INSTRUCTION MANUAL

Serial Number B054117

7B53N DUAL TIME BASE

Tektronix, Inc. ● P. O. Box 500 ● Beaverton, Oregon 97005 ● Phone 644-0161 ● Cables: Tektronix

070-1125-00

DIGITALY REMASTERED
OUT OF PRINT- MANUAL SCANS

By

Artek Media

18265 200th St.
Welch, MN 55089

www.artekmedia.com

"High resolution scans of obsolete technical manuals"

If your looking for a quality scanned technical manual in PDF format please visit our WEB site at www.artekmedia.com or drop us an email at manuals@artekmedia.com and we will be happy to email you a current list of the manuals we have available.

If you don't see the manual you need on the list drop us a line anyway we may still be able to point you to other sources. If you have an existing manual you would like scanned please write for details. This can often be done very reasonably in consideration for adding your manual to our library.

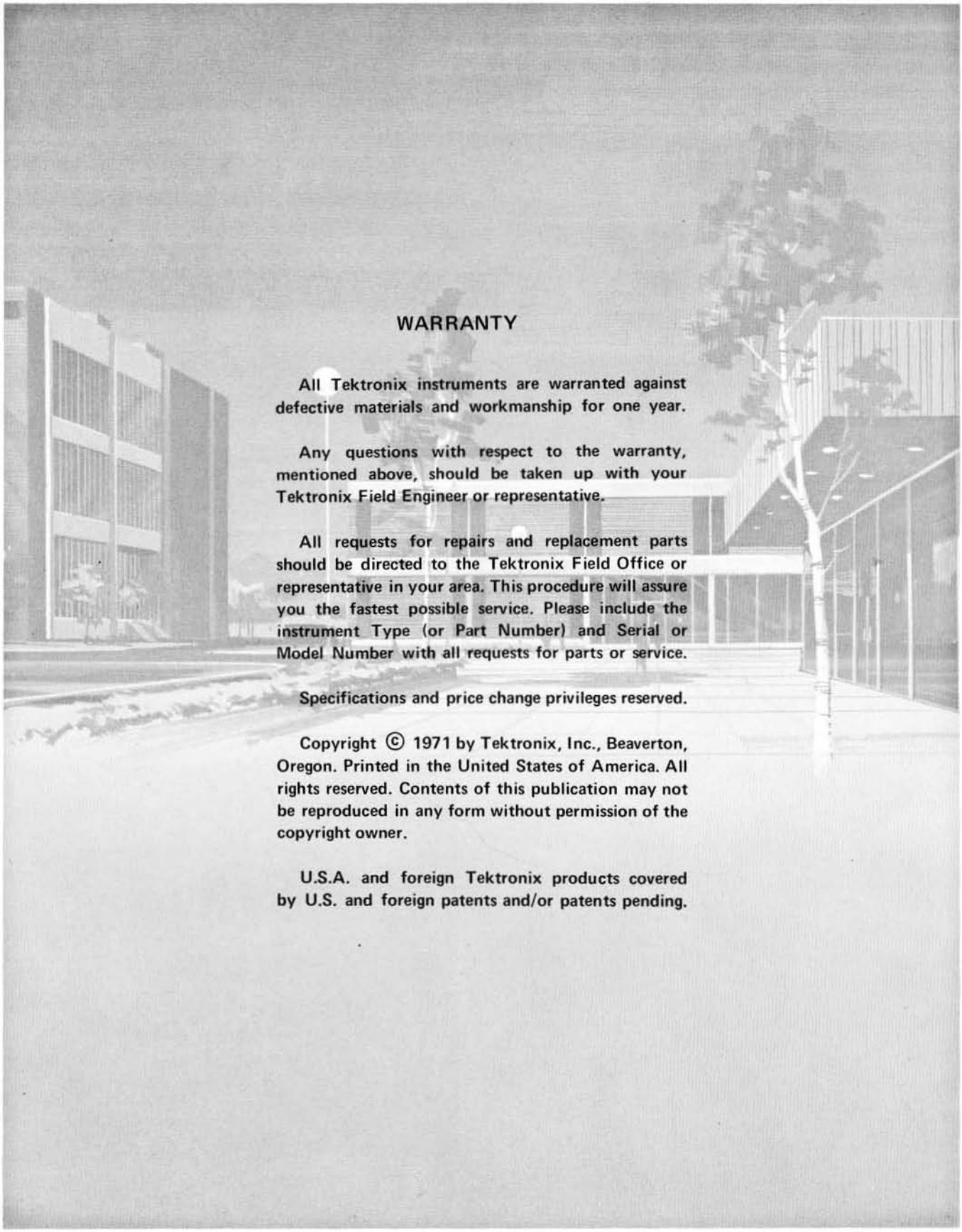
Typically the scans in our manuals are done as follows;

1) Typed text pages are typically scanned in black and white at 300 dpi.
2) Photo pages are typically scanned in gray scale mode at 600 dpi
3) Schematic diagram pages are typically scanned in black and white at 600 dpi unless the original manual had colored high lighting (as is the case for some 70's vintage Tektronix manuals).
4) Most manuals are text searchable
5) All manuals are fully bookmarked

All data is guaranteed for life (yours or mine … which ever is shorter). If for ANY REASON your file becomes corrupted, deleted or lost, Artek Media will replace the file for the price of shipping, or free via FTP download.

Thanks

Dave & Lynn Henderson
Artek Media



WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year.

Any questions with respect to the warranty, mentioned above, should be taken up with your Tektronix Field Engineer or representative.

All requests for repairs and replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type (or Part Number) and Serial or Model Number with all requests for parts or service.

Specifications and price change privileges reserved.

U.S.A. and foreign Tektronix products covered by U.S. and foreign patents and/or patents pending.

TABLE OF CONTENTS

Abbreviations and symbols used in this manual are based on or taken directly from IEEE Standard 260 "Standard Symbols for Units", MIL STD-12B, and other standards of the electronics industry.

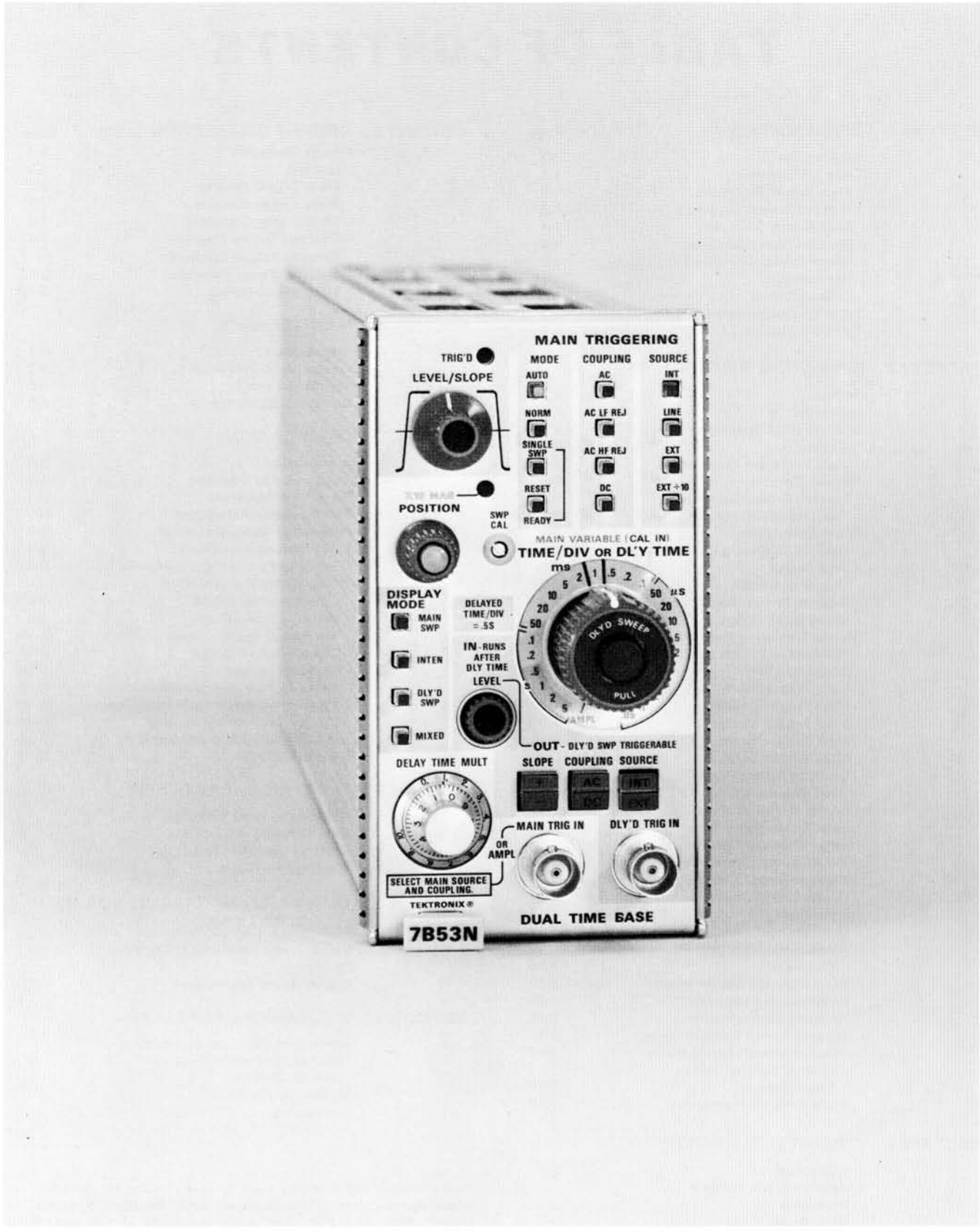


Fig. 1-1. 7B53N Dual Time Base.

SECTION 1
SPECIFICATION

Introduction

The 7B53N is a dual time base unit designed for use in Tektronix 7000-Series Oscilloscopes without a readout system; however it is compatible with all 7000-Series Oscilloscopes. The 7B53N features calibrated sweeps from 5 seconds/division to 50 nanoseconds/division (5 nanoseconds/division with X10 magnification). The Main or Delayed sweep rates may be varied continuously (uncalibrated) between calibrated steps. Sweep triggering is provided to at least 100 megahertz. Separate trigger controls are provided to select the desired triggering for the main and delayed sweeps.

Four display modes are provided. These include separate display of the main sweep, an intensified display, delayed sweep, and mixed sweep. The 7B53N can also be used as an amplifier for X-Y operation.

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

TABLE 1-1

ELECTRICAL

MAIN SWEEP TRIGGERING

Characteristic	Performance Requirement	Supplemental Information
Source	Internal from associated vertical unit. Internal from AC power source. External External divide by ten.	Selected by SOURCE switch.
Coupling	AC AC low-frequency reject. AC high-frequency reject. DC	Selected by COUPLING switch.
Polarity	Sweep can be triggered from positive-going or negative-going portion of trigger signal.	Selected by LEVEL/SLOPE control.
Internal Trigger Sensitivity AC	0.3 division of deflection, minimum, 30 hertz to 10 megahertz; increasing to 1.5 divisions at 100 megahertz.	The specified upper –3 dB frequency of the vertical system supercedes the frequency limits given in the Internal Trigger Sensitivity table when the number in the table is greater than the upper –3 dB frequency of the vertical unit.

TABLE 1-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
AC LF REJ	0.3 division of deflection, minimum, 30 kilohertz to 10 megahertz; increasing to 1.5 divisions at 100 megahertz.	
AC HF REJ	0.3 division of deflection, minimum, 30 hertz to 50 kilohertz.	
DC	0.3 division of deflection, minimum, DC to 10 megahertz; increasing to 1.5 division at 100 megahertz.	
External Trigger Sensitivity		
AC	100 millivolts, minimum, 30 hertz to 10 megahertz; increasing to 500 millivolts at 100 megahertz.	SOURCE switch set to EXT. Triggering signal requirements increased 10 times for EXT ÷10 position.
AC LF REJ	100 millivolts, minimum, 150 kilohertz to 10 megahertz; increasing to 500 millivolts at 100 megahertz.	
AC HF REJ	100 millivolts, minimum, 30 hertz to 50 kilohertz.	
DC	100 millivolts, minimum, DC to 10 megahertz; increasing to 500 millivolts at 100 megahertz.	
Auto Triggering	Stable display presented with signal amplitudes given under Internal and External Trigger Sensitivity above 30 hertz. Presents a free-running sweep for lower frequencies or in absence of a trigger signal.	
Single Sweep	Main Sweep Generator produces only one sweep when triggered. Further sweeps are locked out until RESET button is pressed. Trigger sensitivity same as given for internal and external sensitivity.	
Internal Trigger Jitter	1 nanosecond or less at 75 megahertz.	
External Trigger Input		
Input R and C		Approximately 1 megohm paralleled by 20 pF.
Maximum Safe Input Voltage		500 volts (DC + Peak AC). 500 volts peak-to-peak AC at 1 kilohertz or less.

TABLE 1-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
Level Range		
EXT	At least + and −1.5 volts.	
EXT ÷ 10	At least + and −15 volts.	
DELAYED SWEEP TRIGGERING		
Source	Internal from associated vertical unit External	Selected by Delayed Triggering SOURCE switch.
Coupling	AC DC	Selected by Delayed Triggering COUPLING switch.
Polarity	Sweep can be triggered from positive-going or negative-going portion of trigger signal.	Selected by Delayed Triggering SLOPE switch.
Internal Trigger Sensitivity		
AC	0.3 division of deflection, minimum, 30 hertz to 10 megahertz; increasing to 1.5 divisions at 100 megahertz.	
DC	0.3 division of deflection, minimum, DC to 10 megahertz, increasing to 1.5 divisions at 100 megahertz.	
External Trigger Sensitivity		
AC	100 millivolts, minimum, 30 hertz to 10 megahertz; increasing to 500 millivolts at 100 megahertz.	Delayed Triggering SOURCE switch set to EXT.
DC	100 millivolts, minimum, DC to 10 megahertz; increasing to 500 millivolts at 100 megahertz.	
Internal Trigger Jitter	1 nanosecond or less at 75 megahertz.	
External Trigger Input		
Maximum Safe Input Voltage		500 volts (DC + Peak AC). 500 volts peak-to-peak AC at 1 kilohertz or less.
Input R and C		1 megohm paralleled by 20 picofarads.
Level Range	At least + and −1.5 volts.	

TABLE 1-1 (cont)

MAIN SWEEP GENERATOR

Characteristic	Performance Requirement				Supplemental Information
Sweep Accuracy	Measured in 7400- and 7500-Series Oscilloscopes				
Time Interval	+15°C to +35°C		0°C to +50°C		
Over Center 8 Divisions	Unmagnified	Magnified	Unmagnified	Magnified	
50 milliseconds/division to 0.5 microsecond/division	Within 2%	Within 2.5%	Within 3%	Within 4%	
5 seconds/division to 0.1 second/division and 0.2 microsecond/division to 0.05 microsecond/division	Within 3%	Within 3.5%	Within 4%	Within 5%	
Sweep Linearity Over any 2 division portion within center eight divisions (all sweep rates)	Within 5%		Within 7%		
VARIABLE Sweep Rate Range	Continuously variable between calibrated sweep rates.				Extends sweep rate to at least 12.5 seconds/division. VARIABLE control internally switchable between Main and Delayed Sweeps.
Sweep Hold-Off Time 5 seconds/division to 10 microseconds/division					1.5 times the TIME/DIV setting or less
5 microseconds/division to 0.5 microsecond/division					2.5 microseconds or less
Normal-Mag Registration					Within 0.5 division

DELAYED SWEEP GENERATOR

Sweep Accuracy	Measured in 7400-Series or 7500-Series Oscilloscopes.			
Time Interval	+15°C to +35°C		0°C to 50°C	
Over Center 8 Divisions	Unmagnified	Magnified	Unmagnified	Magnified
50 milliseconds/division to 0.5 microsecond/division	Within 3%	Within 3.5%	Within 4%	Within 5%
0.5 second/division to 0.1 second/division and 0.2 microsecond/division to 0.5 microsecond/division	Within 4%	Within 4.5%	Within 5%	Within 6%

TABLE 1-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
Sweep Linearity Over any 2 division portion within center eight divisions (all sweep rates)	Within 6%	Within 8%
VARIABLE Sweep Rate Range	Continuously variable between calibrated sweep rates.	Extends sweep rate to at least 1.25 seconds/division. VARIABLE control internally switchable between Main and Delayed Sweeps.
Sweep Hold-Off Time		Determined by the Main Sweep TIME/DIV setting.
MIXED SWEEP, VARIABLE TIME DELAY		
Sweep Accuracy	Within 2% ± measured Main Sweep error	Exclude the following portions of Mixed Sweep: First 0.5 division after start of MAIN sweep display and 0.2 division or 1 microsecond (whichever is greater) after transition of MAIN to DLY'D sweep
DELAY TIME MULT Delay Accuracy over center eight divisions 5 seconds/division to 1 second/division	Within 2%	
0.5 second/division to 1 microsecond/division	Within 1%	
Multiplier Linearity	Within 0.2% of full scale (1 minor division)	
Delay Time Jitter	Less than 1 part in 20,000 of the maximum available delay time (10 times the Main Sweep TIME/DIV switch setting).	
AMPLIFIER		
Deflection Factor EXT, MAG X10	10 millivolts/division within 10%.	
EXT, MAG off	100 millivolts/division within 10%.	
EXT ÷ 10, MAG off	1 volt/division within 10%.	

TABLE 1-1 (cont).

Characteristic	Performance Requirement		Supplemental Information
Nominal Frequency Response	System –3 dB points in 7400-Series or 7500-Series Oscilloscope.		
	Lower –3 dB	Upper –3 dB	
AC	40 hertz	2 megahertz	
AC LF REJ	16 kilohertz	2 megahertz	
AC HF REJ	40 hertz	100 kilohertz	
DC	DC	2 megahertz	

OUTPUT SIGNALS

Delayed Sweep Gate		Available at front-panel DLY'D TRIG IN connector when operating in a delayed sweep mode with the Delayed Triggering SOURCE switch set to INT.
Waveshape	Rectangular pulse	
Amplitude	+3.5 volts within 40% with baseline at 0 to –1 volt.	
Polarity	Positive-going	
Duration	For the time of the delayed sweep	
Output Resistance		Approximately 1 kilohm
Loading		At least 10 kilohms shunted by 100 picofarads or less.
Composite Sweep Gate		Coupled to associated indicator oscilloscope by way of pin A1 on Interface circuit board.
Waveshape	Rectangular pulse.	
Polarity	Positive-going	
Duration		
DISPLAY MODE		
MAIN SWP	Coincident with the main sweep interval.	
INTEN	Coincident with the main sweep interval.	
DLY'D SWP	Coincident with the delayed sweep interval.	
MIXED	Coincident with the main sweep interval plus the delayed sweep interval.	

TABLE 1-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
Auxiliary Gate		
Waveshape	Rectangular pulse	Coupled to associated indicator oscilloscope by way of B5 on Interface board.
Polarity	Positive-going	
Duration	Coincident with the delaying sweep (all DISPLAY MODES)	
Composite Sawtooth		Coupled to associated indicator oscilloscope by way of pins A3 and B3 on Interface board
Waveshape		
DISPLAY MODE		
MAIN SWP	Sawtooth signal with slope determined by setting of TIME/DIV OR DL'Y TIME switch.	
INTEN		
DLY'D SWP	Sawtooth signal with slope determined by setting of DELAYED SWEEP Time/Division switch.	
MIXED	Composite sawtooth signal with slope determined by the setting of TIME/DIV OR DL'Y TIME switch during the main sweep portion of display, and by the setting of DELAYED SWEEP Time/Division switch during delayed sweep portion of display.	
Polarity	Negative-going	
Duration		
DISPLAY MODE		
MAIN SWP	Coincident with the main sweep interval	
INTEN		
DLY'D SWP	Ramp duration coincident with the delayed sweep interval; total duration coincident with the delaying sweep interval.	
MIXED	Ramp duration coincident with the main sweep interval plus the delayed sweep interval; total duration coincident with the delaying sweep interval.	

TABLE 1-2

ENVIRONMENTAL CHARACTERISTIC
Refer to the Specification for the associated oscilloscope.

TABLE 1-3

PHYSICAL	
Size	Fits all 7000-series plug-in compartments.
Weight	3.25 pounds. (1.48 kilograms)

SECTION 2
OPERATING INSTRUCTIONS

General

The 7B53N Dual Time Base plug-in Unit operates with a Tektronix 7000-Series indicator oscilloscope and a 7A-Series vertical plug-in unit to form a complete oscilloscope system. To effectively use the 7B53N, its operation and capabilities should be known. This section describes the operation of the front-panel controls, gives simplified operating instructions and general operating information, and lists some basic applications for this instrument.

Installation

The 7B53N is designed to operate in the horizontal plug-in compartment of the indicator oscilloscope. This instrument can also be installed in the vertical plug-in compartment to provide a sweep that runs vertically on the CRT. However, when used in this manner, there are no retrace blanking or internal triggering provisions, and the unit may not meet the specifications given in Section 1. The instructions in this manual are written for use of the 7B53N in the horizontal plug-in compartment.

The 7B53N can be operated in an indicator oscilloscope with four plug-in compartments either independently, in the Alternate or Chopped Horizontal Modes, or as a delayed sweep unit. However, when the 7B53N is operated as a delayed sweep unit, it must be triggered for a CRT display. It cannot delay another time base unit, but it can delay its own internal delayed sweep.

Before proceeding with installation, it is necessary to check the setting of the internal Variable Selector switch on the right side of the instrument (see Fig. 2-1 for location). The Variable Selector switch determines whether the front-panel VARIABLE control operates in conjunction with the main or delayed sweeps (see controls and connectors discussion in this section for VARIABLE control operation).

To install the 7B53N in a plug-in compartment, push it in until it fits firmly into the compartment. The front-panel of the 7B53N should be flush with the front-panel of the indicator oscilloscope. Even though the gain of the indicator oscilloscope is standardized to minimize adjustment when inserting plug-in units, the sweep calibration of the 7B53N should be checked when it is installed. The procedure for checking the unit is given under Sweep Calibration Check in this section.

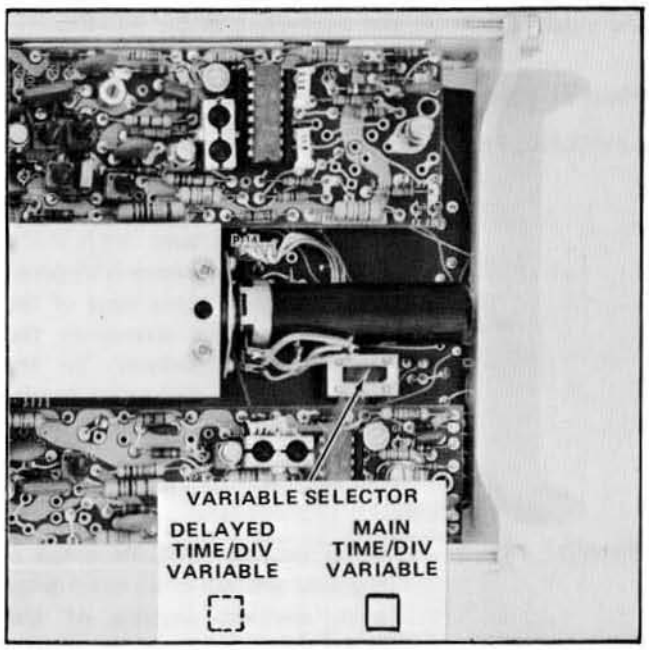


Fig. 2-1. Location of Variable Selector switch.

To remove the 7B53N, pull the release latch (see Fig. 2-2) to disengage the unit from the indicator oscilloscope and pull it out of the plug-in compartment.

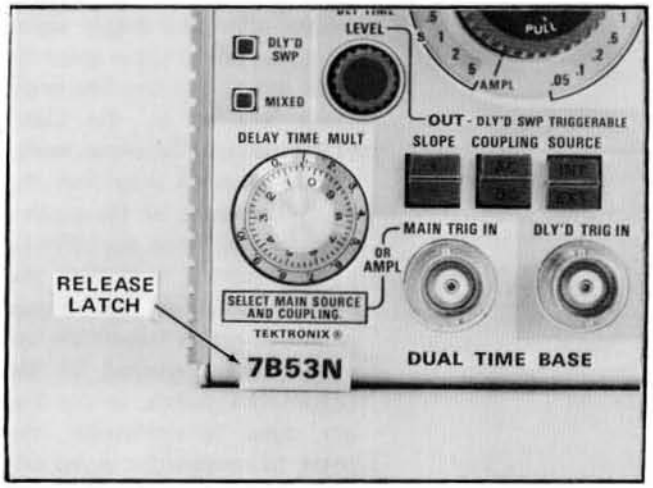


Fig. 2-2. Location of release latch.

CONTROLS AND CONNECTORS

General

To make full use of the capabilities of this instrument, the operator should be familiar with the function and use of each of the controls. A brief description of the controls and connectors is given here. More detailed information is given under General Operating Information. Fig. 2-3 shows the front-panel and external controls and connectors of the 7B53N.

Main Triggering Controls

LEVEL/SLOPE — Selects the amplitude point and slope of trigger signal on which the sweep is triggered. When the indicator line on the outer ring is to the left of center, the sweep is triggered on the positive-going slope of the trigger signal, as shown by the positive-going waveform. To the right of center, the sweep is triggered on the negative-going slope of the trigger signal as shown by the negative-going waveform.

TRIG'D — Lamp indicates that the sweep is triggered and will produce a display with correct setting of the POSITION control and the controls on the associated vertical unit and indicator oscilloscope.

MODE — Four pushbutton switches to select the desired trigger mode.

AUTO: Sweep initiated by the applied trigger signal at point selected by the LEVEL/SLOPE control when the trigger signal repetition rate is above about 30 hertz and within the frequency range selected by the COUPLING switch. Triggered sweep can be obtained only over the amplitude range of the applied trigger signal. When the LEVEL/SLOPE control is outside the amplitude range, 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 sweep rate selected by the TIME/DIV OR DL'Y TIME switch.

NORM: Sweep initiated by the applied trigger signal at point selected by the LEVEL/SLOPE control over the frequency range selected by the COUPLING switch. Triggered sweep can be obtained only over the amplitude range of the applied trigger signal. There is no trace when the LEVEL/SLOPE control is outside the amplitude range, the trigger repetition rate is outside the frequency range selected by the COUPLING switch, or the trigger signal is inadequate.

SINGLE SWP: After a sweep is displayed, further sweeps cannot be presented until the RESET button is pressed. Display is triggered as for NORM operation, using the MAIN TRIGGERING controls.

RESET—READY: Pushbutton to reset the Sweep Generator for the next sweep in the SINGLE SWP mode. The RESET-READY button remains illuminated to indicate that the unit is ready to be triggered. After the unit is triggered and a sweep is completed, the RESET-READY light goes out until the button is pressed again.

COUPLING — Four pushbutton switches to select trigger coupling.

AC: Rejects DC and attenuates AC signals below about 30 hertz. Accepts signals between 30 hertz and 100 megahertz.

AC LF REJ: Rejects DC and attenuates signals below about 30 kilohertz. Accepts signals between 30 kilohertz and 100 megahertz.

AC HF REJ: Accepts signals between about 30 hertz and 50 kilohertz. Rejects DC and attenuates signals from 50 kilohertz to 100 megahertz.

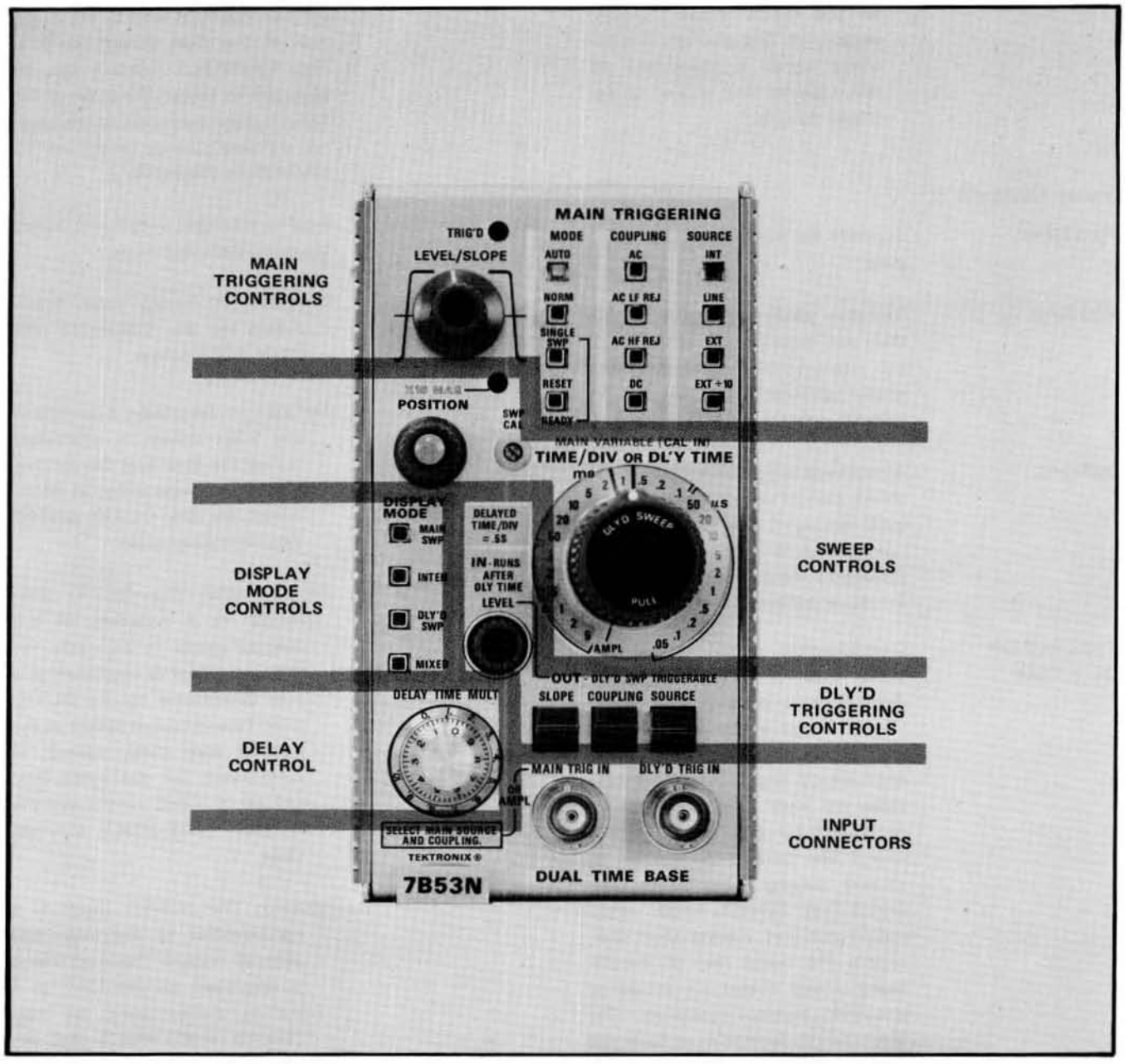


Fig. 2-3. Front-panel controls and connectors.

DC: Accepts all trigger signals from DC to 100 megahertz.

SOURCE — Four pushbutton switches to select the trigger source.

INT: Trigger signal obtained internally from vertical unit by way of associated indicator oscilloscope.

LINE: Trigger signal obtained internally from a sample of the line voltage applied to associated indicator oscilloscope.

EXT: Trigger signal obtained from an external signal applied to the MAIN TRIG IN connector.

EXT ÷10: Trigger signal obtained from an external signal applied

to the MAIN TRIG IN connector. In this position the external signal is attenuated 10 times before it is applied to the trigger circuit.

Sweep Controls

POSITION — Controls the horizontal position of trace.

X10 MAG — Increases sweep rate of both the main and delayed sweeps ten times by horizontally expanding the center division of display. Light indicates when magnifier is on.

SWP CAL — Screwdriver adjustment to set horizontal gain of unit. Used to set the basic timing of the 7B53N and to compensate for differences in CRT deflection factor when changing indicator oscilloscopes.

TIME/DIV OR DL'Y TIME — Combination switch selects the sweep rates for both the main and delayed sweep generators. The clear plastic flange indicates the sweep rate of the main sweep circuit for main sweep display only and indicates the basic delay time (to be multiplied by the DELAY TIME MULT dial setting) for delayed or mixed sweep operation. The DELAYED SWEEP knob, when pulled out and rotated clockwise, selects the sweep rate of the delayed sweep circuit for mixed or delayed sweep operation. The VARIABLE control must be in the CAL position and the X10 MAG switch must be off for indicated sweep rate.

VARIABLE — Two position switch actuated by the VARIABLE knob to select calibrated or uncalibrated sweep rates. In the CAL position (pushed in) the VARIABLE control is inoperative and the sweep rate is calibrated. When pressed and released, the knob moves out to activate the VARIABLE control for uncalibrated sweep rates. The sweep rate in each TIME/DIV switch position can be reduced at least to the sweep rate of the next slower position. The VARIABLE control can be switched to either the main or delayed sweeps by means of the internal Variable Selector switch (see Installation in this section).

DISPLAY MODE — Four pushbutton switches to select the desired display mode.

MAIN SWP: Sweep rates determined by the TIME/DIV OR DL'Y TIME switch.

INTEN: In this mode, a portion of the main sweep is intensified during the time that the delayed sweep is in operation, as determined by the DLY'D SWEEP Time/Division switch.

DLY'D SWP: The DLY'D SWP mode is a function of the delayed sweep. In this mode, the delayed sweep is displayed at a rate determined by the DLY'D SWP Time/Division switch at the end of each delay period, as determined by the TIME/DIV OR DL'Y TIME switch and the DELAY TIME MULT dial settings.

MIXED: The MIXED mode is a combination of the main and delayed sweeps. The main sweep is displayed on the CRT to a point determined by the DELAY TIME MULT dial; the remainder of the sweep is at the rate determined by the delayed sweep.

DELAY TIME MULT — Provides variable delay of 0 to 10 times the basic delay time selected by the TIME/DIV OR DL'Y TIME switch.

Delayed Trigger Controls

LEVEL — Dual function control to determine the mode and level for delayed sweep display.

IN — RUNS AFTER DLY TIME: The delayed sweep runs immediately following the delay time selected by the TIME/DIV OR DL'Y TIME switch and the DELAY TIME MULT dial. Delayed SLOPE, COUPLING, SOURCE, and LEVEL functions inoperative.

OUT—DLY'D SWP TRIGGERABLE: When the LEVEL control is pressed and released the delayed sweep is triggerable. The LEVEL control can now be rotated to select the amplitude point on the trigger signal at which the delayed sweep is triggered. In the OUT—DLY'D SWEEP TRIGGERABLE position the delayed SLOPE, COUPLING, and SOURCE functions are activated.

SLOPE — Two position switch to select the portion of trigger signal which starts the delayed sweep.

+: The delayed sweep can be triggered from positive-going portion of trigger signal.

—: The delayed sweep can be triggered from negative-going portion of trigger signal.

COUPLING — Two position switch to determine the method of coupling delayed trigger signal to the delayed trigger circuit.

AC: Rejects DC and attenuates AC signals below about 30 hertz.

DC: Accepts trigger signals from DC to 100 megahertz.

SOURCE — Two position switch to select source of the delayed trigger. Also determines the function of the DLY'D TRIG IN connector.

INT: The delayed trigger signal is obtained from the vertical amplifier unit by way of the associated indicator oscilloscope. Also connects the Delayed Gate Out signal to the DLY'D TRIG IN connector for external use.

EXT: The delayed trigger signal is obtained from an external signal applied to the DLY'D TRIG IN connector.

Front-Panel Connectors

MAIN TRIG IN — Front-panel BNC connector serving two different input functions, depending upon the setting of the TIME/DIV OR DL'Y TIME switch and the MAIN TRIGGERING SOURCE switch.

MAIN TRIG IN: External trigger input for the Main Triggering circuit. The SOURCE switch for MAIN TRIGGERING must be set to EXT or EXT ÷10 and TIME/DIV OR DL'Y TIME switch set to any position except AMPL.

AMPL: When the TIME/DIV OR DL'Y TIME switch is set to AMPL and the MAIN TRIGGERING SOURCE switch is set to the EXT or EXT ÷10 position, this connector serves as an External Horizontal Input.

DLY'D TRIG IN — Front-panel BNC connector serving two different functions depending upon the setting of the Delayed Triggering SOURCE switch.

DLY'D TRIG IN: When the Delayed Trigger SOURCE switch is set to EXT, this connector serves as an external trigger input for the delayed triggering circuit.

Delayed Gate Output: When the Delayed Trigger SOURCE switch is set to INT the DLY'D TRIG IN connector serves as a Delayed Gate Output. The Delayed Gate signal is a rectangular positive-going pulse with approximately 3.5 volts amplitude and pulse width coincident with the delayed sweep.

Sweep Calibration Check

Whenever the 7B53N is inserted into a plug-in compartment of an indicator oscilloscope other than the one in which it was originally calibrated, the sweep calibration must be checked, and readjusted if necessary. Install the 7B53N into the plug-in compartment of the indicator oscilloscope and allow at least 20 minutes warmup before proceeding with the following:

For accurate sweep timing, apply a signal of known frequency or time period (time-mark signal, calibrator squarewave, 60-hertz line, etc.) to the associated vertical amplifier unit and adjust the TIME/DIV OR DL'Y TIME switch and the SWP CAL control to calibrate that signal to the oscilloscope graticule. The following method, using a Tektronix 2901 Time Mark Generator, is recommended.

1. Connect a 1 millisecond time-mark signal from the time-mark generator through a 50-ohm BNC coaxial cable to the Input of the associated vertical unit.

2. Set the 7B53N TIME/DIV OR DL'Y TIME switch to 1 ms and press the VARIABLE control to the CAL position. Press the MAIN TRIGGERING AUTO, AC, and INT switches.

3. Set the vertical unit for a CRT display amplitude of two to four divisions using DC coupling.

4. Rotate the LEVEL/SLOPE control for a triggered display.

5. Check the CRT display for one marker each major graticule division over center eight divisions.

6. Adjust SWP CAL (front-panel screwdriver adjustment), for one marker each major division. Use the POSITION control as necessary to align the display with the vertical graticule lines.

SIMPLIFIED OPERATING INSTRUCTIONS

The following information is provided to aid in quickly obtaining the correct settings for the 7B53N to present a display. The operator should be familar with the complete function and operation of the unit described in this section before using this procedure.

Main Sweep

The following procedure will provide a stable display for most main sweep applications:

1. Select the MODE, COUPLING, and SOURCE pushbutton of the MAIN TRIGGERING switches which fit the requirements of the signal to be displayed.

2. Press the MAIN SWP pushbutton of the DISPLAY MODE switch.

3. Turn the LEVEL/SLOPE control to the desired slope.

4. If the green TRIG'D light is not on, adjust the LEVEL/SLOPE control throughout the range of the selected SLOPE until the TRIG'D light comes on. If the light does not come on at any setting of the LEVEL/SLOPE control, the trigger signal is not adequate or the COUPLING and SOURCE switches are set incorrectly.

5. Set the TIME/DIV or DL'Y TIME switch and POSITION control for a display which remains on the display area horizontally (VARIABLE control should be in CAL position for calibrated sweep rates).

6. If the display does not start at the correct point on the waveform, readjust the LEVEL/SLOPE control for the desired triggering.

Magnified Display

A magnified-sweep display can be obtained as follows after a normal-sweep display is obtained:

1. Adjust the POSITION control to move the area to be magnified within the center division of the CRT.

2. If necessary, change the TIME/DIV or DELAY TIME switch setting so the complete area to be magnified is within the center graticule division.

3. Press and release the X10 MAG switch. Light indicates when magnifier is on (the indicator oscilloscope Intensity may need to be increased to view magnified display).

4. Use the POSITION control to establish precise positioning of the magnified display.

Delayed Sweep Display

The following procedure is recommended for use of INTEN and DLY'D SWP DISPLAY MODES. Obtain a display as previously given under Main Sweep, then proceed as follows:

1. Press the X10 MAG switch in (off) and press the Delayed Triggering LEVEL control to the IN-RUNS AFTER DLY TIME position.

2. Press the INTEN pushbutton of the DISPLAY MODE switch. Pull out the DLY'D SWEEP Time/Division switch and rotate clockwise to obtain the amount of magnification desired. Note that a normal sweep (Main Sweep) with an intensified portion (Delayed Sweep) is displayed on the CRT. The indicator oscilloscope Intensity may have to be decreased to view the intensified display.

3. Rotate the DELAY TIME MULT dial and note that the intensified portion of the display is controlled by the DELAY TIME MULT.

4. Press the DLY'D SWP button of the DISPLAY MODE switch. Note the magnified display, as determined by the DLY'D SWEEP Time/Division switch. The Intensity may need to be increased to see the delayed sweep display.

5. For a delayed sweep with less jitter, press in and release the Delayed Triggering LEVEL control. Delayed triggering SLOPE, COUPLING, and SOURCE switches should be set to +, AC, and INT respectively. Rotate the Delayed Triggering LEVEL control for a stable delayed sweep display.

Mixed Sweep Display

The procedure that follows can be used for basic mixed sweep operation. Obtain a display as previously given under Main sweep. Then proceed as follows:

1. Press the MIXED pushbutton of the DISPLAY MODE switch and press and Delayed Triggering LEVEL control to the IN—RUNS AFTER DLY TIME position.

2. Pull out the DLY'D SWEEP Time/Division switch and turn clockwise to set the sweep rate for the delayed portion of display.

3. Adjust DELAY TIME MULT dial to vary the point at which the display switches from the Main to Delayed sweep rate.

4. If less jitter is desired for the delayed sweep portion of the mixed sweep display, press in and release the Delayed Triggering LEVEL control. Delayed Triggering SLOPE, COUPLING, and SOURCE switches should be set to +, AC, and INT respectively. Rotate the Delayed Triggering LEVEL control to trigger the delayed sweep portion of display.

GENERAL OPERATING INSTRUCTIONS

Pushbutton Switch Logic

The MODE, COUPLING, and SOURCE pushbuttons of the MAIN TRIGGERING switches and the DISPLAY MODE pushbuttons are arranged in a sequence which places the most-often used position at the top of each series of pushbuttons. With this arrangement, a stable display can usually be obtained by pressing the top pushbuttons: AUTO, AC, INT, and MAIN SWP. When an adequate trigger signal is applied, the unit is triggered as indicated by the illuminated TRIG'D light, with the correct setting of the LEVEL/SLOPE control. If the TRIG'D light is not on, the LEVEL/SLOPE control is at a setting outside the range of the trigger signal applied to this unit from the vertical unit; the trigger signal 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 pushbuttons pushed in, other selections must be made. Refer to the following discussions or the instruction manuals for the associated indicator oscilloscope and vertical unit for more information.

Triggered Light

The TRIG'D light provides a convenient indication of the condition of the triggering circuits. If the MAIN TRIGGERING controls are correctly set and an adequate trigger signal is applied, the TRIG'D light is on. Under certain conditions, the TRIG'D light may be off, indicating that the sweep is not triggered. The cause might be a misadjusted LEVEL/SLOPE control, incorrectly set COUPLING or SOURCE switches, low trigger signal amplitude, or a trigger signal repetition rate outside the acceptable frequency range. This light can be used as a general indication of correct triggering. It is particularly useful when setting up the trigger circuits when a trigger signal is available without a display on the CRT.

Main Trigger Mode

The pushbuttons located under the MODE title select the mode in which the main sweep is triggered.

AUTO. When the AUTO pushbutton is pressed, a triggered display is presented with the correct setting of the LEVEL/SLOPE control (see Trigger Level discussion) whenever an adequate trigger signal is applied. The TRIG'D light indicates when the display is triggered.

When the trigger repetition rate is below about 30 hertz (or outside the frequency range selected by the COUPLING switch) or when the trigger signal is inadequate, the sweep free runs at the sweep rate indicated by the TIME/DIV or DELAY TIME switch (TRIG'D light off). When an adequate trigger signal is again applied, the free-running con-

dition ends and a triggered display is presented. When the LEVEL/SLOPE control is at a setting outside the amplitude range of the trigger signal, the sweep also free runs at the sweep rate indicated by the TIME/DIV or DELAY TIME switch. This type of free-running display can be useful when it is desired to measure only the maximum peak-to-peak amplitude of a signal without observing the waveshape (such as in bandwidth measurements). When the display is of a much greater amplitude than can be displayed on the CRT, the sweep will be triggered in all positions of the LEVEL/SLOPE control and will not free-run.

NORM. When the NORM pushbutton is pressed, a triggered display is presented with the correct setting of the LEVEL/SLOPE control whenever an adequate trigger signal is applied. The TRIG'D light indicates when the display is triggered.

The NORM trigger mode must be used to produce triggered displays with trigger repetition rates below about 30 hertz. When the LEVEL/SLOPE control is at a setting outside the amplitude range of the trigger signal, when the trigger repeitition rate is outside the frequency range selected by the COUPLING switch, or when the trigger signal is inadequate, there is no trace (TRIG'D light is off).

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. A stable display can often be obtained under these circumstances 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 MAIN TRIGGERING switches, press the SINGLE SWP pushbutton. When ready to view the single-sweep display, press the RESET-READY pushbutton. A single trace is presented each time the RESET-READY pushbutton is pressed (as long as the repetitive signal remains connected to the system and MAIN TRIGGERING switches are correctly set); further sweeps cannot be presented until the RESET-READY pushbutton is pressed again. If the displayed signal is a complex waveform composed of pulses of varying amplitude, successive single-sweep displays may not start at the same point of the waveform. To avoid confusion due to the CRT persistence, allow the display to disappear before pressing the RESET-READY pushbutton 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 using a viewing hood as recommended in the indicator oscilloscope instruction manual.

Non-repetitive, random signals can be displayed in the single-sweep mode by first obtaining the best possible display in the NORM MODE with a signal which is about the same amplitude and frequency as the random signal. Then without changing the other MAIN TRIGGERING controls, press the SINGLE-SWP pushbutton. When ready for the random signal, press the RESET-READY pushbutton. The RESET-READY pushbutton remains illuminated to indicate that the unit has been reset and is ready to produce a sweep. The light goes out after the single sweep has been displayed. To prepare the unit for another single-sweep display, press the RESET-READY pushbutton.

When using the single-sweep mode to photograph waveforms, the graticule must 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 RESET-READY pushbutton 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 random signal triggers the unit (RESET-READY pushbutton illuminated). Further information on photographic technique is given in the appropriate camera instruction manual.

RESET-READY. The RESET-READY pushbutton resets the main sweep generator for the next sweep when operating in the SINGLE SWP MODE. See the preceeding Single Sweep discussion for more information.

Main Trigger Coupling

The MAIN TRIGGERING pushbuttons located below the COUPLING title select the method in which the trigger signal is connected to the trigger circuits. Each position permits selection or rejection of the frequency components of the trigger signal which trigger the sweep. Fig. 2-4 graphically illustrates the band of frequencies covered by each position of the COUPLING switch.

AC. In the AC position of the COUPLING switch, the DC component of the trigger signal is blocked. 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 remaining COUPLING switch positions will provide a better display.

The triggering point in the AC position of the COUPLING switch depends upon the average voltage level of the trigger signal. If the trigger signal occurs randomly, the average voltage level will vary, causing the triggering point to vary also. This shift of the triggering point may be enough so it is impossible to maintain a stable display. In such cases, use DC coupling.

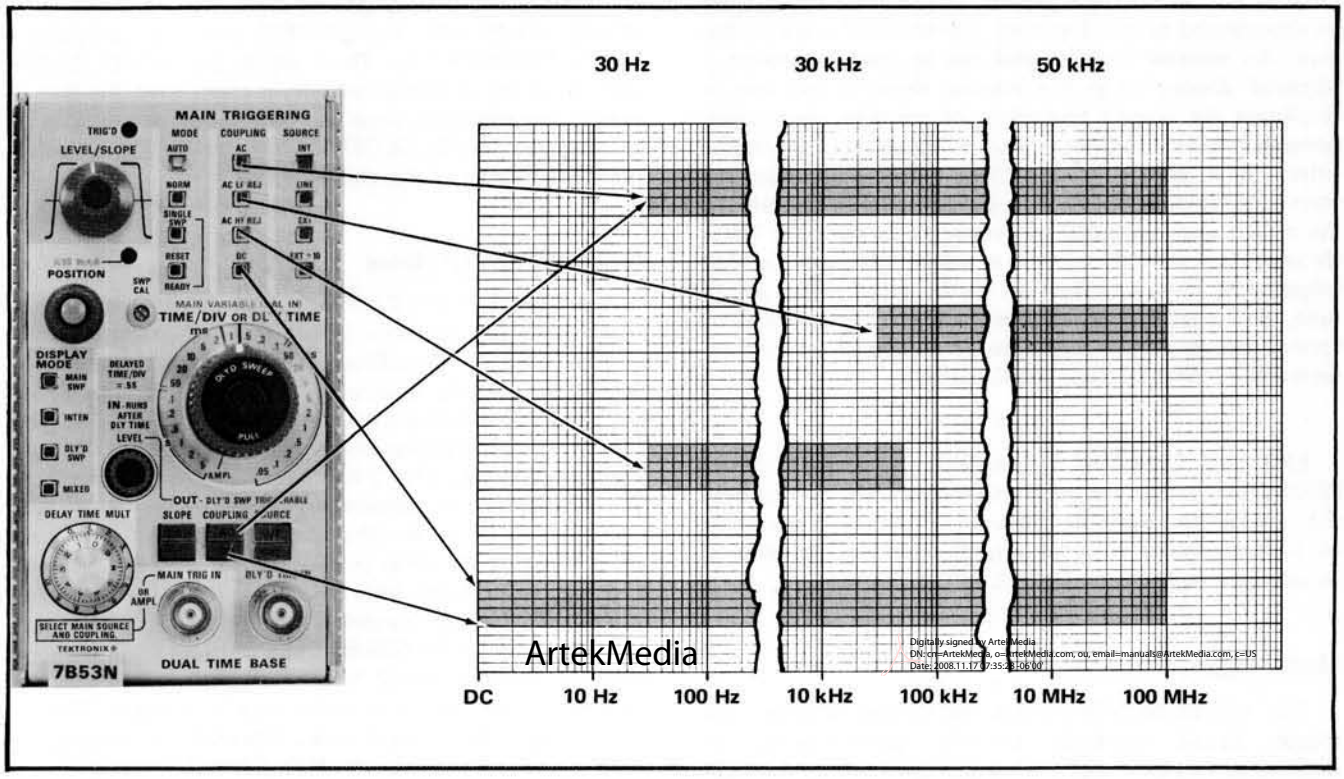


Fig. 2-4. Frequency range of each COUPLING switch position.

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

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

DC. The DC position of the COUPLING switch can be used to provide stable triggering with low-frequency signals which would be attenuated in the other modes, or with low-repetition rate signals. It can also be used to trigger the sweep when the trigger signal reaches a DC level selected by the setting of the LEVEL/SLOPE control. When using internal triggering, the setting of the vertical unit position controls affects the DC triggering point.

Main Trigger Source

The MAIN TRIGGERING pushbuttons located below the SOURCE title select the source of the trigger signal which is connected to the main trigger circuits.

INT. In the INT position of the SOURCE switch, the trigger signal is derived from the associated vertical unit. Further selection of the internal trigger signal may be provided by the associated vertical unit or indicator oscilloscope; see the instruction manuals for these instruments for information. For most applications, the INT position of the SOURCE switch can be used. However, some applications require special triggering which cannot be obtained in the INT position of the SOURCE switch. In such cases LINE or EXT positions of the SOURCE switch must be used.

LINE. The LINE position of the SOURCE switch connects a sample of the power-line voltage from the indicator oscilloscope 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.

EXT. An external signal connected to the MAIN TRIG IN connector can be used to trigger the sweep in the EXT

position of the SOURCE switch. 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 too low in amplitude for correct triggering, or contains signal components on which it is not desired to trigger. 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 under test 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 MAIN TRIGGERING controls.

EXT ÷10. Operation in the EXT ÷10 position of the SOURCE switch is the same as described for EXT except that the external signal is attenuated 10 times. Attenuation of high-amplitude external trigger signals is desirable to broaden the range of the LEVEL/SLOPE control.

Main Trigger Slope

The LEVEL/SLOPE control determines whether the trigger circuit responds on the positive-going or negative-going portion of the trigger signal. When the indicator line on the outer ring of the LEVEL/SLOPE control is to the left of center, the dispaly starts on the positive-going portion of the waveform (notice positive-going waveform to left of control). To the right of center, the display starts on the negative-going portion of the waveform (notice negative-going waveform). Fig. 2-5 illustrates the operation of the LEVEL/SLOPE control at different levels and slopes of the displayed waveform. When several cycles of a signal appear in the display, the selection of the trigger slope is often unimportant. However, if only a certain portion of a cycle is to be displayed, correct setting of the LEVEL/SLOPE control is important to provide a display which starts on the desired slope of the input-signal.

Main Trigger Level

In addition to selecting the trigger slope, the LEVEL/SLOPE control determines the voltage level on the trigger signal at which the display is triggered. The horizontal lines marked on the waveforms to the left and right of the LEVEL/SLOPE control represent the zero-volt level of the triggering signal. When the LEVEL/SLOPE control is set to the line on either the positive-going or negative-going waveform, the sweep is triggered near the zero-volt level of the trigger signal. As the LEVEL/SLOPE control is rotated away from this line, the displayed waveform starts at a point corresponding to the position of the indicator line on the associated slope waveform. For example, if the LEVEL/SLOPE control is turned clockwise from the line on the positive-going slope, the displayed waveform starts at a more positive level.

Before setting the triggering level, the desired SLOPE, MODE, COUPLING, and SOURCE should be selected for MAIN TRIGGERING. Then adjust the LEVEL/SLOPE control so the displayed waveform starts from the desired point. The triggering slope can be changed at any time by rotating the LEVEL/SLOPE control to the corresponding point on the other slope waveform.

Selecting Sweep Rates

The TIME/DIV OR DL'Y TIME switch selects calibrated sweep rates for the Main Sweep Generator, and the DELAYED SWEEP Time/Division switch selects calibrated sweep rates for the Delayed Sweep Generator. The sweep rate of the Main Sweep Generator is bracketed by the black lines on the clear plastic flange of the TIME/DIV OR DL'Y TIME switch (see Fig. 2-6). Sweep rate of the Delayed Sweep Generator is indicated by the white line on the DELAYED SWEEP knob. When the white line on the outer knob is set to the same position as the lines on the inner knob, the two knobs lock together and the sweep rate of both generators is changed at the same time. However, when the DELAYED SWEEP Time/Division knob is pulled outward, the clear plastic flange is disengaged and only the Delayed Sweep Generator sweep rate is changed. This allows changing the delayed sweep rate without changing the delay time determined by the Main Sweep Generator.

A VARIABLE control is provided concentric with the TIME/DIV OR DELAY TIME and DELAYED SWEEP Time/Division switches. This control can be used either with the main or delayed sweep generator. The internal Variable Selector switch (see Fig. 2-1 for location) determines which sweep generator the VARIABLE control operates with. The VARIABLE control also incorporates a two position switch to determine if the applicable sweep rate is calibrated or uncalibrated. When the VARIABLE knob is pressed in, it is inoperative. However, when pressed and released, the VARIABLE control is activated for uncalibrated sweep rates. The sweep rate can be returned to the calibrated position by pressing the VARIABLE control. This feature is useful when a specific uncalibrated sweep rate has been obtained and it is desired to switch between calibrated and uncalibrated sweep rates. Switching from uncalibrated to calibrated and vice-versa does not affect the setting of the VARIABLE control. The VARIABLE control allows the sweep rate in each Time/Division switch position to be reduced to at least the next adjacent switch position.

Time Measurement

When making time measurements from the graticule, the center eight graticule divisions provide the most linear time measurements (see Fig. 2-7). Position the start of the timing area to the second vertical line and adjust the TIME/DIV OR DL'Y TIME switch so the end of the timing area falls between the second and tenth vertical lines.

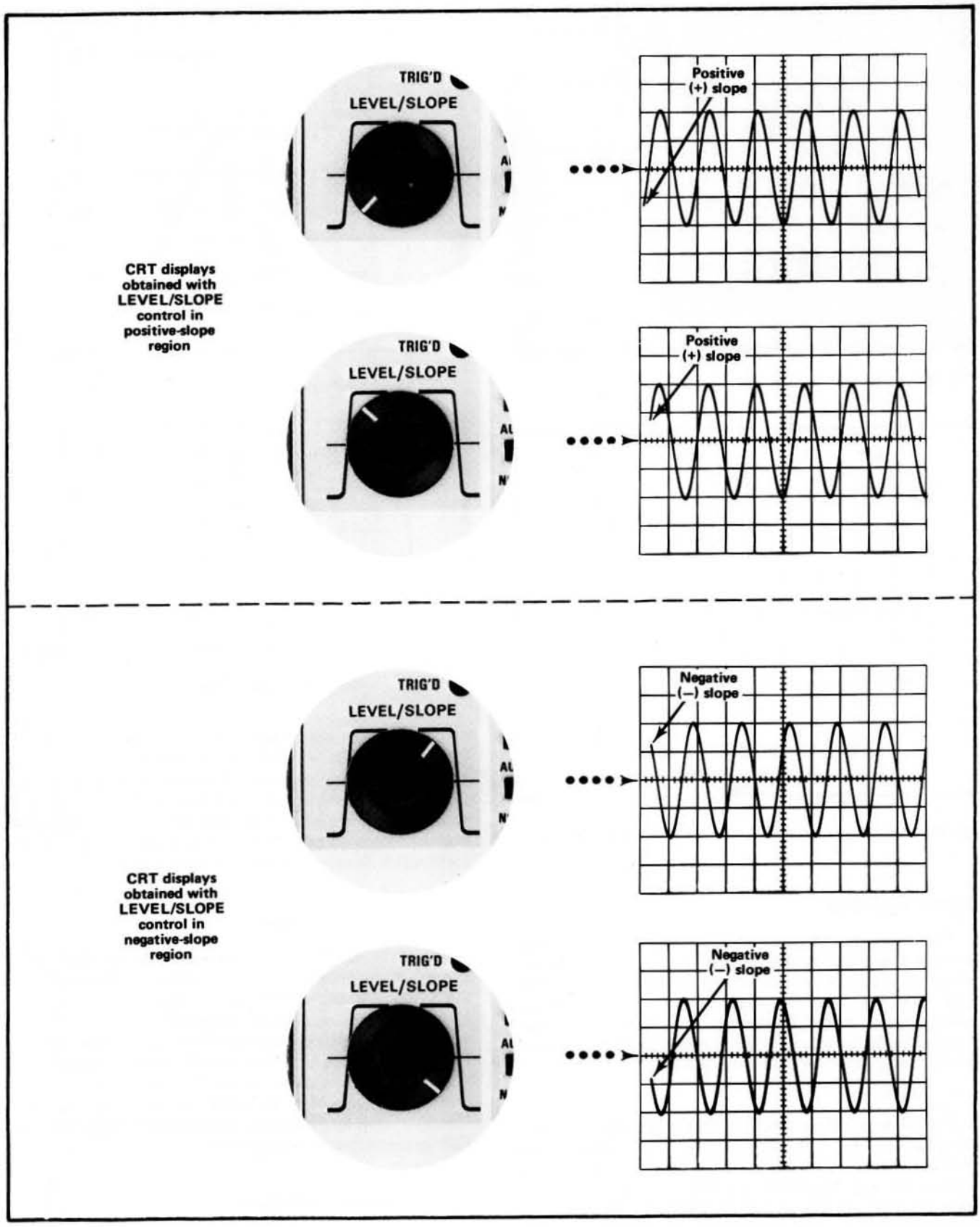


Fig. 2-5. Effect of LEVEL/SLOPE control on CRT display (AUTO or NORM MODE).

