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

7B10
TIME BASE

INSTRUCTION MANUAL

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

070-2316-00
Product Group 42

Serial Number _____

First Printing SEP 1978
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INSTRUMENT SERIAL NUMBERS

Each instrument has a serial number on a panel insert, tag, or stamped on the chassis. The first number or letter designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States have six unique digits. The country of manufacture is identified as follows:

B000000	Tektronix, Inc., Beaverton, Oregon, USA
100000	Tektronix Guernsey, Ltd., Channel Islands
200000	Tektronix United Kingdom, Ltd., London
300000	Sony/Tektronix, Japan
700000	Tektronix Holland, NV, Heerenveen, The Netherlands

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WARNING

THE REMAINING PORTION OF THIS TABLE OF CONTENTS LISTS THE 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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LIST OF ILLUSTRATIONS

The illustrations in section 8 are located near their associated diagrams on the foldout page.

LIST OF TABLES

OPERATORS SAFETY SUMMARY

The following general safety information applies to all operators and service personnel. Specific warnings and cautions will be found throughout the manual where they apply and should be followed in each instance.

WARNING statements identify conditions or practices which could result in personal injury or loss of life.

CAUTION statements identify conditions or practices which could result in damage to the equipment or other property.

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 REMOVE INSTRUMENT COVERS

To avoid electric-shock hazard, operating personnel must not remove the protective instrument covers. Component replacement and internal adjustments must be made by qualified service personnel only.

DO NOT OPERATE IN EXPLOSIVE ATMOSPHERE

To avoid explosion, do not operate this instrument in an explosive atmosphere unless it has been certified for such operation.

CAUTION

PREVENT INSTRUMENT DAMAGE

Plug-in units should not be installed or removed without first turning the instrument power off, to prevent instrument damage.

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SERVICING SAFETY SUMMARY

FOR QUALIFIED SERVICE PERSONNEL ONLY

Refer also to the preceeding Operators Safety Summary

The following are safety precautions which appear in the servicing information sections of this manual. This Servicing Safety Summary is in addition to the Operators Safety Summary given previously.

WARNING

DO NOT SERVICE ALONE

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

DISCONNECT INSTRUMENT POWER

To avoid electric-shock, disconnect the instrument from the power source before removing protective panels, soldering, or replacing components.

SILICONE GREASE HANDLING

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

CAUTION

AVOID EXCESSIVE MOISTURE

Circuit boards and components must be dry before applying power to prevent damage from electrical arcing.

EXERCISE CARE WHEN CHECKING DIODES

When checking diodes, do not use an ohm-meter scale that has a high internal current, since high currents may damage the diodes under test.

EXERCISE CARE WHEN SOLDERING ON MULTI-LAYER BOARDS

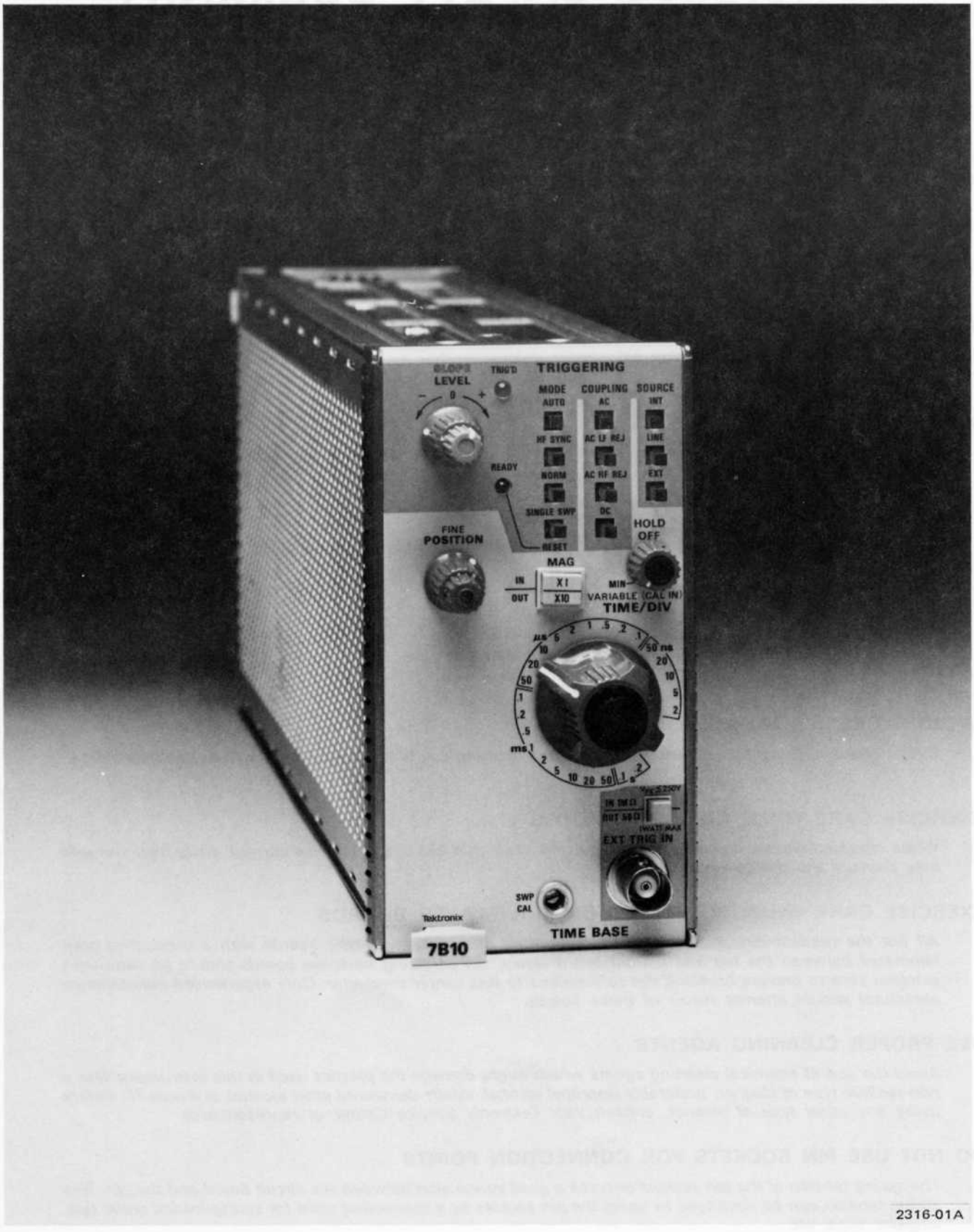
All but the readout circuit board in the instrument are multi-layer type boards with a conductive path laminated between the top and bottom board layers. All soldering on these boards should be done with extreme care to prevent breaking the connections to this center conductor. Only experienced maintenance personnel should attempt repair of these boards.

USE PROPER CLEANING AGENTS

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Use a non-residue type of cleaner, preferably isopropyl alcohol, totally denatured ethyl alcohol, or Freon TF. Before using any other type of cleaner, consult your Tektronix Service Center or representative.

DO NOT USE PIN SOCKETS FOR CONNECTION POINTS

The spring tension of the pin sockets ensures a good connection between the circuit board and the pin. This spring tension can be destroyed by using the pin sockets as a connecting point for spring-loaded probe tips, alligator clips, etc.


TRIGGERING
LEVEL
TRIG'D
MODE
AUTO
HF SYNC
NORM
SINGLE SWP
RESET
READY
COUPLING
AC
AC LF REJ
AC HF REJ
DC
SOURCE
INT
LINE
EXT
FINE
POSITION
HOLD
OFF
MAG
IN
OUT
X1
X10
MIN
VARIABLE (CAL IN)
TIME/DIV
EXT TRIG IN
SWP
CAL
Tektronix
7B10
TIME BASE
2316-01A

GENERAL INFORMATION

INTRODUCTION

OPERATORS MANUAL

The Operators Manual contains information necessary to effectively operate the 7B10 Time Base and is divided into three sections: Section 1 provides a basic description of the 7B10 with instrument specifications and accessories, section 2 contains operating information for the instrument, Instrument Option information is located in section 3 of the manual.

INSTRUCTION MANUAL

The Instruction Manual provides both operating and servicing information for the 7B10 Time Base. The Instruction Manual is divided into nine sections. Operating information is covered in the first two sections; servicing information for use by qualified service personnel is contained in the remaining seven sections of the manual. Schematic diagrams are located at the rear of the manual and can be unfolded for reference while reading other parts of the manual. The reference designators and symbols used on the schematics are defined on the first page of the Diagrams and Circuit Board Illustrations section. All abbreviations used in this manual, with the exception of the parts list and schematic diagrams, comply with the American National Institute Y1.1-1972 publication. The parts lists are computer printouts and use computer-supplied abbreviations. Instrument Option information is located in section 6 of the Instruction Manual.

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 specifications.

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 Operators Checkout procedure in section 2.

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

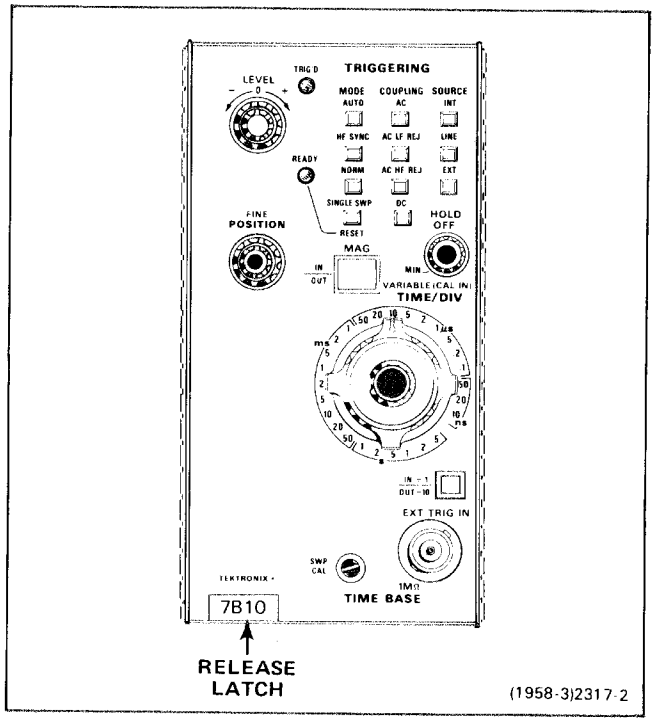


Fig. 1-1. Location of release latch.

SPECIFICATION

This instrument will meet the electrical characteristics listed in Table 1-1, following complete adjustment. The following electrical characteristics are valid over the stated environmental range for instruments calibrated at an ambient temperature of +20° to +30° C, and after a twenty-minute warmup unless otherwise noted.

TABLE 1-1
Electrical Characteristics

Characteristics	Performance Requirement
SWEEP GENERATOR	
Sweep Rates	
Calibrated Range	0.2 s/div to 2 ns/div in 25 steps. X10 Magnifier extends fastest calibrated sweep rate to 0.2 ns/div.
Variable Range	Continuously variable uncalibrated sweep rate to at least 2.5 times the calibrated sweep rate setting.
Sweep Accuracy[1] with 7104, 7900 and 7800 Series Mainframes	Measured over center 8 displayed divisions.[2] SWP CAL is adjusted at 1 ms/div within the +20° to +30°C range.
±15° to ±35° C	UNMAG MAG X10

TABLE 1-1 (CONT.)
Electrical Characteristics

Characteristic	Performance Requirement		
TRIGGERING			
Trigger Sensitivity for Repetitive Signals	Triggering Frequency Range[3]	Minimum Triggering Signal Required	
Coupling		Internal	External
AC	30 Hz to 250 MHz 250 MHz to 1 GHz	0.5 div 1.5 div	50 mV 150 mV
AC LF REJ[4]	50 kHz to 250 MHz 250 MHz to 1 GHz	0.5 div 1.5 div	50 mV 150 mV
AC HF REJ	30 Hz to 30 kHz	0.5 div	50 mV
DC[5]	DC to 250 MHz 250 MHz to 1 GHz	0.5 div 1.5 div	50 mV 150 mV
Single Sweep	Same as for Repetitive Triggering.		
Internal Trigger Jitter	30 ps or less at 1 GHz.		
Operating in HF SYNC MODE			
AC, AC LF REJ, or DC	250 MHz to 1 GHz—0.3 div. Internal 75 mV External.		
External Trigger Input			
LEVEL RANGE	At least ±3.5 V (checked on 1 kHz sine wave).		
Maximum Safe Input			
1-Megohm Input	250 V (dc plus peak ac).		
50-Ohm Input	1 Watt average.		
Input R and C			
1-Megohm Input	1 MΩ within 5%, 20 pF within 10%.		
50-Ohm	50 Ω within 2%.		
Trigger Holdoff Time			
Minimum Holdoff Setting[6]			
0.2 s/div to 50 ms/div	40 ms, or less		
20 ms/div to 2 μs/div	2 times TIME/DIV setting, or less		
1 μs/div to 2 ns/div	2.0 μs, or less		
Maximum Holdoff Setting[6]			
0.2 s/div to 50 ms/div	400 ms, or greater		
20 ms/div to 2 μs/div	20 times TIME/DIV setting, or greater		
1 μs/div to 0.5 μs/div	20.0 μs, or greater		
0.2 μs/div to 2 ns/div	6.0 μs, or greater		

[3]The triggering frequency ranges given here are limited to the -3 dB frequency of the oscilloscope vertical system when operating in the Internal mode.

[4]Will not trigger on sine waves at or below 60 Hz when amplitudes are less than 8 divisions Internal or 3 volts External.

[5]The triggering frequency range for DC COUPLING applies to frequencies above 30 Hz when operating in the AUTO TRIGGERING MODE

[6]Performance requirement not checked in the manual.

TABLE 1-2

Environmental Characteristics

Refer to the Specification section of the associated mainframe manual.

TABLE 1-3

Physical Characteristics

Characteristic	Information
Net Weight	Approximately 2.6 pounds (1.2 kilogram).
Dimensions	See Figure 1-2, dimensional drawing.

STANDARD ACCESSORIES

1 ea ..... Operators Manual

1 ea ..... Instruction Manual

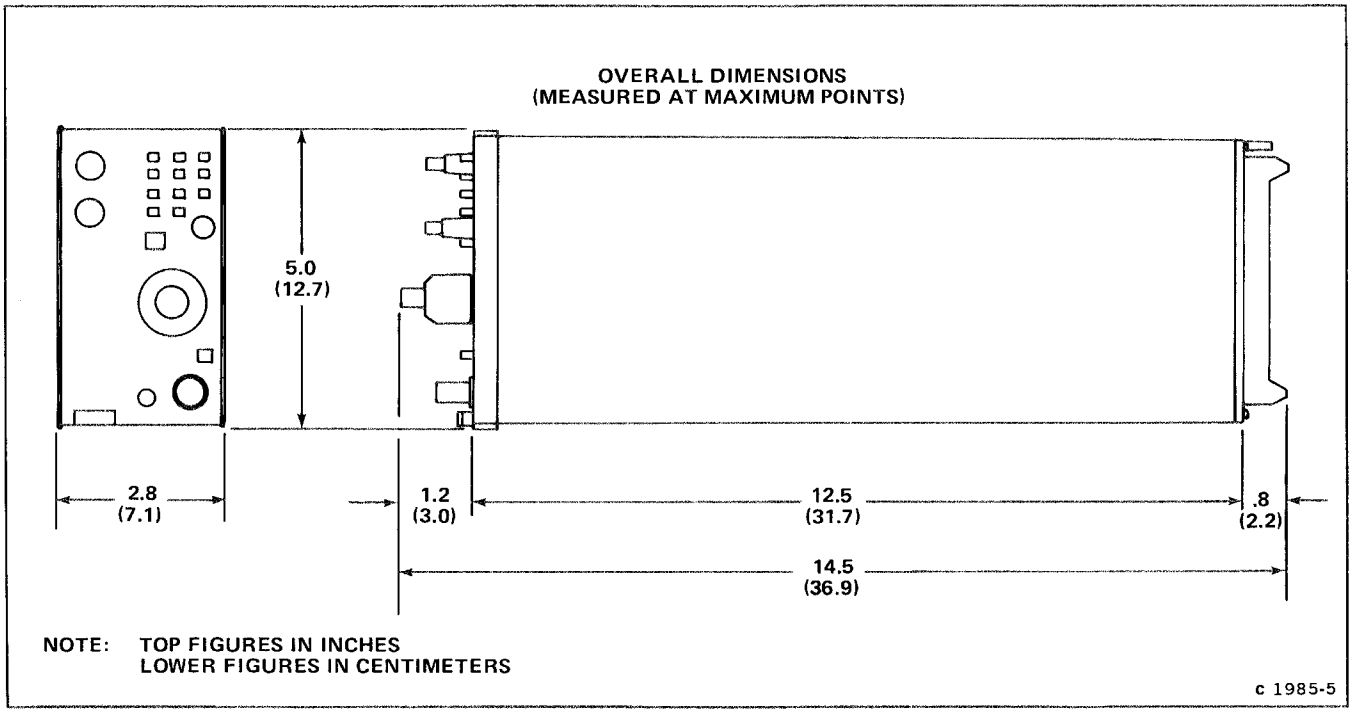


Fig. 1-2. 7B10 dimensional drawing.

OPERATING INSTRUCTIONS

The 7B10 Time-Base unit operates with a Tektronix 7100, 7700, 7800, or 7900-series oscilloscope mainframe 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 detailed operating information, an operators checkout procedure, and basic applications for this instrument.

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 2-1 provides a brief description of all front-panel controls, connectors, and indicators. More detailed information is given in the Detailed Operating Information.

OPERATORS CHECKOUT

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 operators checkout procedure reveals a malfunction or possible maladjustment, 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	AUTO
COUPLING	AC
SOURCE	INT
POSITION	Midrange
TIME/DIV	1 ms
VARIABLE (CAL IN)	Calibrated (Pushed in)
HOLD OFF	MIN (fully counterclockwise)
MAG	X1 (pushed in)
EXT TRIG IN	OUT 50 Ω

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

5. Set the mainframe vertical and horizontal

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).

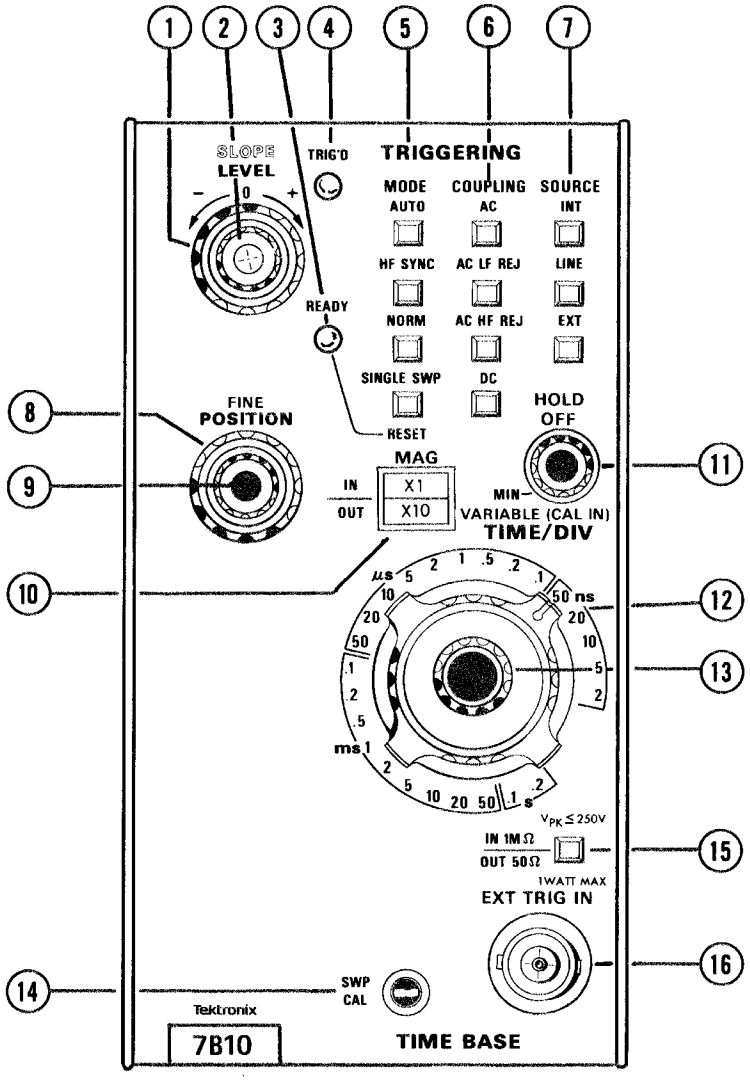
8. Press to release the VARIABLE (CAL IN) control. Turn the VARIABLE (CAL IN) control fully counterclockwise and note that the displayed sweep rate changes to at least the next slower TIME/DIV switch setting (i.e., 2 milliseconds/division). Press the VARIABLE (CAL IN) knob in to the calibrated position.

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



2317-03

Fig. 2-1. 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 SWP 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 Button—Selects input impedance.

(16) EXT TRIG IN Connector—Connector (BNC type) provides input for external trigger signals.

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

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. 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).

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 SINGLE SWP button is pressed again.

13. Disconnect the mainframe calibrator signal from the amplifier unit input and press the SINGLE SWP 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.

DETAILED 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 vertical row of push buttons. With this arrangement, a stable display can usually be obtained by pressing the top push buttons: 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 MODE

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

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).

HF Sync

The HF SYNC mode provides a triggered display with the correct setting of the LEVEL control whenever a high frequency, (100 MHz or higher) low amplitude signal is applied. This mode is useful when the incoming signal is too small to produce stable triggering in the AUTO or NORMAL modes. The HF SYNC mode increases trigger sensitivity and provides automatic trigger amplifier centering for optimum triggering under these conditions.

Normal

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

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.

TRIGGERING 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.

Alternating Current

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.

Alternating Current Low Frequency Rejection

AC LF REJ COUPLING rejects dc, and attenuates low-frequency trigger signals below about 50 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.

Alternating Current High Frequency Rejection

AC HF REJ COUPLING passes all low-frequency signals between about 30 hertz and 30 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.

Direct Current

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.

TRIGGERING 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.

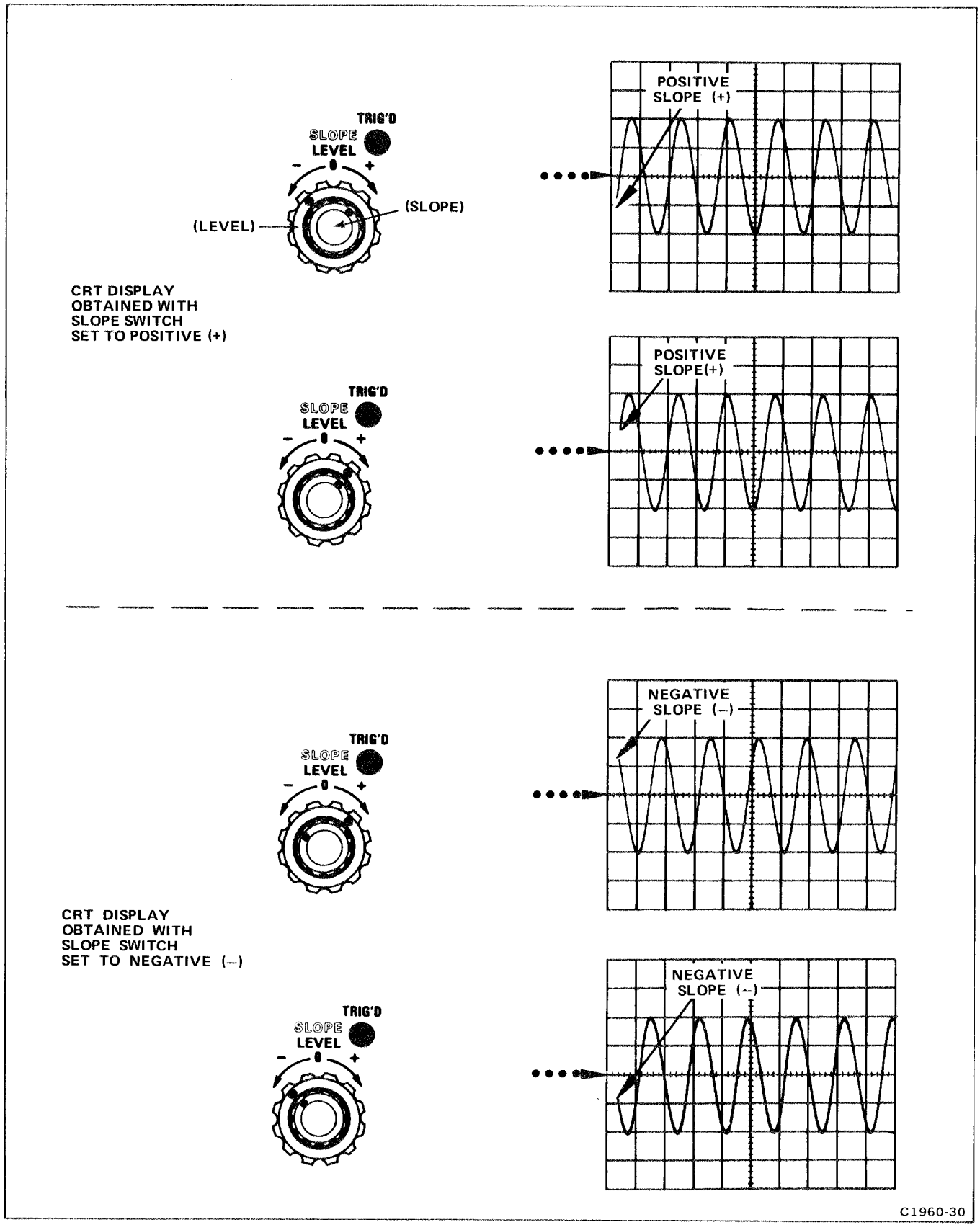


Fig. 2-2. Effect of LEVEL control and SLOPE switch on crt display.

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 resetting the TRIGGERING controls.

The IN 1 MΩ/OUT 50 Ω pushbutton provides a convenient means of selecting external-trigger input impedance. Pushing the button in sets the amplifier input impedance to 1 MΩ and the OUT position provides 50 Ω input impedance.

TRIGGERING 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, display starts on the positive-going portion of the waveform (see Figure 2-2). When several cycles of a signal appear on 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.

TRIGGERING 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 2-2 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.

In the HF SYNC mode, the trigger LEVEL control varies the sensitivity of the Trigger Generator. The LEVEL control is set to provide a stable display.

HORIZONTAL SWEEP RATES

The TIME/DIV switch provides calibrated sweep rates from .2 seconds/division to 2 nanosecond/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 MEASUREMENTS

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 Fig. 2-3). 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.

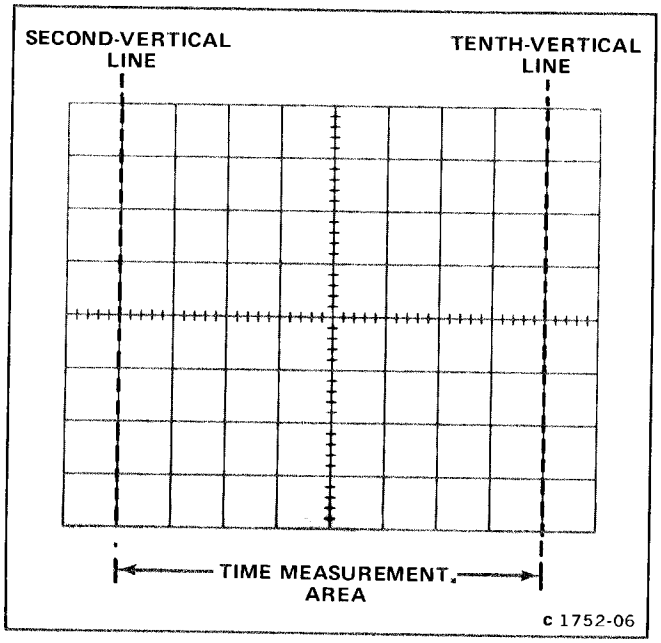


Fig. 2-3. Area of graticule used for most accurate time measurements.

SWEEP MAGNIFICATION

The sweep magnifier can be used to expand the display be a factor of 10. The center division of the unmagnified display is the portion visible on the crt in the magnified form (see Fig. 2-4). 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 carried 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.

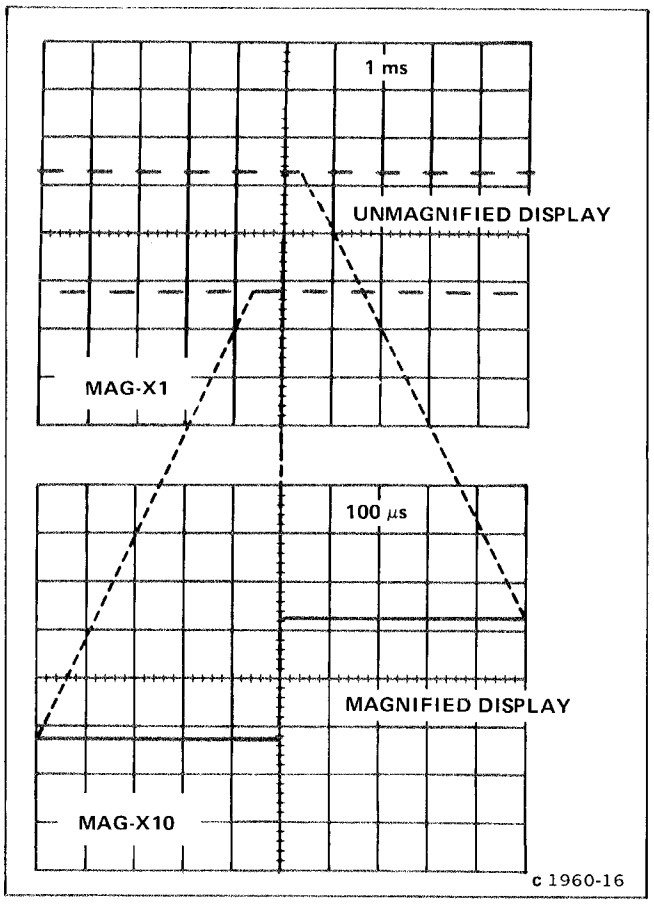


Fig. 2-4. Operation of sweep magnifier.

MAINFRAME OPERATING MODES

The time-base unit can be operated either as an independent time base in any Tektronix 7100-, 7700-, 7800-, or 7900-series oscilloscope mainframes, 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.

APPLICATIONS

The following information describes procedures and techniques for making basic time measurements with the time-base unit installed in a Tektronix 7100, 7700, 7600, 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).

@

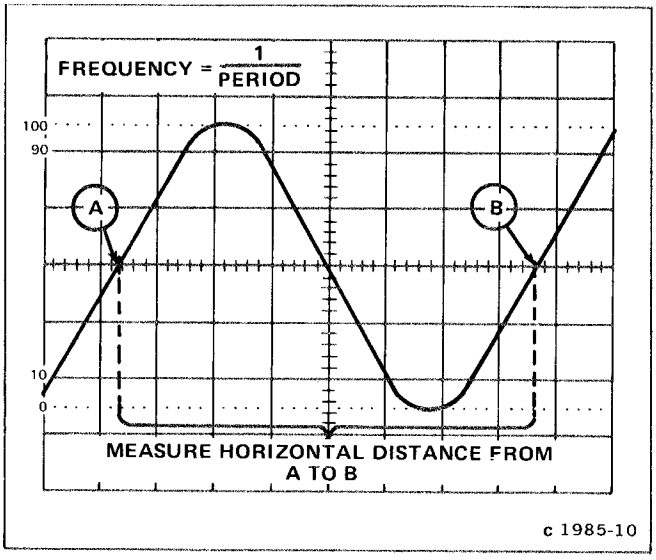


Fig. 2-5. Measuring the period and determining the frequency of a displayed waveform.

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 controls for a complete cycle displayed within the center 8 graticule divisions as shown in Figure 2-5.

7. Measure the horizontal distance in divisions over 1 complete cycle of the displayed waveform.

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 Fig. 2-5).

Using the formula:

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

Substituting values:

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

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 controls 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 2-6 (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 or falling portion of the waveform that is 10% and the point that is 90% of the total display amplitude (see Fig. 2-6).

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 controls 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.

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.)

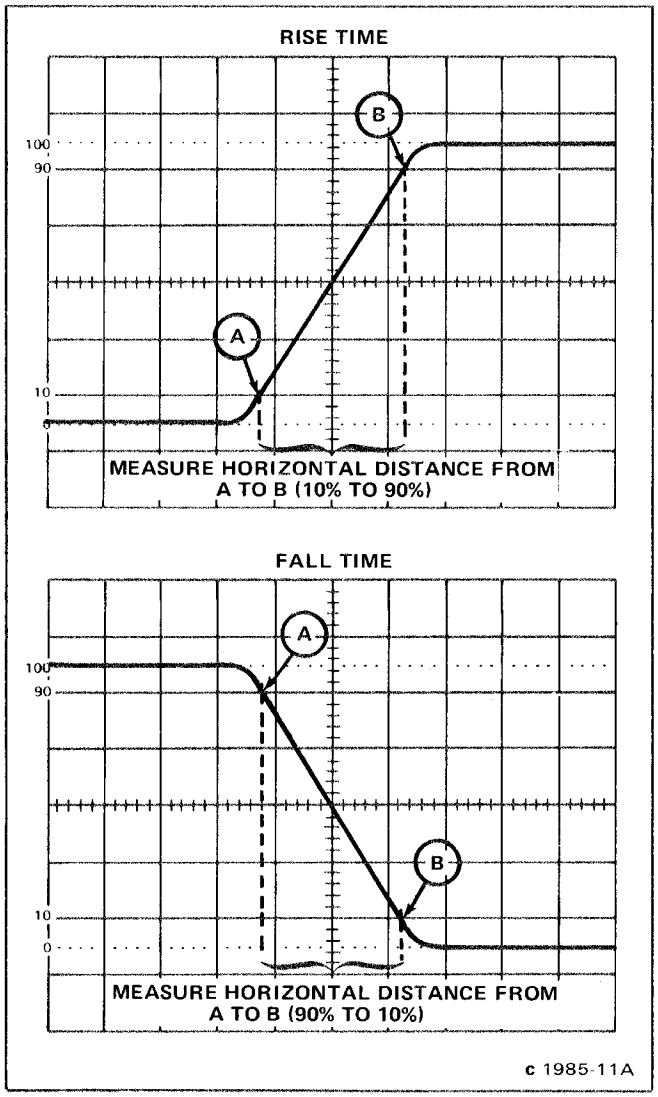


Fig. 2-6. Measuring the rise time and fall time of a displayed waveform.

Example: Assume that the horizontal distance between the 50% amplitude points is 3 divisions, and the TIME/DIV switch setting is .1 μs (see Fig. 2-6).

Using the formula:

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

Substituting values:

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

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 2-7.

7. Measure the horizontal distance in divisions between the 50% amplitude points of the displayed pulse (see Fig. 2-7.).

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.)

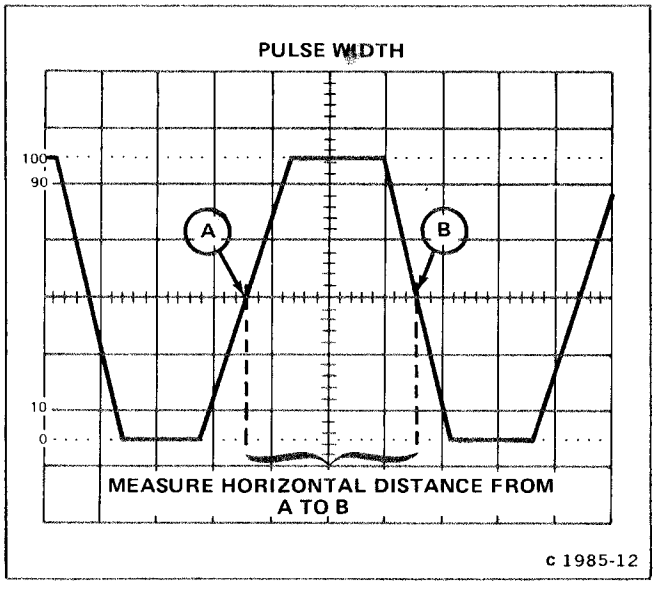


Fig. 2-7. Measuring the pulse width of a displayed waveform.

Example: Assume that the horizontal distance between the B amplitude points is 3 divisions, and the TIME/DIV switch setting is .1 ms (see Fig. 2-7).

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 delayedsweep 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.

WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO. REFER TO OPERATORS SAFETY SUMMARY AND SERVICE SAFETY SUMMARY PRIOR TO PERFORMING ANY SERVICE.

THEORY OF OPERATION

This section of the manual describes the circuitry used in the 7B10 Time-Base unit. The description begins with a discussion of the instrument, using the block diagram shown in Figure 3-1. The schematic diagrams at the rear of this manual are blocked off according to circuit function. These circuit block titles serve as indexes to the circuit diagram discussion. Refer to the appropriate diagram along with the Troubleshooting Chart in the Diagrams and Circuit Board Illustrations section throughout the following discussion.

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 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.

SWEEP GENERATOR

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

LOGIC

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.

DETAILED CIRCUIT DESCRIPTION

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

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.

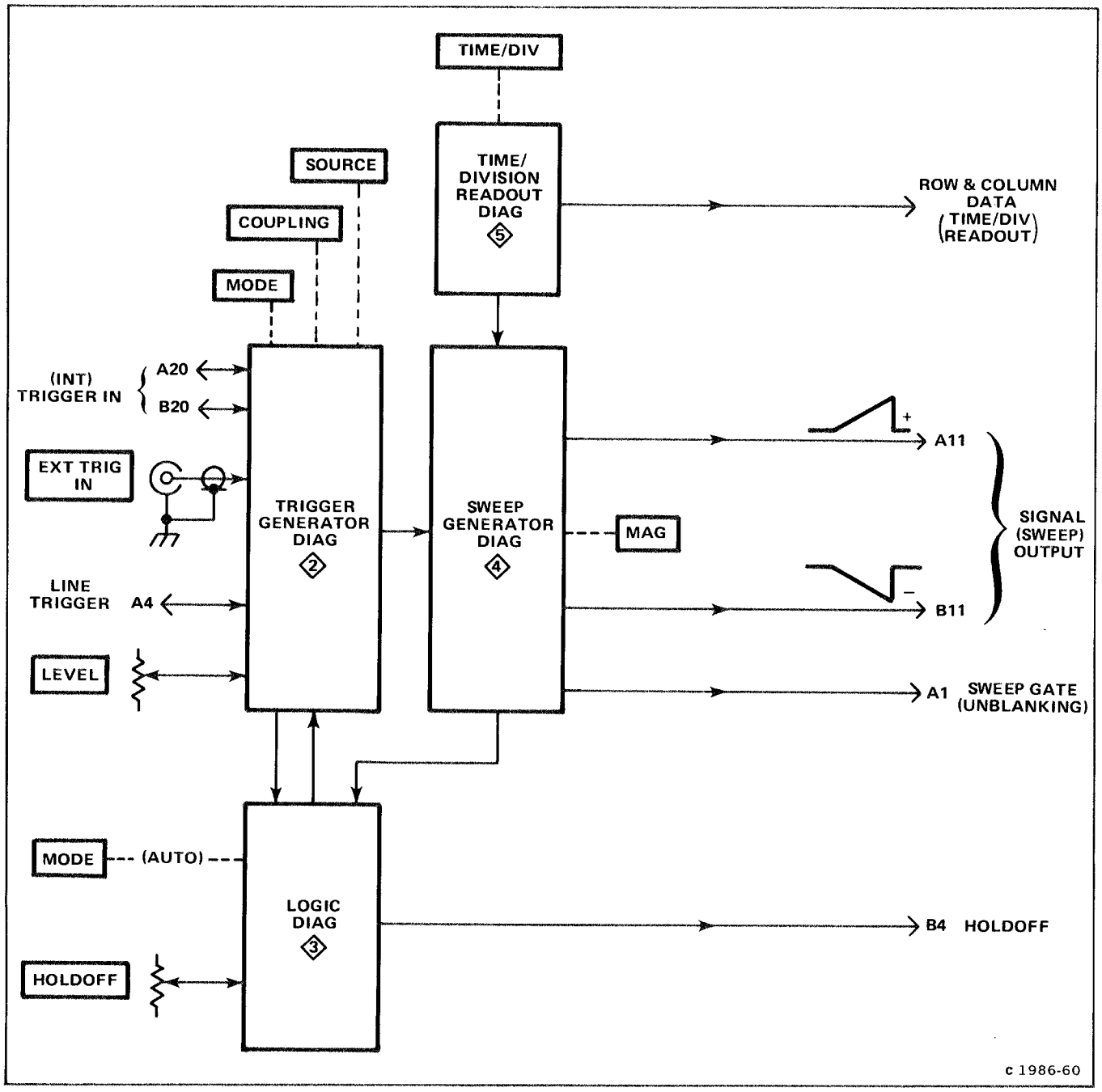


Fig. 3-1. Basic block diagram of the 7B10 Time Base unit.

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 applies either to an individual device or to 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.

