBORO, MA 02703
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
87308	N. L. INDUSTRIES, INC., SOUTHERN SCREW DIV.	P. O. BOX 1360	STATESVILLE, NC 28677

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
1-1	337-1064-04		2						SHIELD,ELEC:RIGHT SIDE	80009	337-1064-00
-2	366-1391-00		1						KNOB:GRAY	80009	366-1391-00
	213-0725-00		1						. SETSCREW:3-48 X 0.095 INCH,HEX SOC STL	74445	OBD
-3	366-1319-00		1						KNOB:GRAY	80009	366-1319-00
	213-0725-00		1						. SETSCREW:3-48 X 0.095 INCH,HEX SOC STL	74445	OBD
-4	366-1077-00		2						KNOB:GRAY	80009	366-1077-00
	-----		-						. EACH KNOB INCLUDES:		
	213-0153-00		1						. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-5	426-0681-00		1						FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00
-6	366-1023-01		1						KNOB:GRAY	80009	366-1023-01
	213-0153-00		1						. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-7	366-1166-00		1						KNOB:RED	80009	366-1166-00
	213-0153-00		1						. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-8	366-1103-00		1						KNOB:GRAY	80009	366-1103-00
	213-0153-00		2						. SETSCREW:5-40 X 0.125 INCH,HEX SOC STL	74445	OBD
-9	366-1058-66		1						KNOB:LATCH	80009	366-1058-66
									(ATTACHING PARTS)		
-10	214-1095-00		1						PIN,SPG,SPLIT:0.094 OD X 0.187 INCH LONG	13257	52-022-094-0187
									-----		
-11	105-0076-02		1						REL BAR,LATCH:PLUG-IN UNIT	80009	105-0076-02
-12	214-1280-00		1						SPRING,HLCPS:0.14 OD X 1.126"L,0.16"DIA W	80009	214-1280-00
-13	426-1072-00		1						FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-14	333-1834-00		1						PANEL,FRONT:	80009	333-1834-00
-15	351-0469-00		2						GUIDE,SWITCH:4 BUTTON	80009	351-0469-00
-16	351-0469-01		1						GUIDE,SWITCH:3 BUTTON	80009	351-0469-01
-17	200-0935-00		3						BASE,LAMPHOLDER:0.29 OD X 0.19 CASE	80009	200-0935-00
-18	-----		1						LAMP,LED:LIGHT EMITTING DIODE(SEE CR220 EPL)		
-19	-----		1						LAMP,LED:LIGHT EMITTING DIODE(SEE CR232 EPL)		
-20	352-0157-00		3						LAMPHOLDER:WHITE PLASTIC	80009	352-0157-00
-21	-----		1						RESISTOR,VAR:(SEE R60 EPL)		
									(ATTACHING PARTS)		
-22	210-0583-00		1						NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
									-----		
-23	-----		1						RESISTOR,VAR:(SEE R410/R415 EPL)		
									(ATTACHING PARTS)		
-24	210-0583-00		2						NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-25	210-0046-00		1						WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
									-----		
-26	-----		1						RESISTOR,VAR:(SEE R210 EPL)		
									(ATTACHING PARTS)		
-27	210-0583-00		2						NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-28	210-0046-00		3						WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
									-----		
-29	-----		1						RESISTOR,VAR:(SEE R705 EPL)		
-30	210-0046-00		1						WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
-31	129-0290-00		1						POST,ELEC-MECH:0.635 INCH LONG,HEX	80009	129-0290-00
									(ATTACHING PARTS)		
-32	358-0342-00		1						BSHG,MACH.THD:0.25 X 32 X 0.352 INCH LONG	80009	358-0342-00
-33	210-0046-00		1						WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
									-----		
-34	131-1315-00		1						CONNECTOR,RCPT,:BNC,FEMALE	24931	28JR235-1
-35	348-0235-00		2						SHLD GSKT,ELEC:4.734 INCH LONG	80009	348-0235-00
	348-0067-00		1						GROMMET,PLASTIC:0.312 INCH DIA	80009	348-0067-00
-36	386-3256-00		1						SUBPANEL,FRONT:	80009	386-3256-00
									(ATTACHING PARTS)		
-37	213-0192-00		4						SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL	87308	OBD
									-----		
-38	386-3439-00		1						LT CNDCT,PB ILL:10 BUTTON,7.5MM SPACING	80009	386-3439-00
-39	214-1061-00		1						SPRING,GROUND:FLAT	80009	214-1061-00
-40	214-1054-00		1						SPRING,DETENT:LATCH	80009	214-1054-00
-41	105-0075-00		1						PAWL:0.475 X 0.21 X 0.184 INCH,PLSTC	80009	105-0075-00
-42	378-0074-00		11						REFLECTOR,LIGHT:PUSH BUTTON	80009	378-0074-00