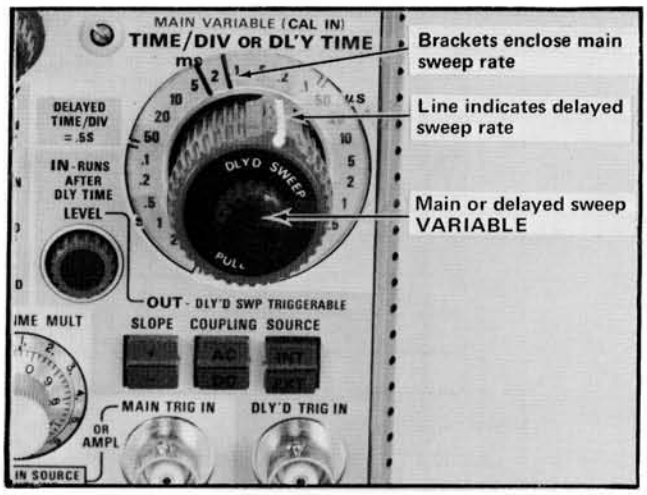


Fig. 2-6. Main and delayed time/division switch.

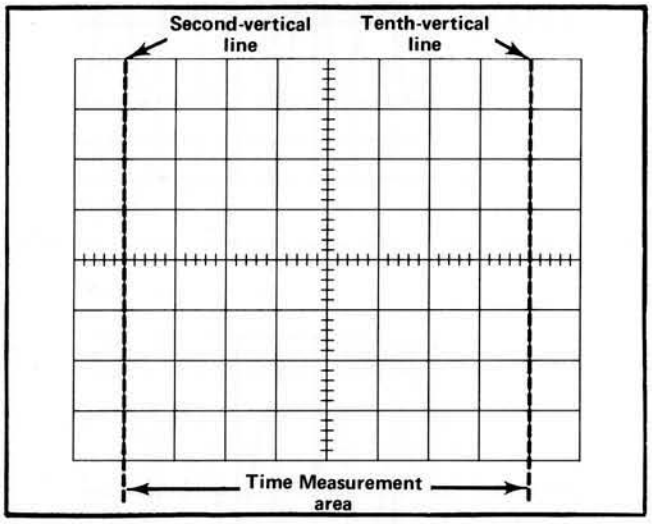


Fig. 2-7. Area of graticule used for accurate time measurements.

Sweep Magnifier

The sweep magnifier can be used to expand each sweep rate ten times. The center division of the unmagnified display is the portion visible on the CRT in the magnified form (see Fig. 2-8). Equivalent length of the magnified sweep is more than 100 divisions; any 10 division portion can be viewed by adjusting the POSITION control to bring the desired portion onto the viewing area.

To use sweep magnification, first move the portion of the display which is to be expanded to the center of the graticule. Then press and release the X10 MAG pushbutton (concentric with POSITION control); the X10 MAG lamp indicates that the sweep rate is magnified. Whenever the X10 MAG indicator is illuminated, the equivalent magnified sweep rate can be determined by dividing the TIME/DIV

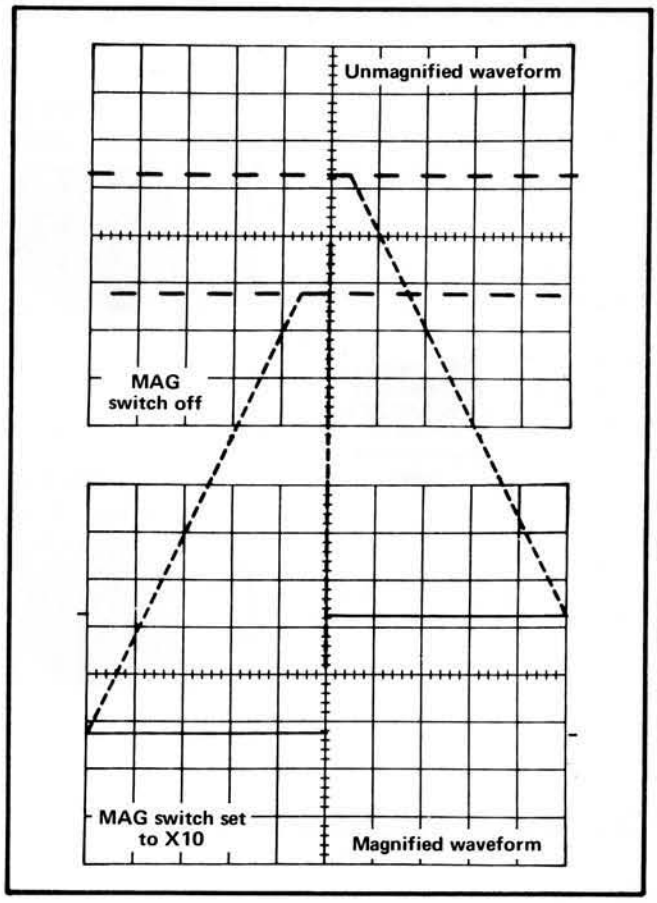


Fig. 2-8. Operation of Sweep Magnifier.

OR DL'Y TIME switch setting by 10. For example, if the TIME/DIV OR DL'Y TIME switch is set to .5 µs, the equivalent magnified sweep rate is 5 nanoseconds/division. The equivalent magnified sweep rate must be used for all time measurements when the X10 MAG indicator is illuminated. The equivalent magnified sweep rate is calibrated when the VARIABLE control is in the calibrated position.

Main Sweep Operation

For main sweep displays, press the MAIN SWP pushbutton of the DISPLAY MODE switch. In this mode the TIME/DIV OR DL'Y TIME switch selects the sweep rate for the main sweep circuit. Calibrated sweep rates from 5 seconds to 50 nanoseconds/division are provided by the TIME/DIV OR DL'Y TIME switch (5 nanoseconds with X10 magnification). By using the VARIABLE control (internal Variable Selector switch must be in the Main Time/Div Variable position) uncalibrated sweep rates to 12.5 seconds/division are available.

Delayed Sweep Operation

The delayed sweep is operable in the INTEN, DLY'D SWP, and MIXED positions of the DISPLAY MODE switch.

Calibrated delayed sweep rates, as determined by the DLY'D SWEEP Time/Division switch, are available from 0.5 seconds to 50 nanoseconds/division (5 nanoseconds/division with X10 magnification). Uncalibrated delayed sweep rates to 1.25 seconds/division can be obtained by using the VARIABLE control (internal Variable Selector switch must be in the Delayed Time/Div Variable position).

The INTEN position of the DISPLAY MODE switch provides an intensified portion on the main sweep during the time that the delayed sweep is in operation. The amount of delay time between the start of the main sweep and the intensified portion is determined by the TIME/DIV OR DL'Y TIME switch and the DELAY TIME MULT dial.

When the DLY'D SWP pushbutton is pressed, the intensified portion, as viewed when the DISPLAY MODE switch is in the INTEN position, is displayed on the CRT at the sweep rate indicated by the DLY'D SWEEP Time/Division switch (see Fig. 2-9).

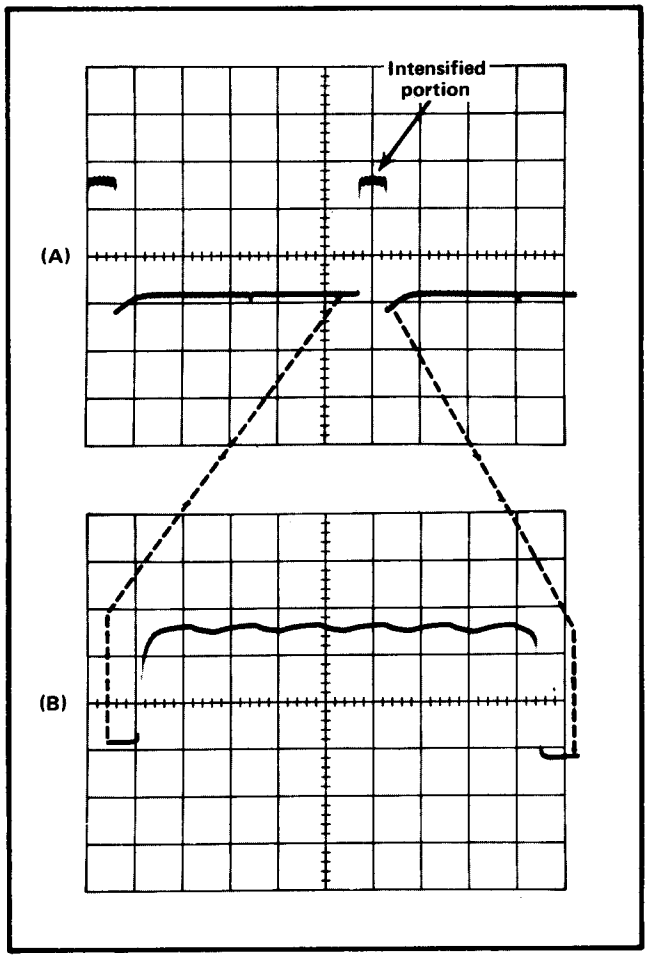


Fig. 2-9. (A) INTEN mode display (DL'Y TIME/DIV, .5 ms; DLY'D SWEEP Time/Division, 50 μs), (B) Delayed Sweep display.

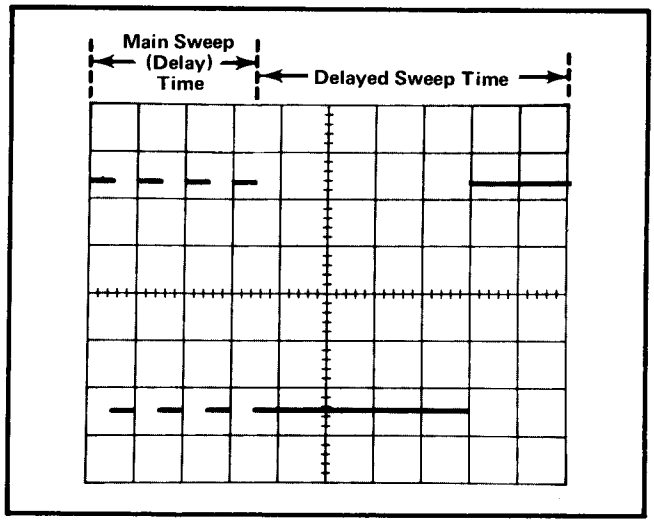


Fig. 2-10. A typical mixed sweep display (TIME/DIV OR DL'Y TIME set to 1 ms, DELAYED SWEEP Time/Division set to .1 ms, and DELAY TIME MULT dial set to 3.55).

Mixed Sweep Operation

The display in the MIXED position of the DISPLAY MODE switch is a function of both the main and delayed sweeps. In this mode, the main sweep is displayed at the rate determined by the TIME/DIV OR DL'Y TIME switch followed by the delayed sweep at a rate determined by the DLY'D SWEEP Time/Division switch. The amount of display allocated to each sweep is determined by the setting of the DELAY TIME MULT dial. A typical mixed sweep display is shown in Fig. 2-10.

Delayed Sweep Triggering

A LEVEL control and SLOPE, COUPLING, and SOURCE switches are provided for delayed sweep triggering. When the LEVEL control is pressed to the IN — RUNS AFTER DLY TIME position the delayed sweep starts immediately after the delay time. The delayed sweep LEVEL control and the SLOPE, COUPLING, and SOURCE switches are inoperative. This mode permits the selection of continuously variable delay times (by varying the DELAY TIME MULT dial).

When the Delayed Triggering LEVEL control is pressed in and released to the OUT — DLY'D SWP TRIGGERABLE position, the delayed sweep does not start at the completion of the delay time. Instead, it waits until a trigger pulse is received by the delayed sweep triggering circuit. The delay time in this mode is dependent not only on the settings of the delay-time controls, but on the delayed sweep triggering controls and the occurrence of the delayed sweep triggering signal as well. The primary purpose of this mode is to eliminate jitter from the displayed delayed-sweep waveform. Since the delayed sweep is triggered by

the input waveform, jitter is eliminated from the delayed sweep display even though it maybe inherent in the input waveform.

In the DLY'D SWP TRIGGERABLE mode (LEVEL control in OUT position) the Delayed Sweep Triggering LEVEL control and SLOPE, COUPLING, and SOURCE switches are activated. The Delayed Sweep Triggering LEVEL control determines the voltage level on the trigger signal at which the delayed sweep is triggered. The SLOPE pushbutton determines whether the delayed trigger circuit responds on the positive-going or negative-going portion of the trigger signal. The selected SLOPE is indicated by the illuminated portion of the pushbutton. COUPLING and SOURCE lights are also provided for delayed triggering. The positions, as marked on the pushbuttons, have the same functions for delayed triggering as the identically marked COUPLING and SOURCE switches for MAIN TRIGGERING (see Main Triggering Coupling and Source discussions given in this section). The selected Delayed Triggering COUPLING and SOURCE positions are indicated by illuminated portions of the pushbuttons.

Delayed Gate Output

When the Delayed Triggering SOURCE switch is set to INT, the DLY'D TRIG IN connector serves as a Delayed Gate Output. The Delayed Gate Output is a positive-going rectangular pulse with approximately 3.5 volts amplitude. The pulse width is coincident with the time that the delayed sweep runs. Therefore, conditions for a triggered delayed sweep, as described under Delayed Sweep Triggering in this section, must be met for a Delayed Gate Output.

APPLICATIONS

General

The following information describes the procedure and techniques for making basic measurements with a 7B53N installed in a 7000-Series Oscilloscope. These applications are not described in detail, since each application must be adapted to the requirements of the individual measurement. This instrument can also be used for many applications not described in this manual. Contact your local Tektronix Field Office or representative for assistance in making specific measurements. Also, the following books describe oscilloscope measurement techniques which can be adapted for use with this instrument:

Harley Carter, "An Introduction to the Cathode Ray Oscilloscope", Philips Technical Library, Cleaver-Hume Press Ltd., London, 1960.

J. Czech, "Oscilloscope Measuring Technique", Philips Technical Library, Springer-Verlag, New York, 1965.

Robert G. Middleton and L. Donald Payne, "Using the Oscilloscope in Industrial Electronics", Howard W. Sams & Co. Inc., The Bobbs-Merill Company Inc., Indianapolis, 1961.

John F. Rider and Seymour D. Uslan, "Encylopedia of Cathode-Ray Oscilloscopes and Their Uses", John F. Rider Inc., New York, 1959.

John F. Rider, "Obtaining and Interpreting Test Scope Traces", John F. Rider Publisher Inc., New York, 1959.

Rufus P. Turner, "Practical Oscilloscope Handbook", Volumes 1 and 2, John F. Rider Publisher Inc., New York, 1964.

Comparison Measurement Techniques

Sweep Rates To establish an arbitrary horizontal sweep rate based upon a specific reference frequency, proceed as follows:

1. Connect the reference signal to the input of the vertical unit. Set the Volts/Division switch of the vertical unit for four or five divisions of vertical deflection.

2. Set the TIME/DIV OR DL'Y TIME switch and the VARIABLE control so one cycle of the signal covers an exact number of horizontal divisions. Do not change the VARIABLE control after obtaining the desired deflection. This display can be used as a reference for frequency comparison measurements.

3. To establish an arbitrary sweep rate so the period (time for one complete cycle) of an unkown signal can be measured accurately at any setting of the TIME/DIV OR DL'Y TIME switch, the period of the reference signal must be known. If it is not known, it can be measured before the VARIABLE switch is set in step 2.

4. Divide the period of the reference signal (seconds) by the product of the horizontal deflection established in step 2 (divisions) and the setting of the TIME/DIV OR DL'Y TIME switch. This is the horizontal conversion factor:

$$\text{Horizontal Conversion Factor} = \frac{\text{reference signal period (seconds)}}{\text{horizontal deflection (divisions)} \times \text{TIME/DIV OR DL'Y TIME switch setting}}$$

5. To measure the period of an unknown signal, disconnect the reference signal and connect the unknown signal to

the vertical unit. Set the TIME/DIV OR DL'Y TIME switch to a setting that provides sufficient horizontal deflection to make an accurate measurement. Do not readjust the VARIABLE control.

6. Measure the horizontal deflection in divisions and calculate the period of the unknown signal using the following formula:

$$\text{Period (Seconds)} = \text{TIME/DIV OR DLY' TIME switching} \times \text{horizontal conversion factor} \times \text{horizontal deflection (divisions)}$$

NOTE

If the horizontal magnifier is used, be sure to use the magnified sweep rate in place of the TIME/DIV DL'Y TIME switch setting.

Example. Assume a reference signal frequency of 455 hertz (period 2.19 milliseconds), a TIME/DIV OR DL'Y TIME switch setting of .2 ms, and the VARIABLE control adjusted to provide a horizontal deflection of eight divisions. Substituting these values in the horizontal conversion factor formula (step 4):

$$\text{Horizontal Conversion Factor} = \frac{2.19 \text{ milliseconds}}{.2 \text{ ms} \times 8} = 1.37$$

Then, with a TIME/DIV OR DL'Y TIME switch setting of 50 μs, the period of an unknown signal which completes one cycle in seven horizontal divisions can be determined by using the period formula (step 6):

$$\text{Period (Seconds)} = 50\ \mu s \times 1.37 \times 7 = 480\ \mu s$$

This answer can be converted to frequency by taking the reciprocal of the period in seconds (see application on Determining Frequency Measurements).

Time Duration Measurements

To measure time between two points on a waveform, use the following procedure:

1. Connect the signal to be displayed to the input of the vertical unit.

2. Set the Vertical and Horizontal Mode switches on the indicator oscilloscope to display the plug-in units used.

3. Set the Volts/Division switch of the vertical unit to display about four divisions of waveform.

4. Set the MAIN TRIGGERING controls to obtain a stable display.

5. Set the TIME/DIV OR DL'Y TIME switch to the fastest sweep rate that displays less than eight divisions between the time measurement points (see topic entitled Time Measurements and Fig. 2-7).

6. Adjust the vertical unit position control to move the points between which the time measurement is made to the center horizontal line.

7. Adjust the horizontal POSITION control to position the time-measurement points within the center eight divisions of the graticule.

8. Measure the horizontal distance between the time measurement points. Be sure the VARIABLE control is set to CAL.

9. Multiply the distance measured in step 8 by the setting of the TIME/DIV OR DL'Y TIME switch. If sweep magnification is used, divide this answer by 10.

Example. Assume that the distance between the time measurement points is five divisions (see Fig. 2-11), and the TIME/DIV OR DL'Y TIME switch is set to .1 ms.

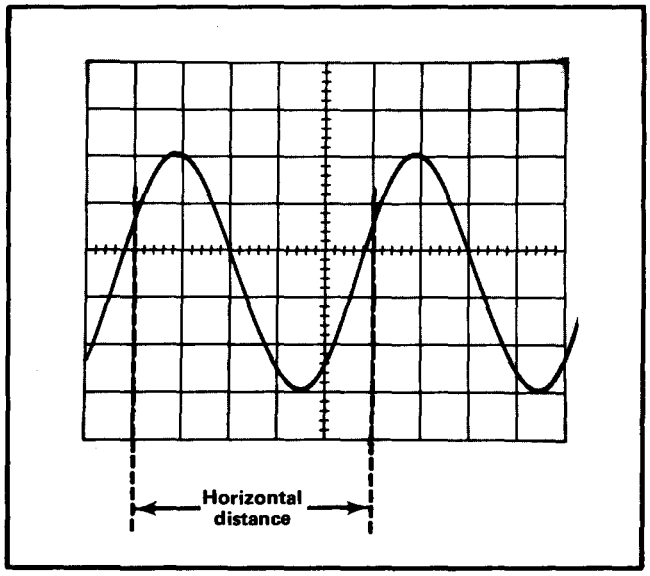


Fig. 2-11. Measuring the time duration between points on a waveform.

Using the formula:

$$\text{Time Duration} = \frac{\text{horizontal distance (divisions)} \times \text{TIME/DIV OR DL'Y TIME setting}}{\text{magnification}}$$

Substituting the given values:

$$\text{Time Duration} = \frac{5 \times 0.1 \text{ ms}}{1}$$

The time duration is 0.5 millisecond.

Determining Frequency

The time measurement technique can also be used to determine the frequency of a signal. The frequency of a periodically recurrent signal is the reciprocal of the time duration (period) of one complete cycle.

Use the following procedure:

1. Measure the time duration of one complete cycle of the waveform as described in the previous application.

2. Take the reciprocal of the time duration to determine the frequency.

Example. The frequency of the signal shown in Fig. 2-11 which has a time period of 0.5 millisecond is:

$$\text{Frequency} = \frac{1}{\text{time period}} \quad \frac{1}{0.5 \text{ millisecond}} = 2 \text{ kilohertz}$$

Risetime Measurements

Risetime measurements employ basically the same techniques as time-duration measurements. The main difference is the points between which the measurement is made. The following procedure gives the basic method of measuring risetime between the 10% and 90% points of the waveform. Falltime can be measured in the same manner on the trailing edge of the waveform.

1. Connect the signal to be displayed to the input of the vertical unit.

2. Set the Vertical and Horizontal Mode switches on the indicator oscilloscope to display the plug-in unit used.

3. Set the Volts/Division switch and the Variable Volts/Division control of the vertical unit to produce a signal an exact number of divisions in amplitude.

4. Center the display about the center horizontal line with the vertical unit Position control.

5. Set the MAIN TRIGGERING controls to obtain a stable display.

6. Set the TIME/DIV OR DL'Y TIME switch to the fastest sweep rate that displays less than eight divisions between the 10% and 90% points on the waveform.

7. Determine the 10% and 90% points on the rising portion of the waveform. The figures given in Table 2-1 are for the points 10% up from the start of the rising portion and 10% down from the top of the rising portion (90% point).

TABLE 2-1

Risetime Measurements

Vertical display (divisions)	10% and 90% points	Divisions vertically between 10% and 90% points
4	0.4 and 3.6 divisions	3.2
5	0.5 and 4.5 divisions	4.0
6	0.6 and 5.4 divisions	4.8
7	0.7 and 5.4 divisions	5.6
8	0.8 and 7.2 divisions	6.4

8. Adjust the horizontal POSITION control to move the 10% point of the waveform to the second vertical line of the graticule. For example, with a five-division display as shown in Fig. 2-12, the 10% point is 0.5 division up from the start of the rising portion.

9. Measure the horizontal distance between the 10% and 90% points. Be sure the VARIABLE control is set to CAL.

10. Multiply the distance measured in step 9 by the setting of the TIME/DIV OR DL'Y TIME switch. If sweep magnification is used, divide this answer by 10.

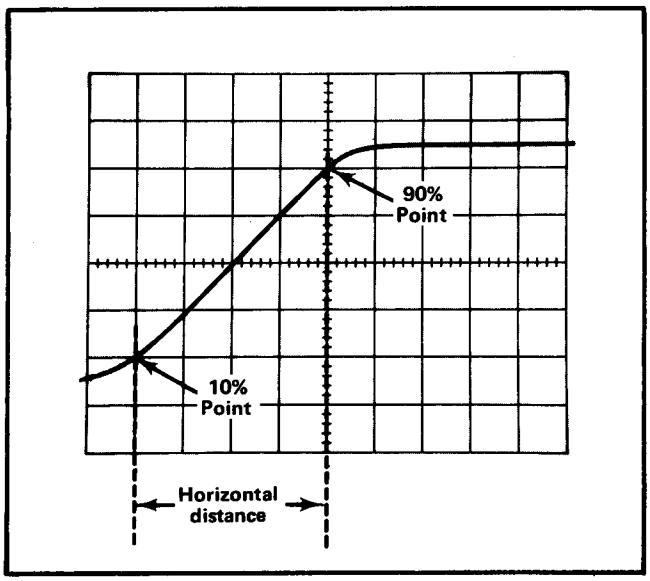


Fig. 2-12. Measuring risetime.

Example. Assume that the horizontal distance between the 10% and 90% points is four divisions (see Fig. 2-12) and the TIME/DIV OR DL'Y TIME switch is set to 1 μs with the MAG switch set to X10. Applying the time duration formula to risetime:

$$\text{Time Duration (Risetime)} = \frac{\text{horizontal distance (divisions)} \times \text{TIME/DIV OR DL'Y TIME setting}}{\text{magnification}}$$

Substitute the given values:

$$\text{Risetime} = \frac{4 \times 1 \text{ microsecond}}{10}$$

The risetime is 0.4 microsecond.

Delayed Sweep Measurements

The delayed sweep mode can be used to make accurate time measurements. The following measurement determines the time difference between two pulses displayed on the same trace. This application may also be used to measure time difference from two different sources (dual-trace) or to measure time duration of a single pulse. See Section 1 for measurement accuracy.

1. Connect the signal to be displayed to the input of the vertical unit.

2. Set the vertical and horizontal Mode switches on the indicator oscilloscope to display the plug-in units used.

3. Set the Volts/Division switch of the vertical unit to produce a display about 4 divisions in amplitude.

4. Adjust the MAIN TRIGGERING controls for a stable display.

5. If possible, set the TIME/DIV OR DL'Y TIME switch to a sweep rate which displays about eight divisions between pulses.

6. Press the INTEN pushbutton of the DISPLAY MODE switch and press the Delayed Triggering LEVEL control to the IN - RUNS AFTER DL'Y TIME position.

7. Set the DLY'D SWEEP Time/Division switch to a setting 1/100 of the TIME/DIV OR DL'Y TIME sweep rate. This produces an intensified portion approximately 0.1 division in length.

NOTE

Measurement accuracy will be affected if the LEVEL control setting for MAIN TRIGGERING or the horizontal POSITION control setting is changed.

8. Rotate the DELAY TIME MULT dial to move the intensified portion of the trace to the first pulse.

9. Press the DLY'D SWP pushbutton of the DISPLAY MODE switch.

10. Adjust the DELAY TIME MULT dial to move the pulse (or the rising portion) to the center vertical graticule line. Note the exact setting of the dials.

11. Turn the DELAY TIME MULT dial clockwise until the second pulse is positioned to the same point as the first pulse. (If several pulses are displayed, return to the INTEN position of the DISPLAY MODE switch to locate the correct pulse). Again note the exact dial setting.

12. Subtract the first dial setting from the second and multiply by the delay time shown by the TIME/DIV OR DL'Y TIME switch. This figure is the time interval between pulses.

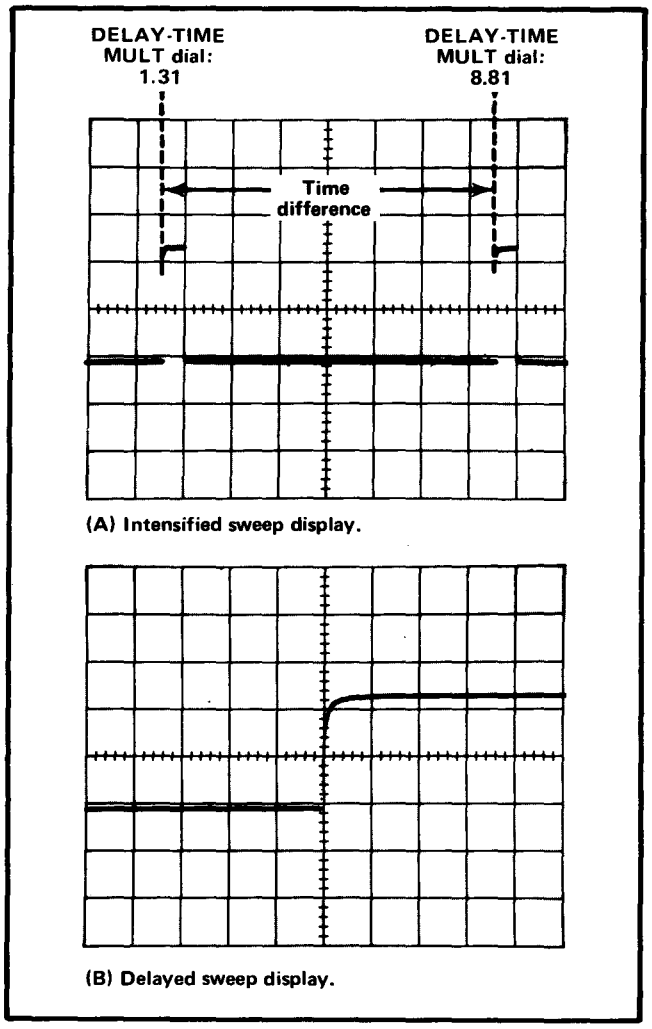
Example. Assume the first dial setting is 1.31 and the second dial setting is 8.81 with the TIME/DIV OR DL'Y TIME switch set to 0.2 microsecond (see Fig. 2-13).

$$\text{Time Difference (Delayed Sweep)} = (\text{second dial setting} - \text{first dial setting}) \times \text{delay time (TIME/DIV OR DL'Y TIME switch setting)}$$

Substituting the given values:

$$\text{Time Difference} = (8.81 - 1.31) \times 0.2\ \mu s$$

The time difference is 1.5 μs



(A) Intensified sweep display.

(B) Delayed sweep display.

Fig. 2-13. Measuring time difference using delayed sweep.

Delayed Sweep Magnification

The delayed sweep feature of the 7B53N can be used to provide higher apparent magnification than is provided by the MAG switch. The sweep rate of the delayed sweep is not actually increased; the apparent magnification is the result of delaying the Delayed Sweep an amount of time selected by the TIME/DIV OR DL'Y TIME switch and the DELAY TIME MULT dial before the display is presented at the sweep rate selected by the DLY'D SWEEP Time/Division switch. The following method uses the IN–RUNS AFTER DL'Y TIME Delayed Trigger Mode to allow the delayed portion of the display to be positioned with the DELAY TIME MULT dial. If there is too much jitter in the delayed sweep display, use the Triggered Delayed Sweep Magnification procedure which follows this procedure.

1. Connect the signal to be displayed to the input connector of the vertical unit. Set the Vertical and Horizontal Mode switches on the indicator oscilloscope to display the plug-in units used.

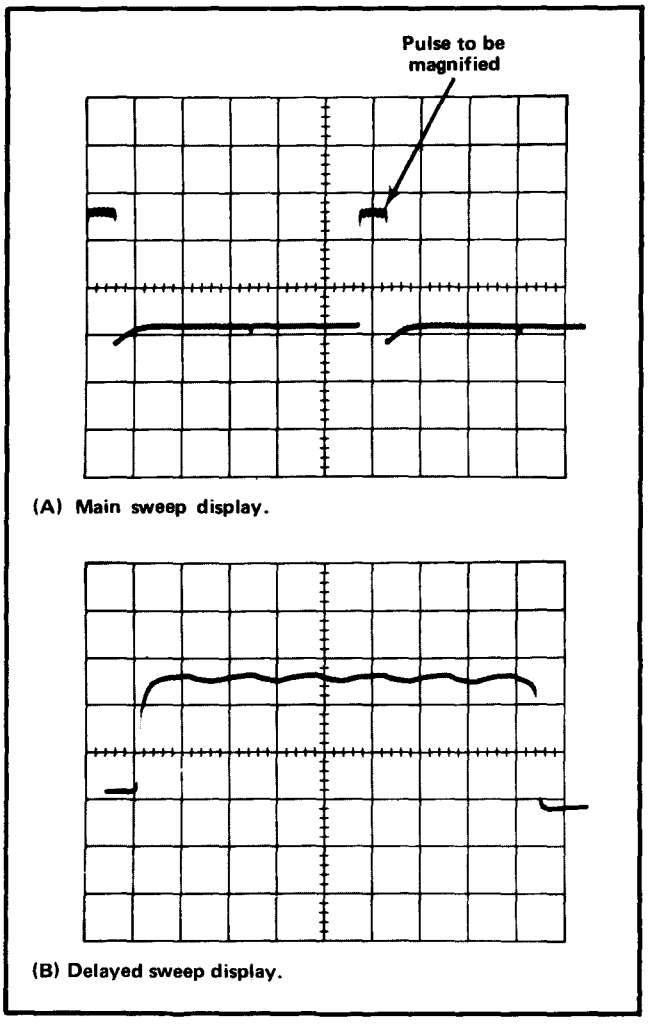
2. Set the Volts/Division switch of the vertical unit to produce a display about 4 divisions in amplitude.

3. Adjust the MAIN TRIGGERING controls for a stable display.

4. Set the TIME/DIV OR DL'Y TIME switch to a sweep rate which displays the complete waveform (see Fig. 2-14A).

5. Press the INTEN pushbutton of the DISPLAY MODE switch and press the Delayed Trigger LEVEL control to IN-RUNS AFTER DL'Y TIME.

6. Position the start of the intensified portion with the DELAY TIME MULT dial to the part of the display to be magnified.



(A) Main sweep display.

(B) Delayed sweep display.

Fig. 2-14. Using delayed sweep for magnification.

7. Set the DLY'D SWEEP Time/Division switch to a setting which intensifies the full portion of the display to be magnified. The start of the intensified trace will remain as positioned in Step 6.

8. Press the DISPLAY MODE switch to DLY'D sweep.

9. Time measurements can be made from the display in the conventional manner. Sweep rate is determined by setting of the DLY'D SWEEP Time/Division switch.

10. The apparent sweep magnification can be calculated by dividing the TIME/DIV OR DL'Y TIME switch setting by the DLY'D SWEEP Time/Division switch setting.

Example. The apparent magnification of the display shown in Fig. 2-14 with a TIME/DIV OR DL'Y TIME setting of .1 ms and a DLY'D SWEEP Time/Division switch setting of 1 microsecond is:

$$\text{Apparent Magnification} = \frac{\text{TIME/DIV OR DL'Y TIME setting}}{\text{DLY'D SWEEP Time/Division setting}}$$

Substituting the given values:

$$\text{Apparent Magnification} = \frac{1 \times 10^{-4}}{1 \times 10^{-6}}$$

The apparent magnification is 100 times.

Triggered Delayed Sweep Magnification

The delayed sweep magnification method just described may produce too much jitter at high apparent magnification ranges. The OUT—DLY'D SWP TRIGGERABLE mode provides a more stable display, since the delayed sweep display is triggered at the same point each time.

1. Set up the display as given in steps 1 through 7 in the Delayed Sweep Magnification procedure.

2. Press in and release the Delayed Triggering LEVEL control to the OUT—DLY'D SWP TRIGGERABLE position. Select the desired Delayed Triggering SLOPE, COUPLING, and SOURCE.

3. Adjust the Delayed Triggering LEVEL control to produce an intensified portion on the display.

4. Inability to produce an intensified zone on the display indicates that the Delayed Triggering controls are incorrectly set, or that the signal does not meet triggering requirements. If the condition cannot be remedied with the Delayed Triggering controls or by increasing the display amplitude (lower Volts/Division setting), externally trigger the delayed sweep.

5. When the correct portion of the display is intensified, set the DISPLAY MODE switch to DLY'D SWP. Slight readjustment of the Delayed Triggering LEVEL control may be necessary to produce a stable display.

6. Measurement and magnification are as described above in Delayed Sweep Magnification discussion.

Displaying Complex Signals Using Delayed Sweep

Complex signals often consist of a number of individual events of differing amplitudes. Since the trigger circuits are sensitive to changes in signal amplitude, a stable display can normally be obtained only when the sweep is triggered by the event(s) having the greatest amplitude. However, this may not produce the desired display of a lower-amplitude portion which follows the triggering event. The delayed sweep feature provides a means of delaying the start of the delayed sweep by a selected amount following the event which triggers the Main Sweep Generator. Then, the part of the waveform which contains the information of interest can be displayed at the delayed sweep rate.

Use the following procedure:

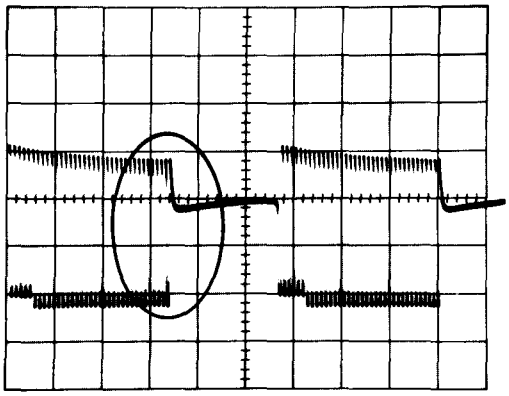
1. Set up the display as given in Steps 1 through 8 of Delayed Sweep Magnification.

2. Time measurements can be made from the display in the conventional manner. Sweep rate is determined by the setting of the DLY'D SWEEP Time/Division switch.

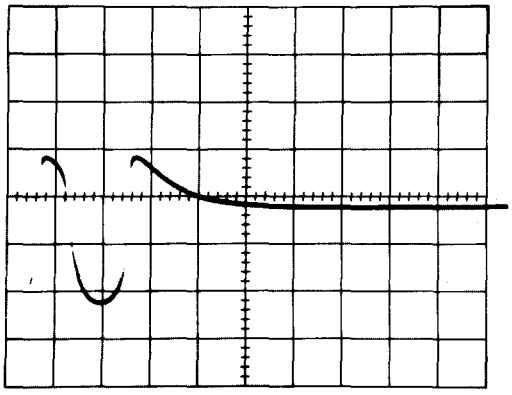
Example: Fig. 2-15 shows a complex waveform as displayed on the CRT. The circled portion of the waveform cannot be viewed in any greater detail because the sweep is triggered by the larger amplitude pulses at the start of the display and a faster sweep rate moves this area of the waveform off the viewing area. The second waveform shows the area of interest magnified 10 times using Delayed Sweep. The DELAY TIME MULT dial has been adjusted so the delayed sweep starts just before the area of interst.

Pulse Jitter Measurements

In some applications it is necessary to measure the amount of jitter on the leading edge of a pulse or jitter between pulses.



(A) This portion of display cannot be viewed adequately because the main sweep is triggered on larger amplitude signals at the start of display.



(B) Area of interest displayed by delaying the main sweep (DLY'D SWP mode).

Fig. 2-15. Displaying a complex signal using delayed sweep.

1. Connect the signal to be displayed to the input connector of the vertical unit. Set the Vertical and Horizontal Mode switches on the indicator oscilloscope to display the plug-in units used.

2. Set the Volts/Division switch of the vertical unit to produce a display about 4 divisions in amplitude.

3. Adjust the MAIN TRIGGERING controls for a stable display.

4. Set the TIME/DIV OR DL'Y TIME switch to a sweep rate which displays the complete waveform (see Fig. 2-14A).

5. Press the INTEN pushbutton of the DISPLAY MODE switch. Press and release the Delayed Triggering LEVEL control to OUT—DLY'D SWP TRIGGERABLE, and adjust the LEVEL control for a stable intensified display.

6. Position the start of the intensified portion with the DELAY TIME MULT dial to the part of the display to be magnified.

7. Set the DLY'D SWEEP Time/Division switch to a setting which intensifies the full portion of the display to be magnified. The start of the intensified trace will remain as positioned in Step 6.

8. Press the DISPLAY MODE switch to DLY'D SWP.

9. Slight readjustment of the Delayed Triggering LEVEL control may be necessary to produce as stable display as possible.

10. Pulse jitter is shown by horizontal movement on the pulse (take into account inherent jitter of Delayed Sweep). Measure the amount of horizontal movement. Be sure that both vertical and horizontal VARIABLE controls are set to CAL.

11. Multiply the distance measured in Step 10 by the DLY'D SWEEP Time/Div switch setting to obtain pulse jitter in time.

Example. Assume that the horizontal movement is 0.5 division (see Fig. 2-16) and the DLY'D SWEEP Time/Division switch is .5 microsecond.

Using the formula:

$$\text{Pulse Jitter} = \begin{matrix}\text{horizontal}\\ \text{jitter}\\ \text{(division)}\end{matrix} \times \begin{matrix}\text{DLY'D SWEEP}\\ \text{Time/Division}\\ \text{setting}\end{matrix}$$

Substituting the given values: Pulse Jitter = 0.5 X 0.5 microsecond

The pulse jitter is 0.25 microsecond.

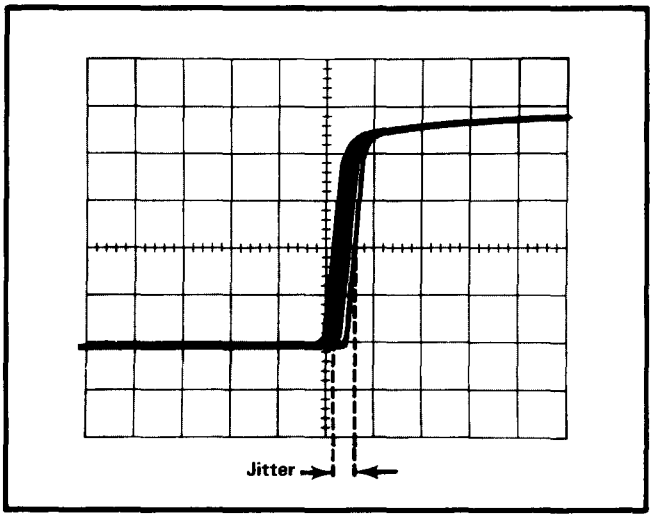


Fig. 2-16. Measuring pulse jitter.

SECTION 3
CIRCUIT DESCRIPTION

Introduction

This section of the manual contains a description of the circuitry used in the 7B53N Dual Time Base. The description begins with a discussion of the major circuit functions using a simplified block diagram.

SIMPLIFIED BLOCK DIAGRAM

The Simplified Block Diagram, Fig. 3-1, shows interconnection of the basic circuit blocks in the 7B53N. In some cases, such as the Main Sweep Trigger, the block includes a number of separate circuits. The individual circuits are discussed in detail later in this section.

Main Sweep Mode

When the DISPLAY MODE switch is set to select MAIN SWP, operation is as follows:

Main Sweep Trigger. This block includes circuitry for selecting the trigger source, type of coupling, triggering mode, and point on the trigger signal where triggering occurs. Also, regardless of the trigger signal shape or amplitude (within specification), this circuitry provides a fast-rise, uniform-amplitude pulse to the Main Sweep Start Multi. Termination of the pulse (or gate) occurs at the rise of Main Sweep Holdoff.

Main Sweep Start Comparator. This circuit is activated by the positive gate from the Main Sweep Trigger. The output signal coupled to the Main Sawtooth Generator is a positive gate with the same duration as the sweep. This gate is also coupled to the Sweep Gate Out. A negative-going gate (coincident with the positive gate) is coupled to the Delayed Sweep Lockout Multi and the Delayed Sweep Start Control.

Main Sawtooth Generator. The main sweep signal is developed by the Main Sawtooth Generator. When a positive gate from the Main Sweep Start Multi is applied, a sawtooth waveform is generated. The sawtooth duration is determined by the positive gate duration. Rate of change of the sawtooth is set by Ct and Rt, selected by the TIME/DIV switch.

Sweep Stop Comparator. One side of this comparator is driven by the main sweep sawtooth signal, and the other side is set by the Main Swp Stop adjustment. When the sawtooth waveform passes through the setting of the Main Swp Stop adjustment, the output of the Sweep Stop Comparator switches to a positive level. This positive step is applied to the Main Sweep Holdoff and by way of a small capacitance to the Main Sweep Start Multi. This resets the Main Sweep Start Multi so that it is ready to receive another trigger signal.

Main Sweep Holdoff. This circuit develops a gate which is used to prevent generation of a trigger signal until the sweep circuits have stabilized after a sweep. The positive step from the Sweep Stop Comparator initiates the positive holdoff gate. The duration of the holdoff gate is variable, depending on the setting of the TIME/DIV switch. Holdoff timing capacitors are separate from sweep timing capacitors. Holdoff is longer for slower sweep rates.

Output from the Main Sweep Holdoff is coupled to the Main Sweep Trigger and the Delayed Sweep Trigger. A trigger signal cannot be generated during the holdoff interval. The holdoff serves to reset the trigger circuits so that they are ready to receive an input trigger signal after holdoff.

Horiz Output. The Horiz Output block includes the Ext Horiz Amp, Position Amp, Horiz Display Selector, and Horiz Out Amp circuits.

With the DISPLAY MODE switch set to MAIN SWP, this circuit selects the signal from the Main Sawtooth Generator, amplifies the signal, and converts the single-ended input to a push-pull output signal. A DC positioning level is also applied to this block.

Delayed Sweep Mode

To generate the delayed sweep, the Main Sawtooth Generator must first be gated on (see Main Sweep Mode).

Delay Pickoff. This circuit supplies a positive gate which starts when the main sawtooth signal passes through the level selected by the DELAY TIME MULT control. The gate ends with the main sawtooth signal. The output signal is coupled to the Delayed Sweep Trigger.

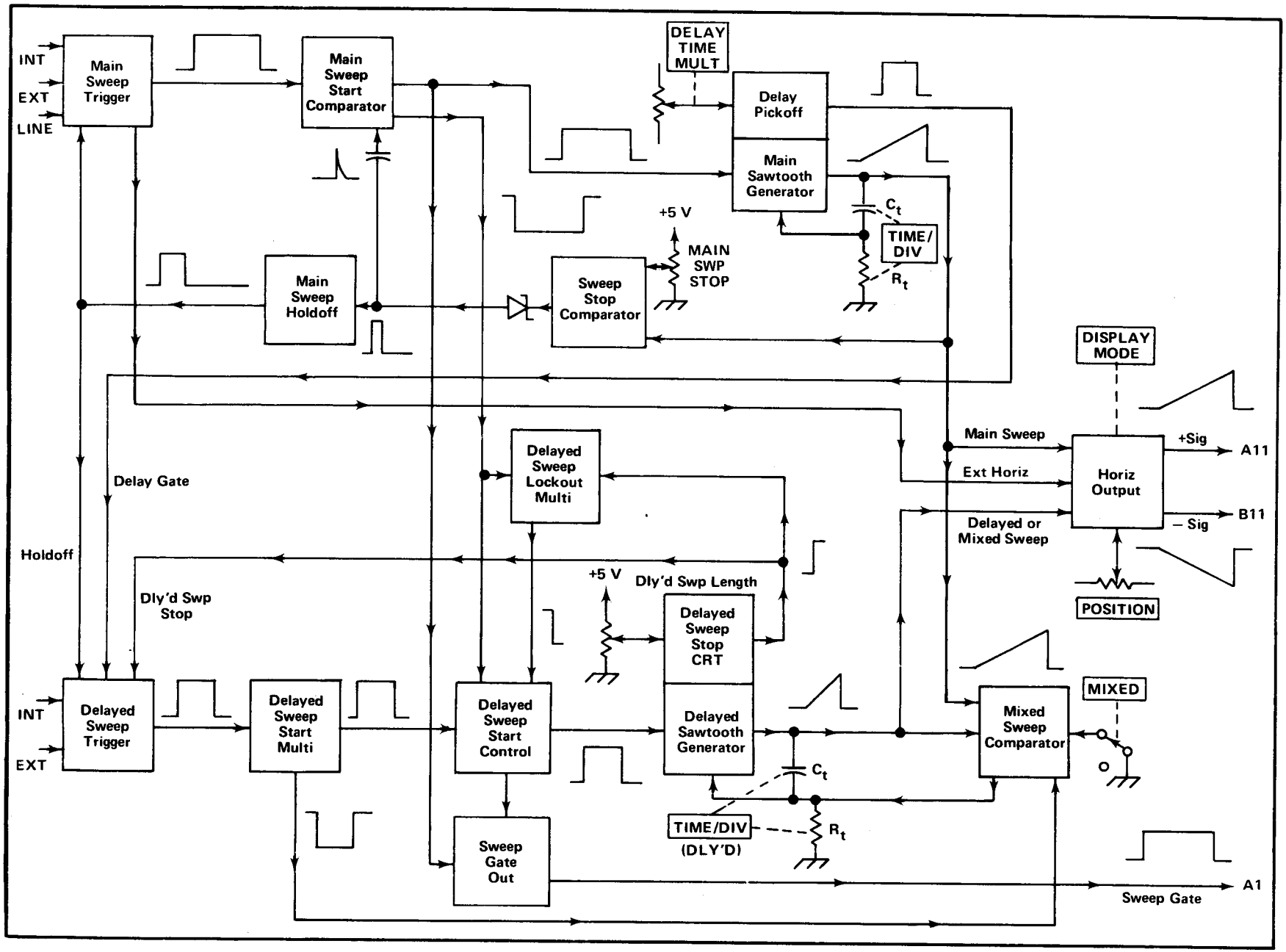


Fig. 3-1. 7B53N Simplified Block Diagram.

Delayed Sweep Trigger. When the Delayed Trigger LEVEL is pushed in, the output trigger is generated as soon as the Delay Gate signal is applied. If the LEVEL control is out, the output trigger is initiated by the next input trigger after the Delay Gate is applied.

The Delayed Sweep Trigger output is a positive gate which is terminated by the Holdoff signal and/or the positive step from the Delayed Sweep Stop circuit. The positive output gate is coupled to the Delayed Sweep Start Multi.

Delayed Sweep Start Multi. The signal from the Delayed Sweep Trigger causes the Delayed Sweep Start Multi to flip so that a positive gate is coupled to the Delayed Sweep Start Control, and a negative gate is applied to the Mixed Sweep Comparator. The output gates are the same in duration as the positive gate from the Delayed Sweep Trigger.

Delayed Sweep Start Control. For DLY'D SWP mode of operation the Delayed Sweep Start Control serves to couple the positive gate from the Delayed Sweep Start Multi to the Delayed Sawtooth Generator and the Sweep Gate Out.

Input signals from the Main Sweep Start Multi and the Delayed Sweep Lockout Multi are not effective in this mode.

Delayed Sawtooth Generator. The delayed sweep signal is developed by the Delayed Sawtooth Generator. The sawtooth is generated during the time that a positive gate is applied from the Delayed Sweep Start Control. Rate of change of the sawtooth is set by Ct and Rt, selected by the TIME/DIV (Dly'd) switch.

The sawtooth output signal is coupled to the Mixed Sweep Comparator and the Horiz Output circuits.

Delayed Sweep Stop Circuit. A positive step occurs at the output of the Delayed Sweep Stop circuit when the delayed sawtooth passes through the level selected by the Dly'd Swp Length adjustment. This step is coupled to the Delayed Sweep Trigger and the Delayed Sweep Lockout Multi.

Mixed Sweep Mode

In this mode of operation, the sweep is first running at the MAIN SWP rate and then, after the selected delay interval, runs at the DLY'D SWP rate. The main sweep and delayed sweep are initiated as previously described. Operation of other circuit blocks follows.

Mixed Sweep Comparator. This circuit determines which sweep signal is coupled to the Horiz Output stage. First, the main sweep sawtooth is coupled through the Mixed Sweep Comparator and the Delayed Sawtooth Generator to the Horiz Output stage. These stages perform as an operational amplifier during the time that the main sweep is being displayed.

When a positive gate from the Delayed Sweep Trigger is applied to the Delayed Sweep Start Multi, a negative gate is generated and coupled to the Mixed Sweep Comparator. This opens the Mixed Sweep Comparator circuit, preventing the main sweep sawtooth from being coupled to the Horiz Output circuit.

Simultaneously, the positive gate from the Delayed Sweep Start Multi is coupled through the Delayed Sweep Start Control to the Delayed Sawtooth Generator. The delayed sweep sawtooth is generated and coupled to the Horiz Output stage.

Delayed Sweep Lockout Multi. The positive step from the Delayed Sweep Stop circuit is inverted by the Delayed Sweep Lockout Multi and coupled to the Delayed Sweep Start Control, thus turning off the Delayed Sawtooth Generator.

Sweep Gate Out. Depending on the selection of the DISPLAY MODE switch, this stage couples the positive gate from either the Main Sweep Start Multi or the Delayed Sweep Start Control to connector A1. The Sweep Gate signal serves to unblank the CRT in the Indicator Oscilloscope during the sweep.

External Horiz Input

When the TIME/DIV switch is set to AMPL, part of the Main Sweep Trigger circuitry becomes the Horiz Input Amp. An external signal connected to the MAIN TRIG IN or AMPL input is amplified and then coupled to the Horiz Output stage. The main and delayed sawtooth generators are disabled to prevent intensity modulation of the CRT trace by the unblanking waveforms.

CIRCUIT OPERATION

General

This section provides a detailed description of the electrical operation and relationship of the circuits in the 7B53N. The theory of operation for circuits unique to this instrument is described in detail in this discussion. Circuits which are commonly used in the electronics industry are not described in detail. If more information is desired on these commonly used circuits, refer to the following textbooks.

Tektronix Circuit Concepts Books (order from your local Tektronix Field Office or representative).

Horizontal Amplifier Circuits, Tektronix Part No. 062-1144-00.

Oscilloscope Trigger Circuits, Tektronix Part No. 062-1056-00.

Sweep Generator Circuits, Tektronix Part No. 062-1098-01.

Phillip Cutler, "Semiconductor Circuit Analysis," McGraw-Hill, New York, 1964.

Lloyd P. Hunter (Ed.), "Handbook of Semiconductor Electronics," second edition, McGraw-Hill, New York, 1962.

Jacob Millman and Herbert Taub, "Pulse, Digital, and Switching Waveforms," McGraw-Hill, New York, 1965.

The main headings in this circuit analysis refer to schematics in the diagrams section with the same name. The sub-headings indicate the individual circuit being described. The main block diagram in the last section of the manual shows interconnection between circuits.

MAIN TRIGGER PREAMP

The Main Trigger Preamp selects trigger source and coupling for the Main Trigger Generator and provides amplification for external horizontal signals when the TIME/DIV OR DL'Y TIME switch is set to AMPL.

This circuit consists of four stages: Trigger Source Switching, External Trigger Preamp or External Input Amplifier, Balanced-to-Single-Ended Converter, and Trigger Coupling. Fig. 3-2 shows a detailed block diagram of the Main Trigger Generator circuit and the schematic of this circuit is shown on diagram 1 at the rear of this manual.

Trigger Source Switching

U330 receives trigger inputs at pins 2 and 15 for internal triggering and at pin 7 for external trigger signals. Pin 4 of U330 determines which input signal is selected by means of

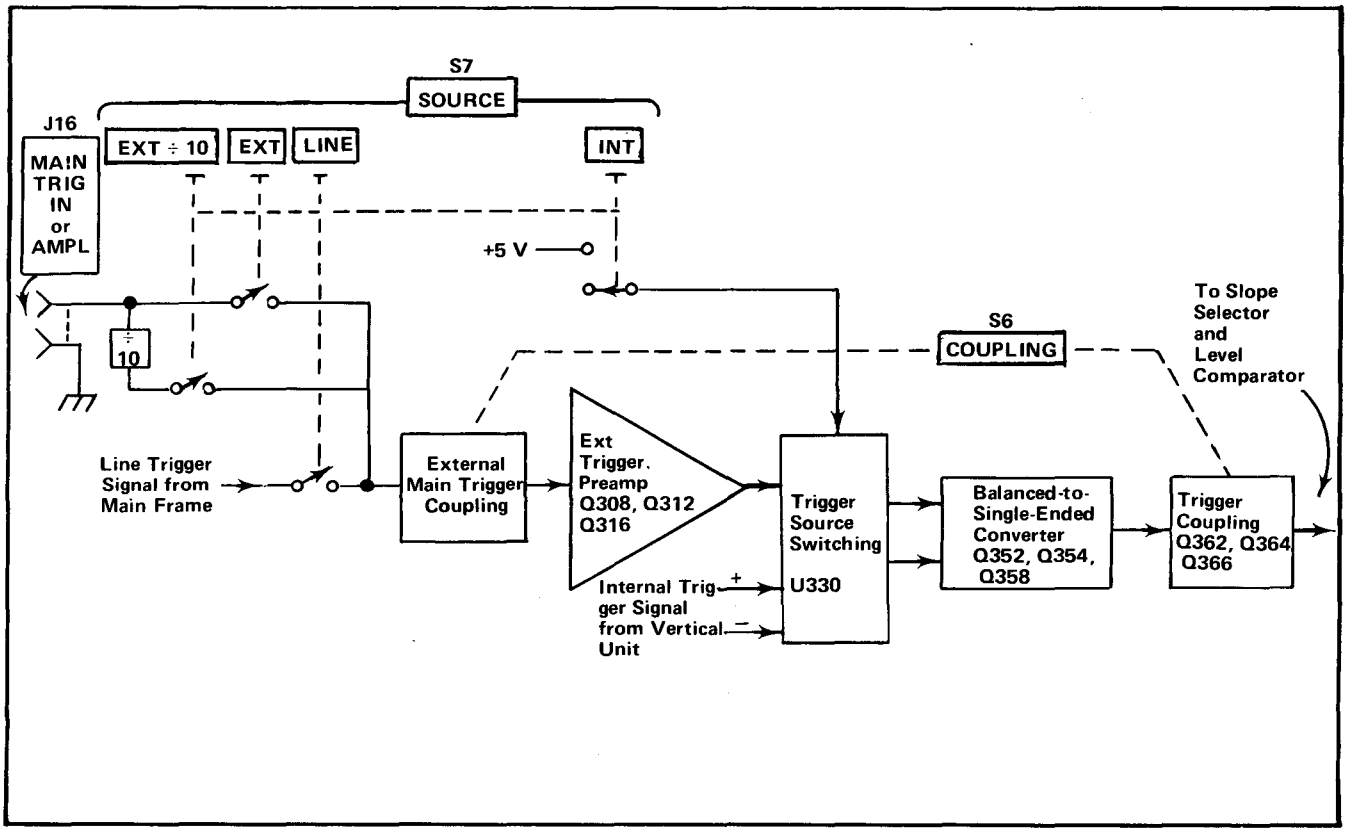


Fig. 3-2. Main Trigger Preamp detailed block diagram.

a digital signal (voltage level). A Low Level at pin 4 activates pins 2 and 15 for internal triggering, while a high level on pin 4 switches U330 to activate pins 7 and 10 for external triggering.

