

# INSTRUCTION MANUAL

Serial Number 3863

**Type 3B3**  
**Plug-In Unit**

*Tektronix, Inc.*

S.W. Millikan Way • P. O. Box 500 • Beaverton, Oregon • Phone MI 4-0161 • Cables: Tektronix



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All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

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Type 3B3

# SECTION 1

## CHARACTERISTICS

### General

The Type 3B3 Time Base Unit is a plug-in time base generator designed for use with Tektronix Types 561A, RM561A, 564, 567 and RM567 Oscilloscopes. The Type 3B3 provides normal or delayed sweeps at 20 calibrated rates from 0.5 microseconds per division to 1 second per division. In delayed sweep operation, the Type 3B3 gives continuous calibrated sweep delay from 0.5 microsecond to 10 seconds after receipt of a triggering impulse.

### Sweep Rates

Both normal and delayed sweep rates from 0.5 microsecond per division to 1 second per division in 20 calibrated steps. A variable control provides uncalibrated sweep rates between steps and also extends the slower rate to approximately 2.5 seconds per division. Calibrated sweep rates for both normal and delayed sweeps are typically within 1%, and in all cases within 3% of the TIME/DIV. and DELAY TIME RANGE switch settings.

### Sweep Magnification

The display can be magnified 5 times, extending both the normal and delayed sweep rates to 0.1 microsecond per division. Sweep rate accuracy with the 5X magnification remains within 5% of the TIME/DIV. and DELAY TIME RANGE switch settings.

### Sweep Delay

The calibrated sweep delay is continuously variable from 0.5 microsecond to 10 seconds. Delay accuracy is 1% of full scale reading, and delay time linearity is within 0.2% of full scale from 5 microseconds to 2 seconds of delay. Time jitter is less than 1 part in 20,000 of the maximum available delay interval.

### Single Sweep

All modes of operation can be displayed as a single sweep for photographic recording.

### Triggering Modes, Normal Sweep

Automatic (15 cps to 10 mcs), ac- or dc-coupled, + or — slope, internal or external source.

### Triggering Modes, Delayed Sweep

Ac- or dc-coupled, + or — slope, internal or external source.

### Internal Triggering Requirements, Either Time Base

Internal triggering with signals in the frequency range from dc to 5 mc requires a trigger amplitude of 0.2 major divisions of vertical deflection. Above 5 mc, the trigger requirements increase, and at 10 mc, a trigger amplitude of 0.5 major division of vertical deflection is required.

### External Triggering Requirements, Either Time Base

External triggering with signals in the frequency range from dc to 5 mc requires a trigger amplitude of 0.5 volts. Above 5 mc the trigger requirements increase and at 10 mc, a trigger amplitude of 1.25 volts is required. Maximum triggering signal is 15 volts direct, or 150 volts through internal attenuator (operated by front panel switch). If ac coupling is used, up to 500 volts total, dc and ac peak combined, may be applied so long as the ac component does not exceed 150 volts.

### Construction

Aluminum-alloy chassis. Front panel photo-etched and anodized.

### Weight

5 pounds 4 ounces.

[illegible]

# SECTION 2

## OPERATING INSTRUCTIONS

### General

This section explains the use of the Type 3B3 as part of an oscilloscope system, the function of the Type 3B3's front panel controls, operating procedures peculiar to the Type 3B3, and how to display a signal.

### Use

The Type 3B3 Plug-In Time Base Generator is normally used as part of an oscilloscope system composed of the Type 3B3, one of the Tektronix oscilloscopes listed in Section 1, and an appropriate vertical amplifier plug-in. When properly operated, the system can (a) determine if a certain event is happening, (b) make accurate measurements of the event, and (c) display the representation of the event in a manner that permits photographing. The functions of the Type 3B3 in such a system are threefold: it provides accurate time bases for precisely measuring the time dimensions of the event being analyzed; it provides a versatile trigger circuit to assure positive synchronization of the time bases with the event, and the single sweep feature provides exposure control when the display is to be photographed. In assembling an oscilloscope system, the Type 3B3 is inserted in the X-axis (right hand) opening of the oscilloscope. The vertical amplifier plug-in (a non-sampling vertical amplifier of the '3' series such as the Type 3A1) is inserted in the Y-axis (left-hand) opening.

### Function of Front Panel Controls and Connectors

The front panel controls and connectors on the Type 3B3 are grouped into blocks according to the sweep circuit in which they function. The blocks of controls are outlined by a heavy black line printed on the front panel. Controls common to both sweep circuits are placed between the two blocks with the exception of the screwdriver adjustable SWEEP CAL. potentiometer which is located in the bottom right-hand corner of the front panel. Overcrowding of the front panel is avoided by giving some controls multiple functions and making others concentric. Table 2-1 lists the function of the individual controls and connectors.

TABLE 2-1

Function of Front-Panel Controls and Connectors

Control	Setting	Function
Delayed Sweep Triggering Block		
LEVEL (PULL EXT. TRIG. ATTEN.)	Pushed in	When turned, sets the point on the slope of the input waveform at which the delayed sweep is triggered.
	Pulled out	Switches an internal 10X attenuator into the external trigger circuit, permitting use of external triggering signals in the 15- to 150-volt range. When turned, sets the point on the slope of the external triggering signal at which the delayed sweep is triggered.

TABLE 2-1 (Cont'd)

Control	Setting	Function
SLOPE	+	Sets the delayed-sweep triggering circuit to trigger on the rising (+) slope of the triggering signal.
	—	Sets the delayed-sweep triggering circuit to trigger on the falling (—) slope of the triggering signal.
COUPLING	AC	Inserts blocking capacitor in the delayed sweep trigger circuit to block any dc components of the triggering signal.
	DC	Shunts triggering signal around blocking capacitor and passes it directly to delayed sweep trigger circuit.
SOURCE	INT.	Switches input of delayed sweep trigger circuit to trigger source (vertical plug-in) within the oscilloscope system.
	EXT.	Switches input of delayed sweep trigger circuit to EXT. TRIG. connector on front panel.
EXT. TRIG. (Connector)		Provides means of connecting external trigger signal to the delayed sweep trigger circuit.

Controls Common to Both Sweeps

MODE	NORM.	Switches circuits in the Type 3B3 so that; the normal (delaying) sweep is displayed on the crt, the sweep rate is set by the normal sweep timing switch, and sweep triggering is selected by the NORMAL or DELAYING SWEEP TRIGGERING controls.
	INTEN.	Switches circuits so that the delayed sweep intensifies a portion of the normal sweep, the intensified zone starts at a point on the normal sweep determined by the setting of the DELAY TIME control, the width of the intensified zone is determined by the setting of the DELAYED SWEEP control, and the DELAYED SWEEP TRIGGERING controls are disconnected.
	TRIG. INTEN.	Same as INTEN. setting except that DELAYED SWEEP TRIGGERING controls are now connected and the start of the intensified zone depends upon

TABLE 2-1 (Cont'd)

Control	Setting	Function
		the settings of the DELAY TIME and DELAYED SWEEP TRIGGERING controls.
	DLY'D SWP.	Switches the Type 3B3 circuits so that, the crt display is the delayed sweep only; the delayed sweep starts at a point on the normal sweep determined by the setting of the DELAY TIME control, and the DELAYED SWEEP TRIGGERING Controls are disconnected.
	TRIG. DLY'D SWP.	Same as DLY'D SWP. setting except that the DELAYED SWEEP TRIGGERING controls are connected, and the start of the delayed sweep is determined by settings of the DELAY TIME and the DELAYED SWEEP TRIGGERING controls.
POSITION (PULL 5X MAG.)	Pushed in Pulled out	Positions trace on crt when turned. Switches in 5X magnification circuit. Positions trace on crt when turned.
TIME/DIV AND DELAY TIME RANGE (Scale)	Fixed	This is a scale printed on the front panel. The scale is common to both the normal sweep and the delayed sweep timing switches. When the MODE control is in TRIG. INTEN., NORM., or INTEN. positions, the scale indicates the time per division of the normal sweep. It also indicates 1/10th the time duration of the delayed sweep. In both DLY'D SWP. positions of the MODE control, the scale indicates time per division of the delayed sweep, and 1/10 of the normal sweep delay time range.
TIME/DIV AND DELAY TIME RANGE (Control)	Any	Selects and indicates the position of the normal sweep timing switch. This control is the clear plastic ring located between the DELAYED SWEEP control and the TIME/DIV. AND DELAY TIME RANGE scale. Position of the normal sweep timing switch is indicated by two black lines on the control. When the white dot on the DELAYED SWEEP control is positioned between the two black lines on the clear plastic ring, the two sweep timing switches lock together and are both turned by the DELAYED SWEEP controls. To unlock, pull the DELAYED SWEEP control out, turn one

TABLE 2-1 (Cont'd)

Control	Setting	Function
		click in the desired direction, then release.
DELAYED SWEEP	Any	Selects and indicates the position of the delayed sweep timing switch. The white dot indicates sweep time duration divided by 10, or time per division. (See explanation of TIME/DIV AND DELAY TIME RANGE SCALE.) When the white dot is located between the two black lines on the clear plastic ring, this control also positions the normal sweep timing switch.
VARIABLE	UNCAL.	Provides variable (uncalibrated) sweep rates in between the fixed steps of the sweep timing switches and lights indicator light to warn that sweep is uncalibrated. When the MODE control is in NORM. position, the VARIABLE control varies the rate of the normal sweep. In all other positions of the MODE control, the variable control is in the delayed sweep.
	CAL.	Switches off the UNCAL. light.
SWEEP CAL.	variable (screw-driver adjustment)	Provides a means of compensating for differences in horizontal sensitivity when changing the Type 3B3 from one oscilloscope system to another.
Normal or Delaying Sweep Triggering Block		
DELAY TIME	variable	When the MODE control is in INTEN. or DLY'D SWP. positions the DELAY TIME control determines the point on the normal sweep at which the delayed sweep starts. When the MODE control is in either TRIG. position, the DELAY TIME control determines the point on the normal sweep at which the delayed sweep becomes triggerable. Delay time is read by multiplying the normal sweep DELAY TIME RANGE setting by the reading of the DELAY TIME dial. The ten major divisions on the DELAY TIME dial are units, the minor divisions are decimal.
Single Sweep	NORM.	Switches single sweep feature off.
	SINGLE SWEEP	Switches the single sweep feature on.
	RESET	Resets the single sweep circuit.



TABLE 2-1 (Cont'd)

Control	Setting	Function
		For single sweep operation of the Type 3B3, push the single sweep switch down to RESET, then release. If a trigger signal is present, a single sweep will appear on the crt. If there is no trigger signal present, the READY light will turn on and the single sweep will occur when a trigger signal is applied.
LEVEL (PULL EXT. TRIG. ATTEN.)	Pushed in	When turned, sets the point on the slope of the input waveform at which the normal sweep is triggered.
	Pulled out	Switches an internal 10X attenuator into the normal sweep external trigger circuit, permitting use of external triggering signals in the 15- to 150-volt range. When turned, sets the point on the slope of the external triggering signal at which the normal sweep is triggered.
SLOPE	+	Sets the normal sweep triggering circuit to trigger on the rising (+) slope of the triggering signal.
	—	Sets the normal sweep triggering circuit to trigger on the falling (—) slope of the triggering signal.
COUPLING	AUTO.	Switches the normal sweep to free-run operation. However, a suitable trigger will override the auto circuitry and trigger the sweep.
	AC	Inserts blocking capacitor in the normal sweep trigger circuit to block any dc components of the triggering signal.
	DC	Shunts triggering signal around blocking capacitor and passes it directly to normal sweep trigger circuit.
SOURCE	INT.	Switches input of normal sweep trigger circuit to trigger source (vertical plug-in) within the oscilloscope system.
	LINE	Applies 60 cycle triggering signal to normal sweep circuit.
	EXT.	Switches input of normal sweep trigger circuit to EXT. TRIG. connector on front panel.
EXT. TRIG. (Connector)		Provides means of connecting external trigger signal to the normal sweep trigger circuit.

## First Time Operation

The steps that follow are designed to instruct the operator in the use of the Type 3B3. The steps cover the controls to use, how and when to use it, and the expected results.

## Normal Sweep Triggering Controls

1. Preset the Type 3B3 controls as follows:

MODE	NORM.
POSITION	Center of range and pushed in DELAYED SWEEP. Line up the white dot between the two black lines on the clear plastic ring, then set the two black lines to straddle the 5mSEC position on the TIME/DIV AND DELAY TIME RANGE scale.
VARIABLE	CALIB.
NORMAL OR DELAYING SWEEP TRIGGERING:	
LEVEL	Center of range and pushed in.
COUPLING	AUTO.
SOURCE	INT.
Single Sweep	NORM.

2. Turn the instrument on and connect a cable from the oscilloscope calibrator to the input connector on the vertical amplifier plug-in.
3. Set the calibrator output for 1 volt and adjust the VOLTS/DIV. switch on the vertical amplifier plug-in for several divisions of vertical deflection. There should now be several cycles of a steady (triggered) calibrator waveform on the crt.
4. Turn the LEVEL control fully clockwise. The display should float (free-run) across the crt. Now return the control slowly toward the center until the display seems to lock into a steady position. Turn the control fully counterclockwise; again the display should float. Turn toward the center until the display locks into a steady position. Try this several times from both extremes of the control. When the display locks into a steady position, the sweep is triggered.
5. Set the COUPLING switch to DC. Turn the LEVEL control to center. The display should be steady. Now turn the control away from center; notice that instead of free-running, the trace disappears.
6. Set the COUPLING switch to AC; the controls should have the same effect as in step 5.
7. Notice that the display starts at either the top or the bottom of a pulse. Set the SLOPE switch to the opposite polarity; the trace should reverse and start opposite to its first condition.
8. Connect a cable from the calibrator to the NORMAL or DELAYING SWEEP TRIGGERING, EXT. TRIG. connector. Set the SOURCE switch to EXT.
9. Repeat steps 4 through 7. Notice that the trigger controls work the same as for internal trigger signals except that the LEVEL adjustment may be more critical. External trigger signals should be used in certain applications, and these are explained later in the text.

## Delayed Sweep Controls

1. Set the NORMAL OR DELAYING SWEEP TRIGGERING-SOURCE switch to INT., COUPLING to AUTO., and adjust the controls for a steady display.
2. Set the DELAY TIME control to 5.00 and turn the MODE control to INTEN. (to the right of NORM.)
3. Pull the DELAYED SWEEP control out and turn it one click to the right. Adjust the INTENSITY control on the oscilloscope and notice that a portion of the display is intensified. Turn the DELAY TIME control and the intensified portion moves across the crt.
4. Turn the DELAYED SWEEP control further to the right. Each click makes the intensified display smaller although it can still be moved by the DELAY TIME control.
5. Turn the MODE control to DLY'D SWP (on the right). The intensified zone seen in the previous step should expand and cover the full width of the crt. The width of the intensified zone set in step 4 is always expanded to the full width of the crt when the MODE control is turned to DLY'D SWP.

The following steps cover the DELAYED SWEEP TRIGGERING controls at the top of the Type 3B3.

1. Return the MODE control to NORM. and the TIME/DIV and DELAY TIME RANGE controls to 5 mSEC.
2. Set the DELAYED SWEEP TRIGGERING controls as follows:

LEVEL	fully counterclockwise
SLOPE	+
COUPLING	AC
SOURCE	INT.

3. Turn the MODE control to TRIG. INTEN. and adjust the INTENSITY control so that the display is barely visible. Turn the Delayed Sweep LEVEL control through its range; notice a portion of the trace intensifies as the control passes midrange. Leave the control at midrange.
4. Pull out the DELAYED SWEEP control and turn it several clicks to the right. The intensified portion of the display will get smaller.
5. Turn the MODE control to TRIG. DLY'D SWP; the intensified portion of the display expands across the full width of the crt.
6. Set the delayed sweep SLOPE control to the opposite polarity; the display should invert and remain stable.
7. Set the delayed sweep COUPLING switch to DC; the display may disappear. Readjust the delayed sweep LEVEL control and the display should return.
8. Connect a cable from the calibrator to the Delayed sweep EXT. TRIG. jack. Set the SOURCE control to EXT. Adjust the delayed sweep LEVEL control, if necessary, until the trace appears.

The following description covers single sweep operation. Single sweep can be used with either normal or delayed sweep.

First set the controls for a normal triggered display (use INT. coupling). Then push the single sweep control to RESET and a single sweep will occur.

To trigger a single sweep proceed as follows:

1. Set the single sweep control to SINGLE SWEEP.
2. Remove the trigger signal. This can be done in several ways, such as:
  - a. Turn the Normal Sweep LEVEL control either clockwise or counterclockwise.
  - b. Set the normal trigger SOURCE control to EXT.
  - c. Remove the input signal.
3. Push the single sweep control to RESET and release. The READY light should turn on.
4. Apply a trigger signal and the crt will show a single sweep.

## Trigger Selection

The choice of triggering to use depends on the type and portion of the signal to be displayed. For example, if the display starts on the leading edge of the signal and it is desired to start on the trailing edge, set the SLOPE control to the other position.

The AUTO position of the COUPLING is useful from approximately 15 cps to 10 mc. It has the advantage of showing a trace when the signal is removed, or when the amplifier input is grounded. This makes it easy to check a reference graticule line, since the trigger controls need not be touched.

The AC position of the COUPLING control is the same as for AUTO except for the free-run of the display. Both the AUTO and AC positions reject any dc component in triggering the signal. Adjusting the POSITION control on the vertical amplifier plug-in does not affect triggering in the AUTO or AC coupling positions.

In the DC position of the COUPLING control, the sweep will trigger in the range from dc to 10 mc. This position should be used with signals that change slowly, such as a slow-rising sawtooth. The normal sweep LEVEL control is used to trigger the sweep at any voltage point on these slow-rising signals. With the LEVEL control centered the sweep will start as the signal voltage crosses the zero voltage point.

For most applications the trigger SOURCE control should be used in the INT. position. However, if the frequency of the signal is related to the line frequency (60 cps), use the LINE position of this control.

External triggering should be used when signals are to be sampled from several points within a device, such as in point to point troubleshooting. With external triggering, the trigger controls do not have to be adjusted for each point check.

## Delayed Triggering

This type of triggering has the advantage of practically eliminating jitter in the display during delayed-sweep operation. Each sweep is triggered by the expanded portion of the waveform and not by the waveform at the beginning of the normal sweep. For example, assume a pulse train

output from a computer circuit. You want to examine a small pulse 5 microseconds from the start of the pulse train. Use the TIME/DIV. and the DELAYED SWEEP controls and the TRIG. DLY'D SWP position of the MODE control to expand the display to show only the small pulse. Then adjust the Delayed Sweep LEVEL control for a stable display. The sweep will then be triggered by the expanded portion and not by the start of the pulse train.

The SLOPE, COUPLING, and SOURCE controls work the same as their counterparts in normal-sweep operation. The choice of position for these controls depends on the type of waveform being examined.

### Sweep Magnification

The display can be expanded to 5 times its normal width by pulling out the 5X MAG. control (POSITION control). Each part of the expanded display can be examined by turning the POSITION control through its range.

The sweep magnifier extends the range of the TIME/DIV. switch 5 times. For example, with the TIME/DIV. switch set at  $.5 \mu\text{SEC}$  and the 5X MAG. switch pulled out, the actual time per division is 0.1 microsecond (VARIABLE control in

the CALIB. position). The magnifier works the same for either normal or delayed sweep.

### Sweep Cal. Check

This check should be made whenever the Type 3B3 is used with a different oscilloscope since the deflection plate sensitivity may not be the same. The accuracy of this check depends on the frequency of the power line supplying the instrument being exactly 60 cps, since this frequency is used to synchronize the calibrator.

Make the check as follows:

1. Set the MODE control to NORM.
2. Set the TIME/DIV. switch to 5 mSEC (be sure the 5X MAG. switch is pushed in).
3. Connect a cable from the oscilloscope calibrator to the vertical amplifier plug-in and adjust the normal sweep triggering controls for a stable display.
4. There should be exactly 3 cycles of the calibrator signal across the 10 divisions of the graticule. If there is not, adjust the SWEEP CAL. control until there is.

## NOTES

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

# SECTION 3

## APPLICATIONS

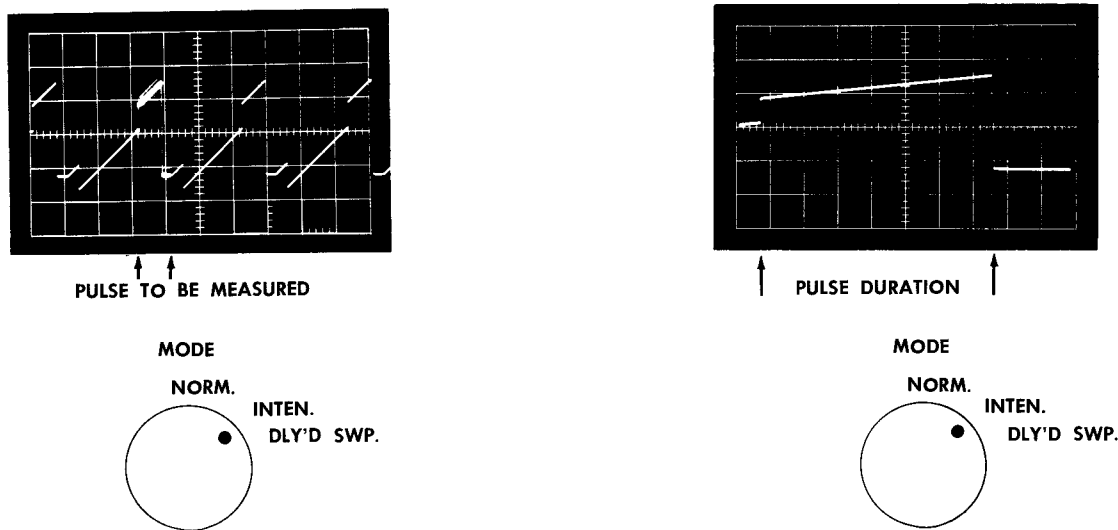


Fig. 3-1. Pulse Duration Measurement

### General

This section describes typical applications for the Type 3B3 Time Base unit. Since the number of applications for the Type 3B3 is large, this section covers only a few. Included are measurements of time, frequency, phase-shift, and waveform jitter.

### Time Measurements

The calibrated sweeps of the Type 3B3 cause any horizontal distance on the crt to represent a definite time interval. Thus, the time interval between points on a display can be accurately measured (within 3%).

For example, assume you have a normal-sweep crt display similar to Fig. 3-1 and you wish to measure the duration of one pulse.