TABLE 3-1

Basic Logic Reference

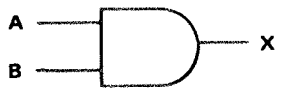
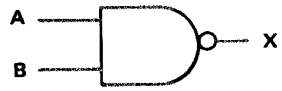
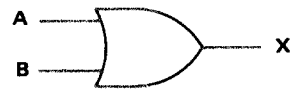
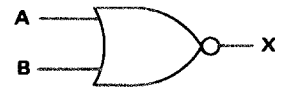
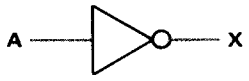
Device	Symbol	Description	Input/Output Table
AND gate		A device with two or more inputs and one output. The output of the AND gate is HI if and only if all of the inputs are at the HI state.	Input / Output A B X LO LO LO LO HI LO HI LO LO HI HI HI
NAND gate		A device with two or more inputs and one output. The output of the NAND gate is LO if and only if all of the inputs are at the HI state.	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.	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.	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.	Input / Output A X LO HI HI LO

TABLE 3-1 (CONT.)
Basic Logic Reference

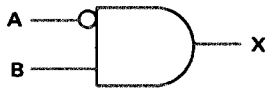
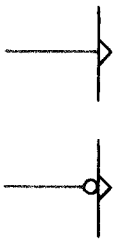
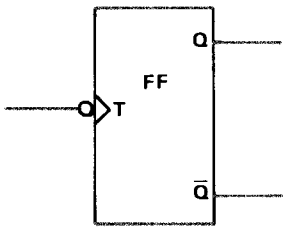
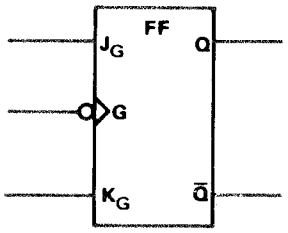
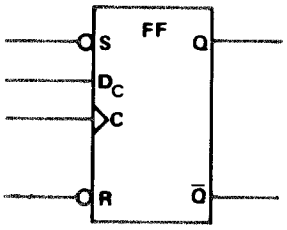
Device	Symbol	Description	Input/Output Table
LO-state indicator		A small circle at the input or output of a symbol indicates that the LO state is the significant state. Absence of the circle indicates that the HI state is the significant state. Two examples follow:	
		AND gate with LO-state indicator at the A input. The output of this gate is HI if and only if the A input is LO and the B input is HI.	Input / Output A B X LO LO LO LO HI HI HI LO LO HI HI LO
		OR gate with LO-state indicator at the A input: The output of this gate is HI if either the A input is LO or the B input is HI.	Input / Output A B X LO LO HI LO HI HI HI LO LO HI HI HI
Dynamic Indicator		Indicates that this input (usually the trigger input of a flip-top) responds to the indicated transition of the applied signal.	
Triggered (toggle) Flip-Flop		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.	Input / Output Condition before trigger pulse: Q $\bar{Q}$ Condition after trigger pulse: Q $\bar{Q}$ LO HI → HI LO HI LO → LO HI

TABLE 3-1 (CONT.)
Basic Logic Reference

Device	Symbol	Description	Input/Output Table
Triggered Set-Clear (J-K) Flip-Flop		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.	Input / Output J K Q $\bar{Q}$ LO LO No change LO HI LO HI HI LO HI LO HI HI Changes state **Output conditions shown after gate pulse.**
D (data) Type Flip-Flop with Direct Inputs (Direct Inputs may be applied to all triggered flip-flops)		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.	Set (S) and reset (R) inputs override data (D) and clock (C) inputs. Input / Output S R Q $\bar{Q}$ HI LO LO HI LO LO Undefined HI HI No Effect LO HI HI LO
		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.	Set (S) and Reset (R) inputs both high. Input / Output Condition before clock pulse | Condition after clock pulse D Q $\bar{Q}$ HI HI LO LO LO HI

1 FRONT-PANEL WIRING

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

2 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).

EXTERNAL TRIGGER AMPLIFIER

The external trigger signal is connected to the Trigger Generator through EXT TRIG IN connector J90. Push-button switch S90 selects either 1 MΩ or 50 Ω input impedance. The 0.2 amp fuse protects the 50 Ω load from signal overload.

Pushing in the EXT push button of SOURCE switch (S50) allows external trigger signals to pass from the External Trigger Amplifier to U124 for amplification. Field-effect transistor Q98 conducts in the DC COUPLING mode only and Q108 is on in all coupling modes except AC LF REJ. Components U110, Q114, and Q118 compose an operational amplifier whose gain is approximately 1/4 determined by feedback resistors R93 and R74. Integrated circuit U110 provides dc stability. Diodes CR74, CR76, and CR77 protect the trigger amplifier from possible overload caused by high amplitude external signals. A portion of the dc leveling voltage from R67 is applied to U110 to provide additional level range in the EXT triggering mode. Pressing the INT button causes Q118 to saturate which interrupts signal flow to the external amplifier of U124.

When the AC HF REJ button is pressed, signals in the frequency range of 5 Hz to 30 kHz pass from U64A to U64B and then to U124's Level Input. Also, U124's Ext In amplifier is disabled and U124's low-frequency amplifier is enabled, allowing only filtered signals from U64B to be amplified.

TRIGGER AMPLIFIER AND SOURCE SELECTOR

The time base trigger source is selected by the SOURCE switch (S50) which enables the appropriate amplifier in U124. A dc voltage from the LEVEL control is applied to pins 6 and 8 of U124 to provide internal amplifier voltage offset. The amplifiers' outputs are summed and applied to pins 14 and 16 to drive the following Trigger Generator stage.

The internal trigger signal from the trigger source selector of the mainframe is connected to U12 via interface connector pins A20 and B20. Integrated circuit U12 provides common mode rejection for frequencies up to 100 kHz; T1 provides cmr above 100 kHz. Ac-coupled trigger signals enter U124 at pin 3 and are terminated in 50 Ω at pin 4. Integrated circuit U38 provides a path for low-frequency trigger signals which are fed to pin 5 of U64B. These signals then arrive at the level port of U124 (pin 6) where they are summed with the high-frequency signals to provide wide-band triggering in the AC and DC COUPLING modes. Pressing the front-panel AC LF REJ push button breaks the low-frequency signal path allowing only high-frequency trigger signals to appear at the output of U124. When the AC HF REJ push button is pressed, the internal signal amplifier is disabled and the low-frequency amplifier is enabled allowing only low-frequency signals to pass.

In the HF SYNC mode, the output of U138A drives the level input of U124. A voltage appears at the output of U138A when a voltage difference is detected at its input. Thus, when an unbalanced trigger condition occurs, U138A provides automatic dc leveling of U124 so that U144 will always have a balanced signal input in the HF SYNC mode. Transistor Q142 is turned off in the HF SYNC mode providing a path through CR145 for voltage from the LEVEL control. This enables the LEVEL control to adjust the hysteresis of Trigger Generator U144 to almost zero, causing very small signals to trigger U144.

SLOPE SELECTOR AND TRIGGER GENERATOR

Integrated circuit U144 converts the differential trigger signal from the Trigger Amplifier and Source Selector block to a differential gate waveform for use by the Gate Generator stage.

SLOPE switch S140 is connected to U144-pin 3 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 5 produces a positive-going gate on pin 15 and a negative-going gate on pin 16. When the SLOPE switch is set to - a negative-going signal on pin 5 produces a positive-going gate on pin 15 and a negative-going gate on pin 16. Trigger Generator sensitivity is controlled by R147.

The delay mode control input at U144-pin 4 provides control 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, U144-pin 4 is HI, causing the trigger disable signal at pin 2 to initiate a trigger gate pulse at U144-pins 15 and 16.

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 3-2 for a timing diagram of the Gate Generator functions.

When an adequate trigger signal is applied to U144-pins 5 and 8 and when U144 is enabled (pin 2 is LO), a HI level is produced at U144-pin 15 and a LO level is produced at U144-pin 16.

The HI level from U144-pin 15 is coupled through emitter follower Q184 and J200-2 into the Logic circuit (diagram 3) to indicate that a triggering signal has been received. The Logic circuit (diagram sets the Auto Drive at J200-3 HI, turning off Q160. Simultaneously, the LO level at U144-pin 16 gates comparator Q174-Q164. The collector of Q164 rises HI to provide a sweep start gate at J200-5 and the collector of Q174 falls LO to provide a Z-Axis gate (unblanking) at J200-4.

In the absence of a trigger signal at U144-pins 5 and 8, pin 15 is set LO and pin 16 is set HI. The LO level from U144-pin 15 is coupled through J200-2 to the Logic circuit (diagram to indicate the absence of a triggering signal. The Logic circuit provides a LO-level auto drive pulse through J200-3 to the base of Q160. This LO level gates the comparator (Q160 and Q174). The collector of Q160 rises high to provide a sweep start gate and the collector of Q174 falls LO to provide a Z-Axis Gate (unblanking) at J200-4.

LOGIC

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.

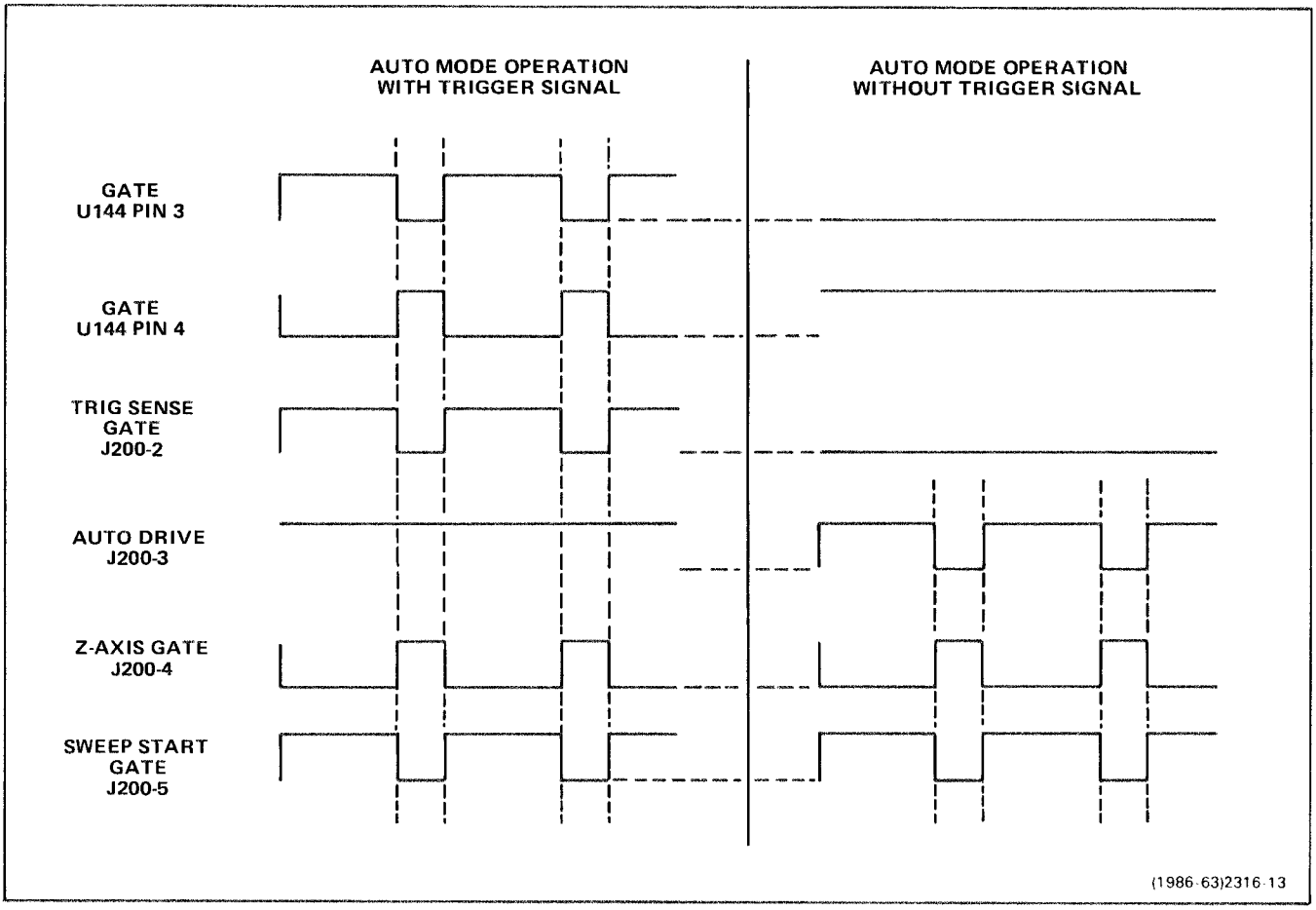


Fig. 3-2. Timing diagram for Gate Generator stages Q160, Q164, and Q174.

TRIGGER MODE SWITCHING

Integrated circuit U220 controls the NORM, AUTO, and SINGLE SWP MODE and also generates control signals used in the 10. HF SYNC operation is described in the Trigger Generator circuit description (diagram 2).

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 Ramp Generator (diagram 4). Integrated circuit U220 controls sweep lockout and hold off functions.

Auto Mode

An internal control stage (within U220) produces a free-running reference trace (bright base line) in the absence of a trigger signal. The HF SYNC mode defaults logic to the auto mode.

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 an internal control 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 enables this internal control stage with a time delay generated by R228, C228, and other circuitry internal to U220-pin 2. After the time delay, an auto sense signal is initiated from U220-pin 3 to the Trigger Generator (diagram 2).

Single Sweep Mode

The SINGLE SWP MODE 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 Ramp 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 Ramp Generator (diagram 4) from being retriggered until the sweep timing capacitors are discharged.

At the end of each sawtooth waveform from the Ramp 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 R215 and resistors R212 through R14. Transistors Q203 and Q204 prevent the sweep disable out pulse at U220-pin 17 from falling LO until the holdoff timing capacitors have discharged. Transistors Q210 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.

TIMING CURRENT SOURCE

The Timing Current Source stages generate a constant current for the Ramp Generator stages. A reference voltage source is established by the +50 volt supply and R306, R305, R304, and R300 (front-panel SWP CAL adjustment).

The reference voltage is applied to operational amplifier U314 which provides unity voltage gain and low output impedance. The output of U314 is connected through Q322 and Q324 to the timing resistors (R392 through R399 and R328). Timing current is the result of the voltage drop across the timing resistors and flows through the collector of Q324 to the Ramp Generator stages.

RAMP GENERATOR

The Ramp Generator stages produce a linear positive-going ramp for the Output Preamplifier and Sweep Gate Generator stages.

Upon the arrival of a HI-level sweep start gate, Q354 turns on and Q356 turns off. The source current from Q324 charges the timing capacitors (C364, C365, C366) in a positive ramp. Field effect transistors Q372A, Q372B, and transistor Q376 form a unity-gain ramp voltage follower for the sweep ramp. The output of Q376 is connected to the Output Preamplifier, Sweep Gate Generator, and Auxiliary Sweep Preamplifier stages.

When the sweep start gate is LO, Q354 turns off and Q356 turns on causing the timing capacitors (C364, C365, and C366) to discharge. Transistors Q336 and Q342 maintain a constant level from which the ramp begins. The output of Q376 is compared (by way of Q336A) with the reference level at the base of Q336B. If the output of Q376 is less than the reference, Q342 will charge the timing capacitors through CR345 until the output and reference voltages are equal. If the output of Q376 is greater than the reference, Q342 conducts more and CR345 conducts less causing the timing capacitors to discharge through Q356 and R358. When the output and reference voltages are equal, the current through CR345 and Q354 equal the current through Q356.

OUTPUT PREAMPLIFIER

The Output Preamplifier 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.

The sweep ramp voltage from Q376 is coupled to the Output Preamplifier stage at the base of Q454. Transistors Q454 and Q464 form a single-ended to push-pull converter with Q458 and Q468 as current follower stages for the push-pull signal. Transistor Q460 is employed as a nonlinear capacitance to compensate for the nonlinear collector to base capacitance of Q458. Output drivers Q476 and Q496 provide final amplification and connect the sweep signal to the mainframe.

The MAG switch, S460, increases the Output Preamplifier gain ten times by connecting R461 and R460 in parallel with R454 and R464. In the 2 ns and 5 ns TIME/DIV switch positions field effect transistor Q484 is biased into a low resistance state setting the gain of the Output Preamplifier at two times its normal value.

Operational amplifier U386 combines the dc voltages of the FINE and POSITION controls to produce a position voltage level at its output. This voltage level on the base of Q464 provides a ramp waveform offset voltage to horizontally position the displayed trace.

AUXILIARY SWEEP PREAMPLIFIER

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 Q434 and Q438 form a unity-gain inverting amplifier for the sawtooth signal from the ramp voltage follower Q376. Diode CR434 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.

The sweep ramp is applied to the base of Q402. A comparison voltage is set at the base of Q406. When the ramp voltage exceeds the comparison voltage, Q402 turns off and Q406 couples a HI level through common-base transistor Q410. The output of Q410 is coupled to Q415, Q420, Q425 and to the hold off start U220 (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 Q420. The resultant HI-level sweep gate pulse at the collector of Q420 is coupled through emitter follower Q425 to the mainframe for sweep unblanking. At the end of the sweep, the HI level from the collector of Q410 turns Q415 off and Q420 on. The resultant LO is coupled through emitter follower Q425 to the mainframe for sweep blanking.

TIME/DIVISION AND READOUT SWITCHING

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

BASIC READOUT SYSTEM

The readout system in 7000-series mainframes provides an alphanumeric 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 (refer to Table 3-2). 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, μ, n, p	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

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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. Use a non-residue type of cleaner, preferably isopropyl alchohol, totally denatured ethyl alchohol, or Freon TF. Before using any other type of cleaner, consult your Tektronix Service Center or representative.

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.

WARNING

To avoid electric shock, disconnect the instrument from the power source before removing protective panels.

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.

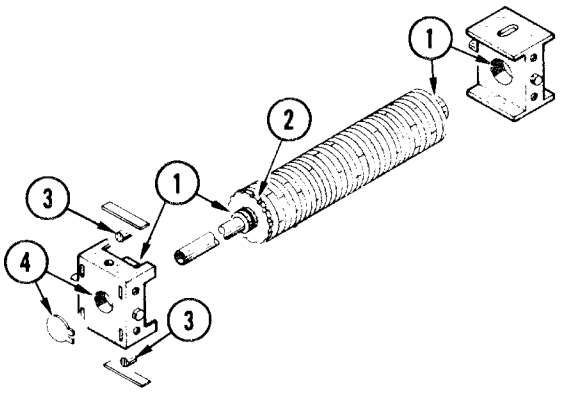
The corrective procedure for most visible defects is obvious; however, particular care must be taken if heat-damaged components are found. Overheating usually indicates other trouble in the instrument; therefore, it is important that the cause of overheating be corrected to prevent recurrence of the 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 silicone grease should be applied sparingly so that the lubricant does not get on the contacts. Refer to Figure 4-1 for lubrication instructions.



(1) Apply lubricant to the drum journals and mating surface in the mounting bearings.

(2) Apply lubricant to the wear surface of the index wheel.

(3) Apply lubricant to the index roller and roller guide in the front bearing. A thin film should be applied to the inner face of the detent springs if more than one spring is replaced.

(4) Ensure that some lubricant is present at the interface between the bearing and retainer clip.

C1967-2

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

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 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.

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 and 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. Voltages and waveform conditions given on the diagram page list the test equipment used and the front-panel control status necessary to obtain the given waveform.

TROUBLESHOOTING CHART

The Troubleshooting Chart in section 8 is useful for locating a fault in the absence or presence of specific symptoms. Refer to the chart, circuit description, and circuit diagrams when troubleshooting the instrument.

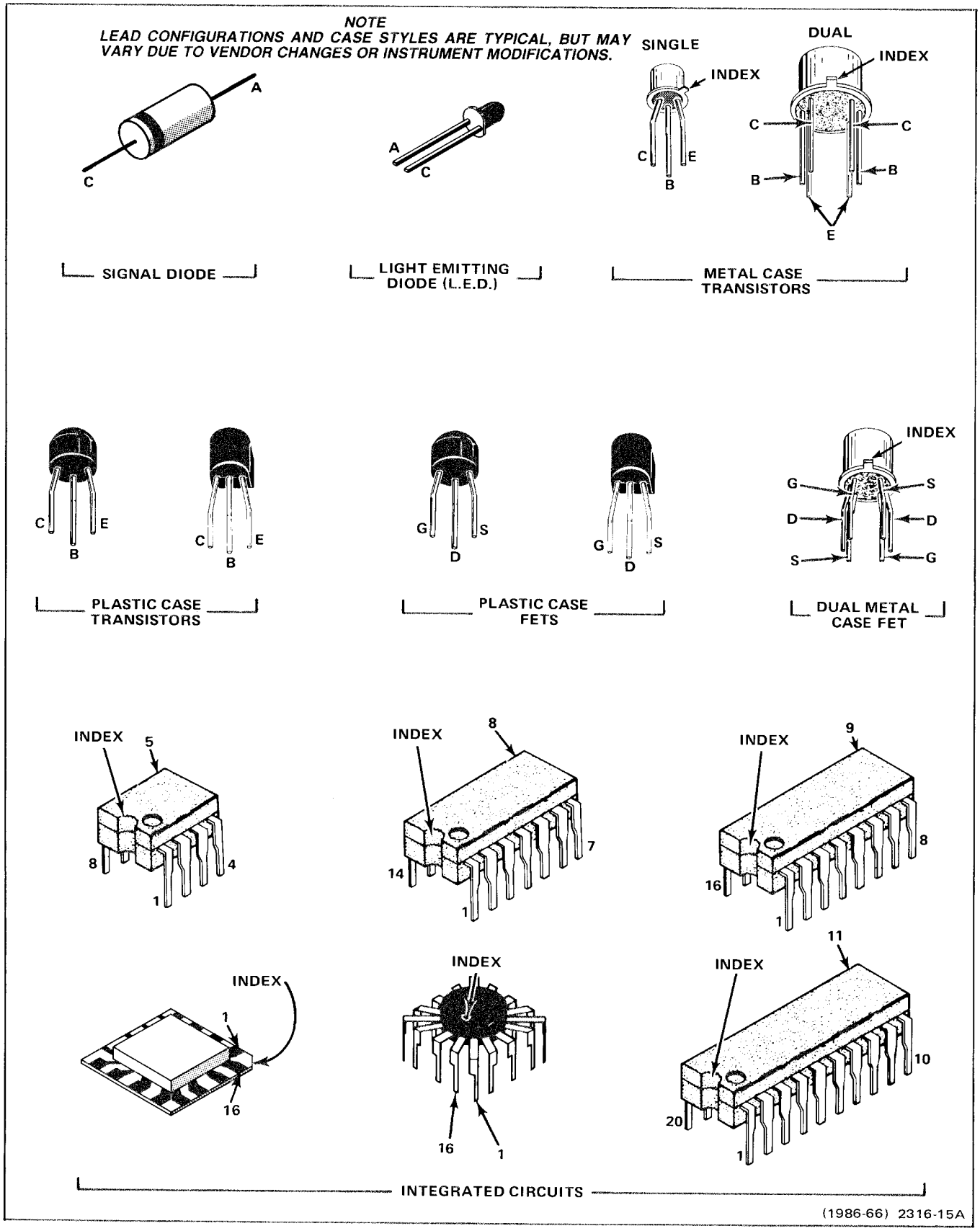


Fig. 4-2. Semiconductor lead configuration.

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 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.

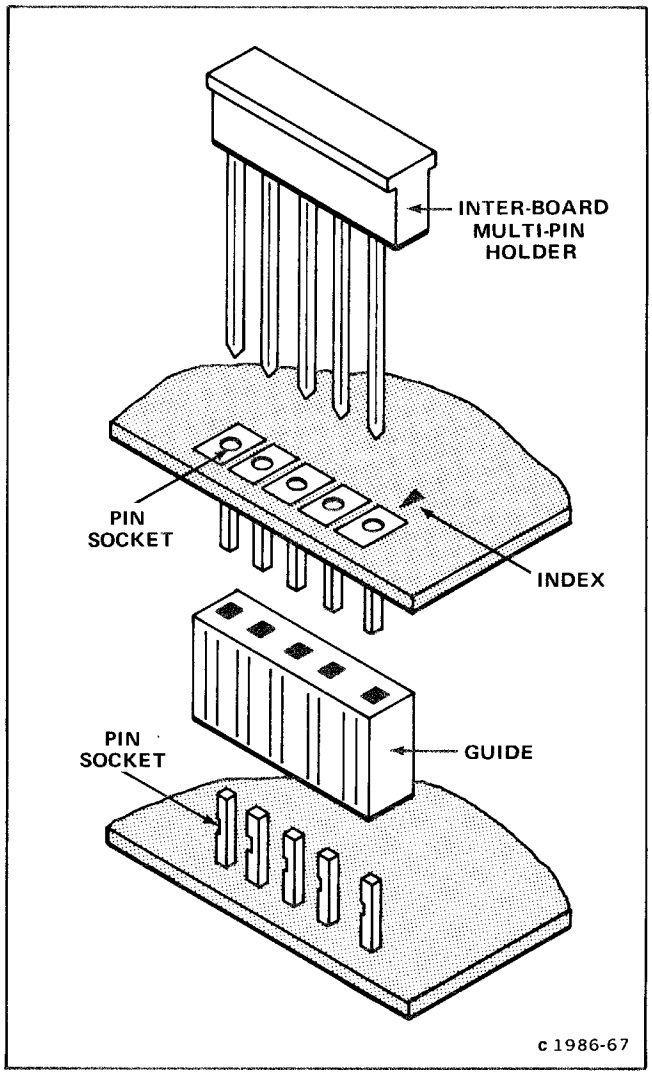


Fig. 4-3. Inter-board multi-pin connector assembly.

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 Fig. 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 correspond with 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. J numbers on the circuit boards correspond with J and P component numbers on the schematic diagrams.

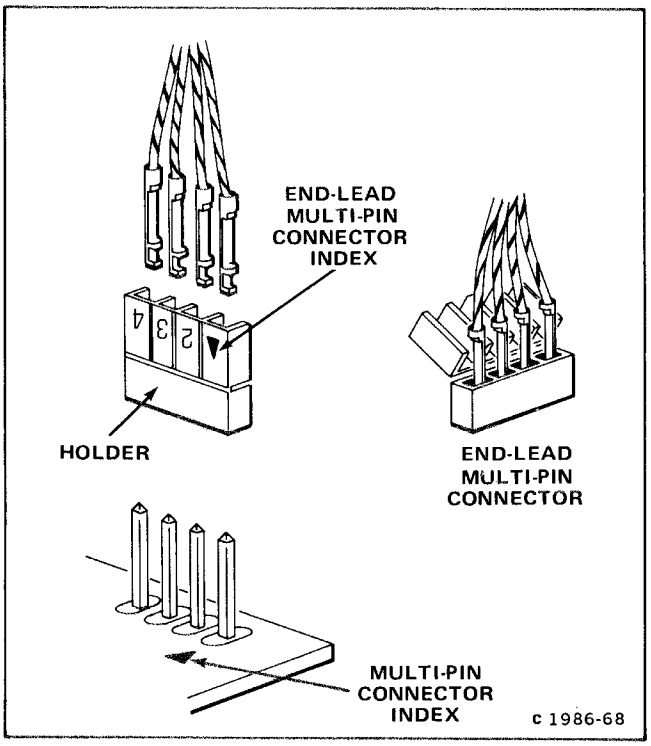


Fig. 4-4. End-lead multi-pin connector assembly.

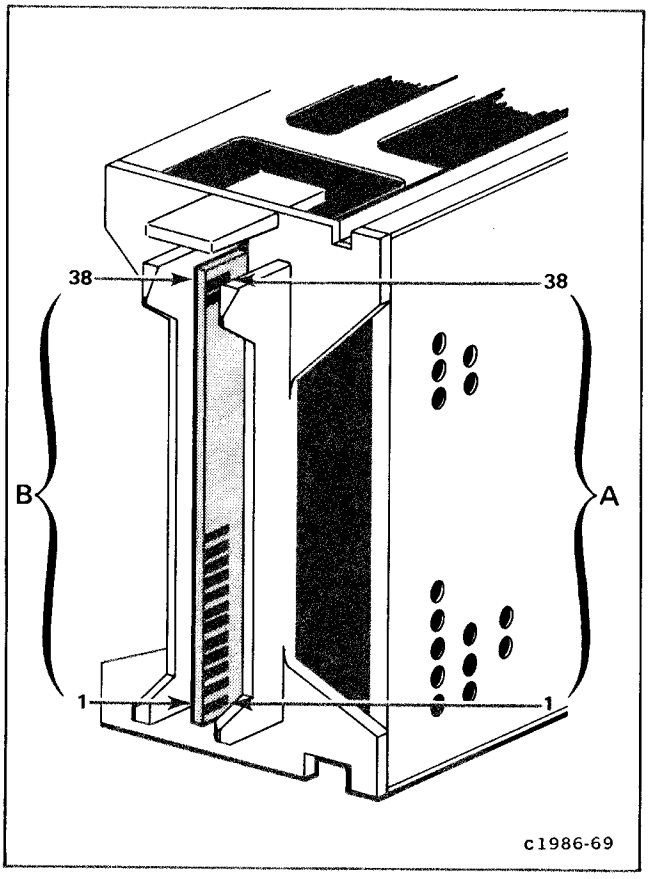


Fig. 4-5. Location of pin numbers on Interface connector.

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 6 in the Diagrams section.

ADJUSTMENT AND PERFORMANCE CHECK

The Adjustment and Performance Check procedure 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 Calibration section, is useful for troubleshooting.

Transistor Tester

Description: Dynamic-type tester.

Purpose: Test semiconductors.

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 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 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, 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,

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.

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 provided in Adjustment and Performance Check, section 5.

5. ISOLATE TROUBLE TO A CIRCUIT

To isolate trouble to a circuit, note the trouble symptom. The sympton 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.

The Troubleshooting Chart at the rear of the manual serves as 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 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.

WARNING

To avoid electric shock, always disconnect the instrument from the power source before replacing components.

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

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 in-line 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

When checking diodes, do not use an ohmmeter scale that has a high internal current, since high currents may damage the diodes under test.

Diodes

A diode can be checked for an open or shorted condition by measuring the resistance between terminals with an ohmmeter, using a 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 does not pass ac signals.

8. REPAIR AND ADJUSTMENT

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

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 are 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 layer. 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

Some component leads are difficult to remove 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 or solder extractor 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

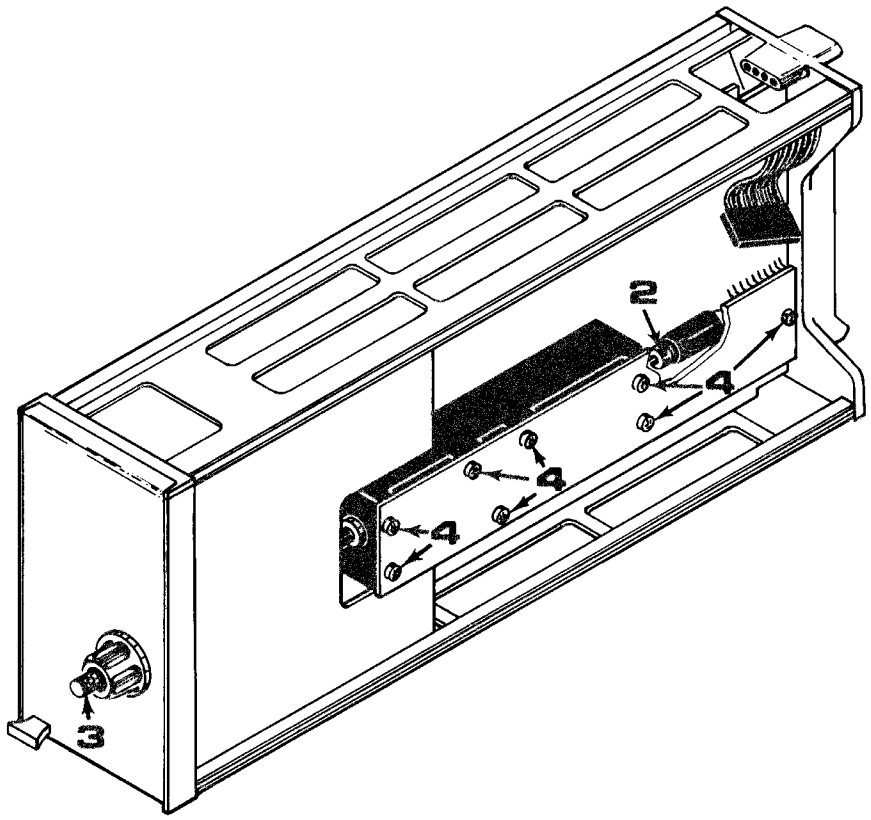
WARNING

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.



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.

c1986-70

Fig. 4-6. Readout board removal procedure.

A3-Readout Circuit Board

To remove the circuit board, follow the procedure given in Figure 4-6.

A2-Trigger Circuit Board

To remove the circuit board:

1. Remove 3 inter-board multi-pin connectors (see Fig. 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 Fig. 4-7 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.

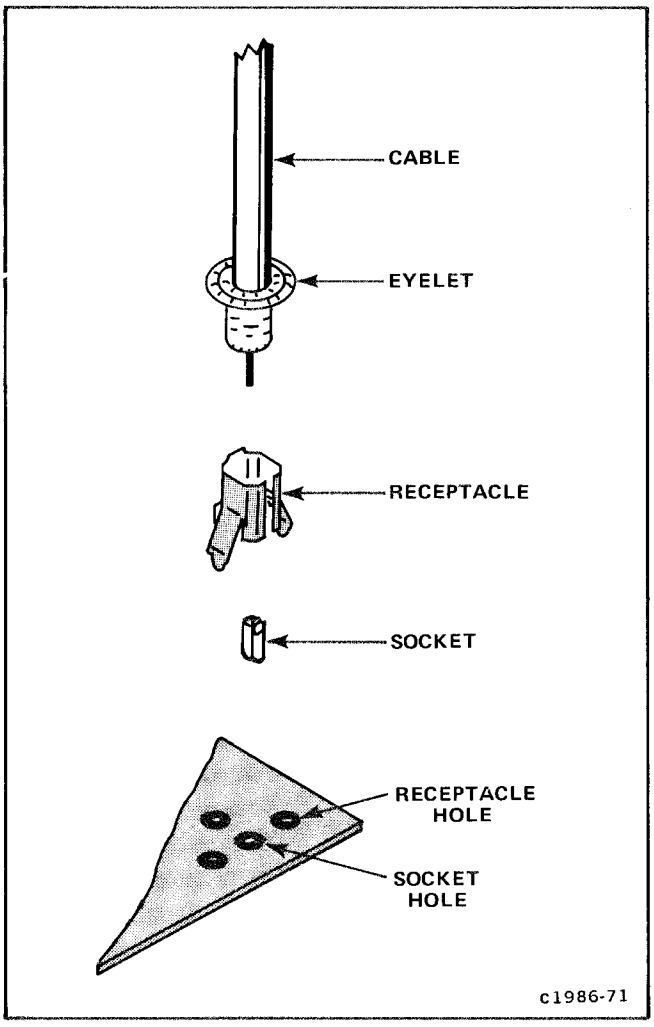


Fig. 4-7. Coaxial end-lead connector assembly.

A1-Interface Circuit Board

To remove circuit board:

1. Remove Trigger and Readout 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.

4. Note color of multi-pin connectors (see Fig. 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.

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

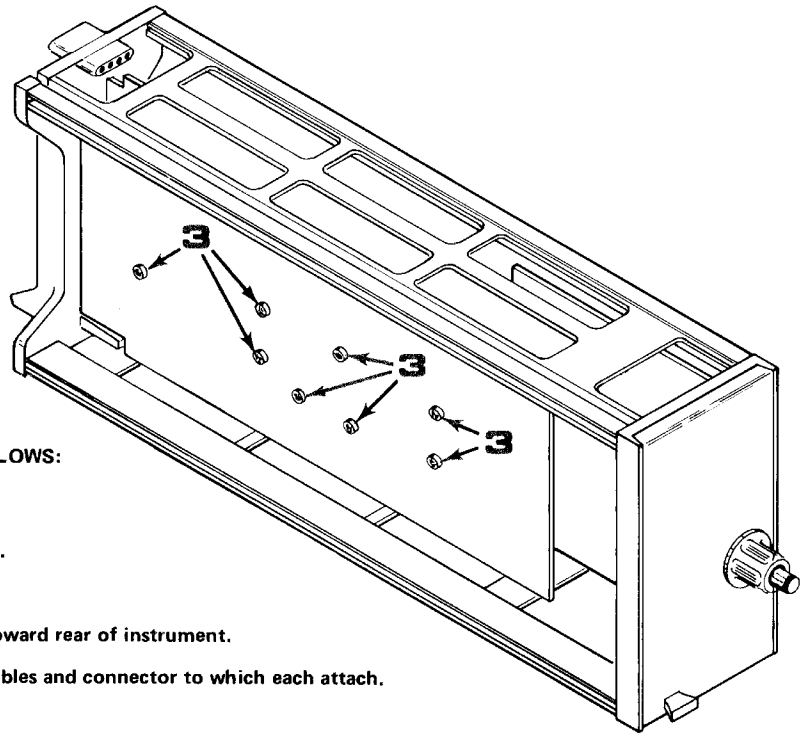
Two types of switches are used in this instrument. Contact alignment and spacing are critical to the operation of the push-button and cam switches. Therefore, defective switches should either be replaced as a unit or repaired only by personnel experienced with these types of switches. Your local Tektronix 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 4-8 for special instructions on cam switch removal.

CAUTION

Cam switch repair 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.



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.

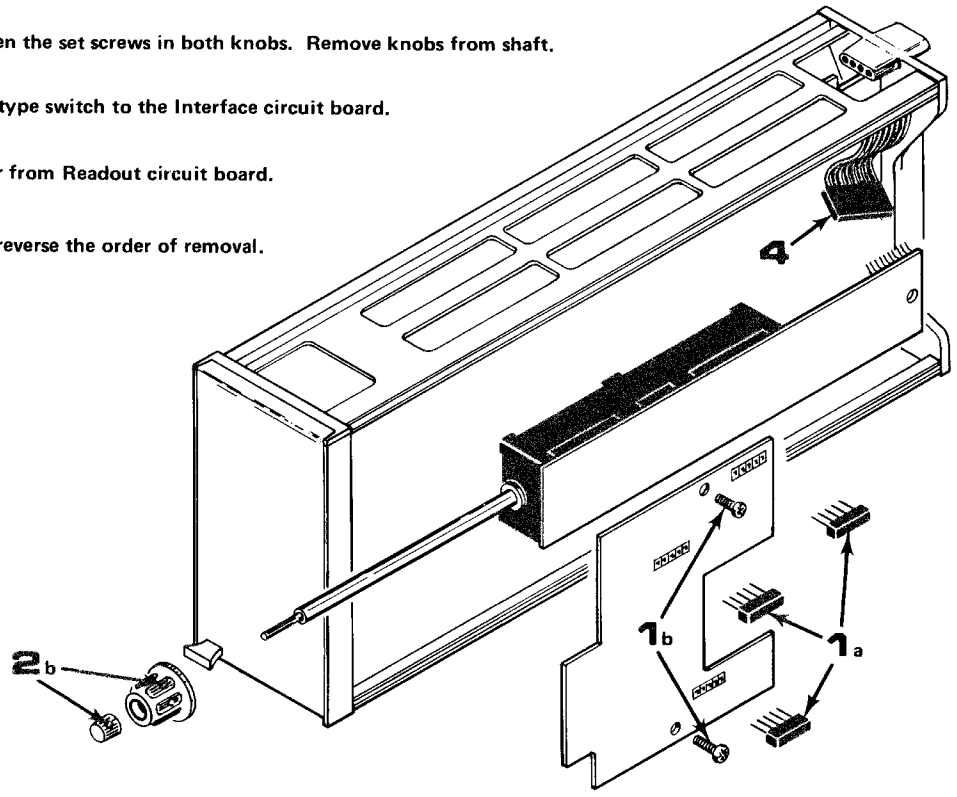


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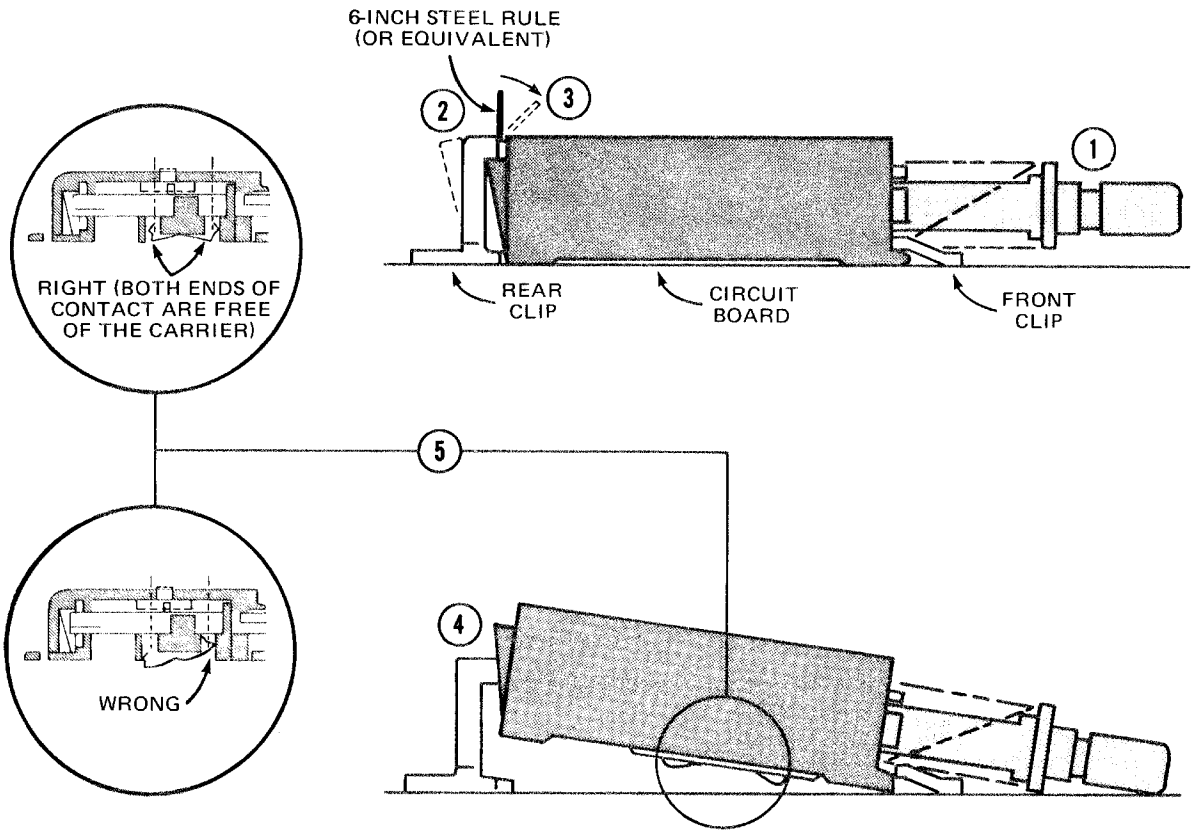
Fig. 4-8. Cam switch removal procedure.



(1) Make sure that all switch shafts are in the OUT position to clear the rear clip.

(2) Place the long edge of a six-inch rule or similar thin straight edge between the top edge of the rear clip and the switch body.

(3) Carefully pry the rear clip back just far enough to push the steel rule down between the clip and switch body.

CAUTION

When the switch is removed, the contacts may drop free and be damaged or lost. Body salts or acids can contaminate the switch contacts. Wear cotton gloves to prevent touching the contacts in the switch or on the board with bare hands.