To further examine U330, assume that pin 4 is low, activating pins 2 and 15 (internal triggering). This input is a relatively high impedance differential configuration. Pin 15 receives the positive-going trigger signal and pin 2 is the negative-going input. The inputs are biased at the center of their dynamic range, and signal-limiting in the trigger pickoff circuitry (in the indicator oscilloscope) assures that the inputs will not be driven into either cutoff or saturation. R336 and R337 terminate the internal trigger signal from the indicator oscilloscope. The current source for internal triggering is by way of Pins 1 and 16 and R343.

The output current appears at pins 12 and 13. A positive-going signal at pin 15 causes an increase in current into pin 13 and out through pin 16, R341 and R343. Simultaneously, the negative-going signal at pin 2 causes a decrease in current into pin 12 and out through pin 1, R342, and R343. The net result is that the total current through pins 12 and 13 and R343 remains constant.

The current source for external triggering is by way of pins 8 and 9 and R346. Operation is the same as internal triggering.

External Trigger Preamp or Horizontal Input Amplifier

SOURCE switch S7 at the input selects internal, external, or line signals for triggering. The external trigger (or horizontal input) signal may be attenuated to one-tenth amplitude by selecting EXT ÷ 10. R13 and R14 (paralleled by R302) form a 10:1 attenuator.

The input impedance for the trigger (or amplifier) input is 1 megohm, consisting primarily of R5 and R302. This resistor pair also causes a 2X attenuation of the input signal as seen at the gate of Q308.

C301 compensates the input stage and C10 compensates the 10X attenuator.

CR303 and CR305 protect Q308 from excessive input signal by clamping the gate if the signal at the input connector exceeds approximately + or −2.5 volts. The signal at the source of Q308 is coupled through emitter-followers Q312 and Q316 to pin 7 of U330. The signal at pin 7 of U330 is terminated in approximately 50 ohms by R319 to preserve the high-frequency characteristics.

R330 sets the DC level at pin 10 of U330, which is the negative side of the external trigger differential input. This matches the DC balance of the external trigger input of U330 to that of the internal trigger input.

Balanced-to-Single-Ended Converter

The balanced to single-ended converter changes the output of U330 to a single-ended signal at the emitter of Q358. The trigger signal through U330 causes a decrease in current into pin 12 from R350 and R354 and an increase in current into pin 13 from R351. This would normally cause the voltage at pin 12 to swing in a positive direction, while pin 13 goes in a negative direction. However, the current through R350 and R354 actually increases due to the feedback via R355 and Q354, causing the voltage at pin 12 to swing negative along with pin 13. Q354 is connected as a diode and is enclosed in the same heat-sink with Q352, providing good DC stability. The DC Balance adjustment R350 sets the quiescent DC level of the Balanced to Single Ended Converter to zero volts allowing the DC level at the output to correspond to the DC level at the input.

Trigger Coupling

When DC coupling is selected by the front-panel COUPLING switch, Q362 is turned on by the +15 volts supply through R18, S6, and R361. The triggering signal is then coupled through R359 and Q362 to the base of Q402 (on Main Trigger Generator diagram).

Q364 is turned on when AC coupling is selected. The triggering signal then passes through Q364 and C364 to the base of Q402. For AC LF REJ coupling, Q364 is off and the triggering signal is coupled through C362 and C364, attenuating low-frequency signals.

For AC HF REJ coupling, both Q364 and Q366 are turned on. The high-frequency components are coupled through C367 and Q366 to ground, while the desired triggering component is coupled through Q364 and C364 (as in AC coupling).

MAIN TRIGGER GENERATOR

The Main Trigger Generator provides selection of the level and slope where triggering occurs and supplies a fast-rise uniform-amplitude pulse to the Main Sweep Start Multi.

The Main Trigger Generator includes the Level Comparator, Slope Selector, Trigger TD and Driver, and Main Trigger Generator circuits. Fig. 3-3 shows a detailed block diagram of the Main Trigger Generator circuit and the schematic is shown on diagram 2 at the rear of the manual.

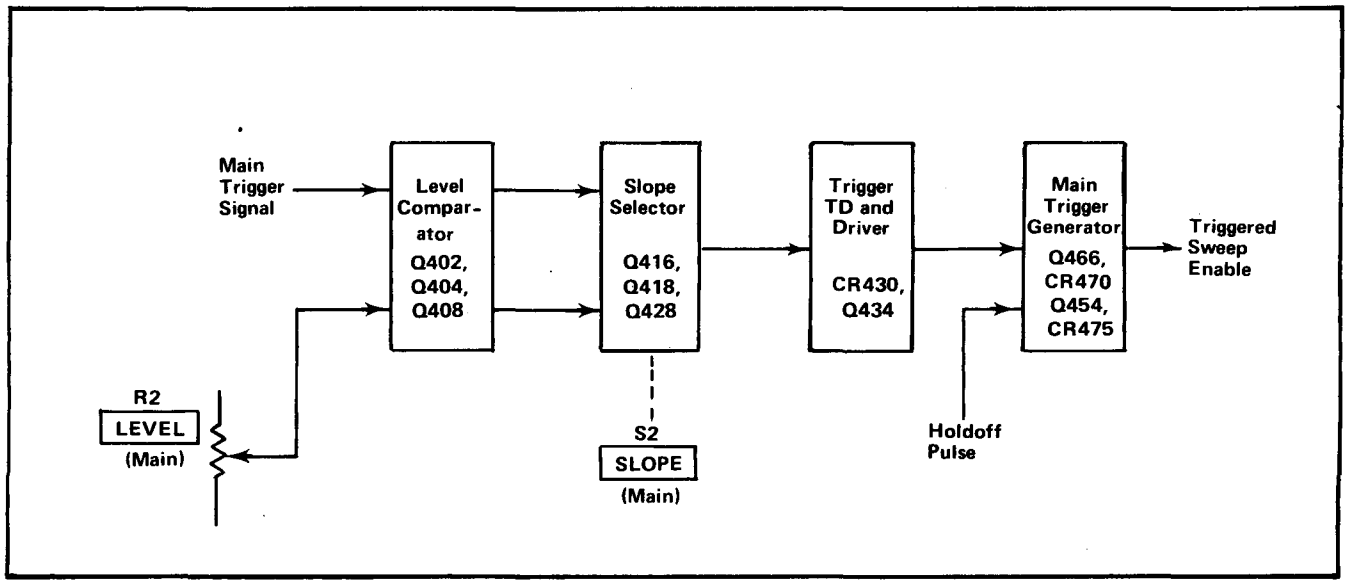


Fig. 3-3. Main Trigger Generator detailed block diagram.

Slope Selector and Level Comparator

Q402 and Q404 are connected as a differential comparator. The reference voltage for the comparator is selected by the setting of LEVEL control R2. The Main Trig Level Center adjustment, R410, sets the level at the base of Q404 so the sweep is triggered at the 0 volt point of the incoming trigger signal when the LEVEL control is set to the center of the positive or negative slope region. The LEVEL control varies the voltage on the base of Q404 to select the point on the trigger signal at which triggering occurs.

Q408 and R408 establish the emitter current for Q402 and Q404. Prior to the arrival of a trigger signal, with the LEVEL control set to the center of the positive or negative slope, Q402 and Q404 are passing equal currents.

Assume that a positive-going signal is applied to the MAIN TRIG IN connector and that the LEVEL/SLOPE control is set to center on the positive slope. The signal at the MAIN TRIG IN connector is inverted by the Main Trigger Preamp, appearing at the base of Q402 as a negative going signal. This causes a decrease in current through Q402, and because of the common emitter source (Q408 and R408), the current through Q404 increases. The decreased collector current of Q402 biases Q418 in a reverse direction, while Q416 becomes more forward biased due to the increased current through Q404.

With SLOPE switch S2 in the + position, the cathode of CR424 is grounded, forward biasing CR424, which reverse biases CR423. At the same time, the base of Q428 is at ground and Q428 is off. This causes CR421 to be reverse biased and CR422 is forward biased through Q416. An increased current is applied to the Trigger TD and Driver circuit through Q416 and Q422 (see Fig. 3-4).

When the SLOPE switch is set to the — position, Q428 and CR421 are forward biased and CR422 is reverse biased. CR424 is reverse biased and CR423 is forward biased so that current flows through Q418 and CR423 to the Trigger TD and Driver circuit.

Trigger TD and Driver

The Trigger TD stage shapes the output of the comparator to provide a trigger pulse with a fast leading edge.

Tunnel diode CR430 is quiescently biased so that it is in its low-voltage state. Increased trigger current from Q416 and CR422 or Q418 and CR423 through R432, L432 and CR430 causes CR430 to switch to the high-voltage state. The resulting fast-rise positive step is coupled through emitter-follower Q434 to C451 and C461 in the Main Trigger Generator stage.

Main Trigger Generator

The Main Trigger Generator includes Q454, Q466, CR470 and CR475. The function of this stage is to supply a fast-rise trigger signal to the Main Sweep Start Multi. For normal triggering, this signal is developed after receipt of a fast-rise transition from the Trigger TD and Driver stage, except during holdoff.

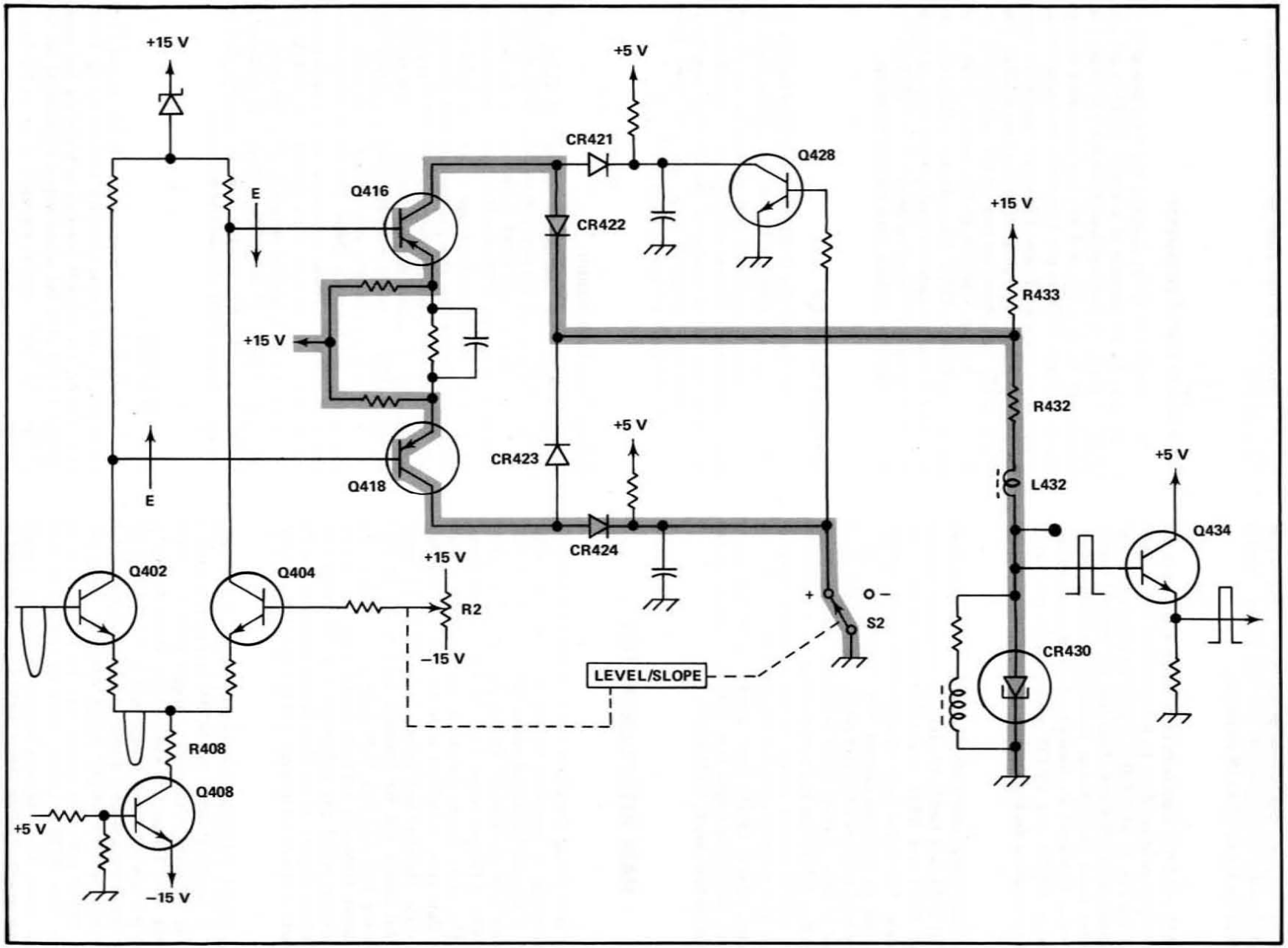


Fig. 3-4. Trigger current path for positive slope triggering.

For the following description of operation, assume that the MODE switch is set to NORM and that a trigger signal is applied to the MAIN TRIG IN connector.

CR470 and CR475 are both in their high states until the holdoff signal switches them to the low state. The holdoff signal from pin 17 of U720 is a positive pulse which forward biases both Q454 and Q466 (see the Holdoff Circuit discussion under Main Sweep Generator in this section). When these transistors are forward biased, they divert current from CR470 and CR475 which causes the tunnel diodes to switch to the low state.

The next trigger after holdoff appears as a positive transition at C451 and C461. The positive transition, coupled through R461 and R462, causes CR470 to switch to its high state. This higher level, through R472, brings CR475 up to near its switching current. The positive transition is also coupled through C451 and R451, and after 3.5 nanoseconds of delay, through R474 to CR475. The short delay assures that CR470 has had time to switch to its high state, arming CR475 before arrival of the switching signal at CR475. This prevents extraneous noise from prematurely activating CR475. CR475 then switches to its high state. The fast-rise positive trigger from CR475 is coupled to the Main Sweep Start Multi, Q722/Q726.

MAIN SWEEP GENERATOR

The Main Sweep Generator circuit produces a sawtooth voltage which is amplified by the Horizontal Amplifier circuit to provide horizontal sweep deflection on the CRT of the indicator oscilloscope. This output signal is generated on command (trigger pulse) from the Main Trigger Generator. The Main Sweep Generator also produces a Main Sweep Gate pulse coincident with the time that the Main Sweep runs. The Main Gate pulse is processed by the Sweep Gate Out circuit and the indicator oscilloscope for CRT unblanking and Auxiliary Gate output. In addition, the Main Sweep Generator produces several control signals for other circuits within the instrument. Fig. 3-5 shows a detailed block diagram of the Main Sweep Generator and the schematic is shown on diagram 3 at the rear of the manual.

The MAIN TRIGGERING MODE switch allows three modes of operation. When the NORM button is pressed, a sweep is produced only when a trigger pulse is received from the Main Trigger Generator circuit. When the AUTO button is pressed, a sweep is produced as in NORM except that a free-running trace is displayed when a trigger pulse is not present. SINGLE SWEEP MODE operation is also similar to NORM operation except that the sweep is not recurrent. The RESET button must be pressed to view another trace. The following circuit description is given with the MAIN TRIGGERING MODE switch pressed to NORM. Difference in operation for the other two modes is discussed later.

Main Sweep Start Comparator

Q722, Q726, and Q728 comprise the Main Sweep Start comparator. In the absence of a trigger, Q722 is off and Q726 is held on by the high level from pin 3 of U720. The collector of Q726 is low and this low is coupled through emitter follower Q728 to pin 1 of U750, thus preventing a sweep. When the Main Trigger Generator supplies a trigger, the positive transition is coupled to the base of Q722. The base of Q722 rises above the level at the base of Q726 and the current through common emitter resistor R724 is diverted from Q726 to Q722. The collector of Q726 rises and the positive step is coupled through emitter-follower Q728. The positive step appears across divider R731/R732 causing pin 1 of U750 to go positive, thus starting the sweep.

Sawtooth Generator

The lower half of the U750 diagram symbol constitutes a Miller Integrator. When pin 1 is positive, a linear sawtooth (positive-going) is generated and appears at pin 8. The timing components, Rt and Ct connected to pins 8 and 9, determine the rate of change of the sawtooth waveform. Q774 prevents high-speed error currents from being coupled into U750 by way of C754 and pin 9.

Sweep Stop Comparator

The Sweep Stop Comparator consists of Q794 and Q796. In the absence of a sawtooth signal at pin 8 of U750, Q796 is conducting and Q794 is held off by the positive level set at its base by R795, the Main Sweep Length adjustment. When the sawtooth voltage at pin 8 of U750 raises the base of Q796 higher than the base of Q794, Q796 turns off and Q794 turns on. The collector of Q794 rises and the positive step is coupled through emitter follower Q792 to pin 16 of U720 and sweep holdoff begins. The positive step at pin 16 will also be seen at pin 17 of U720, and consequently at the bases of Q454 and Q466 (Main Sweep Generator Circuit). These transistors are forward biased, which diverts the current from CR470 and CR475 and causes the tunnel diodes to switch to their low state. As a result, Q722 turns off and Q726 turns on. The collector of Q726 drops and the negative step is coupled through emitter follower Q728, thus ending the sweep.

Holdoff Circuit

The Holdoff Circuit consists of pins 8, 10, 16, and 17 of U720 plus R and C time constants selected by the TIME/DIV switch. The holdoff prevents re-triggering the sweep generator until after the sweep timing capacitor(s) has discharged and sweep circuits are again ready to generate a sweep.

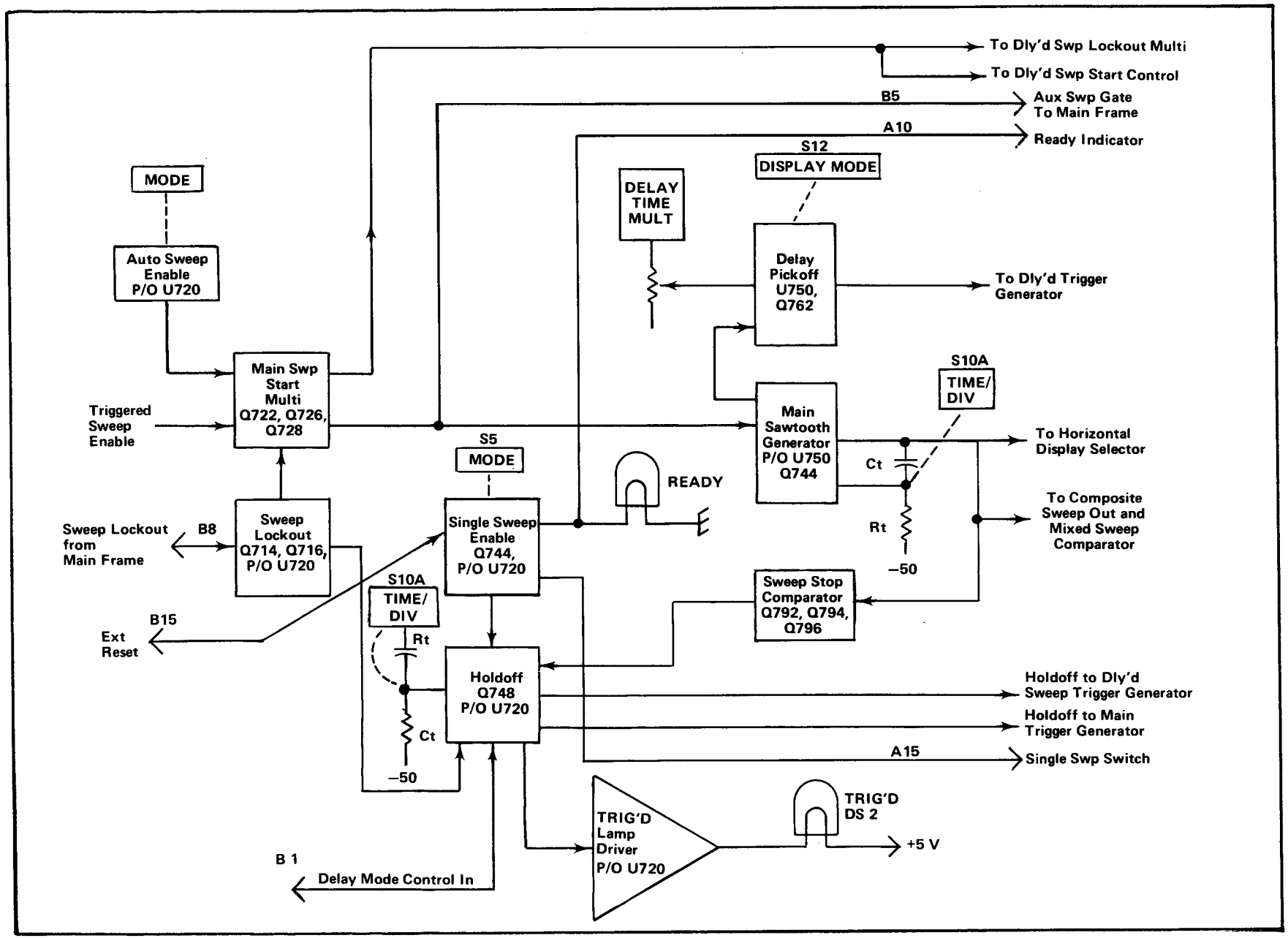


Fig. 3-5. Main Sweep Generator detailed block diagram.

At the end of the sawtooth waveform, a positive step is coupled to pin 16 of U720, by way of the Sweep Stop Comparator as previously described. The positive pulse seen at pin 16 of U720 is coupled internally through U720 to pin 17 and in turn to Q454 and Q466 in the Main Trigger Generator. Q454 and Q466 are turned on, thus robbing the current from CR470 and CR475, switching them to the low state. This prevents the Main Sweep Start Multi from generating a sweep.

After a time determined by the timing components at pin 8, internal circuitry within U720 switches pin 17 to its low state, ending the holdoff gate. The Main Trigger Generator is released to generate a trigger signal.

A negative gate coincident with the positive holdoff gate, appears at pin 10 of U720. This negative gate is inverted by Q748 and coupled to the Delayed Sweep Generator for composite holdoff functions.

Trig'd Lamp Driver

When the main sweep gate is high and the sweep is running, the TRIG'D lamp is on. At all other times the lamp is off.

Delay Pickoff

The upper half of the diagram symbol for U750 includes the Delay Pickoff circuitry. Inside U750, the main sweep sawtooth signal is applied to one side of a comparator circuit. Pin 6 is connected to the other side of the comparator. The setting of the DELAY TIME MULTIPLIER control, R19, determines the point on the main sweep sawtooth at which the comparator switches.

When the comparator switches (delay pickoff occurs), a positive gate appears at pin 4 of U750. This gate terminates at the end of the main sweep sawtooth.

The positive-going gate at pin 4 of U750 is coupled through emitter-follower Q762 to the Delayed Trigger Generator.

Auto Triggering Mode

Operation of the Main Sweep Generator circuit in the AUTO position of the MAIN TRIGGERING MODE switch is the same as for NORM position just described when a trigger pulse is applied. However, when a trigger pulse is not present, a free-running reference trace is produced in the AUTO position. This occurs as follows:

The Auto Triggering circuit consists of pins 1, 3, 6, and 19 of U720. When the AUTO button of the MAIN TRIGGERING MODE switch is pressed, a low at pin 19 of U720 enables the Auto Circuit. When a repetitive trigger signal above 30 Hz, and of adequate amplitude is applied to the Main Sweep Start Comparator and pin 1 of U720, the internal Auto Multi at pin 6 of U720 charges towards five volts through C786 and R786, but is discharged by each incoming trigger pulse.

In the absence of a trigger pulse, C786 charges towards +5 V, switching pin 6 to its high state and pin 3 to its low state. Q726 turns off, its collector rises and a high is coupled through emitter follower Q728 to pin 1 of U750, causing the sweep to run.

Single Sweep Operation

Operation of the Main Sweep Generator in the SINGLE SWEEP position of the MAIN TRIGGERING MODE switch is similar to operation in the NORM position as previously described. However, after one sweep has run, all other sweeps are inhibited until the RESET button is pressed. A READY lamp is provided to indicate when the sweep is ready to accept a trigger.

The Single Sweep circuit consists of pins 11, 12, 14, 15, and 17 of U720. For SINGLE SWEEP operation, the +5 volt supply is applied to pin 12 of U720. The holdoff pulse at pin 17 of U720 goes positive, preventing generation of a sweep. When the RESET button is pressed, pin 15 is momentarily held to ground, pin 17 goes low to allow the Main Trigger Generator to accept a trigger. The holdoff line (pin 17 of U720) stays low until a sweep has been completed. At this time, the holdoff pulse rises at pin 17 and stays in the holdoff state until the RESET button is pressed.

Q744 acts as a switch for the READY lamp. When the holdoff gate at pin 17 is high, preventing the sweep generator from accepting a trigger, pin 11 is high and Q744 and the READY lamp are off. When the RESET button is pressed, the holdoff gate at pin 17 goes low and allows the Main Sweep Generator to accept a trigger. Pin 11 rises and turns on Q744, which provides the current to turn on the READY lamp.

Sweep Lockout

Q714, Q716 and pins 3, 16, and 18 comprise the Sweep Lockout circuit. The Sweep Lockout circuit is functional when the 7B53N is installed in the B Horizontal compartment of an indicator oscilloscope which accommodates two horizontal plug-in units, and it is desired to operate in the Alternate Horizontal Mode, or to operate the 7B53N as a delayed sweep unit. Lockout is applied to the 7B53N during the time that the sweep from the associated time base is displayed.

The indicator oscilloscope controls initiation of a sweep by supplying current to the base of Q714 when lockout is required. This current causes a positive step at pin 18 of U720. Pin 3 of U720 steps positive and Q726 turns on. The collector of Q726 falls and the low is coupled through emitter follower Q728 to pin 1 of U750, thus preventing the sweep. If lockout is initiated while the sweep is running, the leading edge of the lockout pulse is differentiated through C719 and D719, and appears as a high at pin 16 of U720. This starts the holdoff cycle. (The holdoff cycle is as described previously).

Delayed Mode Control

When the 7B53N is installed in the B Horizontal compartment of an indicator oscilloscope with two horizontal compartments, the Delayed Mode Control determines whether the 7B53N operates as an independent timebase or as a delayed sweep unit in the triggerable after delay time mode. When approximately +3 to 4.5 volts is present at interface connector B1 (and therefore pin 13 of U720), the Auto Circuit (previously described) is disabled. A sweep can be enabled only by a trigger pulse to the Sweep Start Comparator. During delay time determined by the settings of the delaying sweep unit, sweep lockout (previously described) inhibits the sweep. After delay time, the 7B53N can be triggered. An approximate zero volt level at pin 13 of U720 enables the Auto Circuit, causing the 7B53N to operate as an independent time base.

DELAYED TRIGGER PREAMP

The delayed Trigger Preamp is very similar to the Main Trigger Preamp previously described. Therefore, only those portions that are different will be described in detail. This circuitry selects trigger source and coupling for the signal driving the Delayed Trigger Generator. Fig. 3-6 shows a detailed block diagram of the Delayed Trigger Preamp circuit and the schematic of this circuit is shown on diagram 4 at the rear of the manual.

Dly'd Trigger Source Switching

U530 initiates the Delayed Trigger Mode. When the DISPLAY MODE switch is set to INTEN, DLY'D SWP, or MIXED position and the Delayed Triggering LEVEL control is in the OUT-DLY'D SWP TRIGGERABLE position, a low level is coupled through Q8 to pin 6 of U530, which allows U530 to accept a trigger. A high at pin 6 (DISPLAY MODE switch set to MAIN SWP, TIME/DIV

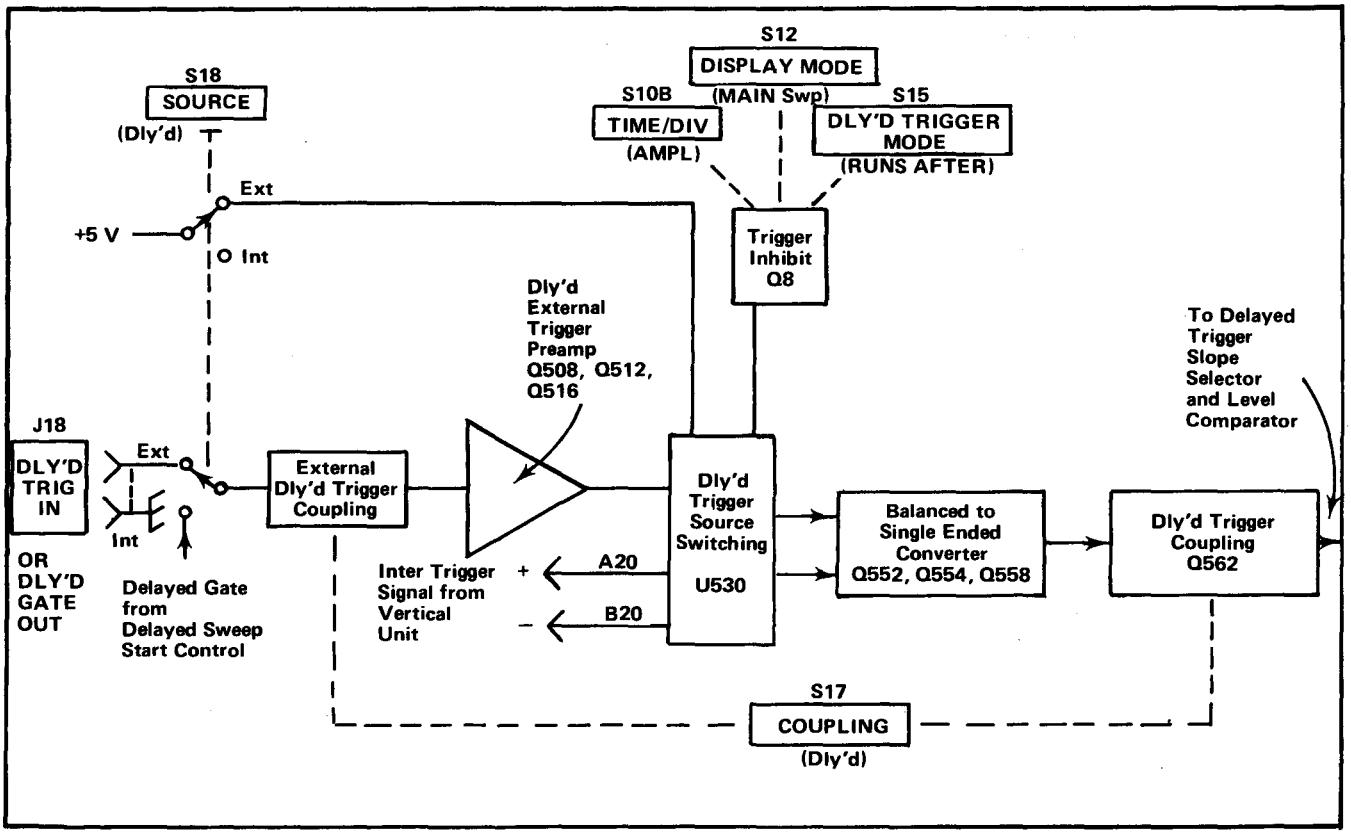


Fig. 3-6. Delayed Trigger Preamp detailed block diagram.

OR DL'Y TIME switch set to AMPL, or the Delayed Triggering LEVEL control at the IN—RUNS AFTER DL'Y TIME position) causes U530 to refuse a trigger.

U530 also performs the function of selecting either the Dly'd Internal Trig Amp or the Dly'd External Trig Amp as the source of trigger. When pin 4 of U530 is positive, pins 7 and 10 are activated and an external trigger must be applied to the DLY'D TRIG IN connector. When pin 4 is low (near ground), pins 2 and 15 are active and an internal trigger source is selected.

Dly'd External Trig Amp

Q508, Q512 and Q516 comprise the Dly'd External Trig Amp. This circuit is identical to the Main External Trigger Preamp. The amplifier provides a current gain and is terminated by R519 at pin 10 of U530.

Balanced-to-Single-Ended Converter

This circuit includes Q552, Q554 and Q558. Except for minor differences in component values, the circuitry is identical with the Balanced-to-Single-Ended Converter in the Main Trigger Preamp. The output signal at the emitter of Q558 is inverted from the signal at the DLY'D TRIG IN connector.

Dly'd Trigger Coupling

When COUPLING switch S17 is set to DC, Q562 is forward biased by way of R56 and R561. The trigger signal is direct coupled between the emitter of Q558 and the base of Q602 (Slope Selector and Level Comparator). If the COUPLING switch is set to AC, Q562 is reverse biased and the trigger signal is coupled through C562.

DELAYED TRIGGER GENERATOR

The Delayed Trigger Generator circuitry is essentially the same as the Main Trigger Generator, except there is no provision for automatic mode of triggering. Therefore, only the circuits that are different will be described in detail. For a detailed description of the rest of the circuitry, refer to the Main Trigger Generator. Fig. 3-7 shows a detailed block diagram of the Delayed Trigger Generator, and the schematic is shown on diagram 5 at the rear of the manual.

Slope Selector and Level Comparator

This circuit consists of Q602, Q604, Q616, Q618 and Q628. Operation is identical to the Slope Selector and Level Comparator on the Main Trigger Generator diagram.

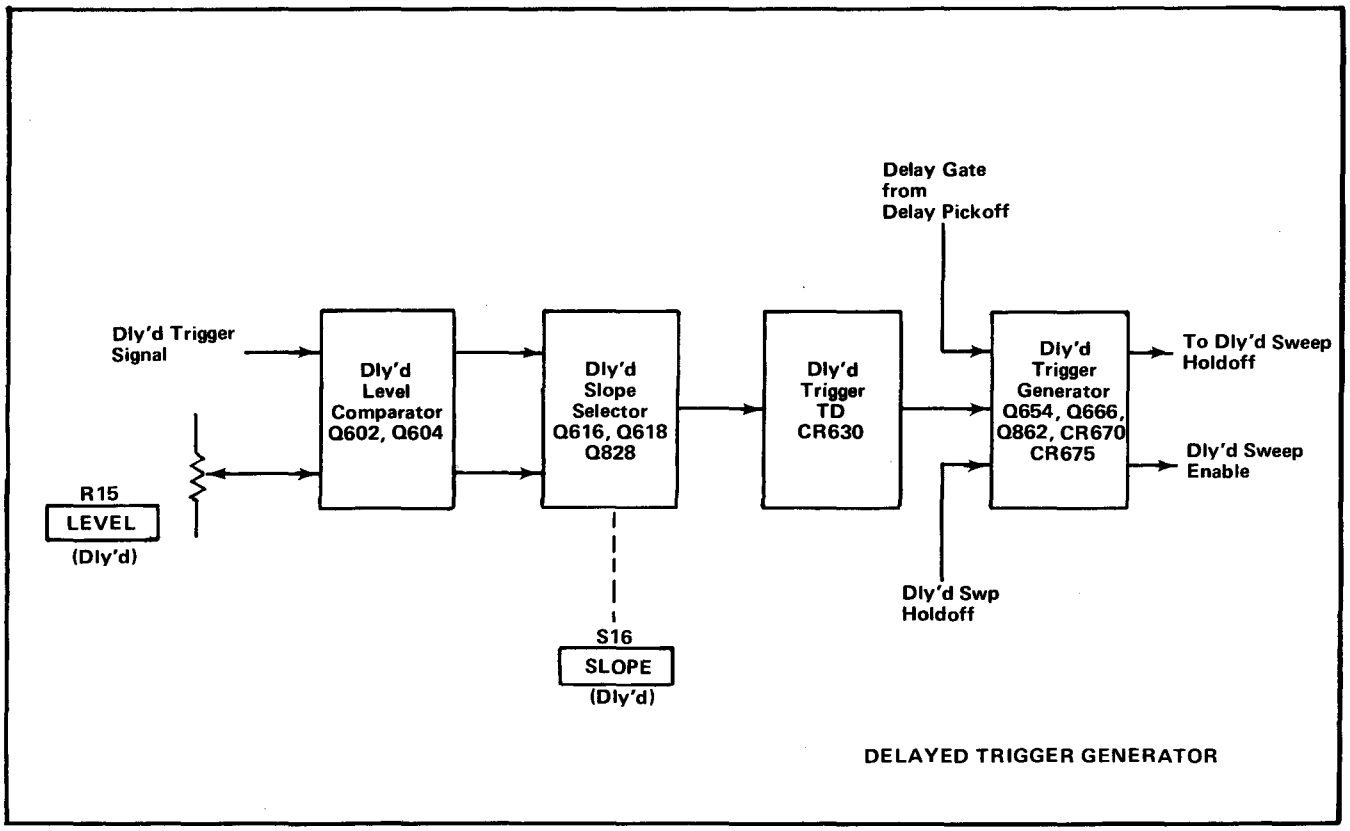


Fig. 3-7. Delayed Trigger Generator detailed block diagram.

When the input signal at the base of Q602 passes through the level set at the base of Q604, an increase in current occurs at the output.

Trigger TD

The Trigger TD is CR630. The increased current caused by applying a trigger signal to the Slope Selector and Level Comparator circuit is coupled through R632 and CR630, switching CR630 to its high state.

Delayed Trigger Generator

The Delayed Trigger Generator circuit includes Q654, Q666, Q862, CR670 and CR675. Operation of the tunnel diodes, CR670 and CR675, is identical to operation of the TD's in the Main Trigger Generator.

If the DLY'D LEVEL control is pushed to the IN–RUNS AFTER DL'Y TIME position, S15 is in the "open" position and current through R871, CR655, and R674 to the Sweep Start TD (CR675) biases CR675 just below the switching level. When the Delay Gate is generated (at the Trigger Pickoff), the positive step at the junction of CR866 and CR869 forward biases Q862. This increases current through the Sweep Start TD, causing it to switch to the high state. This occurs immediately upon arrival of the Delay Gate, without need for a delayed trigger input.

When the DLY'D LEVEL control is in the "out" position (DLY'D SWP TRIGGERABLE), S15 is closed, forward biasing CR71. Q954 becomes forward biased and Q862 is reverse biased. The static current through CR675 is at a low level. Q862 becomes forward biased upon arrival of the Delay Gate signal at its emitter (via CR866). The resulting current biases the Sweep Start TD just below the switching level. A trigger signal from the Trigger TD (CR630) then causes the Sweep Start TD to switch to the high state.

The Dly'd Swp Holdoff coupled to the bases of Q654 and Q666 prevents the Sweep Start TD from switching until after the main sweep has occurred.

DELAYED SWEEP GENERATOR

The Delayed Sweep Generator produces a sawtooth voltage which is amplified by the Horizontal Amplifier circuits to provide a delayed sweep CRT display. The sawtooth output voltage is generated on command of the Delayed Trigger Generator. The Delayed Sweep Generator also produces a Delayed Sweep Gate pulse, coincident with the time that the Delayed Sweep Generator runs, to be processed by the Sweep Gate Out circuit and the indicator oscilloscope for CRT unblanking. Fig. 3-8 shows a detailed block diagram of the Delayed Sweep Generator and the schematic is shown on diagram 6 at the rear of the manual.

Dly'd Swp Start Multi

Q882 and Q886 comprise the Dly'd Swp Start Multi. This circuit is connected as a bistable multivibrator, with Q886 normally conducting and Q882 off.

When the Sweep Start TD switches to its high state, the positive step appears at the base of Q882. This causes the multi to flip, so Q882 is on and Q886 off. The collector of Q886 goes positive. The Sweep Start TD is held in its high state for the duration of the Delay Gate. At the end of the Delay Gate, the Dly'd Sweep Start Multi reverts to its original state with Q882 off and Q886 on.

Dly'd Swp Start Control

The Dly'd Swp Start Control circuit includes Q902, Q904 and Q906. This circuit couples a positive gate to pin 1 of U930 (Miller Integrator) to control the period during which a sawtooth is generated.

In all Positions of the DISPLAY MODE switch except MIXED, Q902 and Q904 are inactive due to reverse bias current via CR901, S12 and the +5 volt supply. When the collector of Q886 (Dly'd Swp Start Multi) goes positive, Q906 couples the positive gate to pin 1 of U930, initiating the generation of a delayed sawtooth. At the end of the Delay Gate, the collector of Q886 drops. This ends the positive gate to pin 1 of U930, terminating the delayed sawtooth.

When the DISPLAY MODE switch is set to MIXED, the anode circuit of CR901 is open. The gate from the Main Swp Start Multi is negative-going at the base of Q904. The resulting current from Q904 forward biases Q906, and a positive gate is coupled to pin 1 of U930.

Mixed Swp Comparator

Q888, Q892, Q896 and Q898 comprise the Mixed Swp Comparator circuit. This circuit determines whether U930 is running at the main sweep or delayed sweep rate.

With the DISPLAY MODE switch set to MIXED, Q892 is forward biased. The main sweep sawtooth at the emitter (and thus, the collector) of Q892 is a positive-going ramp. This causes a ramp of increasing current through Q896. During the time that a Delay Gate is not being generated, Q882 (Dly'd Swp Start Multi) is biased off and Q888 is on. In this condition, U930, Q888, Q896 and Q898 form a operational amplifier. The negative-going ramp at the collector of Q896 becomes a positive-going ramp at pin 8 of U930, running at the main sweep rate.

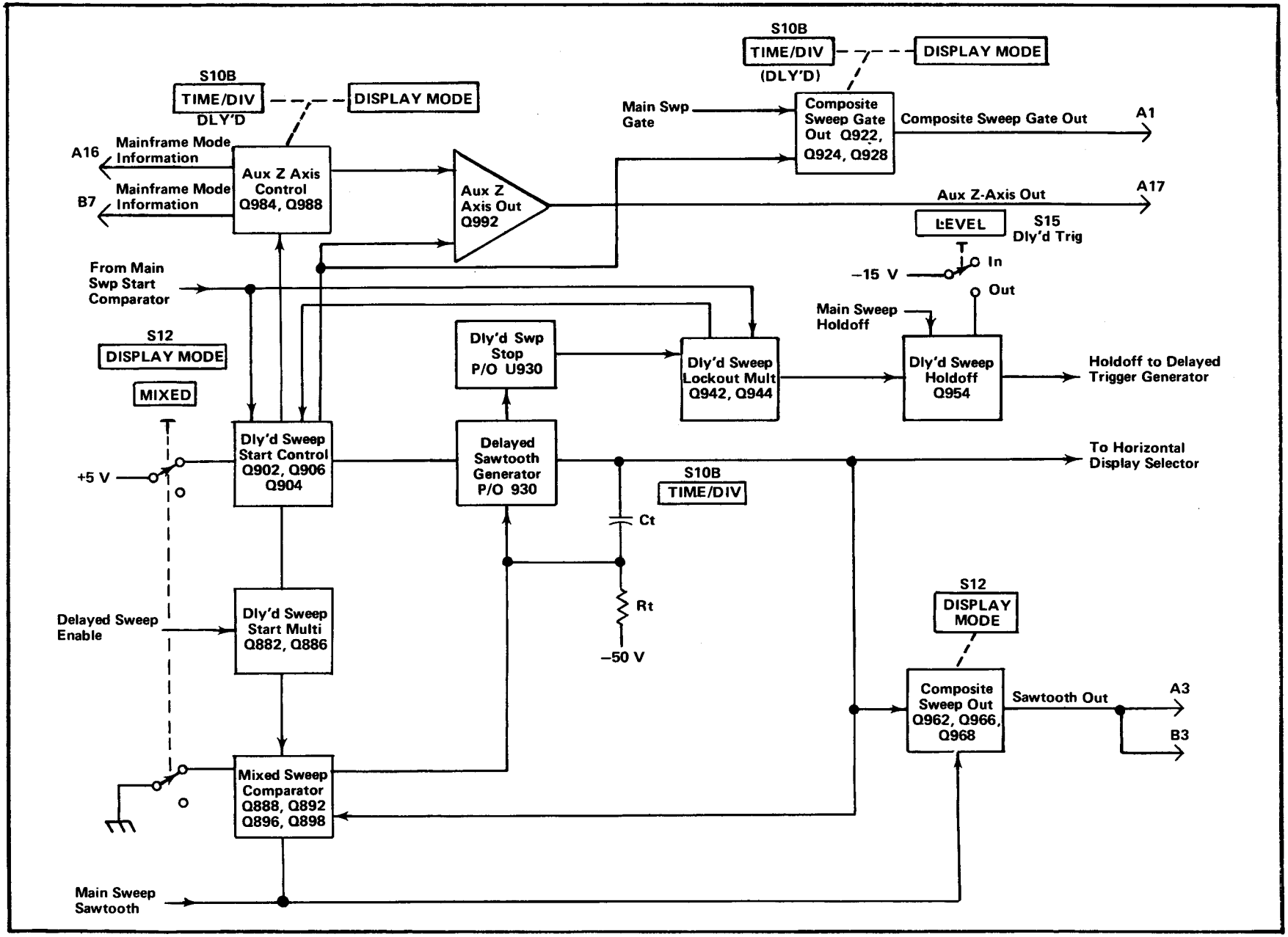


Fig. 3-8. Delayed Sweep Generator detailed block diagram.

When the Delay Gate is generated, the Delayed Trigger Generator forward biases Q882. The collector current through R888 reverse biases Q888, opening the operational amplifier loop. U930 is released to run at the delayed sweep rate. Therefore, the sawtooth at pin 8 of U930 will first run at the main sweep rate and then change to the delayed sweep rate when the Delay Gate is generated.

Dly'd Swp Stop Circuit

The upper half of the diagram symbol for U930 constitutes the Dly'd Swp Stop Circuit. The setting of the Dly'd Sweep Length adjust (R930) determines the point on the delayed sawtooth at which pin 4 of U930 will go positive.

Dly'd Swp Lockout Multi

Q942 and Q944 form the Dly'd Swp Lockout Multi. This circuit serves to terminate the delayed sweep as determined by the setting of the Dly'd Sweep Length adjust. When pin 4 of U930 goes positive, Q942 becomes forward biased. The negative-going step at the collector of Q942 forward biases Q902 (Dly'd Swp Start Control circuit). Q904 and Q906 become reverse biased, dropping the level at pin 1 of U930 and terminating the sweep.

Dly'd Swp Holdoff

The Dly'd Swp Holdoff circuit includes Q954. The holdoff gate at connector G is a composite of the positive gate from the Dly'd Swp Lockout Multi, the Main Swp Holdoff Gate via R952; and, when the DLY'D LEVEL control is set to DLY'D SWP TRIGGERABLE, the positive level set by Q954.

With the DLY'D LEVEL control set to DLY'D SWP TRIGGERABLE, Q954 is forward biased until the Delay Gate is generated. This pulls up the holdoff line to prevent the Sweep Start TD from switching to its high state with a trigger signal until after the Delay Gate is generated.

Composite Swp Out

Q962, Q966 and Q968 form the Composite Swp Out circuit. When the DISPLAY MODE switch is set to MAIN SWP or INTEN, Q966 is forward biased, coupling the main sweep sawtooth to the base of Q968. Q968 is an emitter-follower stage which couples the signal to output terminals A3 and B3.

If DLY'D SWP or MIXED is selected by the DISPLAY MODE switch, Q962 if forward biased and couples the delayed sweep or mixed sweep sawtooth to the base of Q968.

Q966 and Q968 or Q962 and Q968 (depending on DISPLAY MODE setting) are connected as an operational amplifier, providing a high degree of gain stability.

Composite Swp Gate Out

The Composite Sweep Gate Out circuit includes Q922, Q924 and Q928. The output at the collector of Q928 connects to interface connector pin A1 for use in the indicator oscilloscope. In the AMPL position of the TIME/DIV OR DL'Y TIME switch, connector A1 is set to approximately +4.3 volts (via CR100) to unblank the CRT.

Q928 serves as the output stage. With the DISPLAY MODE switch set to either MAIN SWP or INTEN, Q922 couples the main sweep gate to the base of Q928. When either DLY'D SWP or MIXED is selected, Q924 is on. The gate signal at the emitter of Q906 (Dly'd Swp Start Control) is coupled to the base of Q928.

Aux Z Axis Control

The Aux Z Axis Control circuit includes Q984 and Q988. This circuit uses the indicator oscilloscope mode and switching levels to determine when the sweep signal from the 7B53N is being displayed on the CRT. Information of this type is normally used only when operating the 7B53N in a four plug-in indicator oscilloscope.

Typical levels to cause the Aux Z Axis Control to intensify the CRT are +5 volts at terminal A16 and −0.6 volt at terminal B7. This forward biases Q988, resulting in a positive level at its emitter.

When the 7B53N is used in a three plug-in indicator oscilloscope and the DISPLAY MODE is set to INTEN, Q984 is off and Q988 is forward biased.

Aux Z Axis Out

Q992 is the Aux Z-Axis Out stage. The output at connector DZ is connected to pin A17 on the interface connector and then to the Z-axis circuit in the indicator oscilloscope. A reduction in current through Q992 causes the CRT trace to brighten.

For this description, assume that the 7B53N is used in a three plug-in indicator oscilloscope.

As described under Aux Z Axis Control, when INTEN is selected by the DISPLAY MODE switch, Q988 is turned on. The positive level at the emitter of Q988 reverse biases CR991, which reduces conduction of Q992. The positive gate appearing at the emitter of Q906 (Dly'd Swp Start

Control) during the delayed sweep further reduces current through Q992, causing the CRT trace to intensify beyond the normal level of unblanking.

In all other selections of the DISPLAY MODE switch, Q984 is forward biased through CR66. This turns off Q988, which diverts current through CR991. Q992 is in saturation and the CRT trace brightness is now set by the unblanking signal (Sweep Gate).

HORIZONTAL PREAMP

The Horizontal Preamp selects the source of the output signal (main or delayed sweep) and supplies an amplified sawtooth signal to the horizontal circuits in the indicator oscilloscope. In addition, this circuit contains the horizontal magnifier circuit and the horizontal positioning network. Fig. 3-9 shows a detailed block diagram of the Horizontal Preamp and the schematic is shown on diagram 8 at the rear of the manual.

Ext Horiz Amp

The Ext Horiz Amp consists of Q1004 and Q1006 connected as an operational amplifier. When the TIME/DIV (DL'Y) switch is in any setting except AMPL, the +5 volts coupled through CR113, CR1016, and R1016 to the base of Q1006 holds this transistor in saturation. Therefore, any incoming external horizontal signal is by-passed to ground (by way of −15 volt supply) through Q1006 and U1020D. When the TIME/DIV (DL'Y) switch is set to AMPL, the +5 volts is removed from the base of Q1006 allowing Q1004 and Q1006 to function as an operational amplifier. The output signal, inverted from the input at connector A, is coupled through R1007.

Horiz Display Selector

Q1024 and U1020A, B, C, D, and E comprise the Horiz Display Selector circuitry. Depending upon the setting of the DISPLAY MODE switch or the TIME/DIV (DL'Y) switch, this circuit determines which signal is coupled to the Horiz Out Amp.

When the TIME/DIV (DL'Y) switch is set to AMP, U1020C is forward biased and couples the signal from the Ext Horiz Amp to the Horiz Out Amp. Simultaneously, +5 volts is disconnected from the DISPLAY MODE switch, assuring that no internally generated sweep signal is coupled through at this time. In all other positions of the

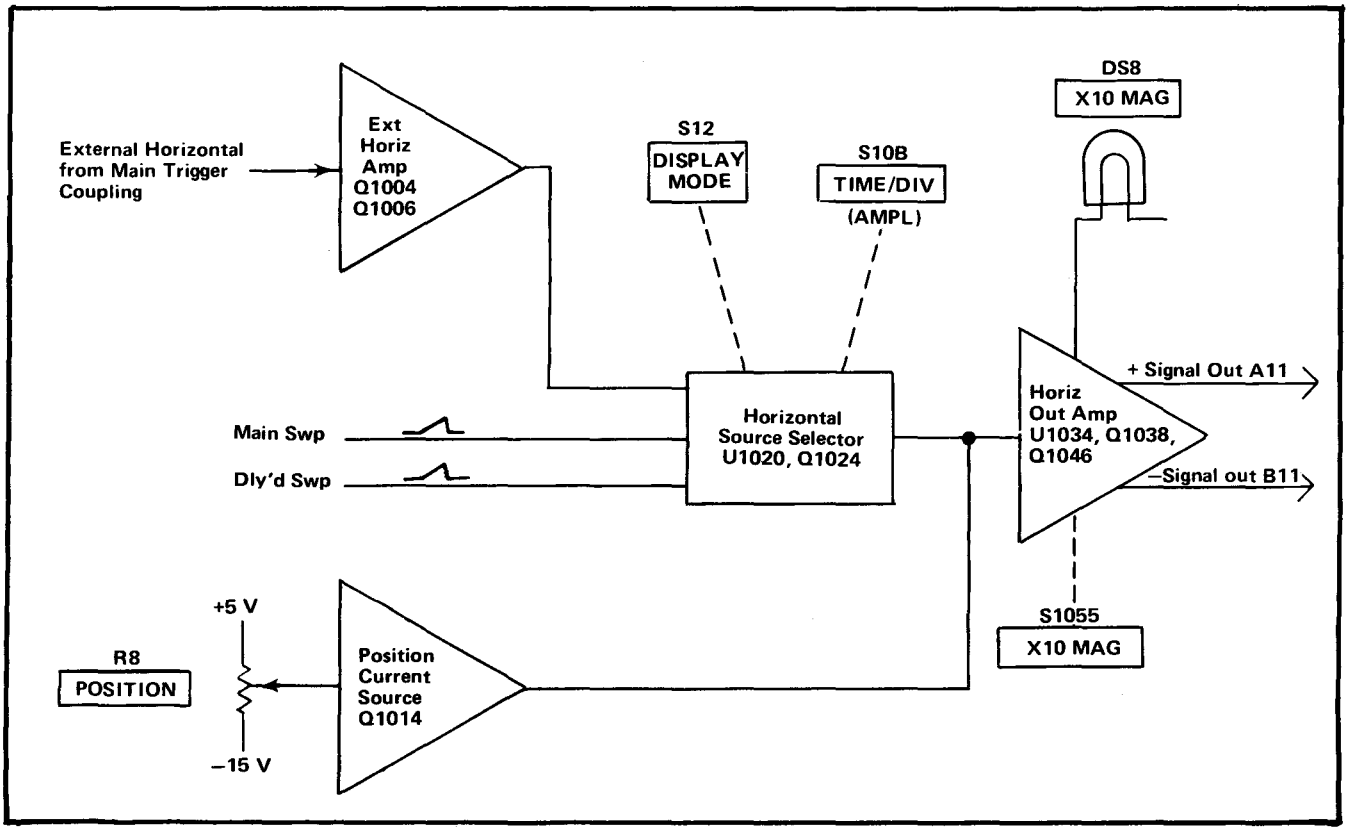


Fig. 3-9. Horizontal Preamp detailed block diagram.

TIME/DIV (DL'Y) switch, +5 volts is connected to the DISPLAY MODE switch.

When MAIN SWP or INTEN is selected by the DISPLAY MODE switch, +5 volts is applied to the anode of CR111 or CR110. This forward biases U1020A, which couples the main sweep sawtooth to the Horiz Out Amp. Q1024 is also forward biased so that any signal developed by the Delayed Sweep Generator is by-passed to ground (via the −15 volt supply). Any output from the Ext Horiz Amp is coupled to ground through U1020D.

If the DISPLAY MODE switch is set to DLY'D SWP or MIXED, +5 volts is applied to the anode of CR108 or CR107. This forward biases U1020B, which couples the delayed sweep or the mixed sweep signal to the Horiz Out Amp. U1020E is also forward biased, coupling the main sweep signal to ground.

Position Amp

The POSITION control R8 sets the bias on Q1014, thus setting the DC current coupled to the Horiz Out Amp.

Horiz Out Amp

The Horiz Out Amp includes Q1038, Q1046, and U1034A, B, C, and D. U1034B and U1034C are connected as an operational amplifer, with R_f being R1052 and R_i the the Swp Cal adjust, R60.

U1034C and U1034D form a paraphase amplifier. This stage converts the single-ended input signal to a push-pull output signal which is necessary to drive the horizontal output stage in the indicator oscilloscope.

This stage also provides the X10 magnification and Mag Gain adjustment. When the X10 MAG switch is activated, R1045 and R1055 are connected in parallel with R1046 and R1056, decreasing the emitter degeneration of the stage. This increases gain of the stage 10 times. The Mag Gain adjust is set to provide a calibrated gain when magnified. A contact of K1055 completes the circuit for the X10 MAG indicator lamp when the X10 MAG switch is activated.

Q1038 and U1034A set the operating bias for the output Stage. Q1046 serves as a constant-current source for U1034C and U1034D.

NOTES

SECTION 4
MAINTENANCE

Introduction

This section of the manual contains maintenance information for use in preventive maintenance, troubleshooting, and corrective maintenance of the 7B53N.

PREVENTIVE MAINTENANCE

General

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 this instrument. The severity of the environment to which the 7B53N is subjected determines the frequency of maintenance. A convenient time to perform preventive maintenance is preceding recalibration of the instrument.

Cleaning

The 7B53N should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket and prevents efficient heat dissipation. It may also provide an electrical conduction path.

The covers of the indicator oscilloscope minimize the amount of dust which reaches the interior of the 7B53N. Operation of the system without the indicator covers in place necessitates more frequent cleaning. When the 7B53N is not in use, it should be stored in a protected location such as a dust-tight cabinet.

CAUTION

Avoid the use of chemical agents which might damage the plastics used in this instrument. Avoid chemicals which contain benzene, toluene, zylene, acetone, or similar solvents.

Exterior. Loose dust accumulated on the outside of the 7B53N can be removed with a soft cloth or small paint brush. The paint brush is particularly useful for dislodging dirt on and around the front-panel controls. Dirt which remains can be removed with a soft cloth dampened in a mild detergent and water solution. Abrasive cleaners can not be used.

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

Visual Inspection

The 7B53N should be inspected occasionally for such defects as broken connections, broken or damaged circuit boards, improperly seated transistors or relays, 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 a recurrence of the damage.

Semiconductor Checks

Periodic checks of the transistors, FET's and IC's used in the 7B53N are not recommended. The best indication of performance is the actual operation of the device in the circuit. Performance of the circuits is thoroughly checked during recalibration; substandard transistors, FET's and IC's will usually be detected at that time.

Recalibration

To ensure accurate measurements, check the calibration of this instrument each 1000 hours of operation or every six months if used infrequently. In addition, replacement of components may necessitate recalibration of the affected circuits. Calibration instructions are given in Section 5.

TROUBLESHOOTING

Introduction

The following information is provided to facilitate troubleshooting of the 7B53N. 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. See the Circuit Description section.

Troubleshooting Aids

Diagrams. Circuit diagrams are given on foldout pages in Section 7. The component number and electrical value of each component in this instrument are shown on the diagrams.