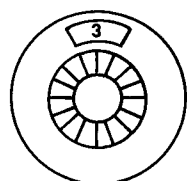
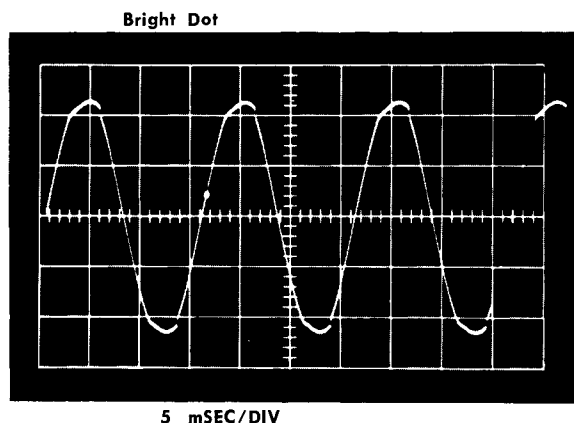
1. Make sure the VARIABLE control is set to CALIB., then pull out the DELAYED SWEEP control and turn it two clicks to the right.
2. Turn the MODE control to INTEN. (clockwise), and adjust the oscilloscope INTENSITY control to show an intensified zone on the display.
3. Turn the DELAY TIME control until the intensified zone begins at the start of the desired circle.
4. Turn the MODE control to DLY'D SWP. (clockwise) and measure the horizontal distance from the 50% point on the rise of the pulse to the 50% point on the fall of

the pulse. Multiply this distance by the setting of the DELAYED SWEEP control (setting of white dot on large black knob).

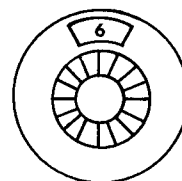
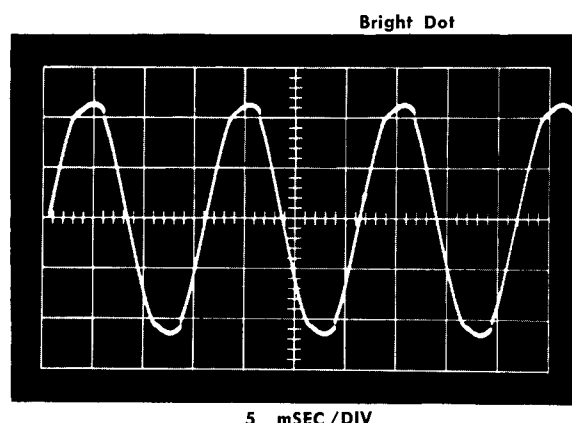
### Measurements with DELAY TIME Control

The following technique minimizes human errors (parallax, interpolation of graticule lines) that occur with graticule measurements and should be used when more than routine accuracy is needed. (See Fig. 3-2.)

1. Set the MODE control to INTEN. (clockwise) and adjust the controls to display one cycle of the signal.
2. Adjust the oscilloscope intensity to make the intensified part of the trace stand out. Pull out the DELAYED SWEEP control and turn it to the right until the intensified area is a small bright dot.
3. To measure pulse duration, turn the DELAY TIME control until the bright dot is at the 50% point on the leading edge of the pulse. Record the reading of the dial. For best accuracy, this reading should be greater than 1.00.
4. Turn the DELAY TIME control to move the bright dot to the 50% point on the trailing edge of the same pulse as step 3. Record the reading of the dial.
5. Subtract the reading of step 3 from that of step 4, then multiply the remainder by the setting of the TIME/DIV. switch. The product is the pulse width.



First Reading = 3.15



Second Reading = 6.48

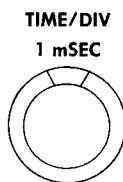
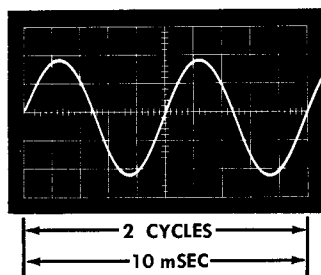
$$6.48 - 3.15 = 3.33$$

$$\text{Time for one cycle} = 3.33 \times 5 \text{ mSEC} = 16.666 \text{ mSEC.}$$

Fig. 3-2. Time measurements with DELAY TIME control

## Frequency Measurements

Time measurements may also be used for frequency measurements. Since frequency and time are reciprocal functions, the frequency of any signal is the reciprocal of the period (time) for one cycle. For example, if the time for one cycle is 0.2 microsecond, the frequency is 5 megacycles.



$$\frac{\text{NUMBER OF CYCLES IN 10 DIVISIONS}}{10 \times \text{TIME/DIV SWITCH SETTING (EXPRESSED IN SECONDS)}} = \text{FREQUENCY}$$

$$\frac{2}{10 \times 1 \text{ mSEC}} = \frac{2}{.01 \text{ SEC.}} = 200 \text{ CYCLES PER SECOND}$$

Fig. 3-3. Frequency Measurement

With any sweep rate, the number of cycles displayed across 10 divisions of the graticule depends on the frequency of the waveform (see Fig. 3-3). To determine the frequency, proceed as follows:

1. Set the TIME/DIV. switch to display several cycles of the waveform (be sure the VARIABLE TIME/DIV. control is in the CALIB. position).
2. Count the number of cycles across the 10 divisions of the graticule.
3. Divide this number by 10 times the TIME/DIV. switch setting. This is the frequency of the waveform.

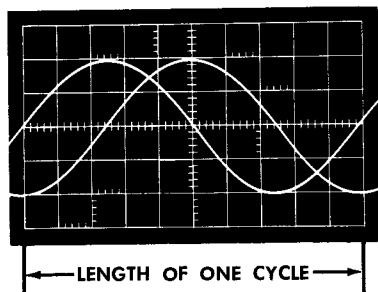
For example, assume that you are using a sweep rate of 5 mSEC/DIV. and you count 3 cycles across the 10 divisions. Multiply 5 milliseconds by 10 (number of divisions); this equals 50 milliseconds or 0.05 second. Dividing 3 cycles by 0.05 second, the frequency is 60 cycles per second.

## Phase-Shift Measurement

To measure the phase difference between two sine waves, proceed as follows:

1. Set up the Type 3B3 for normal-sweep operation and connect a triggering signal (related to the two to be measured) to the NORMAL SWEEP TRIGGERING EXT. TRIG. jack. Then connect one of the signals to be measured to the input connector of the vertical amplifier unit.
2. Set the TIME/DIV. switch so that at least one cycle of the sine wave is displayed on the crt.
3. Vertically center the display and horizontally position it so that one of the positive slopes crosses the centerline at the left side of the graticule (see Fig. 3-4).

4. Measure the time duration of one cycle of the waveform.
5. Without making any adjustments, disconnect the first sine wave from the vertical amplifier and substitute the second. (Normally this can be done simply by moving the probe from one signal source to the other.) Vertically center the display. If there is a phase difference between the two sine waves, you will find that the display has shifted horizontally.
6. Measure the amount of horizontal shift in the display. (You may increase or decrease the deflection sensitivity of the vertical amplifier to make the measurement easier, but be sure the display remains centered.)
7. Divide the distance measured in step 6 by the distance measured in step 4 and multiply the result by  $360^\circ$ . This is the phase difference (within 3%) between the two sine waves.



$$\frac{\text{SHIFT (FROM STEP 6)}}{\text{LENGTH OF ONE CYCLE (STEP 4)}} \times 360^\circ = \text{PHASE DIFFERENCE}$$

$$\frac{2.5 \text{ (div.)}}{10 \text{ (div.)}} \times 360 = 90^\circ$$

Fig. 3-4. Phase Measurement

### Pulse Jitter Measurements

Pulse jitter is defined as relatively small variations in pulse spacing in a pulse train. For example, assume a normal sweep pulse train is displayed on the crt, and you wish to check a small pulse in the train for jitter. The following steps may be used.

1. Turn the MODE control to INTEN. (clockwise). Pull out the DELAYED SWEEP control and turn it to the right until the intensified zone of the display is about the same width as the pulse to be checked.

2. Turn the DELAY TIME control to move the intensified zone over the pulse.
3. Turn the MODE control to DLY'D SWP (clockwise) and adjust the DELAY TIME control to place the intensified pulse at the center of the crt.
4. The intensified pulse will then show jitter if present. The amount of jitter can be measured (in time) by multiplying the horizontal distance in divisions (of the jitter area; see Fig. 3-5) by the setting of the DELAYED SWEEP knob (setting of white dot on large black knob).

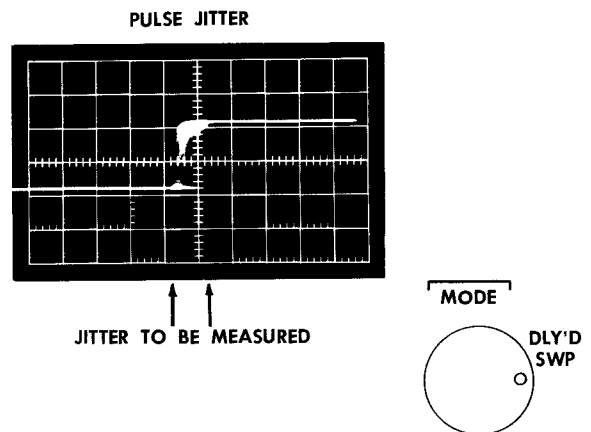


Fig. 3-5. Measurement of Pulse Jitter

### Non-repetitive Pulse Displays

In a device where a trigger pulse initiates a second pulse which occurs at a later time, delayed sweep should be used.

For example, assume a trigger pulse occurs in a system, and five seconds later a second pulse occurs. Also assume that the duration of the second pulse is 5 milliseconds. With a sweep of 10 seconds, the second pulse would probably just be invisible. With delayed sweep the pulse can be examined in detail. The technique is as follows.

1. Set the TIME/DIV. switch of the normal sweep to 1 SEC.
2. Set the DELAYED SWEEP control to 10 mSEC.
3. Set the DELAY TIME control to 5.00.
4. Turn the MODE control to NORM. and adjust the controls for a triggered sweep.
5. Turn the MODE control to DLY'D SWP (clockwise). The second pulse will be displayed 5 seconds after the initial trigger pulse. The pulse can then be photographed.

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# SECTION 4

## CIRCUIT DESCRIPTION

### General

The Type 3B3 is a conventional time-base unit with delayed sweep. The simplified block diagram of Fig. 4-1 shows the relationship of the major circuits. The schematic diagrams at the rear of the manual should be referred to when studying this circuit description.

The Normal Sweep Trigger circuit receives a signal from either the Vertical Amplifier plug-in or from an external source. The circuit converts the signal to a trigger pulse for the Normal Sweep Generator. This trigger pulse switches a tunnel diode in the Normal Sweep Generator and starts the sweep ramp. When the ramp voltage reaches a preset point (normal sweep length), the ramp ends and the crt beam (now blanked) returns to its starting point. A holdoff period delays the start of the next sweep. When this period ends, the next trigger pulse starts another sweep.

The start of the delayed sweep is controlled by the normal sweep rate and the setting of the DELAY TIME control. The delayed sweep rate is set by the DELAYED SWEEP control.

The sweep ramp from both sweep generators passes to the MODE switch. If this switch is set to NORM., INTEN., or TRIG. INTEN., the normal sweep passes to the Horizontal

Amplifier. In the DLY'D SWP or TRIG. DLY'D SWP positions of the MODE switch, the delayed sweep passes to the Horizontal Amplifier.

The Horizontal Amplifier converts the sweep ramp to a push-pull output and applies it to the horizontal deflection plates of the crt.

The Delayed Sweep Trigger circuit operates only when the MODE switch is in the TRIG. INTEN. or TRIG. DLY'D SWP position. This circuit is identical to the Normal Sweep Trigger circuit and uses a signal from either the Vertical Amplifier or an external source.

The trigger pulse formed by the Delayed Sweep Trigger circuit passes to the Delayed Sweep Generator and starts the delayed sweep ramp. The ramp ends when it reaches a preset point (delayed sweep length). During the ramp run-up a positive pulse is coupled to the crt grid to intensify the display.

The two INTEN. positions of the MODE switch show an intensified area of the display that represents both the delayed sweep duration and its position with respect to the start of the normal sweep.

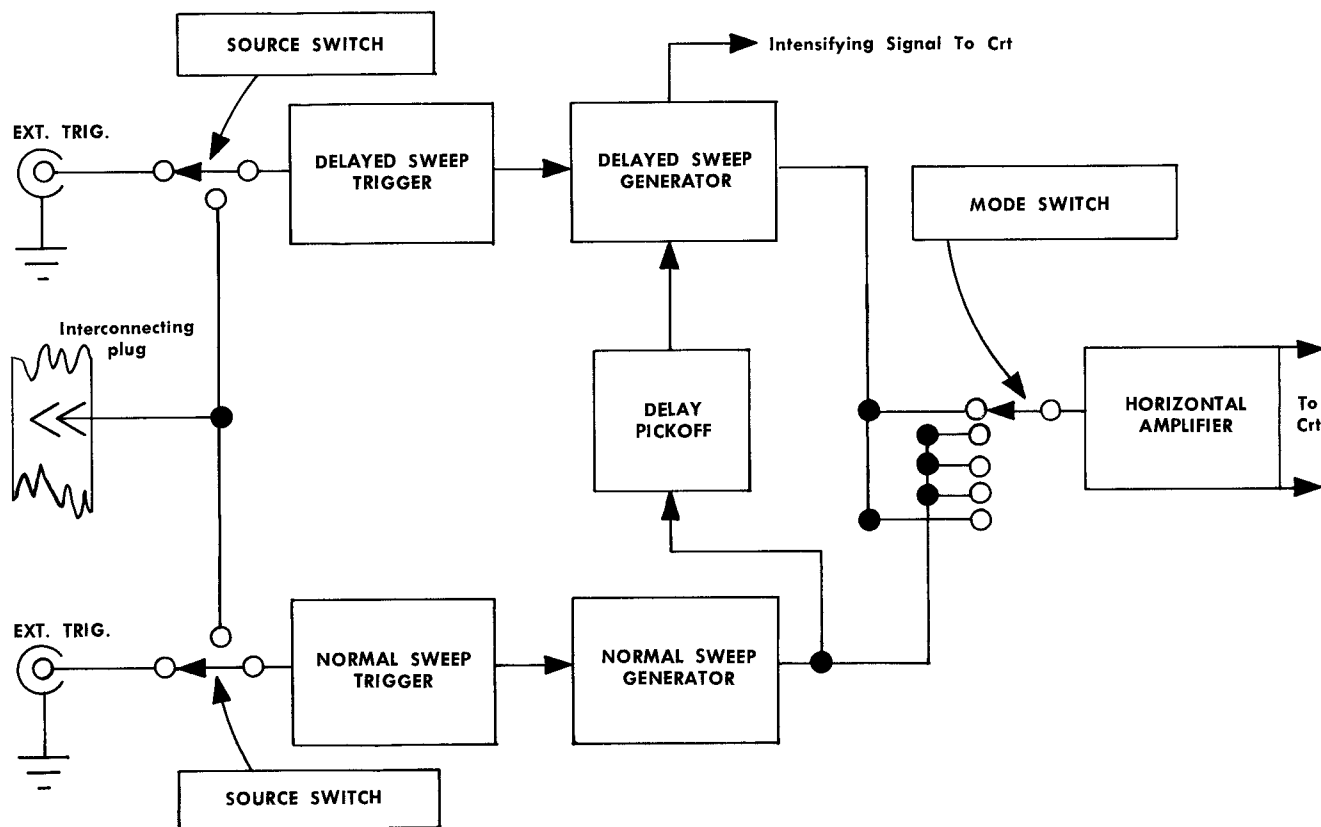


Fig. 4-1. Simplified Block Diagram of Type 3B3.

## Normal Sweep Trigger

The trigger signal (internal or external) enters the circuit through the SOURCE switch and passes to the COUPLING switch. The COUPLING switch passes the signal through a capacitor in the AUTO or AC positions; in the DC position the capacitors are bypassed. R9 and R10 attenuate the signal about 25% and present a high impedance load to the signal source.

When the SOURCE switch is in the EXT. position and the PULL EXT. TRIG. ATTEN. switch is pulled out, R7 is paralleled across R10 and the network becomes an approximate 10 to 1 attenuator. C7 and C9 are frequency compensating capacitors. Neon bulb B10 provides overload protection against high signal voltages. V13 is a long-tailed cathode follower that couples the signal through diode D15 to the SLOPE switch. Diodes D15 and D16 protect transistors Q24 and Q34 from excessive positive voltages. The SLOPE switch directs the signal to either Q24 or Q34 depending on its setting. Q24 and Q34 are a comparator with the signal applied to one base and a dc voltage (set by the LEVEL control) on the other base. Diodes D24 and D34 prevent emitter to base breakdown of Q24 and Q34. When the signal equals the level voltage, tunnel diode D35 switches. The pulse from D35 is amplified by Q44 and applied to T101. This transformer couples the pulse to the Normal sweep generator.

## Normal Sweep Generator

With the COUPLING switch in AC or DC position, sweep ramp generation starts when a trigger pulse coupled through

T101 causes tunnel diode D105 to switch to its high state. This puts a positive pulse on the base of Q114. Q114 turns on hard and its collector voltage goes negative. This negative change drops the voltage on the plates of V152 and the tube cuts off. When V152 cuts off, the timing capacitor C160 starts to charge toward  $-100$  volts through the timing resistor R160. As the grid of V161A starts to drop, its plate voltage starts to rise. The resulting positive swing is coupled through D162 and V161B to the top of C160. This increases the potential to which C160 is trying to charge. The effect is to straighten out the charging curve by increasing the charging voltage with each increment of charge on the capacitor. The positive swing at the top of the timing capacitor also tends to keep the lower side from dropping. This keeps the voltage across R160 essentially constant, providing a constant-current charging source for the timing capacitor. The result is an extremely linear sawtooth ramp at the cathode of V161B, which is then applied to the horizontal amplifier.

The sweep ramp ends when the voltage applied to the base of Q145 reaches approximately  $+4$  volts. Fig. 4-2 shows the waveform on the base of Q145 with the condition of associated diodes. Fig. 4-3 shows the condition of D105 (tunnel diode) during a sweep cycle.

The sweep ramp voltage at the arm of the NORMAL SWEEP LENGTH control (R168) starts at about  $-38$  volts. D171 is back-biased and the ramp voltage cannot reach the base of Q145. As the voltage reaches  $+2$  volts, D171 is forward-biased and the ramp voltage is applied to the base of Q145.

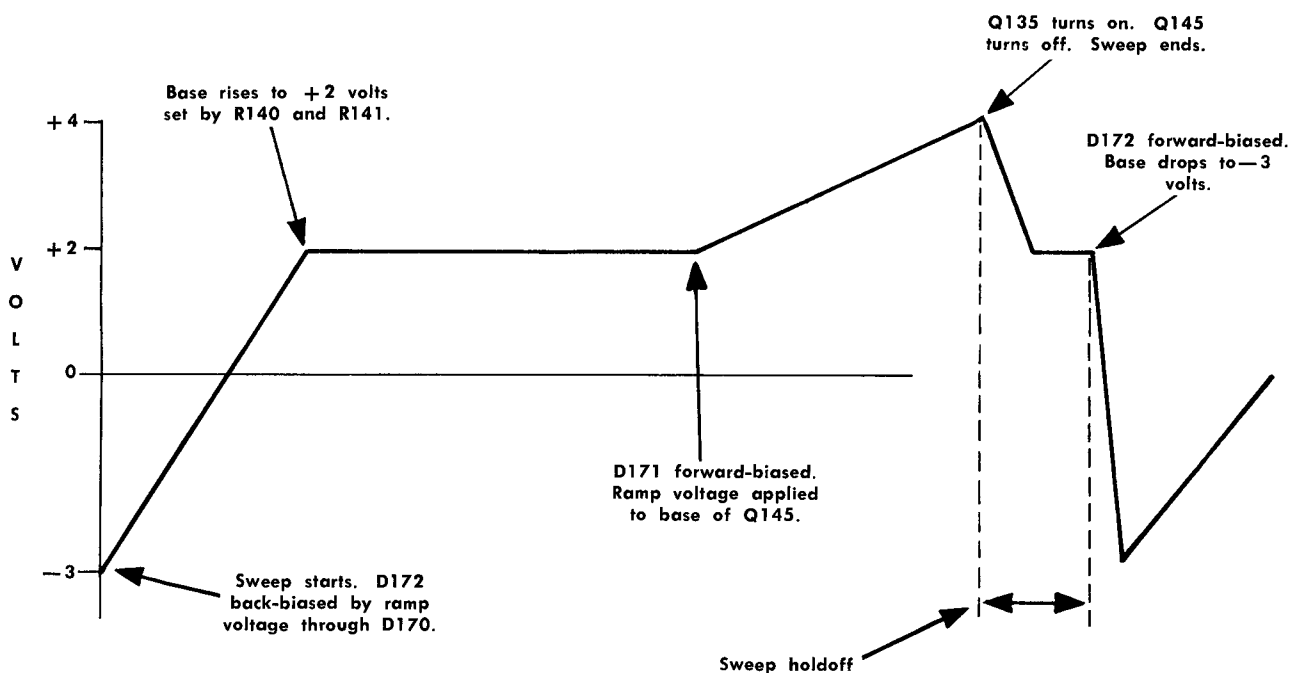


Fig. 4-2. Waveform at base of Q145 with condition of associated diodes.