(4) Pull the rear of the switch up, remove the steel rule, and pull the switch out of the front clip.

(5) To replace the switch, first check that the slide contacts are properly installed in the carrier. Then, place the front of the switch into the front clip and push the rear of the switch down until the rear clip catches and holds the switch in place.

c1967-3

Fig. 4-9. Removal procedure for typical push-button switch.

Push-Button Switches

Removal and replacement instructions for push-button switches are shown in Figure 4-9.

SEMICONDUCTORS

WARNING

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

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. See HYPCON CONNECTORS for hybrid integrated circuit replacement instructions.

An extraction tool should be used to remove the in-line 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.

HYPCON CONNECTORS

The Hypcon connector is a precision-made connector designed to provide low loss electrical and thermally efficient connection between the printed circuit board and hybrid integrated circuit. An exploded view of the Hypcon connector is shown in Figure 4-10. Care must be taken when replacing the hybrid IC's not to touch the elastomer gold-plated contacts with the fingers or to use a cleaner which will degrade the conductivity of the contacts. The Hypcon connector and hybrid IC should be removed if it becomes necessary to use a cleaning solvent near the connector when replacing adjacent (within 1/2") circuit board components. IMPORTANT: Remove all traces of solder flux or foreign material contamination from the circuit board contact area before replacing the connector. Contamination usually takes place during the soldering and cleaning processes. Even when the soldering is done carefully, flux, oil, or other contaminants can be carried into these devices during the cleaning operation. When the solvent evaporates, non-conductive contaminants may remain on or near the contact interfaces.

The cleaning process, either hand cleaning with a solvent or machine cleaning in an automatic detergent wash, is not recommended for boards fitted with Hypcon connectors.

If a component adjacent to a Hypcon connector must be replaced, the following steps are recommended:

1. Remove the hybrid IC and Hypcon connector (see Disassembly and Removal instructions) before any soldering or cleaning and store in a dirt-free covered container. When several hybrids and Hypcon connectors are to be removed, keep parts together and replace as sets; do not interchange parts.

2. Hand soldering:

a. Use small diameter solder (0.030"-0.040").

b. Use low wattage soldering irons (15 to 40 watts).

c. Use care with flux amount and placement.

3. Remove solder flux and contact contamination with isopropyl alcohol.

4. Flush the hybrid and Hypcon connector mounting area with isopropyl alcohol. Do not scrub with a Q-tip, as cotton fibers will adhere to edges and surfaces of contact areas and cause open or intermittent connections. If the etched circuit board surfaces require more cleaning, scrub with a soft rubber eraser and blow or vacuum clean while dusting surface with a small soft clean brush.

5. If the hybrid IC and elastomer contact holder are contaminated, clean the contact holder and hybrid by flushing or spraying with alcohol and oven dry at 100° C. Do not scrub with a cotton-tipped applicator or similar device. If the contact holder is excessively contaminated, replace it with a new one.

Two inch-pounds of torque should be applied to the mounting screws to secure the Hypcon to the circuit board.

Exercise care when mounting the frame-elastomer connector holder-hybrid IC assembly to the circuit board to prevent misalignment between the connector and board. Grasp the assembly at the hybrid (hat) with tweezers to facilitate correct alignment of the plastic frame projections with the circuit board.

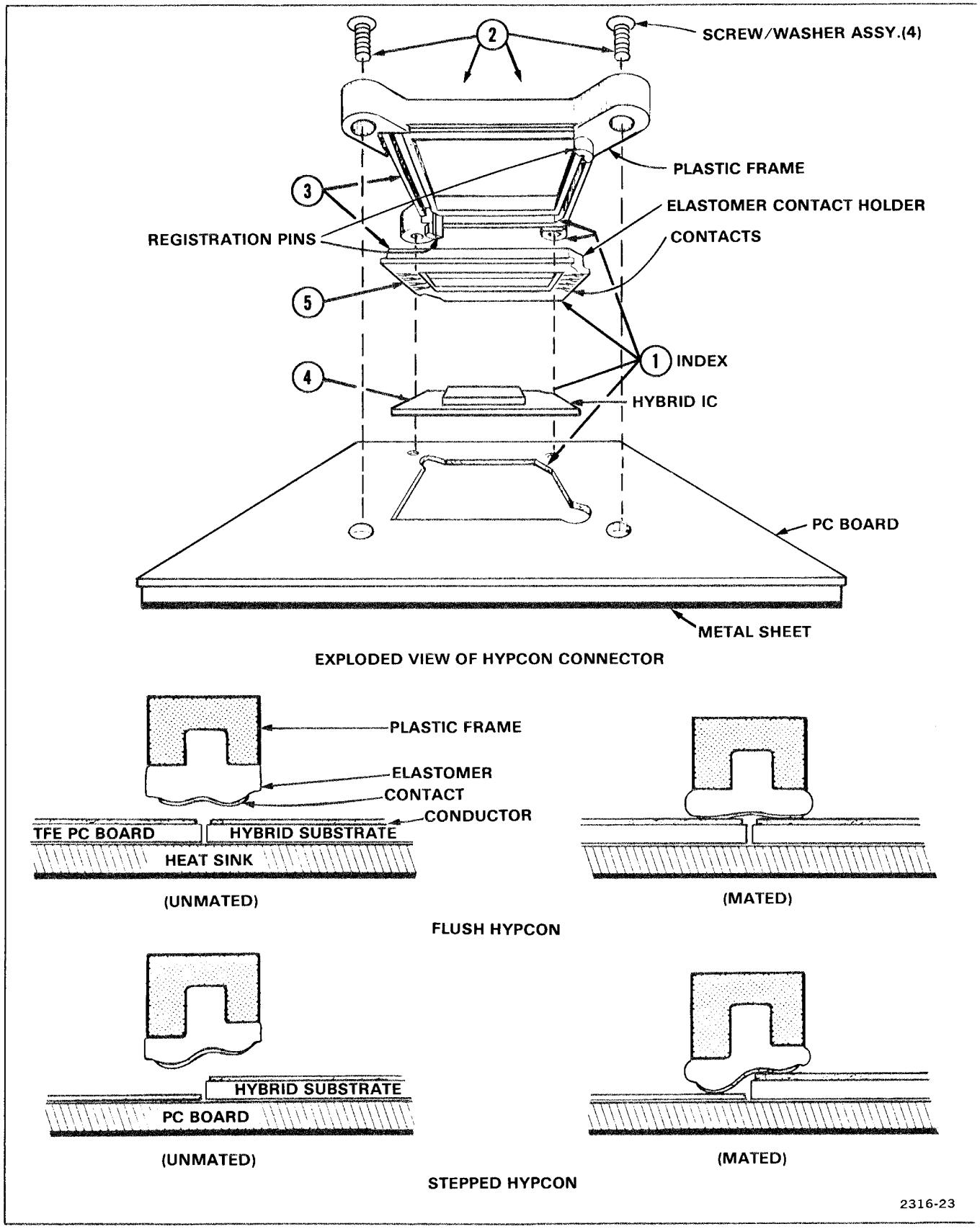


Fig. 4-10. Hypcon connector removal and replacement.

DISASSEMBLY AND REMOVAL

1. Note index on circuit board (arrow) and Hypcon plastic frame (pointed mounting ear).

2. Unscrew and remove the 4 screw/washer assemblies.

3. Lift Hypcon connector from board.

4. Note index location of hybrid and remove from board with tweezers.

5. Note index location of elastomer contact holder and remove by grasping a corner of the contact holder with tweezers and lifting up. Do not touch the gold-plated contacts with your fingers.

REASSEMBLY AND REPLACEMENT

Grasp corner of elastomer contact holder with tweezers and place in plastic frame slot being careful to match the flat contact holder with the flat frame corner. Place a clean plastic envelope over finger and press with finger to seat contact holder into the frame. The contact holder must be evenly seated on all four sides.

Flush Hypcon: Match hybrid flat corner with board receptacle flat corner and place hybrid in receptacle. Match pointed mounting ear of Hypcon connector with flat corner of receptacle and guide registration pins into the board holes.

Stepped Hypcon: Using tweezers, match the hybrid corner index with the elastomer contact holder index and insert between the registration pins. Turn the assembly over, grasp the hybrid "hat" with the tweezers, and guide the registration pins into the board holes. Match the plastic frame pointed mounting ear with the circuit board arrow.

Insert mounting hardware and apply 2 inch-pounds of torque to secure the connector assembly.

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Fig. 4-10 (cont.). Hypcon connector removal and replacement.

CAUTION

Because of the close tolerances involved, special care must be taken to assure correct index alignment of each Hypcon part during reassembly. Failure to do so can result in damage to the parts when they are joined together. See Figure 4-10 for index locations.

If your instrument contains both the flush and stepped type of Hypcon connectors be careful not to mix the elastomer contact holders during reassembly. The flush Hypcon connectors have green elastomer contact holders and the plastic frame is marked "FLUSH." The stepped Hypcons have neutral-colored elastomer contact holders with a slight ridge or step on the contact surface; the large frames are marked "STEPPED." The registration pins on the stepped plastic frame are slightly longer than those on the flush frame. The elastomer contact holder in the small stepped connectors is indexed differently than the large connectors. Look for a small gold arrow in one corner of the holder instead of a flat corner. Match this corner arrow with the pointed corner of the plastic frame. Give close attention to this indexing, as it is easy to insert the elastomer contact holder incorrectly.

Differences also exist between the large flush and large stepped Hypcon circuit board receptacles. Figure 4-10 shows the cross-sectional differences which must be observed when working with an instrument that contains both types of Hypcon connectors.

CAUTION

Damage to the elastomer contact holder can result if the connectors are not mated properly with the board receptacles.

When replacing the flush-type hybrid, insert the hybrid in the board opening and then position the Hypcon connector in the board registration holes for perfect alignment. With the large and small-size stepped connectors, assemble the connector and hybrid before installing on the circuit board. Use tweezers to hold the assembly by the hybrid (hat) and guide the frame registration pins into the circuit board openings. Avoid touching the hybrid and elastomer contact holder with your fingers; finger oils can degrade conductivity.

A procedure for removal and replacement is included in Figure 4-10.

Beginning and ending hybrid substrate contact numbers are printed on the substrate at the index corner. See Figure 4-2, Semiconductor lead configurations.

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 (Fig. 4-7). 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 (Fig. 4-4). When the interconnection is made between adjacent boards, an inter-board multi-pin connector is uded (Fig. 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 and mounted together in a plastic holder; the overall result is that these connectors are removed and installed as a multi-pin connector (see Fig. 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 Fig. 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 Fig. 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 multilayer boards is not recommended; refer such repairs to your local Tektronix Field Office or representative.

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 Fig. 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.

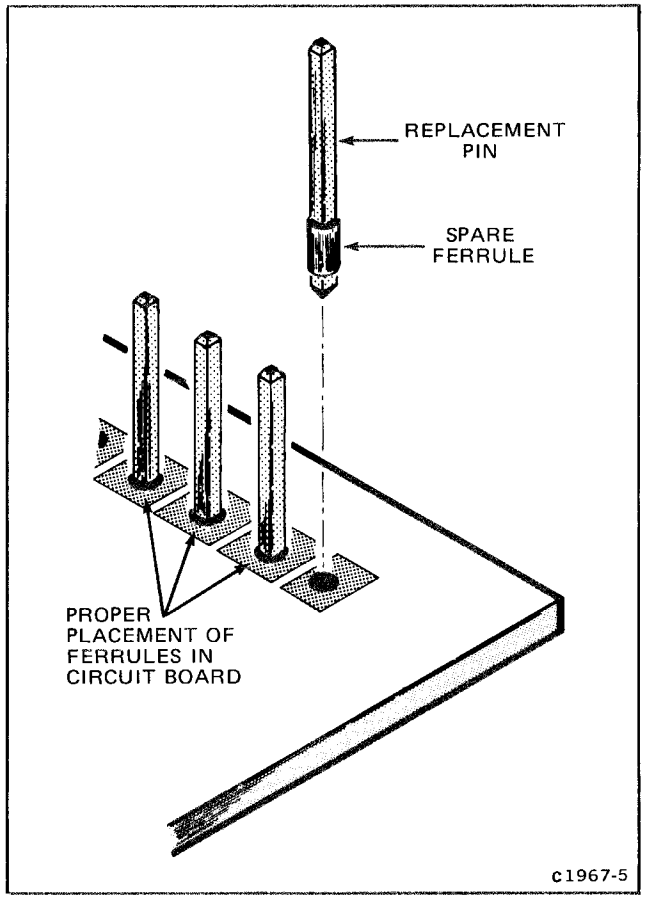


Fig. 4-11. Exploded view of circuit-board pin and ferrule.

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 Fig. 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.

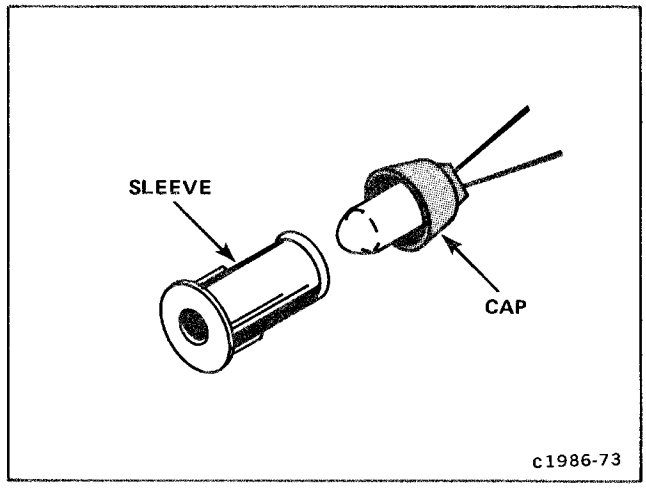


Fig. 4-12. Front-panel light socket assembly.

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. Include 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:

Surround the instrument with polyethylene sheeting to protect the finish of the instrument. Obtain a carton of corrugated cardboard of the correct carton strength and having inside dimensions of no less than six inches more than the instrument dimensions. Cushion the instrument by tightly packing three inches of dunnage or urethane foam between carton and instrument, on all sides. Seal carton with shipping tape or industrial stapler.

The carton test strength for your instrument is 200 pounds.

CALIBRATION

This section provides information necessary to: (1) Verify that this instrument meets the electrical specifications in Section 1, General Information, (2) verify that all controls function properly, and (3) perform all internal adjustments. The Part I—Performance Check procedure checks the electrical specifications listed in section 1 without making any internal adjustments. The Part II—Adjustment and Performance Check procedure provides a complete sequential check of instrument performance concurrent with a complete sequential adjustment of internal controls. A separate Operators Checkout Procedure, in the Installation section of this manual, can be used to check only the functions of the front-panel controls and connectors.

PRELIMINARY INFORMATION

USING THESE PROCEDURES

Both the Part I-Performance Check and Part II-Adjustment and Performance Check procedures are divided into functional block subsections (e.g., A. TRIGGERING SYSTEM and B. HORIZONTAL SYSTEM). The order in which the subsections and steps (A1, A2, B1, B2, etc.) appear in each procedure is the recommended sequence for accomplishing a performance check or calibration of the instrument. Subsections within either procedure can be performed independently, as can each step within any subsection. Refer to Partial Procedures for specific instructions on performing either a partial Performance Check or a partial Adjustment and Performance Check.

All functional block subsections begin with a list of required test equipment, followed by instructions for **Before You Begin** and the list of Preliminary Control Settings for that subsection (e.g., TRIGGERING SYSTEM Preliminary Control Settings, etc.). Each step contains separate Setup Conditions which, if applicable, include the instrument control settings, an illustrated test setup, and test equipment control settings. The instrument and test equipment control settings listed in the Setup Conditions for each step may include additional settings, changes from the previous step, or changes to the Preliminary Control Settings making it possible to perform partial procedures. The Setup Conditions illustrate the setup and the best equipment required to accomplish the step instructions.

Partial Procedures

Part I—Performance Check. To perform a partial Performance Check procedure, first determine which electrical specifications are to be checked. Table 5-1, Performance Check Summary, lists the applicable electrical specifications and provides references to the step(s) in which the performance requirements are checked. The Performance Check Index, at the start of Part I-Performance Check, provides a convenient means for locating the desired subsections and steps. For example: If the external trigger amplifier had been repaired and a performance check was considered necessary, use the Performance Check Summary table to locate the specifications affected by the repair, and the step title of Part I-Performance Check in which those performance requirements are checked. Then use the Performance Check Index to locate the TRIGGER SYSTEM subsection and the step and page number of the applicable step(s).

Any step of a subsection can be performed separately by following the instructions given below.

1. Locate the desired subsection and applicable steps (e.g., B1, B2, B4, etc.) with the Performance Check Summary table and the Performance Check Index.

2. Perform the Performance Check Power-Up Sequence at the start of Part I-Performance Check. Also follow the instructions under **Before You Begin** and Preliminary Control Settings at the beginning of the subsection.

3. Perform the Setup Conditions instructions for the desired step. Disregard any control settings which are the same as those under Preliminary Control Settings.

4. Proceed with the lettered instructions (e.g., a, b, c, etc.).

NOTE

If the steps performed are consecutive, it is not necessary to repeat the Preliminary Control Settings after the first step. However, when a step is skipped, the Preliminary Control Settings must be performed again.

Part II—Adjustment and Performance Check. Although each step in the Part II-Adjustment and Performance Check procedure can be performed independently, we recommend that the entire subsection be performed if any adjustments are made. Table 5-1, Performance Check Summary, lists the applicable electrical specifications and provides references to the step(s) in which the performance requirements are checked and appropriate adjustments are made. The Adjustment and Performance Check Index, at the start of Part II-Adjustment and Performance Check, provides a convenient means for locating the desired subsections and steps. For example: If the A1 Interface board had been replaced, use the Performance Check Summary table to locate the specifications affected by the repair, and the step title(s) of Part II-Adjustment and Performance Check in which those performance requirements are checked or adjusted. Then use the Adjustment and Performance Check Index to locate the HORIZONTAL SYSTEM subsection and the step and page number of the appropriate step(s).

A heading system is used to readily identify the steps (A1, A2, B1, B2, etc.) that contain performance check and/or adjustment instructions. For example, if CHECK is the first word in the title of a step, a performance requirement listed in the Specifications is checked. If ADJUST appears as the first word in the title, the step concerns one or more internal adjustments. And if CHECK/ADJUST appears in the title, the step involves one or more performance requirement checks and adjustments.

The alphabetical instructions under each step (a, b, c, etc.) may contain CHECK, EXAMINE, or ADJUST as the first word of the instruction. These terms are defined as follows:

1. **CHECK**—indicates that the instruction accomplishes a performance requirement check. Each performance requirement is derived from the instrument specification and is listed in Table 5-1 Performance Check Summary.

2. **EXAMINE**—usually precedes an ADJUST instruction and describes how to determine whether the adjustment is necessary. Measurement limits following the word EXAMINE are not to be interpreted as performance limits derived from the instrument specifications. They are provided as indicators of a properly functioning instrument and to aid in the adjustment process.

3. **ADJUST**—describes which adjustment to make the desired result. We recommend that adjustments not be made if a previous CHECK or EXAMINE instruction indicates that no adjustment is necessary.

ADJUSTMENT INTERVAL

To maintain instrument accuracy, check the performance of the time base 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.

TABLE 5-1
Performance Check Summary

Characteristic	Performance Requirement		Performance Check Procedure Title	Adjustment and Performance Check Procedure Title
HORIZONTAL SYSTEM				
Sweep Rates				
Calibrated Range	0.2 s/div to 2 ns/div in 25 steps. X10 Magnifier extends fastest calibrated sweep rate to 0.2 ns/div.		B5. Check Sweep Timing. B6. Check Magnified Sweep Timing.	B5. Adjust Sweep Timing. B7. Check Magnified Sweep Timing.
Variable Range	Continuously variable uncalibrated sweep rate to at least 2.5 times the calibrated sweep rate setting.		B4. Check Variable Time/Division and Variable Hold Off.	B4. Check Variable Time/Division and Variable Hold Off.
Sweep Accuracy[1] with 7104, 7900 and 7800 Series Mainframes	Measured over center 8 displayed divisions.[2] SWP CAL is adjusted at 1 ms/div within the +20° to +30°C range.			
+15° to +35° C	UNMAG	MAG X 10	B5. Check Sweep Timing.	B5. Adjust Sweep Timing.
0.2 s/div to 10 ns/div	2%	3%		
5 ns/div and 2 ns/div	3%	4%[2]		

[1] Some mainframes limit fastest calibrated sweep rate.

[2] 200 ps/div is measured over any 5 divisions within the center 8 divisions.

TABLE 5-1 (CONT.)
Performance Check Summary

Characteristic	Performance Requirement	Performance Check Procedure Title	Adjustment and Performance Check Procedure Title
Sweep Accuracy (cont.)			
0° to +50° C	Derate +15° to +35° C accuracy by additional 1%.	Customer verification normally not required.	
Sweep Length	At least 10.2 div.	B2. Check Sweep Length and Positioning Range.	B2. Check Sweep Length and Positioning Range.
MAG Registration	0.5 div or less from graticule center when changing from MAG X10 to MAG X1.	B3. Check Magnifier Gain and Registration.	B3. Check/Adjust Magnifier Gain and Registration.
Position Range			
POSITION Controls fully CW	Start of sweep must be to right of graticule center at 1 ms/div.	B2. Check Sweep Length and Positioning Range.	B2. Check Sweep Length and Positioning Range.
POSITION Controls fully CCW	End of sweep must be left of graticule center at 1 ms/div.		

TRIGGERING SYSTEM

Trigger Sensitivity for Repetitive Signals	Triggering Frequency Range[3]	Minimum Triggering Signal Required		A4. Check External Triggering Sensitivity. A5. Check Internal Triggering Sensitivity.	A2. Adjust External Trigger Compensation (C117). A3. Adjust Sensitivitiy (R147).
Coupling		Internal	External		
AC	30 Hz to 250 MHz	0.5 div	50 mV		
	250 MHz to 1 GHz	1.5 div	150 mV		
AC LF REJ[4]	50 kHz to 250 MHz	0.5 div	50 mV		
	250 MHz to 1 GHz	1.5 div	150 mV		
AC HF REJ	30 Hz to 30 kHz	0.5 div	50 mV		
DC[5]	Dc to 250 MHz	0.5 div	50 mV		
	250 MHz to 1 GHz	1.5 div	150 mV		

[3]The triggering frequency ranges given here are limited to the -3 dB frequency of the oscilloscope vertical system when operating in the Internal mode.
[4]Will not trigger on sine waves at or below 60 Hz when amplitudes are less than 8 divisions Internal or 3 volts External.
[5]The Triggering Frequency for DC COUPLING applies to frequencies above 30 Hz when operating in the AUTO TRIGGERING MODE.

TABLE 5-1 (CONT.)
Performance Check Summary

Characteristic	Performance Requirement	Performance Check Procedure Title	Adjustment and Performance Check Procedure Title
Trigger Sensitivity (cont.)			
Single Sweep	Same as for Repetitive and Pulsed Triggering.	Customer verification normally not required. Satisfactory operation is substantiated by other tests in the procedures.	
Internal Trigger Jitter	30 ps or less at 1 GHz.	A6. Check Internal Trigger Jitter.	A8. Check Internal Trigger Jitter.
Operating in HF SYNC MODE			
AC, AC LF REJ, or DC	250 MHz to 1 GHz—0.3 div Internal 75 mV External.	A5. Check Internal Triggering Sensitivity. A4. Check External Triggering Sensitivity.	A3. Adjust Sensitivity (R147). A2. Adjust External Trigger Compensation (C117).
External Trigger Input			
LEVEL RANGE	At least ±3.5 V (checked on 1 kHz sine wave).	A3. Check External Level Range.	A5. Check External Level Range.
Maximum Safe Input		Specification applicable under fault conditions; therefore this is not a procedural check.	
1-Megohm Input	250 V (dc plus peak ac).		
50-Ohm Input	1 Watt average.		
Input R and C		Customer verification normally not required. Input resistance and capacitance can be determined with appropriate testing bridge if necessary.	
1-Megohm Input	1 MΩ within 5%, 20 pF within 10%.		
50-Ohm	50 Ω within 2%.	A1. Check External Trigger Input Resistance.	A1. Check External Trigger Input Resistance.
Trigger Holdoff Time			
Minimum Holdoff Setting		Customer verification normally not required. Satisfactory operation is substantiated by other tests in the procedures.	
0.2 s/div to 50 ms/div	40 ms		
20 ms/div to 2 μs/div	2 times TIME/DIV setting.		
1 μs/div to 2 ns/div	2.0 μs		

TABLE 5-1 (CONT.)
Performance Check Summary

Characteristic	Performance Requirement	Performance Check Procedure Title	Adjustment and Performance Check Procedure Title
Trigger Holdoff Time (cont.)			
Maximum Holdoff Setting		Customer verification normally not required. Satisfactory operation is substantiated by other tests in the procedures.	
0.2 s/div to 50 ms/div	400 ms		
20 ms/div to 2 μs/div	20 times TIME/DIV setting		
1 μs/div to 0.5 μs/div	20.0 μs		
0.2 μs/div to 2 ns/div	6.0 μs		

TEST EQUIPMENT REQUIRED

The test equipment listed in Table 5-2 is required for a complete Adjustment and Performance Check of the instrument. If only a Performance Check is to be performed, the items required for Adjustment are not required, and are indicated by footnote 1. The remaining test equipment is common to both procedures.

The specifications for test equipment, given in Table 5-2, are the minimum required to meet the Performance Requirements. Detailed operating instructions for test equipment are omitted in these procedures. 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

All of the listed test equipment is required to completely calibrate this instrument. However, complete checking or calibration may not always be necessary or desirable. You may be satisfied with checking only selected characteristics, thereby reducing the amount of test equipment actually required.

The calibration procedures are based on the first item of equipment given as an example. When other equipment is substituted, control settings or setups may need to be altered. If the exact item of equipment given as an example in Table 5-2 is not available, first check the specifications column carefully to see if any other equipment might suffice. Then check the Purpose column to see what this item is used for. If used for a check or adjustment that is of little or no importance for your measurement requirements, the item and corresponding step(s) can be deleted.

TABLE 5-2
Test Equipment

Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
1. Oscilloscope Mainframe	Tektronix 7000-Series. Bandwidth, 1 GHz with 2 horizontal plug-in compartments.	Provides a display for unit under test.	a. TEKTRONIX 7104 Oscilloscope.
2. High Frequency Amplifier Plug-in Unit	Tektronix 7A-Series. Bandwidth, 1 GHz; deflection factor, 10 mV to 0.5 V.	Provides vertical input to oscilloscope mainframe.	a. TEKTRONIX 7A29 Amplifier plug-in unit.

TABLE 5-2 (CONT.)
Test Equipment

Description	Minimum Specifications	Purpose	Examples of Applicable Test Equipment
3. High Impedance Amplifier Plug-in Unit	Tektronix 7A-Series. Bandwidth, 80 MHz; deflection factor, 5 mV to 10 V/div. Input Impedance, 1 MΩ.	Provides high impedance vertical input to oscilloscope mainframe.	a. TEKTRONIX 7A15A Amplifier Plug-in unit.
4. High-Frequency Sine-Wave Generator[1]	Frequency, 250 MHz to 1 GHz; output amplitude, variable from 50 mV to 0.5 V into 50 Ω.	High-frequency triggering checks.	a. TEKTRONIX SG 504 Leveled Sine Wave Generator with power module. b. Wavetek 2001 Sweep/ Signal Generator.
5. Time-Mark Generator	Marker outputs, 1 ns to 5 ns; accuracy, within 0.1%.	Sweep timing checks and adjustments.	a. TEKTRONIX TG 501 Time Mark Generator with power module.
6. Low-Frequency Function Generator	Frequency, 5 Hz to 500 kHz; output amplitude, variable from 50 mV to 3 V into 50 Ω.	Low-frequency triggering checks and adjustments.	a. TEKTRONIX FG 503 Function Generator with power module. b. General Radio 1310-B Oscillator.
7. Digital Ohmmeter (with test leads)[1]	Range, 200 Ω, accuracy, 0.5% of reading, ±1 count.	Input resistance check.	a. TEKTRONIX DM 502 Digital Multi-meter with power module.
8. Rigid Plug-in Extender	Tektronix 7000-Series extender.	Provides access to internal adjustments and test points.	a. Tektronix 067-0589-00 Calibration Fixture.
9. Coaxial Cables (2 required)	Impedance, 50 Ω; type, RG 58/U; length, 42 and 18 inches; connectors, BNC.	Provides signal interconnections.	a. Tektronix Part 012-0057-01, 012-0076-00.
10. T Connector[1]	Connectors, BNC.	External triggering checks.	a. Tektronix Part 103-0030-00.
11. 10X Attenuator[1]	Dc resistance, 50 Ω, ±1 Ω; connectors, BNC.	Trigger checks and adjustments.	a. Tektronix Part 011-0059-00.
12. Screwdriver	3-inch shaft, 3/32-inch bit.	Adjustments.	a. Xcelite R3323.
13. 10X Probe[2]	Attenuation, 10X; for use with 1 MΩ inputs.	External trigger compensation adjustment.	a. Tektronix Part 010-6105-03.
14. Low-capacitance Screwdriver[2]	2-inch shaft, 3/32-inch bit.	Used for adjusting variable capacitor.	a. Tektronix Part 003-0675-00.

[1]**Used for performance check only; NOT used for adjustment.**
[2]**Used for adjustment only; NOT used for performance check.**

PART I—PERFORMANCE CHECK

The following procedure (Part I—Performance Check) verifies electrical specifications without removing instrument covers or making internal adjustments. All tolerances given are as specified in the Specification tables (section 1) in this manual.

Part II—Adjustment and Performance Check provides the information necessary to: (1) verify that the instrument meets the electrical specifications, (2) verify that all controls function properly, and (3) perform all internal adjustments.

A separate Operators Checkout Procedure is provided in the Operators Manual for familiarization with the instrument and also to verify that all controls and connectors function properly.

See Preliminary Information, at the beginning of this section, for information on performing a partial Performance Check procedure.

PERFORMANCE CHECK PROCEDURE INDEX

PERFORMANCE CHECK POWER-UP SEQUENCE

NOTE

The performance of this instrument can be checked at any ambient temperature from 0° to 50° C unless otherwise indicated.

1. Install a high frequency amplifier plug-in unit in the left vertical compartment of the oscilloscope mainframe.

2. Install the 7B10 in the B horizontal compartment of the mainframe.

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.

A. TRIGGERING SYSTEM

Equipment Required: (Numbers correspond to test equipment listed in Table 5-2)

1. Oscilloscope mainframe
2. High-frequency amplifier plug-in unit
4. High-frequency sine-wave generator
6. Low-frequency function generator
7. Digital ohmmeter
9. Coaxial cables (2 required)
10. BNC T connector
11. 10X attenuator

BEFORE YOU BEGIN:

(1) Perform the Performance Check Power-Up Sequence.

(2) Refer to Section 6, Instrument Options and the Change Information at the rear of this manual for any modifications which may affect this procedure.

(3) See **TEST POINT AND ADJUSTMENT LOCATIONS** foldout page in Section 8, Diagrams and Circuit Board Illustrations.

TRIGGERING SYSTEM PRELIMINARY CONTROL SETTINGS:

7B10 Time Base

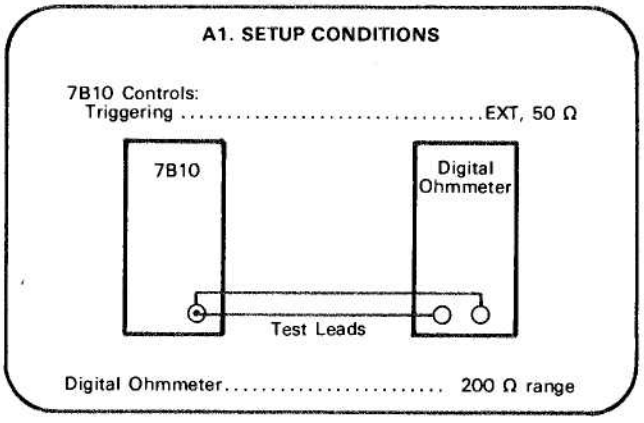
TRIGGERING ..... AUTO, AC, EXT, OUT 50Ω
LEVEL ..... Midrange
TIME/DIV ..... 10 μs
VARIABLE ..... CAL IN
MAG X1
POSITION ..... Midrange
HOLD OFF ..... MIN

Oscilloscope Mainframe

Vertical (plug-in) ..... Midrange
Intensity ..... Visible display
Focus ..... Well defined display

A1. CHECK EXTERNAL TRIGGER INPUT RESISTANCE

SETUP CONDITIONS



a. **CHECK**—That the input resistance is 50Ω within 2% (1Ω).

A2. CHECK TRIGGERING MODES

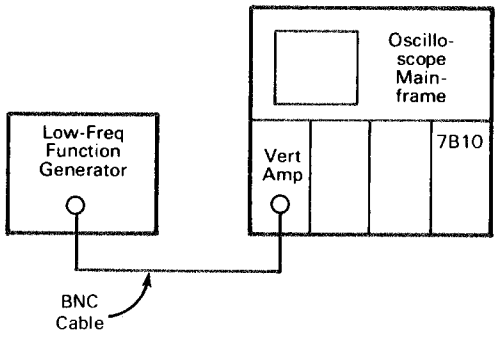
SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Triggering System Preliminary Control Settings, then proceed with the following instructions.

A2. SETUP CONDITIONS

7B10 Controls:
TRIGGERING ..... AUTO, INT



Low-Freq Function Gen ..... 50 kHz, sine wave
Vertical Amplifier (Hi Freq) ..... 2 div.

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

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

c. Set the TRIGGERING MODE to NORM.

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

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

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

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

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

i. **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).

j. Remove the low-frequency function generator cable from the vertical amplifier unit and connect the high-frequency sine-wave generator to the amplifier input with a 10X attenuator.

k. Set the time base TRIGGERING MODE to HF SYNC and the TIME/DIV to 2 ns.

l. Set the high-frequency sine-wave generator and amplifier plug-in unit deflection factor for approximately a 1-division display of 250 MHz signal.

m. **CHECK**—For a stable display (TRIG'D light on) at all positions of the TRIGGERING LEVEL control.

n. Set the TRIGGERING MODE to AUTO, SOURCE to EXT, ~~and TIME/DIV to 10 μs.~~

A3. CHECK EXTERNAL LEVEL RANGE

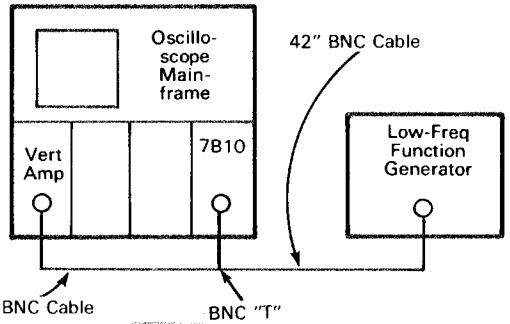
SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Triggering System Preliminary Control Settings, then proceed with the following instructions.

A3. SETUP CONDITIONS

7B10 Controls:
TRIGGERING ..... (+)
TIME/DIV ..... 0.5 ms



Vertical Amplifier (Hi Freq) ..... 0.5 V/div
Low-Freq Function Gen ..... 1 kHz, sine wave

a. **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.

b. **CHECK**—Change the TRIGGERING SLOPE to (-) and repeat part a for the negative slope of the waveform.

A4. CHECK EXTERNAL TRIGGERING SENSITIVITY

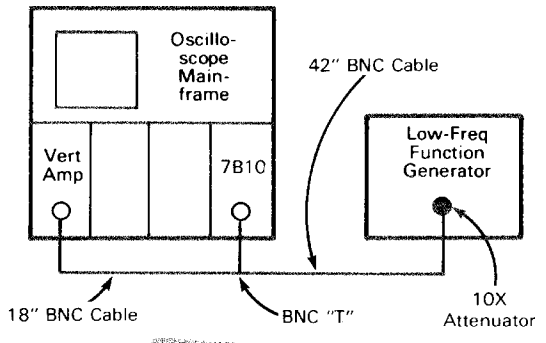
SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Triggering System Preliminary Control Settings, then proceed with the following instructions.

A4. SETUP CONDITIONS

7B10 Controls:
TRIGGERING ..... NORM, (+)
LEVEL ..... Stable display
TIME/DIV ..... 10 ms



Vertical Amplifier (HF Freq) ..... 10 mV/div
Low-Freq Function Gen ..... 30 Hz, sine wave
Amplitude ..... 5 div

a. **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).

b. **CHECK**—Change the TRIGGERING SLOPE to (-) and repeat part a.

c. Disconnect the low-frequency function generator from the 10X attenuator and connect the high-frequency sine-wave generator to the 10X attenuator.

d. Set the SLOPE to (+) and the TIME/DIV switch to 2 ns.

e. Set the high-frequency sine-wave generator for a 5-division display (50 millivolts) at 250 megahertz.

f. **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 TRIGGERING LEVEL control as necessary.)

g. **CHECK**—Set the SLOPE switch to (-) and repeat part f.

h. Set the amplifier plug-in unit deflection factor to 50 millivolts/division and set the high frequency sine-wave generator for a 3-division display (150 millivolts) at 1 GHz.

i. **CHECK**—For a stable display (TRIG'D light on) with the COUPLING switch set to:

1. AC
2. AC LF REJ
3. DC

(Set TRIGGERING LEVEL control as necessary)

j. **CHECK**—Set the SLOPE switch to (+) and repeat part i.

k. Set the TRIGGERING MODE to HF SYNC and the amplifier plug-in unit deflection factor to 10 millivolts/division.

l. Set the high-frequency sine-wave generator for a 7.5 division display (75 millivolts) at 1 GHz.

m. 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 TRIGGERING LEVEL control as necessary.)

n. CHECK—Set the SLOPE switch to (—) and repeat part m.

A5. CHECK INTERNAL TRIGGERING SENSITIVITY

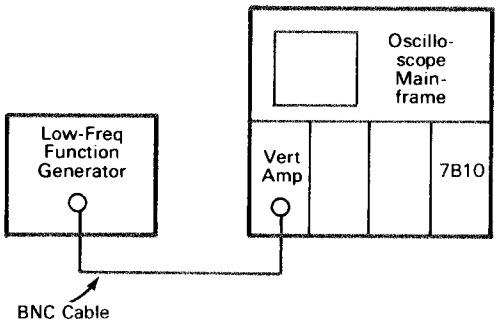
SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Triggering System Preliminary Control Settings, then proceed with the following instructions.

A5. SETUP CONDITIONS

7B10 Controls:
TRIGGERING ..... (+), NORM, INT
LEVEL ..... Stable display (TRIG'D light on)
TIME/DIV ..... 10 ms



Vertical Amplifier (Hi Freq) ..... 5 division display
Low-Freq Function Gen ..... 30 Hz, sine wave

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

1. AC
2. AC HF REJ
3. DC

(Set TRIGGERING LEVEL control as necessary.)

b. Change the TRIGGERING SLOPE to (-) and repeat part a.

c. Disconnect the low-frequency function generator and connect the high-frequency sine-wave generator to the amplifier plug-in unit input. d. Set the TRIGGERING SLOPE to (+) and the TIME/DIV switch to 2 ns.

d. Set the TRIGGERING SLOPE to (+) and the TIME/DIV switch to 2 ns.

e. Set the high-frequency sine-wave generator and the amplifier plug-in unit deflection factor for a 0.5-division display at 250 megahertz (use 10X attenuator).

f. **CHECK**—For a stable display (TRIG'D light on) with the COUPLING switch set to:

1. AC
2. AC LF REJ
3. DC

(Set TRIGGERING LEVEL control as necessary.)

g. **CHECK**—Set the TRIGGERING SLOPE to (-) and repeat part f.

h. Set the high-frequency sine-wave generator and the amplifier plug-in unit deflection factor for a 1.5 division display at 1 GHz.

i. **CHECK**—For a stable display (TRIG'D light on) with the COUPLING switch set to:

k. Set the TRIGGERING MODE switch to HF SYNC and the high-frequency sine-wave generator and amplifier plug-in unit deflection factor for a 0.3-division display at 1 GHz.

l. 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 TRIGGERING LEVEL control as necessary.)

m. CHECK—Set the SLOPE to (—) and repeat part l.

1. AC
2. AC LF REJ
3. DC

(Set TRIGGERING LEVEL control as necessary.)

j. **CHECK**—Set the TRIGGERING SLOPE to (+) and repeat part i.

A6. CHECK INTERNAL TRIGGER JITTER

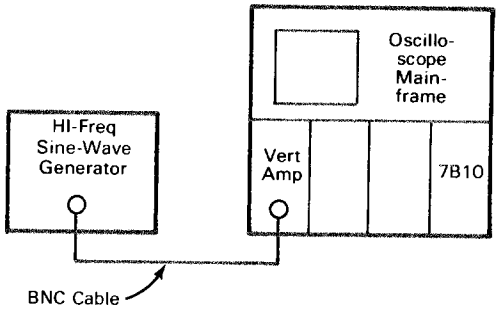
SETUP CONDITIONS

NOTE

Partial procedure: first perform the Triggering System Preliminary Control Settings, then proceed with the following instructions.

A6. SETUP CONDITIONS

7B10 Controls:
TRIGGERING ..... INT
LEVEL ..... Stable display (TRIG'D light on)
TIME/DIV ..... 2 ns
MAG ..... X10 (out)



Vertical Amplifier (Hi Freq) ..... 0.2 V/div.
HI-Freq. Sine-Wave Generator ..... 1 GHz, 1.5 div.

a. **CHECK**—For a stable display with no more than 0.15 division (30 picosecond) of jitter.

A7. CHECK LINE TRIGGERING

SETUP CONDITIONS

NOTE

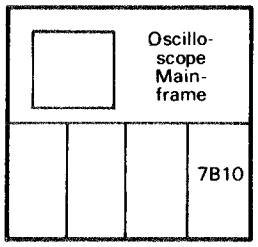
If the preceding step was not performed, first refer to the Triggering System Preliminary Control Settings, then proceed with the following instructions.

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

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

A7. SETUP CONDITIONS

7B10 Controls:
TRIGGERING ..... LINE



B. HORIZONTAL SYSTEM

Equipment Required: (Numbers correspond to test equipment listed in Table 5-2)

1. Oscilloscope Mainframe
2. High Frequency Amplifier Plug-in Unit
5. Time-Mark Generator
8. Coaxial Cables (1 required)
11. Screwdriver

BEFORE YOU BEGIN:

(1) Perform the Performance Check Power-Up Sequence (not necessary if continuing Performance Check.)