Circuit Boards. Fig. 4-1 shows the location of the circuit boards within this instrument along with the assembly numbers. The assembly numbers are also used on the diagrams and in the parts list to aid in locating the boards. Pictures of the circuit boards are shown in Figs. 7-1 through 7-18. These pictures are located in the Diagrams section, on the back of the page opposite the circuit diagram, to aid the cross-referencing between the diagrams and the circuit-board pictures. Each electrical component on the boards is identified by its circuit number as well as the interconnecting wires and/or connectors. The circuit boards are also outlined on the diagrams with a blue line to show which portions of the circuit are located on a circuit board.

Switch Cam Identification. Switch cam numbers shown on the diagrams indicate the position of the cam in the complete switch assembly. The cams are numbered from the front, or mounting end of the switch, toward the rear.

Resistor Color Code. In addition to the brown composition resistors, some metal-film resistors and some wire-wound resistors are used in the 7B53N. The resistance value of a wire-wound resistor is printed on the body of the component. The resistance values of composition resistors and metal-film resistors are color-coded on the components (some metal-film resistors may have the value printed on the body) with EIA color code. The color code is read starting with the stripe nearest the end of the resistor. Composition resistors have four stripes which consist of two significant figures, a multiplier, and a tolerance value; see Fig. 4-2. Metal-film resistors have five stripes consisting of three significant figures, a multiplier, and a tolerance value.

Capacitor Markings. The capacitance values of common disc capacitors and small electrolytics are marked in microfarads on the side of the component body. The white ceramic capacitors used in the 7B53N are color-coded in picofarads using a modified EIA code (see Fig. 4-2).

Diode Color Code. The cathode end of each glass encased diode is identified by a stripe, a series of stripes, or a dot. For most silicon or germanium diodes with a series of stripes, the color code also indicates the type of diode or identifies the Tektronix Part Number using the resistor color-code system (e.g., a diode color coded blue-or pink-brown- gray-green indicates Tektronix Part Number 152-0185-00). The cathode and anode ends of a metal encased diode can be identified by the diode symbol marked on the body.

Wiring Color Code and Multi-Connector Identification. All insulated wire and cable used in the 7B53N is color coded to facilitate circuit tracing.

Multi-connector holders are keyed with two triangles, one on the connector holder and one on the circuit board. The triangle on the multi-connector holder must be matched with the triangle on the circuit board for proper connection. The color of the multi-connector holder is of the last numeral of the circuit number using the EIA color code (e.g., connector P504 is yellow).

Interface Connector Pin Locations. The Interface circuit board couples the 7B53N to the associated indicator oscilloscope. Fig. 4-3 illustrates the locations of pins on the interface connector as shown on the Voltage Distribution and Output Connectors schematic in the diagrams section.

Troubleshooting Equipment

The following equipment is useful for troubleshooting the 7B53N.

1. Transistor Tester

Description: Tektronix Type 576 Transistor-Curve Tracer or equivalent.

Purpose: To test semiconductors used in this instrument.

2. Volt-ohmmeter

Description: 20,000 ohms/volt. 0-500 volts DC. Accurate within 3%.

Purpose: To measure voltages and resistance.

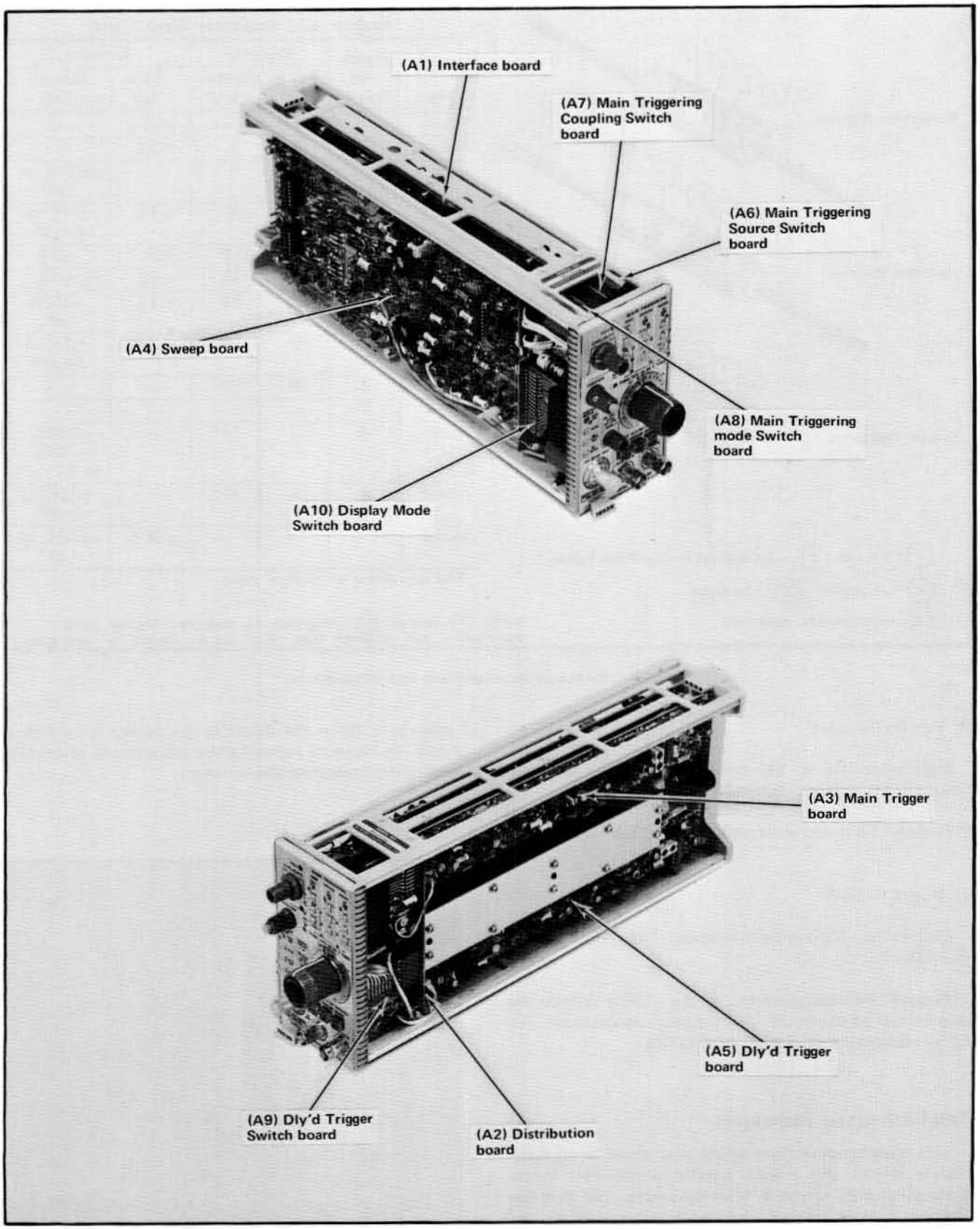
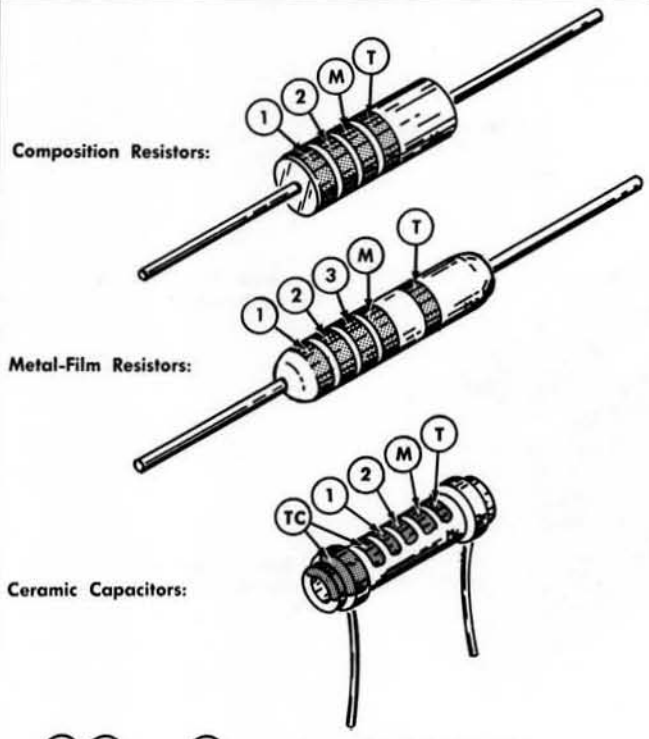


Fig. 4-1. Location of circuit boards in the 7B53N.



Resistor and Capacitor Color Code

Color	Significant Figures	Multiplier: Resistors	Multiplier: Capacitors	Tolerance: Resistors	Tolerance: Capacitors
Silver	---	10^{-2}	---	±10%	---
Gold	---	10^{-1}	---	±5%	---
Black	0	1	1	---	±20% or 2 pF*
Brown	1	10	10	±1%	±1% or 0.1 pF*
Red	2	10^{2}	10^{2}	±2%	±2%
Orange	3	10^{3}	10^{3}	±3%	±3%
Yellow	4	10^{4}	10^{4}	±4%	+100% −0%
Green	5	10^{5}	10^{5}	±0.5%	±5% or 0.5 pF*
Blue	6	10^{6}	10^{6}	---	---
Violet	7	---	---	---	---
Gray	8	---	10^{-2}	---	+80% −20% or 0.25 pF*
White	9	---	10^{-1}	---	±10% or 1 pF*
(none)	---	---	---	±20%	±10% or 1 pF*

*For capacitance of 10 pF or less.

(1) (2) and (3) —1st, 2nd and 3rd significant figures;
(M) —multiplier; (T) —tolerance;
(TC) —temperature coefficient.

NOTE: (T) and/or (TC) color code for capacitors depends upon manufacturer and capacitor type. May not be present in some cases.

Fig. 4-2. Color-code for resistors and ceramic capacitors.

3. Test Oscilloscope

Description: DC to 100 megahertz frequency response, five millivolts to five volts/division. Use a 10X probe.

Purpose: To check waveforms in the instrument.

4. Plug-In Extender

Description: Rigid plug-in extender, Tektronix Part No. 067-0589-00.

Purpose: Permits operation of the 7B53N outside the plug-in compartment of the indicator oscilloscope for better accessibility during troubleshooting.

Troubleshooting Techniques

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

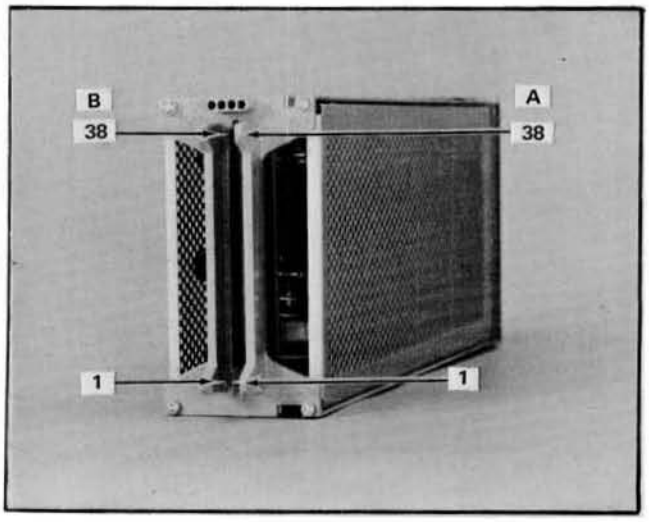


Fig. 4-3. Location of pins on Interface connector.

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. Check Associated Equipment. Before proceeding with troubleshooting of the 7B53N, check that the equipment used with this instrument is operating correctly. Check that the signal is properly connected and that the probe (if used) is not defective. The indicator oscilloscope and vertical plug-in unit can be checked for proper operation by substituting another time-base unit which is known to be operating properly (perferably another 7B53N or similar unit). If the trouble persists after substitution, the indicator oscilloscope and/or vertical plug-in unit should be checked.

3. Check Instrument Calibration. Check the calibration of this instrument, or the affected circuit if the trouble exists in one circuit. The apparent trouble may only be a result of misadjustment and may be corrected by calibration. Complete calibration instructions are given in the Calibration section.

4. Visual Check. Visually check the portion of the instrument in which the trouble is located. Many troubles can be located by visual indications such as unsoldered connections, broken wires, damaged components, etc.

5. Isolate Trouble to a Circuit. To isolate a trouble to a particular circuit, note the trouble symptom. The symptom often indicates the circuit in which the trouble is located. For example, if stable triggering can be obtained in INT position of the SOURCE switch and cannot be obtained in the EXT or LINE positions, the External Trigger Preamp or Trigger Source Switching circuits are probably at fault. When the trouble symptoms appear, use the front-panel controls and the CRT display to try to isolate the trouble to one circuit. Keep in mind the amplifier unit and indicator oscilloscope when isolating the trouble. When trouble appears in more than one circuit, check all affected circuits by taking voltage and waveform measurements. Once the defective circuit has been located, proceed with steps 6 and 7 to locate the defective component(s).

6. Check Individual Components. The following procedures describe methods of checking individual components in the 7B53N. Components which are soldered in place are best checked by disconnecting one end. This isolates the measurement from the effects of surrounding circuitry.

a. RELAY. The eight pin relay used in the 7B53N is symmetrical and may be replaced in its socket facing either direction. This relay, which is plugged into the circuit board, may be removed and checked. Use an ohmmeter to check the 600 ohm resistance. The relay may also be actuated by placing +15 volts across the coil. The internal connections are printed on the body of the relay.

b. TRANSISTORS. The best check of transistor operation is actual performance under operating conditions. If a transistor is suspected of being defective, it can best be checked by substituting a new component or one which 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 (such as a Tektronix Type 576).

c. INTEGRATED CIRCUITS. Integrated circuits should not be replaced unless they are actually defective. The best method for checking these devices is by direct substitution with a new component or one which is known to be good. Be sure that circuit conditions are not such that a replacement component might be damaged.

d. DIODES. A diode can be checked for an open or shorted condition by measuring the resistance between terminals. With an ohmmeter scale having an internal source of between 800 millivolts and 3 volts, the resistance should be very high in one direction and very low when the leads are reversed.

CAUTION

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

e. RESISTORS. Resistors can be checked with an ohmmeter. Check the 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 the specified value.

f. 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.

g. CAPACITORS. A leaky or shorted capacitor can best be detected by checking the resistance with an ohmmeter on the highest scale. Do not exceed the voltage rating of the capacitor. The resistance should be

high after initial charge of the capacitor. An open capacitor can best be detected with a capacitance meter or by checking whether the capacitor passes AC signals.

7. Repair and Readjust the Circuit. If any defective parts are located, follow the replacement procedures given in this section. Be sure to check the performance of any circuit that has been repaired, or that has had any electrical components replaced.

CORRECTIVE MAINTENANCE

General

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

Obtaining Replacement Parts

Standard Parts. All electrical and mechanical part replacements for the 7B53N can be obtained through your local 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, it is important to remember that the physical size and shape of a component may affect the performance in the instrument, particularly at high frequencies. All replacement parts should be direct replacements unless it is known that a different component will not adversely affect instrument performance.

Special Parts. In addition to the standard electronic components, some special parts are used in the 7B53N. These parts are manufactured or selected by Tektronix, Inc. to meet specific performance requirements, or are manufactured for Tektronix, Inc. in accordance with our specifications. These special parts are indicated in the parts list by an asterisk preceding the part number. Most of the mechanical parts used in this instrument have been manufactured by Tektronix, Inc. Order all special parts directly from your local Tektronix Field Office or representative.

Ordering Parts. 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

Disconnect the instrument from the power source before soldering.

Circuit Boards. The components mounted on the circuit boards in the 7B53N can be replaced using normal circuit board soldering techniques. Keep the following points in mind when soldering on the circuit boards.

1. Use a pencil-type soldering iron with a power rating from 15 to 30 watts.

2. Apply heat from the soldering iron to the junction between component and circuit board.

3. Heat-shunt the lead of the component by means of a pair of long-nose pliers.

4. Avoid excessive heating of the junction with the circuit board, as this could separate the circuit board wiring from the laminate.

5. Use electronic grade 60-40 tin-lead solder.

6. Clip off any excess lead length extending beyond the circuit board, and clean off any residual flux with a flux-removing solvent. Be careful that the solvent does not remove any printing from the circuit board.

Metal Terminals. When soldering metal terminals (e.g., switch terminals, potentiometer, etc.), use 60-40 tin-lead solder and a 15 to 50 watt soldering iron. Observe the following precautions when soldering metal terminals:

1. Apply only enough heat to make the solder flow freely.

2. Apply only enough solder to form a solid connection. Excess solder may impair the function of the part.

3. If a wire extends beyond the solder joint, clip off the excess.

4. Clean the flux from the solder joint with a flux-removing solvent.

Component Replacement

WARNING

Disconnect the equipment from the power source before replacing components.

Relay Replacement. The relay in the 7B53N is manufactured by Tektronix, Inc. If the relay fails, a replacement may be ordered from your local Tektronix Field Office or representative. The eight-pin DPDT relay may be replaced in its socket either direction, as this relay is symmetrical.

Semiconductor Replacement. Semiconductor devices used in this instrument should not be replaced unless actually defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement may affect the calibration of this instrument. When replaced, check the operation of that part of the instrument which may be affected.

Replacement devices should be of the original type or a direct replacement. Remount in the same manner as the original. Fig. 4-4 shows the lead configurations of the semiconductor devices used in this instrument. When replacing, check the manufacturer's basing diagram for correct basing.

Interconnecting Pins and Pin Socket Replacement. Two types of mating connectors are used for these interconnecting pins. If the mating connector is mounted on a plug-on circuit board, a special socket is soldered onto the board. If the mating connector is on the end of a lead, a pin connector is used to mate with the interconnecting pin. The following information provides the replacement procedure for the various types of pins and pin sockets.

a. Circuit Board Pins. To replace a pin which is mounted on a circuit board, first disconnect any pin connectors. Unsolder the damaged pin and pull it out of the circuit board. Press the new pin into the hole in the circuit board so the ferrule on the pin is centered in the hole in the board. (Notice that the ferrule is not centered on the pin; be sure the replacement pin is positioned in the same manner as the original.) Solder the pin on both sides of the circuit board. If the pin was bent at an angle to mate with a connector, bend the new pin to match the associated pins. The inside radius of this bend should not be less than 0.025-inch.

b. Circuit Board Pin Sockets. The pin sockets on the circuit boards are soldered to the rear of the board. To replace the sockets, first unsolder the socket (use a vacuum-type desoldering tool to remove excess solder). Straighten the tabs on the socket to remove it from the hole in the circuit board. Place the new socket in the circuit board hole and press the tabs down against the board. Solder the socket tabs to the circuit board.

NOTE

The spring tension of the terminal 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 connection point for spring-loaded probe tips, alligator clips, etc.

c. End-Lead Pin Connectors. The pin connectors used to connect the wires to the circuit board pins are clamped to the ends of the associated leads. To replace a damaged pin connector, first remove the old pin connector from the end of the lead. Clamp the new pin connector to the end of the lead. Some of the pin connectors are grouped together and mounted in a plastic holder. These connectors are removed and re-installed as a unit. To provide correct orientation of this multi- connector when it is replaced, an arrow is moulded into the plastic housing of the multi-pin connector and a matching arrow is stamped on the circuit board.

Switch Replacement. Two types of switches are used in the 7B53N. The pushbutton switches and the cam-type switch should be replaced as a unit if damaged. The following special maintenance information is provided for the cam-type and pushbutton switches.

CAUTION

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

a. Cam-Type Switch. The cam-type switch (TIME/DIV OR DL'Y TIME and DLY'D SWEEP Time/Division) consists of two rotating cams (front portion for TIME/DIV OR DL'Y TIME and rear portion for DLY'D SWEEP

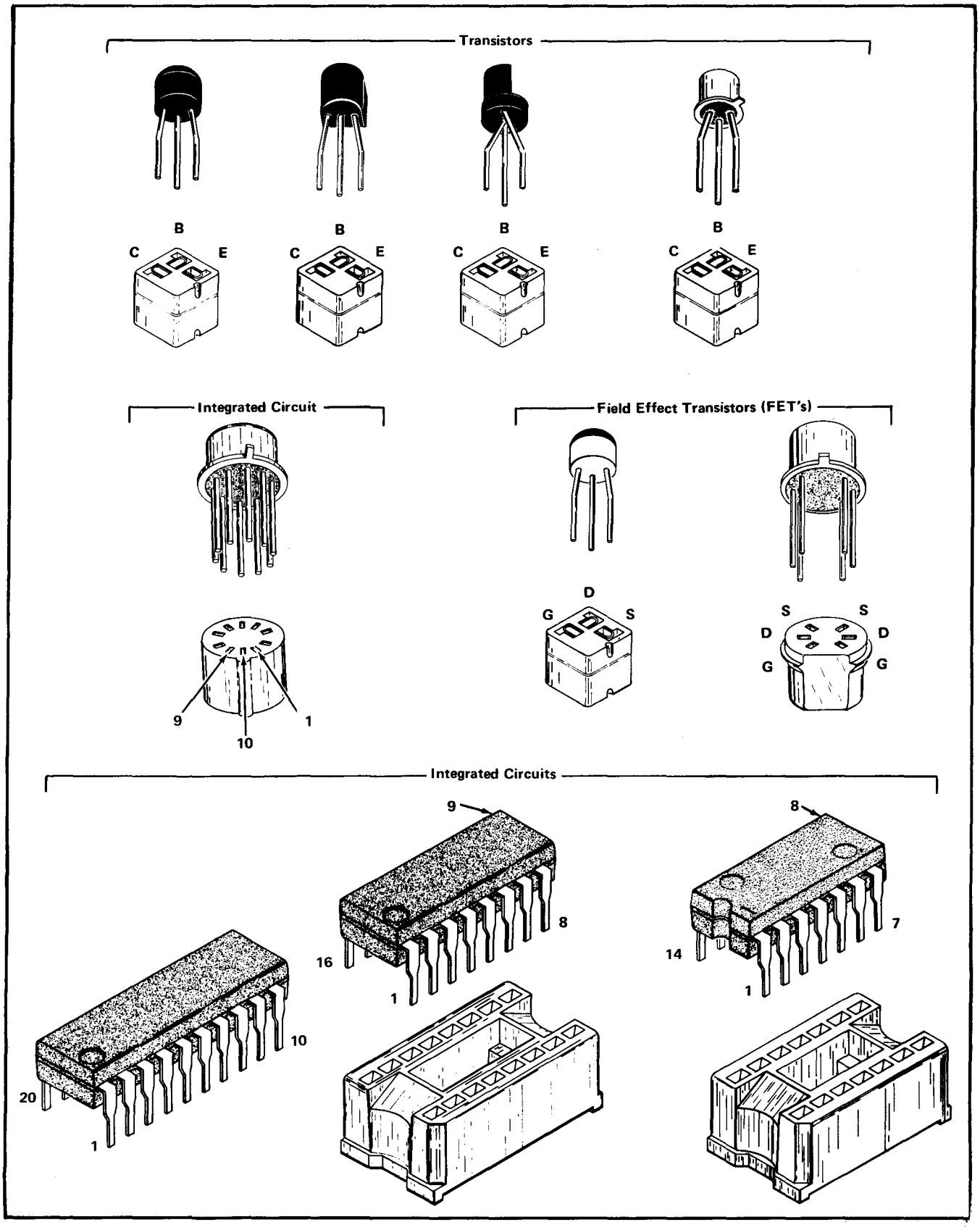


Fig. 4-4. Electrode configuration of transistors, FETs and integrated circuits used in this instrument.

Time/Division), which are turned by front-panel knobs and contacts which are mounted on the adjacent Interface circuit board. These contacts are actuated by lobes on the cam as it is turned. The switch can be disassembled for inspection, cleaning, repair, or replacement; but it is recommended that the switch be removed from the instrument only as a unit. The following procedure should be observed.

NOTE

See Mechanical Parts exploded views for switch breakdown.

1. Set the TIME/DIV OR DL'Y TIME and DELAYED SWEEP switch to AMPL position to provide easy access to the set screw on the clear plastic flange and to facilitate replacement of the switch. Loosen the set screws and remove the VARIABLE and DELAYED SWEEP knobs. Remove the set screw from the rear of the front-subpanel and remove the clear plastic flange associated with the Time/Division assembly.

2. Disconnect P114 from the Interface board (located at the rear of the cam switch between the Main and Delayed Trigger boards).

3. Disconnect the two cables from the Sweep board.

4. Completely loosen the six screws holding the Sweep board.

5. Carefully lift the Sweep board from the instrument; do not bend pins from the Interface board to the Sweep board.

6. Remove the 10 phillips head screws holding the cam switch to the Interface board. Hold the cam switch while removing the screws.

7. Remove the cam switch from the 7B53N.

8. Follow the procedure as given in the switch repair kit to remove, replace, etc., the contacts on the Interface board.

9. To replace the cam switch, reverse the above procedure. Make sure that the clear plastic flange and the DELAYED SWEEP knob are replaced at the same switch position from which they were removed (AMPL).

CAUTION

When replacing the 10 screws, tighten evenly. When replacing the Sweep board, do not apply much pressure until it is certain all pins from the interface board have mated with the connectors on the Sweep board.

NOTE

When replacing the front-panel knobs and ring associated with the cam switch, slide the ring onto the shaft, but do not tighten. Then, install the large knob (it takes a little pressure) and tighten in place. Next, push the ring (from behind front-panel) until it seats properly with the large knob and lock in place. This will insure no backlash between the knob and ring as the cam is rotated.

b. Pushbutton Switches. Use the following procedure to replace the pushbutton switches:

1. Set the TIME/DIV OR DL'Y TIME and DELAYED SWEEP switch to AMPL position to provide easy access to the set screw on the clear plastic flange and to facilitate replacement of the Time/Division switch. Loosen the set screws and remove the LEVEL/SLOPE, POSITION, VARIABLE, and DELAYED SWEEP Time/Division knobs. Loosen the set screw from the rear of the front subpanel and remove the clear plastic flange associated with the Time/Division switch assembly. The X10 MAG button can be pulled from its shaft. Remove the spring from the 7B53N release latch.

2. Remove the front panel to gain access to the switch mounting screws.

3. Loosen the four phillips screws holding the front-panel to the chassis and the phillips screws holding the switch to be replaced to the front-subpanel.

4. Loosen any multipin connector(s) associated with the switch being replaced and unsolder leads or components where necessary.

5. When the switch being replaced is clear from external connection, remove the complete switch assembly.

6. To replace the pushbutton switch, reverse the above procedure. Make sure that the clear plastic flange and the DELAYED SWEEP knob are replaced at the same switch position from which they were removed (AMPL).

NOTE

When replacing the front-panel knobs and ring associated with the cam switch, slide the ring onto the shaft, but do not tighten. Then, install the large knob (it takes a little pressure) and tighten in place. Next, push the ring (from behind front-panel) until it seats properly with the large knob and lock in place. This will insure no backlash between the knob and ring as the cam is rotated.

SECTION 5
CALIBRATION

Introduction

To assure instrument accuracy, check the calibration of the 7B53N every 1000 hours of operation, or every six months if used infrequently. Before complete calibration, thoroughly clean and inspect this instrument as outlined in the Maintenance section.

Tektronix Field Service

Tektronix, Inc., provides complete instrument repair and recalibration service at local Field Service Centers and the Factory Service Center. Contact your local Tektronix Field Office or representative for further information.

Using This Procedure

General. This section provides several features to facilitate checking or adjusting the 7B53N. These are:

Index. To aid in locating a step in the Performance Check or Adjustment procedure, an index is given preceding Part I—Performance Check and Part II—Adjustment procedure.

Performance Check. The performance of this instrument can be checked without removing the covers or making internal adjustments by performing only Part I—Performance Check. This procedure checks the instrument against the tolerances listed in the Performance Requirement column of Section 1. Screwdriver adjustments accessible from the outside of the instrument are adjusted as part of the Performance Check procedure. In addition, a cross-reference is provided to the step in Part II—Adjustment which will return the instrument to correct calibration. In most cases, the adjustment step can be performed without changing control settings or equipment connections.

Adjustment Procedure. To return this instrument to correct calibration with the minimum number of steps, perform only Part II—Adjustment. The Adjustment procedure gives the recommended calibration procedure for all circuits in this instrument. It also includes check procedures for those functions which cannot be checked without removing the covers (e.g., output signals). Procedures are not given for checks which can be made without removing the covers; see Part I—Performance Check for the procedure for these checks.

Partial Procedure. A partial check or adjustment is often desirable after replacing components, or to touch up the adjustment of a portion of the instrument between major recalibrations. To check or adjust only part of the instrument, set the controls as given under Preliminary Control Settings and start with the nearest Equipment Required list preceding the desired portion. To prevent unnecessary recalibration of other parts of the instrument, readjust only if the tolerance given in the CHECK—part of the step is not met. If re-adjustment is necessary, also check the calibration of any steps listed in the INTERACTION— part of the step.

Complete Performance Check/Adjustment. To completely check and adjust all parts of this instrument, perform both Parts I and II. Start the complete procedure by adjusting the trigger system as given in the adjustment procedure and follow this with the Performance Check for the same portion (e.g., Trigger System Check). This method will assure that the instrument is both correctly adjusted and performing within all given specifications.

NOTE

All waveforms shown in this section were taken with a Tektronix Oscilloscope Camera System, unless noted otherwise.

TEST EQUIPMENT REQUIRED

General

The following test equipment and accessories, or its equivalent, is required for complete calibration of the 7B53N. Specifications given for the test equipment are the minimum necessary for accurate calibration. Therefore, some of the specifications listed here may be somewhat less precise than the actual performance capabilities of the test equipment. All test equipment is assumed to be correctly calibrated and operating within the listed specifications.

The Performance Check and Adjustment procedures are based on this recommended equipment. If other equipment is substituted, control settings or calibration setup may need to be altered to meet the requirements of the equipment used. Detailed operating instructions for the test

equipment are not given in this procedure. Refer to the instruction manual for the test equipment if more information is needed.

Special Calibration Fixtures

Special Tektronix calibration fixtures are used in this procedure only where they facilitate instrument calibration. These special calibration fixtures are available from Tektronix, Inc. Order by part number through your local Tektronix Field Office or representative.

Calibration Equipment Alternatives

All of the test equipment is required to completely check and adjust this instrument. However, some of the items used only for instrument checks can be deleted without compromising the measurement capabilities of this instrument. For example, the medium frequency test oscilloscope used only to check output signals in the Performance Check and Adjustment Procedures, may be deleted if the user does not desire to check the output signals of this unit. Equipment used only for the adjustment procedure is indicated by footnote 1.

Test Equipment

1. Tektronix 7000-Series Oscilloscope; readout system not required. A Tektronix 7403N is used in this procedure.

2. Tektronix vertical plug-in unit. Tektronix 7A15 Amplifier unit or 7A18 Dual Trace Amplifier unit is recommended. A 7A18 is used in this procedure.

3. Constant amplitude sine-wave generator. Reference frequency, 50-kilohertz; frequency range, 10 megahertz to 100 megahertz; output amplitude, variable from 100 millivolts to 500 millivolts. Tektronix Type 191 Constant Amplitude Signal Generator recommended.

4. Low-frequency sine-wave generator. Frequency range, 30 hertz to one-megahertz; output amplitude 15 millivolts to 500 millivolts or greater. General Radio Model 1310B Oscillator recommended (use General Radio Type 274 QBJ Adapter to provide BNC output).

5. Time-mark generator. Marker outputs, five seconds to 100 nanoseconds; sine-wave outputs, 50-nanoseconds to 5-nanoseconds; marker accuracy, within 0.1%. Tektronix Type 2901 Time-Mark Generator recommended.

6. Square-wave generator.[1] Frequency, one-kilohertz; risetime, 20-nanoseconds or less at 0.5 volt. Tektronix Type 106 Square-Wave Generator recommend.

[1] **Required only for adjustment procedure.**

7. Test oscilloscope system. Bandwidth, DC to 500 kilohertz; deflection factor, 50-millivolts/division to five-volts/division; accuracy, within 3%. Tektronix Type 422 oscilloscope with P6012 10X Probe recommended.

8. Plug-in extender.[1]. Tektronix Part No. 067-0589-00.

Accessories

9. 10X Voltage Probe. Attenuation, 10X within 3%; connector, BNC; input compensation, adjustable to allow compensation with amplifiers having input capacitance of 15 to 24 picofarads. Tektronix P6054 recommended.

10. 18-inch cable. Impedance, 50-ohms; type, RG-58/U; connectors, BNC. Tektronix Part No. 012-0076-00.

11. 42-inch cable (two). Impedance, 50-ohms; type RG-58/U; connectors, BNC. Tektronix Part No. 012-0057-01.

12. Five-nanosecond cable. Impedance, 50-ohms; type RG-213/U; connectors, GR 874. Tektronix Part No. 017-0502-00.

13. BNC T-Connector. Tektronix Part No. 103-0030-00.

14. BNC termination (two). Impedance, 50-ohms; wattage rating, two watts; accuracy, ±2%; connectors, BNC. Tektronix Part No. 011-0049-01.

15. Input RC Normalizer.[1] Time Constant, one megohm times 20 picofarads; connectors, BNC. Tektronix calibration fixture 067-0538-00.

16. Attenuator.[1] Impedance, 50-ohm; attenuation, 10X; type, feedthrough; connectors, BNC; accuracy, ±3%. Tektronix Part No. 011-0059-01.

17. Adapter. Connectors, GR to BNC male. Tektronix Part No. 017-0064-00.

18. [1] Adapter. Connectors, GR to BNC female. Tektronix Part No. 017-0063-00.

Preliminary Control Settings

Set test equipment and 7B53N controls as follows (for both Performance Check and Adjustment procedure):

7A18

Position (CH 1 and CH 2)	Midrange
AC-DC-GND (CH 1 and CH 2)	AC
CH 2 Polarity	+Up
DISPLAY MODE	CH 1
TRIGGER SOURCE	CH 1
CH 1 Volts/Div	50 mV
CH 2 Volts/Div	50 mV
Variable Volts/Div (CH 1 and CH 2)	Locked in (off)

7403N Indicator Oscilloscope

Vert Mode	Left
Trig Source	Left Vert
Focus	Adjust for well defined display
Intensity	Midrange
Graticule Illum	As desired

7B53N

Main Triggering	
LEVEL/SLOPE	0/+
MODE	AUTO
COUPLING	AC
SOURCE	INT
Delayed Triggering	
LEVEL	IN—RUNS AFTER DLY TIME
SLOPE	+
COUPLING	AC
SOURCE	INT
Sweep Controls	
POSITION	Midrange
X10 MAG	Off
DISPLAY MODE	MAIN SWP
TIME/DIV OR DL'Y TIME	20 μs
DLY'D SWEEP	10 μs
VARIABLE	CAL
Variable Selector (internal)	MAIN TIME/DIV VARIABLE
DELAY TIME MULT	1.00

PART I PERFORMANCE CHECK

Introduction

The following procedure checks the performance of the 7B53N without removing the side-covers or making internal adjustments. All tolerances given in this procedure are based on Section 1 of this manual.

Index to Part I—Performance Check

Preliminary Procedure for Performance Check

NOTE

The performance of this instrument can be checked at any temperature within 0° C to +50° C range unless otherwise stated.

1. Install the 7B53N into the right compartment of the indicator oscilloscope.

2. Install the 7A18 Vertical Amplifier unit into the left vertical compartment.

3. Turn on the 7403N oscilloscope and allow at least 20 minutes warmup before preceeding with the Performance Check.

4. Set the equipment controls as given in this section under Preliminary Control Settings.

TRIGGER SYSTEM CHECK

Equipment Required

1. 7403N Oscilloscope.
2. 7A18 Dual Trace Amplifier Unit.
3. 10X probe.
4. High-Frequency constant-amplitude sine-wave generator.
5. Low-Frequency sine-wave generator.
6. Five nanosecond GR cable.
7. GR to BNC male adapter.
8. BNC T-connector.
9. 42-inch 50-ohm BNC cable.
10. 18-inch 50-ohm BNC cable.
11. 50-ohm BNC termination (two).

Control Settings

Set the controls as given under Preliminary Control Settings.

1. Check Main and Delayed Internal Triggering Operation.

a. Connect a 50-ohm five-nanosecond GR cable, 50-ohm GR to BNC male adapter, and 50-ohm BNC termination from the high frequency constant-amplitude sine-wave generator to the 7A18 CH 1 Input connector.

b. Change the following control settings:

MAIN TRIGGERING	
MODE	NORM
LEVEL/SLOPE	Set for stable main sweep display.
TIME/DIV OR	
DL'Y TIME	.1 μs
DLY'D SWEEP	
Time/division	.05 μs

c. Set the high frequency generator for a 0.3-division display at 10 megahertz.

d. CHECK—Stable CRT display can be obtained with the MAIN TRIGGERING COUPLING switch set to AC, AC LF REJ and DC (MAIN TRIGGERING LEVEL/SLOPE control may be adjusted as necessary to obtain a stable main sweep display; TRIG'D light on).

e. Change the following control settings:

Main Triggering	
COUPLING	AC
LEVEL/SLOPE	Set for stable main sweep display.
DISPLAY MODE	DLY'D SWP
Delayed Triggering	
LEVEL	OUT—DLY'D SWP TRIGGERABLE

f. CHECK—Stable CRT display can be obtained with Delayed Triggering COUPLING switch set to AC and DC (Delayed Triggering LEVEL control may be adjusted as necessary to obtain a stable delayed sweep display).

g. Change the following control settings:

DISPLAY MODE	MAIN SWP
MAG	X10

h. Set the high-frequency generator for a 1.5-division display at 100 megahertz.

i. CHECK—Stable CRT display can be obtained with the COUPLING switch for MAIN TRIGGERING set to AC, AC LF REJ and DC (MAIN TRIGGERING LEVEL/SLOPE control may be adjusted as necessary to obtain a stable display).

j. Change the following control settings:

Main Triggering	
COUPLING	AC
LEVEL/SLOPE	Set for a stable main sweep display
DISPLAY MODE	DLY'D SWP

k. CHECK—Stable CRT display can be obtained with the Delayed Triggering COUPLING switch set to AC and DC (Delayed Triggering LEVEL control may be adjusted as necessary to obtain stable display).

1. Disconnect all test equipment.

2. Check Main and Delayed External Triggering Operation

a. Change the following control settings:

Main Triggering	
COUPLING	AC
SOURCE	EXT
Delayed Triggering	
SOURCE	EXT
COUPLING	AC
X10 MAG	Off
DISPLAY MODE	MAIN SWP

b. Connect the high-frequency constant-amplitude sine-wave generator to the 7A18 CH 1 input connector with the five-nanosecond GR cable, GR to BNC male adapter, BNC T-connector, and 50-ohm BNC termination. Connect the output of the T-connector to the 7B53N MAIN TRIG IN connector with an 18-inch 50-ohm BNC cable and 50-ohm BNC termination.

c. Set the generator for a two-division display (100 millivolts) at 10 megahertz.

d. CHECK—Stable CRT display can be obtained with the MAIN TRIGGERING COUPLING switch set to AC, AC LF REJ and DC (MAIN TRIGGERING LEVEL/SLOPE control may be adjusted as necessary to obtain stable display).

e. Disconnect the 50-ohm cable and termination from the MAIN TRIG IN connector and place them on the DLY'D TRIG IN connector.

f. Change the following controls:

Main Triggering	
SOURCE	INT
COUPLING	AC
LEVEL/SLOPE	Set for stable main sweep display
DISPLAY MODE	DLY'D SWP
Delayed Triggering	
LEVEL	IN—RUNS AFTER DLY TIME

g. Set the high-frequency generator for two-division display (100 millivolts) at 10 megahertz.

h. Press and release the Delayed Triggering LEVEL control to the OUT—DLY'D SWP TRIGGERABLE position.

i. CHECK—Stable CRT display can be obtained with the Delayed Triggering COUPLING switch set to AC and DC (Delayed Triggering LEVEL control may be adjusted as necessary to obtain stable delayed sweep display).

j. Disconnect the 50-ohm cable and termination from the DLY'D TRIG IN connector and connect it to the MAIN TRIG IN connector.

k. Change the following control settings:

7B53N

Main Triggering	
SOURCE	EXT
DISPLAY MODE	MAIN SWP
Delayed Triggering	
LEVEL	IN—RUNS AFTER DLY TIME

7A18

CH 1 VOLTS/DIV	.1 V

l. Set the generator for a five-division display (500 millivolts) at 10 megahertz. Set the MAIN TRIGGERING LEVEL/SLOPE control for a stable display.

m. Without changing the output amplitude, increase the output frequency of the generator to 100 megahertz.

n. Press and release the magnifier to X10 MAG.

o. CHECK—Stable CRT display can be obtained with the MAIN TRIGGERING COUPLING switch set to AC, AC LF REJ and DC (MAIN TRIGGERING LEVEL/SLOPE control may be adjusted as necessary to obtain a stable main sweep display).

p. Disconnect the termination from the MAIN TRIG IN connector and connect it to the DLY'D TRIG IN connector.

q. Change the following control settings:

Main Triggering	
SOURCE	INT
LEVEL/SLOPE	Set for stable main sweep display
DISPLAY MODE	DLY'D SWP
X10 MAG	Off (pressed in)

r. Set the high-frequency generator for five-divisions (500 millivolts) at 10 megahertz.

s. Without changing the amplitude, increase the output frequency to 100 megahertz.

t. Change the following control settings:

MAG	X10
Delayed Triggering	
LEVEL	OUT—DLY'D SWP TRIGGERABLE

u. CHECK—Stable CRT display can be obtained with the Delayed Triggering COUPLING switch set to AC and DC (Delayed Triggering LEVEL control may be adjusted as necessary to obtain a stable delayed sweep display).

v. Disconnect all test equipment.

3. Check Main and Delayed Internal Trigger Jitter.

a. Connect the high-frequency constant amplitude sine-wave generator to the 7A18 Ch 1 Input by way of the five-nanosecond GR cable, the GR to BNC male adapter, and 50-ohm BNC termination.

b. Change the following control settings:

Main Triggering	
LEVEL/SLOPE	Set for stable main sweep display (TRIG'D light on).
Delayed Triggering	
SOURCE	INT
COUPLING	AC
LEVEL	IN—RUNS AFTER DLY TIME

c. Set the high-frequency generator for a one-division display at 75 megahertz.

d. Press in and release the Delayed Triggering LEVEL control to OUT—DLY'D SWP TRIGGERABLE and rotate control for stable delayed sweep display.

e. CHECK—CRT delayed sweep display for no more than 0.2 division (one-nanosecond) of jitter. Disregard any slow drift.

f. Change the following control settings:

DISPLAY MODE	MAIN SWP
Main Triggering	
LEVEL/SLOPE	Set for stable main sweep display.

g. CHECK—CRT main sweep display for less than 0.1 division (one-nanosecond) of jitter. Disregard any slow drift.

h. Disconnect all test equipment.

4. Check Main and Delayed Low-Frequency Triggering Operation.

a. Connect the low-frequency sine-wave generator to the 7A18 CH 1 Input with the 42-inch 50 ohm BNC cable, BNC T-connector, and 50-ohm BNC in-line termination. Connect the output of the BNC T-connector to the MAIN TRIG IN connector with an 18-inch 50-ohm BNC cable and a 50-ohm BNC termination.

b. Change the following control settings:

TIME/DIV OR	
DL'Y TIME	10 ms
DELAYED SWEEP	
Time/Division	5 ms
X10 MAG	Off

c. Set the generator for a 0.3-division display at 30 hertz.

d. CHECK—Stable CRT display can be obtained with the MAIN TRIGGERING COUPLING switch set to AC, AC HF REJ and DC (MAIN TRIGGERING LEVEL/SLOPE control may be adjusted as necessary to obtain a stable main sweep display).

e. Change the following control settings:

Main Triggering	
COUPLING	AC
LEVEL/SLOPE	Set for stable main sweep display.
DISPLAY MODE	DLY'D SWP

f. CHECK—Stable display can be obtained with the Delayed Triggering COUPLING switch set to AC and DC (Delayed Triggering LEVEL control may be adjusted as necessary to obtain a stable delayed sweep display).

g. Change the following control settings:

Main Triggering	
MODE	AUTO
SOURCE	EXT
DISPLAY MODE	MAIN SWP
Delayed Triggering	
SOURCE	EXT

h. Set the generator for a one-division display (100 millivolts) at 30 hertz; then return the MAIN TRIGGERING MODE switch to NORM.

i. CHECK—Stable CRT display can be obtained with the MAIN TRIGGERING COUPLING switch set to AC, AC HF REJ and DC (MAIN TRIGGERING LEVEL/SLOPE control may be adjusted as necessary to obtain a stable display).

j. Change the following control settings:

Main Triggering	
COUPLING	AC
SOURCE	INT
LEVEL/SLOPE	Set for stable main sweep display.
DISPLAY MODE	DLY'D SWP

k. Disconnect the 50-ohm cable from the MAIN TRIG IN connector and place it on the DLY'D TRIG IN connector.

l. CHECK—Stable CRT display can be obtained with the Delayed Triggering COUPLING switch set to AC and DC (Delayed Triggering LEVEL control may be adjusted as necessary for a stable delayed sweep display).

5. Check Main Triggering AC High-Frequency Reject Operation

a. Change the following control settings:

Main Triggering	
MODE	AUTO
COUPLING	AC HF REJ
TIME/DIV OR	
DL'Y TIME	20 μs
DELAYED SWEEP	
Time/Division	20 μs
DISPLAY MODE	MAIN SWP

b. Set the low-frequency generator for a 0.3-division display at 50 kilohertz; then return the MAIN TRIGGERING MODE switch to NORM.

c. CHECK—Stable CRT display can be obtained with the MAIN TRIGGERING LEVEL/SLOPE control.

d. Without changing the output amplitude, set the low-frequency generator to one-megahertz.

e. Press and release magnifier to X10 MAG position.

f. CHECK—Stable CRT display cannot be obtained at any setting of the MAIN TRIGGERING LEVEL/SLOPE control.

6. Check Main Triggering AC Low-Frequency Reject Operation

a. Change the following control settings:

Main Triggering	
MODE	AUTO
COUPLING	AC LF REJ
X10 MAG	Off

b. Set the low-frequency generator for a 0.3-division display at 30 kilohertz; then return the MAIN TRIGGERING MODE switch to NORM.

c. CHECK—Stable CRT display can be obtained with the MAIN TRIGGERING LEVEL/SLOPE control.

d. Without changing the output amplitude, set the low-frequency generator to 60 hertz.

e. Set the TIME/DIV OR DL'Y TIME and DELAYED SWEEP Time/Division switches to 2 ms.

f. CHECK—Stable CRT display cannot be obtained at any setting of the MAIN TRIGGERING LEVEL/SLOPE control.

7. Check Main and Delayed Trigger Level and Slope Operation

a. Change the following control settings:

7A18

Ch 1 Volts/Div	1 V

7B53N

Main Triggering	
MODE	AUTO
COUPLING	DC
DISPLAY MODE	DLY'D SWP
TIME/DIV OR	
DL'Y TIME	1 ms
DELAYED SWEEP	
Time/Division	.5 ms
Delayed Triggering	
LEVEL	IN—RUNS AFTER DL'Y TIME

b. Remove the 50-ohm terminations from the 7A18 Ch 1 Input and from the 7B53N DLY'D TRIG IN connector; then reconnect the cables.

c. Set the low-frequency generator for three-divisions of one kilohertz signal.

d. Press and release the Delayed Triggering LEVEL control to the OUT—DLY'D SWP TRIGGERABLE position.

e. CHECK—Rotate the Delayed Triggering LEVEL control throughout its range and check that display can be triggered at any point along the positive slope of delayed sweep waveform. Display is not triggered at either extreme of rotation.

f. Set the Delayed Triggering SLOPE switch to —.

g. CHECK—Rotate the Delayed Triggering LEVEL control throughout its range and check that display can be triggered at any point along the negative slope of the delayed sweep waveform (indicated Delayed Triggering LEVEL control range at least + and —1.5 volts). Display is not triggered at either extreme of rotation.

h. Change the following control settings:

Main Triggering	
MODE	NORM
SOURCE	EXT
DISPLAY MODE	MAIN SWP

i. Disconnect the cable from the DLY'D TRIG IN connector and connect it to the MAIN TRIG IN connector.

j. Rotate the MAIN TRIGGERING LEVEL/SLOPE control throughout the positive slope corresponding to the markings on the 7B53N front-panel.

k. CHECK—All levels of the positive slope may be selected as the main sweep trigger point. Check for no display with LEVEL/SLOPE control at either end of rotation.

l. Rotate the MAIN TRIGGERING LEVEL/SLOPE control throughout the negative slope corresponding to the markings on the 7B53N front-panel.

m. CHECK—All levels of the negative slope may be selected as the main sweep trigger point (indicates MAIN TRIGGERING LEVEL/SLOPE control range of at least + and —1.5 volts). Check for no display with LEVEL/SLOPE control at either end of rotation.

n. Change the following control settings:

7A18

Ch 1 Volts/Div	5 V

7B53N

Main Triggering	
SOURCE	EXT ÷ 10

o. Set the low-frequency generator for six-divisions of one kilohertz signal.

p. Rotate the MAIN TRIGGERING LEVEL/SLOPE control throughout the positive slope corresponding to the markings on the 7B53N front-panel.

q. CHECK—All levels of the positive slope may be selected as the main sweep trigger point. Check for no display with LEVEL/SLOPE control at either end of rotation.

r. Rotate the MAIN TRIGGERING LEVEL/SLOPE control throughout the negative slope corresponding to the markings on the 7B53N front-panel.

s. CHECK—All levels of the negative slope may be selected as the main sweep trigger point (indicates MAIN TRIGGERING LEVEL/SLOPE control range at least + and —15 volts). Check for no display with LEVEL/SLOPE control at either end of rotation).

t. Disconnect all test equipment.

8. Check Main Trigger Modes

a. Set the following control settings:

7A18

Ch 1 Volts/Div	1 V

7B53N

Main Triggering	
MODE	AUTO
COUPLING	AC
SOURCE	INT
TIME/DIV OR	
DL'Y TIME	20 μs
DELAYED SWEEP	
Time/Division	20 μs

b. Connect the low-frequency generator to the 7A18 Ch 1 Input with a 50-ohm BNC cable and 50-ohm BNC termination.

c. Set the low-frequency generator for a four-division display at 50 kilohertz.

d. Rotate the MAIN TRIGGERING LEVEL/SLOPE control for a free-running display (near the top or bottom of markings on 7B53N front-panel).

e. Set the MAIN TRIGGERING MODE switch to NORM.

f. CHECK—CRT for no display.

g. Set the MODE switch to AUTO. Rotate the MAIN TRIGGERING LEVEL/SLOPE control so display is just triggered.

h. Set the MAIN TRIGGERING MODE switch to NORM.

i. CHECK—CRT for triggered display.

j. Set the low-frequency generator for a four-division display at 500 hertz.

k. Change the following control settings:

Main Triggering	
LEVEL/SLOPE	Set for a stable display (TRIG'D light on)
MODE	SINGLE SWP
TIME/DIV OR	
DL'Y TIME	2 ms
DELAYED SWEEP	
Time/Division	2 ms

l. CHECK—CRT for no display.

m. Press the MAIN TRIGGERING RESET button.

n. CHECK—CRT for one sweep as RESET button is pressed (Intensity control on indicator oscilloscope may need to be rotated clockwise to observe single sweep display).

o. Remove the signal from the 7A18 Ch 1 Input connector, then press the RESET button.

p. CHECK—CRT for no display and READY light on.

q. Reconnect the signal to the 7A18 Ch 1 Input connector.

r. CHECK—For one sweep as the signal is applied to the 7A18 and that the READY light is out after completion of that sweep.

s. Disconnect all test equipment.

9. Check Line Triggering Operation

a. Connect the 10X probe to the 7A18 Ch 1 Input.

b. Change the following control settings:

7A18

Ch 1 Volts/Div	5 V

7B53N

Main Triggering	
SOURCE	LINE
MODE	NORM
TIME/DIV OR	
DL'Y TIME	5 ms
DELAYED SWEEP	
Time/Division	5 ms

c. Connect the X10 probe tip to the same line-voltage source which is connected to the indicator oscilloscope.

d. CHECK—Stable CRT display, triggered on correct slope.

e. Disconnect all test equipment.

NOTES

HORIZONTAL SYSTEM CHECK

Equipment Required

1. 7403N Oscilloscope
2. 7A18 Dual Trace Amplifier unit
3. Time-mark generator
4. Low-frequency sine-wave generator
5. 42-inch 50-ohm cable
6. 50-ohm BNC termination

Control Settings

Set the controls as given under Preliminary Control Settings.

NOTE

The tolerances given in steps 10 and 11 are for an ambient temperature range of +15°C to +35°C. If outside this range see Section I for applicable tolerances.

10. Check Main and Delayed Sweep Timing Accuracy and Linearity

a. Connect the marker output of the time-mark generator to the 7A18 Ch 1 Input with the 42-inch 50-ohm BNC cable and 50-ohm BNC termination.

b. Change the following control settings:

7A18

Ch 1 Volts/Div	.5 V

7B53N

Main Triggering	
MODE	NORM
LEVEL/SLOPE	Set for stable main sweep display (TRIG'D light on).

c. CHECK–Using the TIME/DIV OR DL'Y TIME switch and the time-mark generator settings given in Table 5-1, check main sweep timing over the middle eight graticule divisions to tolerances given in Table 5-1.

d. Change the following control settings:

Main Triggering	
LEVEL/SLOPE	Set for stable main sweep display (TRIG'D light on).
DISPLAY MODE	DLY'D SWP

e. CHECK–Using the time-mark generator settings and the TIME/DIV OR DL'Y TIME and DELAYED SWEEP Time/Division switch settings given in Table 5-1, check delayed sweep timing over the middle eight graticule divisions to the tolerances given in Table 5-1.

f. Set the time-mark generator for one millisecond markers.

g. Change the TIME/DIV OR DL'Y TIME and the DELAYED SWEEP Time/Division switches to 1 ms.

h. Position the second marker to the second graticule line.

i. CHECK–Fourth marker within 0.12 division (6%) of the fourth vertical line.

j. Position the third marker to the third vertical line.

k. CHECK–Fifth marker within 0.12 division of the fifth vertical line.

l. Continue this check for each two division portion of the sweep within center eight divisions of the graticule.

m. Change the DISPLAY MODE switch to MAIN SWP.

n. CHECK–Repeat sweep linearity check given in steps h through l. Check for main sweep linearity within 0.1-division (5%).

o. CALIBRATION–See step 8 of adjustment procedure.

11. Check Main and Delayed Sweep Magnifier Accuracy and Linearity

a. Change the following control settings:

MAG	X10
POSITION	Centered

b. CHECK–Using the TIME/DIV OR DL'Y TIME switch and the time-mark generator settings given in Table 5-2, check the main sweep magnified timing over the middle eight divisions of the total magnified display. Check that X10 MAG light is on.

TABLE 5-1

Main and Delayed Sweep Timing

7B53N		2901	Time-Mark	Tolerance	
TIME/DIV or DL'Y TIME	DLY'D SWEEP	Markers	Generator	MAIN SWP	DLY'D SWP
.05 μs	.05 μs	50 μs	1 (cycle)	±0.24 division	±0.32 division
.1 μs	.1 μs	.1 μs	1		
.2 μs	.2 μs	.1 μs	2		
.5 μs	.5 μs	.5 μs	1	±0.16 division	±0.24 division
1 μs	1 μs	1 μs	1		
2 μs	2 μs	1 μs	2		
5 μs	5 μs	5 μs	1		
10 μs	10 μs	10 μs	1		
20 μs	20 μs	10 μs	2		
50 μs	50 μs	50 μs	1		
.1 ms	.1 ms	.1 ms	1		
.2 ms	.2 ms	.1 ms	2		
.5 ms	.5 ms	.5 ms	1		
1 ms	1 ms	1 ms	1		
2 ms	2 ms	1 ms	2		
5 ms	5 ms	5 ms	1		
10 ms	10 ms	10 ms	1		
20 ms	20 ms	10 ms	2		
50 ms	50 ms	50 ms	1		
.1 s	.1 s	.1 s	1	±0.24 division	±0.32 division
.2 s	.2 s	.1 s	2		
.5 s	.5 s	.5 s	1		
1 s		1 s	1		
2 s		1 s	2		
5 s		5 s	1		

c. Change the following control settings:

Main Triggering	
LEVEL/SLOPE	Set for stable main sweep display (TRIG'D light on).
DISPLAY MODE	DLY'D SWP

d. Using the TIME/DIV OR DL'Y TIME switch and the time-mark generator settings given in Table 5-2, check the delayed sweep magnified timing over the middle eight divisions of the total magnified display. Check that X10 MAG light is on.

e. Set the TIME/DIV OR DL'Y TIME and DELAYED SWEEP Time/Division switch to 1 ms.

f. Set the time-mark generator for 0.1-millisecond markers.

g. Position the second displayed marker to the second vertical line of the graticule.

h. CHECK—Fourth displayed marker within 0.12 division (6%) of the fourth vertical line.

i. Position the third displayed marker to the third vertical line.

j. CHECK—Fifth displayed marker within 0.12 division of the fifth vertical line.

k. Continue this check for each two-division portion of the total displayed sweep within the displayed center eight divisions of the graticule.

l. Change the DISPLAY MODE switch to MAIN SWP.

m. Repeat magnified sweep linearity check given in steps g through k. CHECK—for magnified main sweep linearity within 0.1 division (5%).

n. CALIBRATION—See step 9 of Adjustment Procedure.

TABLE 5-2

Main and Delayed Magnifier Accuracy

7B53N				Tolerance	
TIME/DIV OR DL'Y TIME	DLY'D SWEEP	Time-Mark Generator	CRT Display Markers (or cycle)/Div	MAIN SWP	DLY'D SWP
5 s		.5 s	1	±0.28 division	
2 s		.1 s	2		
1 s		.1 s	1		
.5 s	.5 s	50 ms	1		±0.36 division
.2 s	.2 s	10 ms	2		
.1 s	.1 s	10 ms	1		
50 ms	50 ms	5 ms	1	±0.2 division	±0.28 division
20 ms	20 ms	1 ms	2		
10 ms	10 ms	1 ms	1		
5 ms	5 ms	.5 ms	1		
2 ms	2 ms	.1 ms	2		
1 ms	1 ms	.1 ms	1		
.5 ms	.5 ms	50 μs	1		
.2 ms	.2 ms	10 μs	2		
.1 ms	.1 ms	10 μs	1		
50 μs	50 μs	5 μs	1		
20 μs	20 μs	1 μs	2		
10 μs	10 μs	1 μs	1		
5 μs	5 μs	.5 μs	1		
2 μs	2 μs	.1 μs	2		
1 μs	1 μs	.1 μs	1		
.5 μs	.5 μs	50 ns	1 (cycle)		
.2 μs	.2 μs	20 ns	1 (cycle)	±0.28 division	±0.36 division
.1 μs	.1 μs	10 ns	1 (cycle)		
.05 μs	.05 μs	5 ns	1 (cycle)		

12. Check Delay-Time Accuracy

a. Change the following control settings:

DISPLAY MODE	DLY'D SWP
X10 MAG	Off (in)

b. CHECK—Using the TIME/DIV OR DL'Y TIME switch, DLY'D SWEEP Time/Division switch, and the time-mark generator settings given in Table 5-3, check that the delay time accuracy is within the given tolerance. First set the DELAY TIME MULT control near 1.00 and adjust until the second marker starts at the beginning of the delayed sweep. Note the DELAY TIME MULT dial deviation from 1.00. Next, set the DELAY TIME MULT dial near 9.00 and adjust until the tenth marker starts at the beginning of the delayed sweep; note the deviation from 9.00. Subtract the first reading from the second reading. The difference must not be greater than 8.00 plus the allowable tolerance given in Table 5-3.

c. CALIBRATION—See step 13 of Adjustment procedure.