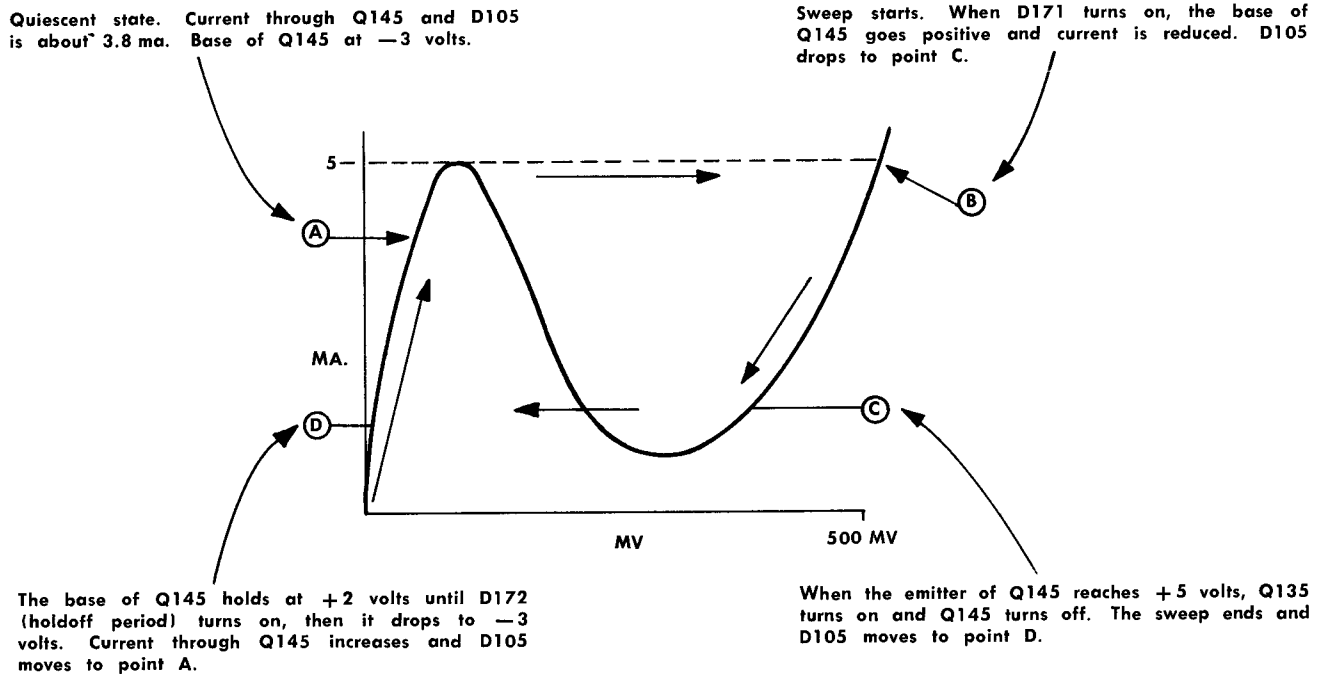


Fig. 4-3. Condition of Tunnel Diode D105 during sweep and holdoff periods

The voltage at the emitter of Q145 follows the base voltage in a positive direction. When the emitter rises to +5 volts, Q135 turns on. This quickly drops the emitter of Q145 to -0.5 volt and it turns off. When Q145 turns off, the current source for D105 is removed and the tunnel diode switches to its low state. This negative change turns Q114 off and allows the plates of V152 to go positive. V152B conducts and timing capacitor C160 discharges through V152B and the cathode resistors of V161B, ending the sweep ramp.

### Sweep Holdoff Period

A holdoff period is necessary between each sweep to prevent display jitter. This is done by preventing the sweep from being retriggered until the whole system is again stable and the electron beam is at the left side of the crt. The holdoff period is developed by the charge and discharge of holdoff capacitor C170. The circuit works as follows: During sweep run-up, the sweep voltage charges C170 through D170. When the sweep ends, C170 discharges exponentially. When the capacitor charge drops to about -3 volts, D172 becomes forward biased and this voltage is applied to the base of Q145. Current through Q145 increases, which causes tunnel diode D105 to move to its ready state (point A on Fig. 4-3). A trigger can now start another sweep.

### Automatic Sweep

If the COUPLING switch is set to AUTO., transistor Q124 provides an additional source of current for Q145. This

added current switches D105 (at the end of the holdoff period) and the sweep free-runs. (See Fig. 4-4).

To trigger in the AUTO. position, a positive trigger pulse from T101 is applied through D119 to a monostable multivibrator consisting of transistors Q115 and Q125. The trigger pulse (applied to the base of Q125) turns on Q125 and the collector voltage of Q125 drops to -5 volts. This negative change back biases D125 and removes Q124 as a current source for Q145. The circuit is now set for normal triggered operation. If a trigger pulse does not switch D105 within about 60 milliseconds, the monostable circuit will reset itself, turn Q124 back on, and free-run the sweep.

The trigger pulse that turned on Q125 is of short duration. Transistor Q125 would normally stay on for the period of the pulse width. However, C115 (in the collector circuit of Q125), prevents the rapid change of voltage. Instead, the RC voltage rise takes about 60 milliseconds. At that time D125 becomes forward biased and the sweep free runs. Because of this reset feature of the AUTO. circuit, the sweep will not trigger at a repetition rate slower than about 15 cps. The use of Q115 and Q125 in a monostable multivibrator assures rapid turn-on of Q125.

### Single Sweep

Transistors Q135 and Q145 form a bistable multivibrator. When the Single Sweep control is pushed to RESET, -100 volts is applied through a differentiating network to the base of transistor Q145. Transistor Q145 is biased into conduction, cutting off transistors Q134 and Q135 and biasing tunnel diode D105 at the ready point. The cutting off of

## Circuit Description — Type 3B3

Q134 removes the shunt path from around the READY lamp B134, and B134 lights. With the arrival of a trigger pulse, tunnel diode D105 is biased to its high state and triggers the Miller runup circuit. As the Miller circuit runs up, the rising positive voltage is coupled back through diode D171 to the base of Q145, eventually cutting off Q145. When Q145 cuts off, diode D105 drops to its low state and the sweep ends. Also when Q145 cuts off, Q134 and Q135 are permitted to conduct. Transistor Q134 extinguishes the READY lamp, and Q135 keeps Q145 cut off until the Single Sweep control is pushed to RESET.

### Timing Switch

Timing in the Miller run-up circuit is determined by Timing Capacitor C160 charging through Timing Resistor R160. Timing Switch SW160 selects the proper combination of timing resistor and timing capacitor for each sweep rate. In the NORM. position of the MODE switch, uncalibrated variable sweep rates are available. If uncalibrated sweep rates are desired, the VARIABLE control (red knob) is turned away from the CALIBRATED position. This control, R160Y, varies the sweep rate over a  $2\frac{1}{2}$  to one range. Switch SW160Y is ganged with the VARIABLE control in such a way that the UNCALIBRATED light comes on when the control is turned away from the CALIBRATED position.

### CRT Unblanking

The electron beam in the crt is unblanked by a negative waveform coupled from the plate of V194A through pin 13

of the interconnecting plug to the blanking plates in the crt. The unblanked period coincides with the time that tunnel diode D105 is in its high state (sweep period). When D105 switches to its high state, Q114 turns on and a negative pulse from its collector is applied to the base of Q182. This transistor is connected as an emitter follower and the negative pulse passes to the MODE switch. From the MODE switch it passes to the base of Q194, where it is amplified and coupled to the grid of V194A. A clamp circuit (D195 and R195) prevents the plate of V194A from dropping below +125 volts.

### Delayed Sweep Trigger

This circuit is almost identical to the normal sweep trigger circuit and the detailed description is the same. The only difference is the supply voltage for the comparator (Q74 and Q84). The +125-volt supply is connected through the MODE switch and is only present in the TRIG. positions of this switch. In all other positions of the MODE switch the delayed sweep trigger circuit is inoperative.

### Delayed Sweep Generator

The part of this circuit that forms the delayed sweep ramp is the same type as that in the normal sweep generator. The major difference between the two sweep generators is the method of starting the sweep.

Transistors Q235 and Q245 and associated circuit elements form a bistable flip-flop. With the MODE switch in the

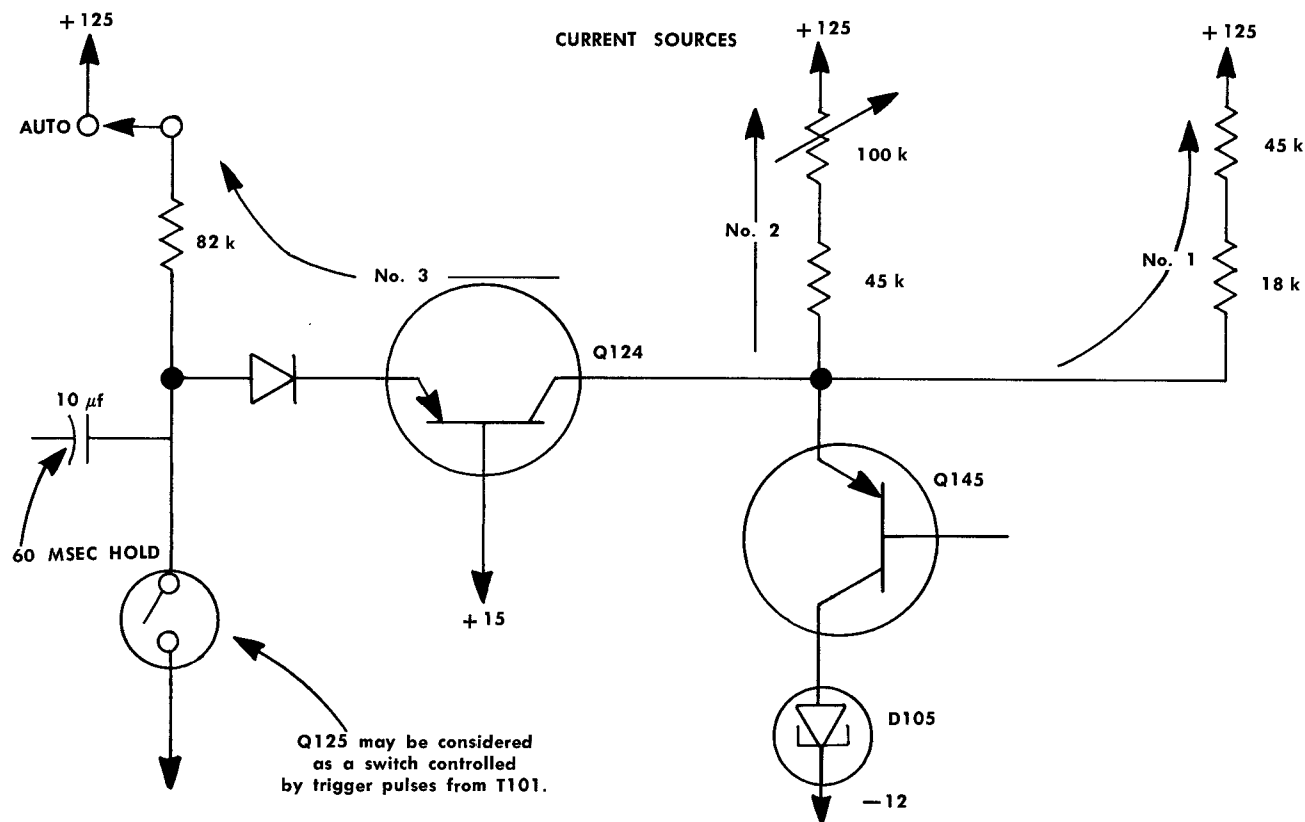


Fig. 4-4. Simplified drawing showing current sources for Q145 in AUTO mode.

NORM. position, the flip-flop is made inoperative by opening the emitter circuit. In all other positions of the MODE switch, the flip-flop gates the delayed sweep circuit.

With the MODE switch in INTEN. or DLY'D SWP. positions, current for the emitter circuit of the transistors and for tunnel diode D205 flows through three parallel resistance paths. For purposes of explanation, assume that Q235 is conducting and Q245 is cut off. The arrival of a delayed trigger pulse from C424 at the base of Q245 switches the flip-flop and Q245 conducts. Due to the three parallel resistance paths in the emitter circuit of Q245, the current through Q245 and D205 switches D205 to its high state, triggering the sweep circuit. As the sweep runs up, Diode D270 becomes forward biased and applies an increasing positive voltage to the base of Q245. The positive voltage applied to the base of Q245 eventually cuts off Q245, ends the sweep and resets the flip-flop.

When the MODE switch is in the TRIG. INTEN. or TRIG. DLY'D SWP. position, R229 is switched out of the parallel resistance network. The arrival of a delayed trigger pulse from C424 at the base of Q245 causes the flip-flop to switch, but due to the increased resistance in the emitter circuit, the current through Q245 is insufficient to cause D205 to switch to its high state. Instead, D205 is moved to the ready point, and switches to its high state only if it receives a trigger pulse from the delayed sweep trigger circuit. With the arrival of a trigger pulse, D205 switches to its high state and triggers the delayed sweep. The run-up of the sweep applies a positive voltage to the base of Q245, ends the sweep and resets the flip-flop as before.

### Intensifying Circuit

The negative pulse (during sweep) at the collector of Q214 passes directly to the base of Q283. This emitter follower sends the waveform in two directions: (1) to Q294 to intensify the display, and (2) to the MODE switch for unblanking the crt when operating in either of the DLY'D SWP. position of the MODE switch.

### Delay Pickoff

This circuit sets the start point for the delayed sweep. V414 is a comparator with the normal sweep ramp voltage applied to one grid, and a positive dc voltage from the DELAY TIME control applied to the other grid. At the start of a normal sweep, V414B is conducting and V414A is cut-off. V194B is a constant-current source for the comparator. When the normal sweep voltage to the grid of V414A rises to equal the delay time voltage, the comparator switches and V414A turns on while V414B cuts off. At this point tunnel diode D415 switches to its low state and puts a more positive voltage on the base of Q424. This signal is inverted in polarity and coupled as a differentiated negative pulse through C424 to the Delayed Sweep Generator circuit at the base of Q245.

### Horizontal Amplifier

The sweep voltage enters the circuit through the MODE switch. When this switch is in NORM. or either INTEN. position, the normal sweep ramp voltage drives the Horizontal Amplifier. In the two DLY'D SWP positions, the delayed sweep ramp voltage drives the amplifier.

The sweep voltage (0.04 Volt/cm at emitter of Q314) drives the emitter of Q314 through R310 and R312 (SWP. CAL.). The POSITION control is also current connected to the emitter of Q314. Since the Horizontal Amplifier is dc coupled, a small current change by the POSITION control biases the signal enough to position the sweep on the crt.

Q314 is a grounded-base amplifier and amplifies the sweep signal without changing the polarity. The sweep voltage then drives the base of emitter follower Q323 and passes from its emitter to the base of Q354. Transistor Q333 balances any changes in Q323 due to temperature drift.

The output stage of the horizontal amplifier is a hybrid paraphase circuit that matches the low-voltage, low impedance characteristics of the transistorized circuitry to the high-voltage, high impedance characteristics needed to drive the crt deflection plates. The ramp voltage from transistor Q323 drives transistor Q354. Transistor Q354 in turn drives grounded grid amplifier V383A, and by sharing emitter current with grounded base transistor Q364, drives that transistor and grounded grid amplifier V383B in push-pull.

The gain of the paraphase amplifier is determined by the amount of degeneration in the emitter circuit. In normal operation, resistor R364 in the emitter circuit of Q354 and Q364 acts as a voltage divider which reduces coupling between the two transistors. At the same time, it is in the emitter circuit of the transistor which is conducting and reduces the amount of current drawn. When the 5X MAG. switch is closed, R364 is shunted by a low resistance, the coupling between the two transistors is increased, and the resistance of the current path from the emitters to the —100 volt supply is decreased. The result of shunting R364 with a low resistance is to increase the gain of the paraphase amplifier; in this case the gain is increased five times (Calibrated by the 5X gain adjustment).

Capacitors C364, C354, and C356 across emitter coupling resistors R354, R355, R356 and R364 compensate for distributed capacitance at the output tube plates that may affect linearity at fast sweep rates. The push-pull output from the plates of V383A and V383B is coupled directly to the crt horizontal deflection plates.

### Timing Switches

The Normal and Delayed Sweep Timing Switches contain the resistors and capacitors that set the sweep rate and holdoff period. Both timing switches are the same except for the VARIABLE TIME/DIV. control, R160Y and the hold off circuit which is not required in the delayed sweep. In the NORM. position of the MODE switch, R160Y is connected to the normal sweep timing resistor R160. In all other positions of the MODE switch the control is connected to the delayed sweep timing resistor R260.

The VARIABLE TIME/DIV. control (R160Y) extends the sweep time by reducing the voltage supplied to the timing resistors. When this control is fully clockwise, SW160Y shorts out R160Y and applies —100 volts to the timing resistors. Any other position of the control reduces the —100 volts and reduces the sweep rate. SW160Y also removes the voltage from R160W and the UNCAL. lamp (B160W) so that the lamp is off in the calibrated position.

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# SECTION 5

## MAINTENANCE

### Preventive Maintenance

Preventive Maintenance for the Type 3B3 Time Base plug-in unit consists of visual inspection, correction of defects found, and cleaning. The schedule of preventive maintenance for the Type 3B3 depends upon environment. A Type 3B3 roughly used in a hot, humid, or dirty atmosphere needs more frequent maintenance than would an instrument used in an air conditioned laboratory. The Type 3B3 should be re-calibrated after every 500 hours of operation or every six months if the instrument is used intermittently. Give the Type 3B3 a thorough visual inspection as a preliminary procedure before re-calibration to minimize other preventive maintenance.

### Visual Inspection

Remove the plug-in unit from the Oscilloscope cabinet. Look for loose screws, knobs, or broken connections; cracks in components; improperly seated tubes or transistors, and scorched wires or components. For most visible defects the repair method is obvious, but if scorched wires or components are found, usually other trouble is indicated. Find and correct the cause of overheating. Install new parts as outlined under Removal and Replacement of Parts.

### Cleaning

Loosen and remove dust on the chassis and around the front panel controls with a clean, dry 1 inch paint brush. Vacuum out any remaining loose dust. If a vacuum cleaner is not available, blow the dust from the equipment with dry, low pressure air, taking care not to damage delicate parts. Areas stained by smoke or oily atmosphere may be cleaned with a cloth dampened with water and a small amount of detergent. Use a cotton swab for cleaning hard-to-get-at places. Be careful not to misplace parts or short leads together.

### Removal and Replacement of Parts

Replacement of parts in the Type 3B3 requires only standard techniques in most cases and only a normal amount of care is required. Whenever a part is replaced, re-calibration of the 3B3 may be required and is covered in the "Calibration" section of this book. Replacement of parts unique to Tektronix equipment or requiring special care is covered in the following paragraphs.

### Tube and Transistor Replacement

Do not change tubes or transistors unless they are defective. When a good tube or transistor is removed from a socket it must be returned to the same socket, otherwise it may be necessary to recalibrate the instrument. Use pre-tested high quality tubes and transistors if replacement is necessary.

### Removal of Part Requiring Soldering

In Tektronix instruments, a special silver-bearing solder is used to establish a bond to the silver alloy coated notches in the ceramic terminal strips. This bond may be broken by repeated use of ordinary tin-lead solder. However, occasional use of ordinary 60-40 solder will not break the bond if excess heat is not used. Use a soldering iron with a rating of 75 watts or less. If several Tektronix instruments are maintained, a stock of solder that contains about 3% silver should be kept on hand. This type of solder is used in printed-circuit work and is generally available locally. Or, it can be purchased from Tektronix in one-pound rolls; order by part number 251-514.

Many components in Tektronix instruments are mounted on ceramic terminal strips. Because of the shape of the terminal notches in the ceramic strips, use a wedge-shaped tip on the soldering iron when installing or removing parts. Be sure the tip of the soldering iron is well tinned. Before tinning the iron, file smooth all surfaces to be tinned. This prevents solder from building up on rough spots where it will oxidize. Tin only the first  $\frac{1}{16}$  to  $\frac{1}{8}$  of the tip. Use solder containing about 3% silver.

Use the following procedure to remove or install parts on ceramic strips.

1. Use needle-nose pliers as a heat sink between the soldering point and the component being installed or removed.
2. Use normal care when manipulating parts and leads.
3. Touch one corner of the iron tip to the notch where you want to solder. Apply enough heat to make the solder flow freely. Do not wedge the soldering iron tip into the terminal notches as the ceramic material is brittle.

### Ceramic Strip Replacement

Unsolder all connections, then use a  $\frac{3}{8}$ " diameter by 3" long plastic or hardwood dowel and a small (2 to 4 oz.) mallet to knock the yoke pins out of the chassis. Place one end of the dowel on the end of the yoke pin protruding through the chassis and rap the opposite end of the dowel smartly with the mallet. When both yokes of the strip to be removed have been loosened in this fashion, the strip is removed as a unit. The spacers will probably come out with the yokes. If not, they can be pulled out separately. An alternate method of removing the terminal strip is to use diagonal cutters to cut off the side of the yoke that holds the ceramic strip. The ceramic strip is removed and the yokes pulled from the chassis with a pair of pliers. Replacement ceramic strips are supplied with yokes and spacers and the old yokes need not be salvaged.

When the damaged strip and yoke assembly has been removed, place new spacers in the holes in the chassis. Using the mallet and dowel, tap the new yoke pins down thoroughly in the spacers. Be sure that these pins are driven completely through the spacers. You may wish to cut off any portion of the yoke pin that protrudes through the spacers with a pair of diagonal cutters. Fig. 5-1 shows how the parts of the ceramic terminal strip fit together.

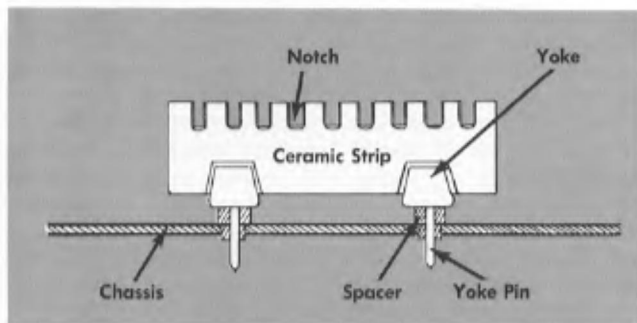


Fig. 5-1. Ceramic strip assembly details.

### Switch Replacement

Single wafers are normally not replaced on the switches used in the Type 3B3. If one wafer is defective, the entire switch should be replaced. Removal and replacement of defective switches is generally a pretty obvious procedure.

When resoldering it is important to use only enough solder to hold leads. Don't let solder run into a contact and ruin its spring pressure. Replacement switches may be ordered from Tektronix either wired or unwired.

### Ordering Replacement Parts

Replacement parts can be ordered from your Tektronix Field Engineering office. Tektronix manufactures most of the mechanical parts and some of the electronic components used in the Type 3B3. The remainder of the electronic components are usually off-the-shelf items that can be purchased locally. Each mechanical and electrical part in the Type 3B3 has a six-digit Tektronix part number. This number and a description of the parts are found in the parts list. When ordering parts, check the parts list to determine Tektronix part number, value rating, and tolerance required. Include the following information when ordering parts:

1. A description of the part.
2. The Tektronix part number.
3. The instrument type and serial number.

As an example, a typical resistor would be ordered as follows:

R54, 3.9 K, 1/4 watt fixed, 5%, part number \_\_\_\_\_, for Type 3B3 Time-Base Plug-In serial \_\_\_\_\_. Parts ordered in this way are shipped promptly.