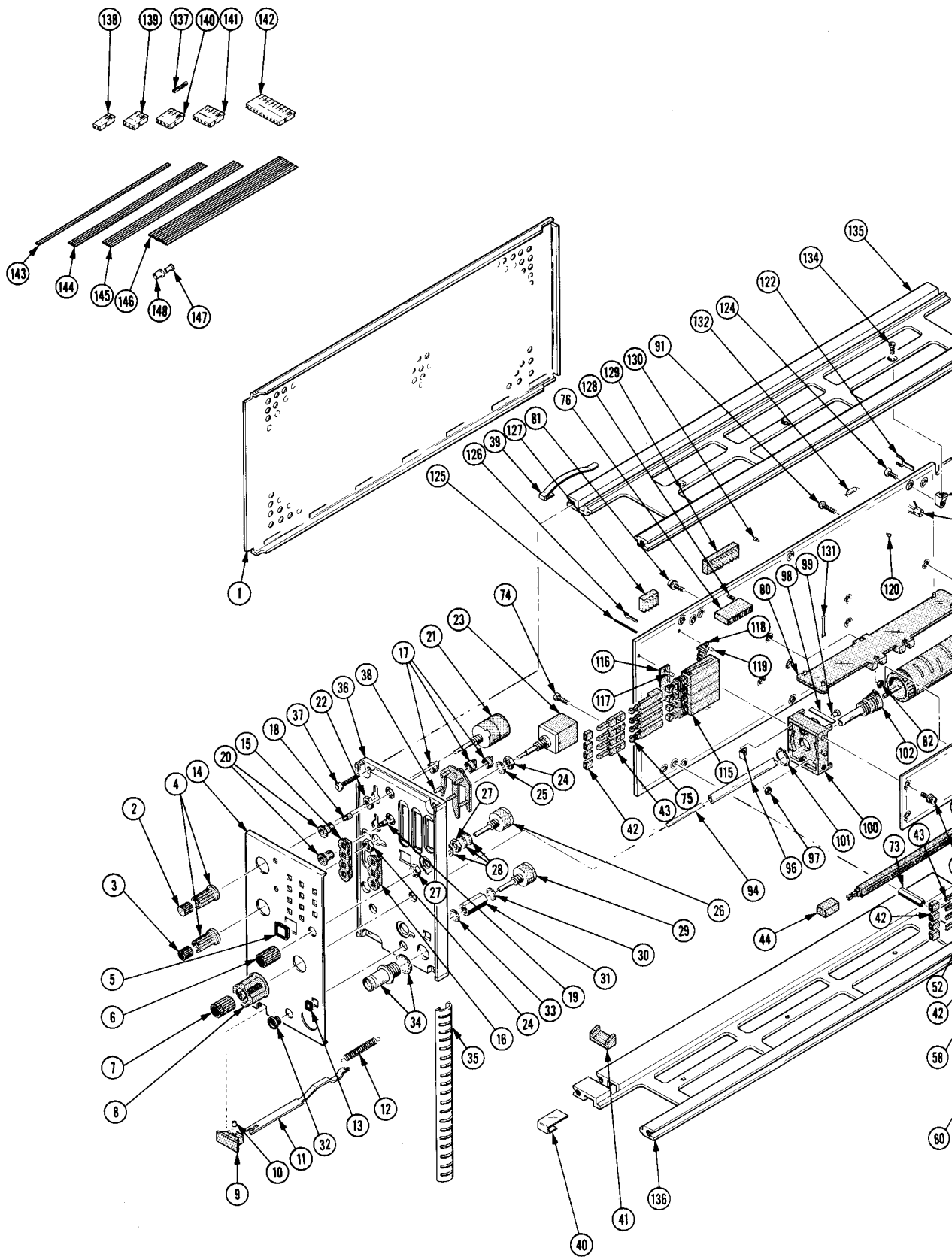
Replaceable Mechanical Parts—7B80

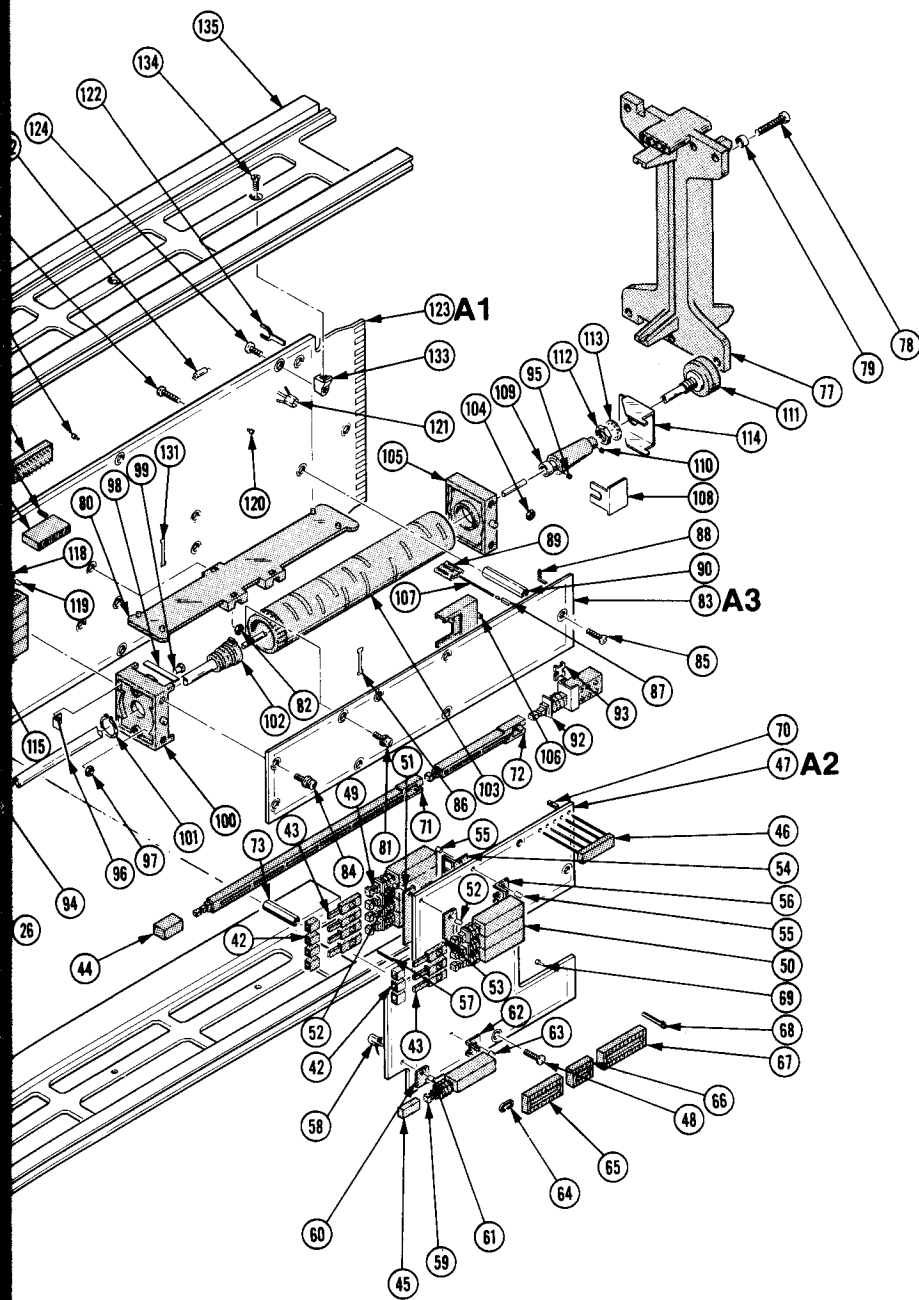
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-43	366-1650-00		11		PUSH BUTTON: CLEAR, 0.184 X 0.214 X 8.0 L	80009	360-1650-00
-44	366-1257-93		1		PUSH BUTTON: +10 MAG	80009	366-1257-93
-45	366-1559-00		1		PUSH BUTTON: GRAY	80009	366-1559-00
-46	131-1820-00		3		CONNECTOR, PLUG, : CKT CD, 5 MALE	22526	65306-002
-47	-----		1		CKT BOARD ASSY: TRIGGER (SEE A2 EPL) (ATTACHING PARTS)		
-48	211-0008-00		2		SCREW, MACHINE: 4-40 X 0.25 INCH, PNH STL -----*-----	83385	OBD
	-----		-		. CKT BOARD ASSEMBLY INCLUDES:		
-49	263-0016-00		1		. ACTR ASSY, PB: 4 LATCHING, 7.5 MM, 5 CONTACT	80009	263-0016-00
-50	263-0015-00		1		. ACTR ASSY, PB: 3 LATCHING, 7.5 MM	80009	263-0015-00
-51	343-0495-04		1		. CLIP, SWITCH: FRONT, 7.5 MM, 4 UNIT (ATTACHING PARTS)	80009	343-0495-04
-52	210-3050-00		3		. EYELET, METALLIC: 0.218 L X 0.059 OD, BRS	07707	SE-27
	210-3033-00		1		. EYELET, METALLIC: 0.59 OD X 0.156 INCH LONG -----*-----	07707	SE-25
-53	343-0495-03		1		. CLIP, SWITCH: FRONT, 7.5 MM, 3 UNIT	80009	343-0495-03
-54	343-0499-04		1		. CLIP, SWITCH: REAR, 7.5MM X 4 UNIT (ATTACHING PARTS)	80009	343-0499-04
-55	210-3050-00		3		. EYELET, METALLIC: 0.218 L X 0.059 OD, BRS	07707	SE-27