13. Check Delay-Time Multiplier Incremental Linearity

a. Change the following control settings:

DELAY TIME MULT	9.00
TIME/DIV OR DL'Y TIME	1 ms
DELAYED SWEEP Time/Division	10 μs

b. Set the time-mark generator for one-millisecond markers.

NOTE

If the display is not exactly 8.00 dial divisions between 1.00 and 9.00 as measured in step 12, use parts c through k to compensate for this error. Then, the incremental linearity of the DELAY TIME MULT dial can be read directly from the dial. If, the difference is exactly eight divisions, proceed to part l of this step.

TABLE 5-3

7B53N		Time-Mark Generator Setting	Allowable Error
TIME/DIV or DL'Y TIME	DLY'D SWEEP		
1 μs	.1 μs	1 μs	±0.08 DELAY TIME MULT dial divisions (± 4-minor dial divisions)
2 μs	.1 μs	1 μs	
5 μs	.5 μs	5 μs	
10 μs	1 μs	10 μs	
20 μs	1 μs	10 μs	
50 μs	5 μs	50 μs	
.1 ms	10 μs	.1 ms	
.2 ms	10 μs	.1 ms	
.5 ms	50 μs	.5 ms	
10 ms	1 ms	10 ms	
20 ms	1 ms	10 ms	
50 ms	5 ms	50 ms	
.1 s	10 ms	.1 s	
.2 s	10 ms	.1 s	
.5 s	50 ms	.5 s	
1 s	.1 s	1 s	±0.16 DELAY TIME MULT dial divisions (±8 minor dial divisions)
2 s	.1 s	1 s	
5 s	.5 s	5 s	

c. Set the TIME/DIV OR DL'Y TIME switch to .5 ms; then return the DELAYED SWEEP Time/Division switch to 10 μs.

d. Set the DISPLAY MODE switch to MAIN SWP.

e. Press and release the VARIABLE Time/Division control to the uncalibrated position and rotate control for one marker each major graticule division between the first and ninth division vertical lines (the internal Variable Selector switch must be set to Main Time/Division Variable).

f. Set the DISPLAY MODE switch to DLY'D SWP.

g. Set the DELAY TIME MULT dial to 1.00 and rotate slightly until the second marker is displayed at the start of the sweep. Note the dial reading.

h. Set the DELAY TIME MULT dial exactly 8.00 dial divisions higher than the reading in part g.

i. Turn the VARIABLE control slightly so a marker is displayed at the start of the sweep.

j. Set the DISPLAY MODE switch to INTEN and check that tenth marker is intensified.

k. Return the DISPLAY MODE switch to DLY'D SWP and repeat parts g through j until the difference between the markers at about 1.00 and 9.00 is exactly 8.00 dial divisions.

l. Set the DELAY TIME MULT dial to 9.00; then rotate the dial slightly so a marker is displayed at the start of the sweep.

m. Note the exact DELAY TIME MULT dial reading; the difference between this reading and 9.00 is the basic dial error to be used in checking linearity.

n. Set the DELAY TIME MULT dial to 8.00; then rotate the dial slightly so a marker is displayed at the start of the sweep.

o. CHECK—The DELAY TIME MULT dial must read 8.00 ± 0.02 (±1 minor dial division). Also take into account the basic dial error at 9.00.

p. Repeat this check at each major dial division between 8.00 and 1.00.

14. Check Delay-Time Jitter

a. Change the following control settings:

DELAY TIME MULT	1.00
TIME/DIV OR DL'Y TIME	1 ms
DELAYED SWEEP Time/Division	0.5 μs
VARIABLE Time/Division	Calibrated (In)

b. Position the pulse near the center of the CRT display area with the DELAY TIME MULT dial.

c. CHECK—Jitter in the leading edge of the pulse should not exceed one graticule division (one part in 20,000). Disregard any slow drift.

d. Turn the DELAY TIME MULT dial to about 9.00 and adjust so the pulse is displayed near the center of the CRT display area.

e. CHECK—Jitter on the leading edge of the pulse should not exceed one graticule division.

15. Check Mixed Sweep Operation

a. Change the following control settings:

DELAY TIME MULT	10.00
DELAYED SWEEP Time/Division	.5 ms
DISPLAY MODE	MAIN SWP

b. CHECK—Timing between second and tenth markers. Note the error for part d.

c. Set the DISPLAY MODE switch to MIXED.

d. CHECK—Timing between second and tenth markers within 0.16 division (2%) plus the main sweep error noted in part b over the center eight divisions of the CRT.

e. Set the DELAY TIME MULT dial to 0.00.

f. Set the time-mark generator for 0.5 millisecond markers.

g. CHECK—Timing between second and tenth marker within 0.16 division (2%).

16. Check Main and Delayed Sweep Variable Control Range

a. Change the following control settings:

DELAYED SWEEP	
Time/Division	1 ms
DISPLAY MODE	MAIN SWP

b. Set the time-mark generator for 10 millisecond markers.

c. Set the MAIN TRIGGERING LEVEL/SLOPE control for stable display.

d. Position the markers to the far left and right graticule lines with the horizontal POSITION control.

e. Turn the VARIABLE control fully counterclockwise.

f. CHECK—CRT display for four-division maximum spacing between markers (indicates adequate range for continuously variable sweep rate between calibrated steps).

g. Change the following control settings:

TIME/DIV OR	
DL'Y TIME	5 ms
DELAYED SWEEP	
Time/Division	1 ms
DISPLAY MODE	DLY'D SWP
Variable Selector	Delayed Time/
(internal)	Div Variable
VARIABLE	
Time/Division	CAL (in)
Delayed Triggering	
LEVEL	OUT—DLY'D SWP TRIGGERABLE

h. Adjust Delayed Triggering LEVEL control for stable delayed sweep display.

i. Position the markers to the far left and right graticule lines with the horizontal POSITION control.

j. Press and release the VARIABLE Time/Division control (uncalibrated) and rotate fully counterclockwise.

k. CHECK—CRT display for four-division maximum spacing between markers (indicates adequate range for continuously variable delayed sweep rate between calibrated steps).

l. Disconnect all test equipment.

17. Check External Amplifier Gain

a. Change the following control settings:

7A18

Ch 1 AC-DC-GND	DC
Ch 1 Volts/Div	.2 V

7B53N

Main Triggering	
MODE	AUTO
SOURCE	EXT
DISPLAY MODE	MAIN SWP
TIME/DIV OR	
DL'Y TIME	10 μs
DELAYED SWEEP	
Time/Division	10 μs
Delayed Triggering	
LEVEL	IN—RUNS AFTER DLY TIME

b. Connect the low-frequency sine-wave generator to the 7A18 Ch 1 Input connector with a 50-ohm BNC cable and 50-ohm BNC termination.

c. Set the generator for a four-division CRT display (800 millivolts) at 100 kilohertz.

d. Disconnect the sine-wave generator from the 7A18 Ch 1 Input and connect it to the 7B53N MAIN TRIG IN OR AMPL connector.

e. Change the TIME/DIV OR DL'Y TIME switch to AMPL. Rotate the POSITION control to center display on the graticule.

f. CHECK—CRT horizontal trace length must be eight divisions ±0.8 division.

g. Press the EXT ÷ 10 button of the MAIN TRIGGERING SOURCE switch.

h. CHECK—CRT horizontal trace length must be 0.8 divisions within ±0.08 division.

i. Press and release the X10 MAG switch. Rotate the POSITION control to center the display on the graticule.

j. CHECK—CRT horizontal trace length must be eight divisions ±0.8 division.

18. Check External Horizontal Bandwidth

a. Change the following control settings:

Main Triggering	
COUPLING	AC
SOURCE	EXT
X10 MAG	Off

b. Set the sine-wave generator to 10 kilohertz and adjust the amplitude for a horizontal trace length of eight divisions.

c. Without changing the amplitude, increase the frequency of the sine-wave generator until the horizontal length decreases to 5.6 divisions.

d. CHECK—Sine-wave generator frequency must be two megahertz or greater (upper —3 dB point).

e. Change the MAIN TRIGGERING COUPLING switch to AC LF REJ. Repeat parts b, c, and d.

f. Change the MAIN TRIGGERING COUPLING switch to DC. Repeat parts b, c, and d.

g. Change the MAIN TRIGGERING COUPLING switch to AC HF REJ. Repeat parts b and c.

h. CHECK—Sine-wave generator frequency must be 100 kilohertz or greater (upper —3 dB point).

i. Disconnect all test equipment.

NOTES

OUTPUT SIGNALS CHECK

Equipment Required

1. 7403N Oscilloscope
2. 7A18 Dual Trace Amplifier unit
3. Low-frequency sine-wave generator
4. Test oscilloscope system
5. 42-inch BNC cable (two)
6. 50-ohm BNC termination

NOTE

Auxiliary sweep gate, composite sweep gate, and composite sawtooth signals are available on the Interface connector at the rear of this instrument. These signals are provided for external use with appropriately equipped indicator oscilloscopes. If it is desired to check the performance requirement of these signals (as given in Section 1) refer to steps 14 through 16 in Adjustment Procedure.

19. Check Delayed Sweep Gate Output

a. Set the controls as given under Preliminary Control Settings.

b. Connect the output of the low-frequency sine-wave generator to the 7A18 Ch 1 Input with a 42-inch BNC cable and 50-ohm BNC termination.

c. Set the low-frequency generator for four-divisions of one kilohertz signal.

d. Change the following control settings:

Main Triggering	
LEVEL/SLOPE	Set for a stable main sweep display.
DELAY TIME MULT	5.00
DISPLAY MODE	DLY'D SWP
TIME/DIV OR DL'Y TIME	1 ms
DELAYED SWEEP	
Time/Division	.2 ms

e. Connect a 42-inch 50-ohm BNC cable from the DLY'D TRIG IN connector (delayed gate output when Delayed Triggering SOURCE switch is set to INT) to the test oscilloscope vertical input.

f. Set the test oscilloscope for a vertical deflection factor of one volt/division at a sweep rate of two milliseconds/division. Adjust test oscilloscope for stable display (DC coupled).

g. CHECK—Test oscilloscope for 3.5 volts, within 1.4 volts, positive-going rectangular pulse with base line from 0 to −1 volts. Check for pulse width of one horizontal division (verifies that delayed gate pulse width is same duration as delayed sweep).

This completes the Performance Check procedure for the 7B53N. If the instrument has met all tolerances given in this procedure, it is correctly calibrated and within the specified tolerances. Disconnect all test equipment.

PART II ADJUSTMENT

Introduction

The following procedure returns the 7B53N to correct calibration. All limits and tolerances given in this procedure are calibration guides, and should not be interpreted as instrument specifications except as listed in the Performance Requirement column of Section 1. The actual operation of the instrument may exceed the given limits or tolerances if the instrument meets the Performance Requirements as checked in Part I–Performance Check of this section.

Index to Part II–Adjustment

Preliminary Adjustment Procedure

1. Install the Vertical Amplifier unit directly into the left vertical compartment of the indicator oscilloscope.

2. Install the 067-0589-00 plug-in extender into the horizontal compartment.

3. Remove the side covers from the 7B53N and connect the instrument to the plug-in extender.

4. Turn on indicator oscilloscope and allow at least 20 minutes warmup before proceeding with adjustments.

5. Set the equipment controls as given in this section under Preliminary Control Settings.

TRIGGER SYSTEM ADJUSTMENT

Equipment Required

1. 7403N Oscilloscope
2. 7A18 Dual Trace Amplifier
3. 10X Probe
4. High-frequency constant amplitude sine-wave generator
5. Square-wave generator
6. Plug-in Extender
7. Five-nanosecond GR Cable
8. 42-inch 50-ohm BNC Cable
9. 18-inch 50-ohm BNC Cable
10. 50-ohm BNC Termination (two)
11. BNC T-connector
12. GR to BNC Male Adapter
13. GR to BNC Female Adapter
14. 50-ohm X10 Attenuator
15. Input RC Normalizer; RC = 1 megohm X 20 picofarads

Control Settings

Set the controls as given under Preliminary Control Settings.

1. Adjust Main Triggering Internal and External DC Balance

a. Connect the high-frequency constant-amplitude sine-wave generator to the 7A18 CH 1 Input connector with the five-nanosecond GR cable, GR to BNC male adapter, BNC T-connector, and 50-ohm BNC termination. Connect the output of the T-connector to the MAIN TRIG IN connector with an 18-inch 50-ohm BNC cable and 50-ohm BNC termination.

b. Set the high-frequency sine-wave generator for a 0.3-division display at 50 kilohertz. Position the display about the center horizontal graticule line with the 7A18 Position control.

c. Set the MAIN TRIGGERING MODE switch to NORM.

d. Rotate the MAIN TRIGGERING LEVEL/SLOPE control near the center of the positive slope for a triggered display.

e. Note the position of the sweep trigger point (start of display) with respect to CRT horizontal center.

f. Press the MAIN TRIGGERING COUPLING switch to DC.

g. CHECK—CRT for a triggered display with the position of the sweep trigger point the same as in part e.

h. ADJUST—Main DC Bal R350 (see Fig. 5-1) for a triggered display with position of sweep trigger point the same as noted in part e.

i. Repeat the above adjustment as necessary until the position of the sweep trigger point remains the same in either AC or DC COUPLING.

j. Set the high-frequency generator for a two-division display at 50 kilohertz.

k. Rotate the MAIN TRIGGERING LEVEL/SLOPE control near 0/+ for a triggered display and note the position of the sweep trigger point with respect to CRT center.

l. Change the following control settings:

Main Triggering	
COUPLING	DC
SOURCE	EXT

m. CHECK—CRT for triggered display with position of sweep trigger point the same as noted in part k.

n. ADJUST—Main Ext DC Bal R330 (see Fig. 5-1) for a triggered display with position of sweep trigger point the same as noted in part k.

o. Repeat the above adjustment as necessary until the position of sweep trigger point remains the same in either INT or EXT.

2. Adjust Trigger Level Centering

a. Change the following control settings:

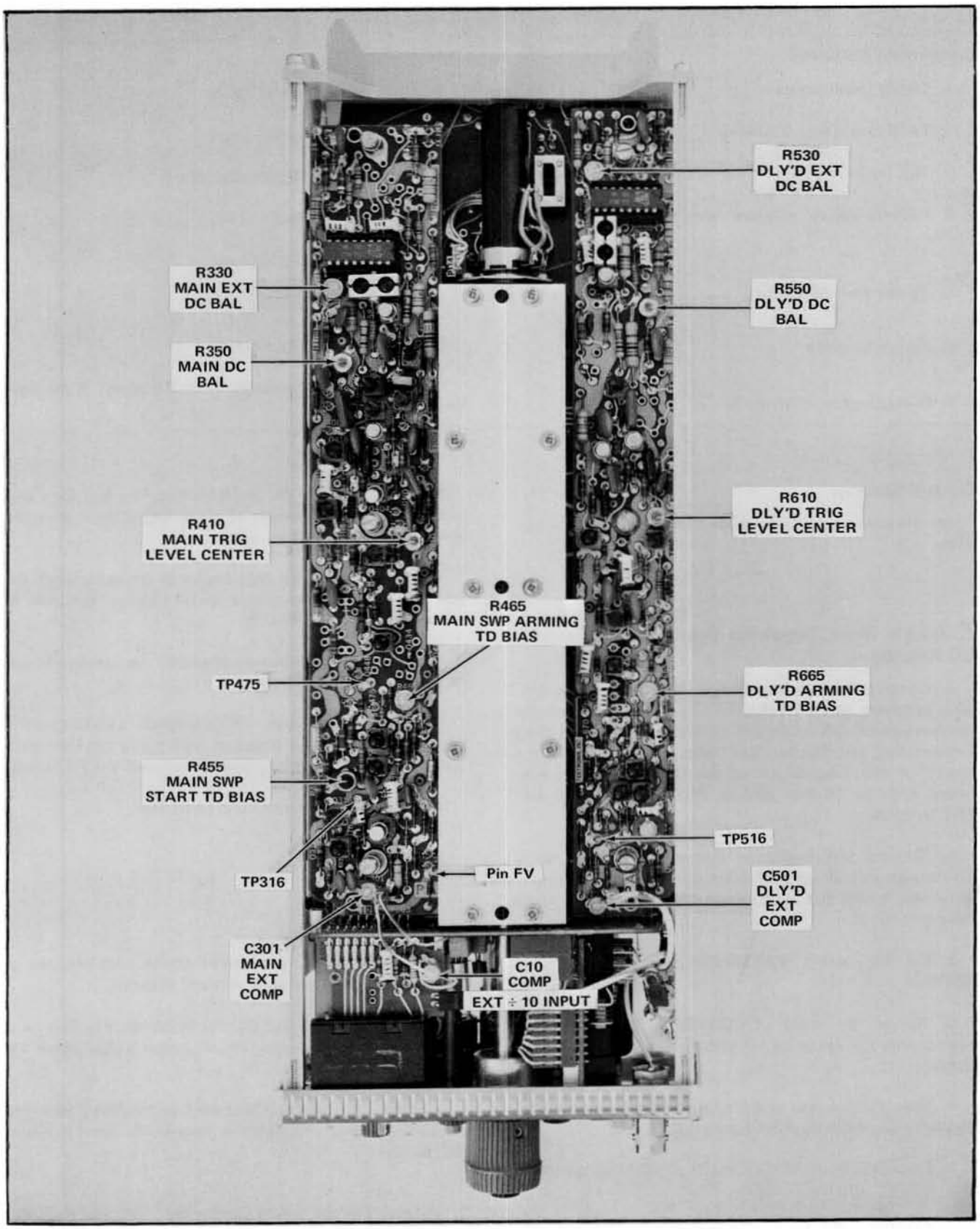


Fig. 5-1. Location of Trigger System adjustments (Main and Delayed Trigger boards).

Main Triggering	
MODE	AUTO
COUPLING	AC
SOURCE	INT
LEVEL/SLOPE	0/+

b. Set the high-frequency generator for 0.3 division of amplitude centered about the graticule horizontal center line.

c. Adjust the LEVEL/SLOPE control for a stable display and note the position of sweep trigger point (start of display) with respect to CRT center.

d. CHECK—CRT display should trigger (sweep start) at CRT center with MAIN TRIGGERING LEVEL/SLOPE control at 0/+.

e. ADJUST—Main Trig Level Center R410 (see Fig. 5-1) to trigger at CRT center.

f. Rotate the LEVEL/SLOPE control to 0/—.

g. CHECK—CRT display should trigger at CRT center.

h. Repeat the adjustment in part e as necessary until the sweep triggering occurs at CRT center with the LEVEL/SLOPE control set to 0/+ and 0/—.

NOTE

If sweep triggering cannot be set to CRT center at both 0/+ and 0/— settings of the LEVEL/SLOPE control, adjustment may be made so that triggering occurs at points equally above (0/+) and below (0/—) CRT center.

3. Adjust Main Sweep TD Bias

a. Rotate the MAIN TRIGGERING LEVEL/SLOPE control midrange between 0/+ and 0/—.

b. CHECK—CRT for free-running display.

c. Press the MAIN TRIGGERING MODE switch to NORM.

d. CHECK—CRT for no display.

e. ADJUST—Main Swp Start TD Bias R455 (see Fig. 5-1) to midrange and change the MAIN TRIGGERING switch to AUTO.

f. Set the high-frequency generator for a 1.5 division display at 100 megahertz.

g. Change the following control settings:

TIME/DIV OR	
DL'Y TIME	1 μs
DELAYED SWEEP	
Time/Division	.05 μs
MAG	X10
Main Triggering	
LEVEL/SLOPE	Set for a stable main sweep display.

h. ADJUST—Main Swp Arming TD Bias R465 (see Fig. 5-1) counterclockwise to a point where the sweep just free-runs. Then rotate R465 about 30° clockwise.

i. CHECK—CRT display should be triggered and TRIG'D lamp must be on. There must be no de-focusing of sine-wave peaks.

j. Observing the CRT display, slowly rotate the frequency of the high-frequency sine-wave generator from 100 megahertz to 42 megahertz and from 42 meaghertz to 100 meaghertz.

k. CHECK—CRT for no double triggering or free-running of display.

NOTE

If the instrument is to be operated over a wide temperature range and the main sweep TD bias cannot be adjusted for stable display over the 100 megahertz to 42 megahertz range, the following alternate method may be used:

l. Connect a 5.6 kilohm resistor from TP475 to pin FV on MAIN TRIG circuit board (see Fig. 5-1).

m. Perform parts a through g. Rotate the MAIN TRIGGERING LEVEL/SLOPE control for a stable main sweep display.

n. ADJUST—R465 to a point where the sweep just free-runs.

o. Remove the 5.6 kilohm resistor from the Main Trig circuit board.

p. CHECK—CRT display as given in parts i through k.

4. Adjust Delayed Triggering Internal and External DC Balance

a. Disconnect the 50-ohm cable and termination from the MAIN TRIG IN connector.

b. Set the high frequency sine-wave generator for a 0.3 division display at 50 kilohertz. Position the display about the center horizontal graticule line with the 7A18 Position control.

c. Change the following control settings:

Main Triggering	
LEVEL/SLOPE	Set for a stable display
DISPLAY MODE	INTEN
X10 MAG	Off
TIME/DIV OR	
DL'Y TIME	20 μs
DELAYED SWEEP	
Time/Division	10 μs
Delayed Triggering	
LEVEL	OUT–DLY'D SWP TRIGGERABLE

d. CHECK–Observing the CRT display, rotate the Delayed Triggering LEVEL control for an intensified display.

NOTE

For better viewing of the intensified sweep, reduce the oscilloscope intensity control.

e. Note the position of the delayed sweep trigger point (start of the intensified display) with respect to the center horizontal graticule line.

f. Change the Delayed Triggering COUPLING switch to DC.

g. CHECK–CRT intensified sweep should be triggered with position of the sweep trigger point the same as noted in part e.

h. ADJUST–Dly'd DC Bal R550 (see Fig. 5-1) for triggered display with position of trigger point as noted in part e.

i. Repeat the adjustment as necessary until the sweep trigger point is the same for both AC and DC positions of the Delayed Triggering COUPLING switch. Return the COUPLING switch to AC.

j. Connect the 50-ohm cable and 50-ohm termination from the T-connector to the DLY'D TRIG IN connector.

k. Disconnect the Delayed Gate Output cable from the sweep board (see Fig. 5-2).

l. Set the high-frequency generator for a two-division display at 50 kilohertz.

m. Rotate the Delayed Triggering LEVEL control for a stable intensified display and note the position of the delayed sweep trigger point.

n. Change the Delayed Triggering SOURCE switch to EXT.

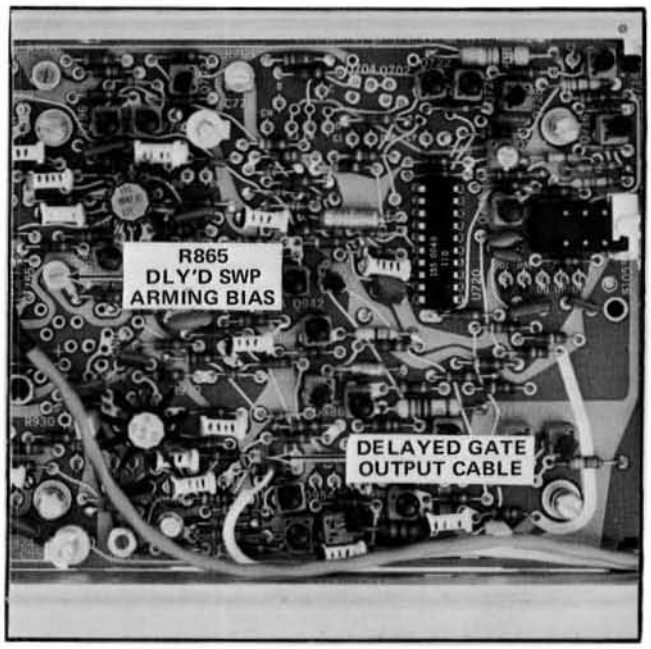


Fig. 5-2. Location of Dly'd Swp Arming TD Bias adjustment R865 (Sweep Board).

o. CHECK–CRT intensified display should be triggered with the trigger point the same as noted in part m.

p. ADJUST–Dly'd Ext DC Bal R530 for a triggered display with the position of the trigger point the same as noted in part m.

q. Repeat the adjustment as necessary until the trigger point, as noted in part m, is the same for both INT and EXT positions of the Delayed Triggering SOURCE switch. Return the SOURCE switch to INT.

r. Disconnect the 50-ohm cable and 50-ohm termination from the DLY'D TRIG IN connector. Connect the Delayed Gate Output cable (removed in part k) to the Sweep circuit board.

5. Adjust Delayed Trigger Level Centering

a. Set the Delayed Triggering LEVEL control to mid-range.

b. Set the high-frequency sine-wave generator for 0.3-divisions of amplitude centered about the center horizontal graticule line.

c. CHECK–CRT for triggered display and note the position of intensified sweep trigger point.

d. ADJUST–Dly'd Trig Level Center R610 (see Fig. 5-1) for a triggered display with the intensified sweep trigger point at or near CRT center.

e. Set the Delayed Triggering SLOPE switch to (−).

f. CHECK—CRT for triggered display with the position of the sweep trigger at CRT center or below CRT center by the same amount the trigger point was above CRT center in part c.

g. Repeat the adjustment in part d as necessary until sweep triggering occurs at or near CRT center with the Delayed Triggering LEVEL control set to midrange and the SLOPE switch set to (+) and (−).

h. Return the Delayed Triggering SLOPE switch to (+).

6. Adjust Delayed Sweep TD Bias

a. Change the following control settings:

TIME/DIV OR DL'Y TIME	.1 μs
DELAYED SWEEP Time/Division	.05 μs
MAG	X10
DISPLAY MODE	MAIN SWP

b. Set the high frequency sine-wave generator for 1.5-divisions of 100 megahertz signal and rotate the MAIN TRIGGERING LEVEL/SLOPE control for a stable display.

c. Set the DISPLAY MODE switch to INTEN and rotate the Delayed Triggering LEVEL control for a stable intensified display.

d. CHECK—CRT for triggered CRT display with no defocused peaks of the displayed sine-wave.

e. Rotate the frequency of the sine-wave generator from 100 megahertz towards 42 megahertz until the first double triggering or free-running occurs.

f. ADJUST—Dly'd Arming TD Bias R665 (see Fig. 5-1) for triggered intensified display.

g. Rotate the Delayed Triggering LEVEL control to both extremes of rotation.

h. CHECK—For no intensified display.

i. ADJUST—Dly'd Swp Arming TD Bias R865 (see Fig. 5-2) for no display with the Delayed Triggering LEVEL control at both extremes of rotation.

NOTE

The adjustments of R865 and R655 may interact. Repeat the above checks and adjustments as necessary until all requirements are met.

j. Disconnect all test equipment.

7. Adjust Main and Delayed External Compensation

a. Connect the output of the square-wave generator to the 7A18 Ch 1 Input with a GR to BNC female adapter, 42-inch 50-ohm BNC cable, X10 attenuator, 50-ohm termination, and 20 picofarad X 1 megohm Input RC Standardizer.

b. Change the following control settings:

7A18

Ch 1 Volts/Div	.1 V

7B53N

Main Triggering	
LEVEL/SLOPE	Set for stable display
COUPLING	DC
DISPLAY MODE	MAIN SWP
X10 MAG	Off
TIME/DIV OR DL'Y TIME	1 ms
DELAYED SWEEP Time/division	.5 ms
Delayed Triggering	
COUPLING	DC
SOURCE	EXT

c. Set the square-wave generator for a five-division display at one kilohertz.

d. Disconnect the 20 picofarad RC Standardizer from the 7A18 Ch 1 Input and connect it to the DLY'D TRIG IN connector.

e. Connect the 10X probe (properly compensated) from the 7A18 Ch 1 Input to TP516 (see Fig. 5-1).

f. Change the following control settings:

7A18

Ch 1 Volts/Div	5 mV

7B53N

Main Triggering	
LEVEL/SLOPE	Set for TRIG'D light on
DISPLAY MODE	DLY'D SWP
Delayed Triggering	
LEVEL	Set for a stable delayed sweep display

g. ADJUST—Dly'd Ext Comp adjustment C501 (see Fig. 5-1) for best square corner on leading edge of displayed waveform.

h. Disconnect the 10X probe from TP516 and connect it to TP316 (see Fig. 5-1). Disconnect the 20 picofarad RC Standardizer from the DLY'D TRIG IN connector and connect it to the MAIN TRIG IN connector.

i. Set the MAIN TRIGGERING SOURCE switch to EXT and the DISPLAY MODE switch to MAIN SWP. Adjust the LEVEL/SLOPE for stable main sweep display.

j. ADJUST–Main Ext Comp adjustment C301 (see Fig. 5-1) for best square corner on leading edge of waveform.

k. Remove the 10X attenuator and connect the 50-ohm termination directly to the 20 picofarad Input Standardizer. Change the MAIN TRIGGERING SOURCE switch to EXT ÷ 10.

l. ADJUST–EXT ÷ 10 Input Compensation adjustment C10 (see Fig. 5-1) for best square corner on leading edge of waveform.

m. Disconnect all test equipment.

NOTES

HORIZONTAL SYSTEM ADJUSTMENT

Equipment Required

1. 7403N Oscilloscope
2. 7A18 Dual Trace Amplifier
3. Time-mark generator
4. 42-inch 50-ohm BNC cable
5. 50-ohm BNC termination
6. 10X voltage probe
7. Plug-in extender

Control Settings

Set the controls as given under Preliminary Control Settings.

8. Adjust SWP CAL.

a. Connect the marker output of the time-mark generator to the 7A18 Ch 1 Input with the 42-inch 50-ohm BNC cable and 50-ohm BNC termination.

b. Set the time-mark generator for one-millisecond markers.

c. Change the following control settings:

7A18

Ch 1 Volts/Div	.5 V

7B53N

Main Triggering	
LEVEL/SLOPE	Set for stable main sweep display
TIME/DIV OR DL'Y TIME DELAYED SWEEP	1 ms
Time/Division	1 ms

d. CHECK–CRT display for one marker each division between the second and tenth graticule lines.

e. ADJUST–Front-panel SWP CAL control (R60) for one marker each division. The second and tenth markers must coincide exactly with their respective graticule lines (Reposition display slightly with the horizontal POSITION control if necessary).

9. Adjust Magnified Sweep Gain.

a. Set the time-mark generator for 0.1 millisecond markers.

b. Press and release MAG switch to X10.

c. CHECK–CRT display for one marker each division between the second and tenth graticule lines.

d. ADJUST–Mag Gain control R1055 (see Fig. 5-3) for one marker each division. The second and tenth markers must coincide exactly with their respective graticule lines (reposition display slightly with the horizontal POSITION control if necessary).

10. Adjust Main and Delayed Sweep Length

a. Set the time-mark generator for 0.1 and one millisecond markers. Press X10 MAG switch to Off position.

b. Rotate the LEVEL/SLOPE control for a triggered display. Then rotate the POSITION control to position the eleventh one-millisecond marker to the center vertical graticule line.

c. CHECK–CRT display for sweep length of 10.4 divisions within 0.3 division as shown by 0.1 to 0.7 division of display to the right of the center vertical graticule line (see Fig. 5-4).

d. ADJUST–Main Swp Length control R795 (see Fig. 5-3) for four 0.1 millisecond markers to the right of the center vertical graticule line.

e. Change the following control settings:

TIME/DIV OR DL'Y TIME DELAYED SWEEP	1 ms
Time/division	.1 ms
DISPLAY MODE	DLY'D SWP
Main Triggering	
LEVEL/SLOPE	Set for TRIG'D light on
Delayed Triggering	
LEVEL	OUT–DLY'D SWP TRIGGERABLE

f. Set the time-mark generator for 0.1 millisecond and 10 microsecond markers.

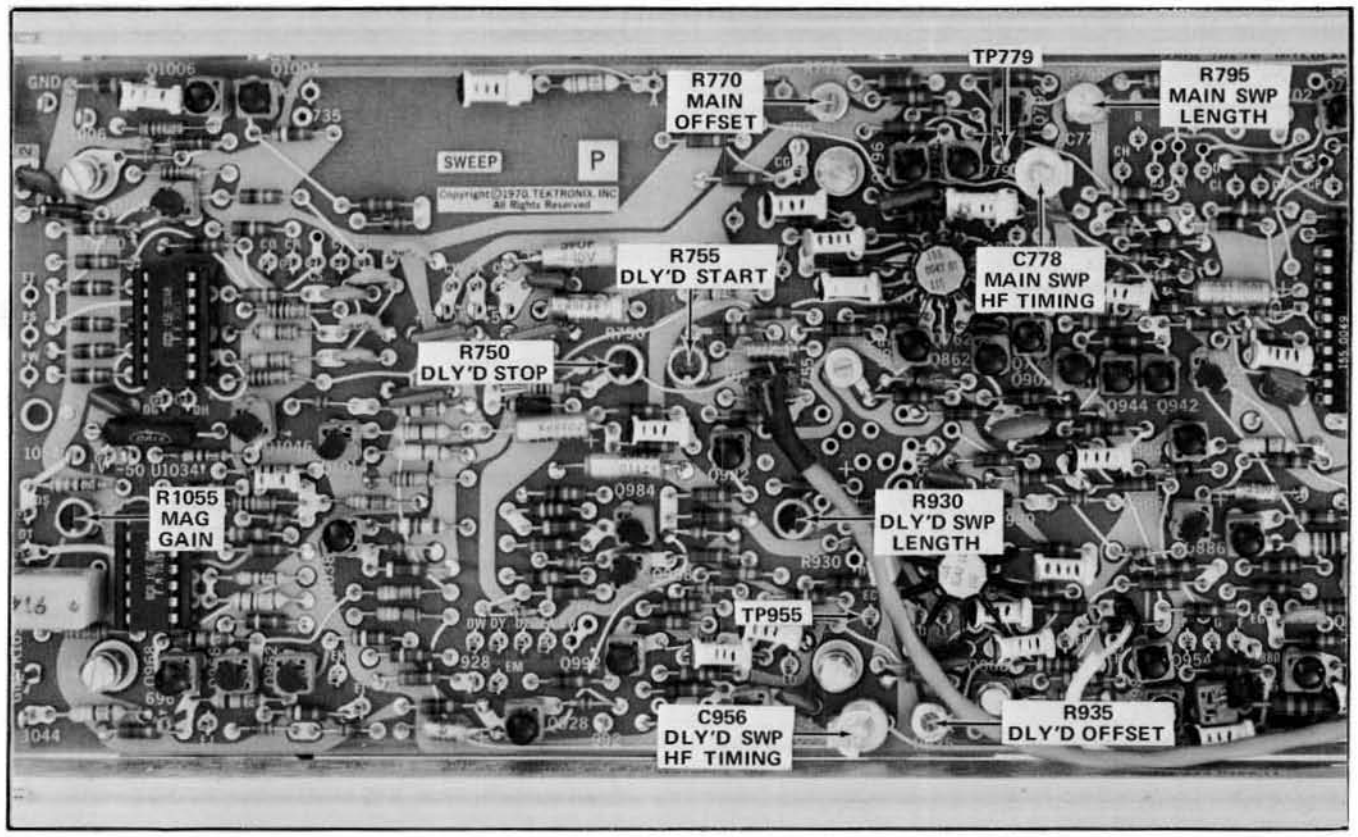


Fig. 5-3. Location of Horizontal System adjustments (Sweep board).

g. Rotate the Delayed Triggering LEVEL control for a stable display. Then rotate the horizontal POSITION control to position the eleventh 0.1 millisecond marker to the center vertical graticule line.

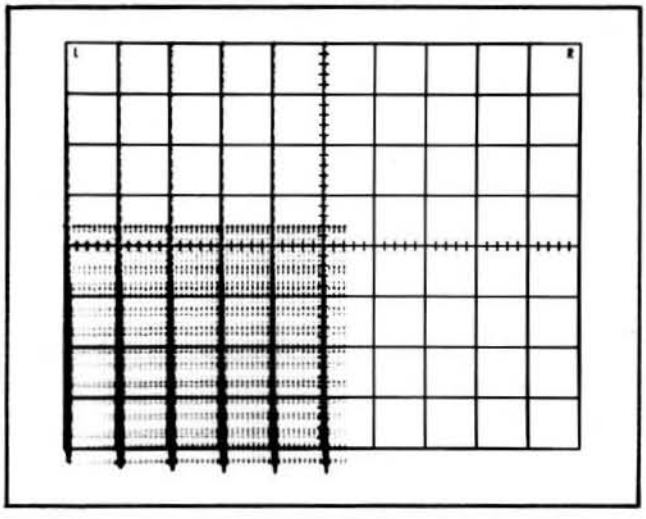


Fig. 5-4. Typical CRT display when checking sweep length.

h. CHECK–CRT display for sweep length of 10.4 divisions within 0.3-division as shown by 0.1 to 0.7 division of display to the right of the center vertical graticule line (see Fig. 5-4).

i. ADJUST–Dly'd Swp Length control R930 (see Fig. 5-3) for four 10 microsecond markers to the right of the center vertical graticule line.

j. INTERACTION–Check step 12.

11. Adjust Main and Delayed Sweep High-Frequency Timing

a. Set the time-mark generator for one-microsecond markers.

b. Change the following control settings:

DISPLAY MODE	MAIN SWP
TIME/DIV OR DL'Y TIME	1 μs
DELAYED SWEEP Time/Division	1 μs
Main Triggering LEVEL/SLOPE	Set for stable main sweep display.

c. Rotate the POSITION control to align the second one-microsecond marker with the second vertical graticule line and the tenth one-microsecond marker with the tenth vertical graticule line.

d. CHECK–CRT display for one-microsecond marker each division within 0.16 division (2%).

e. ADJUST–Main Swp HF Timing control C778 (see Fig. 5-3) for one marker each vertical graticule line.

f. Change the following control settings:

DISPLAY MODE	DLY'D SWP
TIME/DIV OR DL'Y TIME DELAYED SWEEP	2 μs
Time/Division	1 μs
Delayed Triggering LEVEL	Set for a stable delayed sweep display.

g. Rotate the POSITION control to align the second one-microsecond marker with the second vertical graticule line and the tenth marker with the tenth vertical graticule line.

h. CHECK–CRT display for one one-microsecond marker each division within 0.24 division (3%).

i. ADJUST–Dly'd Swp HF Timing control C956 (see Fig. 5-3) for one marker each division. Use the POSITION control as necessary to align the display.

j. Disconnect all test equipment.

12. Adjust Main and Delayed Sweep Offset

a. Change the following control settings:

7A18

Ch 1 Volts/Div	5 mV
AC-DC-GND (CH 1 and CH 2)	DC

7B53N

DISPLAY MODE	MAIN SWP
TIME/DIV OR DL'Y TIME DELAYED SWEEP	1 ms
Time/Division	1 ms
Delayed Triggering LEVEL	IN–RUNS AFTER DL'Y TIME

b. Rotate the 7A18 Ch 1 Position control to position the display to CRT center (0 volts) and the 7B53N POSITION control to start the display at the center vertical graticule line.

c. Set the DISPLAY MODE switch to DLY'D SWP.

d. CHECK–CRT trace must start at CRT center within one-division.

e. Connect a 10X probe from the 7A18 Ch 1 Input to TP779 (see Fig. 5-3).

f. Set the DISPLAY MODE switch to MAIN SWP.

g. ADJUST–Main Offset Zero control R770 (see Fig. 5-3) to start the display at CRT center (zero volts).

h. Disconnect the 10X probe from TP779 and connect it to TP955 (see Fig. 5-3).

i. Set the DISPLAY MODE switch to DLY'D SWP.

j. ADJUST–Dly'd Offset Zero control R935 (see Fig. 5-3) to start the display at CRT center.

k. Disconnect the 10X probe from TP955 and the 7A16 Ch 1 Input. Set the DISPLAY MODE switch to MAIN SWP and set the 7A18 Ch 1 AC-DC-GND switch to GND.

l. Repeat parts b, c, and d.

m. INTERACTION–Check step 10.

13. Adjust Delayed Sweep Start and Delayed Sweep Stop Control

a. Connect the marker output of the time-mark generator to the 7A18 Ch 1 Input with the 42-inch 50-ohm BNC cable and 50-ohm BNC termination.

b. Change the following control settings:

7A18

Ch 1 Volts/Div	0.5 V
AC-DC-GND (Ch 1)	DC

7B53N

DISPLAY MODE	INTEN
Main Trigger LEVEL/SLOPE	Set for stable main sweep display.

c. Set the time-mark generator for one-millisecond markers.

NOTE

Rough adjustments of the Delayed Sweep Start and Delayed Sweep Stop controls will be made in the INTEN DISPLAY MODE followed by fine adjustments in the DLY'D SWP DISPLAY MODE.

d. CHECK–With the DELAY TIME MULT dial set to 1.00, check that the intensified sweep starts on the second marker.

e. ADJUST–Dly'd Start control R755 (see Fig. 5-3) to start the intensified sweep on the second marker.

f. CHECK–Rotate the DELAY TIME MULT dial to 9.00 and check that the intensified sweep starts on the tenth marker.

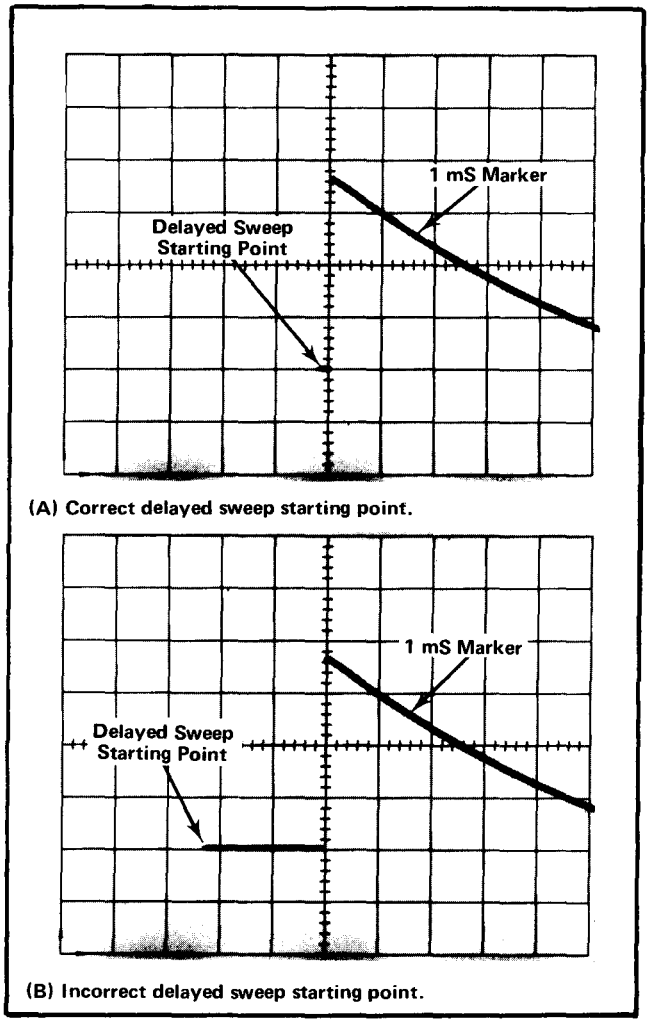
g. ADJUST–Dly'd Stop control R750 (see Fig. 5-3) to start the intensified sweep on the tenth marker.

h. Change the following control settings:

DISPLAY MODE	DLY'D SWP
DELAYED SWEEP	
Time/Division	10 μs
DELAY TIME MULT	1.00

i. ADJUST–Observe one time-marker and adjust R755 to start the delayed sweep at the bottom of marker (see Fig. 5-5). Use the POSITION control to position the display to the center vertical graticule line. If the marker is not displayed, repeat parts b through e, h, and i.

j. Rotate the DTM to 9.00. Observe one time-marker and adjust R750 to start the delayed sweep at the bottom of marker (see Fig. 5-5). Use the POSITION control to position the display to the center vertical graticule line. If the marker is not displayed, repeat parts b, c, f, g, h, and j.



(A) Correct delayed sweep starting point.

(B) Incorrect delayed sweep starting point.

Fig. 5-5. Typical CRT display for adjustment of Dly'd Sweep Start and Dly'd Sweep Stop controls.

k. There may be interaction between the adjustment of R750 and R755. Repeat parts h, i and j if necessary.

l. Disconnect all test equipment.

NOTES

OUTPUT SIGNALS

Equipment Required

1. 7403N Oscilloscope
2. 7A18 Dual Trace Amplifier Unit
3. Low-frequency sine-wave generator.
4. Test oscilloscope system.
5. 42-inch 50-ohm BNC cable
6. 50-ohm BNC termination

14. Check Composite Sweep Gate Output Signal

a. Set the controls as given under Preliminary Control Settings.

b. Connect the output of the low-frequency sine-wave generator to the 7A18 Ch 1 Input with a 42-inch BNC cable and a 50-ohm BNC termination.

c. Change the following control settings:

7A18

AC-DC-GND (Ch 1)	DC

7B53N

TIME/DIV OR DL'Y TIME DELAYED SWEEP Time/Division	1 ms .2 ms

d. Set the low-frequency generator for four-divisions of one-kilohertz signal.

e. Connect the X10 probe from the test oscilloscope vertical input connector to TP928 (see Fig. 5-6).

f. Set the test oscilloscope for a vertical deflection factor of 0.2 volts/division at a sweep rate of two milliseconds/division. Adjust the test oscilloscope for a stable display (DC coupled).

g. CHECK–Test oscilloscope for a positive-going rectangular pulse approximately five divisions in duration (10 milliseconds). This pulse width verifies that the Composite Sweep Gate pulse is the same duration as the main sweep when the DISPLAY MODE switch is set to MAIN SWP.

h. Set the DISPLAY MODE switch to INTEN.

i. CHECK–Test oscilloscope for a positive-going rectangular pulse approximately five divisions in duration (10 milliseconds). This pulse width verifies that the Composite Sweep Gate pulse is the same duration as the main sweep when the DISPLAY MODE switch is set to INTEN.

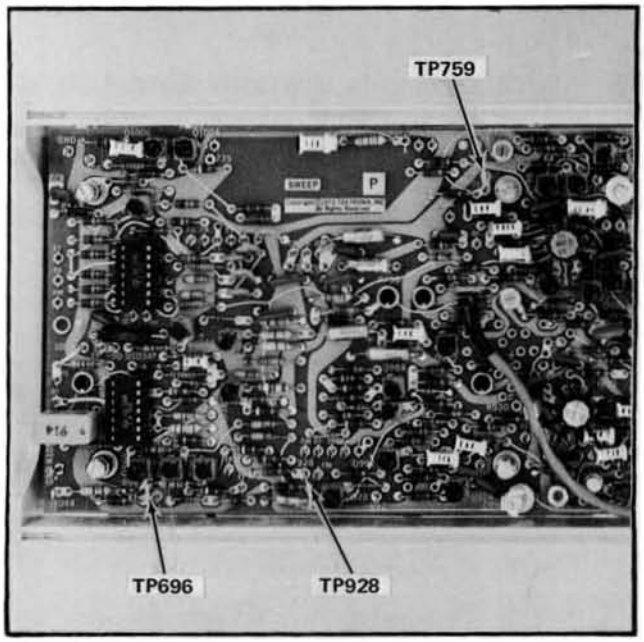


Fig. 5-6. Location of output signals test points (Sweep circuit board).

j. Set the DISPLAY MODE switch to DLY'D SWP.

k. CHECK–Test oscilloscope for a positive-going rectangular pulse approximately one division in duration (10 milliseconds). This pulse width verifies that the Composite Sweep Gate pulse is the same duration as the delayed sweep when the DISPLAY MODE switch is set to DLY'D SWP.

l. Set the DISPLAY MODE switch to MIXED.

m. Set the DELAY TIME MULT dial to 5.00 for a mixed display of approximately five-divisions at the main sweep rate and approximately five-divisions at the delayed sweep rate.

n. CHECK–Test oscilloscope for a positive-going rectangular pulse approximately three divisions in duration (six milliseconds). This pulse width verifies that the Composite Sweep Gate pulse is the same duration as the main sweep (five-divisions at one-millisecond/division) plus the delayed sweep rate (five divisions at 0.2 millisecond/division) when the DISPLAY MODE switch is set to MIXED.

15. Check Auxillary Sweep Gate Output Signal

a. Remove the 10X probe from TP928 and connect it to TP759 (see Fig. 5-6).

b. CHECK–Test oscilloscope for a positive-going rectangular pulse approximately five divisions in duration (10 milliseconds). This pulse verifies that the Composite Sweep Gate pulse is the same duration as the delaying sweep.

c. Repeat part b with the DISPLAY MODE switch set to the MAIN SWP, INTEN, and DLY'D SWP positions.

16. Check Composite Sawtooth Output Signal

a. Remove the 10X probe from TP759 and connect it to TP696 (see Fig. 5-6).

b. Set the DISPLAY MODE switch to MAIN SWP and the DELAY TIME MULT dial to 5.00.

c. CHECK–Test oscilloscope for a negative going ramp with approximately five-divisions duration (10 milliseconds determined by the TIME/DIV OR DL'Y TIME switch). See Fig. 5-7 (A).

d. Change the DISPLAY MODE switch to INTEN.

e. Repeat part c.

f. Change the DISPLAY MODE switch to DLY'D SWP.

g. CHECK–Test oscilloscope for negative-going sawtooth signal with a total time duration of approximately five-divisions (10-milliseconds). Check for a negative-going ramp of approximately one-division duration (two milliseconds determined by the DELAYED SWEEP Time/Division switch). See Fig. 5-7 (B).

h. Change the DISPLAY MODE switch to MIXED.

i. CHECK–Test oscilloscope for negative-going sawtooth signal with a total duration of approximately five-divisions (10-milliseconds). Check the first slope of the negative-going ramp for approximately 2.5-divisions duration (five-milliseconds determined by the TIME/DIV OR DL'Y TIME switch) and the second slope for approximately 0.6-division (1.2-milliseconds determined by the DELAYED SWEEP Time/Division switch). See Fig. 5-7 (C).

This completes the Calibration Procedure for the 7B53N. Disconnect all test equipment and replace the side covers to the 7B53N.

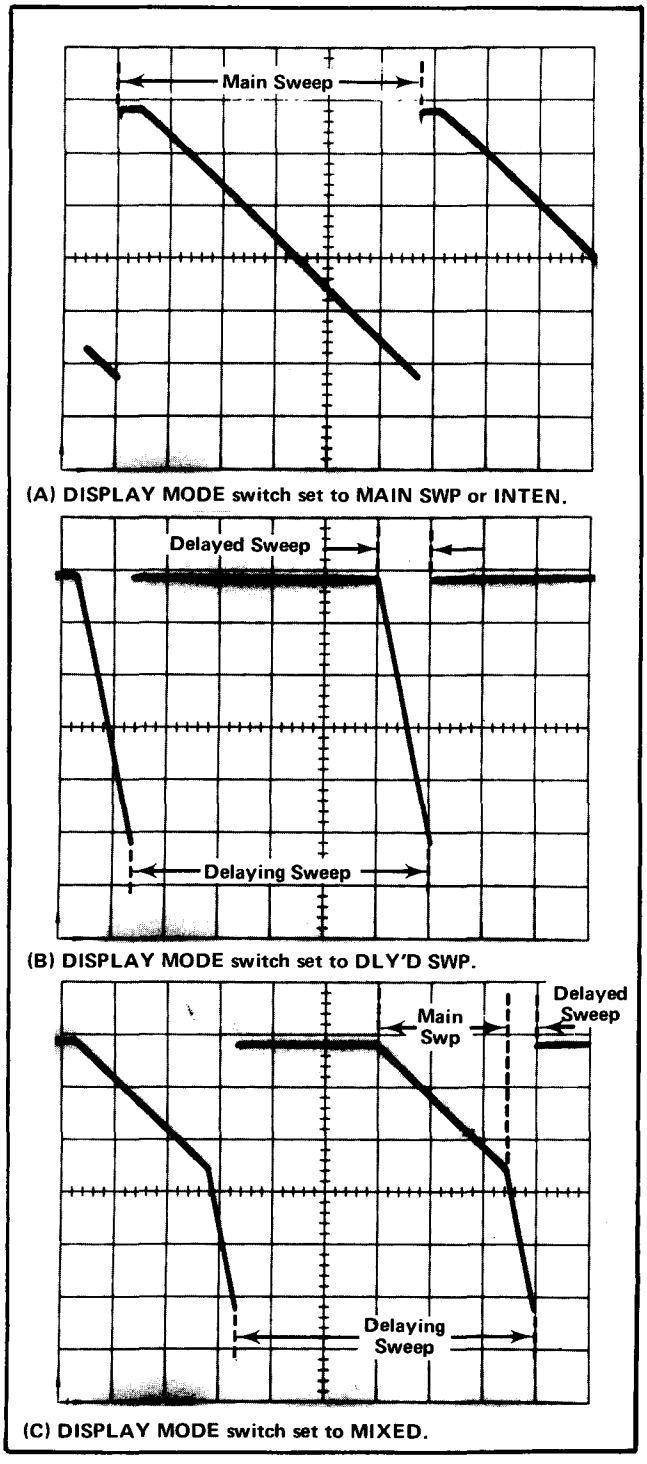


Fig. 5-7. Typical composite sawtooth output signal (TIME/DIV OR DL'Y TIME switch set to 1 ms, DELAYED SWEEP Time/Division switch set to .2 ms, and test oscilloscope set to two-milliseconds/division).

PARTS LIST ABBREVIATIONS

BHB	binding head brass
BHS	binding head steel
cap.	capacitor
cer	ceramic
comp	composition
conn	connector
CRT	cathode-ray tube
csk	countersunk
DE	double end
dia	diameter
div	division
elect.	electrolytic
EMC	electrolytic, metal cased
EMT	electrolytic, metal tubular
ext	external
F & I	focus and intensity
FHB	flat head brass
FHS	flat head steel
Fil HB	fillister head brass
Fil HS	fillister head steel
h	height or high
hex.	hexagonal
HHB	hex head brass
HHS	hex head steel
HSB	hex socket brass
HSS	hex socket steel
ID	inside diameter
inc	incandescent
int	internal
lg	length or long
met.	metal
mtg hdw	mounting hardware
OD	outside diameter
OHB	oval head brass
OHS	oval head steel
P/O	part of
PHB	pan head brass
PHS	pan head steel
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
prec	precision
PT	paper, tubular
PTM	paper or plastic, tubular, molded
RHB	round head brass
RHS	round head steel
SE	single end
SN or S/N	serial number
S or SW	switch
TC	temperature compensated
THB	truss head brass
thk	thick
THS	truss head steel
tub.	tubular
var	variable
w	wide or width
WW	wire-wound

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 or model 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.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number
*000-0000-00	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, Inc., or reworked or checked components.
Use 000-0000-00	Part number indicated is direct replacement.

INDEX OF ELECTRICAL PARTS

SECTION 6
ELECTRICAL PARTS LIST

CHASSIS

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
				Capacitors		
Tolerance ±20% unless otherwise indicated.						
C4	283-0636-00			36 pF	Mica	100 V ±0.5 pF
C51	283-0051-00			0.0033 μF	Cer	100 V 5%
				Bulbs		
DS2	*150-0048-01			Incandescent #683, selected		
DS8	*150-0048-01			Incandescent #683, selected		
				Connectors		
J16	131-0955-00			BNC, receptacle, electrical		
J18	131-0955-00			BNC, receptacle, electrical		
				Resistors		
Resistors are fixed, composition, ±10% unless otherwise indicated.						
R2	311-1063-00			5 kΩ, Var		
R4	317-0510-00			51 Ω	1/8 W	5%
R5	322-0610-00			500 kΩ	1/4 W Prec	1%
R8	311-1059-00			10 kΩ, Var		
R15	311-1068-00			5 kΩ, Var		
R19	311-0946-00			50 kΩ, Var		
R50	315-0102-00			1 kΩ	1/4 W	5%
R51	317-0910-00			91 Ω	1/8 W	5%
				Switches		
	Wired or Unwired					
S2[1]				LEVEL SLOPE (MAIN TRIG)		
S15	Wired *262-0936-00		Push	LEVEL (DLY'D TRIG)		
S15	260-0516-00		Push	LEVEL (DLY'D TRIG)		

[1]**Ganged with R2, furnished as a unit.**

A1 INTERFACE Circuit Board Assembly

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
	*670-1423-00			Complete Board		
				Capacitors		
Tolerance ±20% unless otherwise indicated.						
C6	283-0080-00			0.022 μF	Cer 25 V	+80%—20%
C119	283-0003-00			0.01 μF	Cer 150 V	
C120	283-0000-00			0.001 μF	Cer 500 V	
C121	283-0178-00			0.1 μF	Cer 100 V	+80%—20%
C123	283-0000-00			0.001 μF	Cer 500 V	
C124	283-0178-00			0.1 μF	Cer 100 V	+80%—20%
C128	283-0000-00			0.001 μF	Cer 500 V	
C129	283-0178-00			0.1 μF	Cer 100 V	+80%—20%
C131	283-0000-00			0.001 μF	Cer 500 V	
C132	283-0178-00			0.1 μF	Cer 100 V	+80%—20%
C281[1]				0.001 μF		
C282				0.01 μF		
C283				0.1 μF		
C284	*295-0136-00			1 μF	Timing capacitor assembly	
C285				10 μF		
C291				0.001 μF		
C299	283-0164-00			2.2 μF	Cer 25 V	
				Semiconductor Device, Diodes		
CR48	*152-0185-00			Silicon	Replaceable by 1N4152	
CR67	*152-0185-00			Silicon	Replaceable by 1N4152	
CR100	*152-0185-00			Silicon	Replaceable by 1N4152	
CR101	*152-0185-00			Silicon	Replaceable by 1N4152	
CR102	*152-0185-00			Silicon	Replaceable by 1N4152	
CR104	*152-0185-00			Silicon	Replaceable by 1N4152	
CR105	*152-0185-00			Silicon	Replaceable by 1N4152	
CR107	*152-0185-00			Silicon	Replaceable by 1N4152	
CR108	*152-0185-00			Silicon	Replaceable by 1N4152	
CR110	*152-0185-00			Silicon	Replaceable by 1N4152	
CR111	*152-0185-00			Silicon	Replaceable by 1N4152	
CR113	*152-0185-00			Silicon	Replaceable by 1N4152	
CR114	*152-0185-00			Silicon	Replaceable by 1N4152	
CR116	*152-0185-00			Silicon	Replaceable by 1N4152	
CR117	*152-0185-00			Silicon	Replaceable by 1N4152	
CR121	*152-0185-00			Silicon	Replaceable by 1N4152	
CR122	*152-0185-00			Silicon	Replaceable by 1N4152	

[1]**Individual timing capacitors in this assembly must be ordered by the 9 digit part number, letter suffix and tolerance printed on the timing capacitor to be replaced.**
Example: F—
285-XXXX-XX
The letter suffix and the tolerance should be the same for all of the timing capacitors in this assembly.