(2) Refer to Section 6, Instrument Options and the Change Information at the rear of the manual for any modifications which may affect this procedure.

(3) See **TEST POINT AND ADJUSTMENT LOCATIONS** foldout page in Section 8, Diagrams and Circuit Board Illustrations.

HORIZONTAL SYSTEM PRELIMINARY CONTROL SETTINGS:

7B10 Time Base
- TRIGGERING ..... AUTO, AC, INT
- LEVEL ..... Midrange
- TIME/DIV ..... 1 ms
- MAG X1
- VARIABLE ..... CAL IN
- HOLD OFF ..... MIN

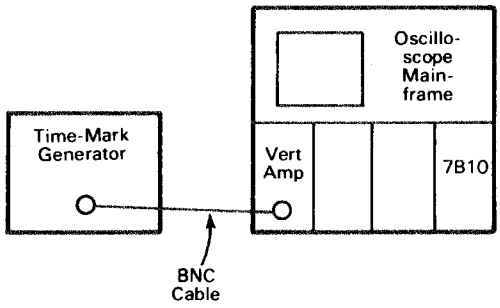
Oscilloscope Mainframe
- Vertical (plug-in) ..... Midrange
- Intensity ..... Visible display
- Focus ..... Well defined display

B1. SET BASIC SWEEP CALIBRATION

SETUP CONDITIONS

B1. SETUP CONDITIONS

7B10 Controls:
No change in settings.



Vertical Amplifier (Hi Freq) ..... 0.5 V/div (2 div display)
Time-Mark Generator ..... 1 ms

a. **EXAMINE**—For 1 marker/division over center 8 divisions (position as necessary).

b. 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

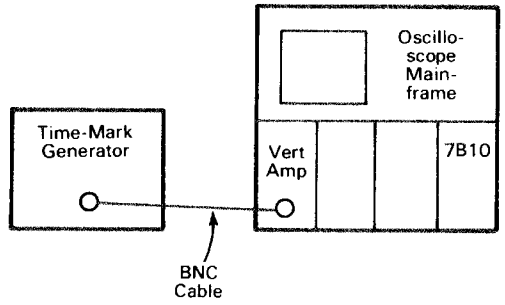
SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Horizontal System Preliminary Control Settings, then proceed with the following instructions.

B2. SETUP CONDITIONS

7B10 Controls:
No change in settings.



Vertical Amplifier (Hi Freq) ..... 0.5 V/div (2 div display)
Time-Mark Generator ..... 1 ms

a. Horizontally position the display to place the second time marker to the first graticule line.

b. **CHECK**—That the end of the 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 counterclockwise.

f. **CHECK**—The end of sweep must be to the left of graticule center.

B3. CHECK MAGNIFIER GAIN AND REGISTRATION

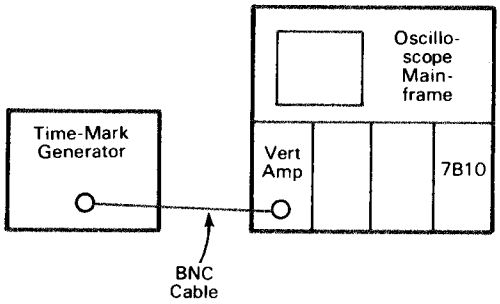
SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Horizontal System Preliminary Control Settings, then proceed with the following instructions.

B3. SETUP CONDITIONS

7B10 Controls:
MAG ..... X10 (out)



Vertical Amplifier (Hi Freq) ..... 0.5 V/div (2 div display)
Time-Mark Generator ..... 0.1 ms

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

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

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

B4. CHECK VARIABLE TIME/DIVISION AND VARIABLE HOLD OFF

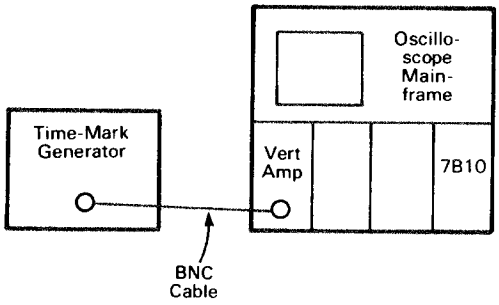
SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Horizontal System Preliminary Control Settings, then proceed with the following instructions.

B4. SETUP CONDITIONS

7B10 Controls:
TIME/DIV VARIABLE ..... Out (uncal)



Vertical Amplifier (Hi Freq) ..... 0.5 V/div (2div display)
Time-Mark Generator 5ms

a. 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 TRIGGERING 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).

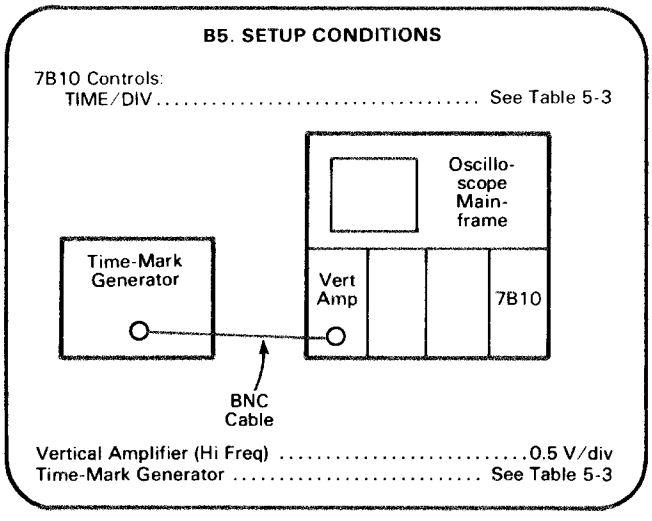
g. Set the HOLD OFF control counterclockwise to MIN and set the TRIGGERING LEVEL control for a stable display.

B5. CHECK SWEEP TIMING

SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Horizontal System Preliminary Control Settings, then proceed with the following instructions.



NOTE

The tolerances given 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. **CHECK**—Using the TIME/DIV setting and time-mark generator settings from Table 5-3, check 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

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 5-3.

TABLE 5-3
Sweep Timing

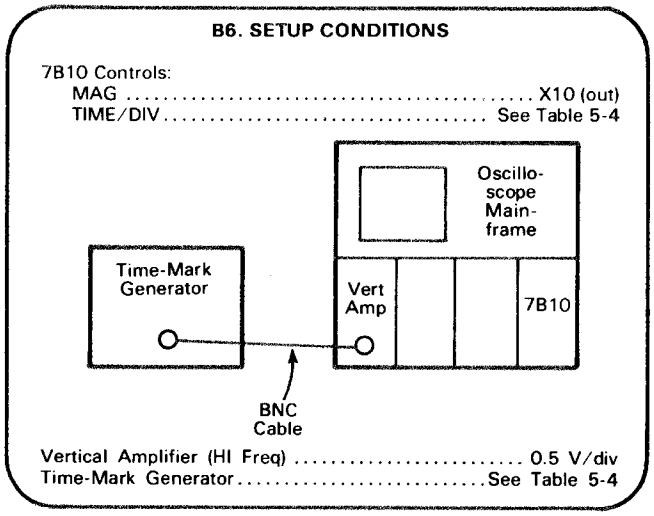
Time/Div	Time Markers	Tolerance (+15° to +35° C)
2 ns	2 ns	Within 0.24 div
5 ns	5 ns	Within 0.24 div
10 ns	10 ns	Within 0.16 div
20 ns	20 ns	Within 0.16 div
50 ns	50 ns	Within 0.16 div
.1 μs	.1 μs	Within 0.16 div
.2 μs	.2 μs	Within 0.16 div
.5 μs	.5 μs	Within 0.16 div
1 μs	1 μs	Within 0.16 div
2 μs	2 μs	Within 0.16 div
5 μs	5 μs	Within 0.16 div
10 μs	10 μs	Within 0.16 div
20 μs	20 μs	Within 0.16 div
50 μs	50 μs	Within 0.16 div
.1 ms	.1 ms	Within 0.16 div
.2 ms	.2 ms	Within 0.16 div
.5 ms	.5 ms	Within 0.16 div
1 ms	1 ms	Within 0.16 div
2 ms	2 ms	Within 0.16 div
5 ms	5 ms	Within 0.16 div
10 ms	10 ms	Within 0.16 div
20 ms	20 ms	Within 0.16 div
50 ms	50 ms	Within 0.16 div
.1 s	.1 s	Within 0.16 div
.1 s	.1 s	Within 0.16 div
.2 s	.2 s	Within 0.16 div

B6. CHECK MAGNIFIED SWEEP TIMING

SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Horizontal System Preliminary Control Settings, then proceed with the following instructions.



NOTE

The tolerances in Table 5-4 are for an ambient temperature range of +15°to +35° C. If outside this range, see the Specification section for applicable tolerances.

a. **CHECK**—Using the TIME/DIV settings and time-mark generator settings in Table 5-4, check magnified sweep accuracy for 1 time mark/division, over the center 8 divisions, within the tolerance given in Table 5-4. Set the POSITION controls and TRIGGERING LEVEL control as necessary for a stable display aligned with the vertical graticule lines.

NOTE

The 7B10 may be operated as a delayed sweep unit (B horizontal compartment) with a companion delaying sweep unit (A horizontal compartment). To check 7B10 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.

TABLE 5-4
Magnified Sweep Timing

Time/Div	Time Markers	Tolerance (+15° to +35° C)
2 ns	1 ns[1]	Within 0.2 div
5 ns	1 ns	Within 0.32 div
10 ns	1 ns	Within 0.24 div
20 ns	2 ns	Within 0.24 div
50 ns	5 ns	Within 0.24 div
.1 μs	10 ns	Within 0.24 div
.2 μs	20 ns	Within 0.24 div
.5 μs	50 ns	Within 0.24 div
1 μs	.1 μs	Within 0.24 div
2 μs	.2 μs	Within 0.24 div
5 μs	.5 μs	Within 0.24 div
10 μs	1 μs	Within 0.24 div
20 μs	2 μs	Within 0.24 div
50 μs	5 μs	Within 0.24 div
.1 ms	10 μs	Within 0.24 div
.2 ms	20 μs	Within 0.24 div
.5 ms	50 μs	Within 0.24 div
1 ms	.1 ms	Within 0.24 div
2 ms	.2 ms	Within 0.24 div
5 ms	.5 ms	Within 0.24 div
10 ms	1 ms	Within 0.24 div
20 ms	2 ms	Within 0.24 div
50 ms	5 ms	Within 0.24 div
.1 s	10 ms	Within 0.24 div
.2 s	20 ms	Within 0.24 div

[1]**Check for 1 cycle in 5 divisions at 200 ps/div over center 8 divisions.**

This completes the Performance Check procedure.

PART II—ADJUSTMENT AND PERFORMANCE CHECK

The following procedure (Part II—Adjustment and Performance Check) provides the information necessary to: (1) verify that the instrument meets the electrical specifications, (2) verify that all controls function properly, and (3) perform all internal adjustments.

Part I—Performance Check verifies electrical specifications without removing instrument covers or making internal adjustments. All tolerances given are as specified in the Specification tables (section 1) in this manual.

A separate Operators Checkout Procedure is provided in the Operators Manual for familiarization with the instrument and also to verify that all controls and connectors function properly.

See Preliminary Information, at the beginning of this section, for further information.

ADJUSTMENT AND PERFORMANCE CHECK PROCEDURE INDEX

ADJUSTMENT AND PERFORMANCE CHECK POWER-UP SEQUENCE

NOTE

The performance of this instrument can be checked to any ambient temperature from 0° to +50° C unless otherwise stated. Adjustments must be performed at an ambient temperature between +20° and +30° C for specified accuracies.

1. Install a high impedance amplifier unit in the left vertical compartment of the oscilloscope mainframe.

2. Install the 7B10 in the B horizontal compartment of the mainframe.

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.

A. TRIGGERING SYSTEM

Equipment Required: (Numbers correspond to test equipment listed in Table 5-2)

1. Oscilloscope mainframe
2. High-frequency amplifier plug-in unit
3. High-impedance amplifier plug-in unit
4. High-frequency sine-wave generator
6. Low-frequency function generator
7. Rigid plug-in extender
8. Coaxial cables (2 required)
9. BNC T connector
11. Screwdriver
12. 10X Probe
13. Low-capacitance Screwdriver

BEFORE YOU BEGIN:

(1) Perform the Adjustment and Performance Check Power-Up Sequence.

(2) Refer to Section 6, Instrument Options and the Change Information at the rear of the manual for any modifications which may effect this procedure.

(3) See **TEST POINT AND ADJUSTMENT LOCATIONS** foldout page in Section 8, Diagrams and Circuit Board Illustrations.

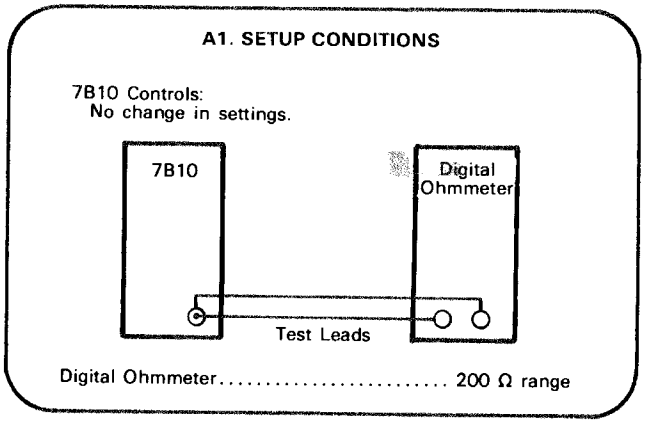
TRIGGERING SYSTEM PRELIMINARY CONTROL SETTINGS:

7B10 Time Base
- TRIGGERING ..... AUTO, AC, EXT OUT 50 Ω
- LEVEL ..... Midrange
- TIME/DIV ..... 2 ms
- MAG X1
- VARIABLE ..... CAL IN

Oscilloscope Mainframe
- Intensity ..... Visible display
- Vertical (plug-in) ..... Midrange
- Focus ..... Well defined display

A1. CHECK EXTERNAL TRIGGER INPUT RESISTANCE

SETUP CONDITIONS



a. **CHECK**—That the input resistance is 50Ω within 2% (1Ω).

A2. ADJUST EXTERNAL TRIGGER COMPENSATION (C117)

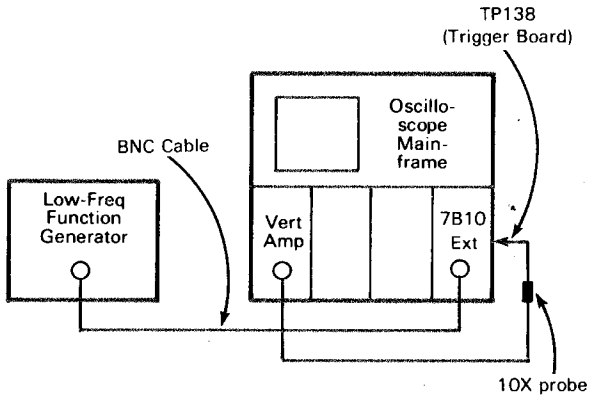
SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Triggering System Preliminary Control Settings, then proceed with the following instructions.

A2. SETUP CONDITIONS

7B10 Controls:
No change in settings.



Vertical Amplifier (Hi Imp) ..... 50 mV/div.
Low-Freq Function Gen ..... 1 kHz, square wave

a. Set the low-frequency function generator and the amplifier plug-in unit for a 4 to 6 division display at 1 kHz (position as necessary).

b. **EXAMINE**—Display pulse for minimum spike and optimum flat top.

c. **ADJUST**—C117 (External Trigger Comp) on the Trigger circuit board for minimum spike and optimum flat top on the displayed pulse.

A3. ADJUST TRIGGER SENSITIVITY (R147)

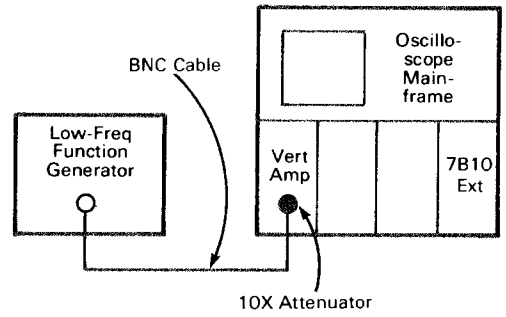
SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Triggering System Preliminary Control Settings, then proceed with the following instructions.

A3. SETUP CONDITIONS

7B10 Controls:
TRIGGERING ..... NORM, INT
LEVEL ..... Stable display
TIME/DIV ..... 1 ms



Vertical Amplifier (Hi Freq) ..... 0.1 V/div
Low-Freq Function Gen ..... 1 kHz, sine wave
Amplitude ..... 2 div

a. Set the amplifier plug-in unit deflection factor for 1V (0.2 division).

b. **EXAMINE**—For a stable 0.2 division display.

c. **ADJUST**—R147 (Sensitivity) on the Trigger circuit board for a stable 0.2 division display.

A4. CHECK TRIGGERING MODES

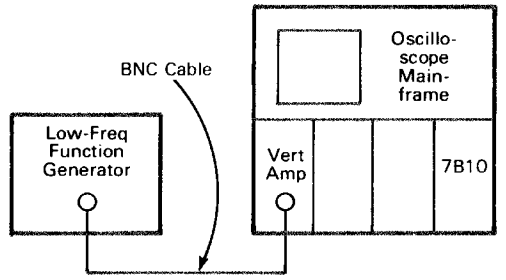
SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Triggering System Preliminary Control Settings, then proceed with the following instructions.

A4. SETUP CONDITIONS

7B10 Controls:
TRIGGERING ..... AUTO, INT
TIME/DIV ..... 10 μs



Low-Freq Sine-Wave Gen ..... 50 kHz, sine wave
Amplitude ..... 2 div.

@

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

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

c. Set the TRIGGERING MODE to NORM.

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

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

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

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

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

i. **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).

j. Remove the low-frequency function generator cable from the amplifier plug-in unit and connect the high-frequency sine-wave generator to the amplifier input with a 10X attenuator.

k. Set the TRIGGERING MODE to HF SYNC and the TIME/DIV to 2 ns.

l. Set the high-frequency sine-wave generator and amplifier plug-in unit deflection factor for approximately a 1-division display of 250 MHz signal.

m. **CHECK**—For a stable display (TRIG'D light on) at all positions of the TRIGGERING LEVEL control.

n. Set the TRIGGERING MODE to AUTO, SOURCE to EXT, and TIME/DIV to 10 μs.

A5. CHECK EXTERNAL LEVEL RANGE

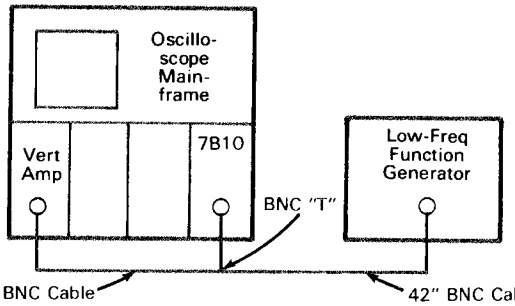
SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Triggering System Preliminary Control Settings, then proceed with the following instructions.

A5. SETUP CONDITIONS

7B10 Controls:
TRIGGERING ..... (+)
TIME/DIV ..... 5 ms
EXT-TRIG-IN ..... 50 Ω



Vertical Amplifier (Hi Freq) ..... 0.5 V/div
Low-Freq Function Gen ..... 3 V, 1 kHz, sine wave

a. **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 TRIGGERING LEVEL control rotation.

b. **CHECK**—Change the TRIGGERING SLOPE to (-) and repeat part a for the negative slope of the waveform.

A6. CHECK EXTERNAL TRIGGERING SENSITIVITY

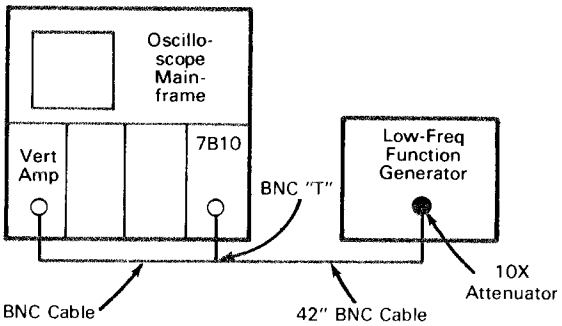
SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Triggering System Preliminary Control Settings, then proceed with the following instructions.

A6. SETUP CONDITIONS

7B10 Controls:
TRIGGERING ..... NORM, (+)
LEVEL ..... Stable display
TIME/DIV ..... 10 ms



Vertical Amplifier (Hi Freq) ..... 10 mV/div.
Low-Freq Function Gen ..... 30 Hz, sine wave
Amplitude ..... 5 divs.

a. **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 LF REJ
3. DC

(Set TRIGGERING LEVEL control as necessary).

b. **CHECK**—Change the TRIGGERING SLOPE to (-) and repeat part a.

c. Disconnect the low-frequency function generator from the 10X attenuator and connect the high-frequency sine-wave generator to the 10X attenuator.

d. Set the SLOPE to (+) and the TIME/DIV switch to 2 ns.

e. Set the high-frequency sine-wave generator for a 5-division display (50 millivolts) at 250 megahertz.

f. **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 TRIGGERING LEVEL control as necessary.)

g. **CHECK**—Set the SLOPE switch to (-) and repeat part f.

h. Set the amplifier plug-in unit deflection factor to 50 millivolts/division and set the high-frequency sine-wave generator for a 3-division display (150 millivolts) at 1 GHz.

i. **CHECK**—For a stable display (TRIG'D light on) with the COUPLING switch set to:

1. AC
2. AC LF REJ
3. DC

(Set TRIGGERING LEVEL control as necessary.)

j. **CHECK**—Set the SLOPE switch to (+) and repeat part i.

k. Set the TRIGGERING MODE to HF SYNC and the amplifier plug-in unit deflection factor to 10 millivolts/division.

l. Set the high-frequency sine-wave generator for a 7.5 division display (75 millivolts) at 1 GHz.

m. **CHECK**—For a stable display (TRIG'D light on) with the COUPLING switch set to:

1. AC
2. AC LF REJ
3. DC

(Set TRIGGERING LEVEL control as necessary)

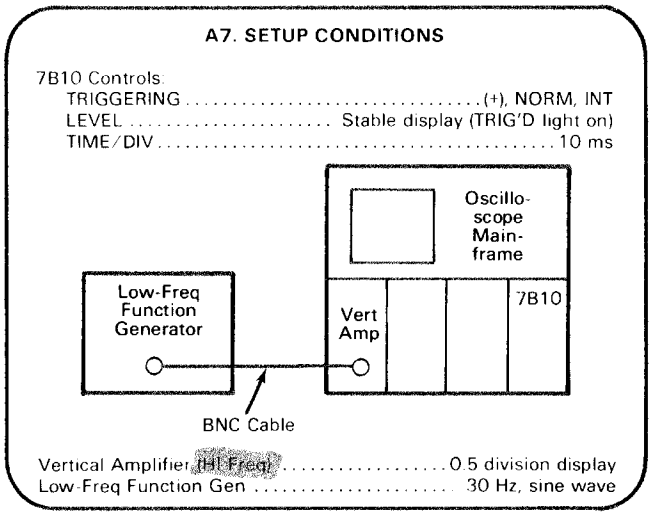
n. **CHECK**—Set the SLOPE switch to (-) and repeat part m.

A7. CHECK INTERNAL TRIGGERING SENSITIVITY

SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Triggering System Preliminary Control Settings, then proceed with the following instructions.



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

1. AC
2. AC LF REJ
3. DC

(Set TRIGGERING LEVEL control as necessary.)

b. Change the TRIGGERING SLOPE to (-) and repeat part a.

c. Disconnect the low-frequency function generator and connect the high-frequency sine-wave generator to the amplifier plug-in unit input.

d. Set the SLOPE to (+) and the TIME/DIV switch to 2 ns.

e. Set the high-frequency sine-wave generator and the amplifier plug-in unit deflection factor for a 0.5-division display at 250 megahertz (use 10X attenuator).

f. **CHECK**—For a stable display (TRIG'D light on) with the COUPLING switch set to:

1. AC
2. AC LF REJ
3. DC

(Set TRIGGERING LEVEL control as necessary).

g. **CHECK**—Set the SLOPE to (-) and repeat part f.

h. Set the high-frequency sine-wave generator and the amplifier plug-in unit deflection factor for a 1.5 division display at 1 GHz.

i. **CHECK**—For a stable display (TRIG'D light on) with the COUPLING switch set to:

1. AC
2. AC LF REJ
3. DC

(Set TRIGGERING LEVEL control as necessary.)

j. **CHECK**—Set the SLOPE to (+) and repeat part i.

k. Set the TRIGGERING MODE switch to HF SYNC and the high-frequency sine-wave generator and amplifier plug-in unit deflection factor for a 0.3 division display at 1 GHz.

l. **CHECK**—For a stable display (TRIG'D light on) with the COUPLING switch set to:

1. AC
2. AC LF REJ
3. DC

(Set TRIGGERING LEVEL control as necessary.)

m. **CHECK**—Set the SLOPE to (+) and repeat part i.

A8. CHECK INTERNAL TRIGGER JITTER

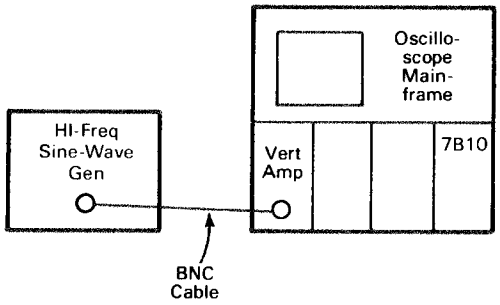
SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Triggering System Preliminary Control Settings, then proceed with the following instructions.

A8 SETUP CONDITIONS

7B10 Controls:
TRIGGERING ..... INT
LEVEL ..... Stable display (TRIG'D light on)
TIME/DIV ..... 2 ns
MAG ..... X10 (out)



Vertical Amplifier (HI Freq) ..... 0.2 V/div.
HI-Freq Sine-Wave Gen ..... 1 GHz, 1.5 div.

a. **CHECK**—For a stable display with no more than 0.15 division (30 picosecond) of jitter.

A9. CHECK LINE TRIGGERING

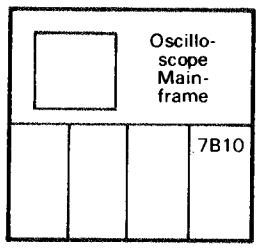
SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Triggering System Preliminary Control Settings, then proceed with the following instructions.

A9. SETUP CONDITIONS

7B10 Controls:
TRIGGERING ..... LINE



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

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

B. HORIZONTAL SYSTEM

Equipment Required: (Numbers correspond to test equipment listed in Table 5-2)

1. Oscilloscope mainframe
2. High-Frequency amplifier plug-in unit
5. Time-mark generator
7. Rigid plug-in extender
8. Coaxial cables (2 required)
11. Screwdriver

BEFORE YOU BEGIN:

(1) Perform the Power-Up Sequence preceding the Adjustment and Performance Check Procedure. (Not necessary if continuing Adjustment and Performance Check.)

(2) Refer to Section 6, Instrument Options and the Change Information at the rear of the manual for any modifications which may affect this procedure.

(3) See **TEST POINT AND ADJUSTMENT LOCATIONS** foldout page in Section 8, Diagrams and Circuit Board Illustrations.

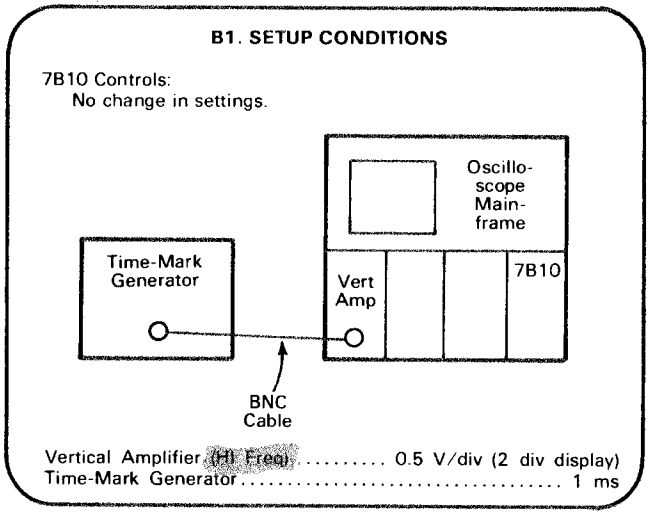
HORIZONTAL SYSTEM PRELIMINARY CONTROL SETTINGS:

7B10 Time Base
- TRIGGERING ..... AUTO, AC, INT
- LEVEL ..... Stable display (TRIG'D light on)
- TIME/DIV ..... 1 ms
- MAG X1
- VARIABLE ..... CAL IN
- POSITION ..... Midrange
- HOLD OFF ..... MIN

Oscilloscope Mainframe
- Vertical position (plug-in) ..... Midrange
- Intensity ..... Visible display
- Focus ..... Well defined display

B1. SET BASIC SWEEP CALIBRATION

SETUP CONDITIONS



a. **EXAMINE**—For 1 marker/division over center 8 divisions (position as necessary).

b. 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

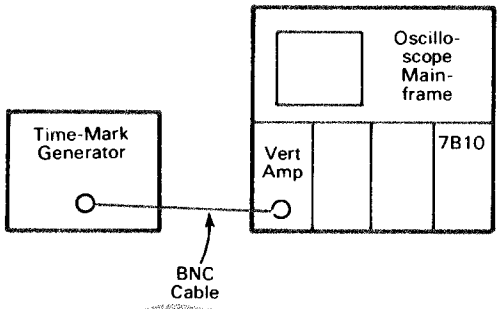
SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Horizontal System Preliminary Control Settings, then proceed with the following instructions.

B2. SETUP CONDITIONS

7B10 Controls:
No change in settings.



Vertical Amplifier (Hi Freq) ..... 0.5 V/div (2 div display)
Time-Mark Generator ..... 1 ms

a. Horizontally position the display to place the second time marker to the first graticule line.

b. **CHECK**—That the end of the 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 counterclockwise.

f. **CHECK**—The end of sweep must be to the left of graticule center.

B3. CHECK/ADJUST MAGNIFIER GAIN AND REGISTRATION (R460, R470)

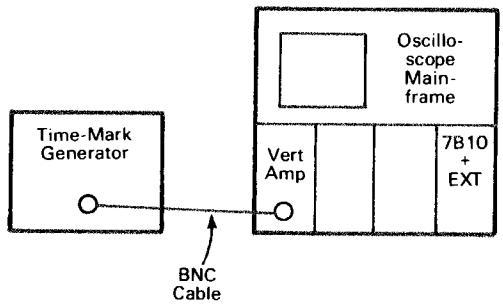
SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Horizontal System Preliminary Control Settings, then proceed with the following instructions.

B3. SETUP CONDITIONS

7B10 Controls:
MAG ..... X10 (out)



Vertical Amplifier (Hi Freq) ..... 0.5 V/div (2 div display)
Time-Mark Generator ..... 0.1 ms

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

b. **ADJUST**—R460 (Mag Gain) for 1 marker/division over the center 8 divisions of display.

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

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

e. **ADJUST**—R470 (Mag Reg) to align the center time marker with graticule center.

B4. CHECK VARIABLE TIME/DIVISION AND VARIABLE HOLD OFF

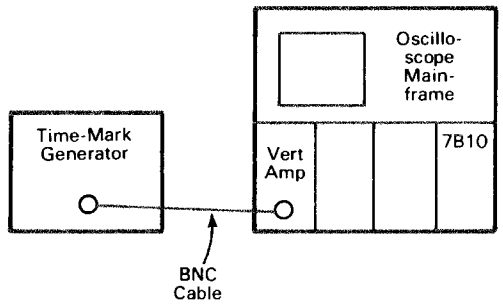
SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Horizontal System Preliminary Control Settings, then proceed with the following instructions.

B4. SETUP CONDITIONS

7B10 Controls:
TIME/DIV VARIABLE ..... Out (uncal)



Vertical Amplifier (Hi Freq) ..... 0.5 V/div (2 div display)
Time-Mark Generator ..... 5 ms

a. 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 TRIGGERING 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).

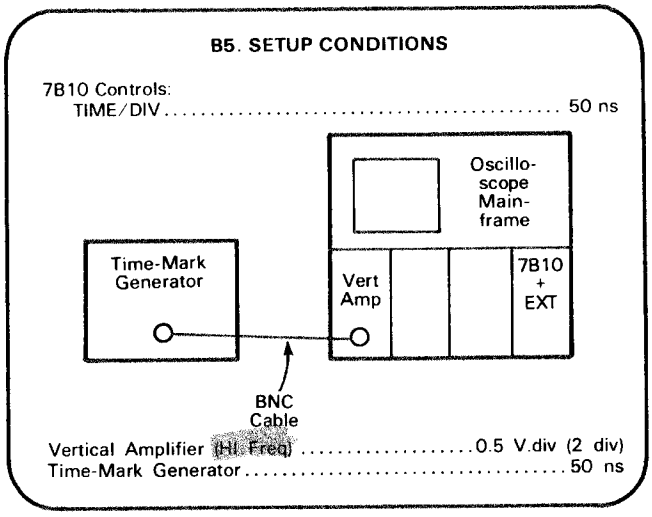
g. Set the HOLD OFF control counterclockwise to MIN and set the TRIGGERING LEVEL control for a stable display.

B5. ADJUST SWEEP TIMING (C361, R305, R310, R480)

SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Horizontal System Preliminary Control Settings, then proceed with the following instructions.



a. **EXAMINE**—For 1 marker/division over the center 8 divisions of display (position as necessary).

b. **ADJUST**—C361 (50 ns Timing) for 1 marker/division over the center 8 divisions of display (position as necessary).

c. Set the TIME/DIV switch to 5 nanoseconds and set the time-mark generator for 5 nanosecond markers.

d. **EXAMINE**—For 1 marker/division over the center 8 divisions of display (position as necessary).

e. **ADJUST**—R480 (5 ns Timing) for 1 marker/division over the center 8 divisions of display (position as necessary).

f. Set the TIME/DIV switch to 10 μs and set the time-mark generator for 10 μs markers.

g. **EXAMINE**—For 1 marker/division over the center 8 divisions of display (position as necessary).

h. **ADJUST**—R310 (10 μs Timing) for 1 marker/division over the center 8 divisions of display (position as necessary).

i. Set the TIME/DIV switch to 10 ms, the TRIGGERING MODE to NORM, and set the time-mark generator for 10 millisecond markers.

j. **EXAMINE**—For 1 marker/division over the center 8 divisions of display (position as necessary).

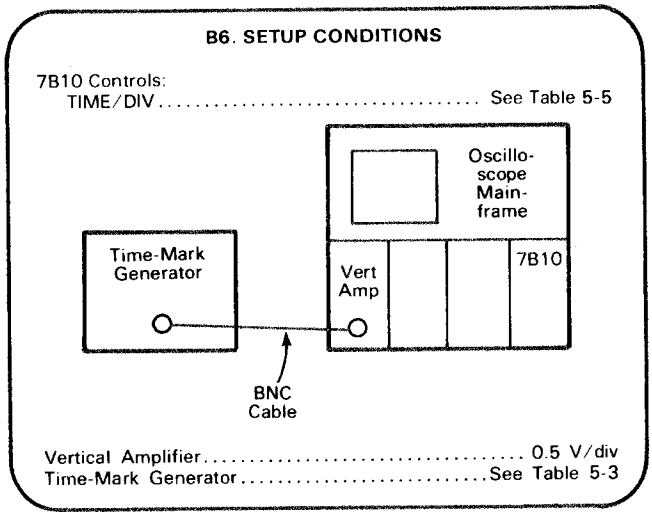
k. **ADJUST**—R305 (10 ms Timing) for 1 marker/division over the center 8 divisions of display (position as necessary).

B6. CHECK SWEEP TIMING

SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Horizontal System Preliminary Control Settings, then proceed with the following instructions.



NOTE

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

a. **CHECK**—Using the TIME/DIV setting and time-mark generator settings from Table 5-5, check sweep accuracy for 1 time mark/ division over the center 8 divisions within the tolerance given in Table 5-5. 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, according to the tolerances given in Table 5-5.

TABLE 5-5
Sweep Timing

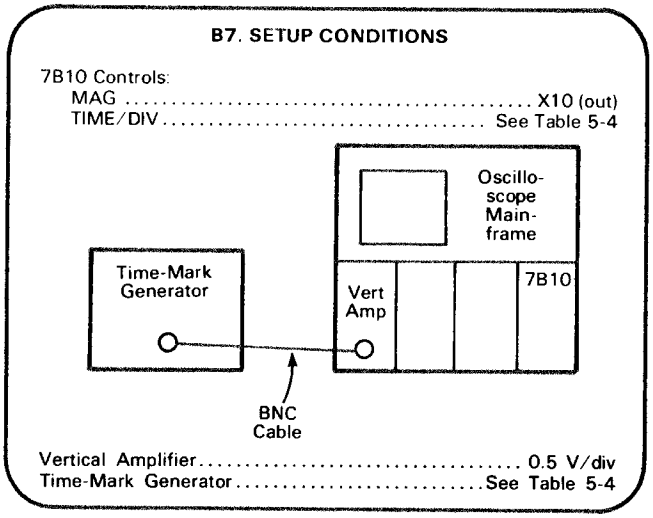
Time/Div	Time Markers	Tolerance (+15° to +35° C)
2 ns	2 ns	Within 0.24 div
5 ns	5 ns	Within 0.24 div
10 ns	10 ns	Within 0.16 div
20 ns	20 ns	Within 0.16 div
50 ns	50 ns	Within 0.16 div
.1 μs	.1 μs	Within 0.16 div
.2 μs	.2 μs	Within 0.16 div
.5 μs	.5 μs	Within 0.16 div
1 μs	1 μs	Within 0.16 div
2 μs	2 μs	Within 0.16 div
5 μs	5 μs	Within 0.16 div
10 μs	10 μs	Within 0.16 div
20 μs	20 μs	Within 0.16 div
50 μs	50 μs	Within 0.16 div
.1 ms	.1 ms	Within 0.16 div
.2 ms	.2 ms	Within 0.16 div
.5 ms	.5 ms	Within 0.16 div
1 ms	1 ms	Within 0.16 div
2 ms	2 ms	Within 0.16 div
5 ms	5 ms	Within 0.16 div
10 ms	10 ms	Within 0.16 div
20 ms	20 ms	Within 0.16 div
50 ms	50 ms	Within 0.16 div
.1 s	.1 s	Within 0.16 div
.1 s	.1 s	Within 0.16 div
.2 s	.2 s	Within 0.16 div

B7. CHECK MAGNIFIED SWEEP TIMING

SETUP CONDITIONS

NOTE

If the preceding step was not performed, first refer to the Horizontal System Preliminary Control Settings, then proceed with the following instructions.



NOTE

The tolerances in Table 5-6 are for an ambient temperature range of +15° to +35° C. If outside this range, see the Specification section for applicable tolerances.

a. **CHECK**—Using the TIME/DIV settings and time-mark generator settings in Table 5-6, check the magnified sweep accuracy for 1 time mark/division, over the center 8 divisions, within the tolerance given in Table 5-6. Set the POSITION controls and TRIGGERING LEVEL control as necessary for a stable display aligned with the vertical graticule lines.

NOTE

The 7B10 may be operated as a delayed sweep unit (B horizontal compartment). To check 7B10 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.

TABLE 5-6
Magnified Sweep Timing

Time/Div	Time Markers	Tolerance (+15° to +35° C)
2 ns	1 ns[1]	Within 0.2 div
5 ns	1 ns	Within 0.32 div
10 ns	1 ns	Within 0.24 div
20 ns	2 ns	Within 0.24 div
50 ns	5 ns	Within 0.24 div
.1 μs	10 ns	Within 0.24 div
.2 μs	20 ns	Within 0.24 div
.5 μs	50 ns	Within 0.24 div
1 μs	.1 μs	Within 0.24 div
2 μs	.2 μs	Within 0.24 div
5 μs	.5 μs	Within 0.24 div
10 μs	1 μs	Within 0.24 div
20 μs	2 μs	Within 0.24 div
50 μs	5 μs	Within 0.24 div
.1 ms	10 μs	Within 0.24 div
.2 ms	20 μs	Within 0.24 div
.5 ms	50 μs	Within 0.24 div
1 ms	.1 ms	Within 0.24 div
2 ms	.2 ms	Within 0.24 div
5 ms	.5 ms	Within 0.24 div
10 ms	1 ms	Within 0.24 div
20 ms	2 ms	Within 0.24 div
50 ms	5 ms	Within 0.24 div
.1 s	10 ms	Within 0.24 div
.2 s	20 ms	Within 0.24 div

[1]**Check for 1 cycle in 5 divisions at 200 ps/div over center 8 divisions.**

This completes the Adjustment and Performance Check procedure.

INSTRUMENT OPTIONS

No options were available for this instrument at the time of this printing.

Information on any subsequent options may be found in the CHANGE INFORMATION section in the back of this manual.