	210-3033-00		1		. EYELET, METALLIC: 0.59 OD X 0.156 INCH LONG -----*-----	07707	SE-25
-56	343-0499-03		1		. CLIP, SWITCH: 7.5 MM, 4 UNIT	80009	343-0499-03
-57	131-0608-00		5		. TERMINAL, PIN: 0.365 L X 0.25 PH, BRZ, GOLD PL	22526	47357
-58	131-1003-00		3		. CONNECTOR BODY, : CKT CD MT, 3 PRONG	80009	131-1003-00
-59	263-0010-01		1		. ACTR ASSY, PB: 1 PUSH, 7.5 MM, 1 CONTACT	80009	263-0010-01
-60	343-0495-01		1		. CLIP, SWITCH: FRONT, 7.5 MM, 1 UNIT (ATTACHING PARTS)	80009	343-0495-01
-61	210-3033-00		1		. EYELET, METALLIC: 0.59 OD X 0.156 INCH LONG -----*-----	07707	SE-25
-62	343-0499-01		1		. CLIP, SWITCH: REAR, 7.5 MM, 1 UNIT (ATTACHING PARTS)	80009	343-0499-01
-63	210-3033-00		1		. EYELET, METALLIC: 0.59 OD X 0.156 INCH LONG -----*-----	07707	SE-25
-64	214-0973-00		1		. HEAT SINK, ELEC: 0.28 X 0.18 OVAL X 0.187"H	80009	214-0973-00
-65	136-0260-02		1		. SOCKET, PLUG-IN: 16 CONTACT, LOW CLEARANCE	82647	C951601
-66	136-0514-00		3		. SOCKET, PLUG IN: MICROCIRCUIT, 8 CONTACT	82647	C950801
-67	136-0634-00		1		. SOCKET, PLUG-IN: 20 LEAD DIP, CKT BD MTG	73803	C952002
-68	214-0579-00		2		. TERM., TEST PT: 0.40 INCH LONG	80009	214-0579-00
-69	136-0252-04	B010100 B049999	21		. SOCKET, PIN TERM: 0.188 INCH LONG	22526	75060