Ⓐ

A1 INTERFACE Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
				Inductors
L120	*120-0382-00			Toroid, 14 turns, single
L123	*120-0382-00			Toroid, 14 turns, single
L128	*120-0382-00			Toroid, 14 turns, single
L131	*120-0382-00			Toroid, 14 turns, single
				Transistor
Q48	151-0190-00			Silicon NPN TO-92 2N3904
				Resistors
Resistors are fixed, composition, ±10% unless otherwise indicated.				
R6	315-0101-00			100 Ω 1/4 W 5%
R7	315-0472-00			4.7 kΩ 1/4 W 5%
R11[1]	311-1017-01			20 kΩ, Var
R20	315-0200-00			20 Ω 1/4 W 5%
R21	315-0200-00			20 Ω 1/4 W 5%
R29	315-0200-00			20 Ω 1/4 W 5%
R39	315-0200-00			20 Ω 1/4 W 5%
R48	315-0472-00			4.7 kΩ 1/4 W 5%
R49	315-0470-00			47 Ω 1/4 W 5%
R60	311-1060-00			500 Ω, Var
R114	315-0102-00			1 kΩ 1/4 W 5%
R115	315-0332-00			3.3 kΩ 1/4 W 5%
R116	315-0273-00			27 kΩ 1/4 W 5%
R119	321-0356-00			49.9 kΩ 1/8 W Prec 1%
R120	315-0101-00			100 Ω 1/4 W 5%
R123	315-0101-00			100 Ω 1/4 W 5%
R128	315-0101-00			100 Ω 1/4 W 5%
R131	315-0101-00			100 Ω 1/4 W 5%
R271	325-0082-00			33.51 MΩ 1 W Prec 1/10%
R272	325-0081-00			11.17 MΩ 1/2 W Prec 1/10%
R273	325-0081-00			11.17 MΩ 1/2 W Prec 1/10%
R274	325-0080-00			3.351 MΩ 1/2 W Prec 1/10%
R275	323-0789-07			1.117 MΩ 1/2 W Prec 1/10%
R276	323-0789-07			1.117 MΩ 1/2 W Prec 1/10%
R280	315-0510-00			51 Ω 1/4 W 5%

[1]Furnished as a unit with S11.

A1 INTERFACE Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Description			
				Resistors (cont)			
R281	323-0788-07			558.5 kΩ	½ W	Prec	1/10%
R282	323-0787-07			223.4 kΩ	½ W	Prec	1/10%
R283	323-0786-07			111.7 kΩ	½ W	Prec	1/10%
R284	323-0785-07			55.85 kΩ	½ W	Prec	1/10%
R286	323-0785-07			558.5 kΩ	½ W	Prec	1/10%
R287	323-0786-07			111.7 kΩ	½ W	Prec	1/10%
R288	323-0787-07			223.4 kΩ	½ W	Prec	1/10%
R289	323-0788-07			558.5 kΩ	½ W	Prec	1/10%
R290	315-0510-00			51 Ω	¼ W		5%
R291	325-0082-00			33.51 MΩ	1 W	Prec	1/10%
R292	325-0081-00			11.17 MΩ	½ W	Prec	1/10%
R293	325-0081-00			11.17 MΩ	½ W	Prec	1/10%
R294	325-0080-00			3.351 MΩ	½ W	Prec	1/10%
R295	323-0789-07			1.117 MΩ	½ W	Prec	1/10%
R296	323-0789-07			1.117 MΩ	½ W	Prec	1/10%
R298	321-0289-00			10 kΩ	⅛ W	Prec	1%
R299	315-0101-00			100 Ω	¼ W		5%
				Switch			
	Wired or Unwired						
S10A,B[1]	*670-1423-00			Cam		TIME/DIV or DL'Y TIME (DLY'D SWEEP)	
S11[2]						MAIN VARIABLE	
S200	260-0723-00			Slide		VARIABLE SELECTOR	

A2 DISTRIBUTION Circuit Board Assembly

*670-1559-00	Complete Board	
	Semiconductor Device, Diodes	
CR54	*152-0185-00	Silicon	Replaceable by 1N4152
CR55	*152-0185-00	Silicon	Replaceable by 1N4152
CR57	*152-0185-00	Silicon	Replaceable by 1N4152
CR58	*152-0185-00	Silicon	Replaceable by 1N4152
CR66	*152-0185-00	Silicon	Replaceable by 1N4152
CR71	*152-0185-00	Silicon	Replaceable by 1N4152

[1]See Mechanical Parts List for replacement parts.

[2]Furnished as a unit with R11.

A2 DISTRIBUTION Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
				Transistors
Q6	151-0301-00			Silicon PNP TO-18 2N2907
Q8	151-0188-00			Silicon PNP TO-92 2N3906
				Resistors
Resistors are fixed, composition, ±10% unless otherwise indicated.				
R71	315-0202-00			2 kΩ ¼ W 5%
R72	315-0102-00			1 kΩ ¼ W 5%
R74	315-0303-00			30 kΩ ¼ W 5%
R75	315-0472-00			4.7 kΩ ¼ W 5%

A3 MAIN TRIGGER Circuit Board Assembly

*670-1431-00		Complete Board

Capacitors

Tolerance ±20% unless otherwise indicated.

C301	281-0122-00	2.5-9 pF, Var	Cer	100 V	
C309	283-0000-00	0.001 μF	Cer	500 V	
C311	281-0613-00	10 pF	Cer	200 V	5%
C313	283-0000-00	0.001 μF	Cer	500 V	
C314	283-0000-00	0.001 μF	Cer	500 V	
C323	283-0080-00	0.022 μF	Cer	25 V	+80%—20%
C333	283-0178-00	0.1 μF	Cer	100 V	+80%—20%
C341	281-0511-00	22 pF	Cer	500 V	10%
C344	281-0511-00	22 pF	Cer	500 V	10%
C357	283-0080-00	0.022 μF	Cer	25 V	+80%—20%
C361	283-0080-00	0.022 μF	Cer	25 V	+80%—20%
C362	283-0051-00	0.0033 μF	Cer	100 V	5%
C363	283-0080-00	0.022 μF	Cer	25 V	+80%—20%
C364	283-0194-00	4.7 μF	Cer	50 V	
C366	283-0080-00	0.022 μF	Cer	25 V	+80%—20%
C367	283-0169-00	0.022 μF	Cer	200 V	10%
C369	283-0178-00	0.1 μF	Cer	100 V	+80%—20%
C402	283-0633-00	77 pF	Mica	100 V	1%
C414	283-0212-00	2 μF	Cer	50 V	
C419	281-0516-00	39 pF	Cer	500 V	10%

A3 MAIN TRIGGER Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
			Capacitors (cont)			
C426	283-0080-00		0.022 μF	Cer	25 V	+80%—20%
C427	283-0080-00		0.022 μF	Cer	25 V	+80%—20%
C451	281-0513-00		27 pF	Cer	500 V	
C457	290-0246-00		3.3 μF	Elect.	15 V	10%
C461	281-0513-00		27 pF	Cer	500 V	
C467	290-0136-00		2.2 μF	Elect.	20 V	
C469	281-0525-00		470 pF	Cer	500 V	
			Semiconductor Device, Diodes			
CR303	*152-0185-00		Silicon	Replaceable by 1N4152		
CR305	*152-0185-00		Silicon	Replaceable by 1N4152		
CR323	*152-0185-00		Silicon	Replaceable by 1N4152		
CR421	*152-0185-00		Silicon	Replaceable by 1N4152		
CR422	*152-0185-00		Silicon	Replaceable by 1N4152		
CR423	*152-0185-00		Silicon	Replaceable by 1N4152		
CR424	*152-0185-00		Silicon	Replaceable by 1N4152		
CR430	152-0140-01		Tunnel	10 mA, 8 pF		
CR455	*152-0185-00		Silicon	Replaceable by 1N4152		
CR470	152-0140-01		Tunnel	10 mA, 8 pF		
CR475	152-0140-01		Tunnel	10 mA, 8 pF		
VR401	152-0226-00		Zener	1N751A 400 mW, 5.1 V, 5%		
			Inductors			
L414	276-0507-00		Core, ferramic suppressor			
L431	*108-0420-00		60 nH			
L432	276-0507-00		Core, ferramic suppressor			
			Transistors			
Q308	151-1011-00		Silicon	FET	N channel, junction type	
Q312	151-0221-00		Silicon	PNP	TO-18 2N4258	
Q316	151-0223-00		Silicon	NPN	TO-18 2N4275	
Q352	151-0221-00		Silicon	PNP	TO-18 2N4258	
Q354	151-0221-00		Silicon	PNP	TO-18 2N4258	
Q358	*151-0230-00		Silicon	NPN	TO-105 Selected from RCA 40235	
Q362	151-0207-00		Silicon	NPN	TO-98 2N3415	
Q364	151-0207-00		Silicon	NPN	TO-98 2N3415	
Q366	*151-0198-00		Silicon	NPN	TO-92 Replaceable by MPS 918	
Q402	*151-0230-00		Silicon	NPN	TO-105 Selected from RCA 40235	

A3 MAIN TRIGGER Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
				Transistors (cont)
Q404	*151-0230-00		Silicon	NPN TO-105 Selected from RCA 40235
Q408	151-0207-00		Silicon	NPN TO-98 2N3415
Q416	151-0221-00		Silicon	PNP TO-18 2N4258
Q418	151-0221-00		Silicon	PNP TO-18 2N4258
Q428	151-0207-00		Silicon	NPN TO-98 2N3415
Q434	*151-0259-00		Silicon	NPN TO-106 Selected from 2N3563
Q454	151-0223-00		Silicon	NPN TO-18 2N4275
Q466	151-0223-00		Silicon	NPN TO-18 2N4275
				Resistors
Resistors are fixed, composition, ±10% unless otherwise indicated.				
R301	317-0221-00		220 Ω	1/8 W 5%
R302	321-0452-00		499 kΩ	1/8 W Prec 1%
R303	317-0562-00		5.6 kΩ	1/8 W 5%
R304	317-0202-00		2 kΩ	1/8 W 5%
R305	317-0682-00		6.8 kΩ	1/8 W 5%
R308	317-0511-00		510 Ω	1/8 W 5%
R309	317-0101-00		100 Ω	1/8 W 5%
R312	315-0102-00		1 kΩ	1/4 W 5%
R313	315-0202-00		2 kΩ	1/4 W 5%
R314	315-0510-00		51 Ω	1/4 W 5%
R316	315-0751-00		750 Ω	1/4 W 5%
R317	315-0820-00		82 Ω	1/4 W 5%
R319	315-0510-00		51 Ω	1/4 W 5%
R321	315-0392-00		3.9 kΩ	1/4 W 5%
R322	315-0183-00		18 kΩ	1/4 W 5%
R330	311-0634-00		500 Ω, Var	
R331	321-0197-00		1.1 kΩ	1/8 W Prec 1%
R332	321-0237-00		2.87 kΩ	1/8 W Prec 1%
R333	315-0510-00		51 Ω	1/4 W 5%
R336	321-0088-00		80.6 Ω	1/8 W Prec 1%
R337	321-0088-00		80.6 Ω	1/8 W Prec 1%
R339	322-0212-00		1.58 kΩ	1/4 W Prec 1%
R341	321-0113-00		147 Ω	1/8 W Prec 1%
R342	321-0113-00		147 Ω	1/8 W Prec 1%
R343	322-0209-00		1.47 kΩ	1/4 W Prec 1%
R344	321-0113-00		147 Ω	1/8 W Prec 1%
R345	321-0113-00		147 Ω	1/8 W Prec 1%
R346	322-0209-00		1.47 kΩ	1/4 W Prec 1%
R350	311-0622-00		100 Ω, Var	
R351	322-0175-00		646 Ω	1/4 W Prec 1%

A3 MAIN TRIGGER Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
			Resistors (cont)			
R353	322-0239-00		3.01 kΩ	1/4 W	Prec	1%
R354	322-0172-00		604 Ω	1/4 W	Prec	1%
R355	321-0205-00		1.33 kΩ	1/8 W	Prec	1%
R357	315-0101-00		100 Ω	1/4 W		5%
R358	323-0197-00		1.1 kΩ	1/2 W	Prec	1%
R359	315-0680-00		68 Ω	1/4 W		5%
R361	317-0303-00		30 kΩ	1/8 W		5%
R363	317-0303-00		30 kΩ	1/8 W		5%
R364	315-0222-00		2.2 kΩ	1/4 W		5%
R366	317-0103-00		10 kΩ	1/8 W		5%
R369	317-0270-00		27 Ω	1/8 W		5%
R401	315-0101-00		100 Ω	1/4 W		5%
R402	317-0150-00		15 Ω	1/8 W		5%
R403	315-0101-00		100 Ω	1/4 W		5%
R404	317-0150-00		15 Ω	1/8 W		5%
R406	315-0203-00		20 kΩ	1/4 W		5%
R407	315-0102-00		1 kΩ	1/4 W		5%
R408	315-0162-00		1.6 kΩ	1/4 W		5%
R410	311-0607-00		10 kΩ, Var			
R411	315-0203-00		20 kΩ	1/4 W		5%
R412	315-0123-00		12 kΩ	1/4 W		5%
R414	315-0222-00		2.2 kΩ	1/4 W		5%
R416	321-0193-00		1 kΩ	1/8 W	Prec	1%
R418	321-0193-00		1 kΩ	1/8 W	Prec	1%
R419	317-0300-00		30 Ω	1/8 W		5%
R426	315-0622-00		6.2 kΩ	1/4 W		5%
R427	315-0622-00		6.2 kΩ	1/4 W		5%
R428	317-0302-00		3 kΩ	1/8 W		5%
R431	317-0360-00		36 Ω	1/8 W		5%
R432	315-0101-00		100 Ω	1/4 W		5%
R433	315-0202-00		2 kΩ	1/4 W		5%
R434	315-0331-00		330 Ω	1/4 W		5%
R436	315-0202-00		2 kΩ	1/4 W		5%
R451	317-0470-00		47 Ω	1/8 W		5%
R453	315-0471-00		470 Ω	1/4 W		5%
R454	317-0202-00		2 kΩ	1/8 W		5%
R455	311-0635-00		1 kΩ, Var			
R456	321-0641-00		1.8 kΩ	1/8 W	Prec	1%
R457	315-0101-00		100 Ω	1/4 W		5%
R461	317-0470-00		47 Ω	1/8 W		5%

A3 MAIN TRIGGER Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
			Resistors (cont)			
R462	317-0470-00			47 Ω	1/8 W	5%
R463	317-0202-00			2 kΩ	1/8 W	5%
R464	315-0471-00			470 Ω	1/4 W	5%
R465	311-0634-00			500 Ω, Var		
R466	315-0821-00			820 Ω	1/4 W	5%
R467	315-0201-00			200 Ω	1/4 W	5%
R469	315-0391-00			390 Ω	1/4 W	5%
R472	317-0101-00			100 Ω	1/8 W	5%
R474	317-0470-00			47 Ω	1/8 W	5%
			Integrated Circuit			
U330	*155-0022-00			Monolithic		

A4 SWEEP Circuit Board Assembly

*670-1424-00	B010100	B019999	Complete Board
*670-1424-01	B020000	B029999	Complete Board
*670-1424-02	B030000	B039999	Complete Board
*670-1424-03	B040000	B049999	Complete Board

Capacitors

Tolerance ±20% unless otherwise indicated.

C709	290-0167-00	10 μF	Elect.	15 V	
C719	281-0523-00	100 pF	Cer	350 V	
C728	283-0177-00	1 μF	Cer	25 V	+80%—20%
C731	281-0504-00	10 pF	Cer	500 V	10%
C743	283-0177-00	1 μF	Cer	25 V	+80%—20%
C750	290-0305-01	3 μF	Elect.	150 V	10%
C753	290-0267-00	1 μF	Elect.	35 V	
C754	283-0220-00	0.01 μF	Cer	50 V	
C758	283-0059-00	1 μF	Cer	25 V	+80%—20%
C759	281-0593-00	3.9 pF	Cer		10%
C772	281-0523-00	100 pF	Cer	350 V	
C773	281-0629-00	33 pF	Cer	600 V	5%
C776	283-0059-00	1 pF	Cer	25 V	+80%—20%
C778	281-0166-00	1.9-15.7 pF, Var	Air		
C779	283-0251-00	87 pF	Cer	100 V	5%
C786	283-0177-00	1 μF	Cer	25 V	+80%—20%
C787	283-0077-00	330 μF	Cer	500 V	5%
C788	283-0212-00	2 μF	Cer	50 V	
C789	283-0268-00	0.015 μF	Cer	50 V	10%
C851	283-0059-00	1 μF	Cer	25 V	+80%—20%

A4 SWEEP Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
			Capacitors (cont)			
C852	290-0134-00		2 μF	Elect.	15 V	
C854	283-0111-00		0.1 μF	Cer	50 V	
C855	290-0297-00		39 μF	Elect.	10 V	10%
C857	283-0059-00		1 μF	Cer	25 V	+80%—20%
C858	290-0134-00		22 μF	Elect.	15 V	
C859	283-0111-00		0.1 μF	Cer	50 V	
C862	283-0080-00		0.022 μF	Cer	25 V	+80%—20%
C891	283-0000-00		0.001 μF	Cer	500 V	
C896	281-0544-00		5.6 pF	Cer	500 V	10%
C899	281-0504-00		10 pF	Cer	500 V	10%
C906	290-0136-00		2.2 μF	Elect.	20 V	
C907	281-0504-00		10 pF	Cer	500 V	10%
C910	281-0504-00		10 pF	Cer	500 V	10%
C915	281-0518-00		47 pF	Cer	500 V	
C922	283-0111-00		0.1 μF	Cer	50 V	
C924	283-0111-00		0.1 μF	Cer	50 V	
C926	290-0136-00		2.2 μF	Elect.	20 V	
C930	283-0111-00		0.1 μF	Cer	50 V	
C932	283-0059-00		1 μF	Cer	25 V	+80%—20%
C937	281-0523-00		100 pF	Cer	350 V	
C938	281-0518-00		47 pF	Cer	500 V	
C939	283-0059-00		1 μF	Cer	25 V	+80%—20%
C942	281-0504-00		10 pF	Cer	500 V	10%
C946	281-0504-00		10 pF	Cer	500 V	10%
C956	281-0166-00		1.9-15.7 pF, Var	Air	250 V	
C957	283-0251-00		87 pF	Cer	100 V	5%
C993	281-0504-00		10 pF	Cer	500 V	10%
C1001	281-0512-00		27 pF	Cer	500 V	10%
C1006	281-0572-00		6.8 pF	Cer	500 V	±0.5 pF
C1014	283-0059-00		1 μF	Cer	25 V	+80%—20%
C1018	283-0000-00		0.001 μF	Cer	500 V	
C1019	283-0111-00		0.1 μF	Cer	50 V	
C1022	283-0000-00		0.001 μF	Cer	500 V	
C1028	283-0000-00		0.001 μF	Cer	500 V	
C1029	283-0000-00		0.001 μF	Cer	500 V	
C1052	281-0612-00		5.6 pF	Cer	200 V	±0.5 pF
			Semiconductor Device, Diodes			
CR706	*152-0185-00		Silicon	Replaceable by 1N4152		
CR707	*152-0185-00		Silicon	Replaceable by 1N4152		
CR714	*152-0185-00		Silicon	Replaceable by 1N4152		
CR716	*152-0185-00		Silicon	Replaceable by 1N4152		
CR719	*152-0185-00		Silicon	Replaceable by 1N4152		

A4 SWEEP Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
		Semiconductor Device, Diodes (cont)		
CR759	*152-0075-00		Germanium	Tek Spec
CR792	*152-0185-00		Silicon	Replaceable by 1N4152
CR866	*152-0075-00		Germanium	Tek Spec
CR869	*152-0185-00		Silicon	Replaceable by 1N4152
CR888	*152-0075-00		Germanium	Tek Spec
CR889	*152-0185-00		Silicon	Replaceable by 1N4152
CR897	152-0307-00		Silicon	Dual
CR901	*152-0075-00		Germanium	Tek Spec
CR926	*152-0185-00		Silicon	Replaceable by 1N4152
CR927	*152-0185-00		Silicon	Replaceable by 1N4152
CR944	*152-0185-00		Silicon	Replaceable by 1N4152
CR948	*152-0185-00		Silicon	Replaceable by 1N4152
CR967	*152-0185-00		Silicon	Replaceable by 1N4152
CR968	*152-0185-00		Silicon	Replaceable by 1N4152
CR981	*152-0185-00		Silicon	Replaceable by 1N4152
CR987	*152-0185-00		Silicon	Replaceable by 1N4152
CR991	*152-0185-00		Silicon	Replaceable by 1N4152
CR993	*152-0185-00		Silicon	Replaceable by 1N4152
CR1003	152-0141-02		Silicon	1N4152
CR1012	*152-0185-00		Silicon	Replaceable by 1N4152
CR1016	*152-0185-00		Silicon	Replaceable by 1N4152
CR1033	*152-0185-00		Silicon	Replaceable by 1N4152
CR1043	*152-0185-00		Silicon	Replaceable by 1N4152
VR750	152-0461-00		Zener	1N821 6.2 V, 5%
VR1019	152-0227-00		Zener	1N753A 400 mW, 6.2 V, 5%
		Relay		
K1055	*148-0034-00		Armature, DPDT	
		Transistors		
Q714	151-0188-00		Silicon PNP	TO-92 2N3906
Q716	151-0190-00		Silicon NPN	TO-92 2N3904
Q722	151-0223-00		Silicon NPN	TO-18 2N4275
Q726	151-0223-00		Silicon NPN	TO-18 2N4275
Q728	151-0190-00		Silicon NPN	TO-92 2N3904
Q744	151-0301-00		Silicon PNP	TO-18 2N2907
Q748	151-0221-00		Silicon PNP	TO-18 2N4258
Q762	151-0221-00		Silicon PNP	TO-18 2N4258
Q774	151-1004-00		Silicon FET	TO-18 N channel, junction type
Q782	151-0190-00		Silicon NPN	TO-92 2N3904

A4 SWEEP Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Description
				Transistors (cont)
Q784	151-0188-00			Silicon PNP TO-92 2N3906
Q792	151-0190-00			Silicon NPN TO-92 2N3904
Q794	151-0221-00			Silicon PNP TO-18 2N4258
Q796	151-0221-00			Silicon PNP TO-18 2N4258
Q862	151-0220-00			Silicon PNP TO-18 2N4122
Q882	151-0223-00			Silicon NPN TO-18 2N4275
Q886	151-0223-00			Silicon NPN TO-18 2N4275
Q888	*151-0289-00			Silicon PNP TO-18 Tek Spec
Q892	151-0190-00			Silicon NPN TO-92 2N3904
Q896	*151-0259-00			Silicon NPN TO-106 Selected from 2N3563
Q898	*151-0259-00			Silicon NPN TO-106 Selected from 2N3563
Q902	151-0220-00			Silicon PNP TO-18 2N4122
Q904	151-0221-00			Silicon PNP TO-18 2N4258
Q906	151-0190-00			Silicon NPN TO-92 2N3904
Q922	151-0223-00			Silicon NPN TO-18 2N4275
Q924	151-0223-00			Silicon NPN TO-18 2N4275
Q928	151-0221-00			Silicon PNP TO-18 2N4258
Q942	151-0223-00			Silicon NPN TO-18 2N4275
Q944	151-0223-00			Silicon NPN TO-18 2N4275
Q954	151-0220-00			Silicon PNP TO-18 2N4122
Q962	*151-0216-00			Silicon PNP TO-92 Replaceable by MOT MPS 6523
Q966	*151-0216-00			Silicon PNP TO-92 Replaceable by MOT MPS 6523
Q968	151-0220-00			Silicon PNP TO-18 2N4122
Q984	*151-0192-00			Silicon NPN TO-92 Replaceable by MPS 6521
Q988	151-0190-00			Silicon NPN TO-92 2N3904
Q992	151-0221-00			Silicon PNP TO-18 2N4258
Q1004	151-0219-00			Silicon PNP TO-18 2N4250
Q1006	151-0224-00			Silicon NPN TO-18 2N3692
Q1014	*151-0192-00			Silicon NPN TO-92 Replaceable by MPS 6521
Q1024	151-0190-00			Silicon NPN TO-92 2N3904
Q1038	151-0224-00			Silicon NPN TO-18 2N3692
Q1046	151-0190-00			Silicon NPN TO-92 2N3904
				Resistors
Resistors are fixed, composition, ±10% unless otherwise indicated.				
R704	315-0512-00			5.1 kΩ 1/4 W 5%
R706	315-0103-00			10 kΩ 1/4 W 5%
R707	317-0622-00			6.2 kΩ 1/8 W 5%
R710	315-0101-00			100 Ω 1/4 W 5%
R711	315-0151-00			150 Ω 1/4 W 5%
R712	321-0313-00			17.8 kΩ 1/8 W Prec 1%

A4 SWEEP Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
				Resistors (cont)			
R713	315-0511-00			510 Ω	1/4 W		5%
R714	315-0431-00			430 Ω	1/4 W		5%
R715	321-0641-00			1.8 kΩ	1/8 W	Prec	1%
R716	321-0231-00			2.49 kΩ	1/8 W	Prec	1%
R717	315-0821-00			820 Ω	1/4 W		5%
R719	315-0392-00			3.9 kΩ	1/4 W		5%
R720	315-0331-00			330 Ω	1/4 W		5%
R721	315-0270-00			27 Ω	1/4 W		5%
R722	315-0620-00			62 Ω	1/4 W		5%
R723	315-0241-00			240 Ω	1/4 W		5%
R724	323-0192-00			976 Ω	1/2 W	Prec	1%
R725	321-0146-00			324 Ω	1/8 W	Prec	1%
R726	315-0151-00			150 Ω	1/4 W		5%
R727	315-0332-00			3.3 kΩ	1/4 W		5%
R728	315-0331-00			330 Ω	1/4 W		5%
R729	315-0152-00			1.5 kΩ	1/4 W		5%
R731	315-0202-00			2 kΩ	1/4 W		5%
R732	315-0511-00			510 Ω	1/4 W		5%
R741	315-0472-00			4.7 kΩ	1/4 W		5%
R742	315-0241-00			240 Ω	1/4 W		5%
R744	315-0102-00			1 kΩ	1/4 W		5%
R745	315-0102-00			1 kΩ	1/4 W		5%
R746	315-0822-00	XB040000		8.2 kΩ	1/4 W		5%
R747	315-0102-00			1 kΩ	1/4 W		5%
R748	315-0102-00			1 kΩ	1/4 W		5%
R749	315-0431-00	B010100	B039999	430 Ω	1/4 W		5%
R749	315-0391-00	B040000		390 Ω	1/4 W		5%
R750	311-0644-00			20 kΩ, Var			
R751	321-0201-00			1.21 kΩ	1/8 W	Prec	1%
R752	321-0289-00			10 kΩ	1/8 W	Prec	1%
R753	315-0103-00			10 kΩ	1/4 W		5%
R754	315-0304-00			300 kΩ	1/4 W		5%
R755	311-0644-00			20 kΩ, Var			
R756	315-0752-00	B010100	B019999	7.5 kΩ	1/4 W		5%
R756	315-0622-00	B020000		6.2 kΩ	1/4 W		5%
R757	315-0101-00			100 Ω	1/4 W		5%
R758	315-0101-00			100 Ω	1/4 W		5%
R759	315-0752-00			7.5 kΩ	1/4 W		5%
R761	315-0563-00			56 kΩ	1/4 W		5%
R762	315-0202-00			2 kΩ	1/4 W		5%
R770	311-0613-00			100 kΩ, Var			
R771	315-0433-00			43 kΩ	1/4 W		5%
R772	315-0820-00			82 Ω	1/4 W		5%

A4 SWEEP Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
			Resistors (cont)			
R774	315-0153-00		15 kΩ	1/4 W		5%
R776	315-0621-00		620 Ω	1/4 W		5%
R781	321-0260-00		4.99 kΩ	1/8 W	Prec	1%
R782	321-0289-00		10 kΩ	1/8 W	Prec	1%
R784	315-0103-00		10 kΩ	1/4 W		5%
R786	315-0124-00		120 kΩ	1/4 W		5%
R787	315-0104-00		100 kΩ	1/4 W		5%
R789	315-0103-00		10 kΩ	1/4 W		5%
R792	315-0102-00		1 kΩ	1/4 W		5%
R793	315-0153-00		15 kΩ	1/4 W		5%
R794	315-0432-00		4.3 kΩ	1/4 W		5%
R795	311-0634-00		500 Ω, Var			
R796	311-0512-00		5.1 kΩ	1/4 W		5%
R798	315-0271-00		270 Ω	1/4 W		5%
R861	315-0302-00		3 kΩ	1/4 W		5%
R862	315-0202-00		2 kΩ	1/4 W		5%
R864	315-0101-00		100 Ω	1/4 W		5%
R865	311-0978-00		250 Ω, Var			
R867	315-0151-00		150 Ω	1/4 W		5%
R871	315-0102-00		1 kΩ	1/4 W		5%
R872	315-0302-00		3 kΩ	1/4 W		5%
R873	315-0752-00		7.5 kΩ	1/4 W		5%
R874	315-0162-00		1.6 kΩ	1/4 W		5%
R881	315-0270-00		27 Ω	1/4 W		5%
R883	315-0361-00		360 Ω	1/4 W		5%
R884	322-0210-00		1.5 kΩ	1/4 W	Prec	1%
R885	315-0301-00		300 Ω	1/4 W		5%
R886	315-0620-00		62 Ω	1/4 W		5%
R887	321-0164-00		499 Ω	1/8 W	Prec	1%
R888	321-0194-00		1.02 kΩ	1/8 W	Prec	1%
R891	315-0103-00		10 kΩ	1/4 W		5%
R892	315-0623-00		62 kΩ	1/4 W		5%
R893	315-0303-00		30 kΩ	1/4 W		5%
R895	317-0510-00		51 Ω	1/8 W		5%
R896	315-0102-00		1 kΩ	1/4 W		5%
R897	317-0510-00		51 Ω	1/8 W		5%
R898	301-0133-00		13 kΩ	1/2 W		5%
R899	315-0102-00		1 kΩ	1/4 W		5%
R902	315-0102-00		1 kΩ	1/4 W		5%
R903	315-0302-00		3 kΩ	1/4 W		5%
R906	315-0270-00		27 Ω	1/4 W		5%
R907	315-0202-00		2 kΩ	1/4 W		5%

A4 SWEEP Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
				Resistors (cont)		
R908	315-0511-00			510 Ω	1/4 W	5%
R909	315-0102-00			1 kΩ	1/4 W	5%
R910	315-0102-00			1 kΩ	1/4 W	5%
R913	315-0202-00			2 kΩ	1/4 W	5%
R915	315-0102-00			1 kΩ	1/4 W	5%
R917	315-0202-00			2 kΩ	1/4 W	5%
R921	315-0202-00			2 kΩ	1/4 W	5%
R922	315-0271-00			270 Ω	1/4 W	5%
R923	315-0104-00			100 kΩ	1/4 W	5%
R924	315-0271-00			270 Ω	1/4 W	5%
R925	315-0104-00			100 kΩ	1/4 W	5%
R926	315-0100-00			10 Ω	1/4 W	5%
R927	315-0241-00			240 Ω	1/4 W	5%
R928	315-0682-00			6.8 kΩ	1/4 W	5%
R930	311-0635-00			1 kΩ, Var		
R931	315-0752-00			7.5 kΩ	1/4 W	5%
R932	315-0101-00			100 Ω	1/4 W	5%
R933	315-0752-00			7.5 kΩ	1/4 W	5%
R935	311-0613-00			100 kΩ, Var		
R936	315-0433-00			43 kΩ	1/4 W	5%
R937	315-0820-00			82 Ω	1/4 W	5%
R939	315-0621-00			620 Ω	1/4 W	5%
R941	315-0471-00			470 Ω	1/4 W	5%
R942	315-0362-00			3.6 kΩ	1/4 W	5%
R944	315-0302-00			3 kΩ	1/4 W	5%
R945	315-0431-00			430 Ω	1/4 W	5%
R946	315-0362-00			3.6 kΩ	1/4 W	5%
R947	315-0511-00			510 Ω	1/4 W	5%
R948	315-0202-00			2 kΩ	1/4 W	5%
R952	315-0102-00			1 kΩ	1/4 W	5%
R953	315-0511-00			510 Ω	1/4 W	5%
R954	315-0391-00			390 Ω	1/4 W	5%
R961	321-0260-00			4.99 kΩ	1/8 W Prec	1%
R962	321-0268-00			6.04 kΩ	1/8 W Prec	1%
R963	321-0268-00			6.04 kΩ	1/8 W Prec	1%
R964	321-0260-00			4.99 kΩ	1/8 W Prec	1%
R966	315-0242-00			2.4 kΩ	1/4 W	5%
R967	315-0391-00			390 Ω	1/4 W	5%
R968	315-0391-00			390 Ω	1/4 W	5%
R969	315-0102-00			1 kΩ	1/4 W	5%

Ⓐ

A4 SWEEP Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
				Resistors (cont)			
R981	315-0243-00			24 kΩ	1/4 W		5%
R982	315-0472-00			4.7 kΩ	1/4 W		5%
R983	315-0682-00			6.8 kΩ	1/4 W		5%
R984	315-0203-00			20 kΩ	1/4 W		5%
R986	315-0472-00			4.7 kΩ	1/4 W		5%
R987	315-0103-00			10 kΩ	1/4 W		5%
R988	315-0122-00			1.2 kΩ	1/4 W		5%
R989	315-0123-00			12 kΩ	1/4 W		5%
R992	315-0683-00			68 kΩ	1/4 W		5%
R993	315-0103-00			10 kΩ	1/4 W		5%
R994	315-0623-00			62 kΩ	1/4 W		5%
R996	315-0153-00			15 kΩ	1/4 W		5%
R998	315-0102-00			1 kΩ	1/4 W		5%
R1001	321-0293-00	B010100	B029999	11 kΩ	1/8 W	Prec	1%
R1001	321-0296-00	B030000		11.8 kΩ	1/8 W	Prec	1%
R1002	315-0623-00			62 kΩ	1/4 W		5%
R1003	315-0751-00			750 Ω	1/4 W		5%
R1005	315-0392-00			3.9 kΩ	1/4 W		5%
R1006	321-0335-00			30.1 kΩ	1/8 W	Prec	1%
R1007	321-0193-00			1 kΩ	1/8 W	Prec	1%
R1008	321-0222-00			2 kΩ	1/8 W	Prec	1%
R1009	321-0222-00			2 kΩ	1/8 W	Prec	1%
R1010	321-0356-00			49.9 kΩ	1/8 W	Prec	1%
R1012	321-0268-00			6.04 kΩ	1/8 W	Prec	1%
R1014	321-0174-00			634 Ω	1/8 W	Prec	1%
R1016	315-0561-00			560 Ω	1/4 W		5%
R1018	315-0103-00			10 kΩ	1/4 W		5%
R1019	315-0104-00			100 kΩ	1/4 W		5%
R1021	321-0327-00			24.9 kΩ	1/8 W	Prec	1%
R1022	315-0104-00			100 kΩ	1/4 W		5%
R1023	315-0103-00			10 kΩ	1/4 W		5%
R1024	315-0104-00			100 kΩ	1/4 W		5%
R1025	321-0327-00			24.9 kΩ	1/8 W	Prec	1%
R1026	315-0104-00			100 kΩ	1/4 W		5%
R1027	315-0103-00			10 kΩ	1/4 W		5%
R1028	315-0104-00			100 kΩ	1/4 W		5%
R1031	315-0273-00			27 kΩ	1/4 W		5%
R1032	315-0104-00			100 kΩ	1/4 W		5%
R1033	321-0260-00			4.99 kΩ	1/8 W	Prec	1%
R1034	315-0621-00			620 Ω	1/4 W		5%
R1036	321-0186-00			845 Ω	1/8 W	Prec	1%

A4 SWEEP Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
				Resistors (cont)			
R1038	321-0207-00			1.4 kΩ	1/8 W	Prec	1%
R1041	321-0220-00			1.91 kΩ	1/8 W	Prec	1%
R1042	321-0236-00			2.8 kΩ	1/8 W	Prec	1%
R1043	315-0912-00			9.1 kΩ	1/4 W		5%
R1044	321-0164-00			499 Ω	1/8 W	Prec	1%
R1045	321-0057-00			38.3 Ω	1/8 W	Prec	1%
R1046	321-0148-00			340 Ω	1/8 W	Prec	1%
R1051	315-0432-00			4.3 kΩ	1/4 W		5%
R1052	321-0222-00			2 kΩ	1/8 W	Prec	1%
R1053	315-0302-00			3 kΩ	1/4 W		5%
R1054	321-0153-00			383 Ω	1/8 W	Prec	1%
R1055	311-0643-00			50 Ω, Var			
R1056	321-0148-00			340 Ω	1/8 W	Prec	1%
R1059	308-0300-00			1.75 kΩ	3 W	WW	1%
				Switch			
	Wired or Unwired						
S1055	260-1132-00			Push-pull	10× MAG		
				Integrated Circuits			
U720	*155-0049-00			Sweep control			
U750	*155-0042-01	B010100	B019999	Miller integrator			
U750	*155-0042-03	B020000		Miller integrator			
U930	*155-0042-01	B010100	B019999	Miller integrator			
U930	*155-0042-03	B020000		Miller integrator			
U1020	156-0048-00			Linear, replaceable by RCA CA3046			
U1034	156-0048-00			Linear, replaceable by RCA CA3046			

A5 DELAYED TRIGGER Circuit Board Assembly

*670-1430-00 Complete Board

Capacitors

Tolerance ±20% unless otherwise indicated.

C501	281-0123-00	5-25 pF, Var	Cer	100 V		
C509	283-0000-00	0.001 μF	Cer	500 V		
C511	281-0613-00	10 pF	Cer	200 V		10%
C513	283-0000-00	0.001 μF	Cer	500 V		
C514	283-0000-00	0.001 μF	Cer	500 V		

A5 DELAYED TRIGGER Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
				Capacitors (cont)			
C523	283-0080-00			0.022 μF	Cer	25 V	+80%—20%
C533	283-0178-00			0.1 μF	Cer	100 V	+80%—20%
C541	281-0508-00			12 pF	Cer	500 V	
C544	281-0508-00			12 pF	Cer	500 V	
C552	283-0080-00			0.022 μF	Cer	25 V	+80%—20%
C556	283-0000-00			0.001 μF	Cer	500 V	
C561	283-0080-00			0.022 μF	Cer	25 V	+80%—20%
C562	283-0194-00			4.7 μF	Cer	50 V	
C569	283-0178-00			0.1 μF	Cer	100 V	+80%—20%
C602	283-0633-00			77 pF	Mica	100 V	1%
C614	283-0212-00			2 μF	Cer	50 V	
C619	281-0562-00			39 pF	Cer	500 V	
C626	283-0080-00			0.022 μF	Cer	25 V	+80%—20%
C627	283-0080-00			0.022 μF	Cer	25 V	+80%—20%
C651	281-0513-00			27 pF	Cer	500 V	
C661	281-0513-00			27 pF	Cer	500 V	
C666	281-0613-00			10 pF	Cer	200 V	10%
C667	290-0136-00			2.2 μF	Elect.	20 V	
				Semiconductor Device, Diodes			
CR503	*152-0185-00			Silicon	Replaceable by 1N4152		
CR505	*152-0185-00			Silicon	Replaceable by 1N4152		
CR523	*152-0185-00			Silicon	Replaceable by 1N4152		
CR621	*152-0185-00			Silicon	Replaceable by 1N4152		
CR622	*152-0185-00			Silicon	Replaceable by 1N4152		
CR623	*152-0185-00			Silicon	Replaceable by 1N4152		
CR624	*152-0185-00			Silicon	Replaceable by 1N4152		
CR630	152-0140-01			Tunnel	10 mA, 8 pF		
CR655	*152-0185-00			Silicon	Replaceable by 1N4152		
CR670	152-0140-01			Tunnel	10 mA, 8 pF		
CR675	152-0140-01			Tunnel	10 mA, 8 pF		
VR601	152-0226-00			Zener	1N751A 400 mW, 5.1 V, 5%		
				Inductors			
L614	276-0507-00			Core, ferramic suppressor			
L631	*108-0420-00			60 nH			

Ⓐ

A5 DELAYED TRIGGER Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
				Transistors
Q508	151-1011-00		Silicon	FET TO-71 N channel, junction type
Q512	151-0221-00		Silicon	PNP TO-18 2N4258
Q516	151-0223-00		Silicon	NPN TO-18 2N4275
Q552	151-0221-00		Silicon	PNP TO-18 2N4258
Q554	151-0221-00		Silicon	PNP TO-18 2N4258
Q558	*151-0230-00		Silicon	NPN TO-105 Selected from RCA 40235
Q562	151-0207-00		Silicon	NPN TO-98 2N3415
Q602	*151-0230-00		Silicon	NPN TO-105 Selected from RCA 40235
Q604	*151-0230-00		Silicon	NPN TO-105 Selected from RCA 40235
Q616	151-0221-00		Silicon	PNP TO-18 2N4258
Q618	151-0221-00		Silicon	PNP TO-18 2N4258
Q628	151-0207-00		Silicon	NPN TO-98 2N3415
Q654	151-0223-00		Silicon	NPN TO-18 2N4275
Q666	151-0223-00		Silicon	NPN TO-18 2N4275
				Resistors
Resistors are fixed, composition, ±10% unless otherwise indicated.				
R501	317-0221-00		220 Ω	1/8 W 5%
R502	321-0452-00		499 kΩ	1/8 W Prec 1%
R503	317-0562-00		5.6 kΩ	1/8 W 5%
R504	317-0202-00		2 kΩ	1/8 W 5%
R505	317-0682-00		6.8 kΩ	1/8 W 5%
R508	317-0511-00		510 Ω	1/8 W 5%
R509	315-0101-00		100 Ω	1/4 W 5%
R512	317-0102-00		1 kΩ	1/8 W 5%
R513	315-0202-00		2 kΩ	1/4 W 5%
R514	317-0510-00		51 Ω	1/8 W 5%
R516	317-0751-00		750 Ω	1/8 W 5%
R517	317-0820-00		82 Ω	1/8 W 5%
R519	317-0510-00		51 Ω	1/8 W 5%
R521	317-0392-00		3.9 kΩ	1/8 W 5%
R522	315-0183-00		18 kΩ	1/4 W 5%
R530	311-0634-00		500 Ω, Var	
R531	321-0197-00		1.1 kΩ	1/8 W Prec 1%
R532	321-0237-00		2.87 kΩ	1/8 W Prec 1%
R533	317-0510-00		51 Ω	1/8 W 5%
R536	317-0820-00		82 Ω	1/8 W 5%
R537	317-0820-00		82 Ω	1/8 W 5%
R539	322-0212-00		1.58 kΩ	1/4 W Prec 1%
R541	321-0113-00		147 Ω	1/8 W Prec 1%
R542	321-0113-00		147 Ω	1/8 W Prec 1%
R543	322-0209-00		1.47 kΩ	1/4 W Prec 1%

A5 DELAYED TRIGGER Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
			Resistors (cont)			
R544	321-0113-00		147 Ω	1/8 W	Prec	1%
R545	321-0113-00		147 Ω	1/8 W	Prec	1%
R546	322-0209-00		1.47 kΩ	1/4 W	Prec	1%
R550	311-0622-00		100 Ω, Var			
R551	322-0173-00		619 Ω	1/4 W	Prec	1%
R552	315-0470-00		47 Ω	1/4 W		5%
R553	322-0239-00		3.01 kΩ	1/4 W	Prec	1%
R554	322-0170-00		576 Ω	1/4 W	Prec	1%
R555	321-0205-00		1.33 kΩ	1/8 W	Prec	1%
R556	315-0101-00		100 Ω	1/4 W		5%
R558	323-0197-00		1.1 kΩ	1/2 W	Prec	1%
R561	317-0303-00		30 kΩ	1/8 W		5%
R562	317-0222-00		2.2 kΩ	1/8 W		5%
R569	315-0270-00		27 Ω	1/4 W		5%
R601	315-0101-00		100 Ω	1/4 W		5%
R602	317-0150-00		15 Ω	1/8 W		5%
R603	315-0101-00		100 Ω	1/4 W		5%
R605	317-0150-00		15 Ω	1/8 W		5%
R608	315-0162-00		1.6 kΩ	1/4 W		5%
R610	311-0607-00		10 kΩ, Var			5%
R611	315-0203-00		20 kΩ	1/4 W		5%
R612	315-0123-00		12 kΩ	1/4 W		5%
R614	315-0222-00		2.2 kΩ	1/4 W	Prec	1%
R616	321-0193-00		1 kΩ	1/8 W	Prec	1%
R618	321-0193-00		1 kΩ	1/8 W		5%
R619	317-0300-00		30 Ω	1/8 W		5%
R626	315-0622-00		6.2 kΩ	1/4 W		5%
R627	315-0622-00		6.2 kΩ	1/4 W		5%
R628	317-0302-00		3 kΩ	1/8 W		5%
R631	317-0330-00		33 Ω	1/8 W		5%
R632	315-0101-00		100 Ω	1/4 W		5%
R633	315-0202-00		2 kΩ	1/4 W		5%
R651	317-0470-00		47 Ω	1/8 W		5%
R653	317-0471-00		470 Ω	1/8 W		5%
R654	317-0302-00		3 kΩ	1/8 W		5%
R661	317-0470-00		47 Ω	1/8 W		5%
R662	317-0470-00		47 Ω	1/8 W		5%
R663	317-0471-00		470 Ω	1/8 W		5%
R664	317-0302-00		3 kΩ	1/8 W		5%
R665	311-0634-00		500 Ω, Var			

A5 DELAYED TRIGGER Circuit Board Assembly (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
			Resistors (cont)			
R666	317-0821-00		820 Ω	1/8 W		5%
R667	317-0201-00		200 Ω	1/8 W		5%
R669	317-0391-00		390 Ω	1/8 W		5%
R672	317-0101-00		100 Ω	1/8 W		5%
R674	317-0470-00		47 Ω	1/8 W		5%
			Integrated Circuit			
U530	*155-0022-00		Monolithic			

A6 SOURCE SWITCH Circuit Board Assembly

*670-1427-00 Complete Board

Capacitors

Tolerance ±20% unless otherwise indicated.

C10	281-0123-00	5-25 pF, Var	Cer	100 V	
C13	281-0661-00	0.8 pF	Mica	500 V	±0.1 pF

Resistors

Resistors are fixed, composition, ±10% unless otherwise indicated.

R10	315-0470-00	47 Ω	1/4 W		5%
R13	321-0448-00	453 kΩ	1/8 W	Prec	1%
R14	321-0361-00	56.2 kΩ	1/8 W	Prec	1%
R16	315-0470-00	47 Ω	1/4 W		5%

Switch

	Wired or Unwired		
S7[1]	*670-1427-00	Pushbutton	SOURCE (MAIN TRIG)

[1]**See Mechanical Parts List for replacement parts.**

A7 COUPLING SWITCH Circuit Board Assembly

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
	*670-1428-00			Complete Board		
			Capacitor			
Tolerance ±20% unless otherwise indicated.						
C17	283-0068-00			0.01 μF	Cer	500 V
			Resistors			
Resistors are fixed, composition, ±10% unless otherwise indicated.						
R17	315-0101-00			100 Ω	¼ W	5%
R18	315-0101-00			100 Ω	¼ W	5%
			Switch			
	Wired or Unwired					
S6[1]	*670-1428-00			Pushbutton	COUPLING (MAIN TRIG)	

A8 TRIGGER MODE SWITCH Circuit Board Assembly

	*670-1429-00		Complete Board		
			Semiconductor Device, Diodes		
CR5	*152-0185-00		Silicon	Replaceable by 1N4152	
CR6	*152-0185-00		Silicon	Replaceable by 1N4152	
			Bulb		
DS5	*150-0048-01		Incandescent, #683, selected		
			Switch		
	Wired or Unwired				
S5[1]	*670-1429-00		Pushbutton	MODE (MAIN TRIG)	

[1]See Mechanical Parts List for replacement parts.

A9 DELAYED TRIGGER SWITCH Circuit Board Assembly

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description		
	*670-1225-02			Complete Board		
				Bulbs		
DS16	*150-0048-01			Incandescent, #683, selected		
DS17	*150-0048-01			Incandescent, #683, selected		
DS18	*150-0048-01			Incandescent, #683, selected		
				Capacitors		
	Tolerance ±20% unless otherwise indicated.					
C53	283-0068-00			0.01 μF	Cer	500 V
C54	283-0636-00			36 pF	Mica	100 V ±0.5 pF
				Resistors		
	Resistors are fixed, composition, ±10% unless otherwise indicated.					
R52	322-0610-00			500 kΩ	1/4 W	Prec 1%
R53	317-0101-00			100 Ω	1/8 W	5%
R54	317-0510-00			51 Ω	1/8 W	Prec 5%
R56	317-0101-00			100 Ω	1/8 W	5%
				Switches		
	Wired or Unwired					
S16 S17 S18	260-1133-00			Pushbutton		SLOPE COUPLING (DLY'D SWEEP) SOURCE

A10 DISPLAY MODE SWITCH Circuit Board Assembly

	*670-1426-00			Complete Board	
				Switch	
	Wired or Unwired				
S12[1]	*670-1426-00			Pushbutton	DISPLAY MODE

[1]See Mechanical Parts List for replacement parts.

SECTION 7

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

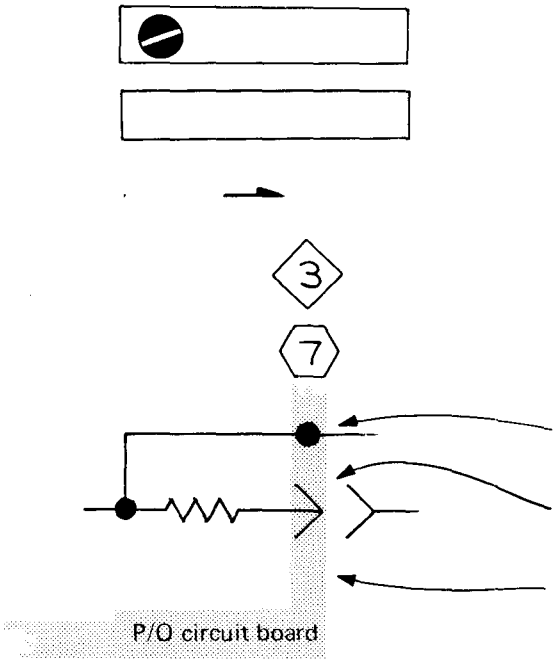
Electrical components shown on the diagrams are in the following units unless noted otherwise:

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

Symbols used on the diagrams are based on USA Standard Y32.2-1967.

Logic symbology is based on MIL-STD-806B in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following special symbols are used on the diagrams:



External Screwdriver adjustment.

External control or connector.

Clockwise control rotation in direction of arrow.

Refer to diagram number indicated in diamond.

Refer to waveform number indicated in hexagon.

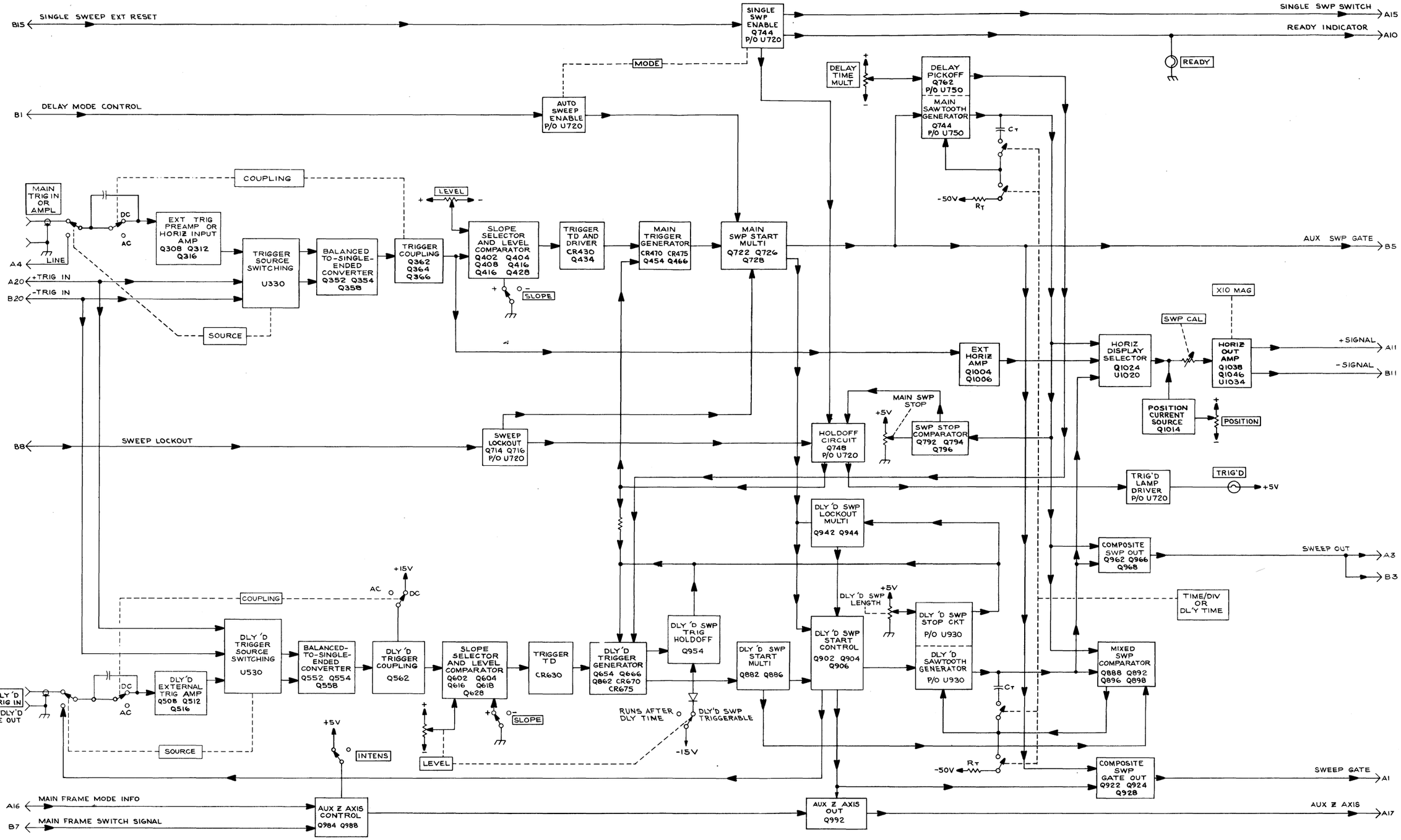
Connection soldered to circuit board.

Connection made to circuit board with interconnecting pin.

Blue tint encloses components located on circuit board.