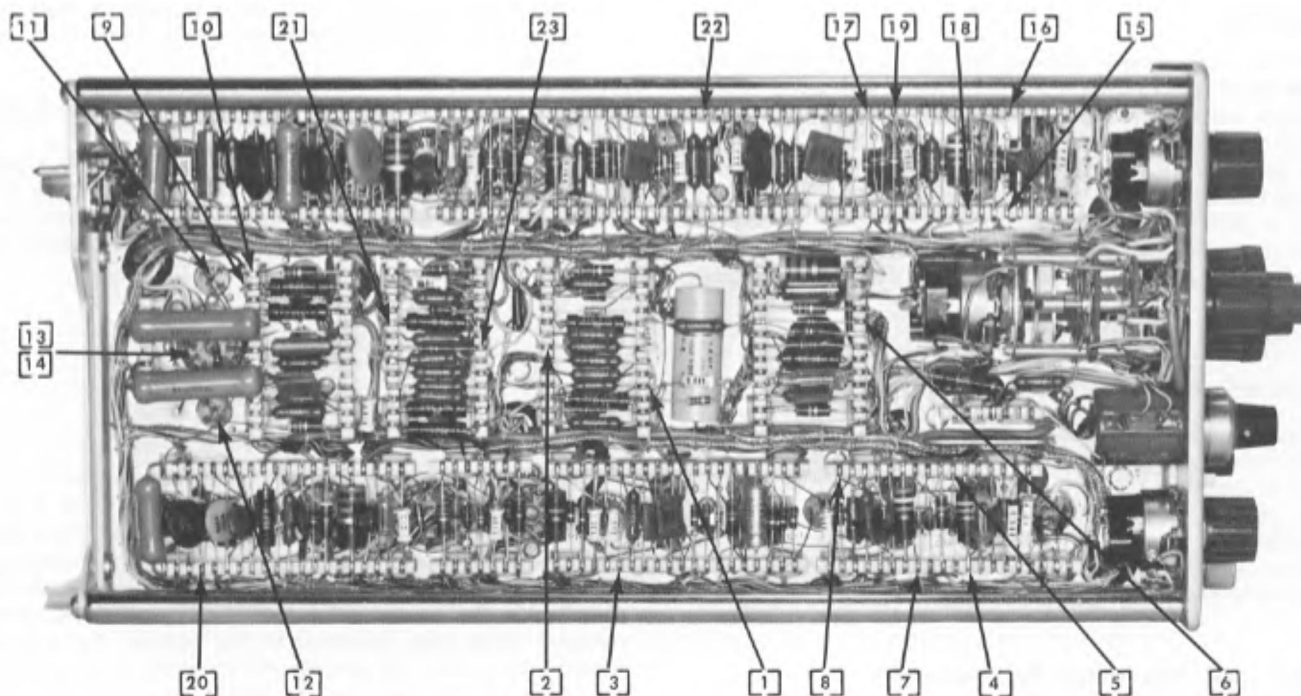


Fig. 5-2. Left side of Type 3B3 illustrating test points designated in Table 5-2.



## Troubleshooting

This portion of the manual is provided as a guide in the event trouble develops in the Type 3B3 Time-Base plug-in unit. During troubleshooting procedures, the information in this section should be compared with appropriate sections of this manual, particularly the circuit description and calibration sections.

## General Information

Before attempting any troubleshooting work, you should check all controls for proper settings. If you are in doubt about control settings you should review the Operating Information section of this manual. Check to see that the power is on. When you have ascertained that a trouble does exist in the instrument, you can then proceed to isolate the defective circuit using the procedures contained later in this section.

In general, troubleshooting consists of two parts; circuit isolation and circuit troubleshooting. Visual inspection and checking control operation will frequently indicate the defective circuit. Normal or abnormal operation of each control helps identify the nature of a trouble. Trouble that occurs only in certain control positions can frequently be found from the indications given. Feel for irregularities in control operation, listen for unusual sounds, and visually check the entire instrument. Table 5-1 lists possible troubles and the circuits to check in each case. If the defective circuit cannot be isolated by visual inspection and operation of controls, make voltage and waveform measurements within the circuits themselves. Once the defective circuit is isolated, troubleshoot the circuit by making detailed checks within the circuit as outlined in Table 5-2.

## Circuit Diagrams

Separate circuit diagrams for each circuit are included in the back of this manual. The circuit diagrams show the reference designation of each component (C39, C44, etc.) as well as important voltages and waveforms. The following is a list of reference designations for each different circuit.

Reference Designation	Circuit Diagram
1 through 49	Normal Sweep Trigger
50 through 99	Delayed Sweep Trigger
100 through 199	Normal Sweep Generator
200 through 299	Delayed Sweep Generator
300 through 399	Horizontal Amplifier
400 through 499	Delay Pickoff

## Switch Wafer Code

Switch wafers shown on the circuit diagrams are coded to indicate the position on the actual switches. The number portion of the code refers to the wafer number on the switch assembly. Wafers are numbered from the front of the switch to the rear. The letters F and R show whether the front or rear of the wafer is used.

## Test Equipment Required

Reference is made in several places in the troubleshooting procedures to the use of an oscilloscope to check waveforms.

Because of the short times involved in many waveforms, it is necessary to use a wide-band oscilloscope such as a Tektronix Type 540 Series with Type K or L plug-in. In addition, an accurately calibrated 20,000 ohm per volt multimeter and a plug-in extension cable (TEKTRONIX Part No. 012-066) are needed. The use of a transistor curve-tracer is optional.

## Circuit Isolation

Table 5-1 lists several indications of trouble and the individual circuits to check in each case. When the trouble has been isolated to a particular circuit, refer to Table 5-2 for a guide in troubleshooting within the individual circuits.

TABLE 5-1  
Circuit Isolation

Symptom	Circuits to Check
1. No sweep in any position of front-panel controls.	Horizontal Amplifier. Normal Sweep Generator
2. No sweep in DLY'D SWP. positions of MODE switch.	Delayed Sweep Generator Delay Pickoff Circuit
3. No intensified area on display in either INTEN. positions of MODE switch.	Delayed Sweep Generator Plug-in will not intensify normal sweep display when located in left hand (vertical) plug-in opening.
4. Sweep too short in both Normal and Delayed sweep.	Horizontal Amplifier
5. Sweep is short in Delayed sweep positions of MODE switch.	Delayed Sweep Generator
6. Sweep non-linear in Normal and Delayed Sweep.	Horizontal Amplifier
7. Sweep Timing incorrect in all positions of TIME/DIV. switch.	Normal Sweep Generator
8. Sweep Timing incorrect only in some positions of TIME/DIV. switch.	Normal Sweep Generator
9. No sweep in AC or DC trigger coupling, sweep in AUTO but not triggerable.	Normal Sweep Trigger
10. No Delayed Sweep in either TRIG. positions of MODE switch.	Delayed Sweep Trigger

### NOTE

Because the Normal and Delayed Sweep circuits are similar, trouble can often be isolated to one or the other by operating each independently. The Delayed sweep can be free run without the Normal Sweep operating by intermittently shorting across R243 in the Delayed Sweep Generator Circuit.

## Individual Circuit Checks

Table 5-2 is given as a troubleshooting guide once the trouble has been isolated to an individual circuit.

TABLE 5-2

## Individual Circuit Checks

Symptom	Checks
<b>Normal Sweep Generator</b>	
1. No sweep	1. If B164 is lighted, check V161. 2. CRT may be blanked. Check V194, Q183, and Q194. Miller circuit check. Set TIME/DIV. and DELAY TIME RANGE switches to 2 mSEC. Remove Q114; voltage at test point 1 should be -3 volts. Momentarily remove V152; voltage at test point 1, Fig. 5-2, should rise to +10 volts. If it does not, check V161 and D171. Return Q114 and V152 to their sockets. 4. Sweep gating check. Remove Q114, connect voltmeter across R146 (test points 2 and 3). Push COUPLING switch to AUTO. voltmeter should read between 2.9 and 3 volts. Turn LEVEL control to mid-range (1 volt external trigger signal required); voltage should drop to 2.3 volts. 5. Check of D105. Set trigger COUPLING switch to DC. Turn LEVEL control fully CW. Connect test scope probe to test point 3. Intermittently short across R143; switching of tunnel diode D105 should be seen on test scope.
2. Sweep in AUTO coupling only. Not triggerable.	1. Check D101 shorted, D102 open.
3. No sweep in AUTO coupling.	1. Check D119, Q115, and Q125.
4. Sweep non-linear at slow sweep ratios.	1. Check V152 for heater cathode leakage.
5. Sweep non-linear at all sweep rates.	Check V161 for non-linear amplification.
<b>Normal Trigger Circuit</b>	
1. Display cannot be triggered.	1. Use test scope to check for triggering signal at test points 4 and 5. 2. Voltage at test point 6 should vary from -10 to +14 as LEVEL control is turned through range. 3. Voltage at test point 7 should vary from -9 to +3 as LEVEL control is turned through range. Move the SLOPE switch to the opposite polarity and repeat measurement at test point 7. The two measurements at test point 7 check Q24 and Q34.

Symptom	Checks
	4. Measure voltage on test point 8. Voltage should read about -12.5 volts. This checks Q44. Connect test scope to test point 8. Display should be a square-wave as shown on schematic. This checks D35.
2. Triggers only on large signals.	1. V13 gassy, weak. 2. D35 Defective
3. Triggering unstable.	1. Check oscilloscope power supply regulations.
<b>Horizontal Amplifier</b>	
1. No Sweep.	1. Measure voltage at test point 9, vary POSITION control, voltage should change from -6.5 to -15 volts. 2. Voltage at test point 10 should change from -6.5 to -15 when POSITION control is turned. 3. Voltage at test points 11 and 12 should vary between +2 and +7 as POSITION control is turned. 4. Connect test scope alternately to test points 13 and 14. Waveform shown on schematic should be seen.
2. Sweep will not cover width of CRT.	1. Check SWP CAL. adjustment. Check Q354, and V383.
<b>Delay Pickoff</b>	
1. No delayed sweep.	1. Place MODE switch in any position except NORMAL. Adjust controls for display. Connect test scope probe to test point 20; waveform shown on schematic should be seen. If waveform is incorrect, check V414, V194B, D415, and Q424.
<b>Delayed Sweep Generator</b>	
1. No delayed sweep.	1. If B264 is lighted, check V261. 2. If CRT is blanked, check Q283, and Q294. 3. Miller circuit check. Remove Q214; voltage at test point 21 should be 4.5 volts. Remove V252; voltage at test point 21 should rise to +10 volts. If it does not, check V261. Return Q214 and V252 to socket. 4. Sweep Gating check. Connect test scope probe to test point 32, switching of D205 should be seen. If it is not, Q245 may be open, or D205 defective.
2. No Delayed sweep in TRIG. INTEN. or TRIG. DLY'D SWP. position of MODE switch.	1. Check D202 and D201.

Symptom	Checks
3. Delayed sweep non-linear at all sweep rates.	1. Check V261 for non-linear amplification.
4. Delayed sweep non-linear at slow sweep rates.	1. Check V252 for heater cathode leakage.
5. Trace not intensified in INTEN. positions of MODE switch.	1. Q294 defective.

#### Delayed Sweep Trigger

1. Delayed sweep cannot be triggered.	<p>1. Use test scope to check for triggering signal at test points 15 and 16.</p> <p>2. Voltage at test point 17 should vary from <math>-10</math> to <math>+14</math> volts as the Delayed Sweep LEVEL control is turned through its range.</p> <p>3. Voltage at test point 18 should vary from <math>-9</math> to <math>+3</math> volts as the Delayed Sweep LEVEL control is turned through its range (be sure MODE switch is in TRIG. DLY'D SWP).</p> <p>4. Voltage at test point 19 should be about <math>-12.5</math> volts.</p> <p>5. Connect test scope probe to test point 19. Waveform seen should be a square-wave as shown on schematic. This checks D85.</p>
2. Delayed sweep triggers only on large signals.	1. V63 possibly weak. D85 possibly open.

## NOTES

This image shows a single sheet of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

# SECTION 6

## CALIBRATION PROCEDURE

### General

The Type 3B3 Time Base should be calibrated after each 500 hours of operation, or at least every six months. Also, when transistors, tubes, and other components are changed, the calibration of the circuit under repair should be checked.

Some troubles can be caused by changes in component values. These troubles can often be found by checking the calibration of the suspected circuit.

The instructions that follow are in proper sequence to calibrate the instrument and avoid unnecessary repetition of checks and adjustments.

### Equipment Required

The following items of equipment, or their equivalent, are required for a complete calibration of the Type 3B3 Time Base.

1. Type 561A or 567 Oscilloscope.
2. Vertical Amplifier Plug-In Unit (non-sampling type).
3. Time-Mark Generator with crystal-controlled markers at 1  $\mu$ sec, 10  $\mu$ sec, 50  $\mu$ sec, 100  $\mu$ sec, 1 msec, 5 msec, 10 msec, 100 msec, and 1 sec. The generator must also have an accurate 10 mc sine-wave output. Tektronix Type 180A Time-Mark Generator recommended.
4. A Tektronix 560-series plug-in extension, Part No. 013-034.
5. A coax cable about 3 feet long with UHF plug connectors on each end. Tektronix 42" 50  $\Omega$  cable, Part No. 012-001, available.

### Preliminary

Install the Vertical Amplifier plug-in unit into the oscilloscope. Install the Type 3B3 Time Base unit using the special plug-in extension mentioned above. Turn on the oscilloscope, and obtain an AUTO operated normal sweep trace at 5 mSEC/DIV. Then set the Type 3B3 front-panel controls as follows:

POSITION	midrange
MODE	NORM.
5X MAG	Off (pushed in)
TIME//DIV.	5 mSEC
DELAYED SWEEP	5 mSEC
VARIABLE TIME/DIV.	CALIB.
DELAY TIME	5.00

Allow a 15-minute warmup before starting calibration.

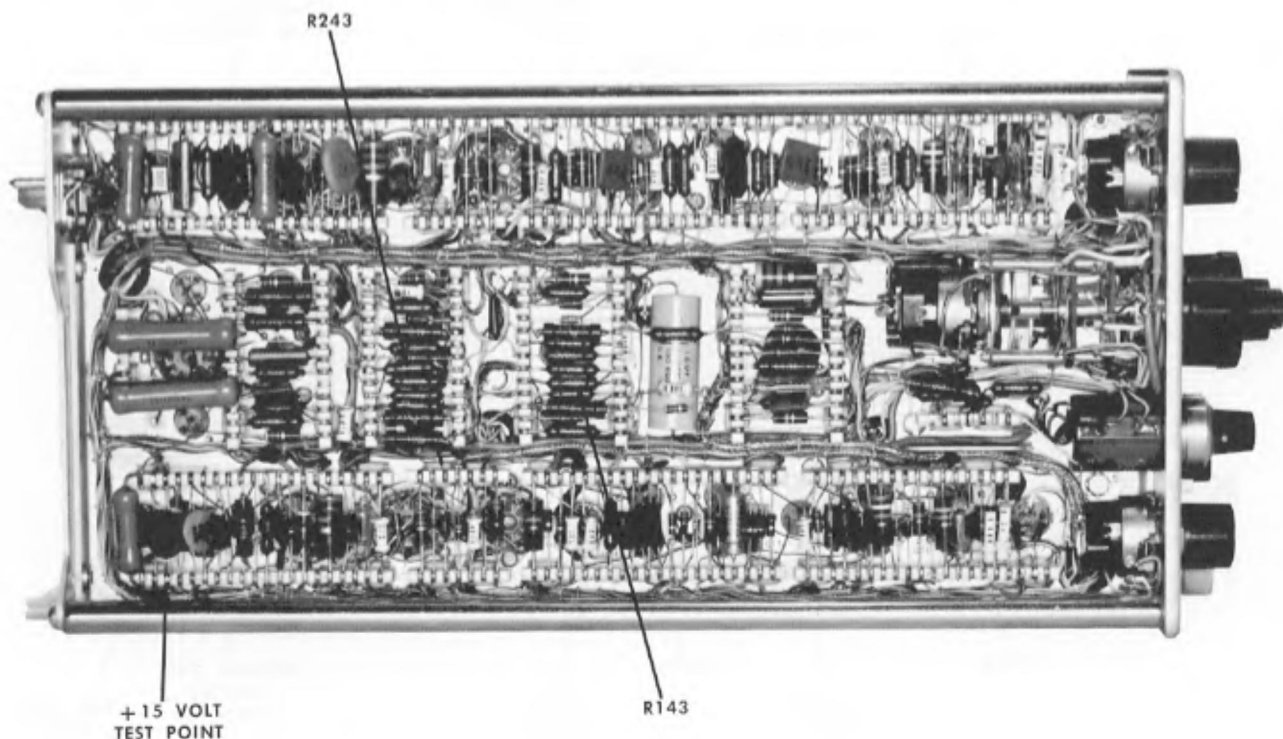


Fig. 6-1. Left side of Type 3B3. See steps 1, 2, and 3 of calibration procedure.

## Procedure

### 1. Check +15-volt Supply

Use the dc voltmeter and measure the voltage across D398, located on the Type 3B3 left rear side (see Fig. 6-1). The voltage should be +15 volts,  $\pm 15\%$ .

### 2. NORMAL SWP. GATING THRESHOLD Control, R130

Set the NORMAL SWEEP COUPLING switch to AC. Connect the short clip lead (with insulated alligator clips) across R143. R143 is located on the left side, about center, (see Fig. 6-1.) Adjust R130, the NORMAL SWP. GATING THRESHOLD control to just produce a free-running trace. R130 is located at the right rear of the Type 3B3; see Fig. 6-2.

Remove the jumper from R143; the trace should disappear.

### 3. DELAYED SWP. GATING THRESHOLD Control, R230

Set the Normal Sweep COUPLING switch to AUTO. The trace should appear. Set the MODE switch to TRIG. DLY'D SWP. connect the short clip lead across R243 (see Fig. 6-1).

Adjust R230, the DELAYED SWP. GATING THRESHOLD control, to just produce a free-running trace. R230 is located at the top right rear of the Type 3B3; see Fig. 6-2.

Remove the jumper from R243; the trace should disappear.

### 4. SWEEP CAL. Control, R312.

Set the MODE switch to NORM., the Normal Sweep SOURCE switch to INT., the COUPLING switch to AUTO, the

SLOPE switch to +, and the TIME/DIV. switch to 1 mSEC. Set the Delayed Sweep SOURCE switch to INT., the COUPLING switch to AC, the SLOPE switch to +, and the DELAY SWEEP knob to 1 mSEC.

Connect the Time-Mark Generator to the Vertical Amplifier, and set the generator for 1-msec time-marks.

Adjust the SWEEP CAL. control, (front-panel screwdriver adjustment) for exactly one time marker per major graticule division.

Set the MODE switch to TRIG. DLY'D SWP. and check the timing accuracy. Readjust the SWEEP CAL. control to reduce any timing error by 50 percent. Set the MODE switch to NORM. and see if now the Normal Sweep has a timing error equal and opposite to the Delayed Sweep timing error. The final adjustment of the SWEEP CAL. control is when any basic timing errors of the two sweep generators are equal and opposite.

## NOTE

Timing adjustments should always be made with the trace beginning at the left edge of the graticule markings. Make visual measurements between the 1st division line and the 9th division line.

### 5. NORMAL SWEEP LENGTH Control, R168

Use the same set-up as in step 4, and adjust R168, the NORMAL SWEEP LENGTH control, for 10.5 major divisions of deflection.

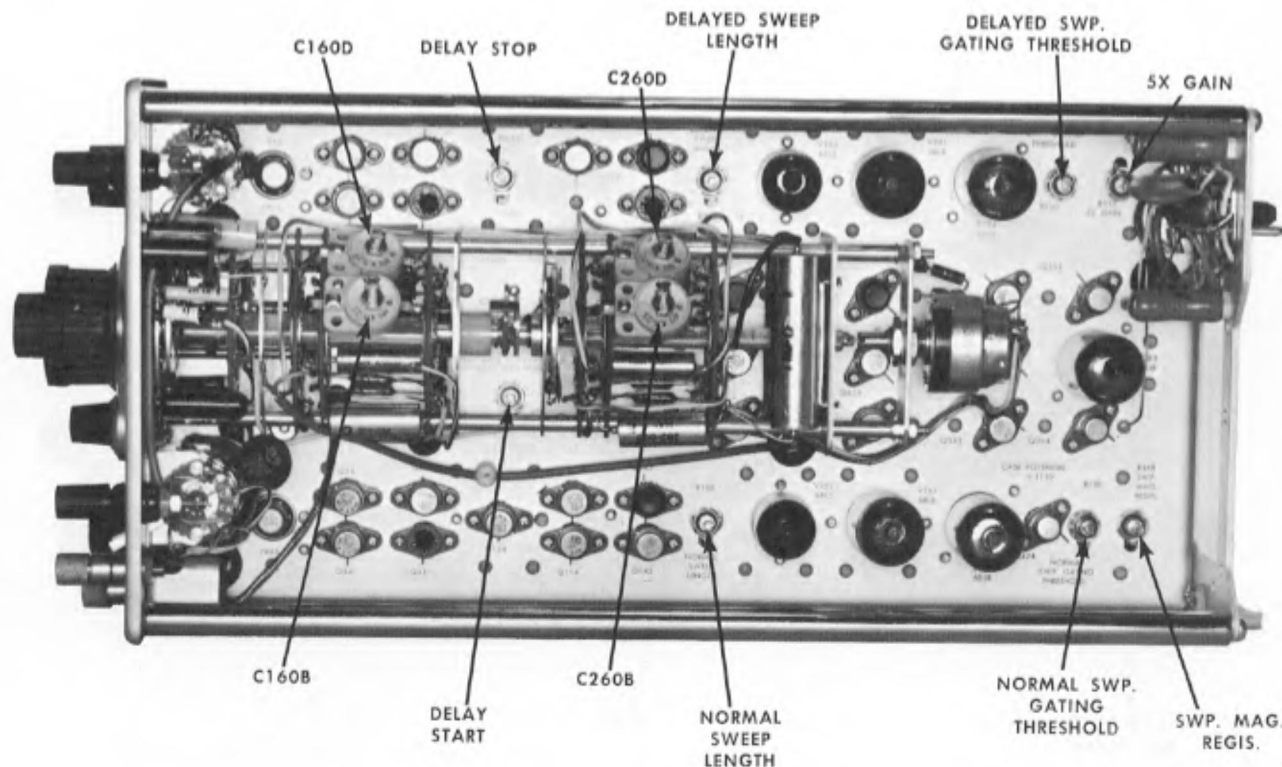


Fig. 6-2. Right side of Type 3B3 with locations of internal adjustments.

## 6. DELAYED SWEEP LENGTH Control, R268

Use the same set-up as in step 4. Set the MODE switch to TRIG. DLY'D SWP., the TIME/DIV. switch to 2 mSEC, the DELAYED SWEEP knob to 1 mSEC, and adjust the Delayed Sweep LEVEL control for a stable display. Adjust R268, the DELAYED SWEEP LENGTH control, for 10.5 major divisions of deflection.

## 7. 5X GAIN Control, R355

Set the MODE switch to NORM., and the TIME/DIV. switch to 1 mSEC. Set the Time-Mark Generator for 1-msec and 100- $\mu$ sec time marks. Adjust the Normal Sweep LEVEL control for a stable display. Pull the 5X MAG. switch out and adjust R355, 5X GAIN, for one large time mark every 5 major divisions and 2 small time marks every major division. Check the linearity over the entire magnified sweep by moving the POSITION control throughout its range.

## 8. SWP. MAG. REGIS. Control, R368

Use the same set-up as in step 7. Pull the 5X MAG. switch out and position the display so that the first large time mark falls on the center line of the graticule. Push the 5X MAG. switch in and adjust R368, the SWP. MAG. REGIS. control, so that the first time mark again falls on the center line of the graticule. Repeat this adjustment until there is no shift in the start of the display when the 5X MAG. switch is pulled out.