	136-0252-04	B050000	18		. SOCKET, PIN TERM: 0.188 INCH LONG	22526	75060
-70	136-0263-04		15		. SOCKET, PIN TERM: FOR 0.025 INCH SQUARE PIN	22526	48059
-71	384-1100-00		1		EXTENSION SHAFT: 0.13 SQ X 6.215" LONG, PLSTC	80009	384-1100-00
-72	384-1292-00		1		EXTENSION SHAFT: 2.417 INCH LONG, PLASTIC	80009	384-1292-00
-73	129-0198-00		2		POST, ELEC-MECH: 0.188 HEX X 0.74 INCH L, BRS (ATTACHING PARTS FOR EACH)	80009	129-0198-00
-74	211-0008-00		1		SCREW, MACHINE: 4-40 X 0.25 INCH, PNH STL -----*-----	83385	OBD
-75	384-1382-00		4		EXTENSION SHAFT: 1.09 INCH LONG	80009	384-1382-00
-76	204-0683-00		3		BODY, CONN, RCPT: 5 FEMALE POSN CONTACT	22526	65058-061
-77	386-1402-02	B010100 B052839	1		PANEL, REAR:	80009	386-1402-02
	386-1402-00	B052740	1		PANEL, REAR: (ATTACHING PARTS)	80009	386-1402-00
-78	213-0192-00		4		SCR, TPG, THD FOR: 6-32 X 0.50 INCH, PNH STL	87308	OBD
-79	361-0326-00		1		SPACER, SLEEVE: 0.18 ID X 0.25 OD X 0.10"L -----*-----	80009	361-0326-00
	672-0538-00		1		CKT BOARD ASSY: CAM SWITCH	80009	672-0538-00
-80	200-1362-00		2		. COVER, CAM SW: BLACK PLASTIC (ATTACHING PARTS FOR EACH)	80009	200-1362-00
-81	211-0207-00		3		. SCR, ASSEM WSHR: 4-40 X 0.312 INCH, PNH STL	83385	OBD
-82	210-0406-00		3		. NUT, PLAIN, HEX.: 4-40 X 0.188 INCH, BRS -----*-----	73743	2X12161-402