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	SEMICOND	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
00213	NYTRONICS, COMPONENTS GROUP, INC., SUBSIDIARY OF NYTRONICS, INC.	ORANGE STREET	DARLINGTON, SC 29532
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
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
03888	KDI PYROFILM CORPORATION	60 S JEFFERSON ROAD	WHIPPANY, NJ 07981
04222	AVX CERAMICS, DIVISION OF AVX CORP.	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
08806	GENERAL ELECTRIC CO., MINIATURE LAMP PRODUCTS DEPARTMENT	NELA PARK	CLEVELAND, OH 44112
09023	CORNELL-DUBILIER ELECTRONIC DIVISION FEDERAL PACIFIC ELECTRIC CO.	2652 DALRYMPLE ST.	SANFORD, NC 27330
11237	CTS KEENE, INC.	3230 RIVERSIDE AVE.	PASO ROBLES, CA 93446
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
14552	MICRO SEMICONDUCTOR CORP.	2830 E FAIRVIEW ST.	SANTA ANA, CA 92704
15801	FENWAL ELECTRONICS, DIV. OF KIDDE WALTER AND CO., INC.	63 FOUNTAIN ST.	FRAMINGHAM, MA 01701
17856	SILICONIX, INC.	2201 LAURELWOOD DRIVE	SANTA CLARA, CA 95054
18324	SIGNETICS CORP.	811 E. ARQUES	SUNNYVALE, CA 94086
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
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.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
59660	TUSONIX INC.	2155 N FORBES BLVD	TUCSON, AZ 85705
63743	WARD LEONARD ELECTRIC CO., INC.	31 SOUTH ST.	MOUNT VERNON, NY 10550
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
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
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
76493	BELL INDUSTRIES, INC., MILLER, J. W., DIV.	19070 REYES AVE., P O BOX 5825	COMPTON, CA 90224
78488	STACKPOLE CARBON CO.		ST. MARYS, PA 15857
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E. WASHINGTON STREET P. O. BOX 372	INDIANAPOLIS, IN 46206
91418	RADIO MATERIALS COMPANY, DIV. OF P.R. MALLORY AND COMPANY, INC.	4242 W BRYN MAWR	CHICAGO, IL 60646
91637	DALE ELECTRONICS, INC.	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	672-0649-00			CKT BOARD ASSY:INTERFACE	80009	672-0649-00
A2	670-5108-00			CKT BOARD ASSY:TRIGGER	80009	670-5108-00
A3	670-4182-00			CKT BOARD ASSY:READOUT	80009	670-4182-00
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
C10	281-0786-00			CAP.,FXD,CER DI:150PF,10%,100V	72982	8035D2AADX5P151K
C12	281-0599-00			CAP.,FXD,CER DI:1PF,+/-0.25PF,500V	59660	374-018-C0K0109C
C37	283-0249-00			CAP.,FXD,CER DI:0.068UF,10%,50V	72982	8131N075 C 683K
C41	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8121N083Z5U0224M
C42	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	72982	8121N083Z5U0224M
C43	281-0572-00			CAP.,FXD,CER DI:6.8PF,+/-0.5PF,500V	59660	301-000C0H0689D
C61	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	SA205E104MAA
C63	281-0815-00			CAP.,FXD,CER DI:0.027UF,20%,50V	72982	8005D9AABW5R273M
C64	281-0786-00			CAP.,FXD,CER DI:150PF,10%,100V	72982	8035D2AADX5P151K
C65	281-0791-00			CAP.,FXD,CER DI:270PF,10%,100V	72982	8035D2AADX5R271K
C90	281-0611-00			CAP.,FXD,CER DI:2.7PF,+/-0.25PF,200V	59660	374-018C0J0279C
C95	281-0534-00			CAP.,FXD,CER DI:3.3PF,+/-0.25PF,500V	04222	7001-1316
C98	281-0617-00			CAP.,FXD,CER DI:15PF,10%,200V	59660	374-018-C0G0150K
C108	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C113	283-0066-00			CAP.,FXD,CER DI:2.5PF,20%,200V	72982	8101-047C0J259D
C114	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	04222	SA205E104MAA
C117	281-0219-00			CAP.,VAR,CER DI:5-35PF,+2-2.5%,100V	59660	513-001 5-30
C118	283-0066-00			CAP.,FXD,CER DI:2.5PF,20%,200V	72982	8101-047C0J259D
C133	281-0788-00			CAP.,FXD,CER DI:470PF,10%,100V	72982	8005H9AADW5R471K
C144	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C183	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	04222	GC70-1C103K
C184	281-0786-00			CAP.,FXD,CER DI:150PF,10%,100V	72982	8035D2AADX5P151K
C204	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-519-Y5P-102P
C211	283-0641-00	B010100	B031514	CAP.,FXD,MICA D:180PF,1%,100V	00853	D151E181F0
C211	283-0640-00	B031515		CAP.,FXD,MICA D:160PF,1%,100V	00853	D151E161F0
C212	283-0555-00			CAP.,FXD MICA D:2000PF,1%,500V	09023	CD19FD202J03
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
C222	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C225	290-0536-00			CAP.,FXD,ELCTLT:10UF,20%,25V	90201	TDC106M025FL
C228	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C230	281-0786-00			CAP.,FXD,CER DI:150PF,10%,100V	72982	8035D2AADX5P151K
C302	290-0420-00			CAP.,FXD,ELCTLT:0.68UF,20%,75V	56289	150D684X0075A2
C315	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C322	283-0204-00			CAP.,FXD,CER DI:0.01UF,20%,50V	72982	8121N061Z5U0103M
C323	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C324	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C338	283-0691-00			CAP.,FXD,MICA D:650PF,1%,300V	00853	D153F651F0
C352	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C361	281-0166-00			CAP.,VAR,AIR DI:1.9-15.7PF,250V	74970	187-0109-055
C362	283-0633-00			CAP.,FXD,MICA D:77PF,1%,100V	00853	D151E770F0
C364						
C365	295-0172-00			CAP SET,MATCHED:0.1UF,10UF,905PF,0.75%	80009	295-0172-00
C366						

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C371	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C376	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C386	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C388	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8121-N088Z5U104M
C405	281-0763-00			CAP.,FXD,CER DI:47PF,10%,100V	72982	8035D9AADC1G470K
C409	283-0616-00			CAP.,FXD,MICA D:75PF,5%,500V	00853	D155E750J0
C457	281-0658-00			CAP.,FXD,CER DI:6.2PF,+/-0.25PF,500V	59660	301-000C0H0629C
C461	281-0618-00			CAP.,FXD,CER DI:4.7PF,+/-0.5PF,200V	59660	374-018C0H0-479D
C483	281-0811-00	B020790		CAP.,FXD,CER DI:10PF,10%,100V	72982	8035D2AADC1G100K
C795	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	56289	19C242B
C810	283-0178-00			CAP.,FXD,CER DI:0.1UF,+80-20%,100V	72982	8131N145651 104Z
C820	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	56289	502D225
C821	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	91418	SP203Z151-4R9
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	91418	SP203Z151-4R9
CR74	152-0321-00			SEMICOND DEVICE:SILICON,30V,0.1A	07263	FSA1480
CR76	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR77	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR124	152-0278-00			SEMICOND DEVICE:ZENER,0.4W,3V,5%	04713	SZG35009K20
CR145	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR202	152-0153-00			SEMICOND DEVICE:SILICON,15V,50MA	07263	FD7003
CR206	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR208	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR224	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR225	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR226	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR303	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR304	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR336	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR337	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR375	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR406	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR415	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR434	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR452	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR455	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
C465	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR345	152-0322-00			SEMICOND DEVICE:SILICON,15V,HOT CARRIER	50434	5082-2672
CR420	152-0322-00			SEMICOND DEVICE:SILICON,15V,HOT CARRIER	50434	5082-2672
CR725	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR751	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR752	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR772	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR773	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR782	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR783	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
DS227	150-1029-00			LT EMITTING DIO:GREEN,565NM,35MA	53184	XC209G
DS232	150-1033-00			LT EMITTING DIO:YELLOW,585NM,40MA MAX	50434	HLMP 1401
DS820	150-0048-01			LAMP,INCAND:5V,0.06A,SEL	08806	683AS15

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
E274	276-0507-00	B031830		SHIELDING BEAD,:FERRITE	78488	57-3443
E425	276-0507-00	B031830		SHIELDING BEAD,:FERRITE	78488	57-3443
F90	159-0120-00			FUSE,CARTRIDGE:0.2A,125V,0.08 SEC AXIAL	75915	279.200
L3	108-0537-00			COIL,RF:200UH	80009	108-0537-00
L5	108-0537-00			COIL,RF:200UH	80009	108-0537-00
L7	108-0537-00			COIL,RF:200UH	80009	108-0537-00
L324	276-0543-00			SHLD BEAD,ELEK:FERRITE	80009	276-0543-00
L462	108-0240-00			COIL,RF:FIXED,820UH	76493	B5147
L485	108-0509-00			COIL,RF:2.45UH	80009	108-0509-00
LR68	108-0325-00			COIL,RF:0.5UH	80009	108-0325-00
LR88	108-0325-00			COIL,RF:0.5UH	80009	108-0325-00
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
Q98	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q108	151-1005-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	80009	151-1005-00
Q114	151-1025-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	01295	SFB8129
Q118	151-0441-00			TRANSISTOR:SILICON,NPN	04713	SRF501
Q142	151-0190-00			TRANSISTOR:SILICON,NPN	07263	S032677
Q160	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q164	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q174	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q184	151-0427-00			TRANSISTOR:SILICON,NPN	80009	151-0427-00
Q201	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q202	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q203	151-0435-00			TRANSISTOR:SILICON,PNP	04713	SPS8335
Q204	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q206	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q210	151-0273-00			TRANSISTOR:SILICON,NPN	80009	151-0273-00
Q214	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q230	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q234	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q242	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q272	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q274	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q322	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q324	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q328	151-0273-00			TRANSISTOR:SILICON,NPN	80009	151-0273-00
Q336	151-0354-00			TRANSISTOR:SILICON,PNP,DUAL	32293	ITS1200A
Q342	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q354	151-0367-00			TRANSISTOR:SILICON,NPN,SEL FROM 3571TP	01295	SKA6516
Q356	151-0367-00			TRANSISTOR:SILICON,NPN,SEL FROM 3571TP	01295	SKA6516
Q372	151-1036-00			TRANSISTOR:SILICON,JFE,N-CHANNEL,DUAL	17856	DN1665
Q376	151-0127-00			TRANSISTOR:SILICON,NPN	07263	S006075
Q402	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q406	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q410	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q415	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q420	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026

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Q425	151-0223-00			TRANSISTOR:SILICON,NPN	04713	SPS8026
Q434	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q438	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q454	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q458	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q460	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q464	151-0220-00			TRANSISTOR:SILICON,PNP	07263	S036228
Q468	151-0325-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N4258	80009	151-0325-00
Q476	151-0472-00	B010100	B020206	TRANSISTOR:SILICON,NPN	80009	151-0472-00
Q476	151-0212-00	B020207		TRANSISTOR:SILICON,NPN	04713	SRF 518
Q484	151-1113-00			TRANSISTOR:FE,N CHANNEL,SILICON	80009	151-1113-00
Q496	151-0472-00	B010100	B020206	TRANSISTOR:SILICON,NPN	80009	151-0472-00
R496	151-0212-00	B020207		TRANSISTOR:SILICON,NPN	04713	SRF 518
Q844	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
R2	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R10	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	MFF1816G60400F
R12	321-0201-00			RES.,FXD,FILM:1.21K OHM,1%,0.125W	91637	MFF1816G12100F
R20	321-0268-00			RES.,FXD,FILM:6.04K OHM,1%,0.125W	91637	MFF1816G60400F
R22	321-0201-00			RES.,FXD,FILM:1.21K OHM,1%,0.125W	91637	MFF1816G12100F
R23	321-0099-00			RES.,FXD,FILM:105 OHM,1%,0.125W	91637	MFF1816G105R0F
R24	321-0099-00			RES.,FXD,FILM:105 OHM,1%,0.125W	91637	MFF1816G105R0F
R30	311-0467-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	11237	300SF-41334
R34	321-0074-00			RES.,FXD,FILM:57.6 OHM,1%,0.125W	91637	MFF1816G57R60F
R35	315-0163-00			RES.,FXD,CMPSN:16K OHM,5%,0.25W	01121	CB1635
R36	315-0302-00			RES.,FXD,CMPSN:3K OHM,5%,0.25W	01121	CB3025
R37	321-0222-00			RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R38	321-0332-00			RES.,FXD,FILM:28K OHM,1%,0.125W	91637	MFF1816G28001F
R39	321-0184-00			RES.,FXD,FILM:806 OHM,1%,0.125W	91637	MFF1816G806R0F
R42	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R43	321-0349-00			RES.,FXD,FILM:42.2K OHM,1%,0.125W	91637	MFF1816G42201F
R63	321-0270-00			RES.,FXD,FILM:6.34K OHM,1%,0.125W	91637	MFF1816G63400F
R64	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R65	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R66	321-0248-00			RES.,FXD,FILM:3.74K OHM,1%,0.125W	91637	MFF1816G37400F
R67	315-0335-00			RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
R68	321-0097-00			RES.,FXD,FILM:100 OHM,1%,0.125W	91637	MFF1816G100R0F
R69	301-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.50W	01121	EB3015
R71	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R72	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R74	321-0423-00			RES.,FXD,FILM:249K OHM,1%,0.125W	91637	MFF1816G24902F
R76	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R77	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R79	301-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.50W	01121	EB3015
R84	315-0181-00			RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R85	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R86	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R90	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R91	323-0095-00			RES.,FXD,FILM:95.3 OHM,1%,0.50W	75042	CECT0-95R30F
R92	323-0095-00			RES.,FXD,FILM:95.3 OHM,1%,0.50W	75042	CECT0-95R30F
R93	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R94	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R95	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R96	315-0335-00			RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355

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R97	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R106	315-0335-00			RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
R107	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R110	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
R114	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R117	317-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.125W	01121	BB1015
R118	315-0152-00			RES.,FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R131	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R132	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R133	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R134	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R135	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R138	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R139	325-0053-00			RES.,FXD,FILM:50 OHM,1%,0.05W	03888	PME50C50R00F
R140	311-1192-00			RES.,VAR,NONWIR:10K OHM,20%,1W,W/SW	71590	BA-232-001
R140	----- -----			(FURNISHED AS A UNIT WITH S140)		
R141	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R142	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R143	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R144	315-0512-00			RES.,FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R146	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R147	311-1234-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T06-503
R148	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R154	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R155	315-0241-00			RES.,FXD,CMPSN:240 OHM,5%,0.25W	01121	CB2415
R158	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R159	325-0053-00			RES.,FXD,FILM:50 OHM,1%,0.05W	03888	PME50C50R00F
R160	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R161	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R162	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R164	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R173	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R174	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R182	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R183	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R184	321-0202-00			RES.,FXD,FILM:1.24K OHM,1%,0.125W	91637	MFF1816G12400F
R185	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
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	MFF1816G619R0F
R208	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R209	321-0322-00			RES.,FXD,FILM:22.1K OHM,1%,0.125W	91637	MFF1816G22101F
R210	311-0467-00			RES.,VAR,NONWIR:100K OHM,20%,0.50W	11237	300SF-41334
R211	301-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.50W	01121	EB4325
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
R217	321-0292-00			RES.,FXD,FILM:10.7K OHM,1%,0.125W	91637	MFF1816G10701F

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R218	321-0267-00			RES.,FXD,FILM:5.9K OHM,1%,0.125W	91637	MFF1816G59000F
R219	321-0293-00			RES.,FXD,FILM:11K OHM,1%,0.125W	91637	MFF1816G11001F
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
R225	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
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
R230	315-0911-00			RES.,FXD,CMPSN:910 OHM,5%,0.25W	01121	CB9115
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
R241	315-0331-00			RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
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
R273	321-0243-00			RES.,FXD,FILM:3.32K OHM,1%,0.125W	91637	MFF1816G33200F
R274	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R275	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R300	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R301	321-0438-00			RES.,FXD,FILM:357K OHM,1%,0.125W	91637	MFF1816G35702F
R302	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R303	321-0363-00			RES.,FXD,FILM:59K OHM,1%,0.125W	91637	MFF1816G59001F
R304	321-0360-00			RES.,FXD,FILM:54.9K OHM,1%,0.125W	91637	MFF1816G54901F
R305	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T04-503
R306	321-0458-00			RES.,FXD,FILM:576K OHM,1%,0.125W	91637	MFF1816G57602F
R310	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T04-503
R312	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R313	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R315	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R316	301-0432-00			RES.,FXD,CMPSN:4.3K OHM,5%,0.50W	01121	EB4325
R317	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R321	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R322	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R323	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R328	321-0133-00			RES.,FXD,FILM:237 OHM,1%,0.125W	91637	MFF1816G237R0F
R333	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R334	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R336	321-0275-00			RES.,FXD,FILM:7.15K OHM,1%,0.125W	91637	MFF1816G71500F
R337	321-0301-00			RES.,FXD,FILM:13.3K OHM,1%,0.125W	91637	MFF1816G13301F
R338	315-0201-00			RES.,FXD,CMPSN:200 OHM,5%,0.25W	01121	CB2015
R341	315-0301-00			RES.,FXD,CMPSN:300 OHM,5%,0.25W	01121	CB3015
R342	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R343	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R344	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R346	315-0112-00			RES.,FXD,CMPSN:1.1K OHM,5%,0.25W	01121	CB1125
R352	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R353	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R354	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R356	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015

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R357	315-0221-00			RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R358	323-0175-00			RES.,FXD,FILM:649 OHM,1%,0.50W	75042	CECT0-6490F
R359	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R361	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R362	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R363	315-0560-00			RES.,FXD,CMPSN:56 OHM,5%,0.25W	01121	CB5605
R364	315-0100-00			RES.,FXD,CMPSN:10 OHM,5%,0.25W	01121	CB1005
R371	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R373	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R375	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R376	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R377	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R380A,B	311-1781-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	12697	388CM40913
R383	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R384	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R385	321-0362-00			RES.,FXD,FILM:57.6K OHM,1%,0.125W	91637	MFF1816G57601F
R386	321-0289-03			RES.,FXD,FILM:10K OHM,0.25%,0.125W	91637	MFF1816D10001C
R388	315-0180-00			RES.,FXD,CMPSN:18 OHM,5%,0.25W	01121	CB1805
R391	323-1500-07			RES.,FXD,FILM:1.6M OHM,0.1%,0.50W	91637	HFF129C16003B
R392	323-1500-07			RES.,FXD,FILM:1.6M OHM,0.1%,0.50W	91637	HFF129C16003B
R393	323-0620-07			RES.,FXD,FILM:800K OHM,0.1%,0.50W	91637	MFF1226C80002B
R394	323-0806-07			RES.,FXD,FILM:266.7K OHM,0.1%,0.50W	91637	MFF1226C26672B
R395	323-1404-07			RES.,FXD,FILM:160K OHM,0.1%,0.50W	91637	MFF1226C16002B
R396	323-0805-07			RES.,FXD,FILM:80.0K OHM,0.1%,0.50W	91637	MFF1226C80001B
R397	323-0802-07			RES.,FXD,FILM:26.67K OHM,0.1%,0.50W	91637	MFF1226C26671B
R398	323-1308-07			RES.,FXD,FILM:16.0K OHM,0.1%,0.50W	91637	MFF1226C16001B
R399	308-0586-00			RES.,FXD,WW:5K OHM,0.25%,3W	00213	1240S-5 K 0.25%
R401	315-0751-00			RES.,FXD,CMPSN:750 OHM,5%,0.25W	01121	CB7515
R402	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R403	315-0101-00	B010100	B031439	RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R403	315-0161-00	B031440		RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
R404	321-0222-07			RES.,FXD,FILM:2K OHM,0.1%,0.125W	91637	MFF1816C20000B
R405	321-0196-00			RES.,FXD,FILM:1.07K OHM,1%,0.125W	91637	MFF1816G10700F
R406	315-0162-00			RES.,FXD,CMPSN:1.6K OHM,5%,0.25W	01121	CB1625
R409	321-0229-00			RES.,FXD,FILM:2.37K OHM,1%,0.125W	91637	MFF1816G23700F
R410	321-0185-00			RES.,FXD,FILM:825 OHM,1%,0.125W	91637	MFF1816G825R0F
R415	315-0122-00			RES.,FXD,CMPSN:1.2K OHM,5%,0.25W	01121	CB1225
R419	315-0121-00			RES.,FXD,CMPSN:120 OHM,5%,0.25W	01121	CB1215
R421	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R422	321-0173-00			RES.,FXD,FILM:619 OHM,1%,0.125W	91637	MFF1816G619R0F
R425	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R426	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R431	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R432	315-0474-00			RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R433	321-0263-00			RES.,FXD,FILM:5.36K OHM,1%,0.125W	91637	MFF1816G53600F
R434	315-0431-00			RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R435	315-0242-00			RES.,FXD,CMPSN:2.4K OHM,5%,0.25W	01121	CB2425
R438	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R439	315-0510-00			RES.,FXD,CMPSN:51 OHM,5%,0.25W	01121	CB5105
R451	321-0400-00			RES.,FXD,FILM:143K OHM,1%,0.125W	91637	MFF1816G14302F
R452	315-0151-00			RES.,FXD,CMPSN:150 OHM,5%,0.25W	01121	CB1515
R454	321-0190-00			RES.,FXD,FILM:931 OHM,1%,0.125W	91637	MFF1816G931R0F
R455	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R456	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R457	315-0111-00			RES.,FXD,CMPSN:110 OHM,5%,0.25W	01121	CB1115
R458	321-0928-07			RES.,FXD,FILM:250 OHM,0.1%,0.125W	91637	MFF1816C250R0B
R459	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R460	311-1423-00			RES.,VAR,NONWIR:20 OHM,20%,0.50W	73138	72-1-0
R461	321-0122-00			RES.,FXD,FILM:182 OHM,1%,0.125W	91637	MFF1816G182R0F
R462	308-0366-00			RES.,FXD,WW:3.4K OHM,1%,3W	63743	29338
R464	321-0190-00			RES.,FXD,FILM:931 OHM,1%,0.125W	91637	MFF1816G931R0F
R465	315-0820-00			RES.,FXD,CMPSN:82 OHM,5%,0.25W	01121	CB8205
R466	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R468	321-0928-07			RES.,FXD,FILM:250 OHM,0.1%,0.125W	91637	MFF1816C250R0B
R469	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R470	311-1226-00			RES.,VAR,NONWIR:2.5K OHM,20%,0.50W	32997	3386F-T04-252
R471	322-0200-00			RES.,FXD,FILM:1.18K OHM,1%,0.25W	91637	MFF1421G11800F
R472	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R474	321-0071-00			RES.,FXD,FILM:53.6 OHM,1%,0.125W	91637	MFF1816G53R60F
R475	321-0055-00			RES.,FXD,FILM:36.5 OHM,1%,0.125W	91637	MFF1816G36R50F
R476	322-0224-00			RES.,FXD,FILM:2.15K OHM,1%,0.25W	75042	CEBT0-2101F
R480	311-1232-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	32997	3386F-T04-503
R481	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R482	315-0683-00			RES.,FXD,CMPSN:68K OHM,5%,0.25W	01121	CB6835
R483	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R484	307-0472-00			RES.,THERMAL:100K OHM,5% DISC	15801	JP51J5
R485	323-0186-00			RES.,FXD,FILM:845 OHM,1%,0.50W	75042	CECT0-8450F
R491	322-0200-00			RES.,FXD,FILM:1.18K OHM,1%,0.25W	91637	MFF1421G11800F
R492	315-0562-00			RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R494	321-0071-00			RES.,FXD,FILM:53.6 OHM,1%,0.125W	91637	MFF1816G53R60F
R495	321-0055-00			RES.,FXD,FILM:36.5 OHM,1%,0.125W	91637	MFF1816G36R50F
R496	322-0224-00			RES.,FXD,FILM:2.15K OHM,1%,0.25W	75042	CEBT0-2101F
R725	311-1590-00			RES.,VAR,NONWIR:10K OHM,10%,1W	12697	CM40256
R725	----- -----			(FURNISHED AS A UNIT WITH S725)		
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
R756	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	321-0289-03			RES.,FXD,FILM:10K OHM,0.25%,0.125W	91637	MFF1816D10001C
R844	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
S20	263-0016-03			SWITCH,PB ASSY:4 CATCH,7.5MM,6 CONTACTS	80009	263-0016-03
S50	263-0015-00			SWITCH PB ASSY:3 LATCHING,7.5 MM	80009	263-0015-00
S90	263-0010-02			SWITCH PB ASSY:1 PUSH,7.5MM,1 CONTACT	80009	263-0010-02
S140	----- -----			(FURNISHED AS A UNIT WITH R140)		
S230	263-0016-02			SWITCH,PB ASSY:3 LCH & 1 CANC,7.5MM,5 CONT	80009	263-0016-02
S460	260-1771-00			SWITCH,PUSH:DPDT,1 BUTTON,2 POLE	80009	260-1771-00
S725	----- -----			(FURNISHED AS A UNIT WITH R725)		
S800	263-1166-00			SW,CAM,ACTR AS:TIME/CM	80009	263-1166-00

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
T1	120-0444-00			XFMR,TOROID:5 TURNS,BIFILAR	80009	120-0444-00
U12	156-0105-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	27014	LM301AN
U38	156-1149-00			MICROCIRCUIT,LI:OPERATIONAL AMP,JFET INPUT	27014	LF351N
U64	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458N
U110	156-1149-00			MICROCIRCUIT,LI:OPERATIONAL AMP,JFET INPUT	27014	LF351N
U124	155-0160-00			MICROCIRCUIT,LI:TRIGGER AMPL/CHANNEL SW	80009	155-0160-00
U135	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458N
U138	156-0158-00			MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458N
U144	155-0150-00			MICROCIRCUIT,DI:TRIGGER	80009	155-0150-00
U220	155-0049-02			MICROCIRCUIT,DI:SWEEP CONTROL,W/LOCKOUT	80009	155-0049-02
U314	156-1149-00			MICROCIRCUIT,LI:OPERATIONAL AMP,JFET INPUT	27014	LF351N
U386	156-0067-02			MICROCIRCUIT,LI:OPNL AMPLIFIER,SELECTED	80009	156-0067-02
U842	156-0067-02			MICROCIRCUIT,LI:OPNL AMPLIFIER,SELECTED	80009	156-0067-02
VR118	152-0226-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	14552	TD3810980
VR134	152-0395-00			SEMICOND DEVICE:ZENER,0.4W,4.3V,5%	14552	TD332317
VR154	152-0395-00			SEMICOND DEVICE:ZENER,0.4W,4.3V,5%	14552	TD332317
VR317	152-0226-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	14552	TD3810980

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).

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975.

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 overline on a signal name indicates that the signal performs its intended function when it goes to the low state.

Abbreviations are based on ANSI Y1.1-1972.

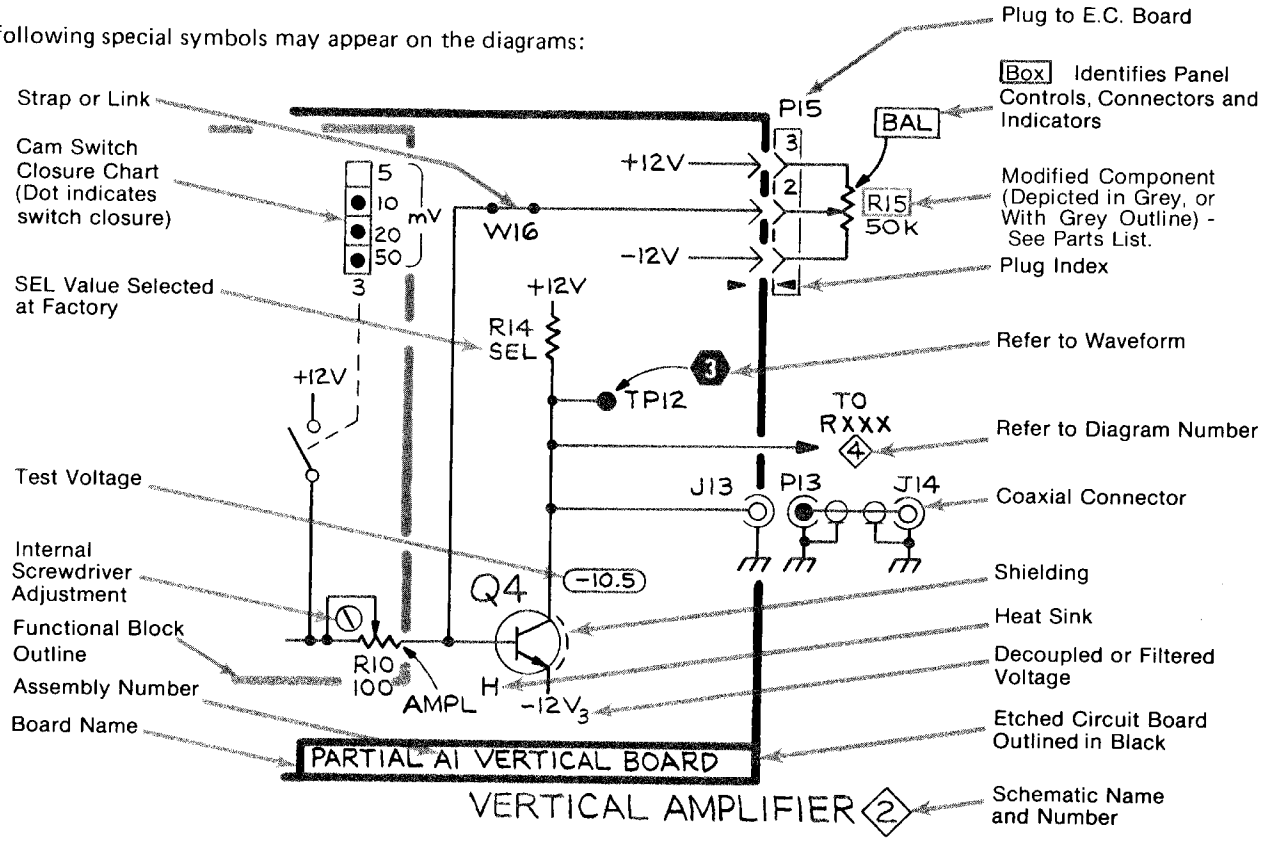
Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

Y14.15, 1966	Drafting Practices.
Y14.2, 1973	Line Conventions and Lettering.
Y10.5, 1968	Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

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

The following special symbols may appear on the diagrams:



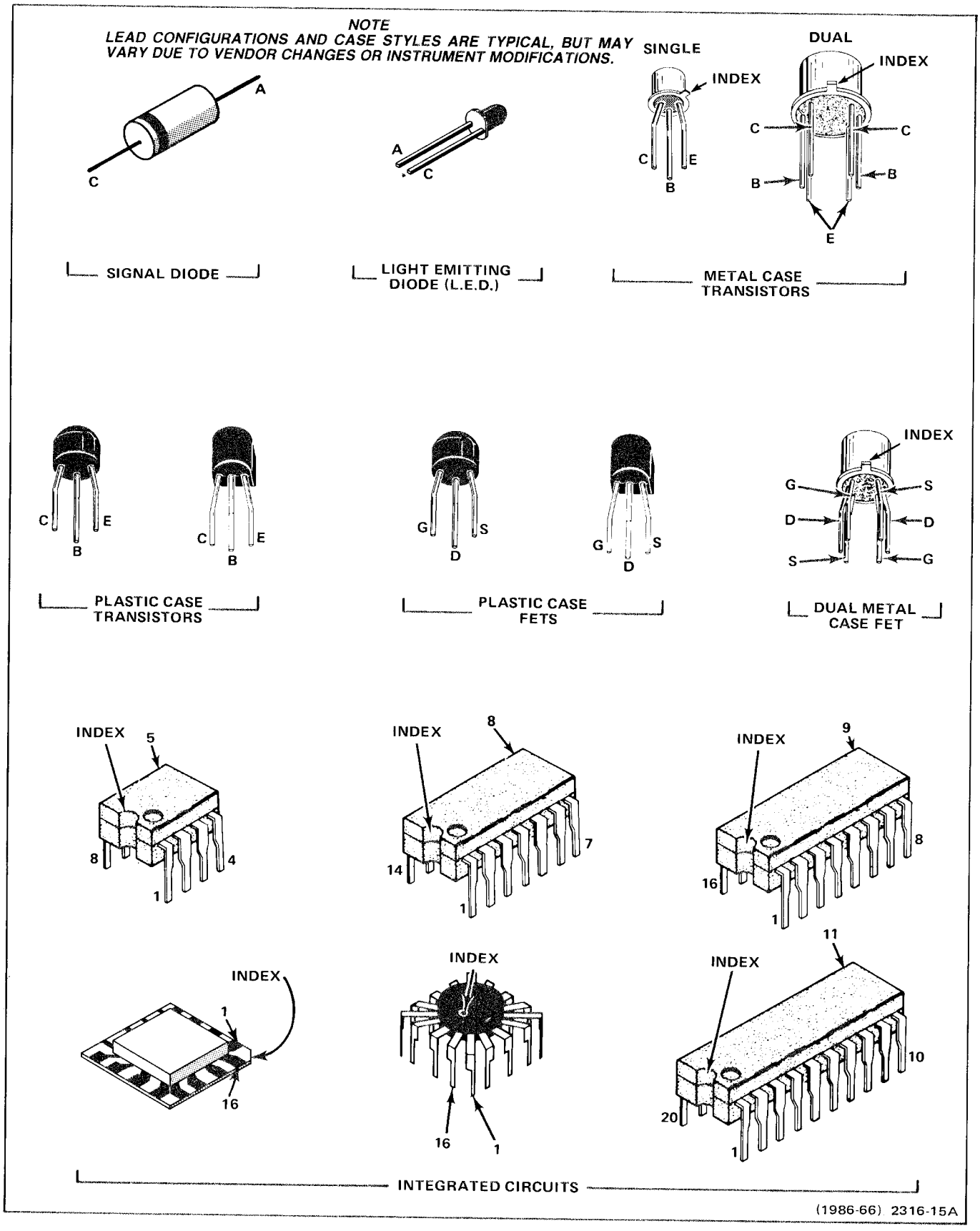


Figure 8-1. Semiconductor lead configurations.

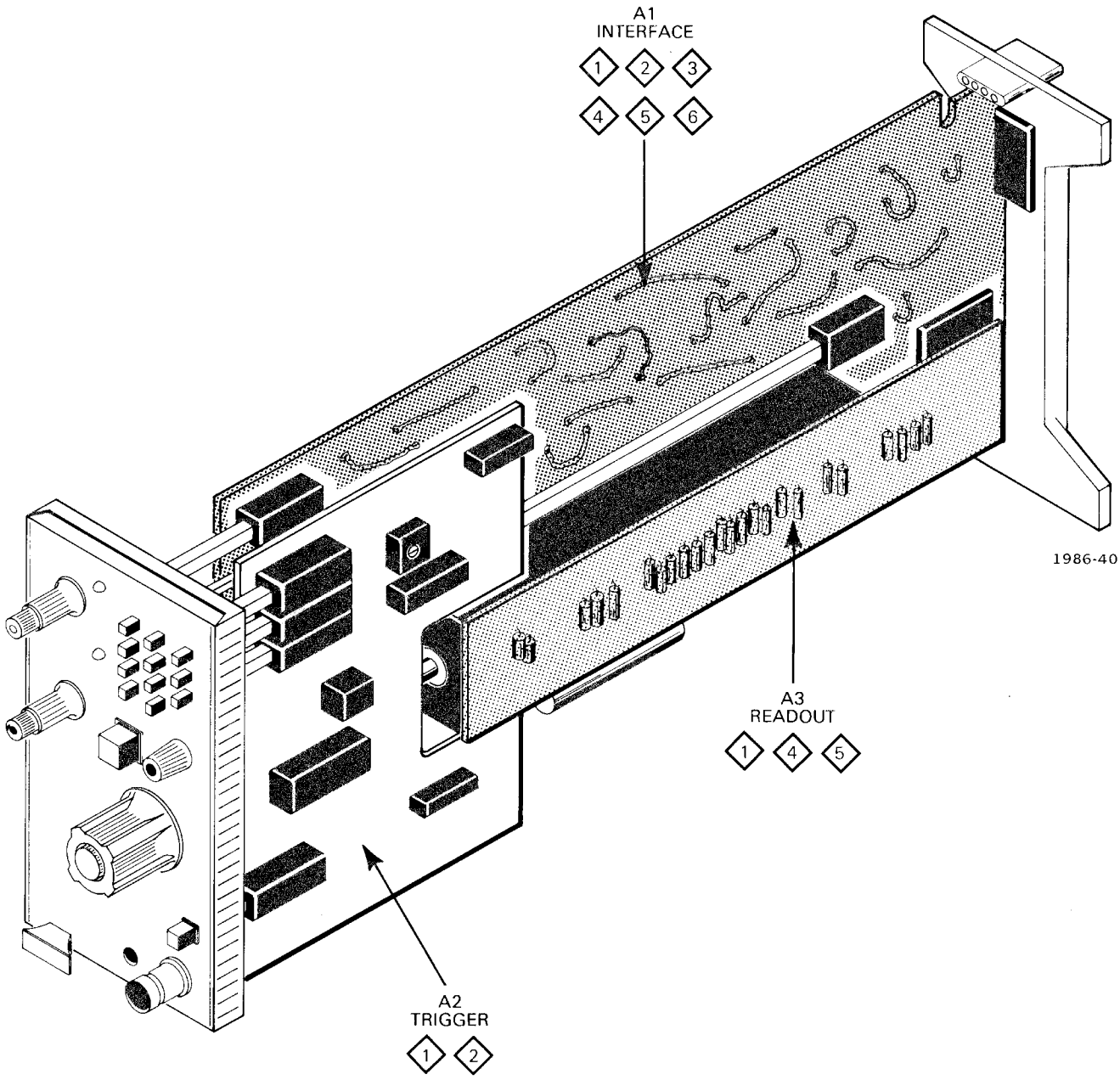


Figure 8-2. Location of circuit boards in the 7B10.

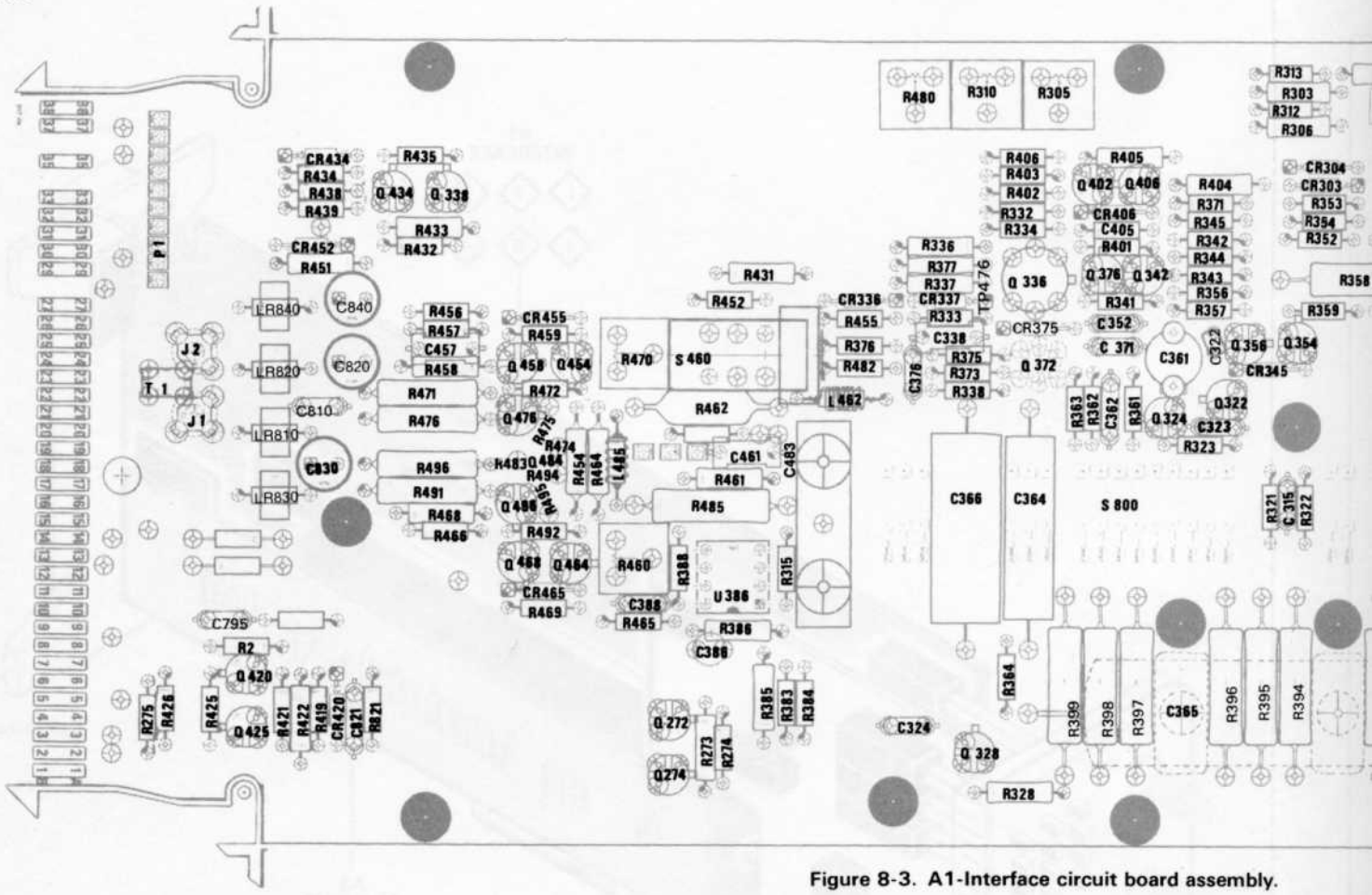


Figure 8-3. A1-Interface circuit board assembly.