## 9. DELAY START and DELAY STOP

Set the front-panel controls as follows:

MODE switch	INTEN.
TIME/DIV.	1 mSEC
DELAYED SWEEP	10 $\mu$ SEC.

Set the Time-Mark Generator for 1-msec time mark and adjust the Normal Sweep LEVEL control for a stable display. Turn the DELAY TIME control to 1.00 and adjust DELAY START, R430, until the bright part of the display just passes to the right of the second time mark. Next, turn the DELAY TIME control to 9.00 and adjust DELAY STOP, R439, until the brightened part of the display just passes to the right of the tenth time mark. With the DELAY TIME control at 9.00, turn the MODE switch to DLY'D SWP., and adjust DELAY STOP, R439, until the peak of the time mark is just at the left side of the crt. Return the DELAY TIME control to 1.00 and adjust DELAY START, R430, to set the peak of the time mark at the left side of the crt. Because these two controls interact, you may have to repeat this adjustment several times.

## 10. Normal and Delay Sweep Rates

Set the front-panel controls as follows:

MODE	NORM.
TRIGGERING (Normal Sweep)	+ AC INT.
TRIGGERING (Delayed Sweep)	+ AC INT.
TIME/DIV.	50 $\mu$ sec.
DELAYED SWEEP knob	50 $\mu$ sec.

Set the Time-Mark Generator for 50- $\mu$ sec time marks. Adjust the Normal Sweep LEVEL control for a stable display. Check for 1 time mark for each major graticule division between the 2nd and 9th division lines. Set the MODE switch to TRIG. DLY'D SWP. and adjust the Delayed Sweep LEVEL control for a stable display. Check for 1 time mark for each major graticule division between the 2nd and 9th division lines.

Make the above check at each of the settings shown in Table 6-1. Notice that the TIME/DIV. and DELAYED SWEEP switches are set to the same position for each check.

TABLE 6-1

TIME/DIV. and DELAYED SWEEP controls	TIME-MARKS	MARKS/DIVISION
50 $\mu$ SEC	50 $\mu$ sec	1
.1 mSEC	100 $\mu$ sec	1
.2 mSEC	100 $\mu$ sec	2
.5 mSEC	500 $\mu$ sec	1
1 mSEC	1 msec	1
2 mSEC	1 msec	2
5 mSEC	5 msec	1
10 mSEC	10 sec	1
20 mSEC	10 msec	2
50 mSEC	50 msec	1
.1 SEC	100 msec	1
.2 SEC	100 msec	2
.5 SEC	500 msec	1
1 SEC	100 msec	1

### NOTE

The over-all timing error for all sweep rates must be within 3% (1.2 minor div.). Timing checks are made over 8 major divisions of the graticule between the 1st and the 9th division lines.

## 11. VARIABLE TIME/DIV. Control

Set the MODE switch to NORM., the TIME/DIV. switch to 1 mSEC, the DELAYED SWEEP knob to .2 mSEC, and the Time-Mark Generator for 10-msec time marks. Obtain a triggered display of a time marker at the left and right edges of the graticule.

Rotate the VARIABLE TIME/DIV. control fully counterclockwise. The display should now be at least 4 time marks, a ratio of at least 2.5 to 1.

Set the TIME-MARK Generator for 1-msec time marks. The VARIABLE TIME/DIV. control should now affect the display in all five positions of the MODE switch.

## 12. Fast Normal Sweep Rates

Remove the plug-in extension, and install the Type 3B3 directly into the oscilloscope. Set the VARIABLE TIME/DIV. control to CALIB. Set the Time-Mark Generator, TIME/DIV. switch, and adjustments as shown in Table 6-2.

TABLE 6-2

TIME/DIV.	Time-Mark Generator	Adjustment	Marks/Div.
10 $\mu$ SEC	10 $\mu$ sec	C160D	1
20 $\mu$ SEC	10 $\mu$ sec	check	2
5 $\mu$ SEC	5 $\mu$ sec	check	1
1 $\mu$ SEC	1 $\mu$ sec	C160B	1
2 $\mu$ SEC	1 $\mu$ sec	check	2
.5 $\mu$ SEC	1 $\mu$ sec	check	1 per 2 div.
.5 $\mu$ SEC	10 megacycles	Pull 5X MAG.	1 cycle/div.

## NOTE

Over-all timing accuracy must be within 3% (1.2 minor div.)

## 13. Fast Delayed Sweep Rates

Set the MODE switch to TRIG. DLY'D SWP. Using Table 5-2, substitute DELAYED SWEEP knob settings for the TIME/-DIV. settings. At 10  $\mu$ SEC, adjust C260D, and at 1  $\mu$ SEC, adjust C260B. Check the 10-megacycle display the same as for the Normal Sweep.

## 14. Single Sweep

Set the Time-Mark Generator for 1-msec time marks. Set the TIME/DIV. switch to 1 mSEC, the MODE switch to NORM, the Normal Sweep COUPLING switch to AC, and adjust the LEVEL control for a stable display. Then turn the Normal Sweep LEVEL control fully counterclockwise. Push the NORM.-SINGLE SWEEP-RESET switch to RESET and release; the ready lamp should turn on. Watch the crt, and slowly turn the LEVEL control clockwise. One sweep should occur and the ready lamp should turn off.



# SECTION 7

## PARTS LIST AND SCHEMATICS

### PARTS ORDERING INFORMATION

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


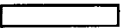
Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information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

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

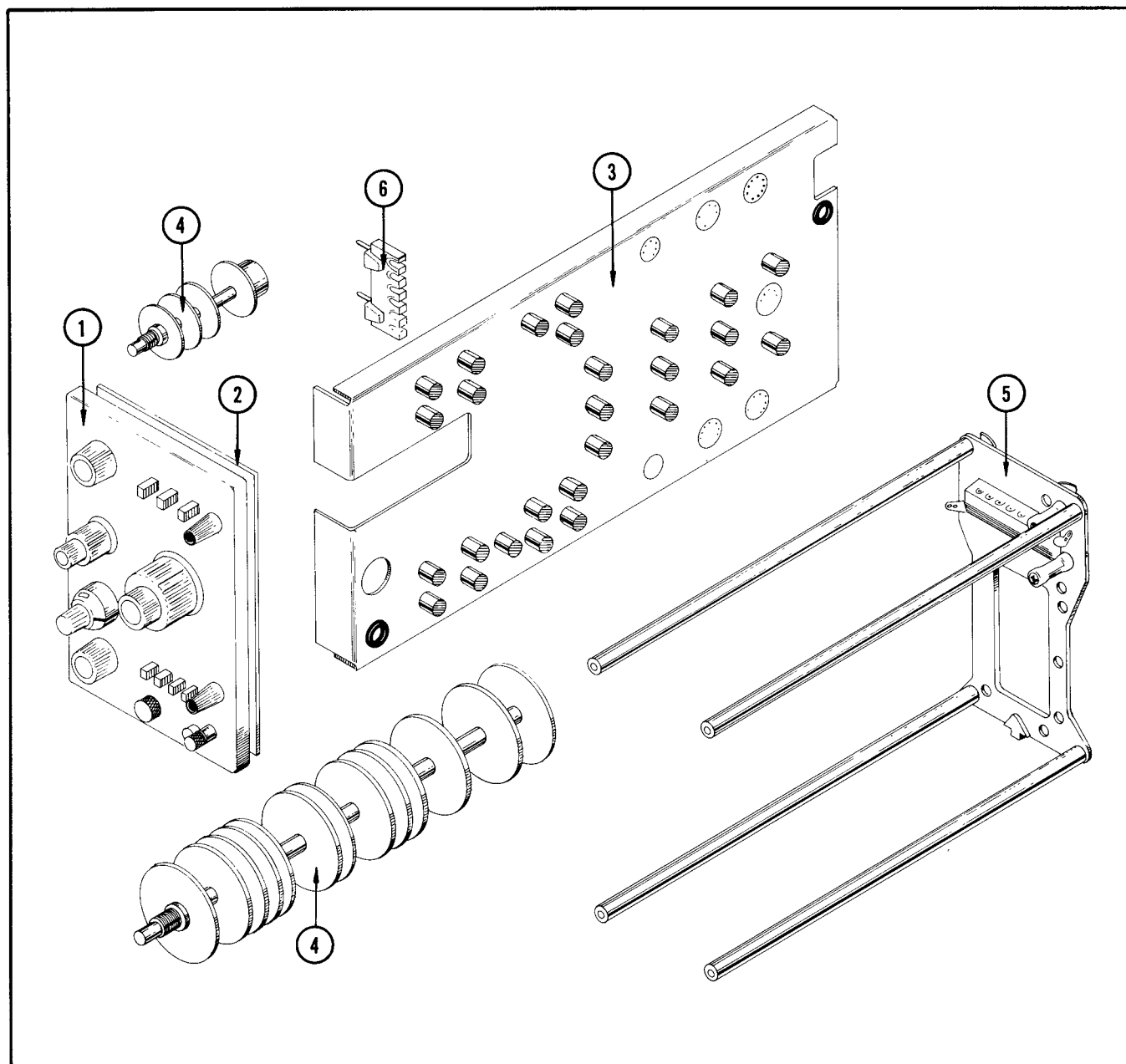
### ABBREVIATIONS AND SYMBOLS

a or amp	amperes	mm	millimeter
BHS	binding head steel	meg or M	megohms or mega ( $10^6$ )
C	carbon	met.	metal
cer	ceramic	$\mu$	micro, or $10^{-6}$
cm	centimeter	n	nano, or $10^{-9}$
comp	composition	$\Omega$	ohm
cps	cycles per second	OD	outside diameter
crt	cathode-ray tube	OHS	oval head steel
CSK	counter sunk	p	pico, or $10^{-12}$
dia	diameter	PHS	pan head steel
div	division	piv	peak inverse voltage
EMC	electrolytic, metal cased	plstc	plastic
EMT	electrolytic, metal tubular	PMC	paper, metal cased
ext	external	poly	polystyrene
f	farad	Prec	precision
F & I	focus and intensity	PT	paper tubular
FHS	flat head steel	PTM	paper or plastic, tubular, molded
Fil HS	fillister head steel	RHS	round head steel
g or G	giga, or $10^9$	rms	root mean square
Ge	germanium	sec	second
GMV	guaranteed minimum value	Si	silicon
h	henry	S/N	serial number
hex	hexagonal	t or T	tera, or $10^{12}$
HHS	hex head steel	TD	toroid
HSS	hex socket steel	THS	truss head steel
HV	high voltage	tub.	tubular
ID	inside diameter	v or V	volt
incd	incandescent	Var	variable
int	internal	w	watt
k or K	kilohms or kilo ( $10^3$ )	w/	with
kc	kilocycle	w/o	without
m	milli, or $10^{-3}$	WW	wire-wound
mc	megacycle		

### SPECIAL NOTES AND SYMBOLS

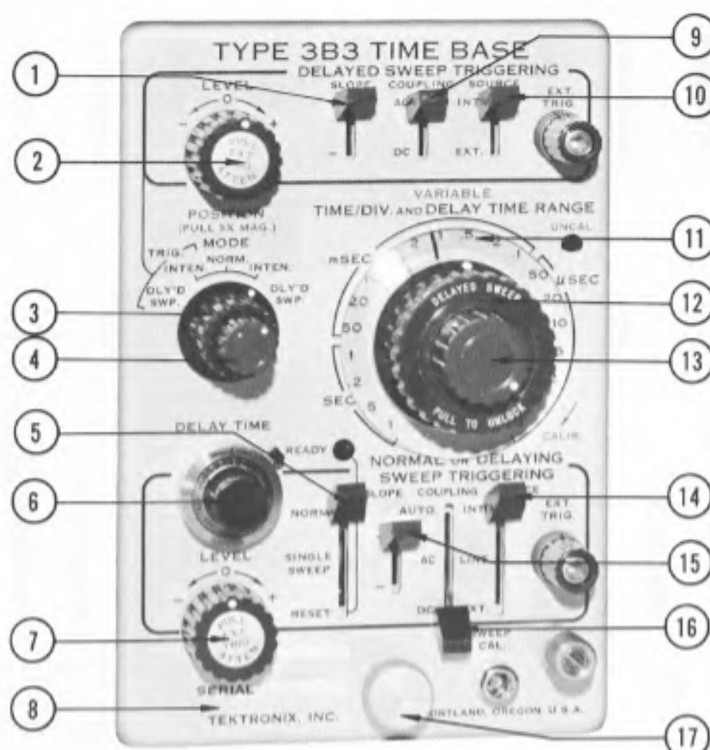
X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, or reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.
	Front-panel adjustment or connector.

LOCATOR



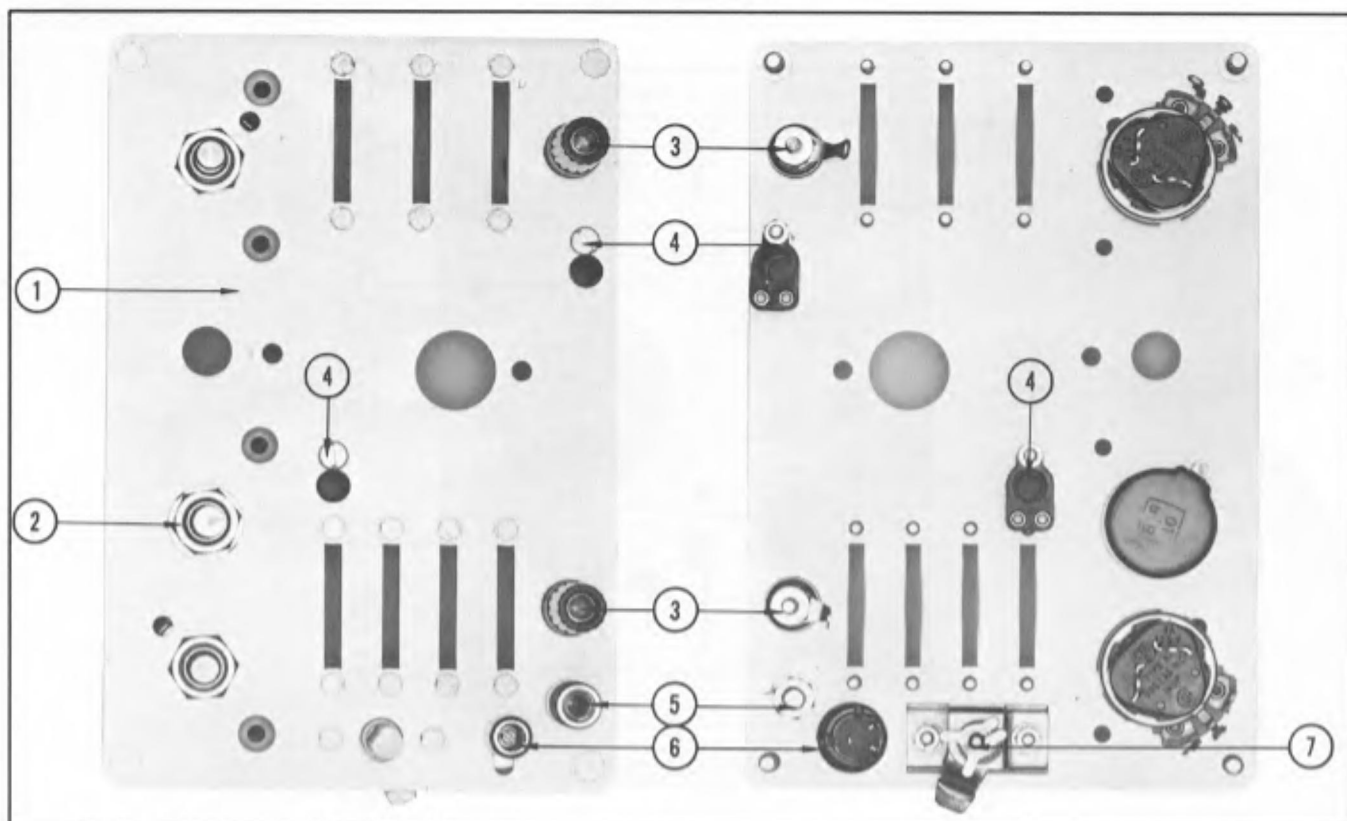
REF. NO.	PART NO	SERIAL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	Pg. 7-3				Knobs and Front Group
2	Pg. 7-4				Subpanel Group
3	Pg. 7-5				Chassis Group
4	Pg. 7-7				Switches
5	Pg. 7-9				Rear and Frame Group
6	Pg. 7-10				Ceramic Strips

## KNOBS AND FRONT GROUP



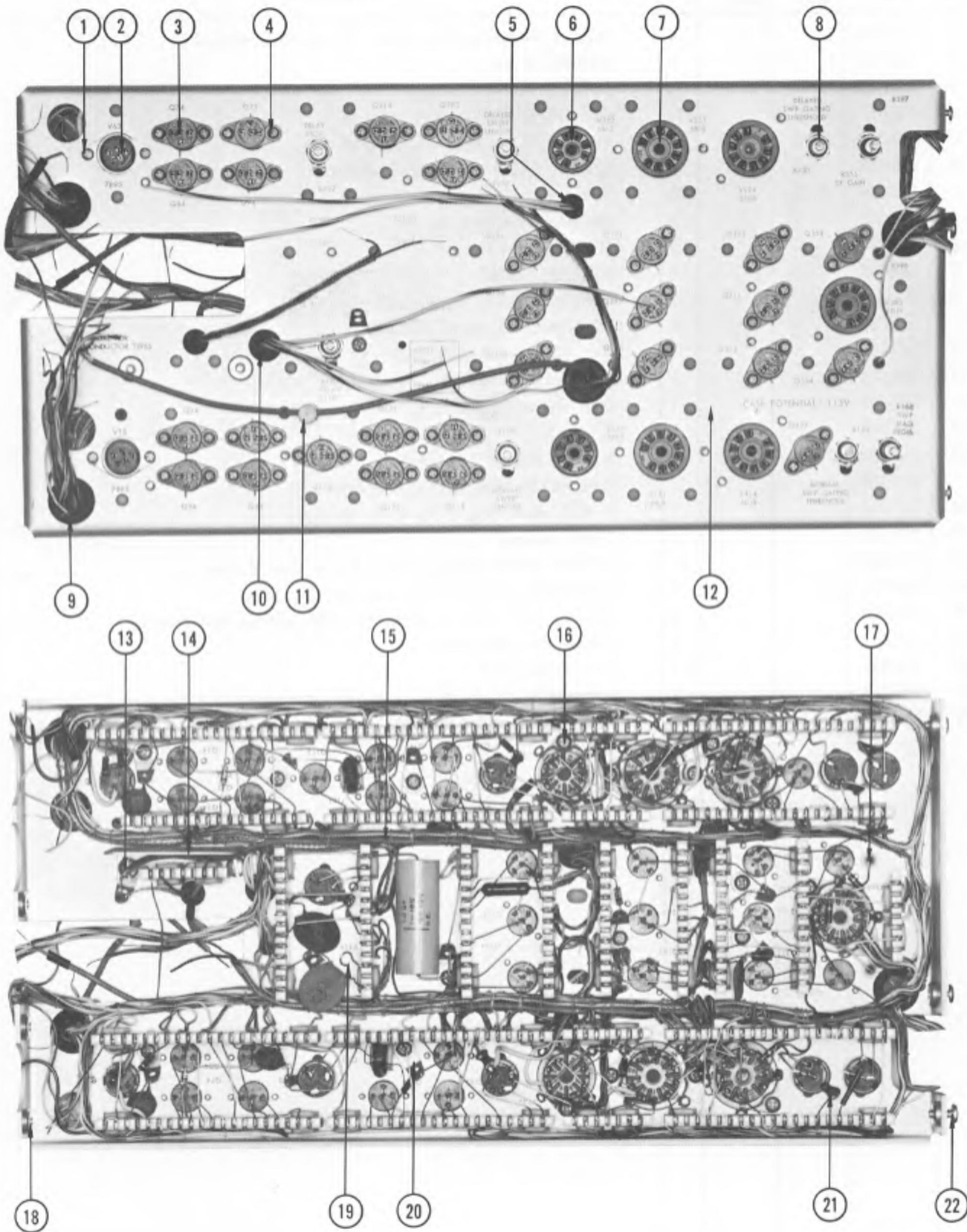
REF. NO.	PART NO.	SERIAL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	366-215			1	KNOB, SLOPE, charcoal
2	366-191			1	KNOB, EXT. TRIG. ATTEN., charcoal
3	366-175			1	KNOB, MODE, charcoal
4	366-189	101	1569	1	KNOB, POSITION, red
	366-262	1570		1	KNOB, POSITION, red
5	366-215			1	KNOB, RESET, Single, Normal, charcoal
6	331-096			1	DIAL, with charcoal knob
7	366-191			1	KNOB, EXT. TRIG. ATTEN., charcoal
8	333-737			1	PANEL, front
9	366-215			1	KNOB, AC-DC, charcoal
10	366-215			1	KNOB, INT.-EXT., charcoal
11	331-092			1	DIAL, clear plexiglas
12	366-194			1	KNOB, DELAYED SWEEP
13	366-038			1	KNOB, VARIABLE, red
14	366-215			1	KNOB, INT.-LINE-EXT., charcoal
15	366-215			1	KNOB, SLOPE, charcoal
16	366-215			1	KNOB, AUTO-AC-DC, charcoal
17	366-109			1	KNOB, securing, anodized alum.