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
1-83	-----		1	.	.	.	.	.	CKT BOARD ASSY:READOUT (SEE A3 EPL) (ATTACHING PARTS)		
-84	211-0207-00		4	.	.	.	.	.	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	83385	OBD
-85	211-0008-00		1	.	.	.	.	.	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
	-----		-	.	.	.	.	.	CKT BOARD ASSEMBLY INCLUDES:		
-86	131-0604-00		9	.	.	.	.	.	CONTACT,ELEC:CKT CD SW,SPR	80009	131-0604-00
-87	136-0263-04		3	.	.	.	.	.	SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	48059
-88	131-0589-00		10	.	.	.	.	.	CONTACT,ELEC:0.46 INCH LONG	22526	47350
-89	352-0274-00		1	.	.	.	.	.	HOLDER,TERMINAL:FOR 8 SQUARE PINS	80009	352-0274-00
-90	129-0570-00		1	.	.	.	.	.	POST,ELEC-MECH:0.188 HEX X 0.976"LONG,BRS	80009	129-0570-00
	-----		1	.	.	.	.	.	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-91	211-0008-00		1	.	.	.	.	.	SWITCH,PUSH:1 BUTTON,DPDT	71590	2KAB010000
-92	260-1771-00		2	.	.	.	.	.	SPACER,PUSH SW:0.13 W X 0.375 INCH L,PLSTC	71590	J64285-00
-93	361-0411-00		1	.	.	.	.	.	EXTENSION SHAFT:10.275 INCH LONG,PLASTIC	80009	384-1417-00
-94	384-1417-00		1	.	.	.	.	.	SETSCREW:4-40 X 0.125 INCH,HEX SOC STL	56878	OBD
	-----		1	.	.	.	.	.	ACTR ASSY,CAM S:FRONT,TIME/CM	80009	263-1134-00
-95	213-0299-00		1	.	.	.	.	.	CONTACT,ELEC:GROUNDING	80009	131-0963-00
	263-1134-00		1	.	.	.	.	.	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-96	131-0963-00		3	.	.	.	.	.	SPRING,FLAT:RED COLORED	80009	214-1139-03
-97	210-0406-00		2	.	.	.	.	.	ROLLER,DETENT:	80009	214-1752-00
-98	214-1139-03		2	.	.	.	.	.	BEARING,CAM SW:FRONT	80009	401-0180-00
-99	214-1752-00		1	.	.	.	.	.	RING,RETAINING:0.338 ID X 0.025" THK,STL	79136	5100-37MD
-100	401-0180-00		1	.	.	.	.	.	SHAFT,CAM SW:OUTER CONCENTRIC,W/DRIVER	80009	384-0878-08
	-----		1	.	.	.	.	.	DRUM,CAM SW:CAM SWITCH	80009	105-0696-00
-101	354-0390-00		4	.	.	.	.	.	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-102	384-0878-08		1	.	.	.	.	.	BEARING,CAM SW:CENTER/REAR	80009	401-0178-01
-103	105-0696-00		1	.	.	.	.	.	SLIDE,GUIDE:SWITCH ACTUATOR	80009	351-0180-00
-104	210-0406-00		1	.	.	.	.	.	CONTACT,ELEC:1.15 INCH LONG	22526	47354
-105	401-0178-01		3	.	.	.	.	.	ACTUATOR,SL SW:DUAL DPST	80009	214-1136-00
-106	351-0180-00		1	.	.	.	.	.	EXTENDER,RETRAC:	80009	214-1190-00
-107	351-0180-00		1	.	.	.	.	.	SETSCREW:3-48 X 0.062 INCH,HEX SOC STL	71159	OBD
-108	131-0593-00		1	.	.	.	.	.	RESISTOR,VAR: (SEE R725 EPL) (ATTACHING PARTS)		
-109	214-1136-00		1	.	.	.	.	.	NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20224-402
-110	214-1190-00		1	.	.	.	.	.	WASHER,LOCK:INTL,0.26 ID X 0.40" OD,STL	78189	1214-05-00-0541C
	-----		1	.	.	.	.	.	BRACKET,CMPNT:	80009	407-0803-00
-111	-----		1	.	.	.	.	.	ACTR ASSY,PB:3 LATCHING,7.5 MM,5 CONTACT	80009	263-0016-01
-112	210-0583-00		5	.	.	.	.	.	CLIP,SWITCH:FRONT,7.5 MM,4 UNIT	80009	343-0495-04
-113	210-0046-00		4	.	.	.	.	.	EYELET,METALLIC:0.59 OD X 0.156 INCH LONG	07707	SE-25
	-----		1	.	.	.	.	.	CLIP,SWITCH:REAR,7.5MM X 4 UNIT	80009	343-0499-04
-114	407-0803-00		4	.	.	.	.	.	EYELET,METALLIC:0.59 OD X 0.156 INCH LONG	07707	SE-25
-115	263-0016-01		3	.	.	.	.	.	SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-116	343-0495-04		2	.	.	.	.	.	CONNECTOR BODY,:CKT CD MT,3 PRONG	80009	131-1003-00
	-----		2	.	.	.	.	.	HLD,ER,ELEK CMPNT:PNL MT 0.531 ID MOLD PLSTC	80009	352-0196-00
-117	210-3033-00		1	.	.	.	.	.	CKT BOARD ASSY:INTERFACE (SEE A1 EPL) (ATTACHING PARTS)		
-118	210-3033-00		6	.	.	.	.	.	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-119	136-0252-04		3	.	.	.	.	.			
-120	131-1003-00		2	.	.	.	.	.			
-121	352-0196-00		2	.	.	.	.	.			
-122	-----		1	.	.	.	.	.			
-123	-----		1	.	.	.	.	.			
-124	211-0008-00		6	.	.	.	.	.			