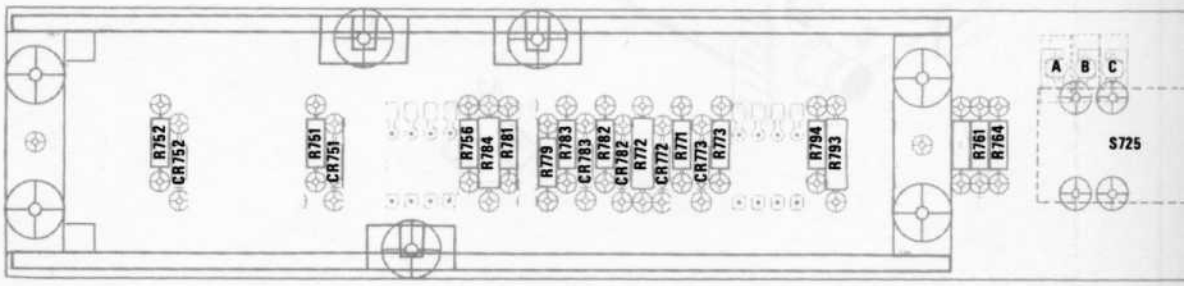
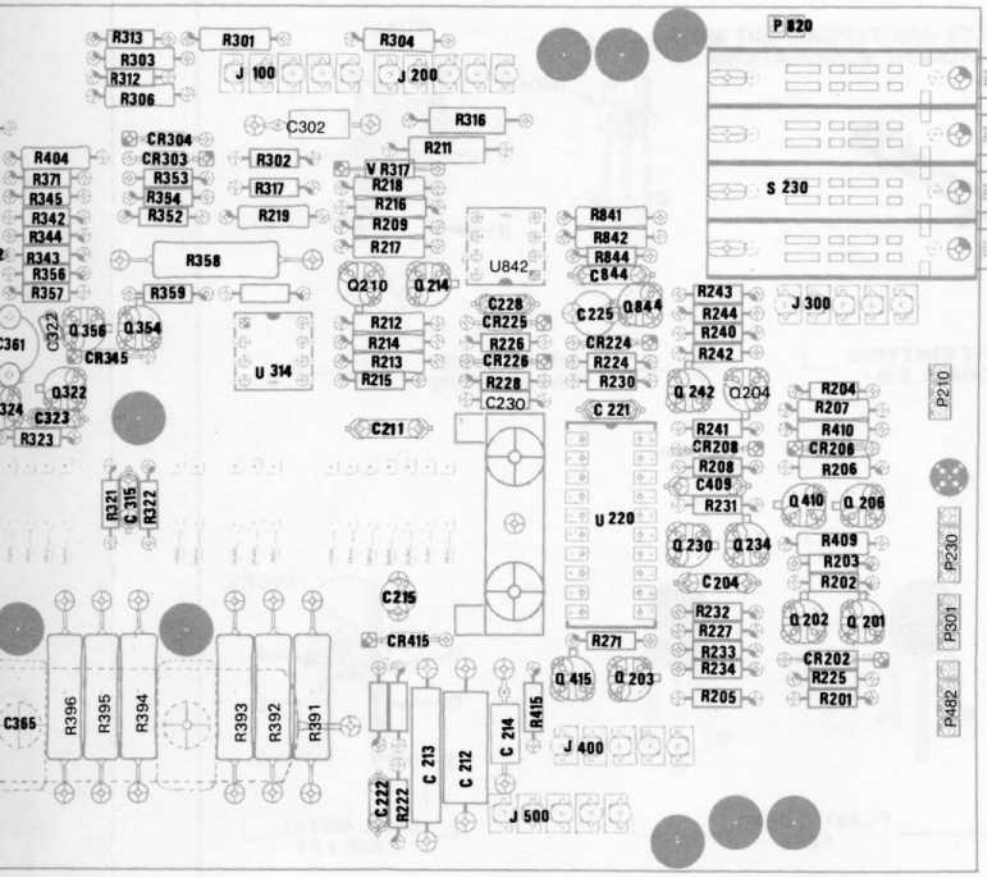
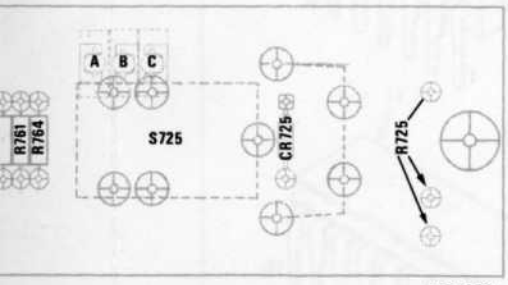


Figure 8-5. A3-Readout circuit board assembly.



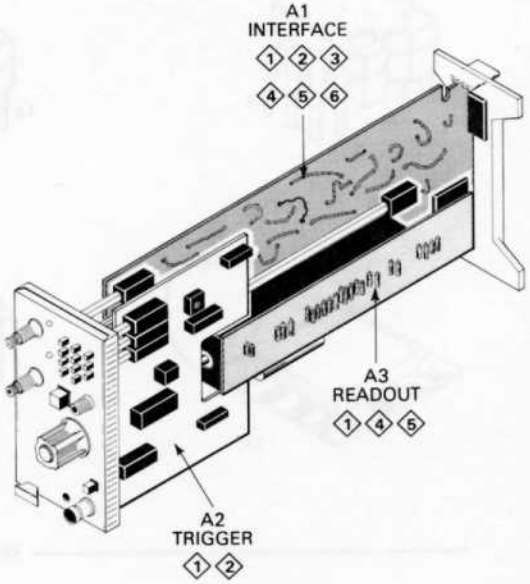
2316-50B

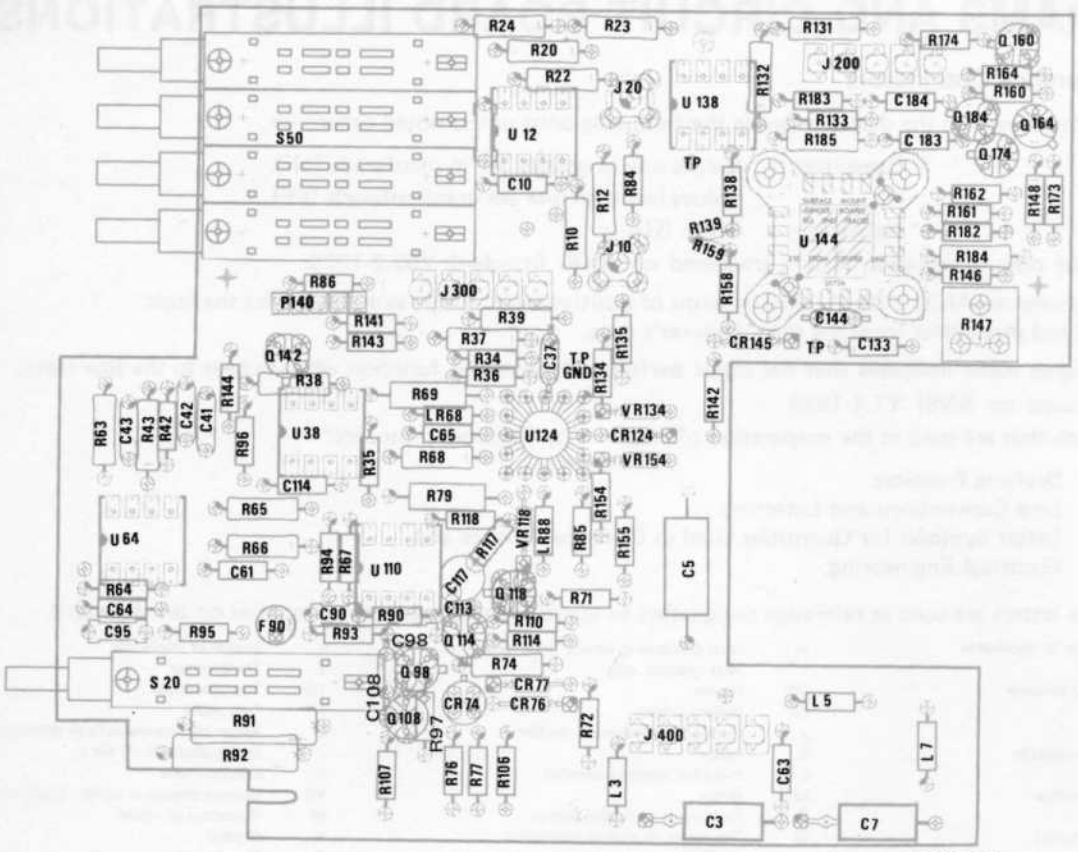
rd assembly.



2316-52

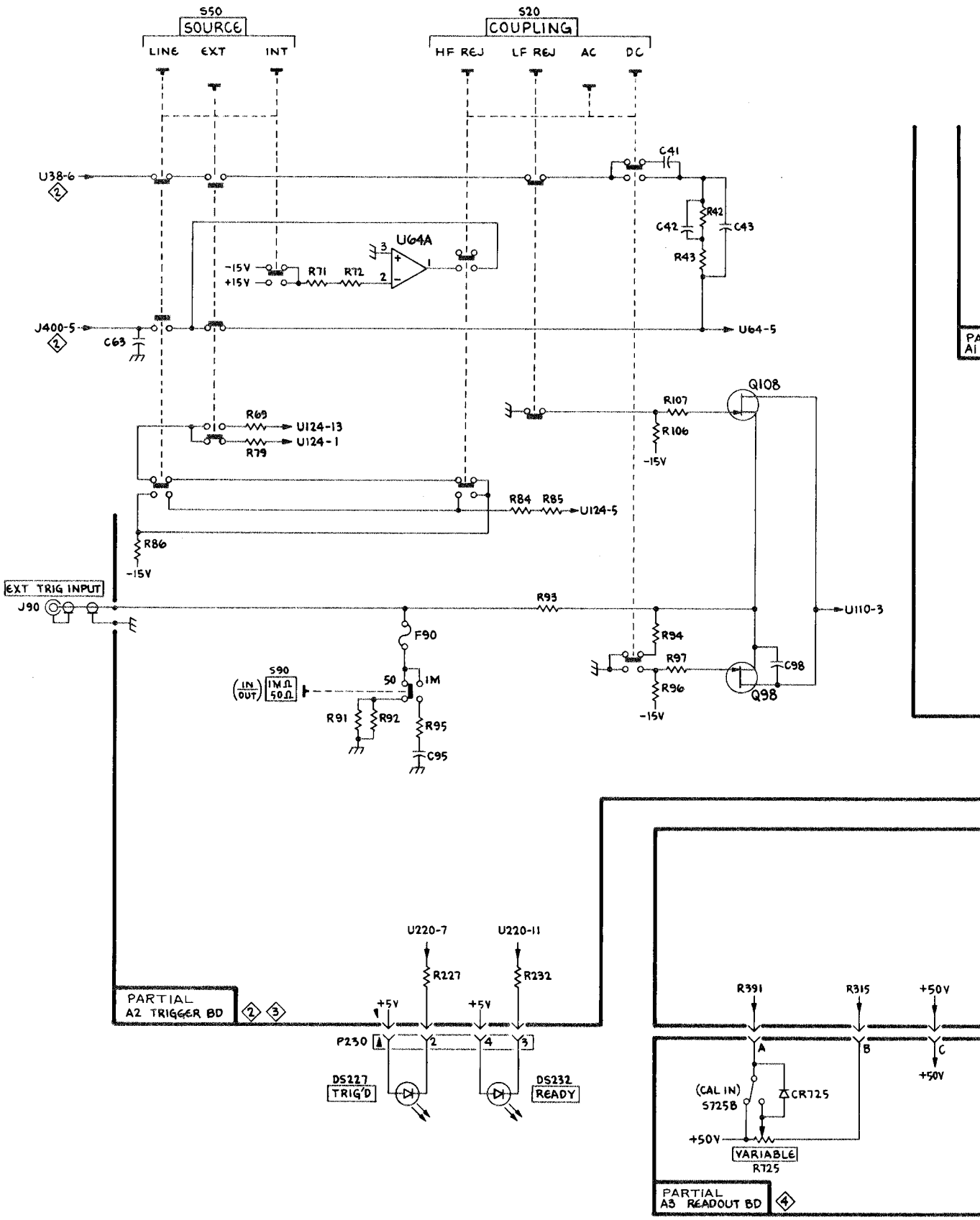
nbly.

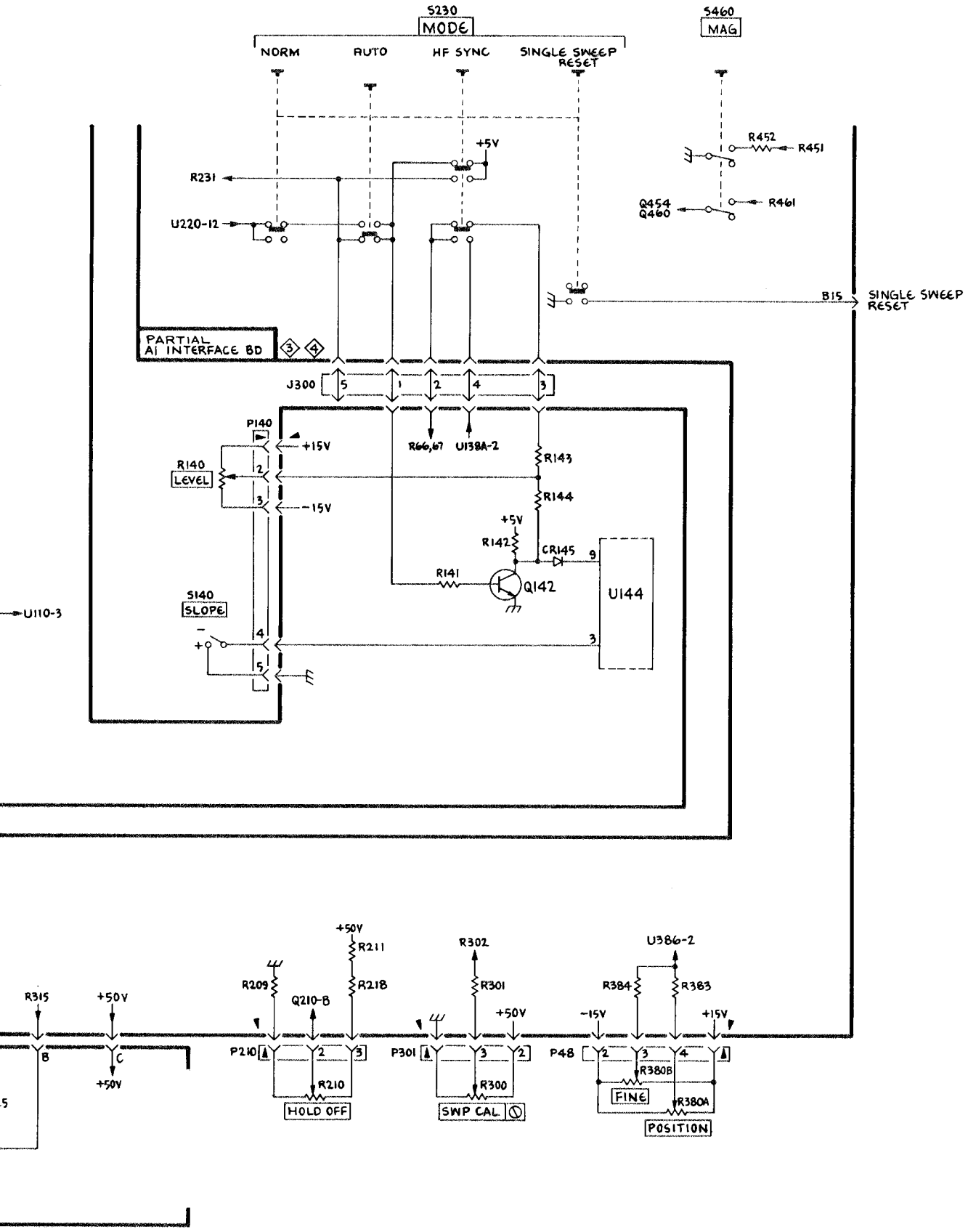




2316-51A

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


S50
SOURCE
LINE
EXT
INT
S20
COUPLING
HF REJ
LF REJ
AC
DC
U38-6
C41
R42
C42
C43
R43
U64A
-15V
+15V
R71
R72
J400-5
C63
U64-5
Q108
R107
R106
R69
U124-13
R79
U124-1
R84
R85
U124-5
R86
EXT TRIG INPUT
J90
R93
U110-3
F90
R94
R97
C98
R96
Q98
S90
IN
OUT
1MΩ
50Ω
50
1M
R91
R92
R95
C95
U220-7
U220-11
R227
R232
PARTIAL
A2 TRIGGER BD
+5V
P230
DS227
TRIG'D
DS232
READY
R391
R315
+50V
A
B
C
(CAL IN)
S725B
CR725
VARIABLE
R725
PARTIAL
A3 READOUT BD



FRONT PANEL WIRING

1

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FRONT PANEL WIRING 1

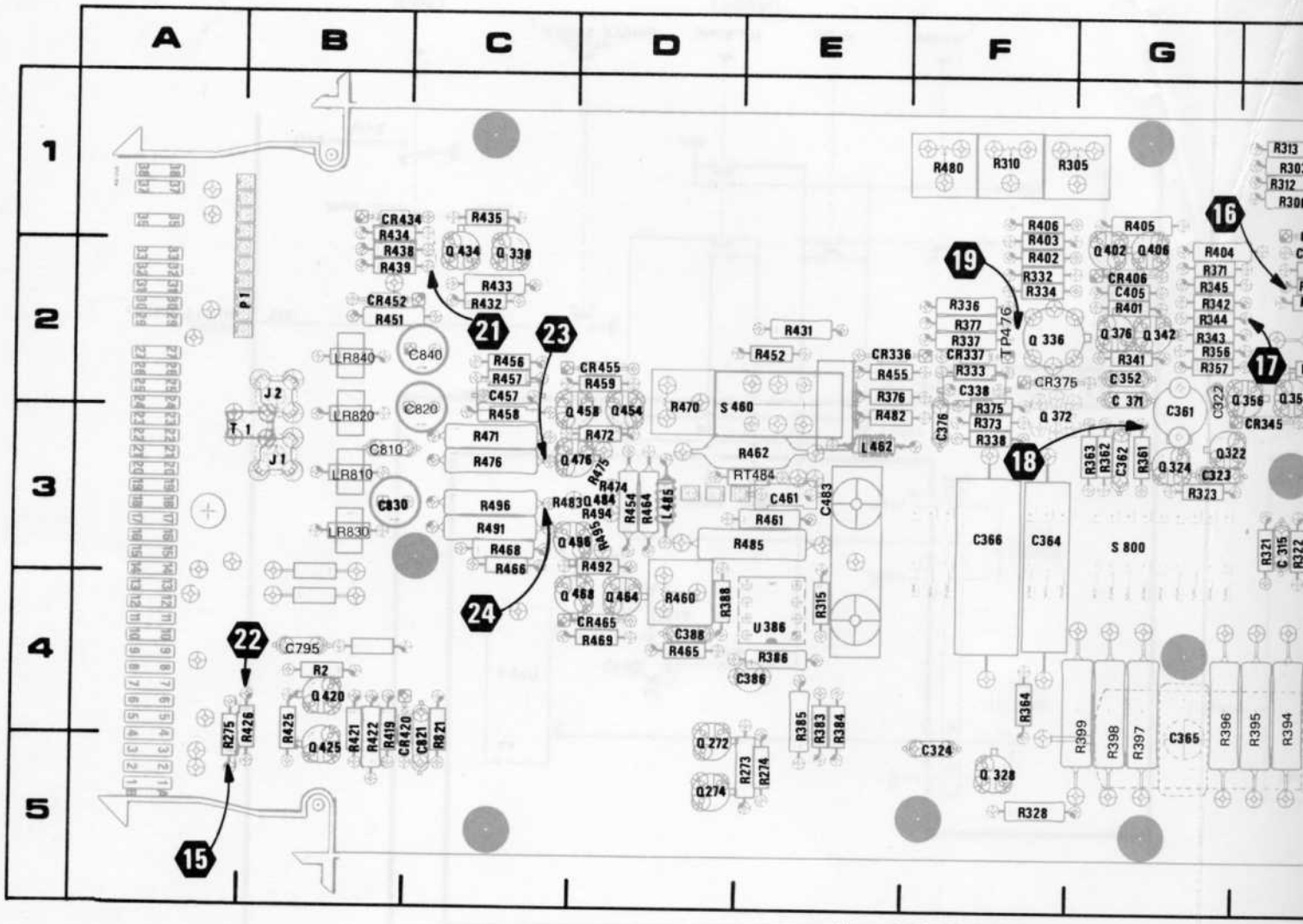
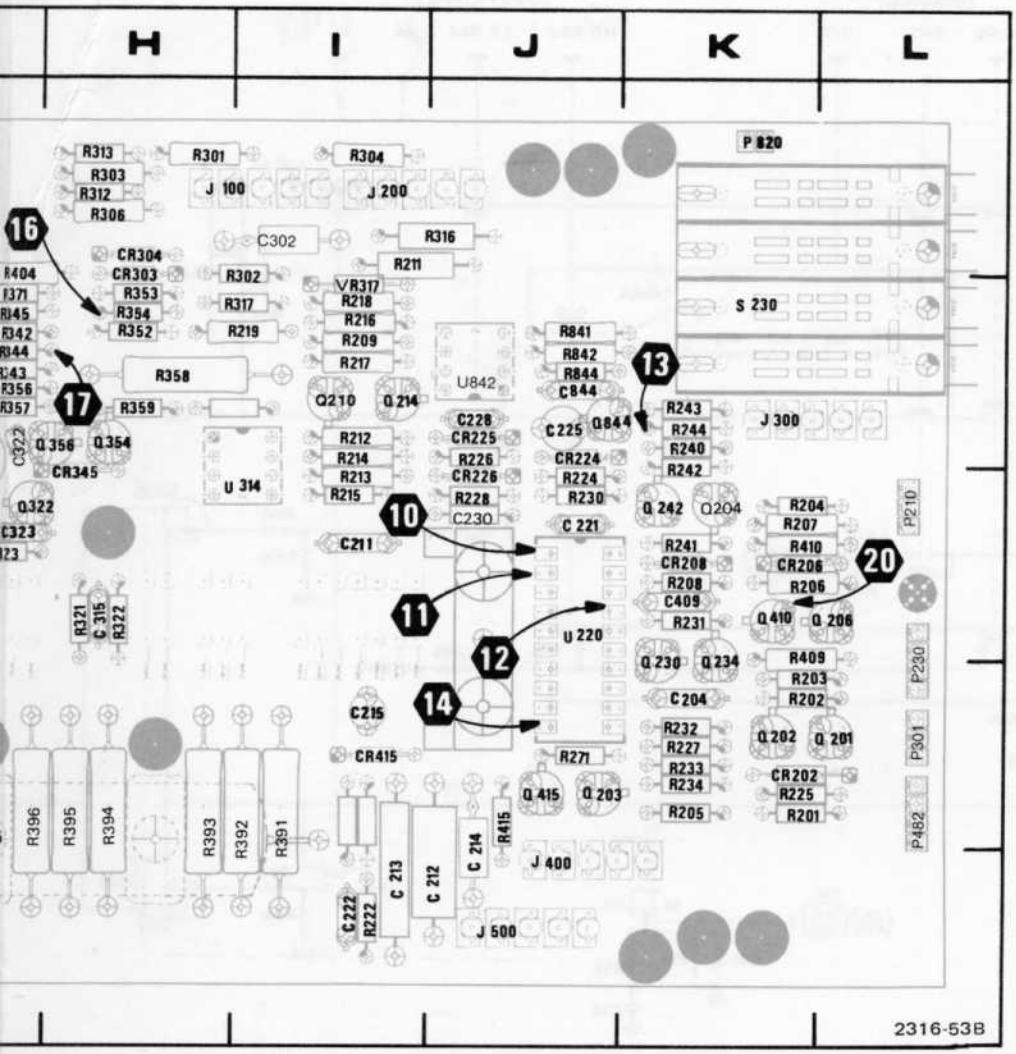


Figure 8-6. A1-Interface circuit board assembly.

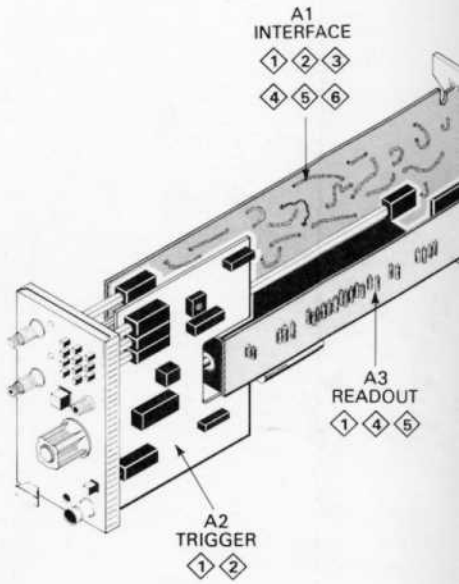
CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C204	4K	C409	3K	CR465	4D	Q206	3L	Q468	4D	R227	4K	R323	3G
C211	3I	C457	2C			Q210	2I	Q476	3D	R228	3J	R328	5F
C212	5J	C461	3E	J001	3B	Q214	2I	Q484	3D	R230	3J	R332	2F
C213	5I	C795	4B	J002	2B	Q230	3K	Q496	3D	R231	3K	R333	2F
C214	5J	C810	3B	J100	1H	Q234	3K	Q844	2J	R232	4K	R334	2F
C215	4I	C820	3C	J200	1I	Q242	3K			R233	4K	R336	2F
C221	3J	C821	4C	J300	2K	Q272	5D	R002	4B	R234	4K	R337	2F
C222	5I	C830	3B	J400	5J	Q274	5D	R201	4K	R240	2K	R338	3F
C225	2J	C840	2C	J500	5J	Q322	3G	R202	4K	R241	3K	R341	2G
C228	2J	C844	2J			Q324	3G	R203	4K	R242	3K	R342	2G
C230	3J			L462	3E	Q328	5F	R204	3K	R243	2K	R343	2G
C302	1I	CR202	4K	L485	3D	Q336	2F	R205	4K	R244	2K	R344	2G
C315	3H	CR206	3K			Q342	2G	R206	3K	R271	4J	R345	2G
C322	2G	CR208	3K	LR810	3B	Q354	2H	R207	3K	R273	5E	R352	2H
C323	3G	CR224	2J	LR820	3B	Q356	2H	R208	3K	R274	5E	R353	2H
C324	5F	CR225	2J	LR830	3B	Q372	2F	R209	2I	R275	4A	R354	2H
C338	2F	CR226	3J	LR840	2B	Q376	2G	R211	1I	R301	1H	R356	2G
C352	2G	CR303	2H			Q402	2G	R212	2I	R302	2I	R357	2G
C361	2G	CR304	1H	P001	2B	Q406	2G	R213	3I	R303	1H	R358	2H
C362	3G	CR336	2E	P210	3L	Q410	3K	R214	2I	R304	1I	R359	2H
C364	3F	CR337	2F	P230	4L	Q415	4J	R215	3I	R305	1F	R361	3G
C365	4G	CR345	3H	P301	RL	Q420	4B	R216	2I	R306	1H	R362	3G
C366	3F	CR375	2F	P482	4L	Q425	5B	R217	2I	R310	1F	R363	3G
C371	2G	CR406	2G	P820	1K	Q434	2C	R218	2I	R312	1H	R364	4F
C376	3F	CR415	4I			Q438	2C	R219	2I	R313	1H	R371	2G
C483	3E	CR420	4B	Q201	4L	Q454	2D	R222	5I	R315	4E	R373	3F
C386	4E	CR434	1B	Q202	4K	Q458	2D	R224	3J	R316	1J	R375	2F
C388	4D	CR452	2B	Q203	4J	Q460	*	R225	4K	R321	3H	R376	2E
C405	2G	CR455	2D	Q204	3K	Q464	4D	R226	2J	R322	3H	R377	2F

*Mounted on S460



sembly.

	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
3	3G	R383	4E	R432	2C	R482	2E
8	5F	R384	4E	R433	2C	R483	3D
2	2F	R385	4E	R434	1B	R485	3E
3	2F	R386	4E	R435	1C	R491	3C
4	2F	R388	4D	R438	2B	R492	3D
6	2F	R391	4I	R439	2B	R494	3D
7	2F	R392	4I	R451	2B	R495	3D
8	3F	R393	4H	R452	2E	R496	3C
1	2G	R394	4H	R454	3D	R821	4C
2	2G	R395	4H	R455	2E	R841	2J
3	2G	R396	4G	R456	2C	R842	2J
4	2G	R397	4G	R457	2C	R844	2J
5	2G	R398	4G	R458	3C		
2	2H	R399	4G	R459	2D	RT484	3E
3	2H	R401	2G	R460	4D		
4	2H	R402	2F	R461	3E	S230	2K
6	2G	R403	1F	R462	3E	S460	2D
7	2G	R404	2G	R464	3D	S800	3G
8	2H	R405	1G	R465	4D		
9	2H	R406	1F	R466	3C	T001	3B
1	3G	R409	3K	R468	3C		
2	3G	R410	3K	R469	4D	U220	2J
3	3G	R415	4J	R470	2D	U314	3I
4	4F	R419	4B	R471	3C	U386	4E
1	2G	R421	4B	R472	3D	U842	2J
3	3F	R422	4B	R474	3D		
5	2F	R425	4B	R475	3D	VR317	2I
6	2E	R426	4B	R476	3C		
7	2F	R431	2E	R480	1F		



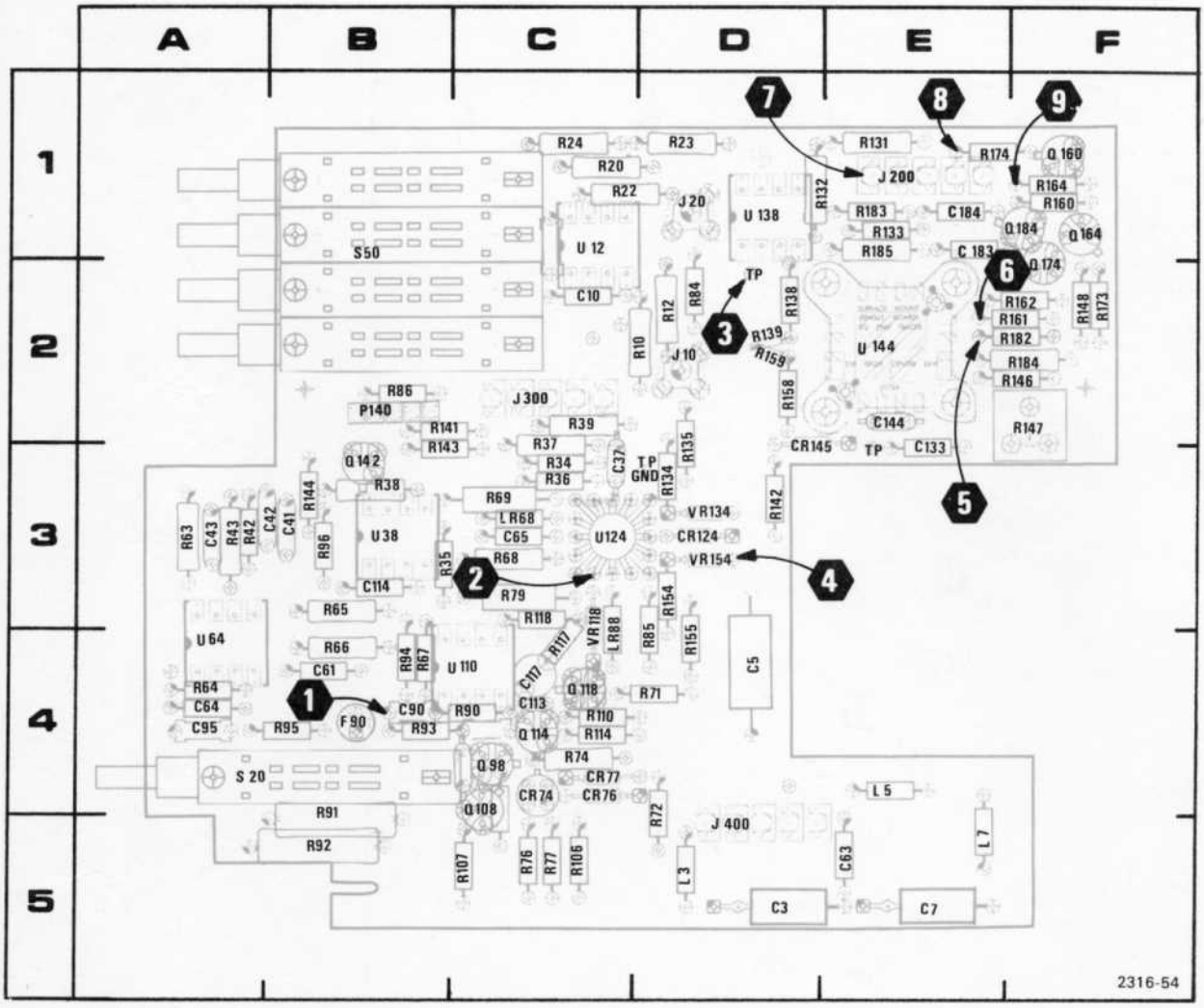
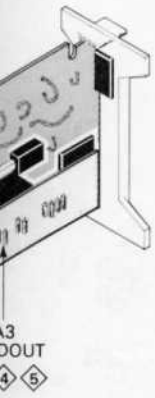


Figure 8-7. A2-Trigger circuit board assembly.

CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD	CKT NO	GRID COORD
C3	5D	GND	3D	R22	1C	R93	4B	R162	2F
C5	4D			R23	1D	R94	4B	R164	1F
C7	5E	J10	2D	R24	1C	R95	4B	R173	2F
C10	2C	J20	1D	R34	3C	R96	3B	R174	1E
C37	3C	J200	1E	R35	3B	R106	5C	R182	2F
C41	3B	J300	2C	R36	3C	R107	5C	R183	1E
C42	3B	J400	5D	R37	3C	R110	4C	R184	2F
C43	3A			R38	3B	R114	4C	R185	1E
C61	4B	L3	5D	R39	2C	R117	4C		
C63	5E	L5	4E	R42	3A	R118	3C	S20	4A
C64	4A	L7	5E	R43	3A	R131	1E	S50	1B
C65	3C			R63	3A	R132	1D		
C90	4B	LR68	3C	R64	4A	R133	1E	TP	2D
C95	4A	LR88	4C	R65	3B	R134	3D	TP	3D
C113	4C			R66	4B	R135	3D	TP	3E
C114	3B	P140	2B	R67	4B	R138	2D		
C117	4C			R68	3C	R139	2D	U12	1C
C133	3E	Q98	4C	R69	3C	R141	2B	U38	3B
C144	2E	Q108	4C	R71	4D	R142	3D	U64	4A
C183	1E	Q114	4C	R72	5D	R143	3B	U110	4C
C184	1E	Q118	4C	R74	4C	R144	3B	U124	3C
		Q142	3B	R76	5C	R146	2F	U138	1D
CR74	4C	Q160	1F	R77	5C	R147	2F	U144	2E
CR76	4C	Q164	1F	R79	3C	R148	2F		
CR77	4C	Q174	2F	R84	2D	R154	3D	VR118	4C
CR124	3D	Q184	1F	R85	4D	R155	4D	VR134	3D
CR145	3D			R86	2B	R158	2D	VR154	3D
		R10	2D	R90	4C	R159	2D		
F90	4B	R12	2D	R91	4B	R160	1F		
		R20	1C	R92	5B	R161	2F		



VOLTAGE AND WAVEFORM CONDITIONS

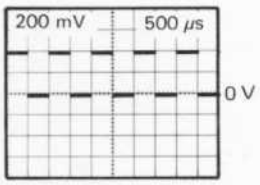
The voltages and waveforms shown were obtained with the controls set as follows:

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, AUTO; COUPLING, AC; SOURCE, EXT; SLOPE, +; EXT TRIG IN, IN (1 MΩ).

Voltage Conditions. The voltages shown on the diagram were obtained using a digital multimeter with a 1 MΩ input impedance (Tektronix DM 501 Digital Multimeter or Tektronix 7D13 Digital Multimeter used with readout equipped, series oscilloscope).

Waveform Conditions. The waveforms shown below were obtained using a test oscilloscope system with 1 MΩ input impedance and at least 15 MHz bandwidth (Tektronix 7603 Oscilloscope, 7B53A Time Base, and 7A13 Differential Comparator equipped with 10X probe). A 4 volt, 1 kHz square wave signal was fed to the EXT TRIG IN connector.

1



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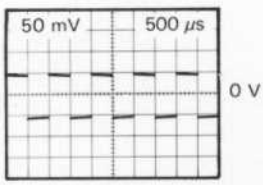

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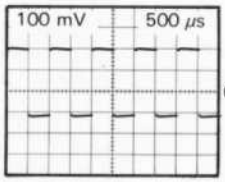

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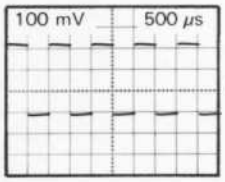

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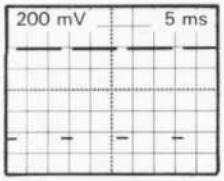

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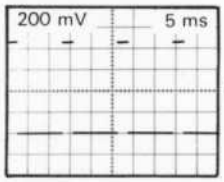

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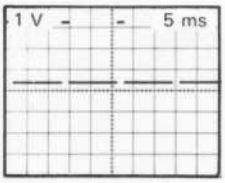

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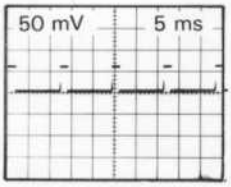

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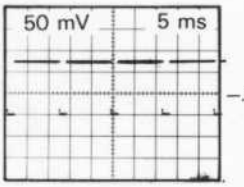
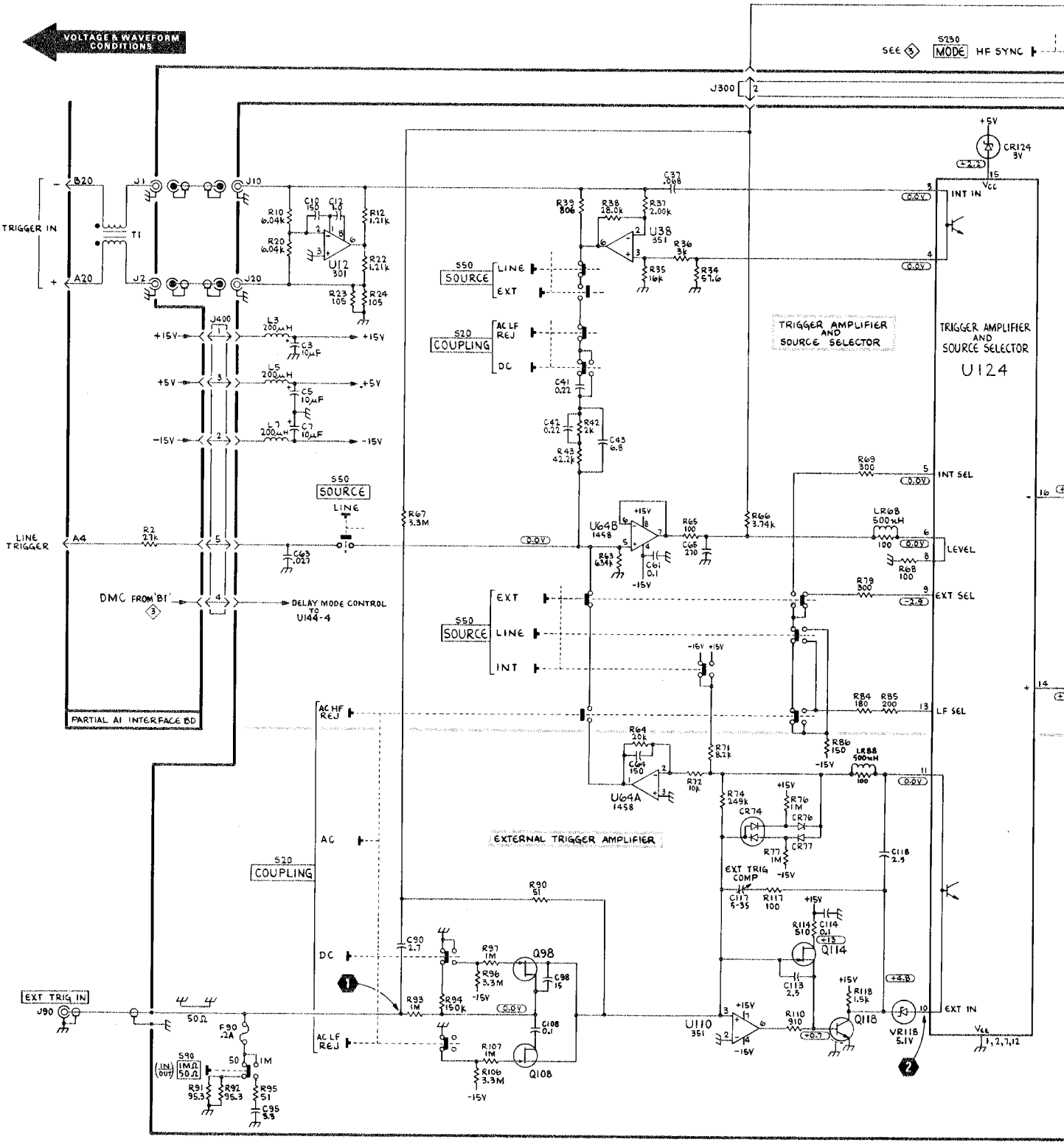
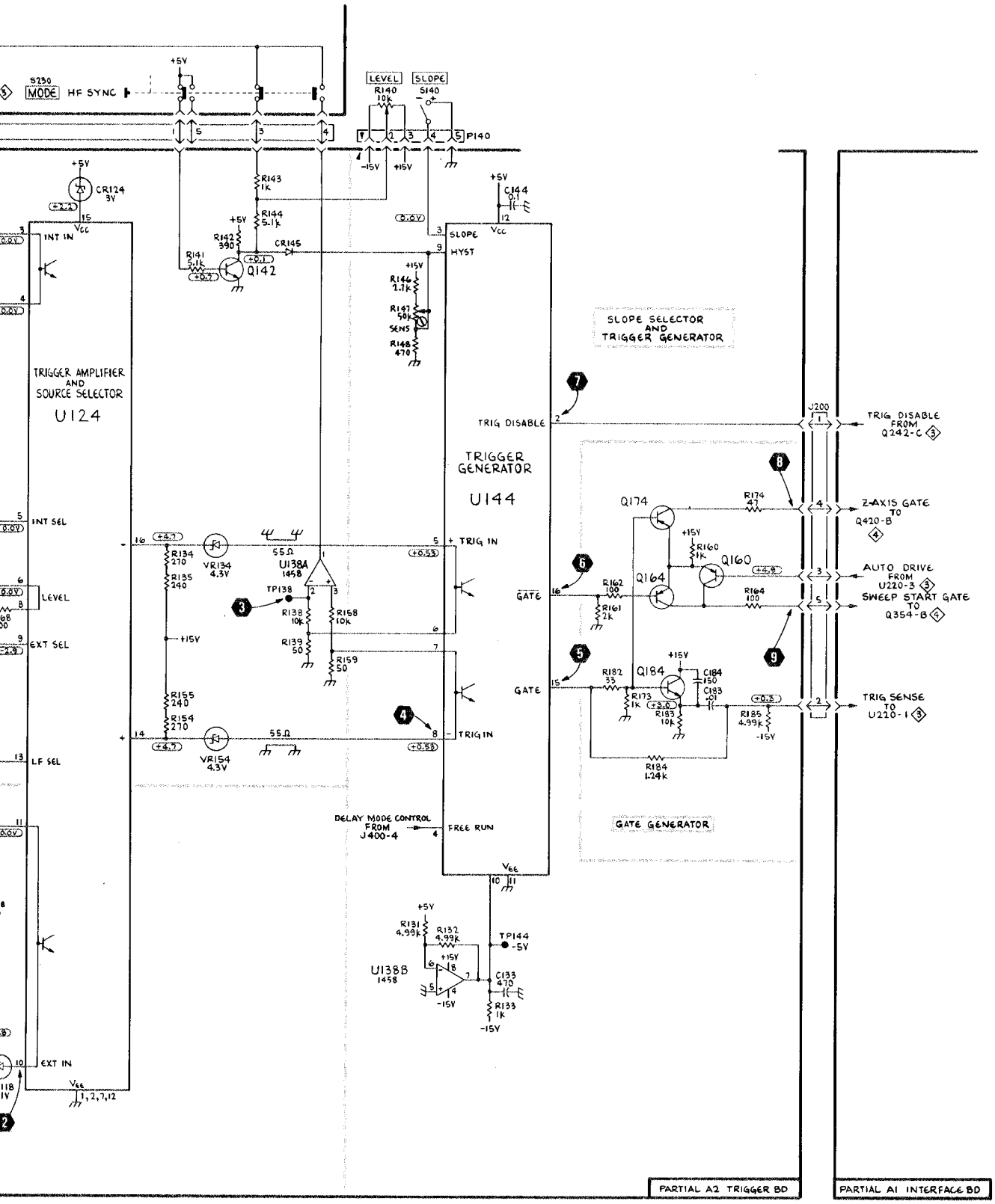



VOLTAGE & WAVEFORM CONDITIONS
SEE 3
S230 MODE HF SYNC
J300 2
TRIGGER IN
B20
A20
J1
J2
J10
J20
T1
R10 6.04k
R20 6.04k
C10 150
C12 1.0
U12 301
R12 1.21k
R22 1.21k
R23 105
R24 105
J400
+15V
+5V
-15V
L3 200uH
L5 200uH
L7 200uH
C3 10uF
C5 10uF
C7 10uF
S50 SOURCE LINE EXT
S20 COUPLING AC LF REJ DC
R39 806
R38 28.0k
R37 2.00k
C37 .008
U38 351
R36 3k
R35 16k
R34 57.6
C41 0.22
C42 0.22
R42 2k
R43 42.2k
C43 6.8
TRIGGER AMPLIFIER AND SOURCE SELECTOR
TRIGGER AMPLIFIER AND SOURCE SELECTOR U124
CR124 3V
INT IN
INT SEL
LEVEL
EXT SEL
LF SEL
EXT IN
LINE TRIGGER
A4
R2 27k
C63 .027
R67 3.3M
U64B 1458
R65 100
C66 270
R66 3.74k
LR68 500uH
R68 100
C61 0.1
R69 300
R79 300
R84 180
R85 200
R86 150
LR88 500uH
R71 8.2k
R72 10k
C64 150
R69 20k
U64A 1458
R74 249k
R76 1M
CR74
CR76
CR77
R77 1M
EXT TRIG COMP
C117 5-35
R117 100
C118 2.9
C113 2.5
R114 510
C114 .01
Q114
R118 1.5k
Q118
R110 910
U110 351
VR118 5.1V
DMC FROM 'BI' 3
DELAY MODE CONTROL TO U144-4
PARTIAL A1 INTERFACE BD
EXTERNAL TRIGGER AMPLIFIER
EXT TRIG IN J90
50Ω
F90 .2A
S90 (IN/OUT) 1MΩ 50Ω
R91 95.3
R92 95.3
R95 51
C95 3.3
R90 51
C90 2.7
R97 1M
R96 3.3M
R94 150k
R93 1M
Q98
C98 15
C108 0.1
R107 1M
R106 3.3M
Q108
-15V
+15V
Vcc
Vee
1,2,7,12

7B10



2316-62
REV SEP 1982

TRIGGER GENERATOR ◇2

3

VOLTAGE AND WAVEFORM CONDITIONS

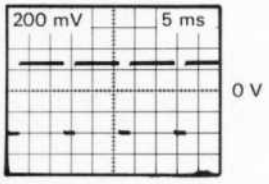
The voltages and waveforms shown were obtained with the controls set as follows:

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

Voltage Conditions. The voltages shown on the diagram were obtained using a digital multimeter with a 1 MΩ 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 1 MΩ input impedance and at least 15 MHz bandwidth (Tektronix 7603 Oscilloscope, 7B53A Time Base, and 7A13 Differential Comparator equipped with 10X probe). A 4 volt, 1 kHz square wave signal was fed to the EXT TRIG IN connector.