## SUBPANEL GROUP



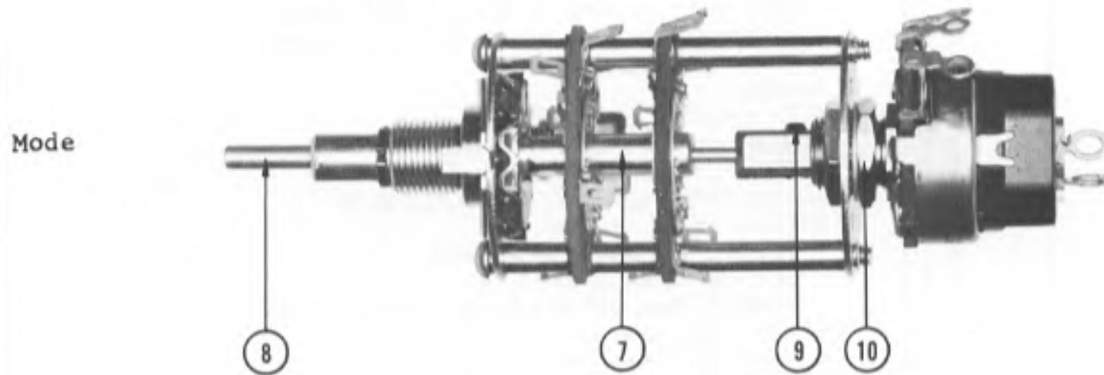
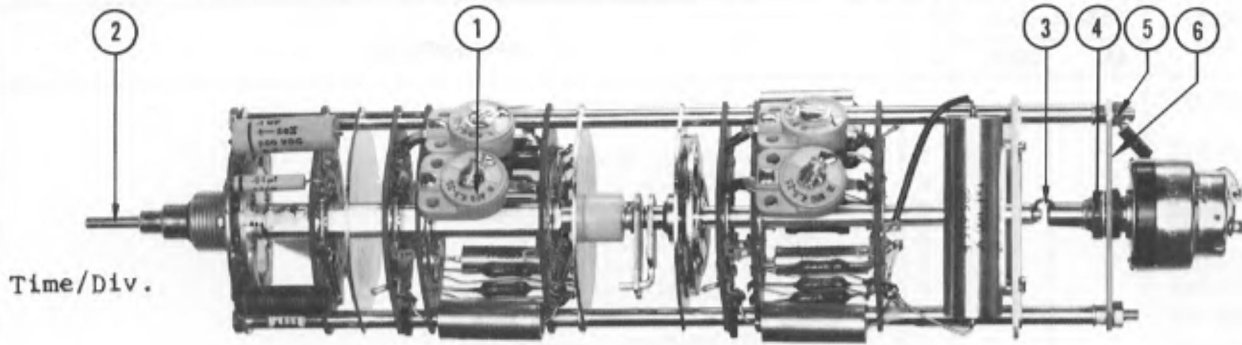
REF. NO.	PART NO.	SERIAL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	387-728			1	PLATE, subpanel, front
2	210-413			3	NUT, hex, brass, $\frac{3}{8}$ -32 x $\frac{1}{2}$ in.
	210-840			3	WASHER, steel, .390 ID x $\frac{7}{16}$ OD
	210-012			3	LOCKWASHER, steel, pot, internal $\frac{3}{8}$ x $\frac{1}{2}$ in.
3	129-065			2	POST, binding, assembly Consisting of:
	119-064			1	POST, binding, miniature fluted, 5 way, charcoal
	210-408			2	NUT, hex, brass, 6-32 x $\frac{5}{16}$ in.
	358-181			1	BUSHING, nylon, charcoal
	210-206			2	LUG, solder, SE6, long
4	352-008			2	HOLDER, melamine, neon bulb
	211-031			2	SCREW, 4-40 x 1 in. FHS
	210-406			4	NUT, hex, brass, 4-40 x $\frac{3}{16}$ in.
5	129-020			1	POST binding, BPN 13, assembly Consisting of:
	200-072			1	CAP, BPN13
	210-010			1	LOCKWASHER, steel, internal #10
	210-410			1	NUT, hex, brass, 10-32 x $\frac{5}{16}$ in.
	355-503			1	STEM, BPN13
	210-206			1	LUG, solder, SE10, long (not shown)
6	358-075			1	BUSHING, brass, .343 OD x $\frac{1}{4}$ -32 in.
	337-558			1	SHIELD, brass, .562 OD x $\frac{7}{8}$ in. long
7	214-052			1	FASTENER, pawl right, with stop
	210-004			2	LOCKWASHER, steel, internal #4
	210-406			2	NUT, hex, brass, 4-40 x $\frac{3}{16}$ in.

CHASSIS GROUP



## CHASSIS GROUP

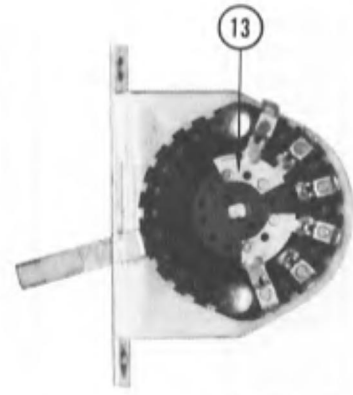
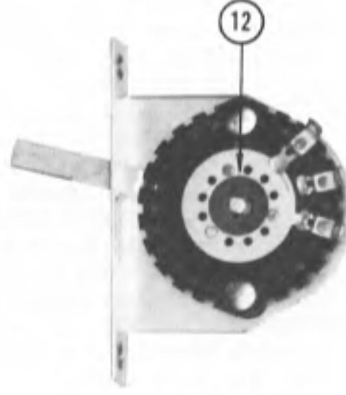
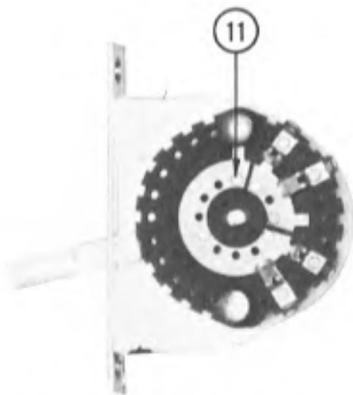
REF. NO.	PART NO.	SERIAL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	213-055			4	SCREW, thread cutting, 2-56 x $\frac{5}{16}$ in. RHS, phillips
2	136-101			2	SOCKET, 5 pin
3	136-095	101	2109	28	SOCKET, 4 pin, transistor
	136-181	2110		22	SOCKET, 3 pin transistor snap in
	136-182	2110		6	SOCKET, 3 pin transistor snap in
4	213-113	101	2109	56	SCREW, 2-32 x $\frac{5}{16}$ in. RHS, phillips
	354-234	2110		28	RING, socket
5	348-002			2	GROMMET, rubber, $\frac{1}{4}$ in.
6	136-008			2	SOCKET, STM7G
7	136-015			5	SOCKET, STM9G
8	210-583			8	NUT, hex, brass, $\frac{5}{16}$ x $\frac{1}{4}$ -32 in.
	210-046			8	LOCKWASHER, steel, .400 OD x .261 ID
9	348-005			4	GROMMET, rubber, $\frac{1}{2}$ in.
10	348-003			1	GROMMET, rubber, $\frac{5}{16}$ in.
11	385-099			1	ROD, nylon, $\frac{1}{4}$ dia. x $\frac{5}{8}$ in.
12	441-465			1	CHASSIS
13	211-504			2	SCREW, 6-32 x $\frac{1}{4}$ in. BHS
	210-202			1	LUG, solder, SE6, with 2 wire holes
14	337-532			1	SHIELD, alum. $1\frac{3}{4}$ x $\frac{7}{16}$ x $1\frac{1}{4}$ in.
15	179-703			1	CABLE harness
16	213-044			25	SCREW, thread cutting, 5-32 x $\frac{3}{16}$ in. Pan H steel
17	348-031			2	GROMMET, polyurethane, snap in, $\frac{1}{4}$ in. dia.
18	211-538			4	SCREW, 6-32 x $\frac{5}{16}$ in. RHS 100° CSK, phillips (not shown)
19	343-043			6	CLAMP, for neon bulbs
20	210-201			12	LUG, solder, SE4
21	210-223			6	LUG, solder, $\frac{1}{4}$ in. hole
22	211-507			3	SCREW, 6-32 x $\frac{5}{16}$ in. BHS



Slope

AC - DC

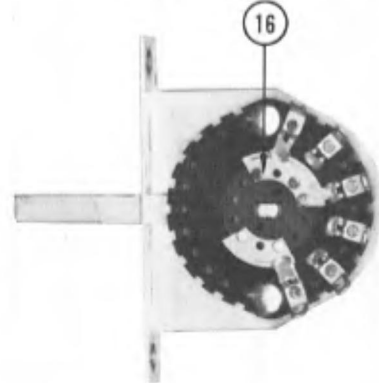
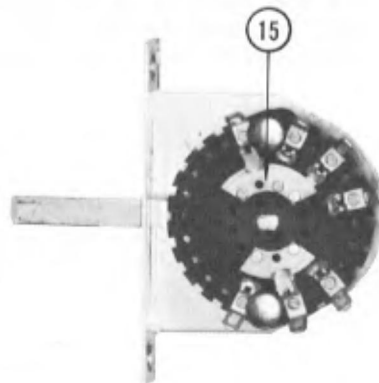
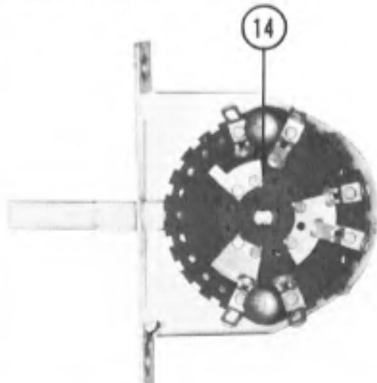
Int. - Ext.



Normal - Single - Reset

Auto - AC - DC

Int. - Line - Ext.

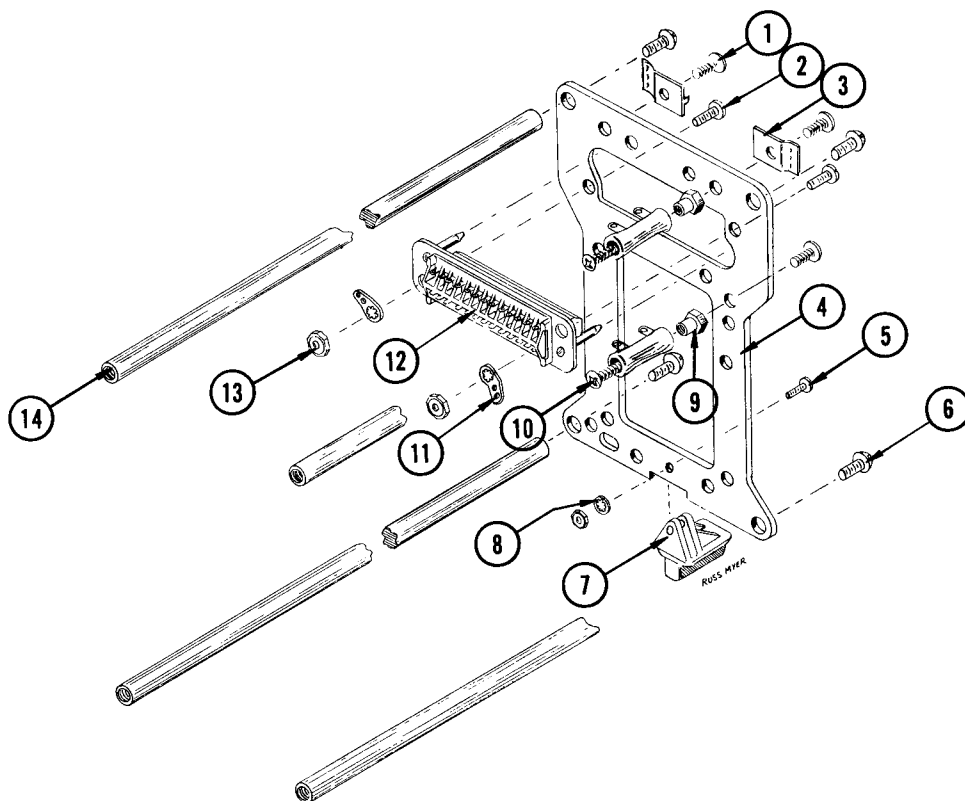


## SWITCHES

REF. NO.	PART NO.	SERIAL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	262-529			1	SWITCH, TIME/DIV. wired
2	384-260			1	Includes: ROD, extension, $\frac{1}{8}$ dia. x $9\frac{3}{8}$ in. long
3	376-014			1	COUPLING, wire
4	210-413			2	NUT, hex, brass, $\frac{3}{8}$ -32 x $\frac{1}{2}$ in.
5	210-449			2	NUT, hex, brass, 5-40 x $\frac{1}{4}$ in.
	210-006			1	LOCKWASHER, steel, internal #6
	210-202			1	LUG, solder, SE6 with 2 wire holes
6	386-450			1	PLATE, alum. $1\frac{5}{16}$ x $2\frac{5}{16}$ in.
	260-505			1	SWITCH, TIME/DIV. unwired
					Mounting Hardware: (not included)
	210-579			1	NUT, switch mounting, $\frac{5}{8}$ -24 x $\frac{3}{4}$ in. (not shown)
	210-049			1	LOCKWASHER, brass, internal $\frac{5}{8}$ in. (not shown)
7	262-498			1	SWITCH, MODE, wired
					Includes:
8	384-237			1	ROD, extension, 3 in. long
9	213-048			1	SCREW, set, 4-40 x $\frac{1}{8}$ in. HHS, allen head
10	210-413			2	NUT, hex, brass, $\frac{3}{8}$ -32 x $\frac{1}{2}$ in.
	210-012			1	LOCKWASHER, steel, pot, internal $\frac{3}{8}$ x $\frac{1}{2}$ in.
	260-456			1	SWITCH, MODE, unwired
					Mounting Hardware: (not included)
	210-413			1	NUT, hex, brass, $\frac{3}{8}$ -32 x $\frac{1}{2}$ in.
	210-840			1	WASHER, steel, .390 ID x $\frac{7}{16}$ in. OD (not shown)
11	260-472			2	SWITCH, SLOPE, unwired
					Mounting Hardware: (not included)
	210-406			2	NUT, hex, brass, 4-40 x $\frac{3}{16}$ in.
	210-006			2	LOCKWASHER, steel, internal #6
12	260-473			1	SWITCH, AC-DC, unwired
					Mounting hardware: (not included)
	210-406			2	NUT, hex, brass, 4-40 x $\frac{3}{16}$ in.
	210-006			2	LOCKWASHER, steel, internal #6
13	260-474	101	1999	1	SWITCH, INT.-EXT. unwired
	260-640	2000		1	SWITCH, INT.-LINE-EXT. unwired
					Mounting Hardware: (not included)
	210-406			2	NUT, hex, brass, 4-40 x $\frac{3}{16}$ in.
	210-006			2	LOCKWASHER, steel, internal #6
14	260-477			1	SWITCH, NORMAL-SINGLE-RESET, unwired
					Mounting Hardware: (not included)
	210-406			2	NUT, hex, brass, 4-40 x $\frac{3}{16}$ in.
	210-006			2	LOCKWASHER, steel, internal #6
15	260-475			1	SWITCH AUTO.-AC-DC, unwired
					Mounting Hardware: (not included)
	210-406			2	NUT, hex, brass, 4-40 x $\frac{3}{16}$ in.
	210-006			2	LOCKWASHER, steel, internal #6
16	260-476			1	SWITCH, INT.-LINE-EXT. unwired
					Mounting Hardware: (not included)
	210-406			2	NUT, hex, brass, 4-40 x $\frac{3}{16}$ in.
	210-006			2	LOCKWASHER, steel, internal #6



## REAR AND FRAME GROUP



REF. NO.	PART NO.	SERIAL NO.		QTY.	DESCRIPTION
		EFF.	DISC.		
1	211-507			3	SCREW, 6-32 x $\frac{5}{16}$ in. BHS
2	211-008			2	SCREW, 4-40 x $\frac{1}{4}$ in. BHS
3	214-276			2	SPRING, ground, $\frac{29}{64}$ x $\frac{1}{2}$ x $1\frac{1}{16}$ in.
4	387-647			1	PLATE, rear, alum. $3\frac{31}{32}$ x $5\frac{31}{32}$ in.
5	211-013			1	SCREW, 4-40 x $\frac{3}{8}$ in. RHS
6	212-044			4	SCREW, 8-32 x $\frac{1}{2}$ in. RHS, phillips
7	351-037			1	GUIDE, delrin, $\frac{5}{8}$ x $1\frac{3}{16}$ in.
8	210-004			1	LOCKWASHER, steel, internal #4
9	210-478			2	NUT, hex, alum. $\frac{5}{16}$ x $2\frac{1}{32}$ in.
10	211-544			2	SCREW, 6-32 x $\frac{3}{4}$ in. truss HS, phillips
11	210-201			2	LUG, solder, SE4
12	131-149			1	CONNECTOR, chassis mount, 24 contact
13	210-406			3	NUT, hex, brass, 4-40 x $\frac{3}{16}$ in.
14	384-566	100	1109	4	ROD, frame, spacing
	384-615	1110		4	ROD, frame, spacing

## CERAMIC STRIPS AND MOUNTINGS

### 3/4 inch



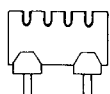
1 notch ..... 124-100



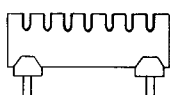
2 notch ..... 124-086



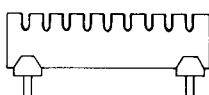
3 notch ..... 124-087



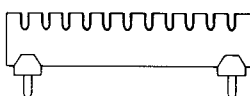
4 notch ..... 124-088



7 notch ..... 124-089



9 notch ..... 124-090



11 notch ..... 124-091

### 7/16 inch



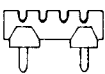
1 notch ..... 124-118



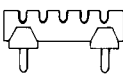
2 notch ..... 124-119



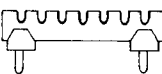
3 notch ..... 124-092



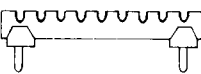
4 notch ..... 124-120



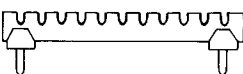
5 notch ..... 124-093



7 notch ..... 124-094

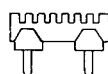


9 notch ..... 124-095

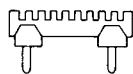


11 notch ..... 124-106

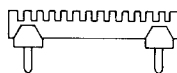
### 7/16 inch SMALL NOTCH —Short Stud



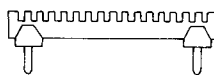
7 notch ..... 124-149



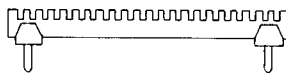
9 notch ..... 124-148



13 notch ..... 124-147

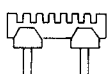


16 notch ..... 124-146

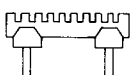


20 notch ..... 124-145

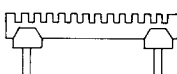
### 7/16 inch SMALL NOTCH —Tall Stud



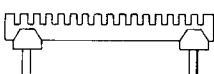
7 notch ..... 124-158



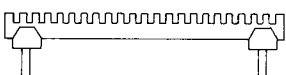
9 notch ..... 124-157



13 notch ..... 124-156



16 notch ..... 124-155



20 notch ..... 124-154

## MOUNTINGS



Stud, nylon, short...355-046



Stud, nylon, tall .. 355-082



Spacer, 1/32 inch...361-039



Spacer, 3/8 inch .. 361-009



Spacer, 1/4 inch...361-008



Spacer, 5/32 inch...361-007

Ceramic strips include studs, but spacers must be ordered separately by part no.

## ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description	S/N Range
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**Bulbs**

B10	150-027	Neon, NE-23	
B60	150-027	Neon, NE-23	
B134	150-027	Neon, NE-23	READY
B149	150-027	Neon, NE-23	
B160W	150-027	Neon, NE-23	UNCAL.
B164	150-027	Neon, NE-23	
B264	150-027	Neon, NE-23	

**Capacitors**Tolerance  $\pm 20\%$  unless otherwise indicated.

Tolerance of all electrolytic capacitors as follows (with exceptions):

3 V — 50 V =  $-10\%$ ,  $+250\%$ 51 V — 350 V =  $-10\%$ ,  $+100\%$ 351 V — 450 V =  $-10\%$ ,  $+50\%$ 

C4	283-041	.0033 $\mu f$	Disc Type	500 v	5%	
C5	283-068	.01 $\mu f$	Disc Type	500 v		
C7	281-560	198 pf	Cer.	500 v	10%	100-149
	281-543	270 pf	Cer.	500 v	10%	150-up
C9	281-586	25 pf	Cer.	500 v	5%	
C11	283-000	.001 $\mu f$	Disc Type	500 v		
C13	283-003	.01 $\mu f$	Disc Type	150 v		
C16	283-003	.01 $\mu f$	Disc Type	150 v		X1030-up
C18	283-003	.01 $\mu f$	Disc Type	150 v		
C37	283-026	.2 $\mu f$	Disc Type	25 v		
C39	281-543	270 pf	Cer.	500 v	10%	
C55	283-068	.01 $\mu f$	Disc Type	500 v		
C57	281-560	198 pf	Cer.	500 v	10%	100-149
	281-543	270 pf	Cer.	500 v	10%	150-up
C59	281-586	25 pf	Cer.	500 v	5%	
C61	283-000	.001 $\mu f$	Disc Type	500 v		
C63	283-003	.01 $\mu f$	Disc Type	150 v		
C66	283-003	.01 $\mu f$	Disc Type	150 v		X1030-up
C68	283-003	.01 $\mu f$	Disc Type	150 v		
C87	283-026	.2 $\mu f$	Disc Type	25 v		
C89	281-524	150 pf	Cer.	500 v		
C106	283-026	.2 $\mu f$	Disc Type	25 v		
C109	281-525	470 pf	Cer.	500 v		
C113	281-518	47 pf	Cer.	500 v		X2319-up
C115	290-175	10 $\mu f$	EMT	35 v		
C118	283-026	.2 $\mu f$	Disc Type	25 v		
C137	281-523	100 pf	Cer.	350 v		
C148	281-524	150 pf	Cer.	500 v		

**Parts List—Type 3B3**
**Capacitors (Cont'd)**

Ckt. No.	Tektronix Part No.	Description					S/N Range
C149	Use 283-057	.1 $\mu$ f	Disc Type		100 v		
C152	281-546	330 pf	Cer.		500 v	10%	
C160A	281-505	12 pf	Cer.		500 v	10%	
C160B	281-010	4.5-25 pf	Cer.	Var.			
C160C	283-534	82 pf	Mica		500 v	5%	
C160D	281-010	4.5-25 pf	Cer.	Var.			
C160E	*295-069	.001 $\mu$ f	Timing Series†				
C160F		.01 $\mu$ f					
C160G		.1 $\mu$ f					
C160H		1 $\mu$ f					
C162	283-003	.01 $\mu$ f	Disc Type		150 v		
C163	281-511	22 pf	Cer.		500 v	10%	X2319-up
C167	281-524	150 pf	Cer.		500 v		
C170A	281-523	100 pf	Cer.		350 v		
C170B	285-501	.001 $\mu$ f	MT		600 v		
C170C	285-569	.01 $\mu$ f	PTM		200 v		
C170D	285-572	.1 $\mu$ f	PTM		200 v		
C170E	285-576	1 $\mu$ f	PTM		100 v	10%	
C170F	281-518	47 pf	Cer.		500 v		
C188	281-573	11 pf	Cer.			10%	
C195	283-004	.02 $\mu$ f	Disc Type		150 v		
C197	283-003	.01 $\mu$ f	Disc Type		150 v		
C206	283-026	.2 $\mu$ f	Disc Type		25 v		
C209	281-525	470 pf	Cer.		500 v		
C215	281-518	47 pf	Cer.		500 v		X2319-up
C237	281-523	100 pf	Cer.		350 v		
C252	281-546	330 pf	Cer.		500 v	10%	100-2318X
C260A	281-505	12 pf	Cer.		500 v	10%	
C260B	281-010	4.5-25 pf	Cer.	Var.			
C260C	283-534	82 pf	Mica		500 v	5%	
C260D	281-010	4.5-25 pf	Cer.	Var.			
C260E	*295-069	.001 $\mu$ f	Timing Series†				
C260F		.01 $\mu$ f					
C260G		.1 $\mu$ f					
C260H		1 $\mu$ f					
C262	283-003	.01 $\mu$ f	Disc Type		150 v		
C263	281-511	22 pf	Cer.		500 v	10%	X2319-up
C267	281-524	150 pf	Cer.		500 v		
C303	283-026	.2 $\mu$ f	Disc Type		25 v		
C336	283-026	.2 $\mu$ f	Disc Type		25 v		
C354	Use 285-007	160 pf	Glass		500 v	5%	100-2318
C354	281-605	200 pf	Cer.		500 v		2319-up
C356	283-526	.001 $\mu$ f	Mica		500 v	1%	
C364	283-519	360 pf	Mica		500 v	5%	100-2318
C364	283-551	270 pf	Mica			5%	2319-up
C394	283-026	.2 $\mu$ f	Disc Type		25 v		
C396	283-006	.02 $\mu$ f	Disc Type		600 v		
C397	283-006	.02 $\mu$ f	Disc Type		600 v		

† C160 E, F, G, H and C260 E, F, G, H furnished as a unit.