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
CR	Diode, signal or rectifier
DL	Delay line
DS	Indicating device (lamp)
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, heat radiator, etc.)
HR	Heater
J	Connector, stationary portion
K	Relay
L	Inductor, fixed or variable
LR	Inductor/resistor combination
M	Meter
Q	Transistor or silicon-controlled rectifier
P	Connector, movable portion
R	Resistor, fixed or variable
RT	Thermistor
S	Switch
T	Transformer
TP	Test point
U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
V	Electron tube
VR	Voltage regulator (zener diode, etc.)
Y	Crystal

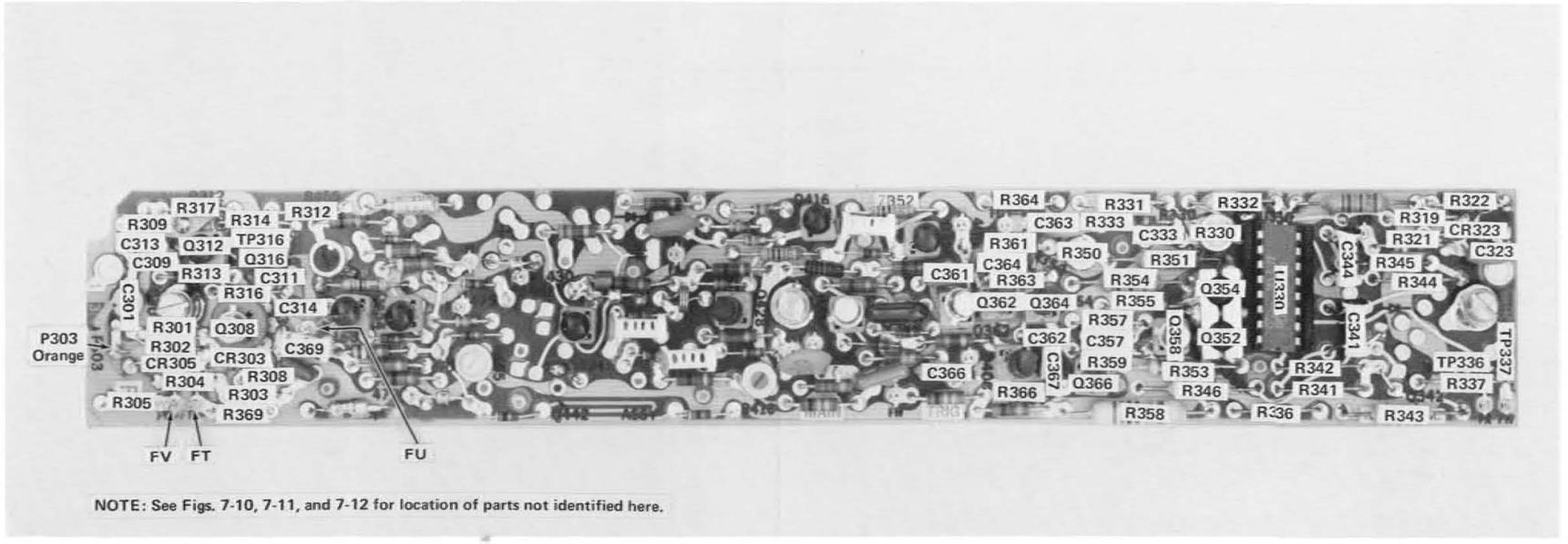


7B53N DUAL TIME BASE

Ⓐ

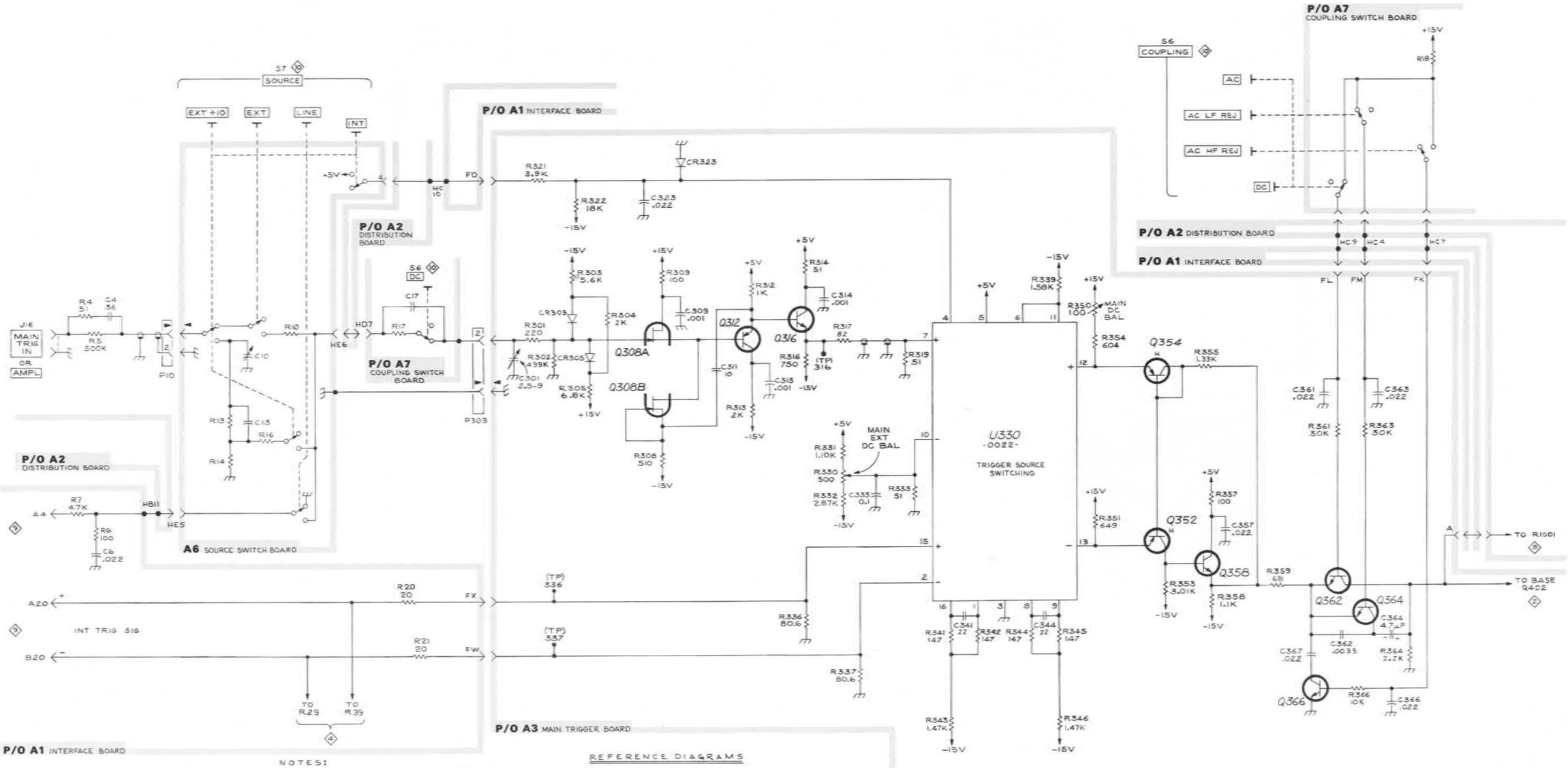
BLOCK DIAGRAM

0671 BC/grs



NOTE: See Figs. 7-10, 7-11, and 7-12 for location of parts not identified here.

Fig. 7-1. P/O A3. Partial Main Trigger circuit board.



NOTES:
1. FOR VOLTAGE DISTRIBUTION SEE ⑨
2. SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAMS
- ② MAIN TRIGGER GENERATOR
- ④ DELAYED TRIGGER PREAMP
- ⑥ HORIZONTAL PREAMP
- ⑨ VOLTAGE DISTRIBUTION & OUTPUT CONNECTORS
- ⑩ TRIGGER SWITCHING

7853N DUAL TIME BASE

BC/grs
0671

MAIN TRIGGER PREAMP ①

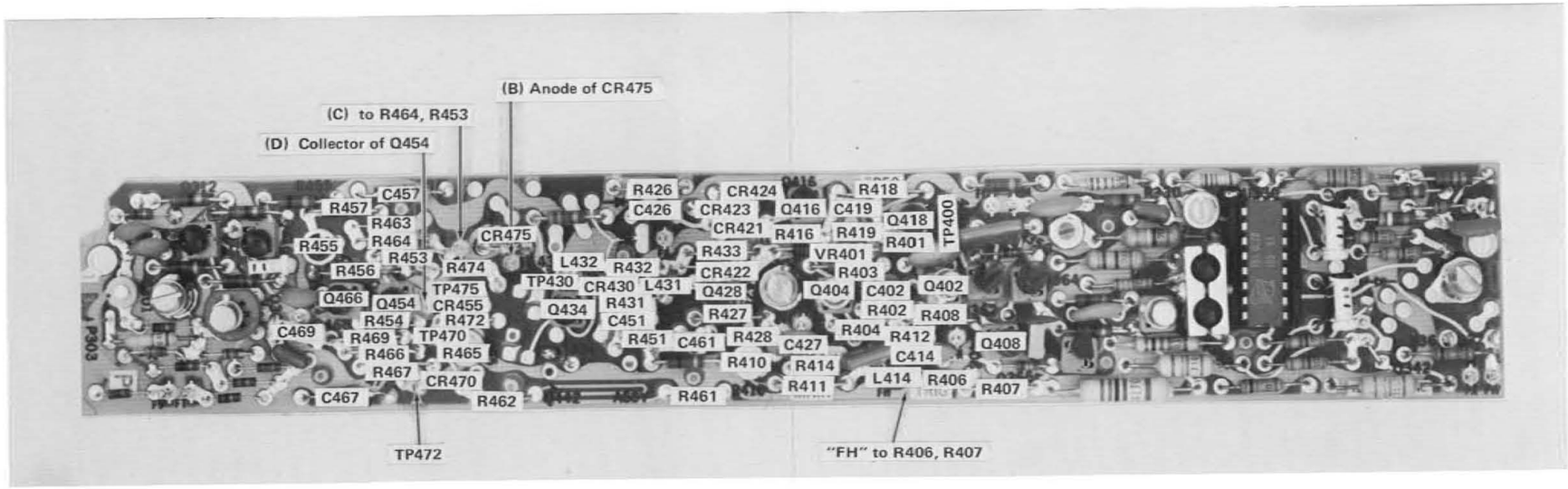
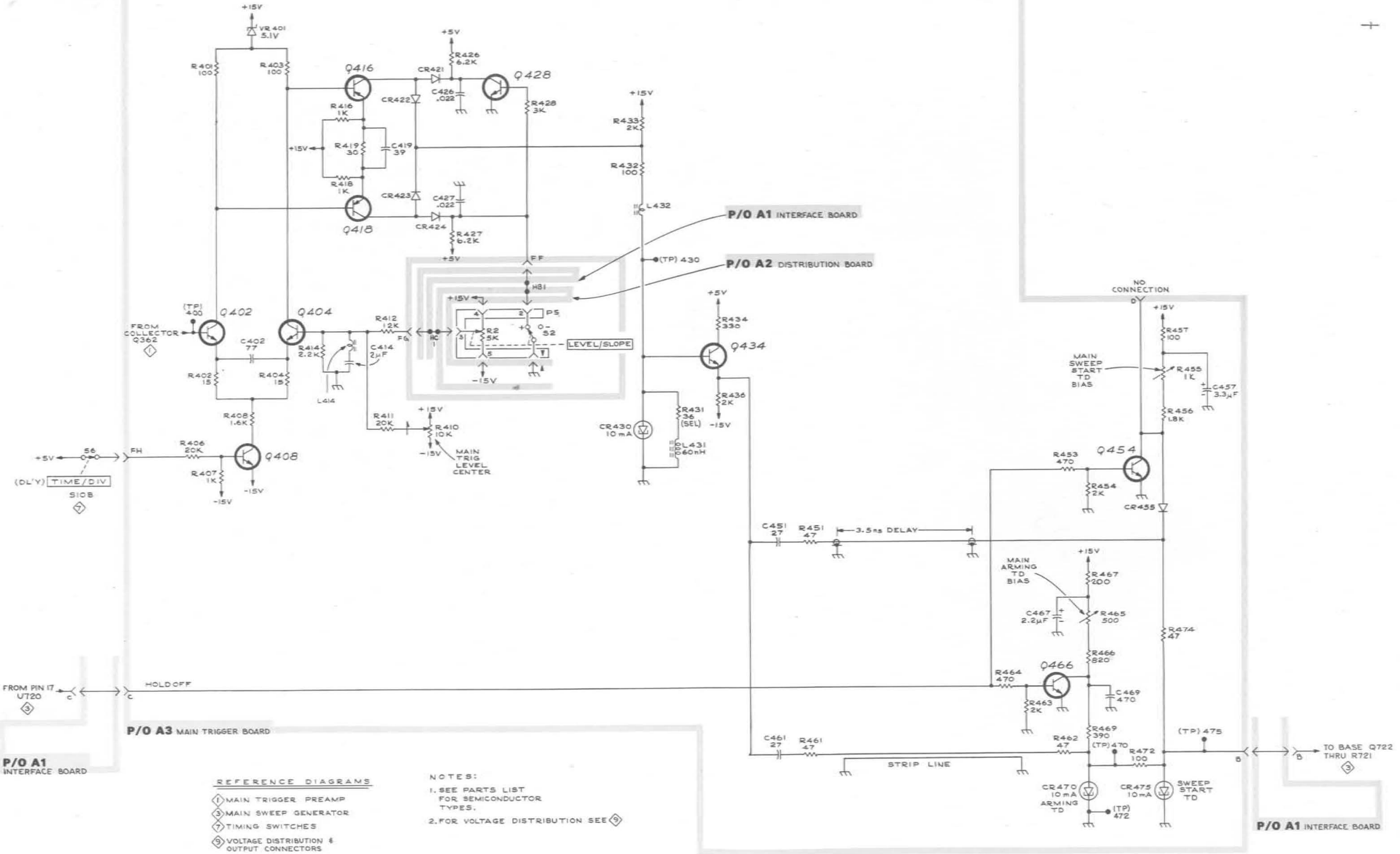


Fig. 7-2. P/O A3. Partial Main Trigger circuit board.

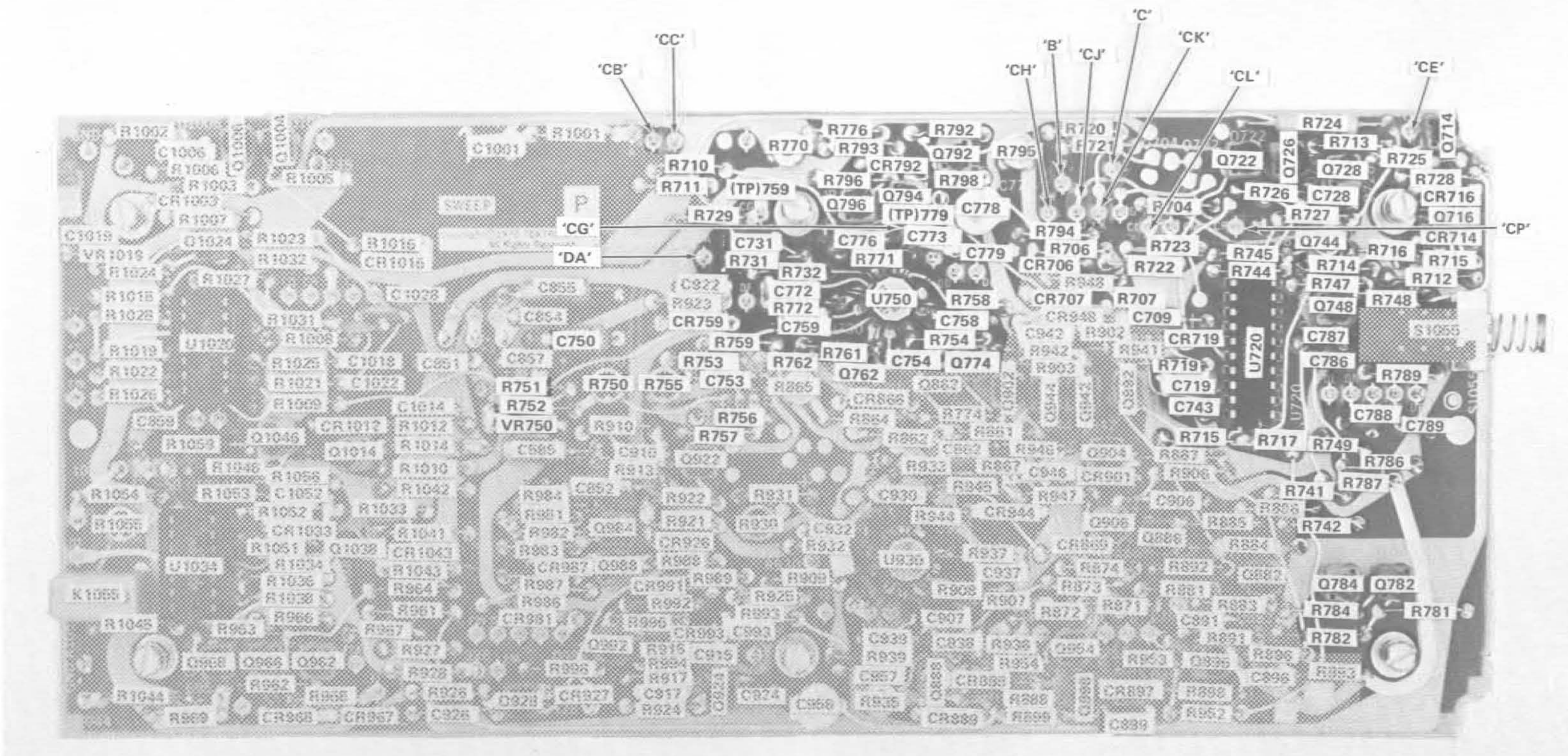


REFERENCE DIAGRAMS

- (1) MAIN TRIGGER PREAMP
- (3) MAIN SWEEP GENERATOR
- (7) TIMING SWITCHES
- (9) VOLTAGE DISTRIBUTION & OUTPUT CONNECTORS

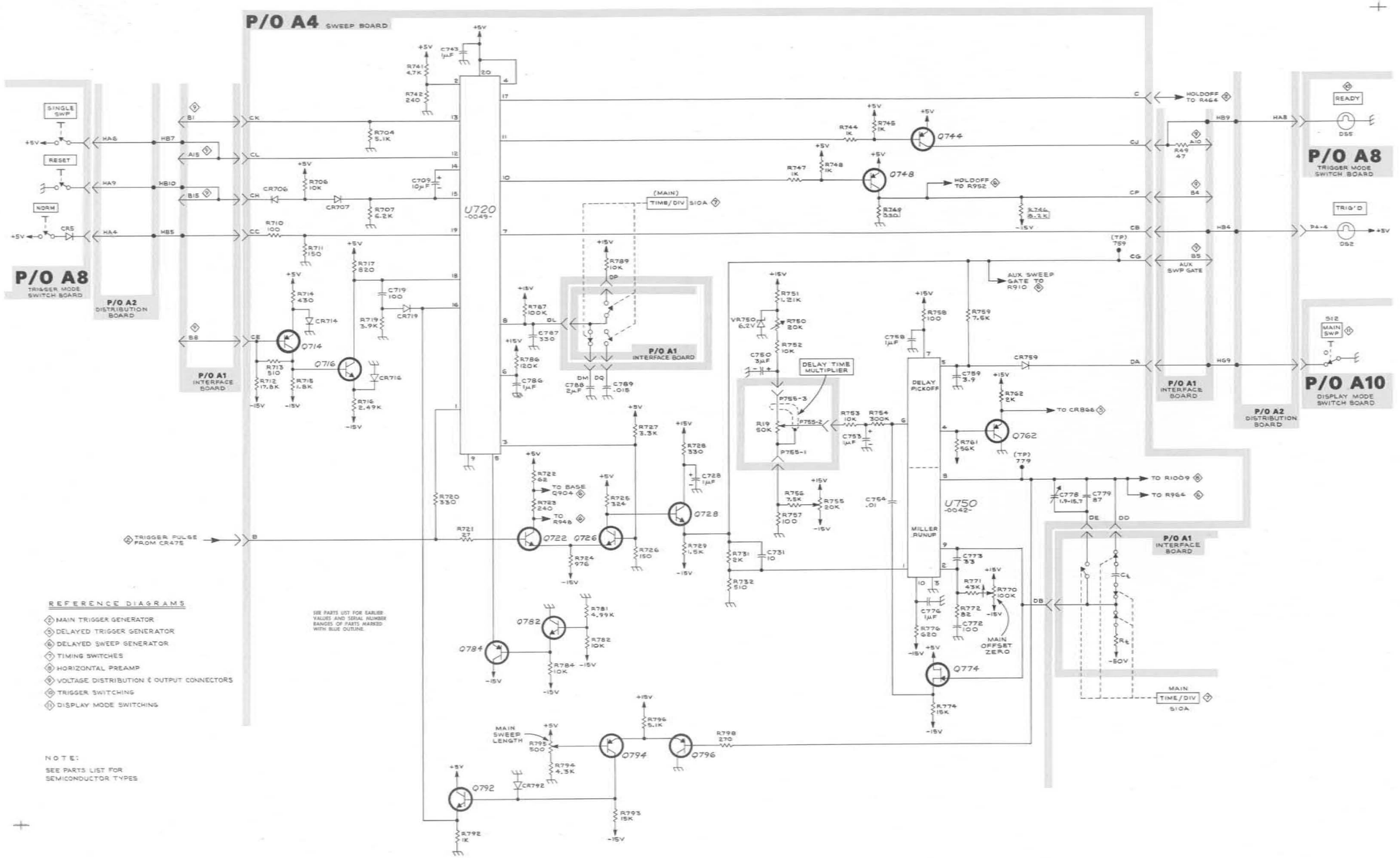
NOTES:

1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
2. FOR VOLTAGE DISTRIBUTION SEE (9)



NOTE: See Figs. 7-8, 7-13, and 7-16 for location of parts not identified here.

Fig. 7-3. P/O A4. Partial Sweep circuit board.



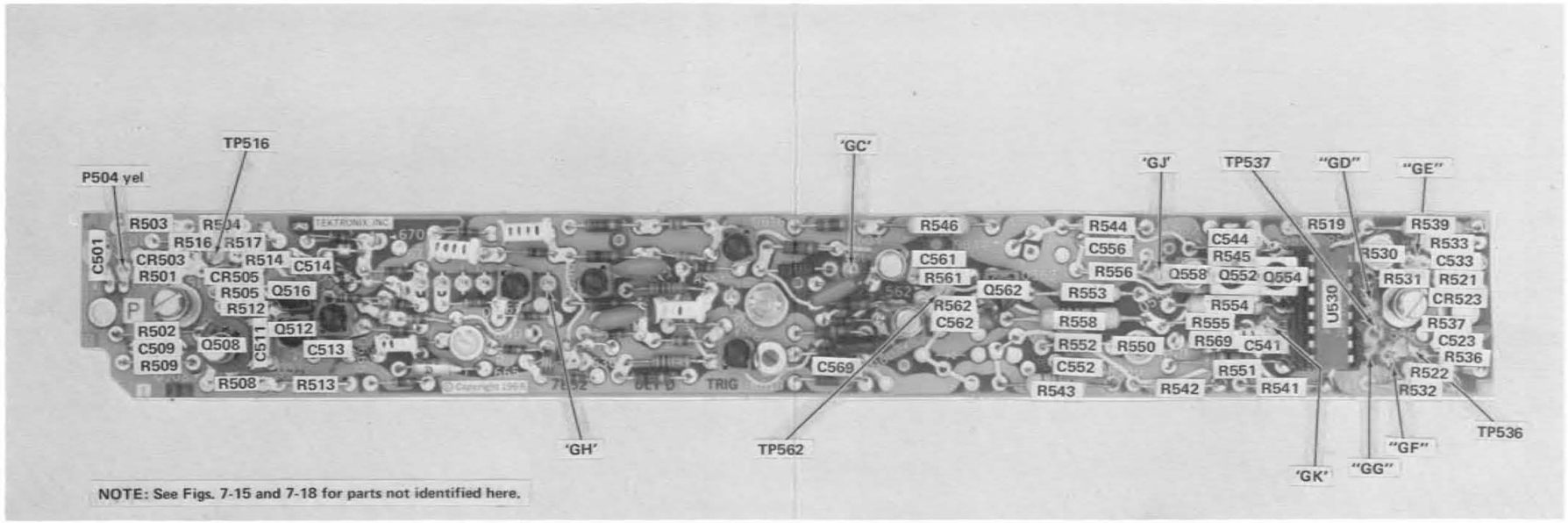
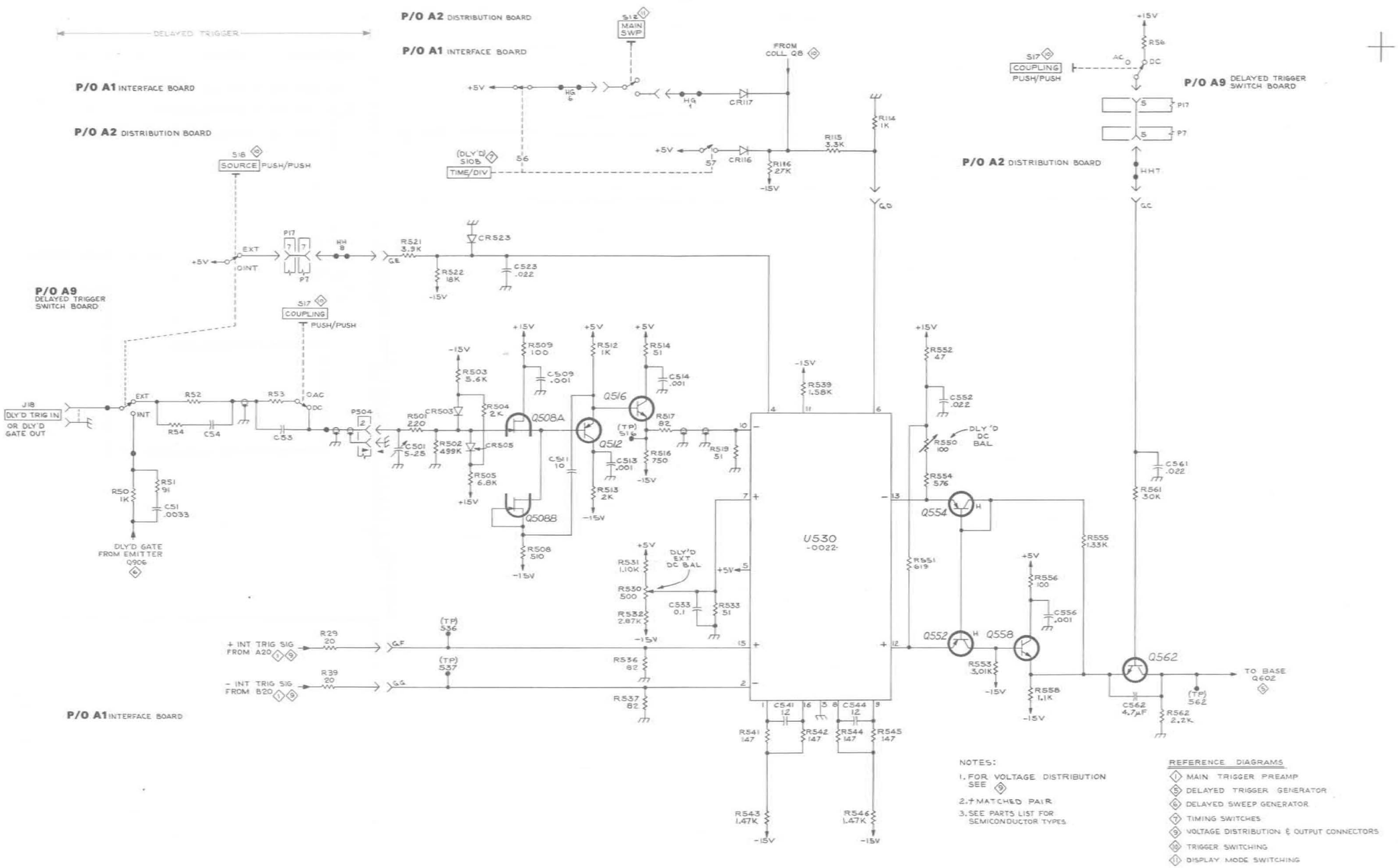


Fig. 7-4. P/O A5. Partial Delayed Trigger circuit board.



NOTES:

1. FOR VOLTAGE DISTRIBUTION SEE (9)
2. † MATCHED PAIR
3. SEE PARTS LIST FOR SEMICONDUCTOR TYPES

REFERENCE DIAGRAMS

(1) MAIN TRIGGER PREAMP
(5) DELAYED TRIGGER GENERATOR
(6) DELAYED SWEEP GENERATOR
(7) TIMING SWITCHES
(9) VOLTAGE DISTRIBUTION & OUTPUT CONNECTORS
(10) TRIGGER SWITCHING
(11) DISPLAY MODE SWITCHING

P/O A5 DELAYED TRIGGER BOARD

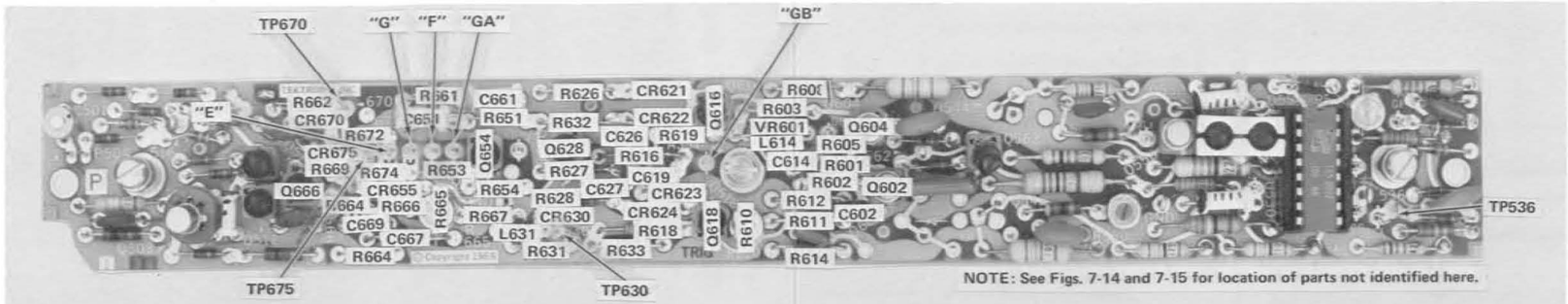


Fig. 7-5. P/O A5. Partial Delayed Trigger circuit board.

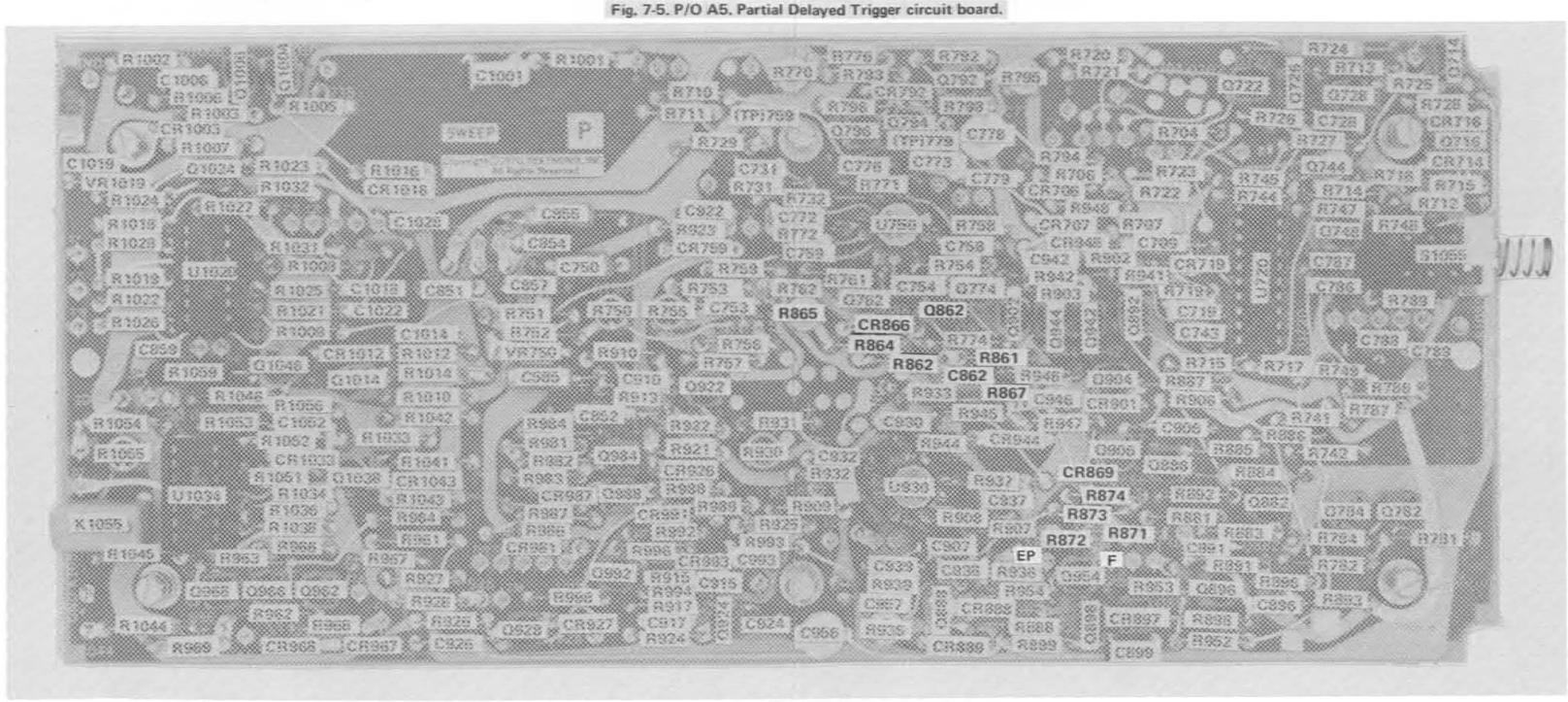
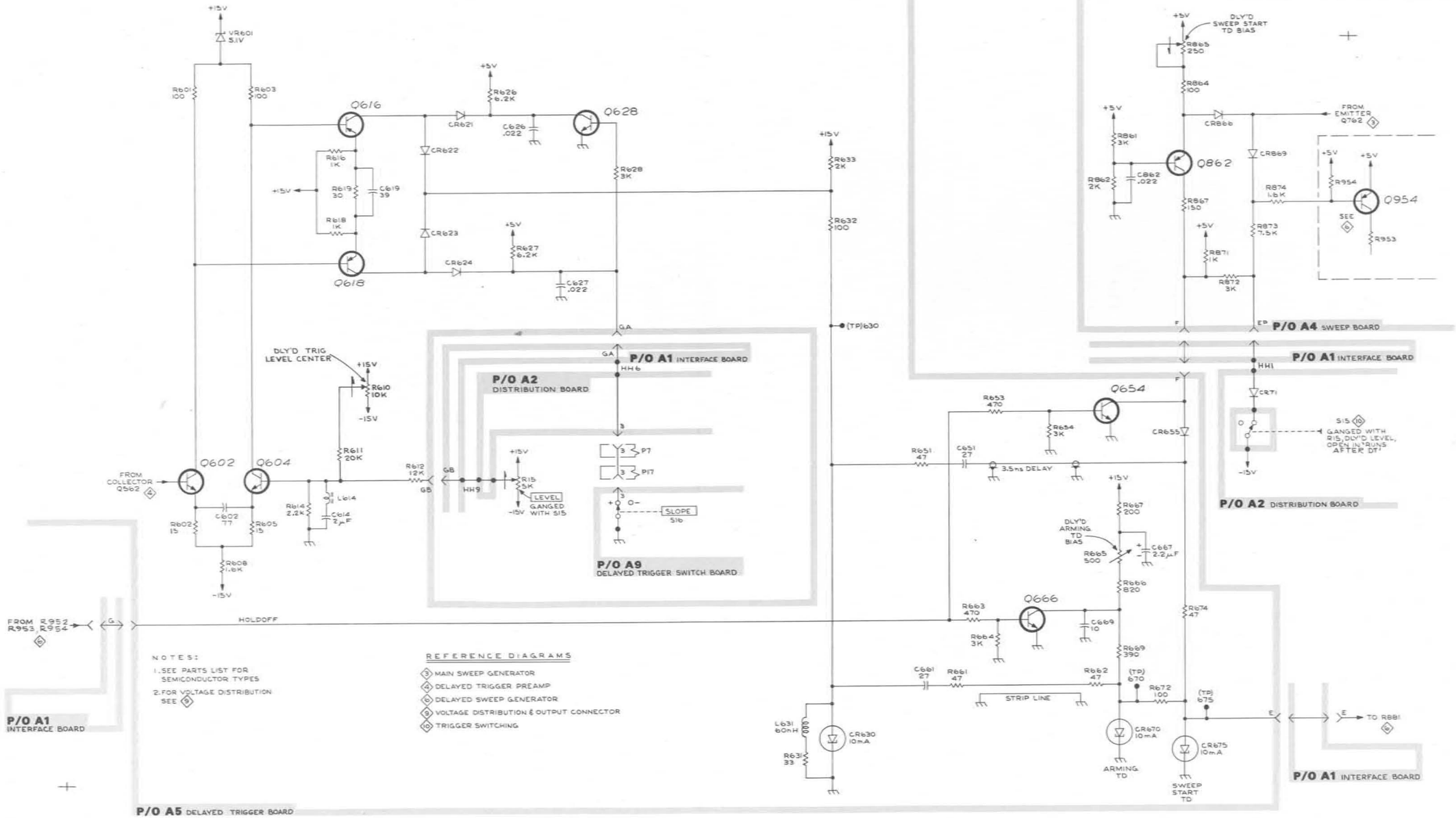
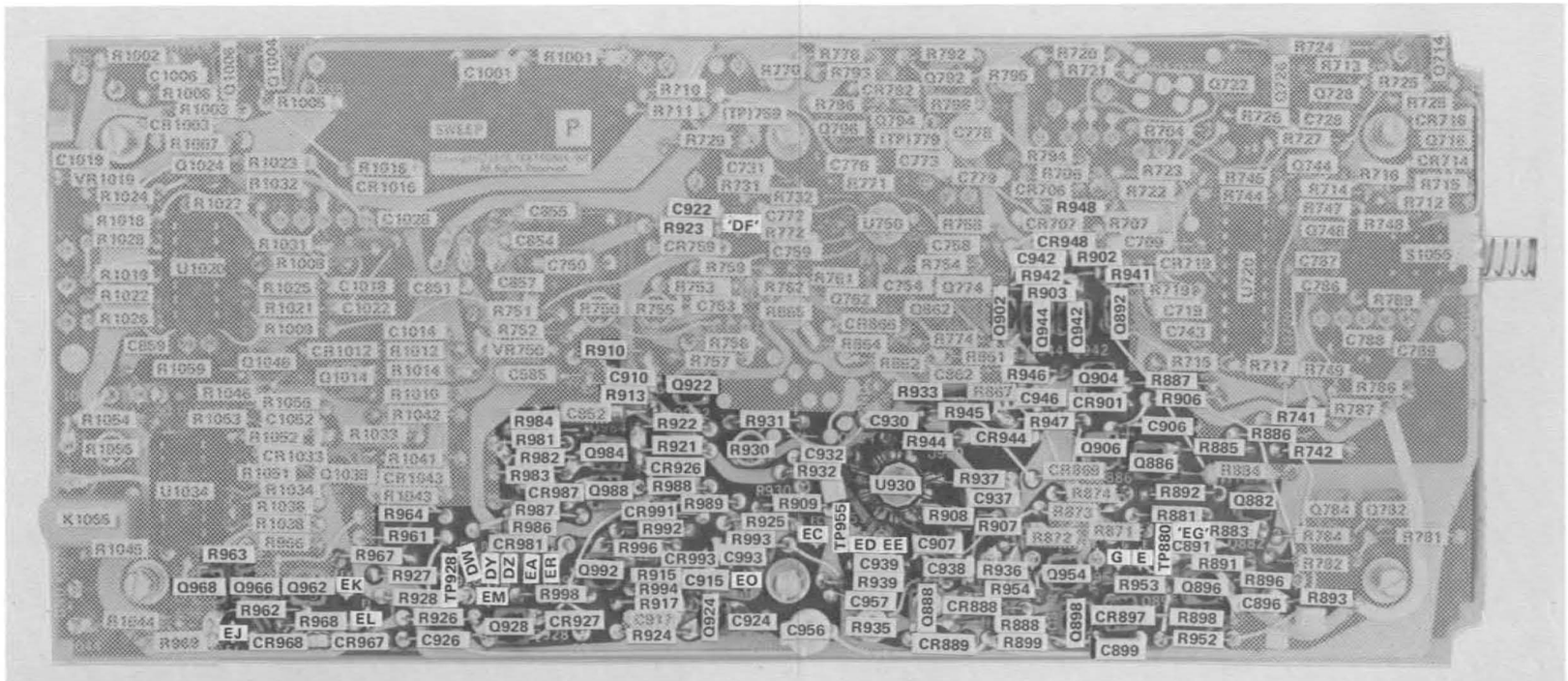


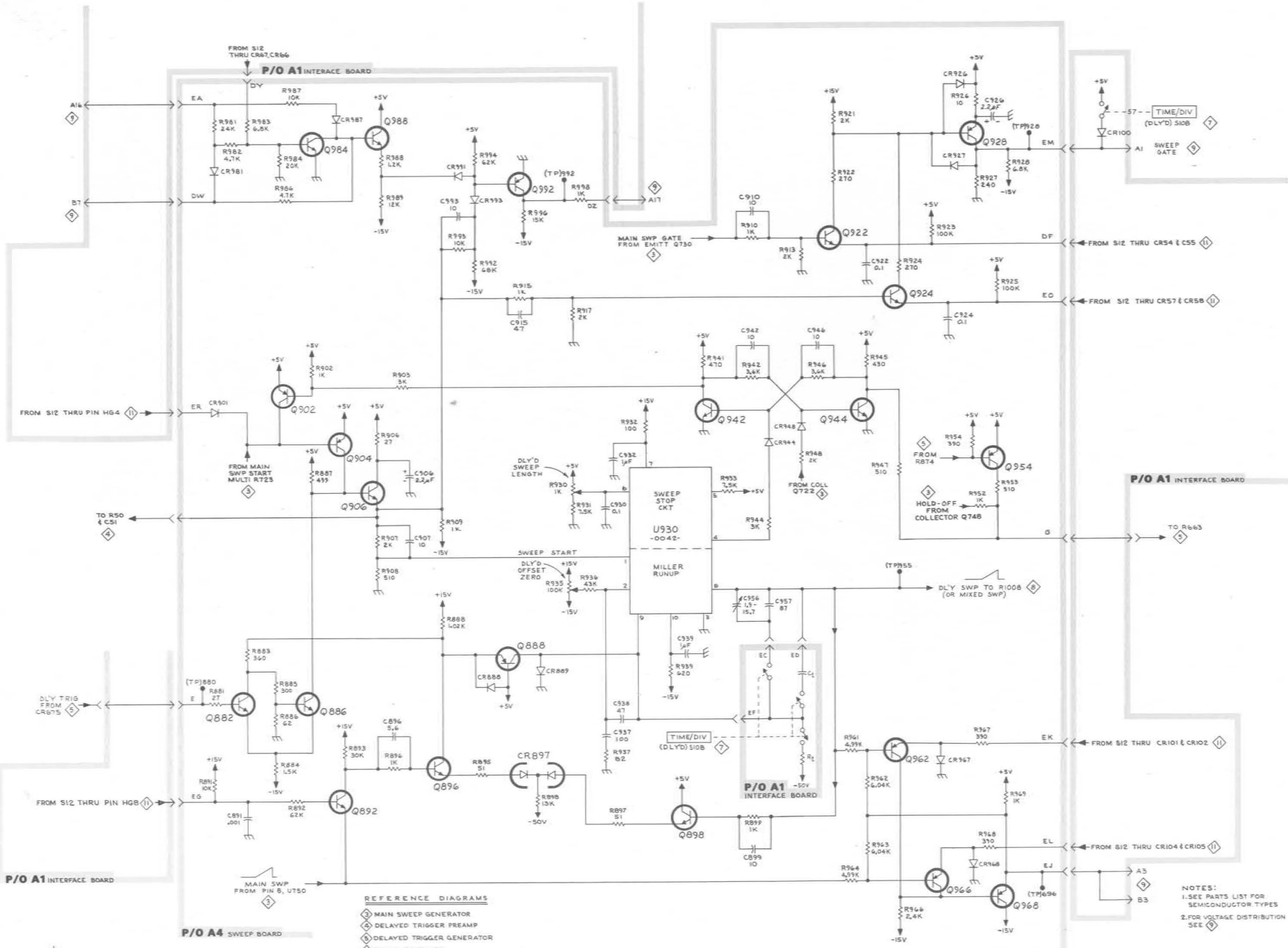
Fig. 7-6. P/O A4. Partial Sweep circuit board.





NOTE: R895 and R897 are mounted on rear of board.
See Fig. 7-10 for location of parts not identified here.

Fig. 7-7. P/O A4. Partial Sweep circuit board.



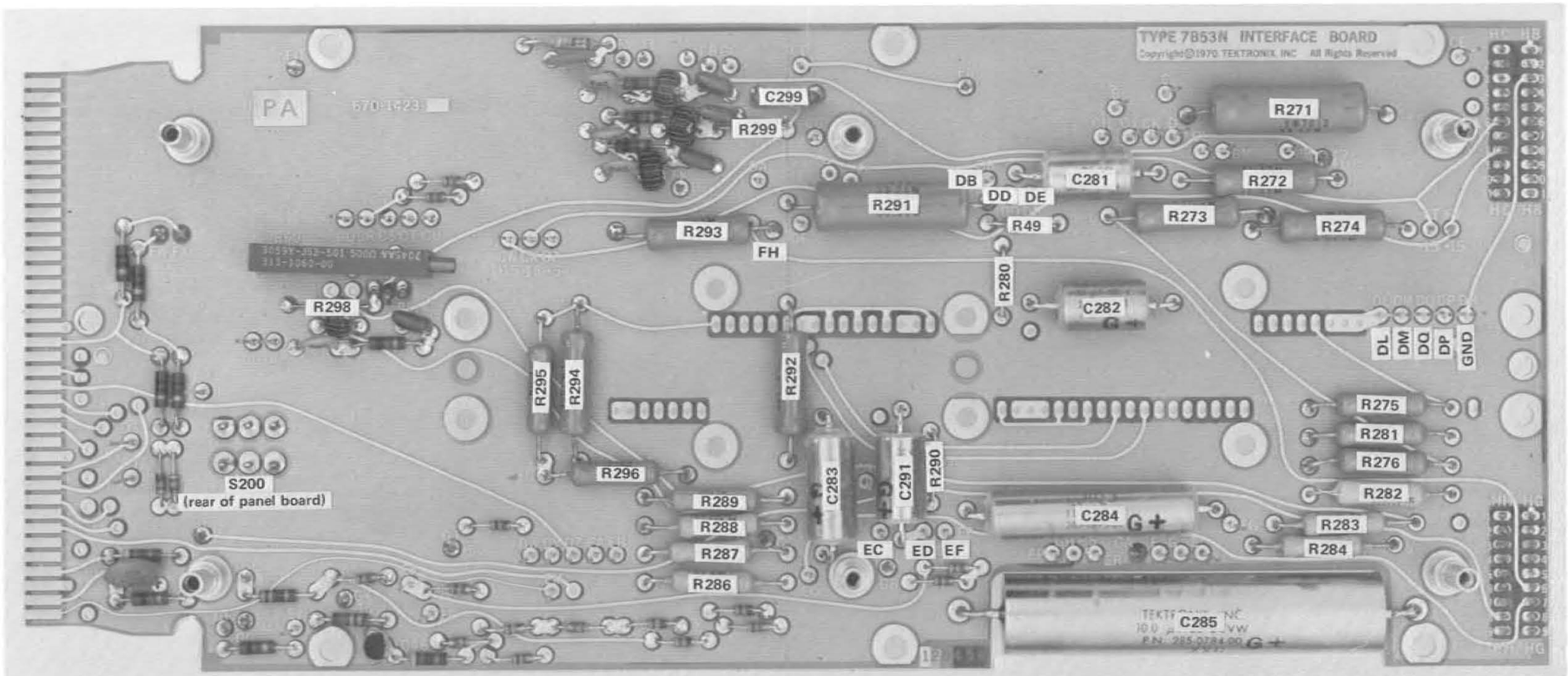
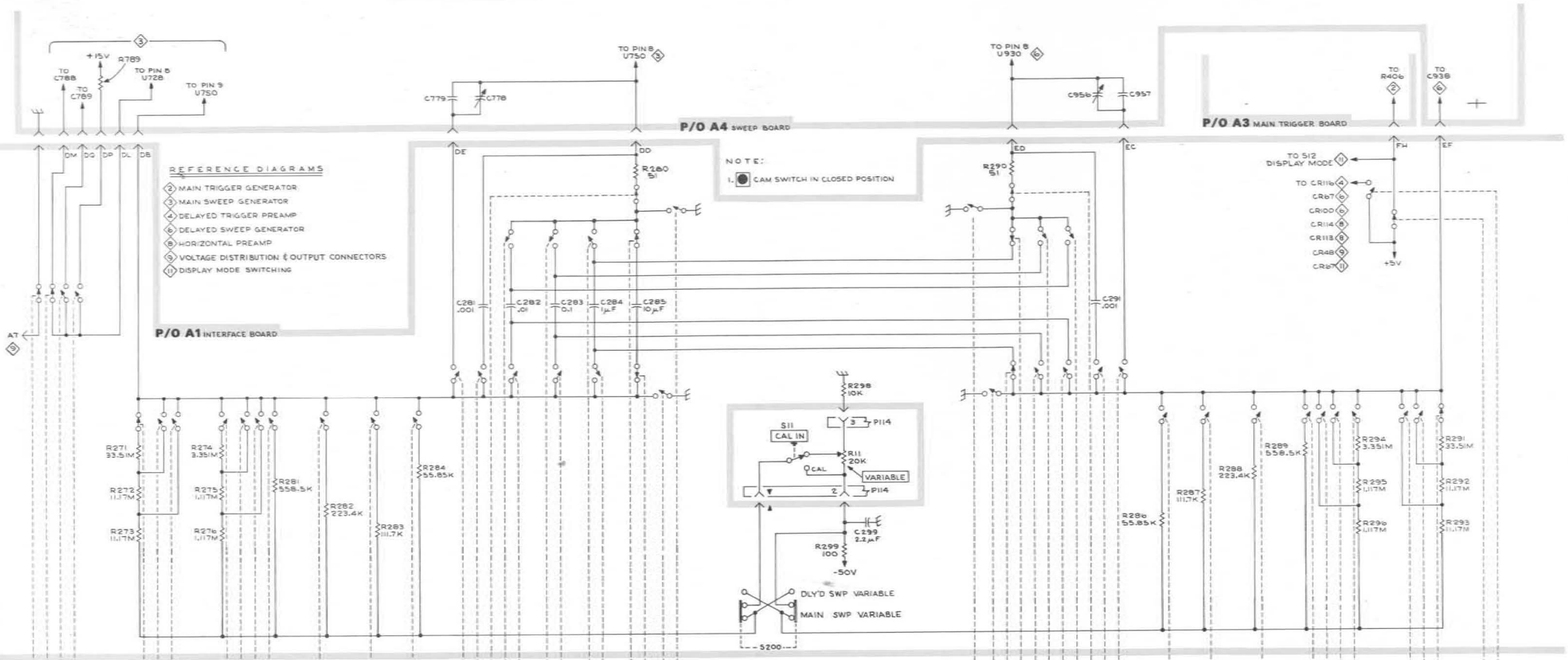
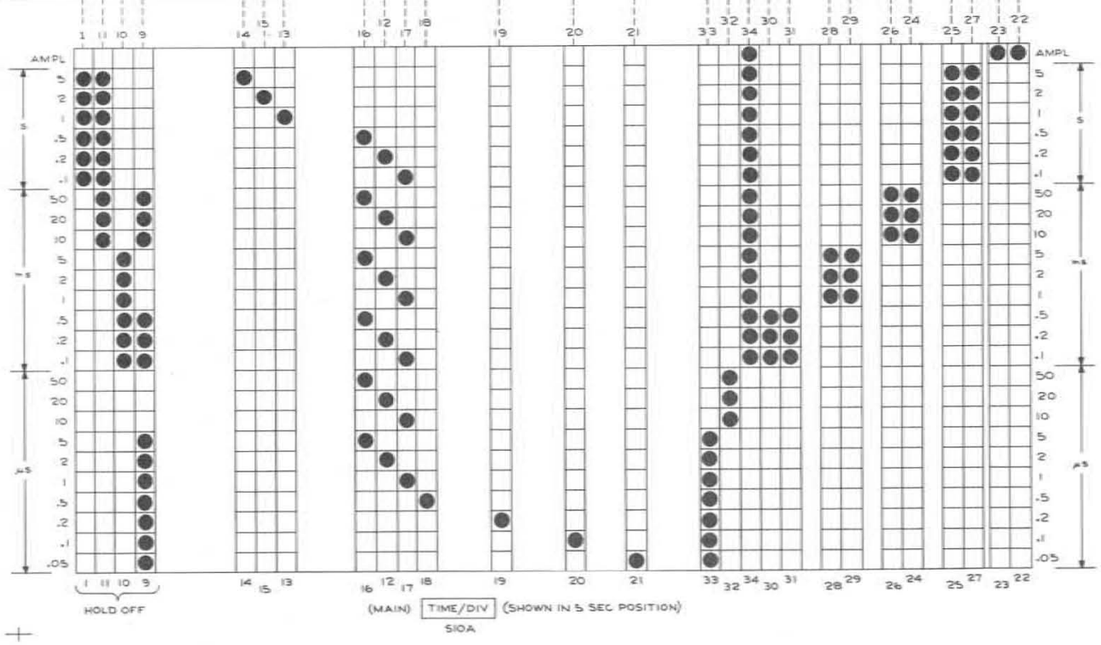
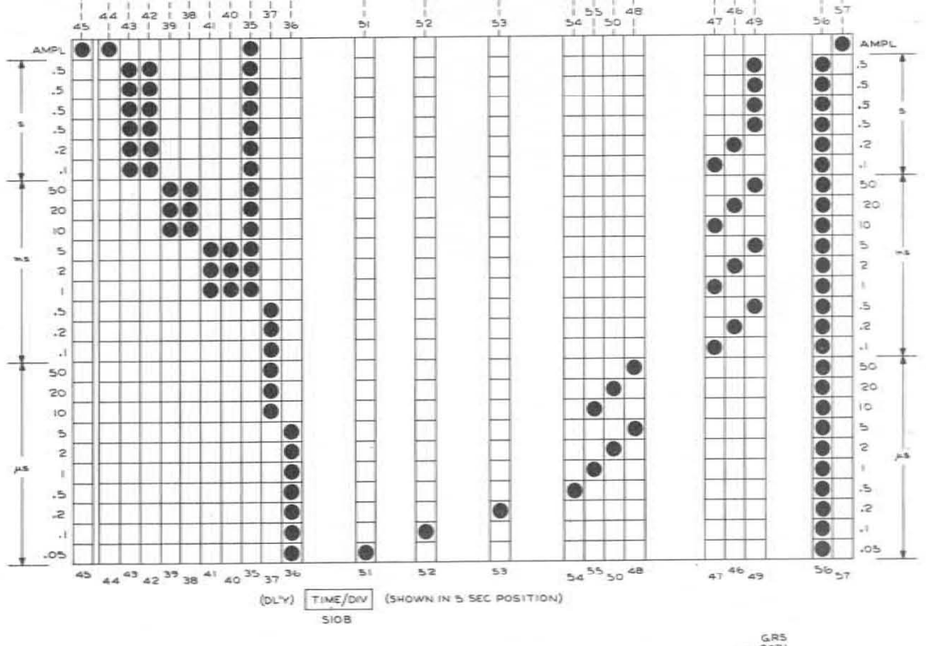


Fig. 7-8. P/O A1. Partial Interface circuit board.







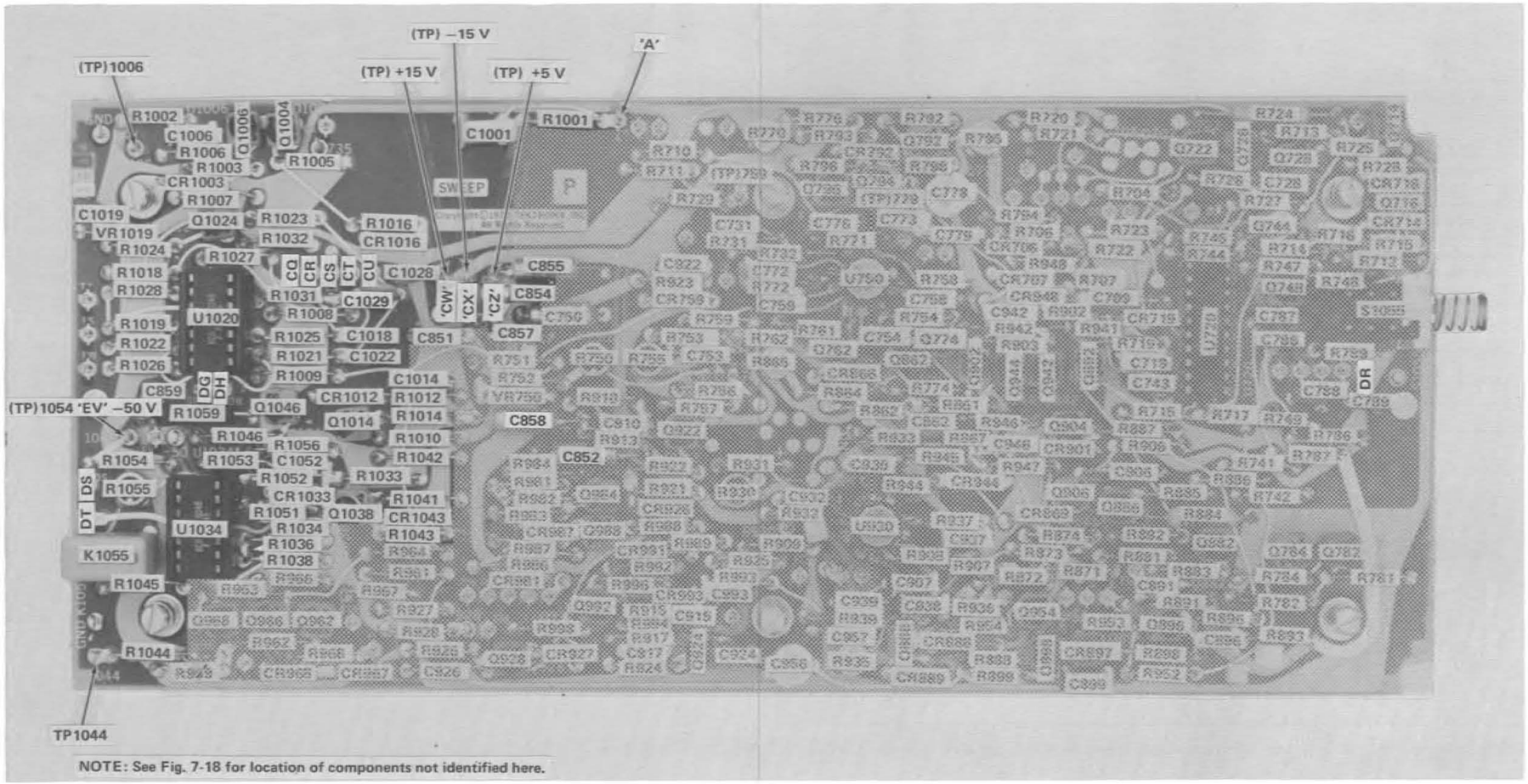
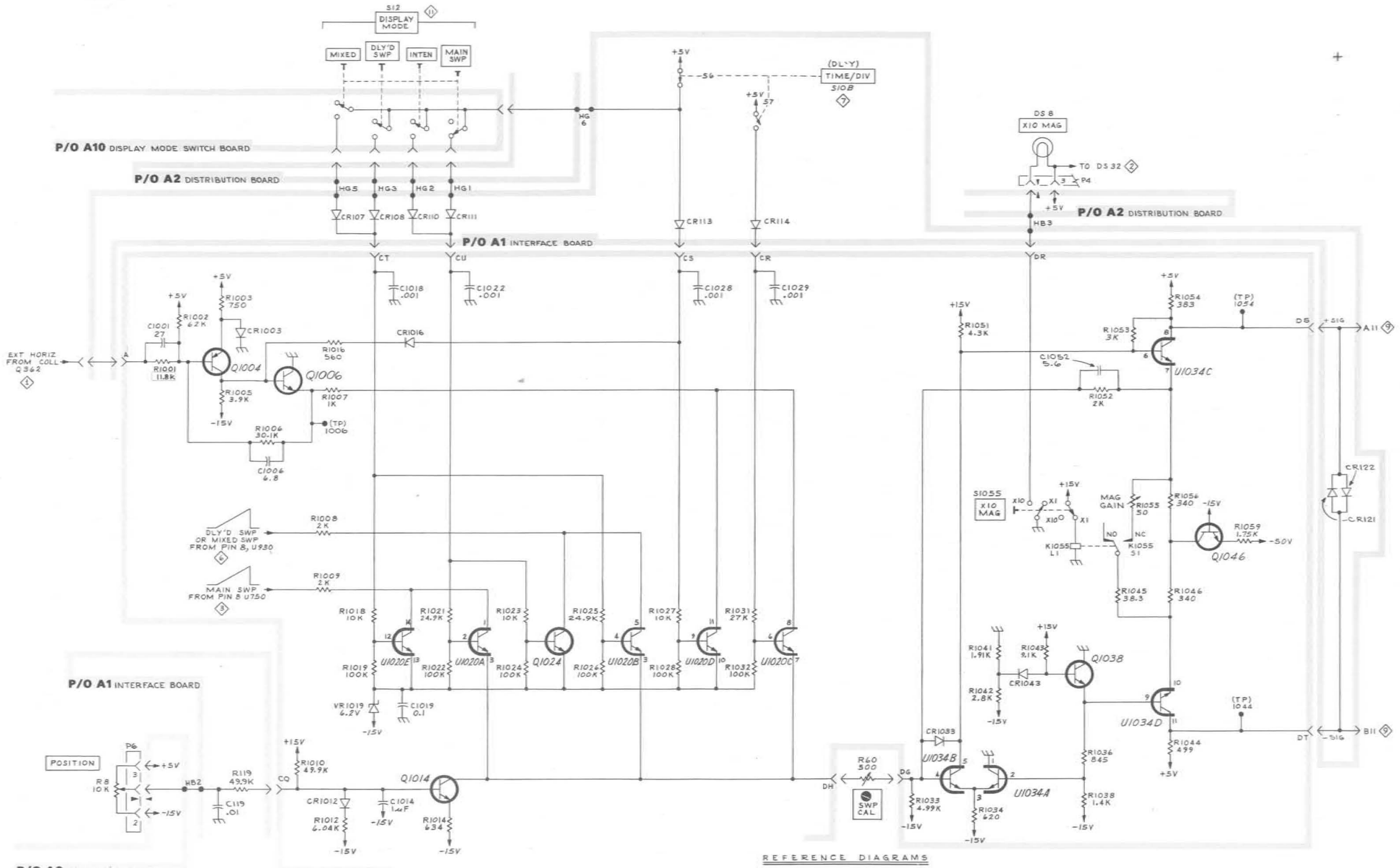


Fig. 7-9. P/O A4. Partial Sweep circuit board.