10



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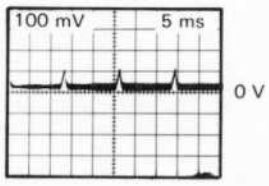

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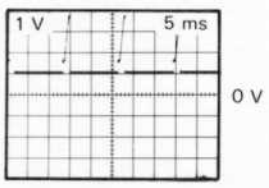

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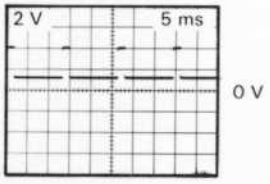

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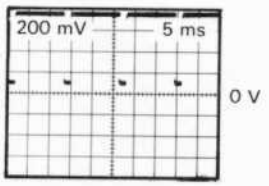

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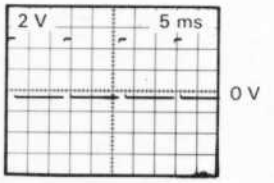
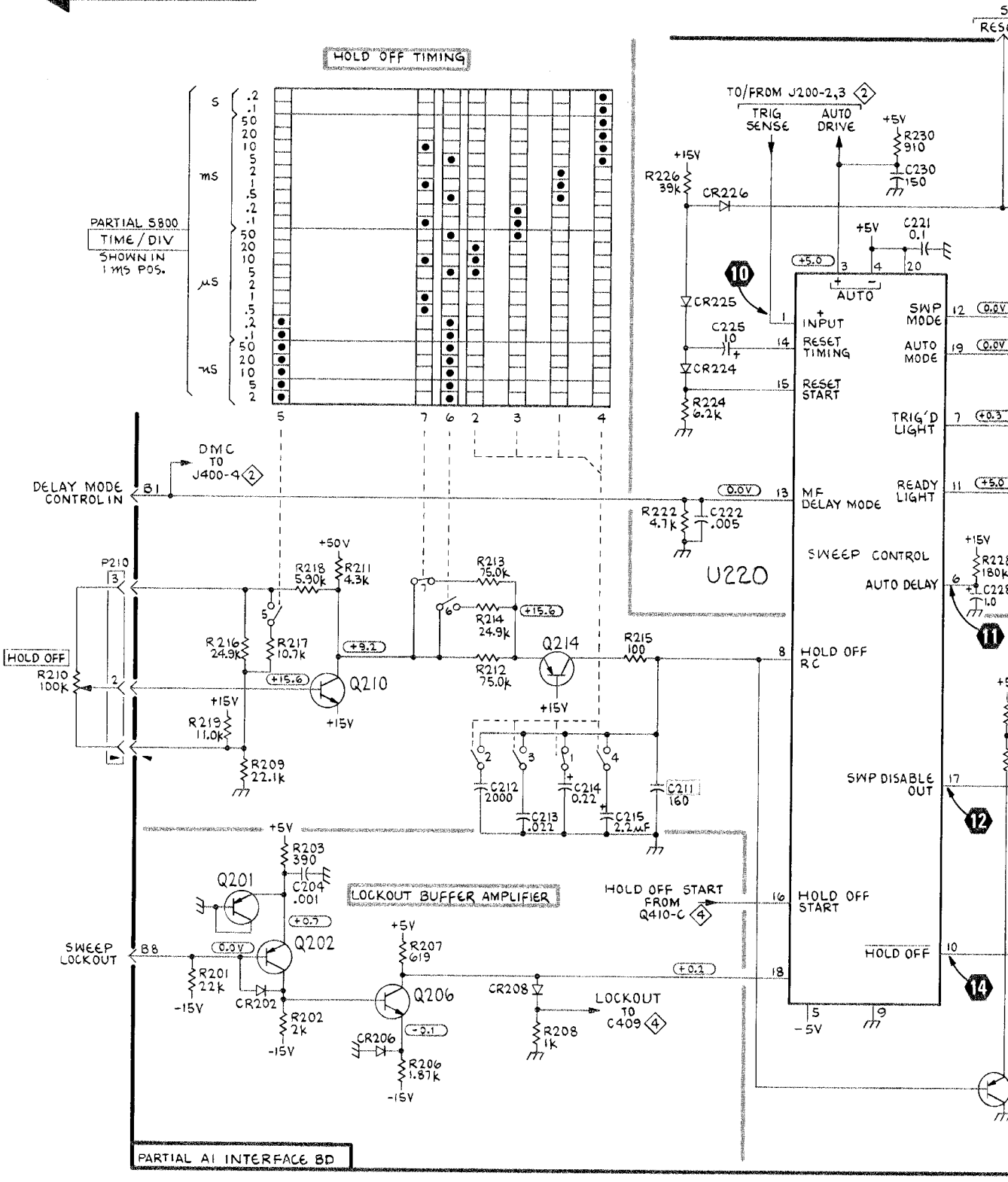
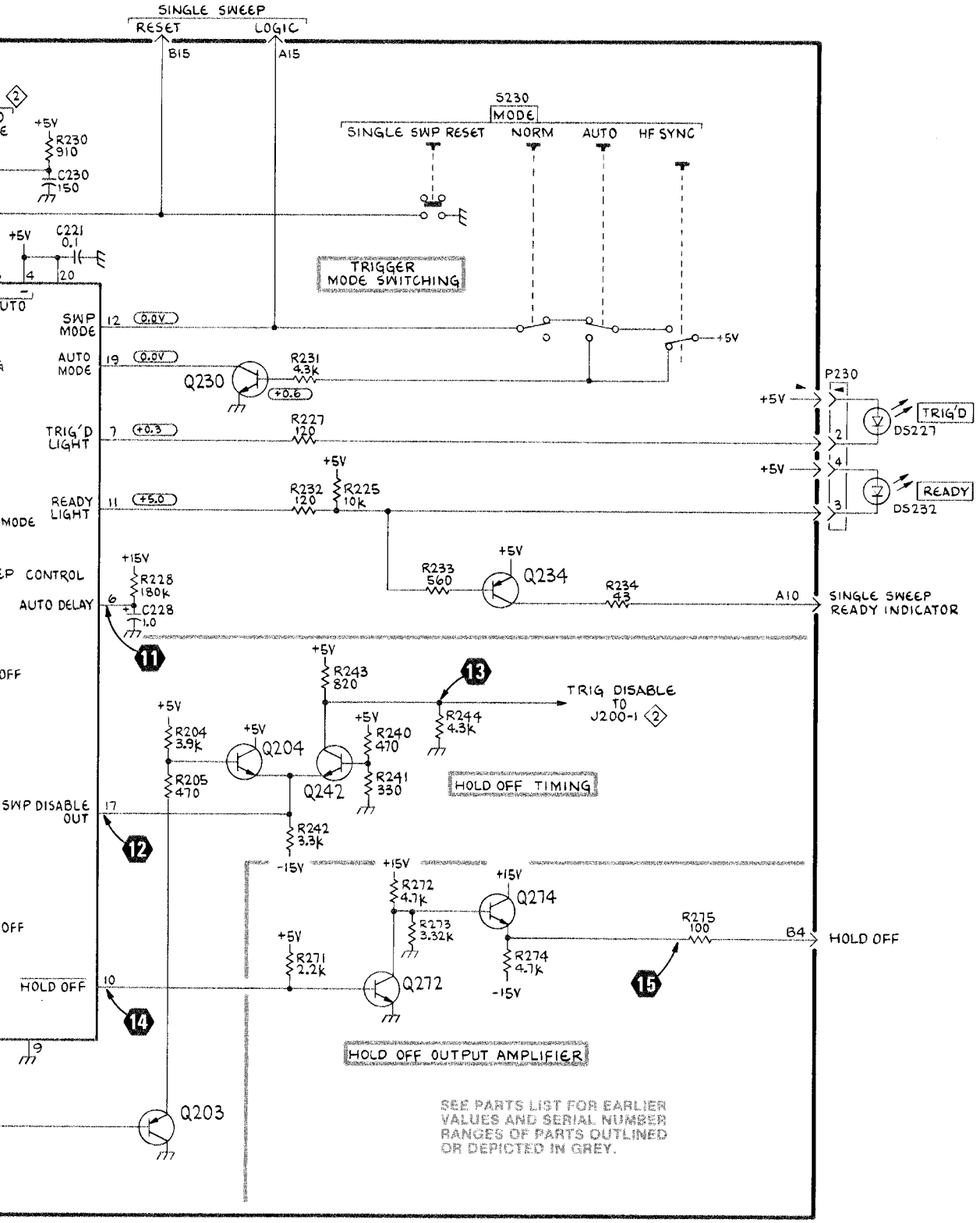




2316-63
REV DEC 1981



2316-63
REV DEC 1981

LOGIC 3

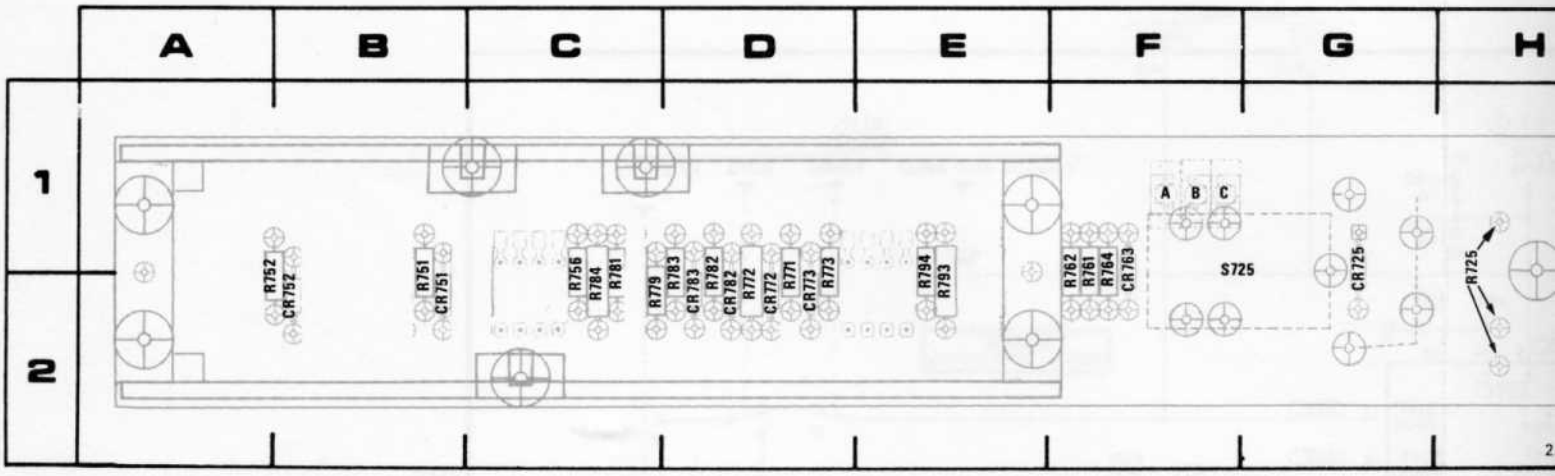
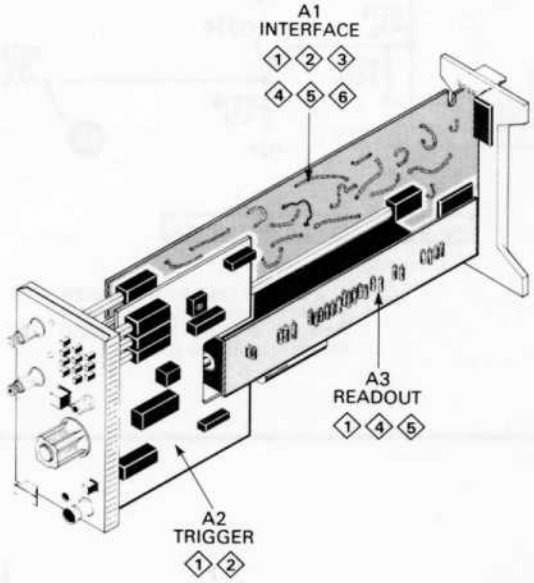
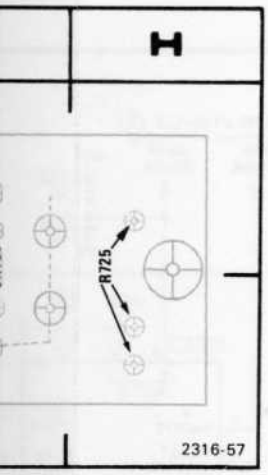


Figure 8-8. A3-Readout circuit board assembly.

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




R725
2316-57

VOLTAGES AND WAVEFORM CONDITIONS

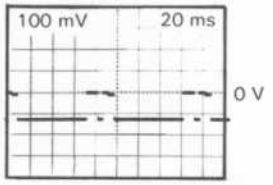
The voltages and waveforms shown were obtained with the controls set as follows:

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, AUTO; COUPLING, AC; SOURCE, EXT; SLOPE, +; EXT TRIG IN, IN (1 MΩ).

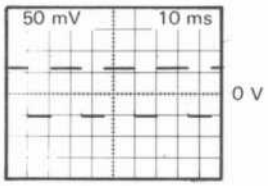
Voltage Conditions. The voltages shown on the diagram were obtained using a digital multimeter with a 1 MΩ input impedance (Tektronix DM 501 Digital Multimeter or Tektronix 7D13 Digital Multimeter used with readout equipped, 7000-series oscilloscope).

Waveform Conditions. The waveforms shown below were obtained using a test oscilloscope system with 1 MΩ input impedance and at least 15 MHz bandwidth (Tektronix 7603 Oscilloscope, 7B53A Time Base, and 7A13 Differential Comparator equipped with 10X probe).

16



17



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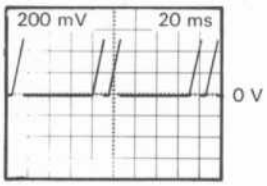

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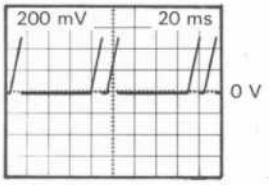

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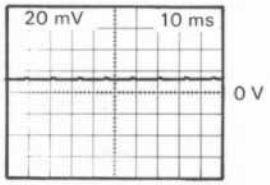

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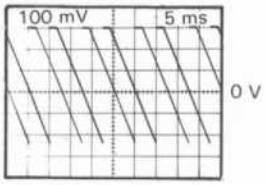

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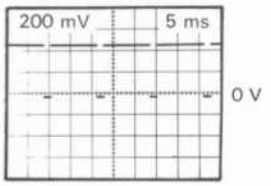

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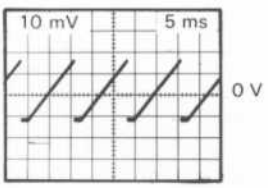

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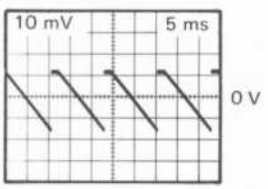
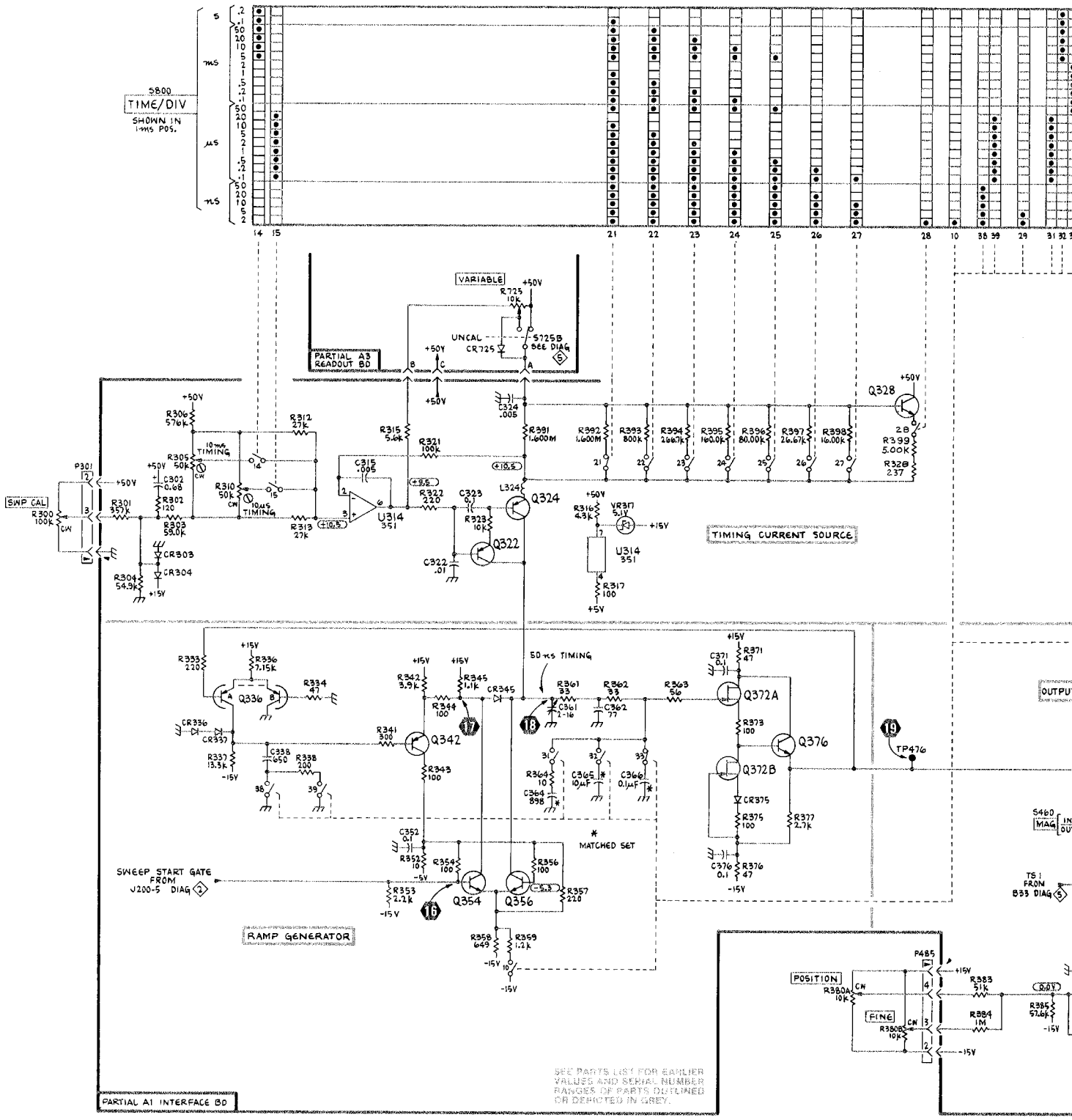
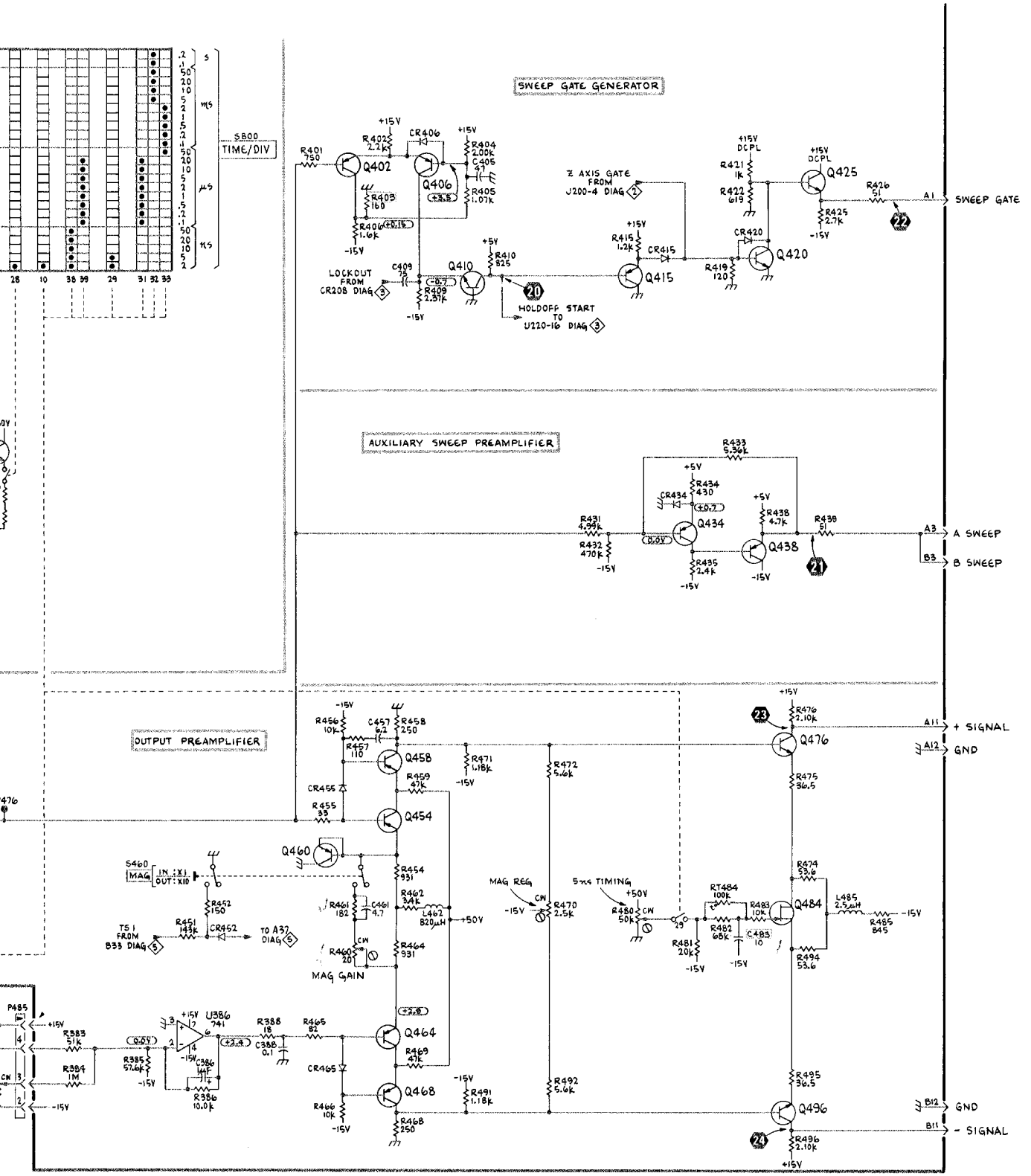
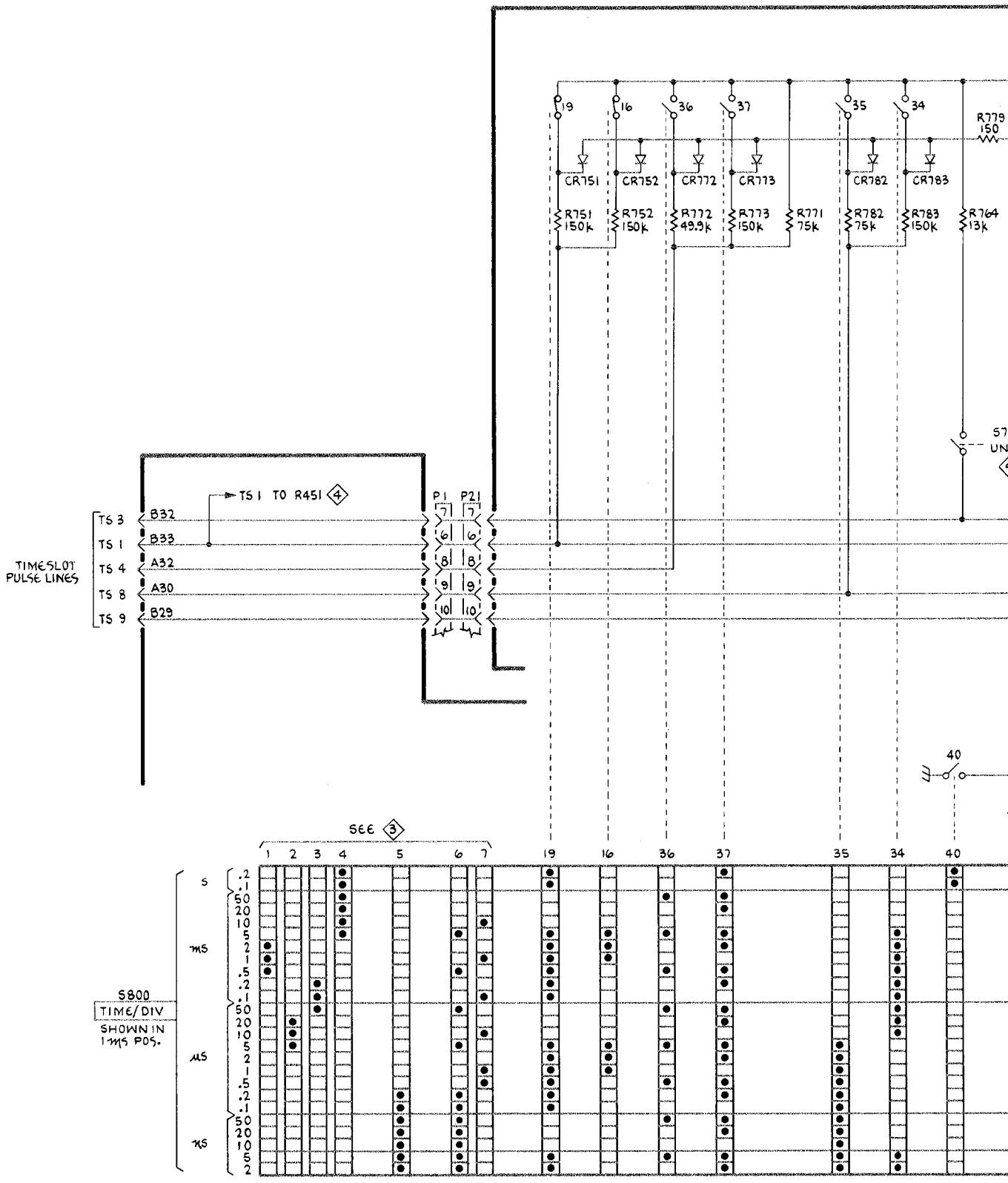


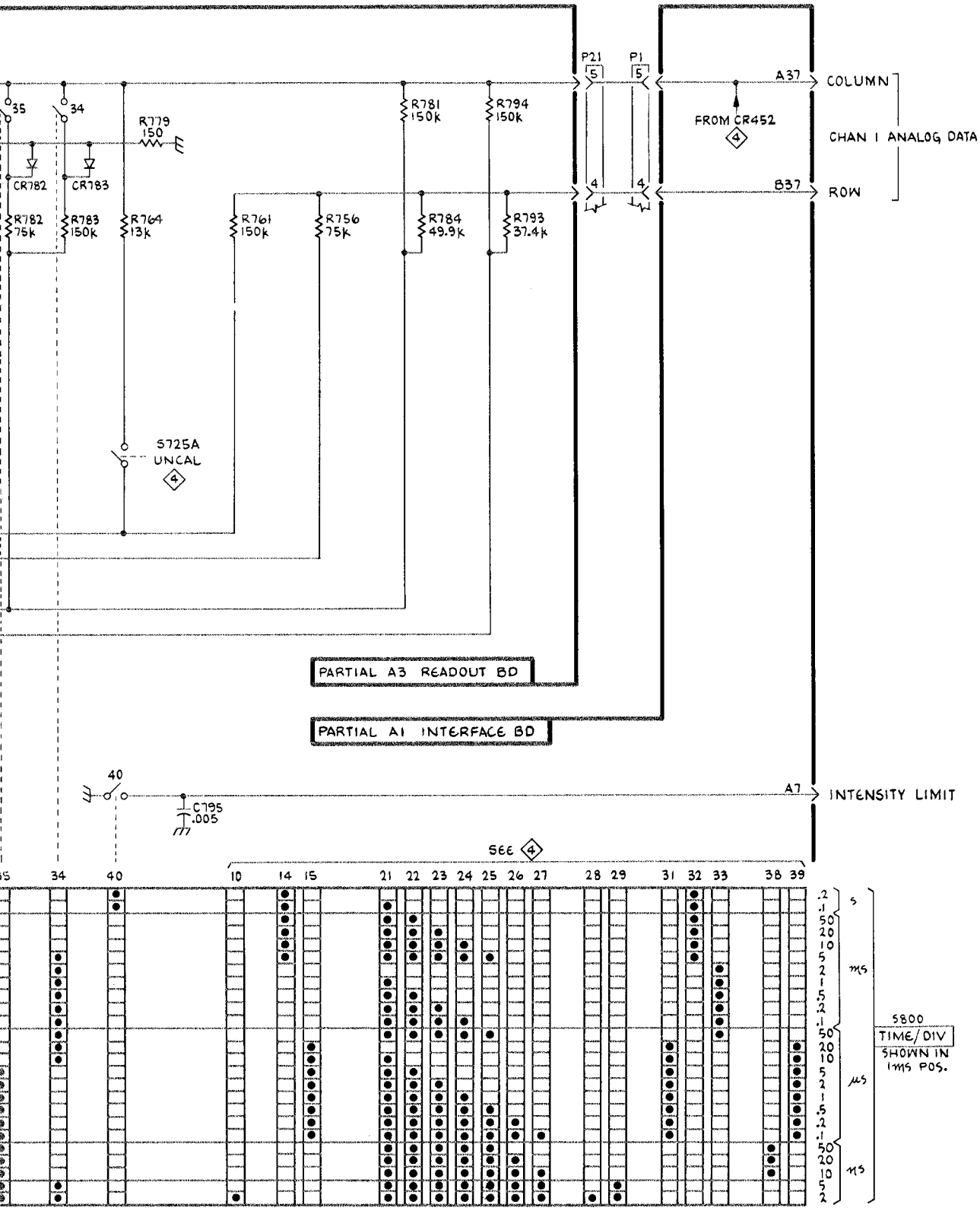

S800
TIME/DIV
SHOWN IN 1-ms POS.
VARIABLE
PARTIAL A3 READOUT BD
UNCAL
CR725
S725B
SEE DIAG 5
TIMING CURRENT SOURCE
RAMP GENERATOR
50 ns TIMING
SWEEP START GATE FROM J200-5 DIAG 2
MATCHED SET
POSITION
FINE
PARTIAL A1 INTERFACE BD
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.



64
1982

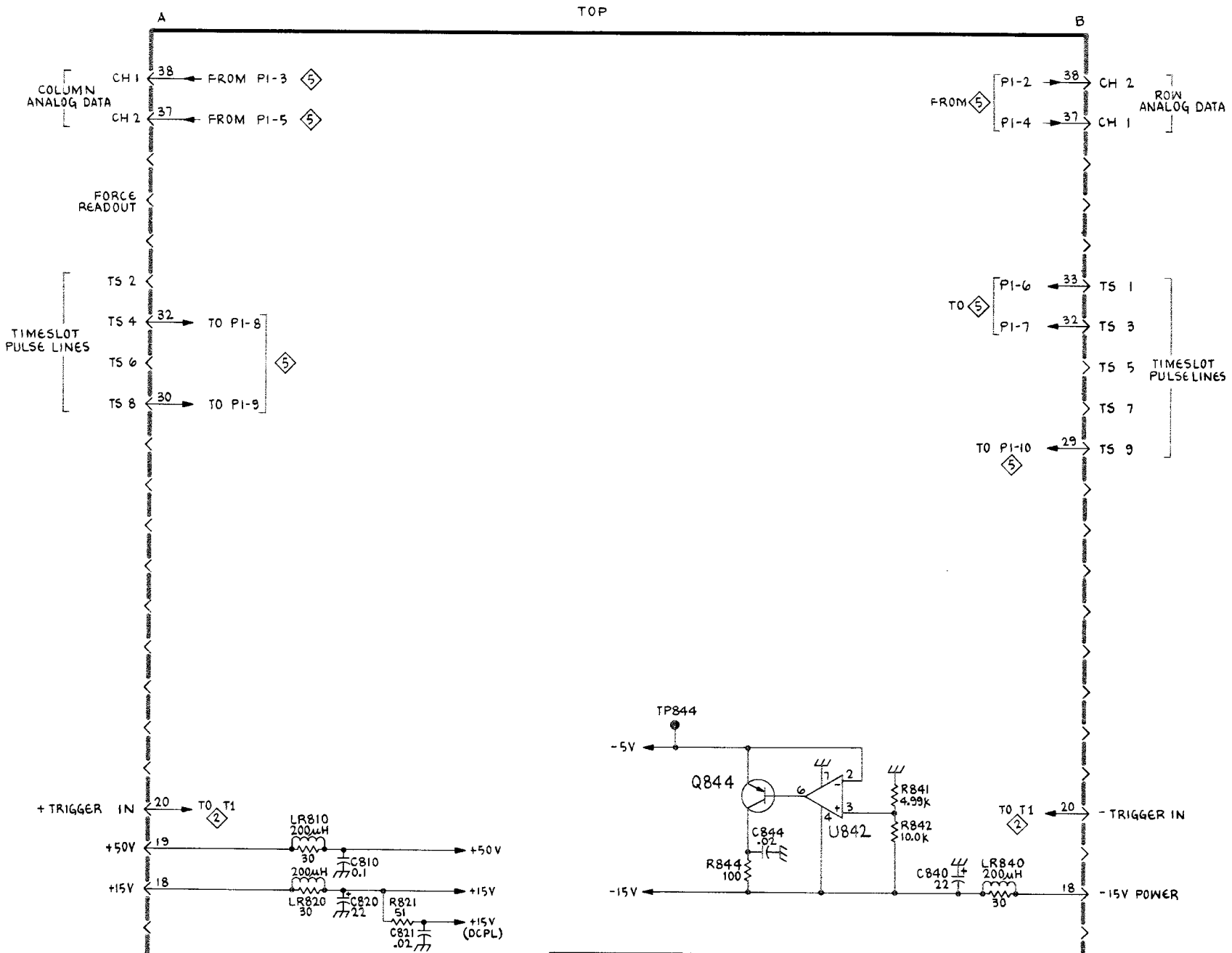
SWEEP GENERATOR 4

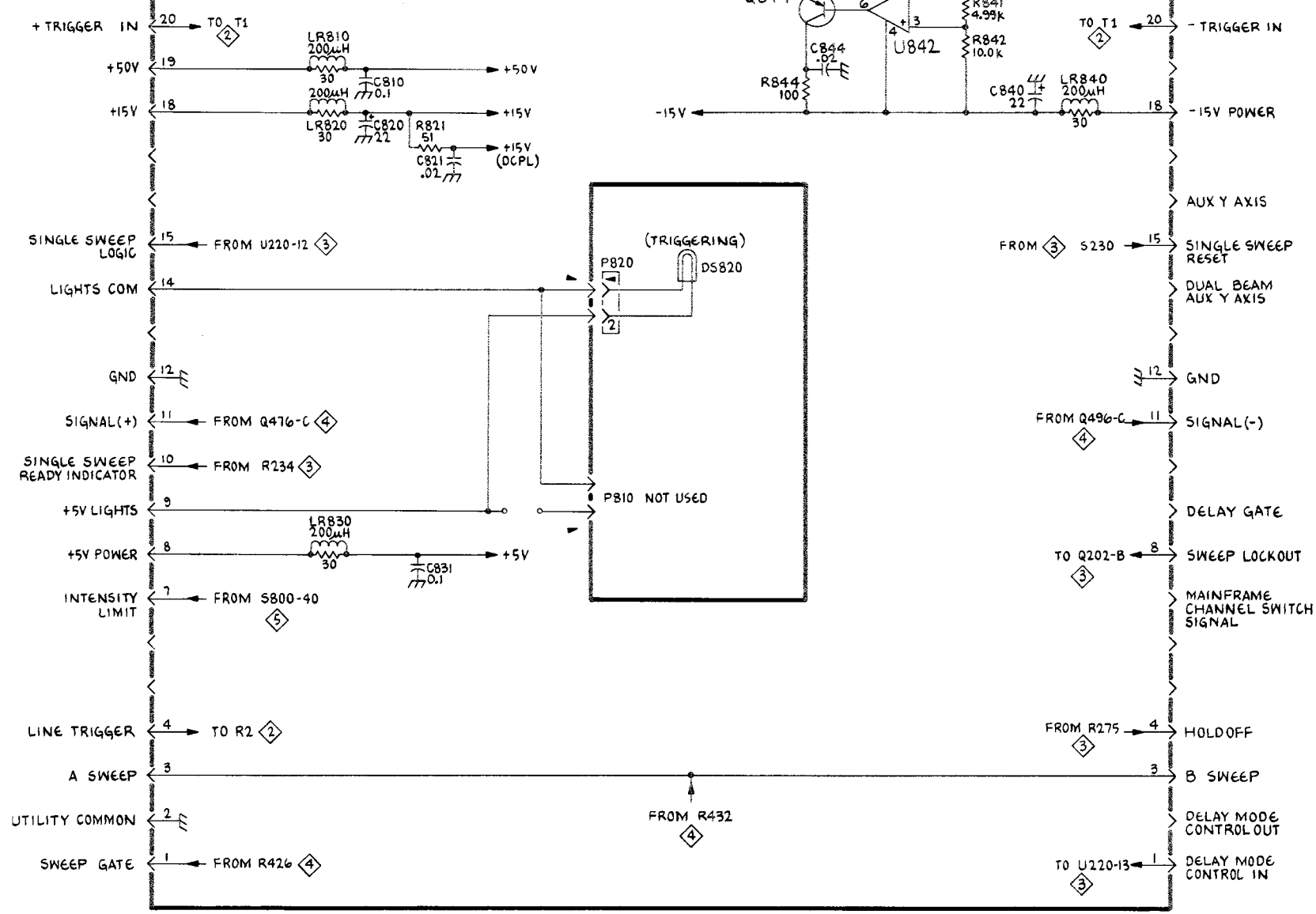

TIMESLOT PULSE LINES
TS 3
TS 1
TS 4
TS 8
TS 9
B32
B33
A32
A30
B29
TS 1 TO R451 4
P1
P21
CR751
CR752
CR772
CR773
CR782
CR783
R751 150k
R752 150k
R772 49.9k
R773 150k
R771 75k
R782 75k
R783 150k
R764 13k
R779 150
SEE 3
S800 TIME/DIV
SHOWN IN 1 mS POS.
S
mS
µS
nS



SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

TIME/DIVISION AND READOUT SWITCHING ◇5


A
TOP
B
COLUMN ANALOG DATA
CH 1
38
FROM P1-3
5
CH 2
37
FROM P1-5
5
FORCE READOUT
TS 2
TS 4
32
TO P1-8
TS 6
TS 8
30
TO P1-9
5
TIMESLOT PULSE LINES
FROM 5
P1-2
38
CH 2
P1-4
37
CH 1
ROW ANALOG DATA
TO 5
P1-6
33
TS 1
P1-7
32
TS 3
TS 5
TS 7
TO P1-10
5
29
TS 9
TIMESLOT PULSE LINES
TP844
-5V
Q844
U842
R841 4.99k
R842 10.0k
C844 .02
R844 100
-15V
C840 22
LR840 200µH 30
18
-15V POWER
+TRIGGER IN
20
TO T1
2
TO T1
20
-TRIGGER IN
+50V
19
LR810 200µH 30
C810 0.1
+50V
+15V
18
200µH
LR820 30
C820 22
R821 51
C821 .02
+15V
+15V (DCPL)
2316-66



SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

INTERFACE CONNECTORS AND POWER SUPPLY ⑥

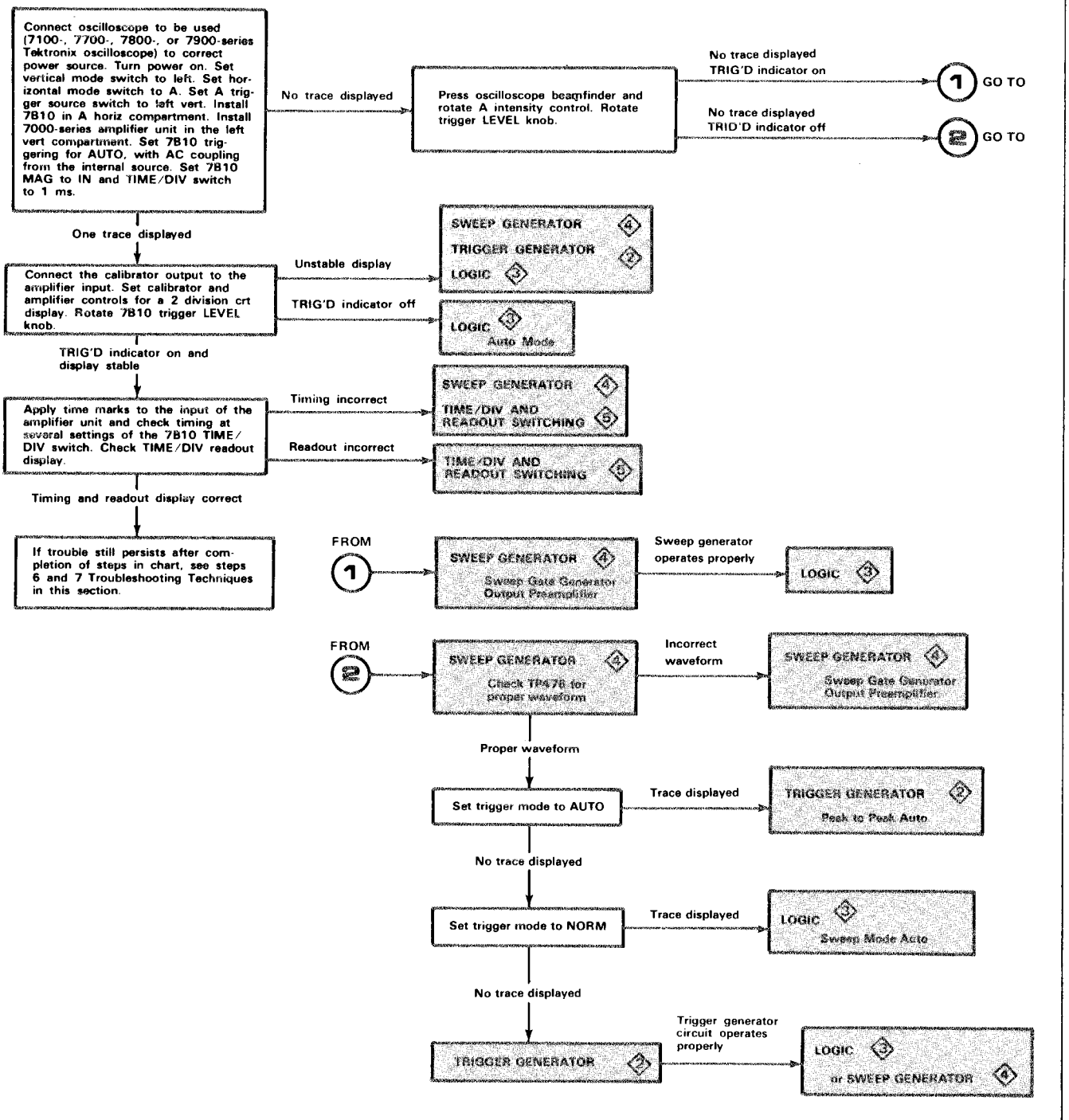
TROUBLESHOOTING CHART INSTRUCTIONS:

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.