## Capacitors (Cont'd)

Ckt. No.	Tektronix Part No.	Description			S/N Range
C399	283-057	.1 $\mu$ f	Disc Type	200 v	
C412	283-004	.02 $\mu$ f	Disc Type	150 v	
C414	283-003	.01 $\mu$ f	Disc Type	150 v	
C417	283-001	.005 $\mu$ f	Disc Type	500 v	
C423	283-003	.01 $\mu$ f	Disc Type	150 v	
C424	283-002	.01 $\mu$ f	Disc Type	500 v	
C427	283-057	.1 $\mu$ f	Disc Type	200 v	
C433	283-026	.2 $\mu$ f	Disc Type	25 v	
C438	283-057	.1 $\mu$ f	Disc Type	200 v	

## Diodes

D14	152-141	Silicon	1N3605	X1030-up
D15	152-008	Germanium	T12G	100-1029
D15	*152-061	Silicon	Tek Spec	1030-up
D16	152-008	Germanium	T12G	100-1029
D16	152-141	Silicon	1N3605	1030-up
D24	*152-075	Germanium	Tek Spec	100-1029
D24	152-141	Silicon	1N3605	1030-up
D34	*152-075	Germanium	Tek Spec	100-1029
D34	152-141	Silicon	1N3605	1030-up
D35	152-081	Tunnel	TD2 2.2MA	
D64	152-141	Silicon	1N3605	X1030-up
D65	152-008	Germanium	T12G	100-1029
D65	*152-061	Silicon	Tek Spec	1030-up
D66	152-008	Germanium	T12G	100-1029
D66	152-141	Silicon	1N3605	1030-up
D74	*152-075	Germanium	Tek Spec	100-1029
D74	152-141	Silicon	1N3605	1030-up
D84	*152-075	Germanium	Tek Spec	100-1029
D84	152-141	Silicon	1N3605	1030-up
D85	152-081	Tunnel	TD2 2.2MA	
D101	*152-075	Germanium	Tek Spec	
D102	*152-075	Germanium	Tek Spec	
D105	152-093	Tunnel	TD3 4.7 MA	
D113	*152-075	Germanium	Tek Spec	
D119	*152-075	Germanium	Tek Spec	
D125	*152-075	Germanium	Tek Spec	
D138	*152-075	Germanium	Tek Spec	
D162	152-091	Zener	1N982 75 v	
D170	*152-061	Silicon	Tek Spec	
D171	*152-061	Silicon	Tek Spec	
D172	*152-061	Silicon	Tek Spec	
D189	*152-075	Germanium	Tek Spec	
D195	*152-061	Silicon	Tek Spec	
D198	*152-075	Germanium	Tek Spec	
D201	*152-075	Germanium	Tek Spec	
D202	*152-075	Germanium	Tek Spec	
D205	152-093	Tunnel	TD3 4.7 MA	
D213	*152-075	Germanium	Tek Spec	
D238	*152-075	Germanium	Tek Spec	
D262	152-091	Zener	1N982 75 v	

# Parts List—Type 3B3

## Diodes (Cont'd)

Ckt. No.	Tektronix Part No.	Description	S/N Range
D270	*152-061	Silicon	Tek Spec
D292	152-075	Germanium	Tek Spec
D398	152-031	Zener	1N718A 15 v
D415	152-081	Tunnel	TD2 2.2 MA

## Inductors

L35	*108-146	5 $\mu$ h	X1810-up
L85	*108-146	5 $\mu$ h	
L149	*108-054	6.4 $\mu$ h	
L303	108-249	12 $\mu$ h	

## Resistors

Resistors are fixed, composition,  $\pm 10\%$  unless otherwise indicated.

R7	315-753	75 k	$\frac{1}{4}$ w	5%	100-1029 1030-up
R9	301-914	910 k	$\frac{1}{2}$ w	5%	
R10	301-275	2.7 meg	$\frac{1}{2}$ w	5%	
R11	315-224	220 k	$\frac{1}{4}$ w	5%	
R12	316-101	100 $\Omega$	$\frac{1}{4}$ w		
R13	316-102	1 k	$\frac{1}{4}$ w		
R14	303-243	24 k	1 w	5%	
R16	301-623	62 k	$\frac{1}{2}$ w	5%	
R17	315-124	120 k	$\frac{1}{4}$ w	5%	
R18	316-470	47 $\Omega$	$\frac{1}{4}$ w		
R19	316-824	820 k	$\frac{1}{4}$ w		
R20	315-562	5.6 k	$\frac{1}{4}$ w	5%	
R21	315-473	47 k	$\frac{1}{4}$ w	5%	100-1029 1030-up
R21	315-393	39 k	$\frac{1}{4}$ w	5%	
R23†	311-311	200 k		LEVEL	
R29	303-393	39 k	1 w	5%	
R29	303-363	36 k	1 w	5%	100-1029 1030-up
R35	309-345	225 $\Omega$	$\frac{1}{2}$ w	Prec.	1%
R37	316-101	100 $\Omega$	$\frac{1}{4}$ w		
R39	315-270	27 $\Omega$	$\frac{1}{4}$ w	5%	
R44	302-563	56 k	$\frac{1}{2}$ w		
R57	315-753	75 k	$\frac{1}{4}$ w	5%	
R59	301-914	910 k	$\frac{1}{2}$ w	5%	
R60	301-275	2.7 meg	$\frac{1}{2}$ w	5%	
R61	315-224	220 k	$\frac{1}{4}$ w	5%	
R62	316-101	100 $\Omega$	$\frac{1}{4}$ w		
R63	316-102	1 k	$\frac{1}{4}$ w		
R64	303-243	24 k	1 w	5%	
R66	301-623	62 k	$\frac{1}{2}$ w	5%	
R67	315-124	120 k	$\frac{1}{4}$ w	5%	
R68	316-470	47 $\Omega$	$\frac{1}{4}$ w		
R69	316-824	820 k	$\frac{1}{4}$ w		
R70	315-562	5.6k	$\frac{1}{4}$ w	5%	
R71	315-473	47 k	$\frac{1}{4}$ w	5%	100-1029
R71	315-393	39 k	$\frac{1}{4}$ w	5%	1030-up
R73††	311-311	200 k		Var.	LEVEL

† Concentric with SW6. Furnished as a unit.

†† Concentric with SW56. Furnished as a unit.

## Resistors (Cont'd)

Ckt. No.	Tektronix Part No.		Description			S/N Range
R79	303-393	39 k	1 w		5%	100-1029
R79	303-363	36 k	1 w		5%	1030-up
R85	309-345	225 $\Omega$	$\frac{1}{2}$ w	Prec.	1%	
R87	316-101	100 $\Omega$	$\frac{1}{4}$ w			
R89	315-330	33 $\Omega$	$\frac{1}{4}$ w		5%	
R94	302-563	56 k	$\frac{1}{2}$ w			
R102	315-102	1 k	$\frac{1}{4}$ w		5%	
R106	316-470	47 $\Omega$	$\frac{1}{4}$ w			
R108	321-380	88.7 k	$\frac{1}{8}$ w	Prec.	1%	X2319-up
R109	315-331	33 $\Omega$	$\frac{1}{4}$ w		5%	
R110	315-823	82 k	$\frac{1}{4}$ w		5%	100-2318
R110	321-392	118 k	$\frac{1}{8}$ w	Prec.	1%	2319-up
R112	302-683	68 k	$\frac{1}{2}$ w			
R113	315-222	2.2 k	$\frac{1}{4}$ w		5%	
R114	316-332	3.3 k	$\frac{1}{4}$ w			
R116	316-272	2.7 k	$\frac{1}{4}$ w			
R117	316-101	100 $\Omega$	$\frac{1}{4}$ w			
R118	316-102	1 k	$\frac{1}{4}$ w			
R119	315-681	680 $\Omega$	$\frac{1}{4}$ w		5%	
R120	316-561	560 $\Omega$	$\frac{1}{4}$ w			
R125	301-823	82 k	$\frac{1}{2}$ w		5%	
R129	315-472	4.7 k	$\frac{1}{4}$ w		5%	
R130	311-110	100 k		Var.	NORMAL SWP. GATING THRESHOLD	
R131	309-354	45 k	$\frac{1}{2}$ w	Prec.	1%	
R132	316-334	330 k	$\frac{1}{4}$ w			
R133	315-752	7.5 k	$\frac{1}{4}$ w		5%	
R134	301-104	100 k	$\frac{1}{2}$ w		5%	
R135	319-067	1.21 k	$\frac{1}{4}$ w	Prec.	1%	
R136	319-065	121 k	$\frac{1}{4}$ w	Prec.	1%	
R137	319-063	3.01 k	$\frac{1}{4}$ w	Prec.	1%	
R138	319-068	7.5 k	$\frac{1}{4}$ w	Prec.	1%	
R139	319-070	75 k	$\frac{1}{4}$ w	Prec.	1%	
R140	319-071	806 k	$\frac{1}{4}$ w	Prec.	1%	
R141	319-064	9.76 k	$\frac{1}{4}$ w	Prec.	1%	
R142	309-354	45 k	$\frac{1}{2}$ w	Prec.	1%	
R143	319-069	17.8 k	$\frac{1}{4}$ w	Prec.	1%	
R145	319-066	604 $\Omega$	$\frac{1}{4}$ w	Prec.	1%	
R146	319-066	604 $\Omega$	$\frac{1}{4}$ w	Prec.	1%	
R148	316-823	82 k	$\frac{1}{4}$ w			
R149	316-102	1 k	$\frac{1}{4}$ w			
R152	315-221	220 $\Omega$	$\frac{1}{4}$ w		5%	
R160A	309-380	250 k	$\frac{1}{2}$ w	Prec.	1%	
R160B	309-380	250 k	$\frac{1}{2}$ w	Prec.	1%	
R160C	309-140	500 k	$\frac{1}{2}$ w	Prec.	1%	
R160D	323-604	750 k	$\frac{1}{2}$ w	Prec.	$\frac{1}{4}$ %	
R160E	323-604	750 k	$\frac{1}{2}$ w	Prec.	$\frac{1}{4}$ %	
R160F	323-603	1.5 meg	$\frac{1}{2}$ w	Prec.	$\frac{1}{4}$ %	
R160G	309-399	7.5 meg	$\frac{1}{2}$ w	Prec.	1%	
R160H	309-399	7.5 meg	$\frac{1}{2}$ w	Prec.	1%	
R160W	302-104	100 k	$\frac{1}{2}$ w			

# Parts List—Type 3B3

## Resistors (Cont'd)

Ckt. No.	Tektronix Part No.	Description	S/N Range
R160X	301-103	10 k	1/2 w
R160Y†	311-108	20 k	1/2 w
R161	316-101	100 Ω	1/4 w
R162	306-683	68 k	2 w
R162	305-433	43 k	2 w
R163	316-472	4.7 k	1/4 w
R164	315-224	220 k	1/4 w
R165	316-101	100 Ω	1/4 w
R167	301-752	7.5 k	1/2 w
R168	311-310	5 k	1 w
R169	303-153	15 k	1 w
R170	316-184	180 k	1/4 w
R184	316-182	1.8 k	1/4 w
R186	316-332	3.3 k	1/4 w
R187	315-124	120 k	1/4 w
R188	315-752	7.5 k	1/4 w
R190	316-152	1.5 k	1/4 w
R192	316-470	47 Ω	1/4 w
R194	308-213	25 k	7 w
R195	302-101	100 Ω	1/2 w
R196	302-274	270 k	1/2 w
R197	316-121	120 Ω	1/4 w
R198	315-162	1.6 k	1/4 w
R199	316-101	100 Ω	1/4 w
R202	315-681	680 Ω	1/4 w
R206	316-470	47 Ω	1/4 w
R209	316-331	330 Ω	1/4 w
R210	315-823	82 k	1/4 w
R212	302-683	68 k	1/2 w
R213	315-222	2.2 k	1/4 w
R214	316-332	3.3 k	1/4 w
R229	301-823	82 k	1/2 w
R230	311-110	100 k	1/2 w
R231	309-354	45 k	1/2 w
R236	319-065	121 k	1/4 w
R237	319-063	3.01 k	1/4 w
R238	319-068	7.5 k	1/4 w
R239	319-070	75 k	1/4 w
R240	319-071	806 k	1/4 w
R241	319-064	9.76 k	1/4 w
R242	309-354	45 k	1/2 w
R243	319-069	17.8 k	1/4 w
R245	319-066	604 Ω	1/4 w
R246	319-066	604 Ω	1/4 w
R252	315-221	220 Ω	1/4 w
R260A	309-380	250 k	1/2 w
R260B	309-380	250 k	1/2 w

† Concentric with SW160Y. Furnished as a unit.



## Resistors (Cont'd)

Ckt. No.	Tektronix Part No.	Description		S/N Range		
R260C	309-140	500 k	1/2 w	Prec.	1%	
R260D	309-141	750 k	1/2 w	Prec.	1%	
R260E	309-141	750 k	1/2 w	Prec.	1%	
R260F	309-017	1.5 meg	1/2 w	Prec.	1%	
R260G	309-399	7.5 meg	1/2 w	Prec.	1%	
R260H	309-399	7.5 meg	1/2 w	Prec.	1%	
R261	316-101	100 $\Omega$	1/4 w			
R262	306-683	68 k	2 w			100-2318
R262	305-433	43 k	2 w		5%	2319-up
R263	316-472	4.7 k	1/4 w			X2319-up
R264	315-224	220 k	1/4 w			
R265	316-101	100 $\Omega$	1/4 w			
R267	Use 303-752	7.5 k	1 w		5%	
R268	311-310	5 k		Var.	DELAYED SWEEP LENGTH	
R269	303-153	15 k	1 w		5%	
R284	316-182	1.8 w	1/4 w			
R286	301-623	62 k	1/2 w		5%	
R287	315-752	7.5 k	1/4 w		5%	
R288	301-473	47 k	1/2 w		5%	
R292	301-104	100 k	1/2 w		5%	
R294	316-332	3.3 k	1/4 w			
R310	Use 309-392	20 k	1/2 w	Prec.	1%	
R312	311-326	10 k		Var.	SWP. CAL.	
R314	309-343	107 k	1/2 w		Prec.	1%
R316†	311-312	150 k		Var.	POSITION	
R317	309-430	60.4 k	1/2 w		Prec.	1%
R318	309-426	2.87 k	1/2 w		Prec.	1%
R319	309-431	80.6 k	1/2 w		Prec.	1%
R323	302-473	47 k	1/2 w			
R333	302-473	47 k	1/2 w			
R335	309-100	10 k	1/2 w	Prec.	1%	
R336	309-388	6 k	1/2 w	Prec.	1%	
R354	309-345	225 $\Omega$	1/2 w		Prec.	1%
R355	311-169	100 $\Omega$		Var.	5X GAIN	
R356	315-330	33 $\Omega$	1/4 w		5%	
R357	308-054	10 k	5 w		WW	5%
R364	319-067	1.21 k	1/4 w		Prec.	1%
R367	308-053	8 k	5 w		WW	5%
R368	311-310	5 k		Var.	SWP. MAG. REGIS.	
R381	316-101	100 $\Omega$	1/4 w			
R382	308-178	15 k	8 w		WW	5%
R384	316-101	100 $\Omega$	1/4 w			
R385	308-178	15 k	8 w		WW	5%
R391	301-151	150 $\Omega$	1/2 w			5%
R392	301-151	150 $\Omega$	1/2 w			5%
R394	301-910	91 $\Omega$	1/2 w			5%
R396	308-229	4 k	5 w		WW	5%

† Concentric with SW367. Furnished as a unit.

## Parts List—Type 3B3

### Resistors (Cont'd)

Ckt. No.	Tektronix Part No.	Description	S/N Range
R397	308-003	2 k 5 w WW	5%
R398	301-334	330 k 1/2 w	5%
R411	316-101	100 Ω 1/4 w	
R412	316-101	100 Ω 1/4 w	
R413	316-103	10 k 1/4 w	
R414	309-118	4.23 k 1/2 w	Prec. 1%
R415	309-100	10 k 1/2 w	Prec. 1%
R417	315-470	47 Ω 1/4 w	5%
R419	303-223	22 k 1 w	5%
R423	316-101	100 Ω 1/4 w	
R424	315-152	1.5 k 1/4 w	5%
R426	309-432	82.5 k 1/2 w	Prec. 1%
R427	309-429	16.5 k 1/2 w	Prec. 1%
R428	316-101	100 Ω 1/4 w	
R429	309-270	3.92 k 1/2 w	Prec. 1%
R430	311-329	50 k	Var. DELAY START
R431	309-195	90 k 1/2 w	Prec. 1%
R432	309-159	5 k 1/2 w	Prec. 1%
R433	309-430	60.4 k 1/2 w	Prec. 1%
R434	311-342	50 k	Var. WW DELAY TIME
R436	Use 305-333	33 k 2 w	5%
R437	309-350	12.4 k 1/2 w	Prec. 1%
R438	301-563	56 k 1/2 w	5%
R439	311-329	50 k	Var. DELAY STOP

### Switches

	Unwired	Wired		
SW3	260-476	Lever	SOURCE	
SW5	260-475	Lever	COUPLING	
SW6 <sup>1</sup>	311-311		PULL EXT. TRIG. ATTEN.	
SW19	260-472	Lever	SLOPE	
SW53 Use	*050-211	Lever	SOURCE	100-1999
SW53	260-640	Lever	SOURCE	2000-up
SW55	260-473	Lever	COUPLING	
SW56 <sup>2</sup>	311-311		PULL EXT. TRIG. ATTEN.	
SW69	260-472	Lever	SLOPE	
SW81	260-456	*262-498 Rotary	MODE	
SW135	260-477	Lever	SINGLE SWEEP	
SW160 <sup>3</sup>	260-505	*262-529 Rotary	TIME/DIV (Normal Sweep)	
SW160Y <sup>4</sup>	311-108			
SW260 <sup>5</sup>	260-505	*262-529 Rotary	TIME/DIV (Delayed Sweep)	
SW367 <sup>5</sup>	311-312		PULL 5X MAG.	

<sup>1</sup> Concentric with R23. Furnished as a unit.

<sup>2</sup> Concentric with R73. Furnished as a unit.

<sup>3</sup> SW160 and SW260 furnished as a unit.

<sup>4</sup> Concentric with R160Y. Furnished as a unit.

<sup>5</sup> Concentric with R316. Furnished as a unit.