Ⓐ



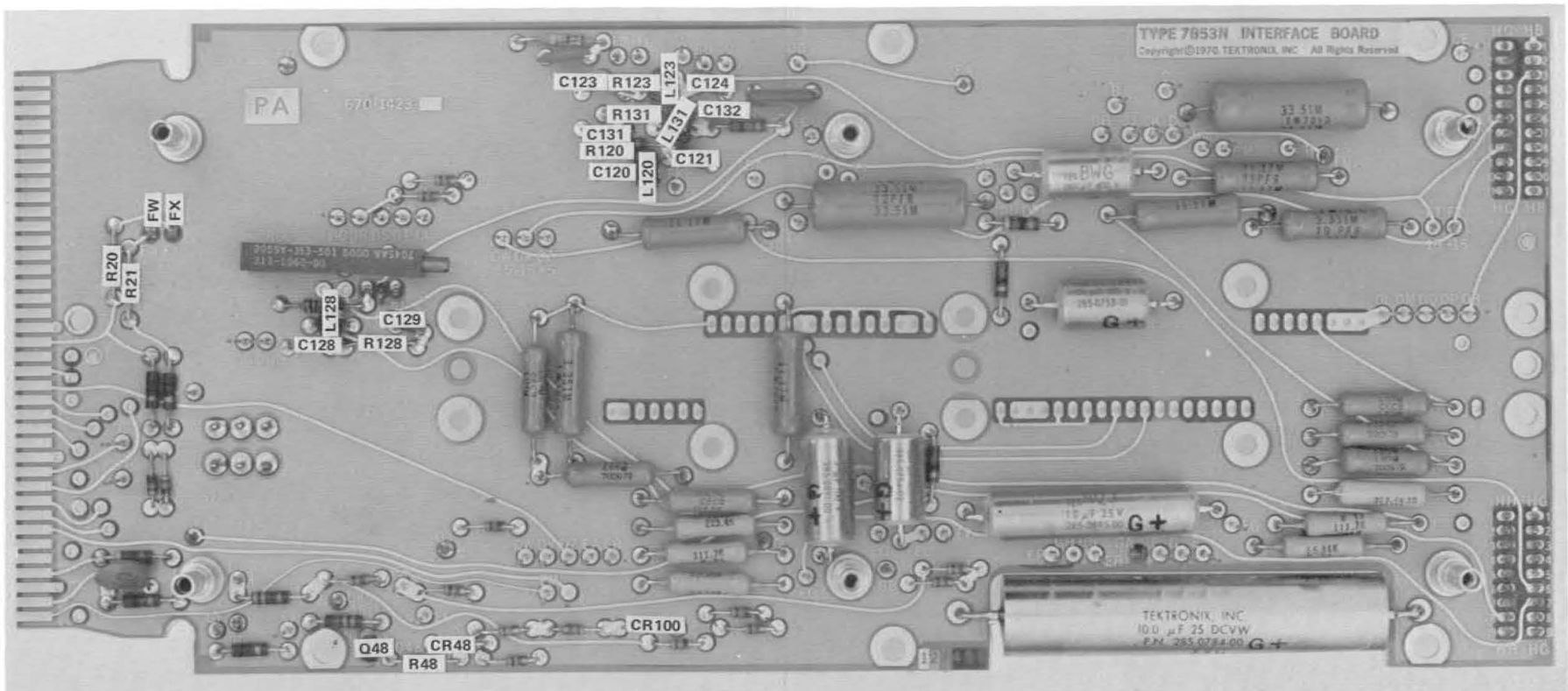
REFERENCE DIAGRAMS

1. MAIN TRIGGER PREAMP
2. MAIN TRIGGER GENERATOR
3. MAIN SWEEP GENERATOR
6. DELAYED SWEEP GENERATOR
7. TIMING SWITCHES
9. VOLTAGE DISTRIBUTION & OUTPUT CONNECTORS
11. DISPLAY MODE SWITCHING

NOTES:

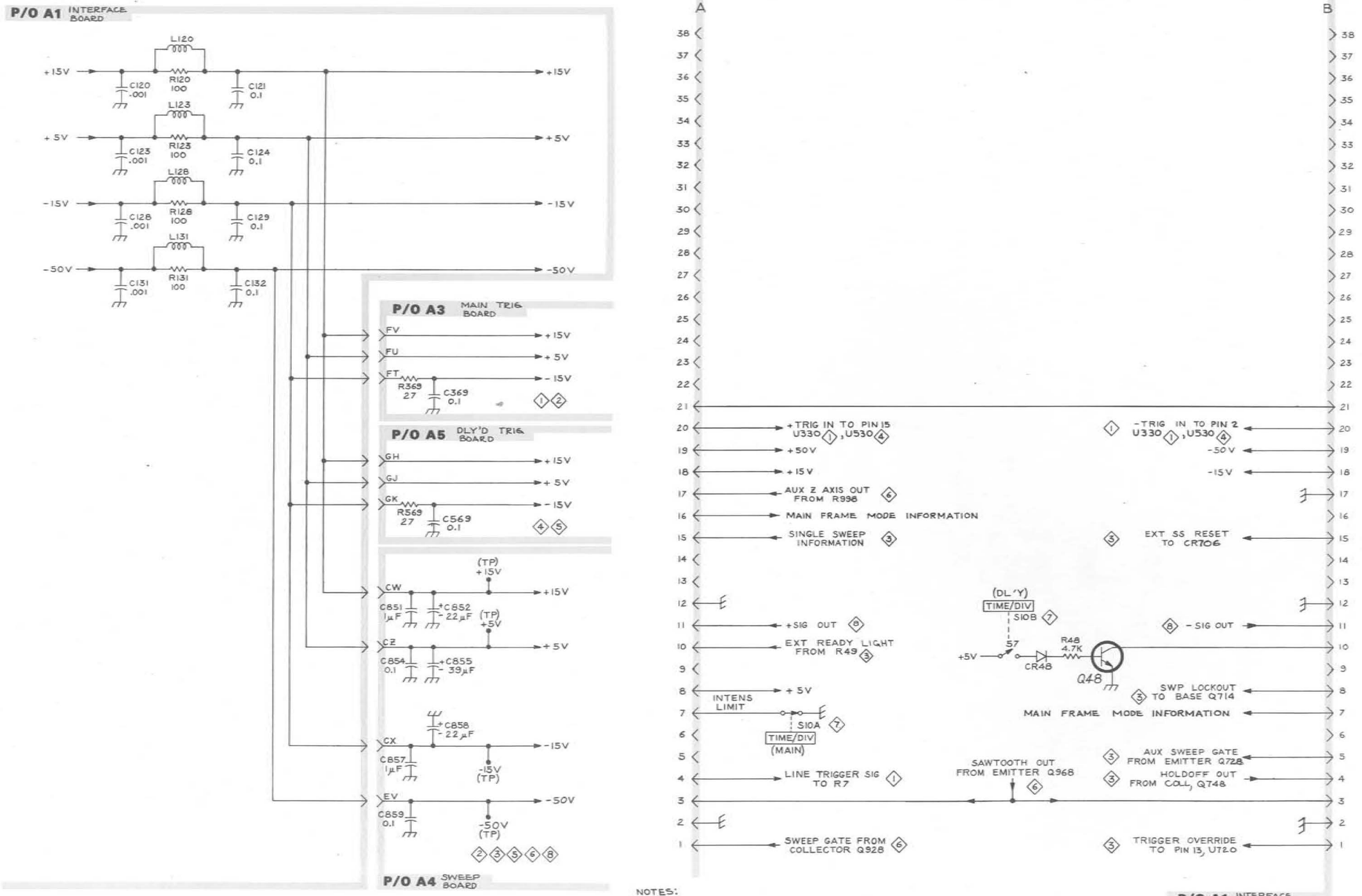
1. PINS 12, 13, 14, U1034 ARE TIED TO -15V.
2. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.



NOTE: See Figs. 7-1, 7-4, and 7-9 for location of parts not identified here.

Fig. 7-10. P/O A1. Partial Interface circuit board.



NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES

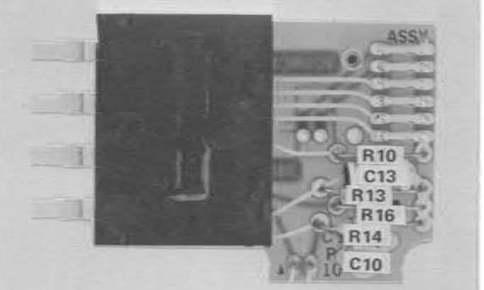


Fig. 7-11. A6. Source Switch circuit board.

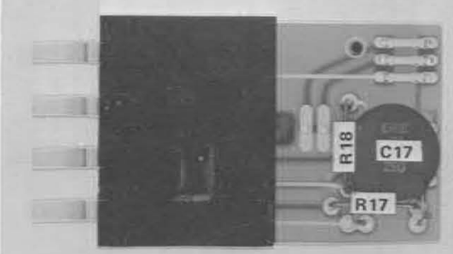


Fig. 7-12. A7. Coupling Switch circuit board.

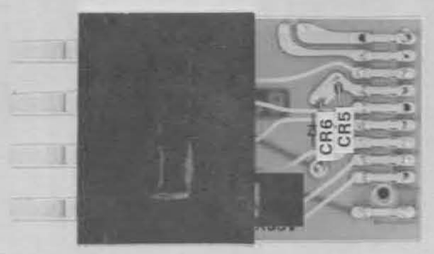


Fig. 7-13. A8. Trigger Mode Switch circuit board.

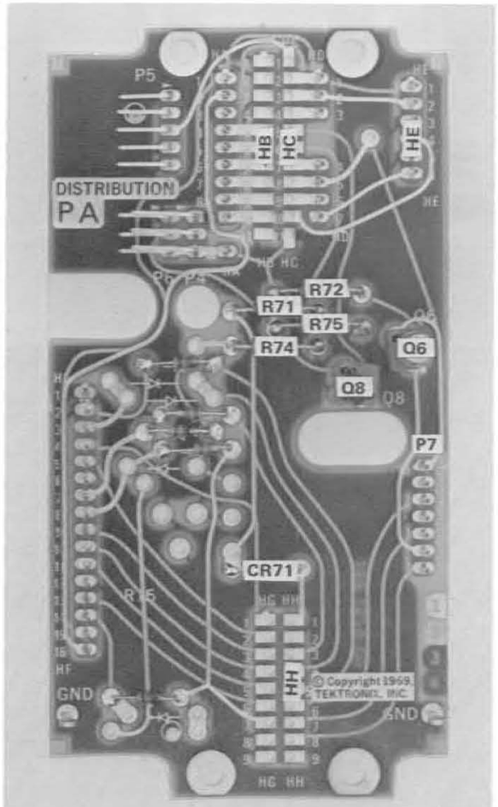


Fig. 7-14. P/O A2. Partial Distribution circuit board.

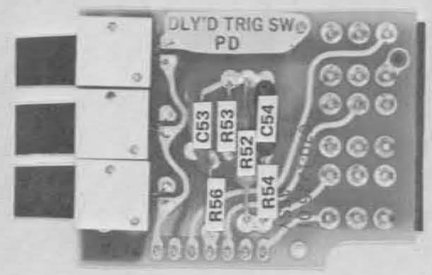
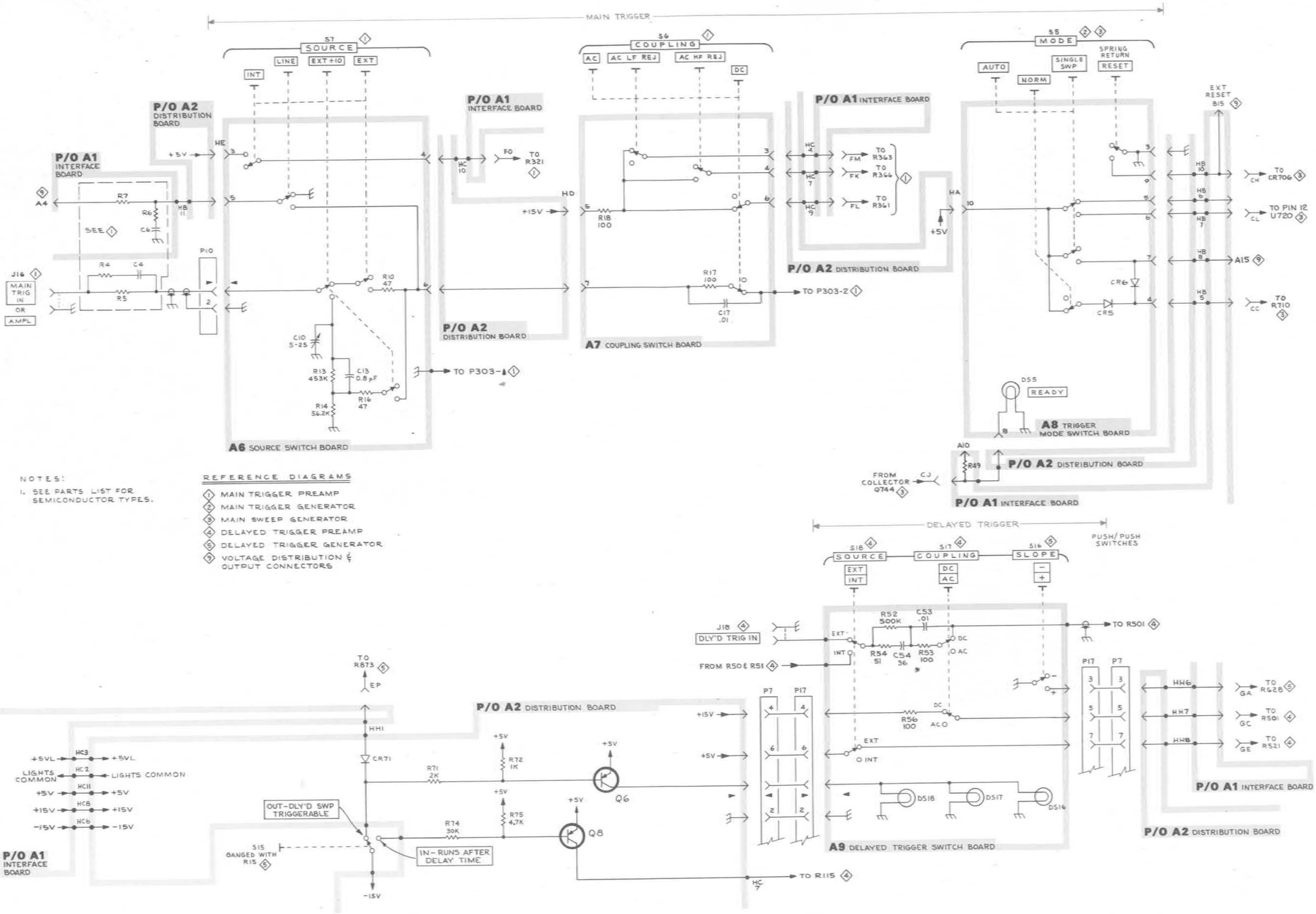


Fig. 7-15. A9. Delayed-Trigger Switch circuit board.



NOTES:

1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.

REFERENCE DIAGRAMS

1. MAIN TRIGGER PREAMP
2. MAIN TRIGGER GENERATOR
3. MAIN SWEEP GENERATOR
4. DELAYED TRIGGER PREAMP
5. DELAYED TRIGGER GENERATOR
9. VOLTAGE DISTRIBUTION & OUTPUT CONNECTORS

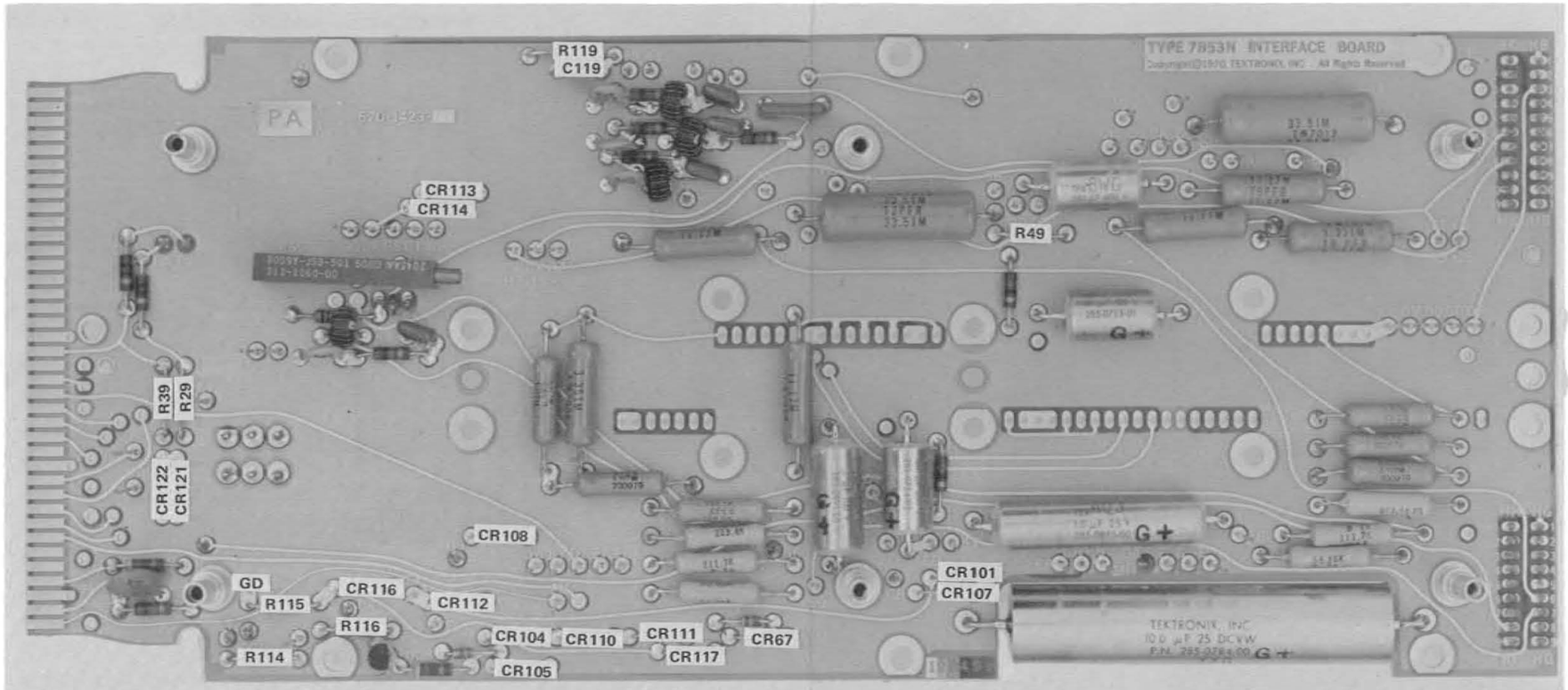


Fig. 7-18. P/O A1. Partial Interface circuit board.

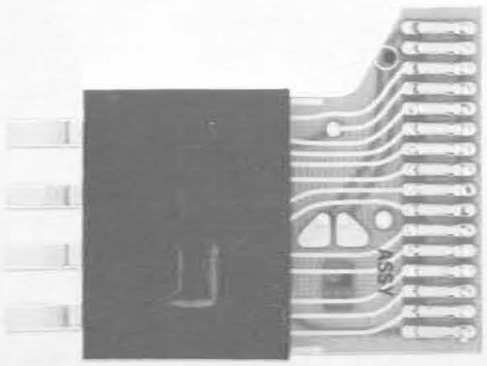


Fig. 7-16. P/O A10. Partial Display Mode Switch circuit board.

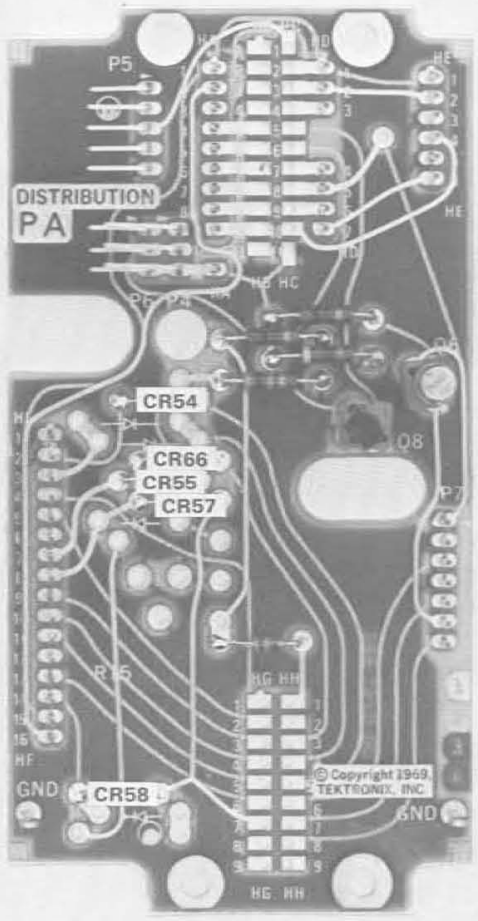


Fig. 7-17. P/O A2. Partial Distribution circuit board.

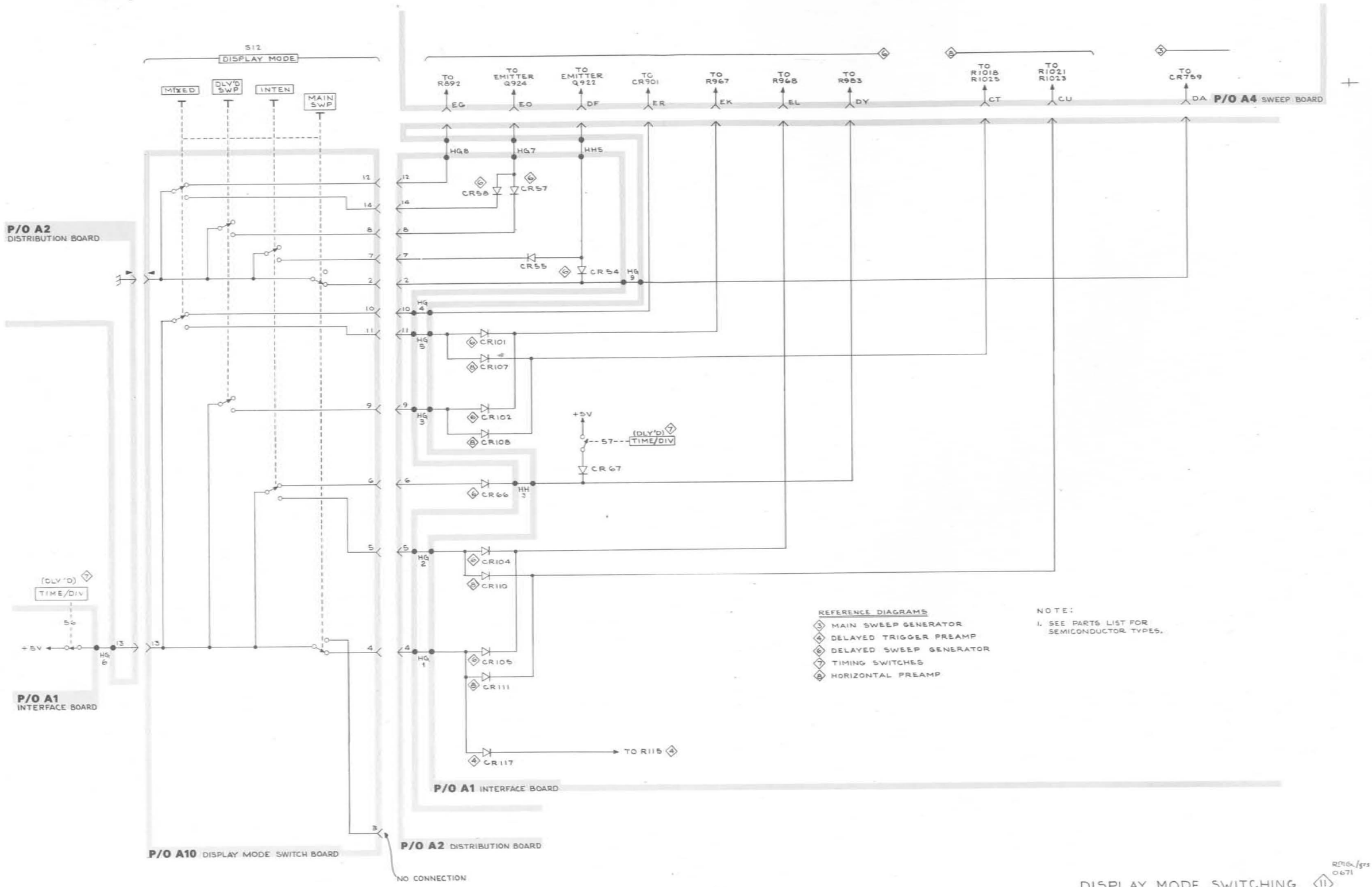


FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations which appear either on the back of the diagrams or on pullout pages immediately following the diagrams of the instruction manual.

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.

Assembly and/or Component
Detail Part of Assembly and/or Component
mounting hardware for Detail Part
Parts of Detail Part
mounting hardware for Parts of Detail Part
mounting hardware for Assembly and/or Component

Mounting hardware always appears 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.

Mounting hardware must be purchased separately, unless otherwise specified.

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 or model 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.

ABBREVIATIONS AND SYMBOLS

For an explanation of the abbreviations and symbols used in this section, please refer to the page immediately preceding the Electrical Parts List in this instruction manual.

INDEX OF
MECHANICAL PARTS LIST & ILLUSTRATIONS

SECTION 8
MECHANICAL PARTS LIST

FIGURE 1 EXPLODED & STANDARD ACCESSORIES

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
1-1	366-1168-00			1		KNOB, red—MAIN VARIABLE (CAL IN)
	- - - - - -			-		knob includes:
	213-0153-00			1		SETSCREW, 5-40 x 0.125 inch, HSS
-2	366-1219-00			1		KNOB, gray—TIME/DIV OR DL'Y TIME
	- - - - - -			-		knob includes:
	213-0153-00			2		SETSCREW, 5-40 x 0.125 inch, HSS
-3	354-0383-00			1		RING, knob skirt
	- - - - - -			-		ring includes:
	213-0153-00			1		SETSCREW, 5-40 x 0.125 inch, HSS
-4	366-1064-00			1		KNOB, gray—LEVEL/SLOPE
	- - - - - -			-		knob includes:
	213-0153-00			1		SETSCREW, 5-40 x 0.125 inch, HSS
-5	354-0342-00			1		RING, knob skirt
-6	366-1059-00			1		KNOB, gray—×10 MAG
-7	366-1213-00			1		KNOB, gray—POSITION
	- - - - - -			-		knob includes:
	213-0153-00			1		SETSCREW, 5-40 x 0.125 inch, HSS
-8	358-0378-00			1		BUSHING, sleeve, front panel trim
-9	366-1023-00			1		KNOB, gray—DLY TIME LEVEL
	- - - - - -			-		knob includes:
	213-0153-00			1		SETSCREW, 5-40 x 0.125 inch, HSS
-10	366-1058-28			1		KNOB, latch
	- - - - - -			-		mounting hardware: *(not included w/knob)*
-11	214-1095-00			1		PIN, spring, split
-12	105-0076-00			1		RELEASE BAR, latch
-13	214-1280-00			1		SPRING, helical compression
-14	214-1054-00			1		SPRING, flat, latch detent
-15	105-0075-00			1		BODY, latch
-16	333-1308-00			1		PANEL, front
-17	348-0235-00			2		SHIELDING GASKET
-18	- - - - - -			1		RESISTOR, variable
	- - - - - -			-		mounting hardware: *(not included w/resistor)*
-19	331-0247-00			1		DIAL, control
-20	200-0935-00			2		CAP, lamp holder
-21	378-0602-00			2		LENS, lamp
-22	352-0157-00			2		HOLDER, lamp
-23	401-0080-00			1		BEARING, knob skirt
-24	358-0408-00			1		BUSHING, sleeve

FIGURE 1 EXPLODED & STANDARD ACCESSORIES (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
1-25	131-0955-00			1		CONNECTOR, coaxial, BNC, female
	- - - - - -			-		mounting hardware: *(not included w/connector)*
	210-0590-00			1		NUT, hex., 0.375-32 x 0.438 inch
-26	210-0012-00			1		WASHER, lock, internal, 0.375 ID x 0.50 inch OD
-27	337-1317-00			1		SHIELD, electrical
-28	131-0955-00			1		CONNECTOR, coaxial, BNC, female
	- - - - - -			-		mounting hardware: *(not included w/connector)*
-29	220-0581-00			1		NUT, sleeve, 0.375-32 x 0.437 inch
-30	210-0012-00			1		WASHER, lock, internal, 0.375 ID x 0.50 inch OD
-31	131-0373-00			2		CONNECTOR, standoff
	- - - - - -			-		mounting hardware for each: *(not included w/connector)*
-32	210-0405-00			1		NUT, hex., 2-56 x 0.188 inch
-33	210-0001-00			1		WASHER, lock, internal, 0.092 ID x 0.18 inch OD
	- - - - - -			1		RESISTOR, variable
	- - - - - -			-		resistor includes:
-34	- - - - - -			1		RESISTOR, variable
-35	214-1235-00			1		DRIVE, turns reduction
	- - - - - -			-		mounting hardware: *(not included w/resistor)*
-36	210-0590-00			1		NUT, hex., 0.375-32 x 0.438 inch
-37	210-0978-00			1		WASHER, fiber, 0.375 ID x 0.50 inch OD
	262-0936-00			1		SWITCH ASSEMBLY, push-push—DLY TIME LEVEL, wired
	- - - - - -			-		switch assembly includes:
-38	- - - - - -			1		RESISTOR, variable
	- - - - - -			-		mounting hardware: *(not included w/resistor)*
-39	210-0583-00			1		NUT, hex., 0.25-32 x 0.312 inch
-40	210-0046-00			1		WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-41	407-0749-00			1		BRACKET, component mounting
-42	260-0516-00			1		SWITCH, sensitive
	- - - - - -			-		mounting hardware: *(not included w/switch)*
-43	211-0159-00			2		SCREW, 2-56 x 0.375 inch, PHS
-44	210-0001-00			2		WASHER, lock, internal, 0.092 ID x 0.18 inch OD
-45	210-0405-00			2		NUT, hex., 2-56 x 0.188 inch
-46	214-1190-00			1		EXTENDER-RETRACTOR, knob
	- - - - - -			-		extender-retractor includes:
	213-0075-00			1		SETSCREW, 4-40 x 0.094 inch, HSS
	213-0140-00			1		SETSCREW, 2-56 x 0.094 inch, HSS
-47	384-1009-00			1		SHAFT, extension, 0.56 inch long

FIGURE 1 EXPLODED & STANDARD ACCESSORIES (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty 1 2 3 4 5	Description
1-48	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: *(not included w/resistor)*
-49	210-0583-00			1	NUT, hex., 0.25-32 x 0.312 inch
-50	210-0940-00			1	WASHER, flat, 0.25 ID x 0.375 inch OD
-51	210-0046-00			1	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-52	384-1004-00			1	SHAFT, extension, 2.25 inches long
-53	214-1355-00			1	ACTUATOR, switch
-54	214-1353-00			1	SPRING, helical compression
-55	670-1426-00			1	CIRCUIT BOARD ASSEMBLY, switch—DISPLAY MODE A10
	- - - - - -			-	circuit board assembly includes:
-56	136-0328-02			16	SOCKET, terminal, pin
	- - - - - -			-	mounting hardware: *(not included w/circuit board assembly)*
-57	211-0156-00			2	SCREW, 1-72 x 0.25 inch, 82° csk, FHS
-58	670-1429-00			1	CIRCUIT BOARD ASSEMBLY, switch—TRIGGER MODE A8
	- - - - - -			-	circuit board assembly includes:
	136-0328-02			10	SOCKET, terminal, pin
	- - - - - -			-	mounting hardware: *(not included w/circuit board assembly)*
	211-0156-00			2	SCREW, 1-72 x 0.25 inch, 82° csk, FHS
-59	670-1428-00			1	CIRCUIT BOARD ASSEMBLY, switch—TRIGGER COUPLING A7
	- - - - - -			-	circuit board assembly includes:
	136-0328-02			7	SOCKET, terminal, pin
	- - - - - -			-	mounting hardware: *(not included w/circuit board assembly)*
	211-0156-00			2	SCREW, 1-72 x 0.25 inch, 82° csk, FHS
-60	670-1427-00			1	CIRCUIT BOARD ASSEMBLY, switch—TRIGGER SOURCE A6
	- - - - - -			-	circuit board assembly includes:
	136-0328-02			6	SOCKET, terminal, pin
-61	131-0589-00			2	TERMINAL, pin, 0.50 inch long
	- - - - - -			-	mounting hardware: *(not included w/circuit board assembly)*
	211-0156-00			2	SCREW, 1-72 x 0.25 inch, 82° csk, FHS
-62	670-1225-02			1	CIRCUIT BOARD ASSEMBLY, switch—DELAYED TRIGGER A9
	- - - - - -			-	circuit board assembly includes:
	388-1589-01			1	CIRCUIT BOARD
-63	131-0608-00			7	TERMINAL, pin, 0.365 inch
-64	260-1133-00			1	SWITCH, push, SLOPE, COUPLING, SOURCE
-65	352-0239-00			3	LAMP HOLDER
	- - - - - -			-	mounting hardware for each: *(not included w/lamp holder)*
-66	213-0098-00			2	SCREW, 0-80 x 0.125 inch, FHS
	- - - - - -			-	mounting hardware: *(not included w/circuit board assembly)*
-67	211-0541-00			3	SCREW, 6-32 x 0.25 inch, 100° csk, FHS

FIGURE 1 EXPLODED & STANDARD ACCESSORIES (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
1-68	380-0200-00			3		HOUSING, pushbutton
-69	366-1214-03			1		KNOB, push, + & —
-70	366-1214-02			1		KNOB, push, AC-DC
-71	366-1214-01			1		KNOB, push, INT-EXT
-72	386-1447-39			1		SUBPANEL, front
	- - - - - -			-		mounting hardware: *(not included w/subpanel)*
-73	213-0192-00			4		SCREW, thread forming, 6-32 x 0.50 inch, Fil HS
-74	426-0499-11			1		FRAME SECTION, bottom
-75	426-0505-11			1		FRAME SECTION, top
-76	214-1061-00			1		SPRING, flat, sliding ground
-77	337-1435-00			1		SHIELD, electrical, right
-78	337-1064-00			1		SHIELD, electrical, left
-79	670-1431-00			1		CIRCUIT BOARD ASSEMBLY—MAIN TRIGGER A3
	- - - - - -			-		circuit board assembly includes:
	388-1578-00			1		CIRCUIT BOARD
-80	131-0608-00			2		TERMINAL, pin, 0.365 inch long
-81	136-0220-00			19		SOCKET, transistor, 3 pin, square
-82	136-0235-00			1		SOCKET, transistor, 6 pin
-83	136-0260-01			1		SOCKET, integrated circuit, 16 pin
-84	136-0263-03			17		SOCKET, pin terminal
-85	200-0945-00			1		COVER, half, temperature stabilizer
-86	200-0945-01			1		COVER, half, temperature stabilizer, threaded
-87	211-0062-00			1		SCREW, 2-56 x 0.312 inch, PHS
-88	214-0579-00			10		PIN, test point
-89	352-0213-00			7		HOLDER, cable, double, plastic
-90	352-0228-00			3		HOLDER, cable, single, plastic
-91	352-0238-00			4		HOLDER, coaxial, single, grounding
-92	211-0155-00			3		SCREW, relieved shank, 4-40 x 0.375 inch
-93	361-0238-00			3		SPACER, sleeve, 0.34 inch long
-94	670-1430-00			1		CIRCUIT BOARD ASSEMBLY—DELAYED TRIGGER A5
	- - - - - -			-		circuit board assembly includes:
	388-1572-00			1		CIRCUIT BOARD
-95	131-0608-00			2		TERMINAL, pin, 0.365 inch long
-96	136-0220-00			13		SOCKET, transistor, 3 pin, square
-97	136-0235-00			1		SOCKET, transistor, 6 pin
-98	136-0260-01			1		SOCKET, integrated circuit, 16 pin
-99	136-0263-03			13		SOCKET, pin terminal
-100	200-0945-00			1		COVER, half, temperature stabilizer
-101	200-0945-01			1		COVER, half, temperature stabilizer, threaded
-102	211-0062-00			1		SCREW, 2-56 x 0.312 inch, PHS
-103	214-0579-00			9		PIN, test point
-104	352-0213-00			8		HOLDER, cable, double, plastic
-105	352-0238-00			2		HOLDER, coaxial, single, grounding
-106	352-0212-00			1		HOLDER, coaxial, double, grounding
-107	211-0155-00			3		SCREW, relieved shank, 4-40 x 0.375 inch
-108	361-0238-00			3		SPACER, sleeve, 0.34 inch long
-109	384-1008-00			1		SHAFT, extension, 1.50 inches long
-110	376-0029-00			1		COUPLING, shaft, 0.128 ID x 0.312 inch OD

FIGURE 1 EXPLODED & STANDARD ACCESSORIES (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5 Description
1-111	384-1007-00			1	SHAFT, extension, plastic, 9 inches long
-112	376-0101-00			1	COUPLING, shaft, 0.375 inch long
-113	352-0240-00			2	HOLDER, cable, plastic, long
-114	670-1559 00			1	CIRCUIT BOARD ASSEMBLY—DISTRIBUTION A2
	- - - - - -			-	circuit board assembly includes:
	388-1570-00			1	CIRCUIT BOARD
-115	131-0589-00			46	TERMINAL, pin, 0.50 inch long
-116	131-0590-00			3	TERMINAL, pin, 0.665 inch long
	131-0608-00			7	TERMINAL, pin, 0.365 inch long
-117	136-0220-00			2	SOCKET, transistor, 3 pin, square
	- - - - - -			-	mounting hardware: *(not included w/circuit board assembly)*
-118	211-0116-00			4	SCREW, sems, 4-40 x 0.312 inch, PHB
-119	220-0547-01			4	NUT BLOCK
-120	211-0105-00			4	SCREW, 4-40 x 0.188 inch, 100° csk, FHS
-121	670-1424-00	B010100	B019999	1	CIRCUIT BOARD ASSEMBLY—SWEEP A4
	670-1424-01	B020000	B029999	1	CIRCUIT BOARD ASSEMBLY—SWEEP A4
	670-1424-02	B030000	B039999	1	CIRCUIT BOARD ASSEMBLY—SWEEP A4
	670-1424-03	B040000		1	CIRCUIT BOARD ASSEMBLY—SWEEP A4
	- - - - - -			-	circuit board assembly includes:
	388-1978-00			1	CIRCUIT BOARD
-122	131-0608-00			4	TERMINAL, pin, 0.365 inch long
-123	136-0220-00			43	SOCKET, transistor, 3 pin, square
-124	136-0252-01			8	SOCKET, pin, connector, 0.178 inch long
-125	136-0263-03			56	SOCKET, pin terminal
-126	136-0241-00			2	SOCKET, integrated circuit, 10 pin
-127	136-0269-00			2	SOCKET, integrated circuit, 14 pin
-128	136-0399-00			20	SOCKET, pin connector
-129	214-0579-00			18	PIN, test point
-130	214-1292-00			2	HEAT SINK, transistor
-131	260-1132-00			1	SWITCH, push—×10 MAG
-132	352-0228-00			1	HOLDER, cable, small
-133	386-1545-00			1	PLATE, relay mounting
-134	211-0155-00			6	SCREW, relieved shank, 4-40 x 0.375 inch
-135	361-0238-00			6	SPACER, sleeve, 0.34 inch long
-136	670-1423-00			1	CIRCUIT BOARD ASSEMBLY—INTERFACE A1
	- - - - - -			-	circuit board assembly includes:
	388-1979-00			1	CIRCUIT BOARD
	131-0590-00			23	TERMINAL, pin, 0.665 inch long
	131-0589-00			20	TERMINAL, pin, 0.50 inch long
	131-0591-00			20	TERMINAL, pin, 0.835 inch long
	131-0592-00			50	TERMINAL, pin, 0.885 inch long
-137	131-0595-00			7	TERMINAL, pin, 1.37 inches long
-138	131-0604-00			50	CONTACT, electrical, spring
	131-0608-00			3	TERMINAL, pin, 0.365 inch long
-139	136-0252-01			3	SOCKET, pin connector, 0.178 inch long
-140	260-0723-00			1	SWITCH, slide—DELAY
-141	- - - - - -			1	RESISTOR, variable

FIGURE 1 EXPLODED & STANDARD ACCESSORIES (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
1-	105-0268-00			1		CAM SWITCH ASSEMBLY—TIME/DIV OR DL'Y TIME
	- - - - - -			-		cam switch assembly includes:
-142	- - - - - -			1		RESISTOR, variable
	- - - - - -			-		mounting hardware: *(not included w/resistor)*
-143	210-0583-00			1		NUT, hex., 0.25-32 x 0.312 inch
-144	210-0046-00			1		WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-145	386-1792-00			1		PLATE, variable resistor mounting
	- - - - - -			-		mounting hardware: *(not included w/plate)*
-146	211-0087-00			2		SCREW, 2-56 x 0.188 inch, 82° csk, FHS
-147	210-0001-00			2		WASHER, lock, internal, 0.092 ID x 0.18 inches OD
-148	200-1228-00			1		COVER, cam switch
	- - - - - -			-		mounting hardware: *(not included w/cover)*
-149	211-0001-00			10		SCREW, 2-56 x 0.25 inch, PHS
	210-0001-00			10		WASHER, lock, internal, 0.092 ID x 0.18 inch OD
-150	210-0405-00			10		NUT, hex., 2-56 x 0.188 inch
-151	200-1115-00			2		COVER, cam switch, rear
	- - - - - -			-		mounting hardware for each: *(not included w/cover)*
	211-0116-00			1		SCREW, sems, 4-40 x 0.312 inch, PHB
-152	210-0591-00			1		NUT, hex., 4-40 x 0.188 inch
-153	200-1116-00			2		COVER, cam switch, front
	- - - - - -			-		mounting hardware for each: *(not included w/cover)*
	211-0116-00			1		SCREW, sems, 4-40 x 0.312 inch, PHB
-154	210-0591-00			1		NUT, hex., 4-40 x 0.188 inch
-155	131-0963-00			1		CONTACT, electrical, grounding
-156	354-0391-00			1		RING, retaining
-157	401-0081-02			1		BEARING, cam switch, front
	- - - - - -			-		mounting hardware: *(not included w/bearing)*
-158	211-0116-00			2		SCREW, sems, 4-40 x 0.312 inch, PHB
-159	210-0591-00			2		NUT, hex., 4-40 x 0.188 inch
-160	214-1127-00			4		ROLLER, detent
-161	214-1139-00[1]			-		SPRING, flat, gold
	214-1139-02[1]			-		SPRING, flat, green
	214-1139-03[1]			-		SPRING, flat, red
-162	105-0189-00			1		DRUM ASSEMBLY, front
-163	401-0083-00			1		BEARING, cam switch, center
	- - - - - -			-		mounting hardware: *(not included w/bearing)*
	211-0116-00			2		SCREW, sems, 4-40 x 0.312 inch, PHB
	210-0591-00			2		NUT, hex., 4-40 x 0.188 inch
-164	105-0187-00			1		DRUM ASSEMBLY, rear
-165	401-0081-01			1		BEARING, cam switch, rear
	- - - - - -			-		mounting hardware: *(not included w/bearing)*
	211-0116-00			2		SCREW, sems, 4-40 x 0.312 inch, PHB
	210-0591-00			2		NUT, hex., 4-40 x 0.188 inch
-166	384-1020-00			1		EXTENSION, shaft, 10.342 inches long
	- - - - - -			-		mounting hardware: *(not included w/extension)*
	376-0039-00			1		COUPLING, shaft, 0.438 inch long
	- - - - - -			-		coupling includes:
	213-0075-00			2		SETSCREW, 4-40 x 0.094 inch, HSS

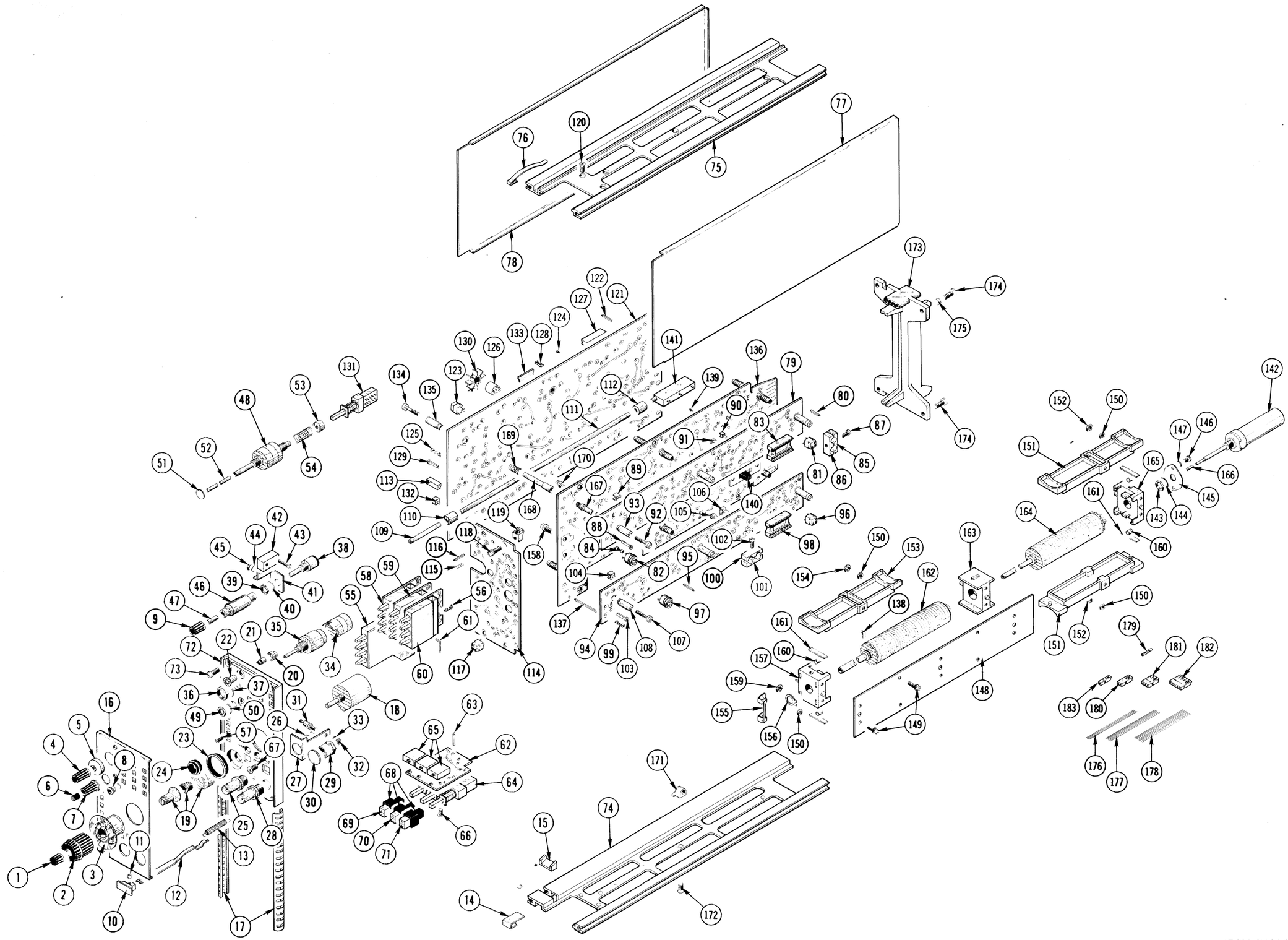
[1]**Replace only with part bearing the same color code as the original part in your instrument.**

FIGURE 1 EXPLODED & STANDARD ACCESSORIES (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty	1 2 3 4 5	Description
1-167	351-0185-00			6		GUIDE-POST, lock, 0.65 inch long
-168	351-0186-00			6		GUIDE-POST, lock, 0.84 inch long
-169	214-1140-00			12		SPRING, helical compression
	- - - - - -			-		mounting hardware: *(not included w/circuit board assembly)*
-170	211-0116-00			6		SCREW, sems, 4-40 x 0.312 inch, PHB
-171	210-0547-01			6		NUT BLOCK
-172	211-0105-00			6		SCREW, 4-40 x 0.188 inch, 100° csk, FHS
-173	386-1402-00			1		PANEL, rear
	- - - - - -			-		mounting hardware: *(not included w/panel)*
-174	213-0192-00			4		SCREW, thread forming, 6-32 x 0.50 inch, Fil HS
-175	361-0326-00			1		SPACER, sleeve, 0.10 inch long
-176	175-0826-00			ft		WIRE, electrical, 3 wire ribbon, 9.75 inches long
-177	175-0828-00			ft		WIRE, electrical, 5 wire ribbon, 3.25 inches long
-178	175-0830-00			ft		WIRE, electrical, 7 wire ribbon, 2.50 inches long
-179	131-0707-00			35		CONNECTOR, terminal
	131-0708-00			3		CONNECTOR, terminal
-180	352-0169-03			1		HOLDER, terminal connector, 2 wire *(orange)*
	352-0169-00			1		HOLDER, terminal connector, 2 wire *(black)*
	352-0169-04			1		HOLDER, terminal connector, 2 wire *(yellow)*
-181	352-0161-04			2		HOLDER, terminal connector, 3 wire *(yellow)*
	352-0161-05			1		HOLDER, terminal connector, 3 wire *(green)*
	352-0161-06			1		HOLDER, terminal connector, 3 wire *(blue)*
-182	352-0163-05			1		HOLDER, terminal connector, 5 wire *(green)*
	352-0165-07			2		HOLDER, terminal connector, 7 wire *(violet)*
-183	352-0171-00			1		HOLDER, terminal connector, 1 wire *(black)*

STANDARD ACCESSORIES

	070-1125-00			1		MANUAL, instruction *(not shown)*



CARTON ASSEMBLY
(Part No. 065-0125-00)

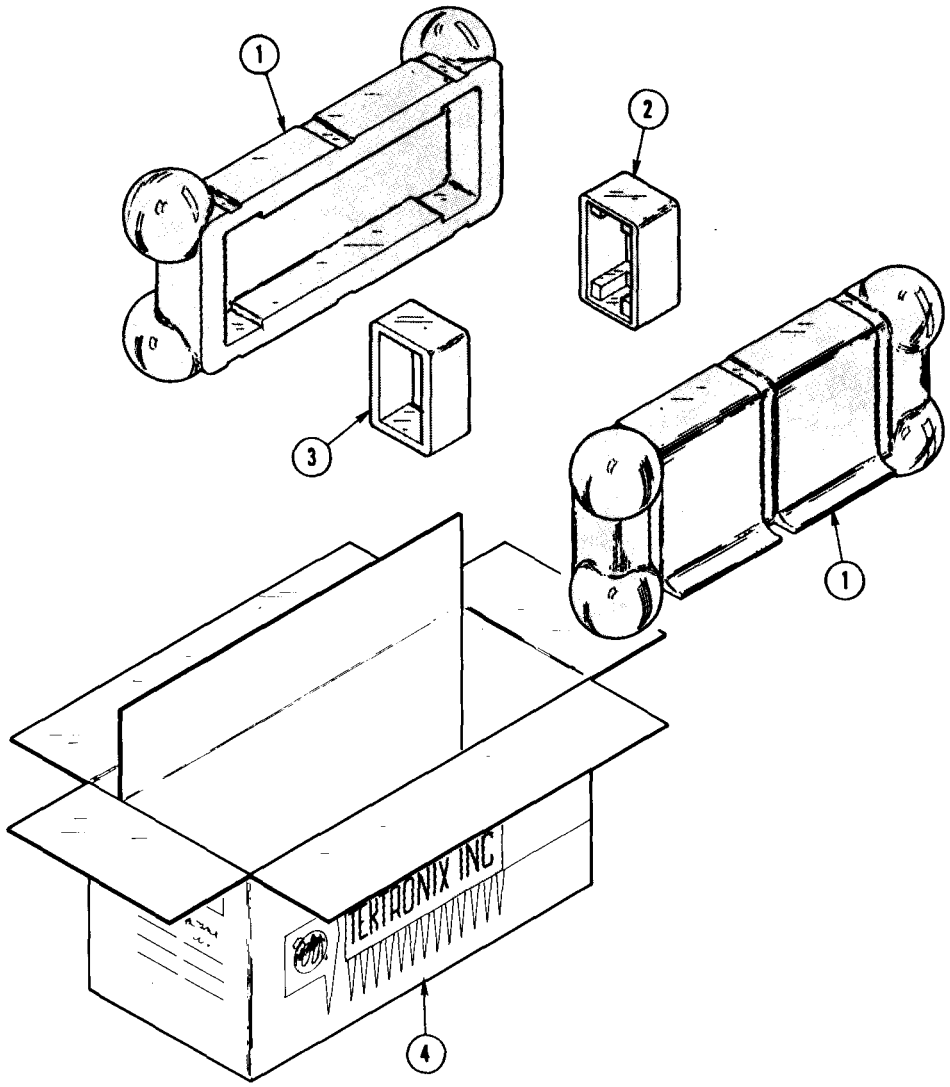


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Serial/Model No. Disc	Qty 1 2 3 4 5	Description
	065-0125-00			1	ASSEMBLY, carton
	- - - - - -			-	assembly includes:
-1	004-0241-00			2	CASE HALF
-2	004-0242-00			1	END CAP, rear
-3	004-0243-00			1	END CAP, front
-4	004-0748-00			1	CARTON

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. Sections of the manual are often printed at different times, so some of the information on the change pages may already be in your manual. 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 in this section, your manual is correct as printed.

7B52 EFF SN B110000-up

7B53N EFF SN B050000-up

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

SWEEP Circuit Board Assembly

CHANGE TO:

670-1217-07	(7B52)	Complete Board		
670-1424-04	(7B53N)	Complete Board		
C758	283-0111-00	0.1 μF	Cer	50 V
C932	283-0111-00	0.1 μF	Cer	50 V

REMOVE:

R758	315-0101-00	100 Ω	1/4 W	5%
R932	315-0101-00	100 Ω	1/4 W	5%

ADD:

LR758	108-0333-00	0.9 μH	(wound on a 160 Ω 1/4 W 5% resistor)
LR932	108-0333-00	0.9 μH	(wound on a 160 Ω 1/4 W 5% resistor)

(Replace R758 and R932 with LR758 and LR932)

M18,163/971

7B52 EFF SN B110000-up

7B53N EFF SN B050000-up

ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

SWEEP Circuit Board Assembly

CHANGE TO:

670-1217-07	(7B52)	Complete Board		
670-1424-04	(7B53N)	Complete Board		
C758	283-0111-00	0.1 μF	Cer	50 V
C932	283-0111-00	0.1 μF	Cer	50 V

REMOVE:

R758	315-0101-00	100 Ω	1/4 W	5%
R932	315-0101-00	100 Ω	1/4 W	5%

ADD:

LR758	108-0333-00	0.9 μH	(wound on a 160 Ω 1/4 W 5% resistor)
LR932	108-0333-00	0.9 μH	(wound on a 160 Ω 1/4 W 5% resistor)

(Replace R758 and R932 with LR758 and LR932)

M18,163/971

Scans
By
Artek Media

Artek Media
1042 Plummer Cir. SW
Rochester, MN 55902

www.artekmedia.com

"High resolution scans of obsolete technical manuals"

If your looking for a quality scanned technical manual in PDF format please visit our WEB site at www.artekmedia.com or drop us an email at manuals@artekmedia.com and we will be happy to email you a current list of the manuals we have available.

If you don't see the manual you need on the list drop us a line anyway we may still be able to point you to other sources. If you have an existing manual you would like scanned please write for details, This can often be done very reasonably in consideration for adding your manual to our library.

Typically the scans in our manuals are done as follows;

1) Typed text pages are typically scanned in black and white at 300 dpi.
2) Photo pages are typically scanned in gray scale mode at 600 dpi
3) Schematic diagram pages are typically scanned in black and white at 600 dpi unless the original manual had colored high lighting (as is the case for some 70's vintage Tektronix manuals).

If you purchased this manual from us (typically through our Ebay name of ArtekMedia) thank you very much. If you received this from a well-meaning "friend" for free we would appreciate your treating this much like you would "share ware". By that we mean a donation of at least $5-10 per manual is appreciated in recognition of the time (a manual can take as much as 40 hours to reproduce, book, link etc.), energy and quality of effort that went into preserving this manual. Donations via PayPal go to: manuals@artekmedia.com or can be mailed to us the address above.

Thanks

Dave & Lynn Henderson
Artek Media