Replaceable Mechanical Parts—7B80

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1	2	3	4	5	Name & Description	Mfr Code	Mfr Part Number
1-	-----	-----		-						CKT BOARD ASSEMBLY INCLUDES:		
-125	131-0608-00			30						TERMINAL,PIN:0.365 L X 0.25 PH,BRZ,GOLD PL	22526	47357
-126	214-0579-00			3						TERM.,TEST PT:0.40 INCH LONG	80009	214-0579-00
-127	136-0514-00			3						SOCKET,PLUG IN:MICROCIRCUIT,8 CONTACT	82647	C950801
-128	136-0263-04			15						SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	48059
-129	136-0634-00			1						SOCKET,PLUG-IN:20 LEAD DIP,CKT BD MTG	73803	C952002
-130	136-0252-04			105						SOCKET,PIN TERM:0.188 INCH LONG	22526	75060
-131	131-0604-00			25						CONTACT,ELEC:CKT CD SW,SPR	80009	131-0604-00
-132	131-0566-00			5						LINK,TERM.CONNE:0.086 DIA X 2.375 INCH L	55210	L-2007-1
-133	220-0547-01			6						NUT,BLOCK:0.38 X 0.25 X 0.282"OA	80009	220-0547-01
										(ATTACHING PARTS FOR EACH)		
-134	211-0105-00			1						SCREW,MACHINE:4-40 X 0.188"100 DEG,FLH STL	83385	OBD
										-----*		
-135	426-0505-11			1						FR SECT,PLUG-IN:TOP	80009	426-0505-11
-136	426-0499-11			1						FR SECT,PLUG IN:BOTTOM	80009	426-0499-11
-137	131-0707-00			50						CONNECTOR,TERM.:0.48" L,22-26AWG WIRE	22526	75691-005
-138	352-0169-00			1						CONN BODY,PL,EL:2 WIRE BLACK	80009	352-0169-00
-139	352-0161-05			1						CONN BODY,PL,EL:3 WIRE GREEN	80009	352-0161-05
	352-0161-07			1						CONN BODY,PL,EL:3 WIRE VIOLET	80009	352-0161-07
-140	352-0162-00			1						CONN BODY,PL,EL:4 WIRE BLACK	80009	352-0162-00
	352-0162-04			1						CONN BODY,PL,EL:4 WIRE YELLOW	80009	352-0162-04
	352-0162-05			1						CONN BODY,PL,EL:4 WIRE GREEN	80009	352-0162-05
-141	352-0163-06			1						CONN BODY,PL,EL:5 WIRE BLUE	80009	352-0163-06
-142	352-0168-00			2						CONN BODY,PL,EL:10 WIRE BLACK	80009	352-0168-00
-143	175-0825-00			FT						WIRE,ELECTRICAL:2 WIRE RIBBON	08261	OBD
-144	175-0827-00			FT						WIRE,ELECTRICAL:4 WIRE RIBBON	08261	SS-0426-710610C
-145	175-0828-00			FT						WIRE,ELECTRICAL:5 WIRE RIBBON	08261	SS-0526-710610C
-146	175-0833-00			FT						WIRE,ELECTRICAL:10 WIRE RIBBON	08261	OBD
-147	210-0775-00			4						EYELET,METALLIC:0.126 OD X 0.23 INCH L,BRS	80009	210-0775-00
-148	210-0774-00			4						EYELET,METALLIC:0.152 OD X 0.245 INCH L,BRS	80009	210-0774-00





7B80 TIME BASE



Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	No. Dscnt	Qty	1	2	3	4	5	Name & Description	Mfr	
											Code	Mfr Part Number
STANDARD ACCESSORIES												
2-												
-1	070-1958-00			1						MANUAL, TECH: OPERATORS	80009	070-1958-00
-2	070-1959-00			1						MANUAL, TECH: INSTRUCTION	80009	070-1959-00