2316-58A

7B10 Troubleshooting Chart.

REV MAY 1981

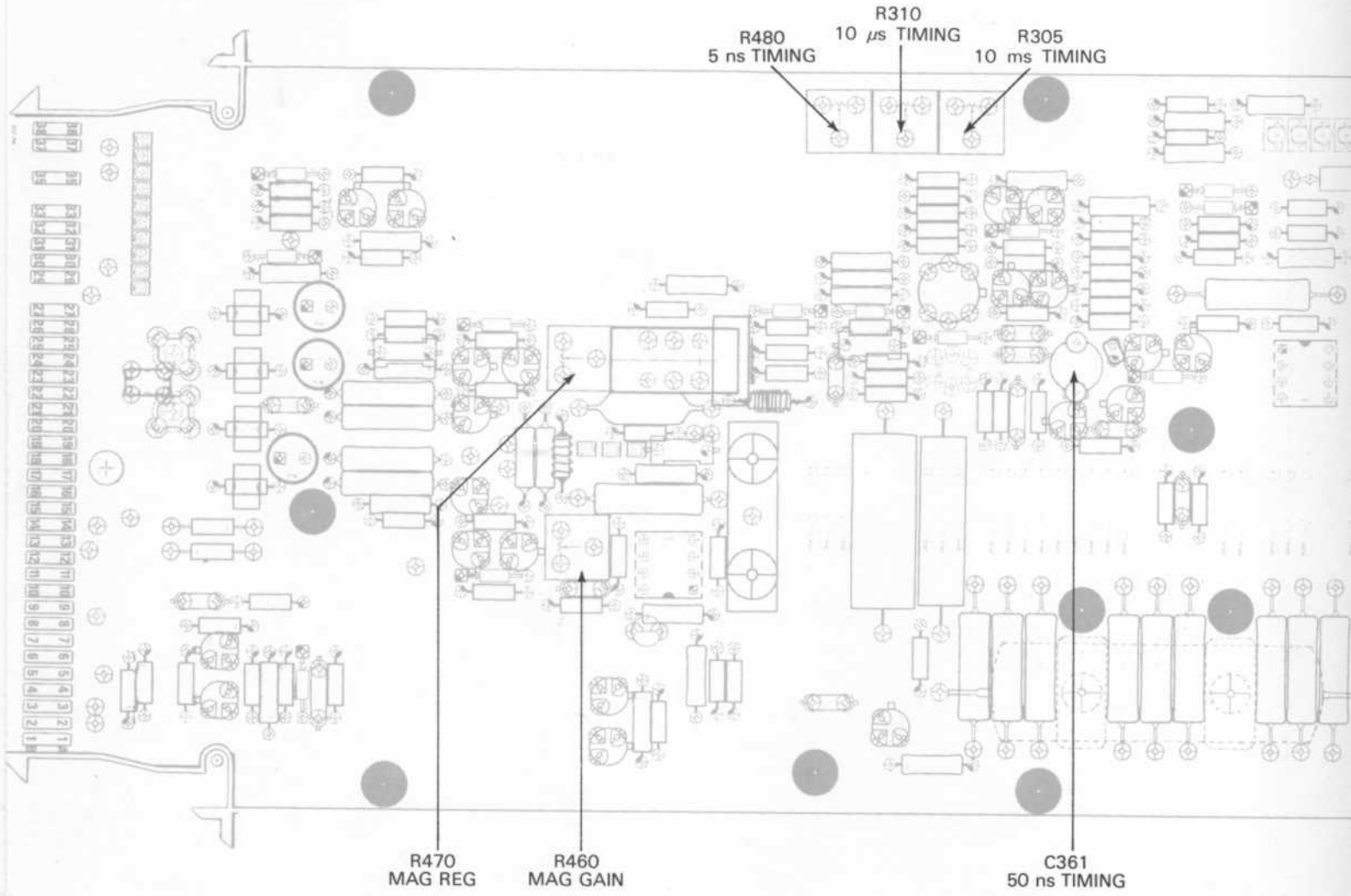
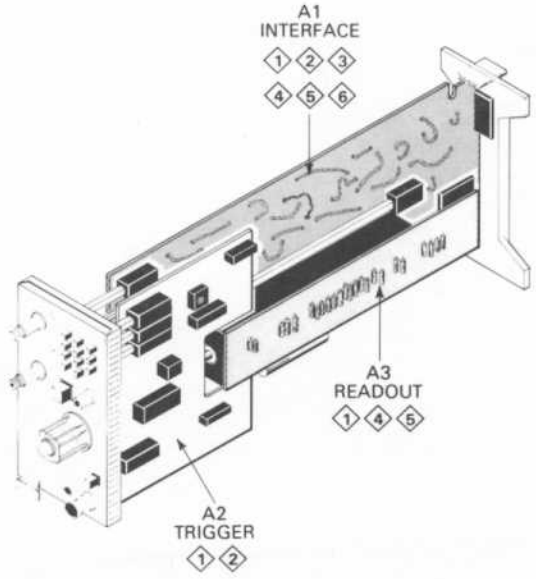
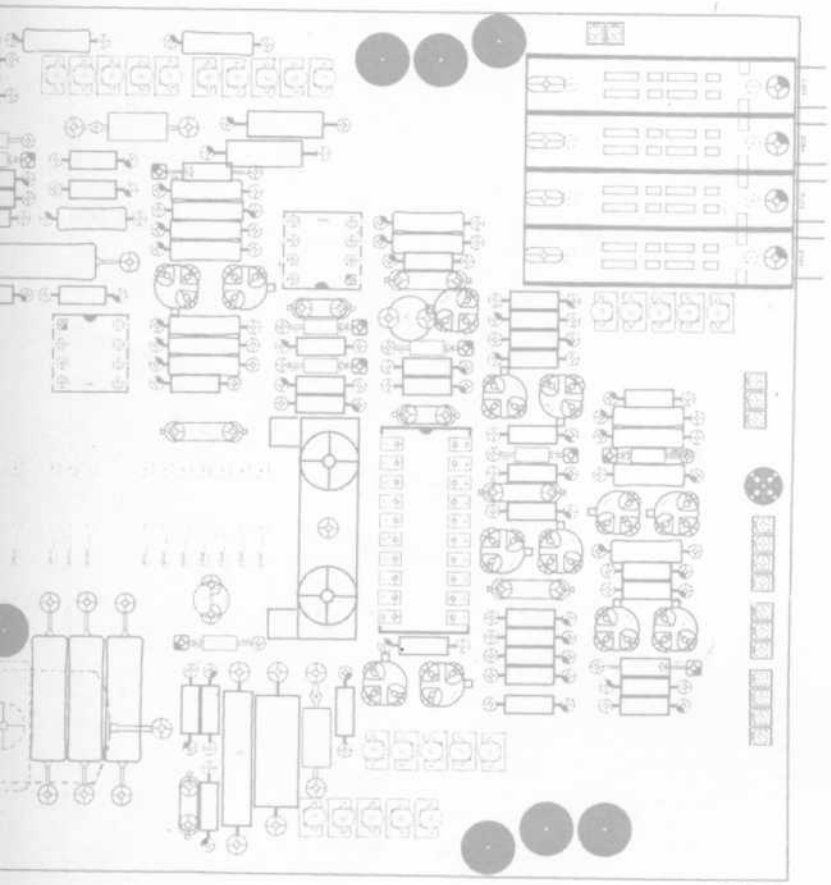
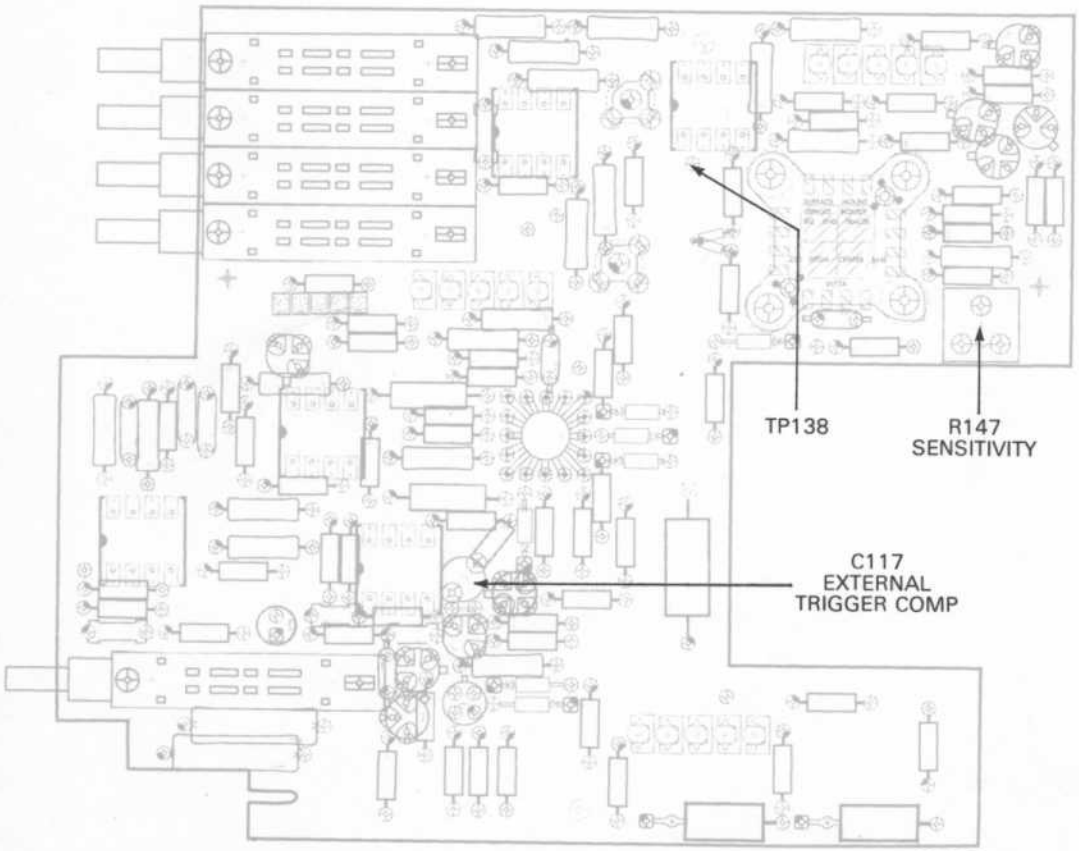


Figure 8-9. Location of Sweep Timing adjustments.





2316-59



2316-60

Figure 8-10. Location of Triggering adjustments.

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

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

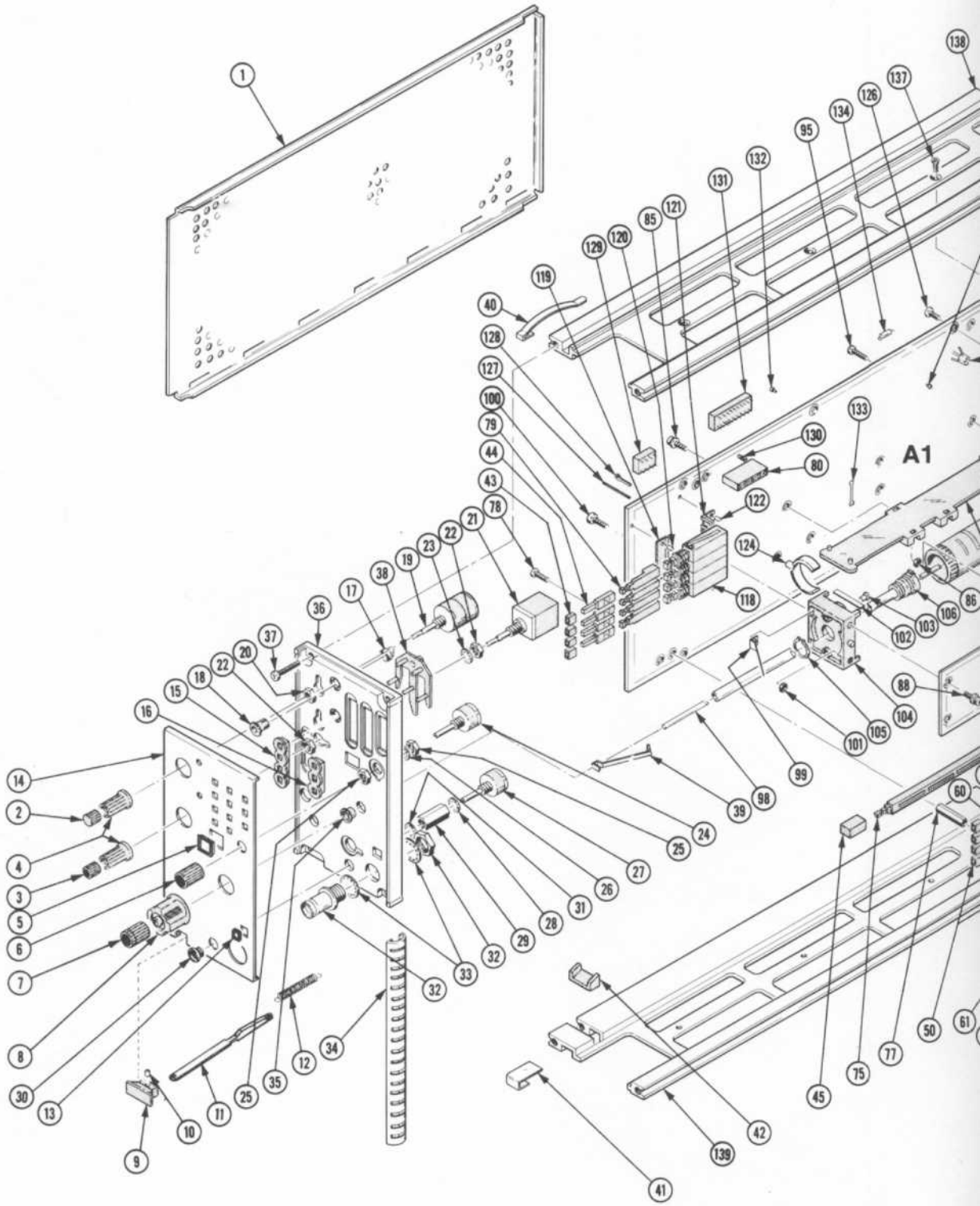
Mfr. Code	Manufacturer	Address	City, State, Zip
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON, OR 97005
000EX	O'HARA METAL PRODUCT COMPANY	542 BRANNAN STREET	SAN FRANCISCO, CA 94107
000FW	WESTERN SINTERING CO INC.	2620 STEVENS DRIVE	RICHLAND, WA 99352
01536	CAMCAR DIV OF TEXTRON INC. SEMS PRODUCTS UNIT	1818 CHRISTINA ST.	ROCKFORD, IL 61108
07707	USM CORP., USM FASTENER DIV.	510 RIVER RD.	SHELTON, CT 06484
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
09922	BURNDY CORPORATION	RICHARDS AVENUE	NORWALK, CT 06852
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
22599	ESNA, DIV. OF AMERACE CORPORATION	16150 STAGG STREET	VAN NUYS, CA 91409
46384	PENN ENGINEERING AND MFG. CORP.	P O BOX 311	DOYLESTOWN, PA 18901
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
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
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
93907	TEXTRON INC. CAMCAR DIV	600 18TH AVE	ROCKFORD, IL 61101

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:SIDE PLUG-IN UNITS	80009	337-1064-00
-2	366-1391-02			1	KNOB:GY,0.081 ID,0.28 OD,0.32 L	80009	366-1391-02
	213-0725-00			1	.SETSCREW:3-48 X 0.095 INCH,HEX SOC S	74445	OBD
-3	366-1319-02			1	KNOB:GY,0.79 ID,0.28 OD,0.32 H	80009	366-1319-02
	213-0725-00			1	.SETSCREW:3-48 X 0.095 INCH,HEX SOC S	74445	OBD
-4	366-1077-00			2	KNOB:GRAY	80009	366-1077-00
	213-0153-00			2	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-5	426-0681-00			1	FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00
-6	366-1023-01			1	KNOB:GY,0.127 ID X 0.392 OD X 0.	80009	366-1023-01
	213-0153-00			1	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-7	366-1166-00			1	KNOB:RED,0.127 ID X 0.392 OD	80009	366-1166-00
	213-0153-00			1	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-8	366-1103-00			1	KNOB:GRAY	80009	366-1103-00
	213-0153-00			2	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-9	366-1058-76			1	KNOB:LATCH,MARKED 7B10	80009	366-1058-76
					**********(ATTACHING PARTS)**********		
-10	214-1095-00			1	PIN,SPG,SPLIT:0.094 OD X 0.187 INCH LONG	22599	52-022-094-0187
					**********-***-**********		
-11	105-0076-02	B010100	B031754	1	REL BAR,LATCH:PLUG-IN UNIT	80009	105-0076-02
	105-0076-04	B031755		1	RELEASE BAR,LCH:PLUG-IN UNIT	80009	105-0076-04
-12	214-1280-00			1	SPRING,HLCPS:0.14 OD X 1.126"L,0.16"DIA	80009	214-1280-00
-13	426-1072-00			1	FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-14	333-1213-11			1	PANEL,FRONT:	80009	333-1213-11
-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	352-0157-00			2	LAMPHOLDER:WHITE PLASTIC	80009	352-0157-00
-19	----- -----			1	RESISTOR,VAR:(SEE R140 AND S140 REPL)		
					**********(ATTACHING PARTS)**********		
-20	210-0583-00			2	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
					**********-***-**********		
-21	----- -----			1	RESISTOR,VAR:(SEE R380A AND B REPL)		
					**********(ATTACHING PARTS)**********		
-22	210-0583-00			2	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-23	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
					**********-***-**********		
-24	----- -----			1	RESISTOR,VAR:(SEE R210 REPL)		
					**********(ATTACHING PARTS)**********		
-25	210-0583-00			2	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-26	210-0046-00			3	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
					**********-***-**********		
-27	----- -----			1	RESISTOR,VAR:(SEE R300 REPL)		
-28	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
-29	129-0290-00			1	POST,ELEC-MECH:0.635 INCH LONG,HEX	80009	129-0290-00
					**********(ATTACHING PARTS)**********		
-30	358-0342-00			1	BSHG,MACH.THD:0.25 X 32 X 0.352 INCH LONG	80009	358-0342-00
-31	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
					**********-***-**********		
-32	131-1315-00			1	CONN,RCPT,ELEC:BNC,FEMALE	80009	131-1315-00
-33	210-0012-00			1	WASHER,LOCK:INTL,0.375 ID X 0.50" OD S	78189	1220-02-00-0541C
					**********-***-**********		
-34	348-0235-00			2	SHLD GSKT,ELEC:4.734 INCH LONG	80009	348-0235-00
-35	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	B010100	B021124	4	SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL	87308	OBD
	213-0793-00	B021125		4	SCREW,TPG,TF:6-32 X 0.4375,TAPTITE,FIL	93907	OBD
					**********-***-**********		
-38	386-3439-00			1	LT CNDCT,PB ILL:10 BUTTON,7.5MM SPACING	80009	386-3439-00
-39	131-1266-00			1	CONTACT,ELEC:GROUND SPRING	80009	131-1266-00
-40	214-1061-00			1	SPRING,GROUND:FLAT	80009	214-1061-00
-41	214-1054-00			1	SPRING,FLAT:0.825 X 0.322,SST	80009	214-1054-00
-42	105-0075-00			1	BOLT,LATCH:7A & 7B SER PL-IN	80009	105-0075-00
-43	378-0074-00			4	REFLECTOR,LIGHT:PUSH BUTTON	80009	378-0074-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-44	366-1650-00			4		PUSH BUTTON:CLEAR,0.184 X 0.214 X 8.0 L	80009	360-1650-00
-45	366-1257-93			1		PUSH BUTTON:+10 MAG	80009	366-1257-93
-46	366-1559-00			1		PUSH BUTTON:SIL GY,0.18 SQ X 0.43	80009	366-1559-00
-47	131-1820-00			3		CONNECTOR,PLUG,:CKT CD,5 MALE	22526	65306-002
-48	----- -----			1		CKT BOARD ASSY:TRIGGER(SEE A2 REPL)		
						**********(ATTACHING PARTS)**********		
-49	211-0008-00			2		SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
						**********-***-***********-**********		
	----- -----			-		CKT BOARD ASSEMBLY INCLUDES:		
-50	378-0074-00			7		.REFLECTOR,LIGHT:PUSH BUTTON	80009	378-0074-00
-51	366-1650-00			7		.PUSH BUTTON:CLEAR,0.184 X 0.214 X 8.0 L	80009	360-1650-00
-52	263-0016-03			1		.SWITCH,PB ASSY:4 CATCH,7.5MM,6 CONTACTS	80009	263-0016-03
-53	263-0015-00			1		.SWITCH PB ASSY:3 LATCHING,7.5 MM	80009	263-0015-00
-54	343-0495-04			1		.CLIP,SWITCH:FRONT,7.5 MM,4 UNIT	80009	343-0495-04
						.**********(ATTACHING PARTS)**********		
-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	343-0495-03			1		.CLIP,SWITCH:FRONT,7.5 MM,3 UNIT	80009	343-0495-03
-57	343-0499-04	B010100	B021344	1		.CLIP,SWITCH:REAR,7.5MM X 4 UNIT	80009	343-0499-04
	343-0499-13	B021545		1		.CLIP,SWITCH:7.5MM X 4 UNIT	80009	343-0499-13
						.**********(ATTACHING PARTS)**********		
-58	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
						.**********-***-***********-**********		
-59	343-0499-03	B010100	B021544	1		.CLIP,SWITCH:7.5 MM,4 UNIT	80009	343-0499-03
	343-0499-12	B021545		1		.CLIP,SWITCH:REAR,7.5MM X 3 UNIT	80009	343-0499-12
-60	131-0589-00			5		.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-61	131-1003-00			2		.CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-62	263-0010-02			1		.SWITCH PB ASSY:1 PUSH,7.5MM,1 CONTACT	80009	263-0010-02
-63	343-0495-01			1		.CLIP,SWITCH:FRONT,7.5 MM,1 UNIT	80009	343-0495-01
						.**********(ATTACHING PARTS)**********		
-64	210-3033-00			1		.EYELET,METALLIC:0.59 OD X 0.156 INCH LONG	07707	SE-25
						.**********-***-***********-**********		
-65	343-0499-01			1		.CLIP,SWITCH:REAR,7.5 MM,1 UNIT	80009	343-0499-01
						.**********(ATTACHING PARTS)**********		
-66	210-3033-00			1		.EYELET,METALLIC:0.59 OD X 0.156 INCH LONG	07707	SE-25
						.**********-***-***********-**********		
-67	136-0514-00	B010100	B031699	4		.SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
-68	214-0579-00			3		.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-69	136-0252-04			58		.SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-70	136-0263-04			14		.SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	75377-001
-71	426-1337-00			1		.FRAME,MICROCKT:1.22 CM	80009	426-1337-00
						.**********(ATTACHING PARTS)**********		
-72	211-0259-00			4		.SCR,ASSEM WSHR:2-56 X 0.437,PNH,STL CD PL	78189	OBD
						.**********-***-***********-**********		
-73	131-1923-00			1		.CONTACT,ELEC:MICROCIRCUIT	80009	131-1923-00
-74	220-0797-00			4		.NUT,CAPTIVE:2-56 X 0.218 DIA,STL CD PL	46384	KF2-256
-75	384-1100-00			1		EXTENSION SHAFT:0.13 SQ X 6.215" LONG,PLST	80009	384-1100-00
-76	384-1292-00			1		EXTENSION SHAFT:2.417 INCH LONG,PLASTIC	80009	384-1292-00
-77	129-0198-00			2		POST,ELEC-MECH:0.188 HEX X 0.74 INCH L,BRS	80009	129-0198-00
						**********(ATTACHING PARTS)**********		
-78	211-0008-00			2		SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
						**********-***-***********-**********		
-79	384-1382-00			4		EXTENSION SHAFT:1.09 INCH LONG	80009	384-1382-00
-80	204-0683-00			3		BODY,CONN,RCPT:5 FEMALE POSN CONTACT	22526	65058-061
-81	386-1402-00			1		PANEL,REAR:	80009	386-1402-00
						**********(ATTACHING PARTS)**********		
-82	213-0192-00	B010100	B021124	4		SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL	87308	OBD
	213-0793-00	B021125		4		SCREW,TPG,TF:6-32 X 0.4375,TAPTITE,FIL	93907	OBD
-83	361-0326-00			1		SPACER,SLEEVE:0.18 ID X 0.25 OD X 0.10"L	80009	361-0326-00
						**********-***-***********-**********		
	672-0649-00			1		CKT CARD ASSY:	80009	672-0649-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-84	200-1362-00			2	.COVER,CAM SW:BLACK PLASTIC	80009	200-1362-00
					.**********(ATTACHING PARTS)**********		
-85	211-0244-00	B010100	B021199	6	.SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
	211-0292-00	B021200		6	.SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	OBD
-86	210-0406-00			6	.NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
					.**********- - - * - - -**********		
-87	----- -----			1	.CKT BOARD ASSY:READOUT(SEE A3 REPL)		
					.**********(ATTACHING PARTS)**********		
-88	211-0678-00			4	.SCR,ASSEM WSHR:4-40 X 0.281 L,PNH STEEL	01536	OBD
-89	211-0008-00			1	.SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
					.**********- - - * - - -**********		
	----- -----			-	CKT BOARD ASSEMBLY INCLUDES:		
-90	131-0604-00			9	..CONTACT,ELEC:CKT BD SW,SPR,CU BE	80009	131-0604-00
-91	136-0263-04			3	..SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PI	22526	75377-001
-92	131-0589-00			10	..TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-93	352-0274-00			1	.HOLDER,TERMINAL:FOR 8 SQUARE PINS	80009	352-0274-00
-94	129-0570-00			1	.POST,ELEC-MECH:0.188 HEX X 0.976"LONG,BRS	80009	129-0570-00
					.**********(ATTACHING PARTS)**********		
-95	211-0008-00			1	.SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
					.**********- - - * - - -**********		
-96	----- -----			1	.SWITCH,PUSH:(SEE S460 REPL)		
-97	361-0411-00			2	.SPACER,PUSH SW:0.13 W X 0.375 INCH L,PLST	71590	J64285-00
-98	384-1417-00			1	.EXTENSION SHAFT:10.275 INCH LONG,PLASTIC	80009	384-1417-00
-99	131-0963-00			2	.CONTACT,ELEC:GROUNDING	000EX	OBD
	263-1166-00			1	.SW,CAM,ACTR AS:TIME/CM	80009	263-1166-00
					.**********(ATTACHING PARTS)**********		
-100	211-0244-00	B010100	B021199	4	.SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
	211-0292-00	B021200		4	.SCR,ASSEM WSHR:4-40 X 0.29,BRS NI PL	78189	OBD
					.**********- - - * - - -**********		
-101	210-0406-00			2	..NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-102	214-1139-03			2	..SPRING,FLAT:RED COLORED	80009	214-1139-03
-103	214-1752-00			2	..ROLLER,DETENT:	80009	214-1752-00
-104	401-0180-00			1	..BEARING,CAM SW:FRONT & REAR	80009	401-0180-00
					**********(ATTACHING PARTS)**********		
-105	354-0390-00			1	..RING,RETAINING:0.338 ID X 0.025" THK,STL	79136	5100-37MD
					**********- - - * - - -**********		
-106	384-0878-08			1	..SHAFT,CAM SW:4.964 L X 0.248 OD OUTER	80009	384-0878-08
-107	105-0755-00			1	..ACTUATOR,CAM SW:TIME/CM,DRUM TYPE	80009	105-0755-00
-108	210-0406-00			4	..NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-109	401-0178-01			1	..BEARING,CAM SW:CENTER/REAR	80009	401-0178-01
-110	351-0180-00			1	.SLIDE,GUIDE:SWITCH ACTUATOR	80009	351-0180-00
-111	131-0593-00			3	.CONTACT,ELEC:1.15 INCH LONG	22526	47354
-112	214-1136-00			1	.ACTUATOR,SL SW:DUAL DPST	80009	214-1136-00
-113	214-1190-00			1	.CPLG,SHAFT,RGD:0.125 OD TO 0.125 OD,AL	80009	214-1190-00
-114	----- -----			1	.RESISTOR,VAR:(SEE R725 AND S725 REPL)		
					.**********(ATTACHING PARTS)**********		
-115	210-0583-00			1	.NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-116	210-0046-00			1	.WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
					.**********- - - * - - -**********		
-117	407-0803-00			1	.BRACKET,ELEC SW:BRASS	80009	407-0803-00
-118	263-0016-01			1	.SWITCH PB ASSY:3 LCH & 1 CANC,7.5MM,5 CON	80009	263-0016-01
-119	343-0495-04			5	.CLIP,SWITCH:FRONT,7.5 MM,4 UNIT	80009	343-0495-04
					.**********(ATTACHING PARTS)**********		
-120	210-3033-00			4	.EYELET,METALLIC:0.59 OD X 0.156 INCH LONG	07707	SE-25
					.**********- - - * - - -**********		
-121	343-0499-04	B010100	B021544	1	.CLIP,SWITCH:REAR,7.5MM X 4 UNIT	80009	343-0499-04
	343-0499-13	B021545		1	.CLIP,SWITCH:7.5MM X 4 UNIT	80009	343-0499-13
					.**********(ATTACHING PARTS)**********		
-122	210-3033-00			4	.EYELET,METALLIC:0.59 OD X 0.156 INCH LONG	07707	SE-25
					.**********- - - * - - -**********		
-123	136-0252-07			4	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-124	352-0196-00			2	.HLDR,ELEK CMPNT:PNL MT 0.531 ID MOLD PLST	80009	352-0196-00
-125	----- -----			1	.CKT BOARD ASSY:INTERFACE(SEE A1 REPL)		
					.**********(ATTACHING PARTS)**********		
-126	211-0008-00			6	.SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
					.**********- - - * - - -**********		

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:		
-127	131-0608-00			26		..TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-128	214-0579-00			6		..TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-129	136-0514-00	B010100	B031764	3		..SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
-130	136-0263-04			15		..SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PI	22526	75377-001
-131	136-0634-00	B010100	B031764	1		..SOCKET,PLUG-IN:20 LEAD DIP,CKT BD MTG	73803	CS9002-20
	136-0752-00	B031765		1		..SKT,PL-IN ELEK:MICROCIRCUIT,20 DIP	09922	DILB20P-108
-132	136-0252-04			113		..SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-133	131-0604-00			25		..CONTACT,ELEC:CKT BD SW,SPR,CU BE	80009	131-0604-00
-134	131-0566-00			5		..BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
-135	131-1003-00			2		..CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-136	220-0547-01			6		NUT,BLOCK:0.38 X 0.26 X 0.282 (2)4-40	000FW	OBD
						**********(ATTACHING PARTS)**********		
-137	211-0105-00			6		SCREW,MACHINE:4-40 X 0.188,100 DEG,FLH ST	83385	OBD
						**********- - - * - - -**********		
-138	426-0505-11			1		FR SECT,PLUG-IN:TOP	80009	426-0505-11
-139	426-0499-11			1		FR SECT,PLUG IN:BOTTOM	80009	426-0499-11
	198-3825-00			1		WIRE SET,ELEC:	80009	198-3825-00
-140	131-0707-00			21		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-141	352-0161-05			1		.CONN BODY,PL,EL:3 WIRE GREEN	80009	352-0161-05
-142	352-0168-00			2		.CONN BODY,PL,EL:10 WIRE BLACK	80009	352-0168-00
-143	175-0826-00			FT		.WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
-144	175-0833-00			FT		.WIRE,ELECTRICAL:10 WIRE RIBBON	08261	SS-1026-7
	198-2478-00			1		WIRE SET,ELEC:	80009	198-2478-00
	131-0707-00			18		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-145	352-0169-00			1		.HLDR,TERM CONN:2 WIRE BLACK	80009	352-0169-00
	352-0161-07			1		.CONN BODY,PL,EL:3 WIRE VIOLET	80009	352-0161-07
-146	352-0162-00			1		.HLDR,TERM CONN:4 WIRE BLACK	80009	352-0162-00
	352-0162-04			1		.CONN BODY,PL,EL:4 WIRE YELLOW	80009	352-0162-04
-147	352-0163-06			1		.CONN BODY,PL,EL:5 WIRE BLUE	80009	352-0163-06
-148	175-0825-00			FT		.WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
	175-0826-00			FT		.WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
-149	175-0827-00			FT		.CABLE,SP,ELEC:4,26 AWG,STRD,PVC JKT,RBN	08261	SS04267(1061)0C
-150	175-0828-00			FT		.WIRE,ELECTRICAL:5 WIRE RIBBON	08261	SS-0526-710610C
-151	198-4156-00			1		WIRE SET,ELEC:	80009	198-4156-00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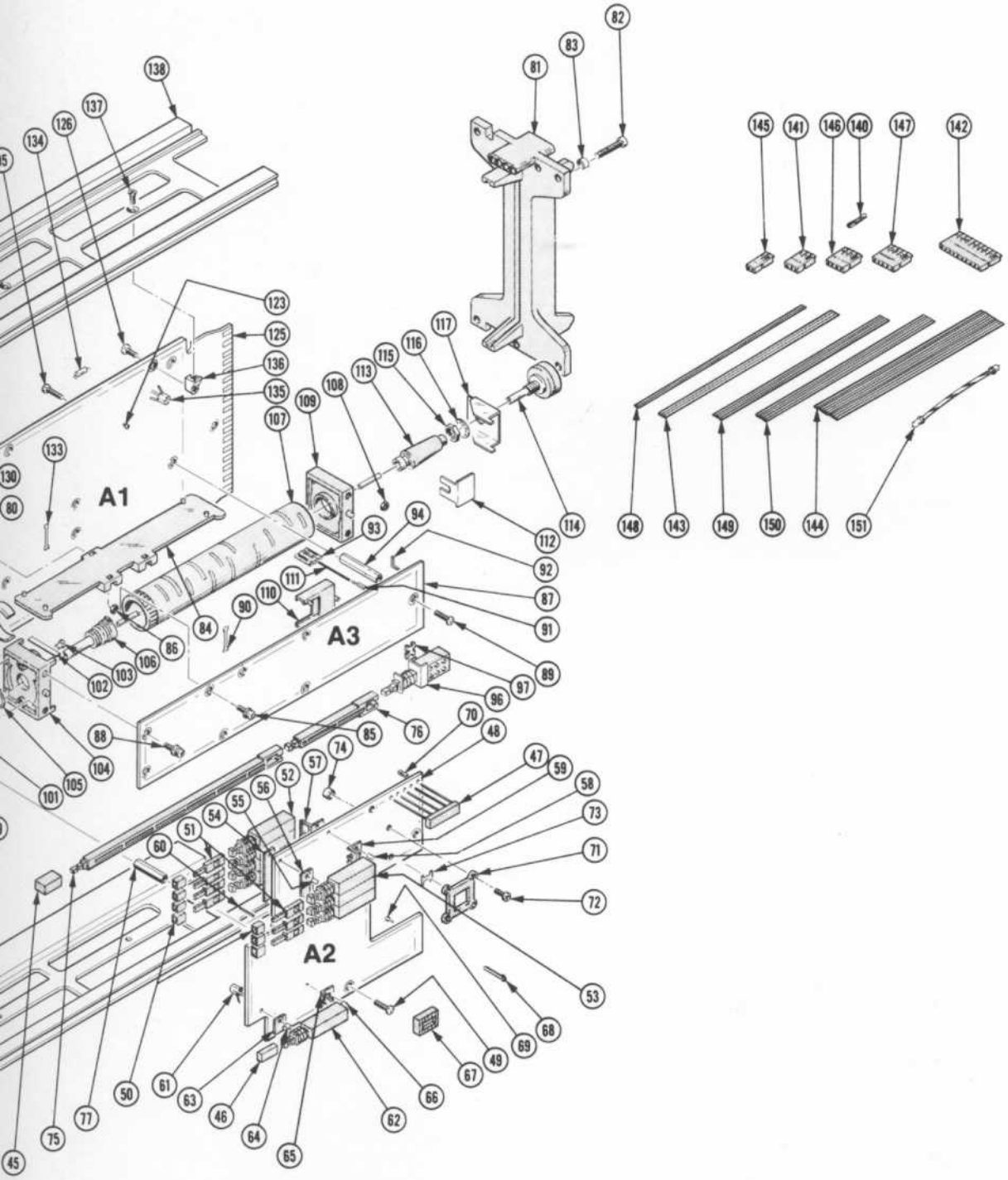

7B10 TIME BASE

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
	070-2317-00			1		MANUAL,TECH:OPERATORS	80009	070-2317-00
	070-2316-00			1		MANUAL,TECH:INSTRUCTION	80009	070-2316-00

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.

Tektronix®
COMMITTED TO EXCELLENCE

MANUAL CHANGE INFORMATION

Date: March 8, 1983 Change Reference: M48213

Product: 7B10, 7B15 Manual Part No.: See Below:

DESCRIPTION

EFF SN: B032140 (7B10) 070-2316-00
B032220 (7B15) 070-2318-00

REPLACEABLE ELECTRICAL PARTS & SCHEMATIC CHANGES

CHANGE TO:

R433	321-0265-00	RES,FXD,FILM:5.62 K OHM,1%,0.125 W

This part is located on the A1-INTERFACE board, and is shown on Diagram 4.