FIG. 2 ACCESSORIES

# OPTION 2

## X-Y Display

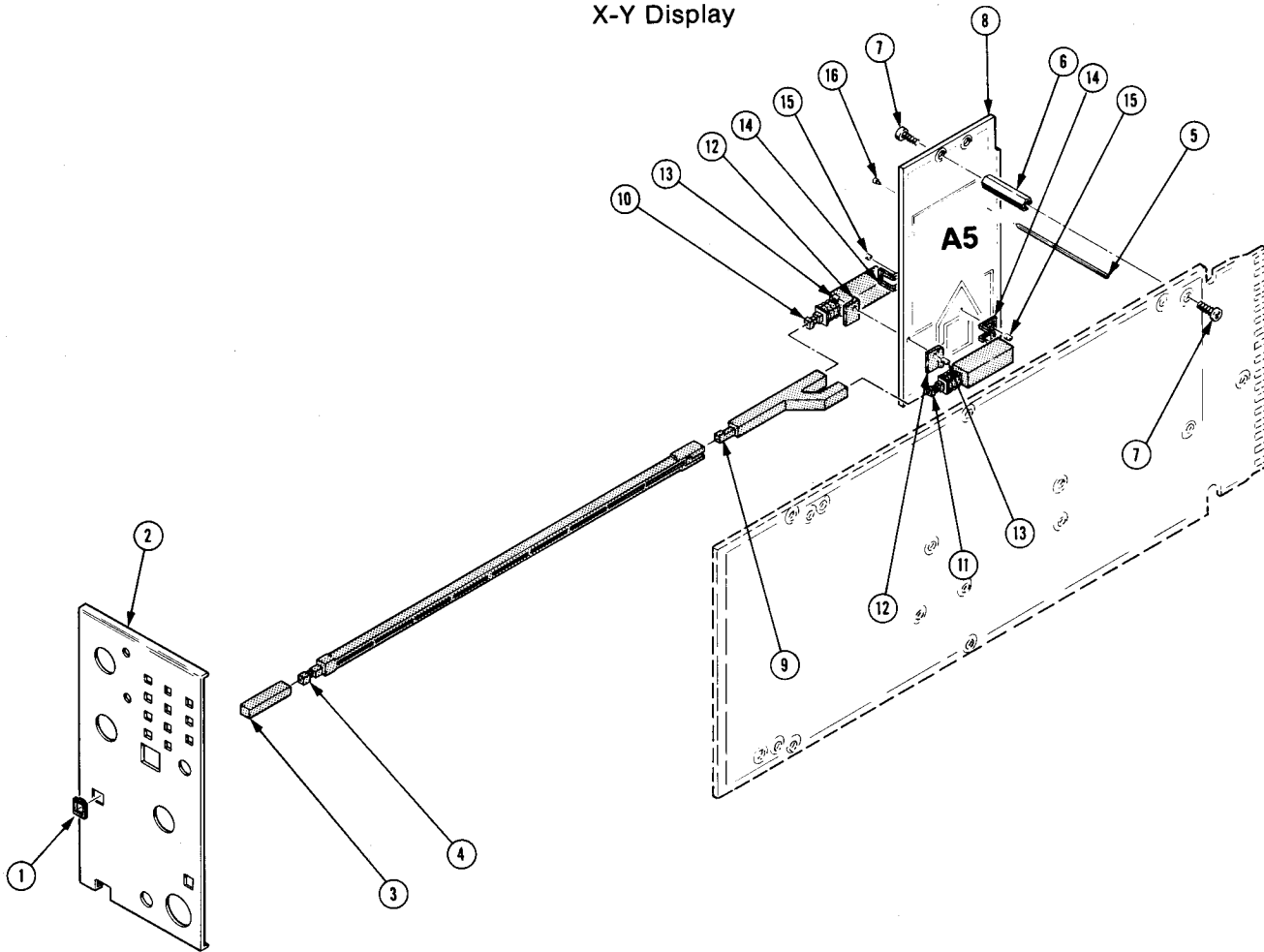


Fig. &  
Index  
No.

Tektronix  
Part No.

Serial/Model No.  
Eff Dscont

Qty

1 2 3 4 5

Name & Description

Mfr

Code

Mfr Part Number

3-1	426-1072-00				1	FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-2	333-2151-00				1	PANEL,FRONT:	80009	333-2151-00
-3	366-1512-00				1	PUSH BUTTON:GRAY,0.18 SQ X 0.83 INCH LG	80009	366-1512-00
-4	384-1058-00	B010100	B019999		1	EXTENSION SHAFT:8.157 INCH LONG	80009	384-1058-00
	384-1445-00	B020000			1	EXTENSION SHAFT:10.294 INCH LONG,PLASTIC	80009	384-1445-00
-5	131-0592-00				13	CONTACT,ELEC:0.885 INCH LONG	22526	47353
-6	129-0198-00				2	POST,ELEC-MECH:0.188 HEX X 0.74 INCH L,BRS (ATTACHING PARTS)	80009	129-0198-00
-7	211-0008-00				1	SCREW,MACHINE:4-40 X 0.25 INCH,PNH STL	83385	OBD
-8	211-0116-00				1	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS - - - * - - -	83385	OBD
-9	-----				1	CKT BOARD ASSY:X-Y SWITCHING(SEE A5 EPL)		
-10	384-1425-00	B010100	B019999		1	. EXTENSION SHAFT:2.137 INCH LONG	80009	384-1425-00
	384-1445-00	B020000			1	. EXTENSION SHAFT:10.294 INCH LONG,PLASTIC	80009	384-1445-00
-11	263-0011-00				1	. ACTR ASSY:PB:1 PUSH,10MM	80009	263-0011-00
-12	263-0011-06				1	. ACTR ASSY:PB:1 MOMENTARY,11 MM,3 CONTACT	80009	263-0011-06
-13	343-0495-01				2	. CLIP,SWITCH:FRONT,7.5 MM,1 UNIT (ATTACHING PARTS)	80009	343-0495-01
-14	210-3050-00				2	. EYELET,METALLIC:0.218 L X 0.059 OD,BRS - - - * - - -	07707	SE-27
-15	343-0499-01				2	. CLIP,SWITCH:REAR,7.5 MM,1 UNIT (ATTACHING PARTS FOR EACH)	80009	343-0499-01
-16	210-3050-00				2	. EYELET,METALLIC:0.218 L X 0.059 OD,BRS - - - * - - -	07707	SE-27
-17	136-0252-04				6	. CONTACT,ELEC:0.188 INCH LONG	22526	75060

## **MANUAL CHANGE INFORMATION**

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.

## **SERVICE NOTE**

Because of the universal parts procurement problem, some electrical parts in your instrument may be different from those described in the Replaceable Electrical Parts List. The parts used will in no way alter or compromise the performance or reliability of this instrument. They are installed when necessary to ensure prompt delivery to the customer. Order replacement parts from the Replaceable Electrical Parts List.

# CALIBRATION TEST EQUIPMENT REPLACEMENT

## Calibration Test Equipment Chart

This chart compares TM 500 product performance to that of older Tektronix equipment. Only those characteristics where significant specification differences occur, are listed. In some cases the new instrument may not be a total functional replacement. Additional support instrumentation may be needed or a change in calibration procedure may be necessary.

### Comparison of Main Characteristics

DM 501 replaces 7D13		
PG 501 replaces 107	PG 501 - Risetime less than 3.5 ns into 50 $\Omega$ .	107 - Risetime less than 3.0 ns into 50 $\Omega$ .
108	PG 501 - 5 V output pulse; 3.5 ns Risetime.	108 - 10 V output pulse; 1 ns Risetime.
111	PG 501 - Risetime less than 3.5 ns; 8 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger Pulse delay.
114	PG 501 - $\pm 5$ V output.	114 - $\pm 10$ V output. Short proof output.
115	PG 501 - Does not have Paired, Burst, Gated, or Delayed pulse mode; $\pm 5$ V dc Offset. Has $\pm 5$ V output.	115 - Paired, Burst, Gated, and Delayed pulse mode; $\pm 10$ V output. Short-proof output.
PG 502 replaces 107		
108	PG 502 - 5 V output	108 - 10 V output.
111	PG 502 - Risetime less than 1 ns; 10 ns Pretrigger pulse delay.	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger pulse delay.
114	PG 502 - $\pm 5$ V output	114 - $\pm 10$ V output. Short proof output.
115	PG 502 - Does not have Paired, Burst, Gated, Delayed & Undelayed pulse mode; Has $\pm 5$ V output.	115 - Paired, Burst, Gated, Delayed & Undelayed pulse mode; $\pm 10$ V output. Short-proof output.
2101	PG 502 - Does not have Paired or Delayed pulse. Has $\pm 5$ V output.	2101 - Paired and Delayed pulse; 10 V output.
PG 506 replaces 106	PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude output, 60 V.	106 - Positive and Negative-going trigger output signal, 50 ns and 1 V; High Amplitude output, 100 V.
067-0502-01	PG 506 - Does not have chopped feature.	0502-01 - Comparator output can be alternately chopped to a reference voltage.
SG 503 replaces 190, 190A, 190B		
191	SG 503 - Amplitude range 5 mV to 5.5 V p-p.	190B - Amplitude range 40 mV to 10 V p-p.
067-0532-01	SG 503 - Frequency range 250 kHz to 250 MHz.	191 - Frequency range 350 kHz to 100 MHz.
	SG 503 - Frequency range 250 kHz to 250 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
TG 501 replaces 180, 180A		
181	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	180A - Marker outputs, 5 sec to 1 $\mu$ s. Sinewave available at 20, 10, and 2 ns. Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously.
184	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	181 - Marker outputs, 1, 10, 100, 1000, and 10,000 $\mu$ s, plus 10 ns sinewave.
2901	TG 501 - Marker outputs, 5 sec to 1 ns. Sinewave available at 5, 2, and 1 ns. Trigger output - slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	184 - Marker outputs, 5 sec to 2 ns. Sinewave available at 50, 20, 10, 5, and 2 ns. Separate trigger pulses of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 $\mu$ s. Marker amplifier provides positive or negative time marks of 25 V min. Marker intervals of 1 and .1 sec; 10, 1, and .1 ms; 10 and 1 $\mu$ s.
		2901 - Marker outputs, 5 sec to 0.1 $\mu$ s. Sinewave available to 50, 10, and 5 ns. Separate trigger pulses, from 5 sec to 0.1 $\mu$ s. Multiple time-marks can be generated simultaneously.

NOTE: All TM 500 generator outputs are short-proof. All TM 500 plug-in instruments require TM 500-Series Power Module.



# MANUAL CHANGE INFORMATION

PRODUCT 7B50A, 7B80 & 7B85

CHANGE REFERENCE C4/978

DATE 9-29-78

CHANGE:

DESCRIPTION

7B50A (070-1986-00)

7B80 (070-1959-00)

7B85 (070-1961-00)

## TEXT CORRECTIONS

ADD new Step A4 as follows: Page 5-5 (7B50A & 7B80) Page 5-6 (7B85)

### A4. ADJUST TRIGGERING SENSITIVITY (R49)

- a. Set the TRIGGERING LEVEL control to 0. Set the TRIGGERING MODE to NORM, SOURCE to INT.
- b. Set the amplifier unit deflection factor to 50 millivolts/division. Set the low-frequency sine-wave generator for a 5-division display (250 millivolts) at 1 kilohertz.
- c. Set the amplifier unit deflection factor to 1 volt/division (0.25 division). Set the TRIGGERING LEVEL control for a stable display.
- d. ADJUST - R49, Trigger Sensitivity, for a stable crt display.
- e. Set the amplifier unit deflection factor to 2 volts/division (0.125 division). Set the TRIGGERING LEVEL control for a stable display (stable display may not be possible).
- f. ADJUST - R49, Trigger Sensitivity, to a setting that provides a visible trace, but the display remains unstable.
- g. Repeat part c of this step.
- h. Set the amplifier unit deflection factor to 5 volts/division (0.05 division).
- i. CHECK - Rotate the TRIGGERING LEVEL control throughout its range and check for no trace (one displayed sweep will occur when control passes the midrange point).

RENUMBER: Step A4 to A5  
          A5 to A6  
          A6 to A7  
          A7 to A8



# MANUAL CHANGE INFORMATION

PRODUCT 7B80 & 7B85

CHANGE REFERENCE M34715

DATE 9-21-78

CHANGE:	DESCRIPTION
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EFF SN B054000 (7B80) 070-1959-00  
EFF SN B084000 (7B85) 070-1961-00

### ELECTRICAL PARTS LIST CHANGES

CHANGE TO:

- |      |             |                               |
|------|-------------|-------------------------------|
| Q98  | 151-0342-00 | TRANSISTOR:SILICON,PNP,2N4249 |
| Q201 | 151-0221-00 | TRANSISTOR:SILICON,PNP,2N5771 |
| Q352 | 151-0221-00 | TRANSISTOR:SILICON,PNP,2N5771 |
| Q356 | 151-0221-00 | TRANSISTOR:SILICON,PNP,2N5771 |
| Q362 | 151-0221-00 | TRANSISTOR:SILICON,PNP,2N5771 |