### Transformers

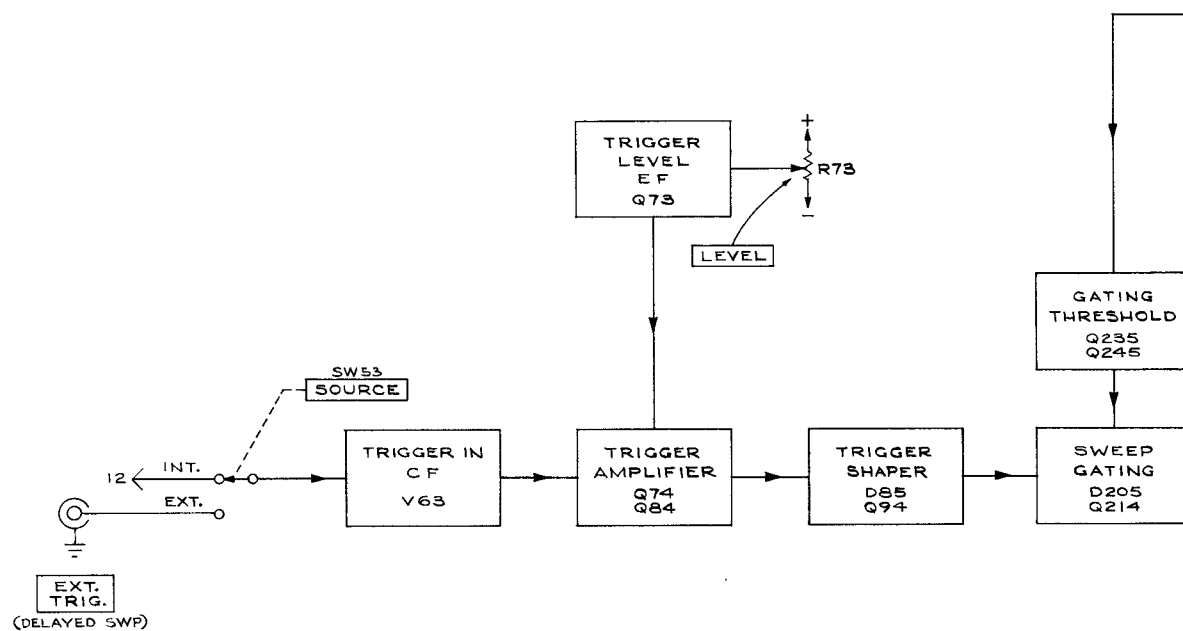
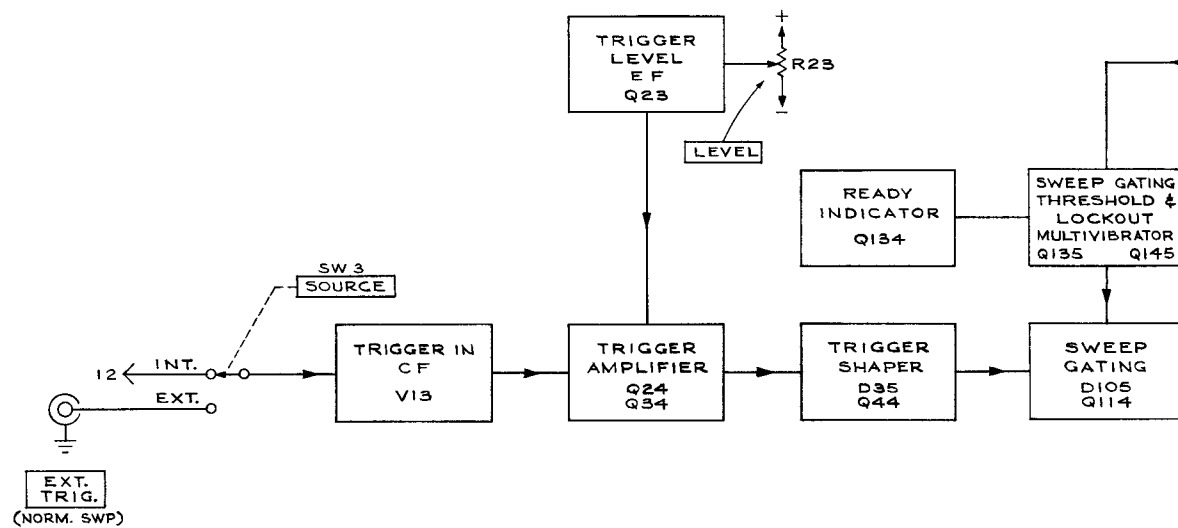
T101	*120-278	Toroid TD71	3-8 turn winding
T201	*120-277	Toroid TD70	2-8 turn winding

## Transistors

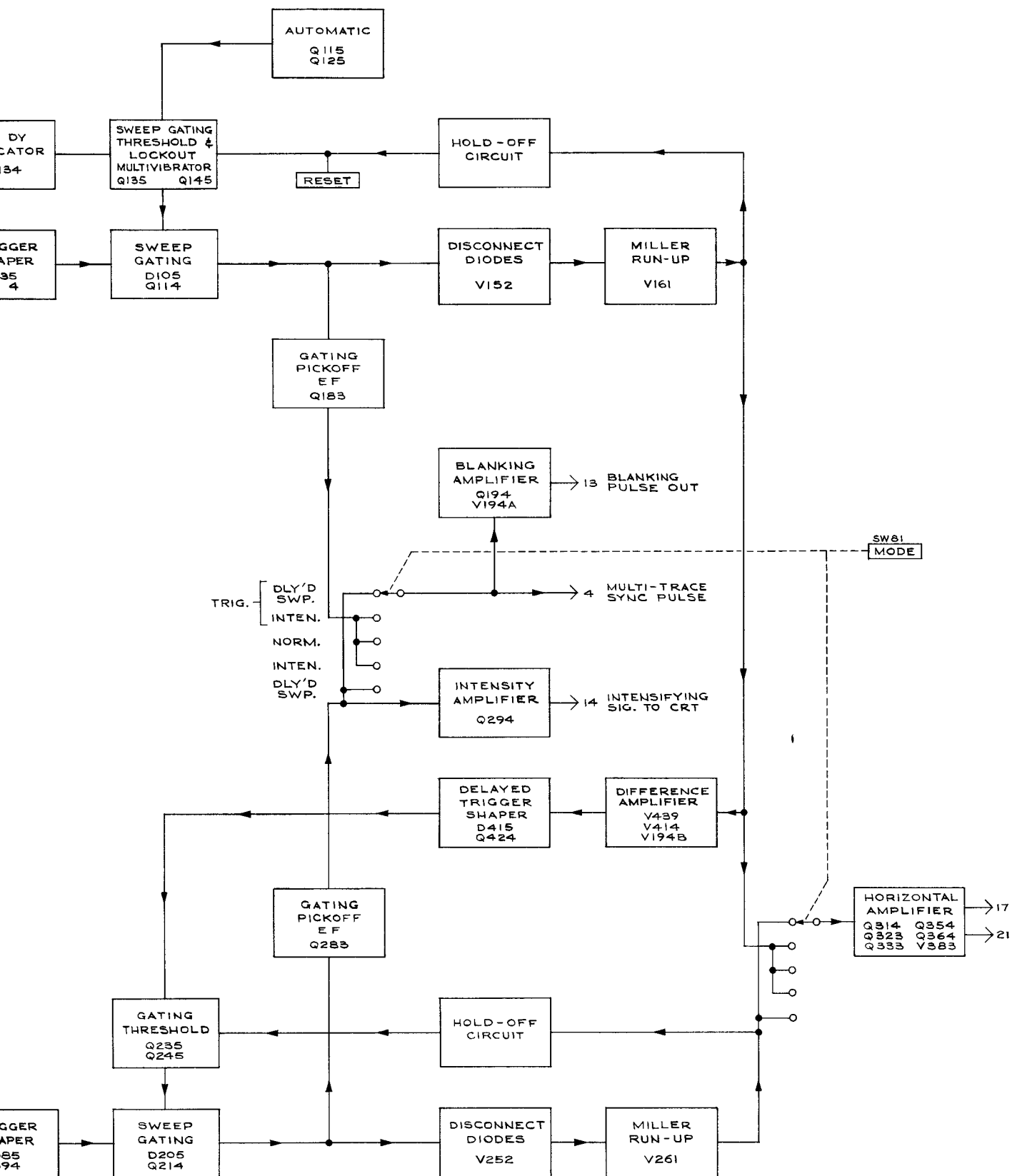
Ckt. No.	Tektronix Part No.	Description	S/N Range
Q23	151-070	2N1377	100-1029
Q23	151-063	2N2207	1030-up
Q24	151-084	2N1225	100-1029
Q24	151-063	2N2207	1030-up
Q34	151-084	2N1225	100-1029
Q34	151-063	2N2207	1030-up
Q44	151-094	2N835	100-1029
Q44	*151-108	Replaceable by 2N2501	1030-up
Q73	151-070	2N1377	100-1029
Q73	151-063	2N2207	1030-up
Q74	151-084	2N1225	100-1029
Q74	151-063	2N2207	1030-up
Q84	151-084	2N1225	100-1029
Q84	151-063	2N2207	1030-up
Q94	151-094	2N835	100-1029
Q94	*151-108	Replaceable by 2N2501	1030-up
Q114	*151-062	Selected from TIN101	100-2318
Q114	*151-108	Replaceable by 2N2501	2319-up
Q115	*151-062	Selected from TIN101	
Q124	*151-087	Selected from 2N1131	
Q125	*151-062	Selected from TIN101	
Q134	*151-096	Selected from 2N1893	
Q135	*151-087	Selected from 2N1131	
Q145	*151-087	Selected from 2N1131	
Q183	151-076	2N2048	
Q194	151-076	2N2048	
Q214	*151-062	Selected from TIN101	
Q235	*151-087	Selected from 2N1131	
Q245	*151-087	Selected from 2N1131	
Q283	151-076	2N2048	
Q294	151-094	2N835	100-1029
Q294	*151-108	Replaceable by 2N2501	1030-up
Q314	151-076	2N2048	
Q323	*151-062	Selected from TIN101	100-1029
Q323	*151-108	Replaceable by 2N2501	1030-up
Q333	*151-062	Selected from TIN101	100-1029
Q333	*151-108	Replaceable by 2N2501	1030-up
Q354	151-058	RT5204	100-2318
Q354	*151-103	Replaceable by 2N2219	2319-up
Q364	151-058	RT5204	100-2318
Q364	*151-103	Replaceable by 2N2219	2319-up
Q424	151-058	RT5204	

## Electron Tubes

V13	154-378	7895
V63	154-378	7895
V152	154-016	6AL5
V161	154-278	6BL8
V194	154-187	6DJ8
V252	154-016	6AL5
V261	154-278	6BL8
V383	154-187	6DJ8
V414	154-187	6DJ8
V439	154-370	ZZ1000

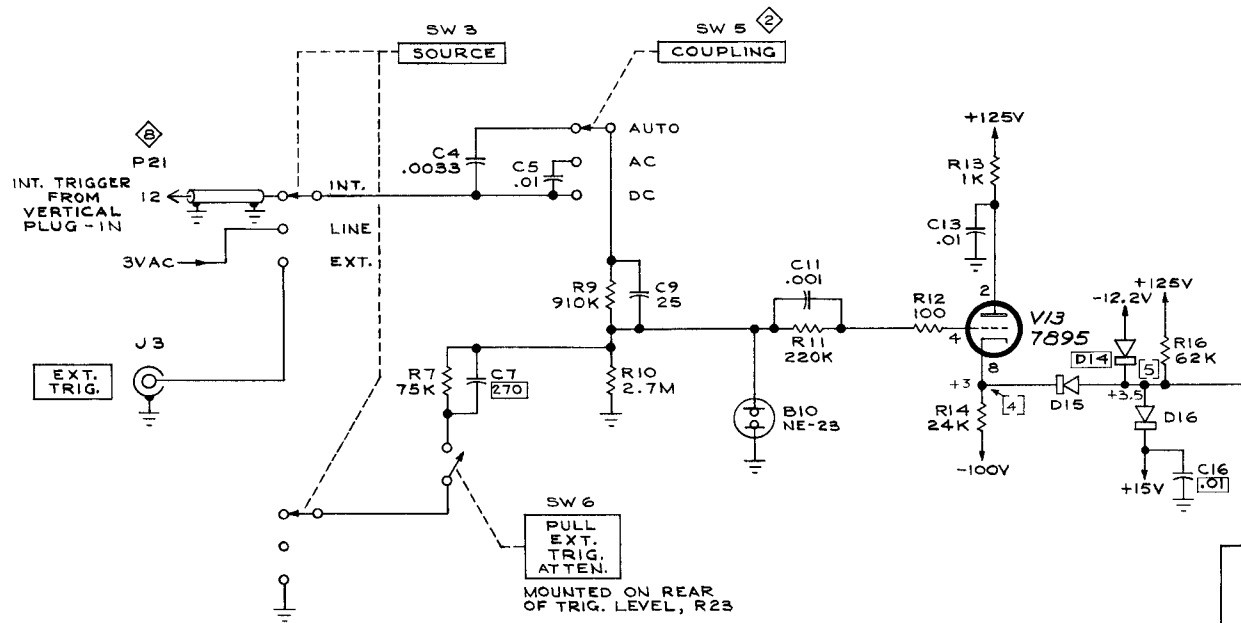


TYPE 3B3 PLUG-IN



MR4  
1264

BLOCK DIAGRAM



#### IMPORTANT:

ALL CIRCUIT VOLTAGES WERE OBTAINED WITH A 20,000Ω/V VOM. ALL READINGS ARE IN VOLTS.  
VOLTAGE & WAVEFORM AMPLITUDE MEASUREMENTS ARE NOT ABSOLUTE. THEY MAY VARY BETWEEN INSTRUMENTS AS WELL AS WITHIN THE INSTRUMENT ITSELF DUE TO NORMAL MANUFACTURING TOLERANCES AND TRANSISTOR AND VACUUM TUBE CHARACTERISTICS.  
ACTUAL PHOTOGRAPHS OF WAVEFORMS ARE SHOWN.

#### REFERENCE DIAGRAMS

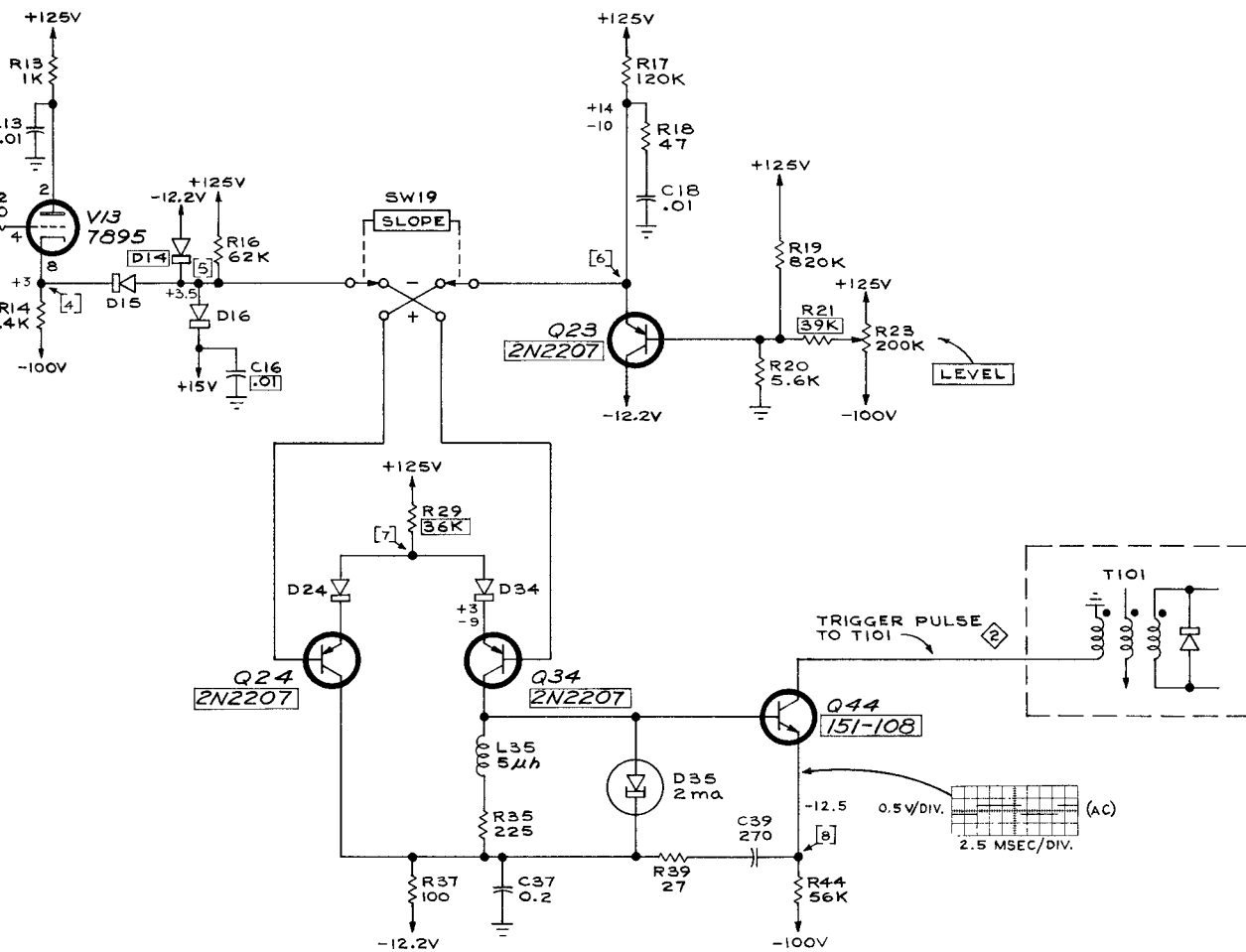
- ② NORMAL SWEEP GENERATOR
- ⑧ HORIZONTAL AMPLIFIER

WAVEFORMS & VOLTAGE READINGS WERE OBTAINED UNDER FOLLOWING CONDITIONS:

LEVEL:	
UPPER VOLTAGE READINGS	CW
LOWER VOLTAGE READINGS	CCW
COUPLING	AC
SOURCE	LINE
SLOPE	+

TYPE 3B3 PLUG-IN

B



WERE

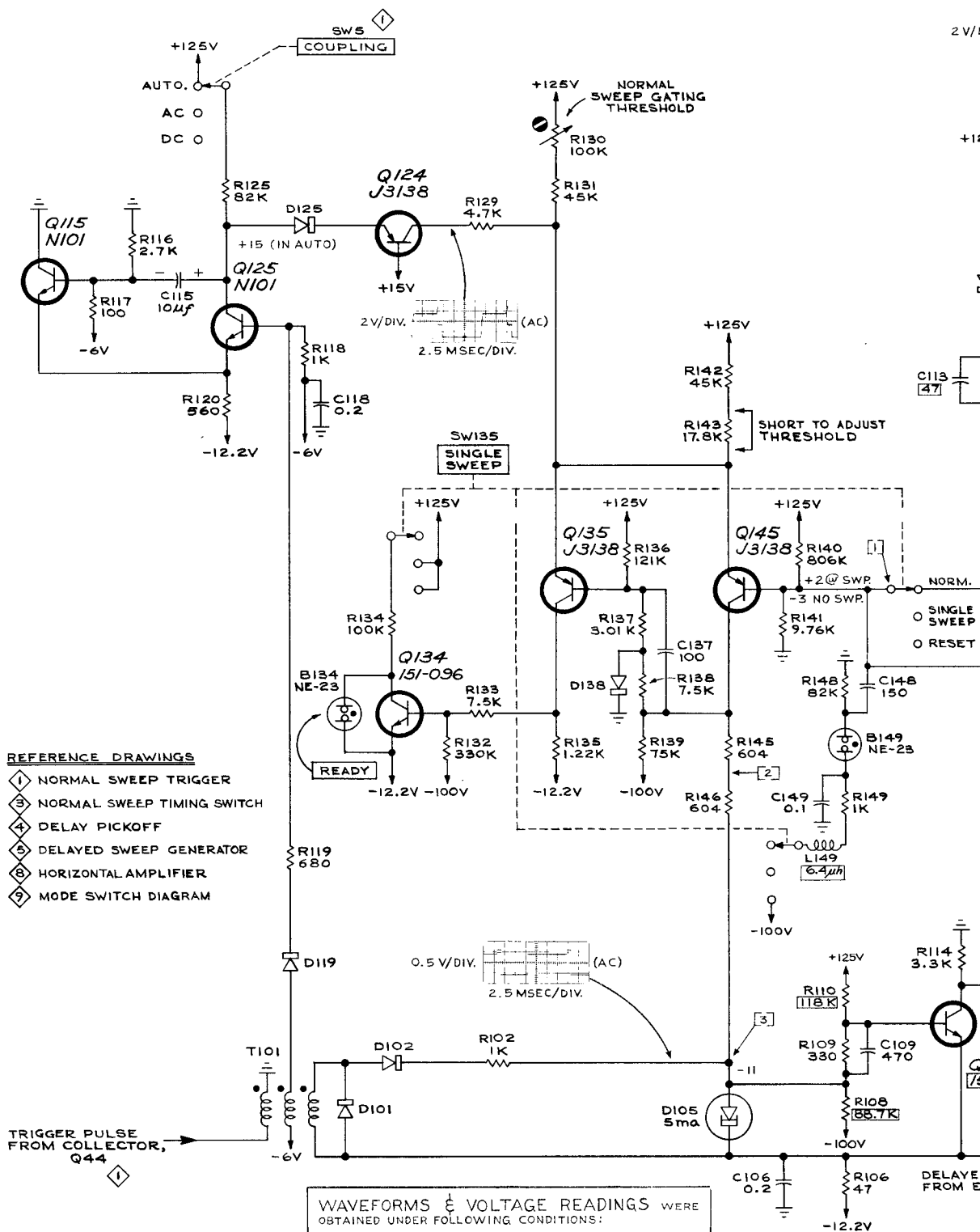
CW  
CW  
AC  
INE  
+

SEE PARTS LIST FOR EARLIER  
VALUES AND S/N CHANGES OF  
PARTS MARKED WITH BLUE  
OUTLINE

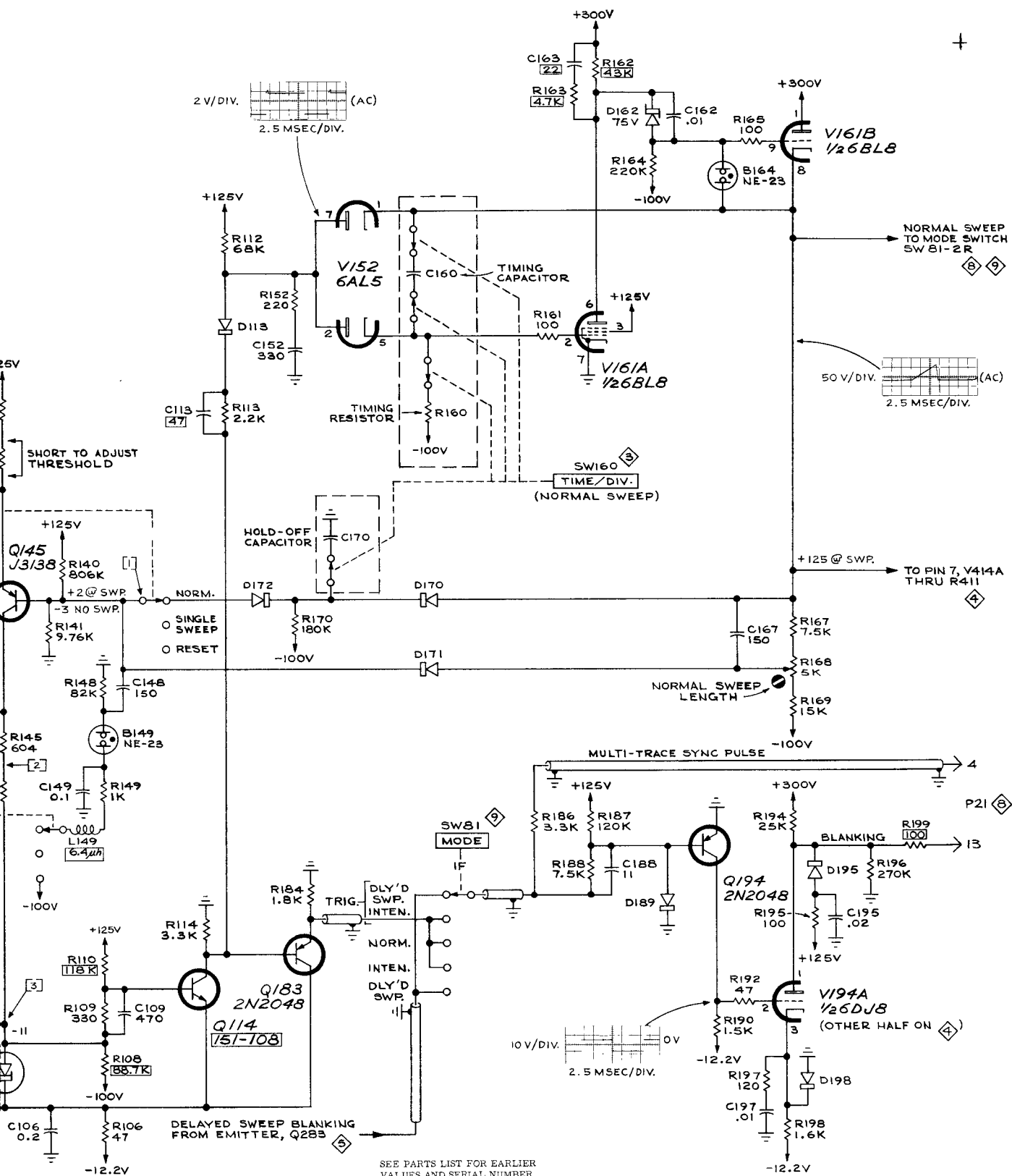
MR4  
1063

# NORMAL SWEEP TRIGGER

CIRCUIT NUMBERS  
1 THRU 49





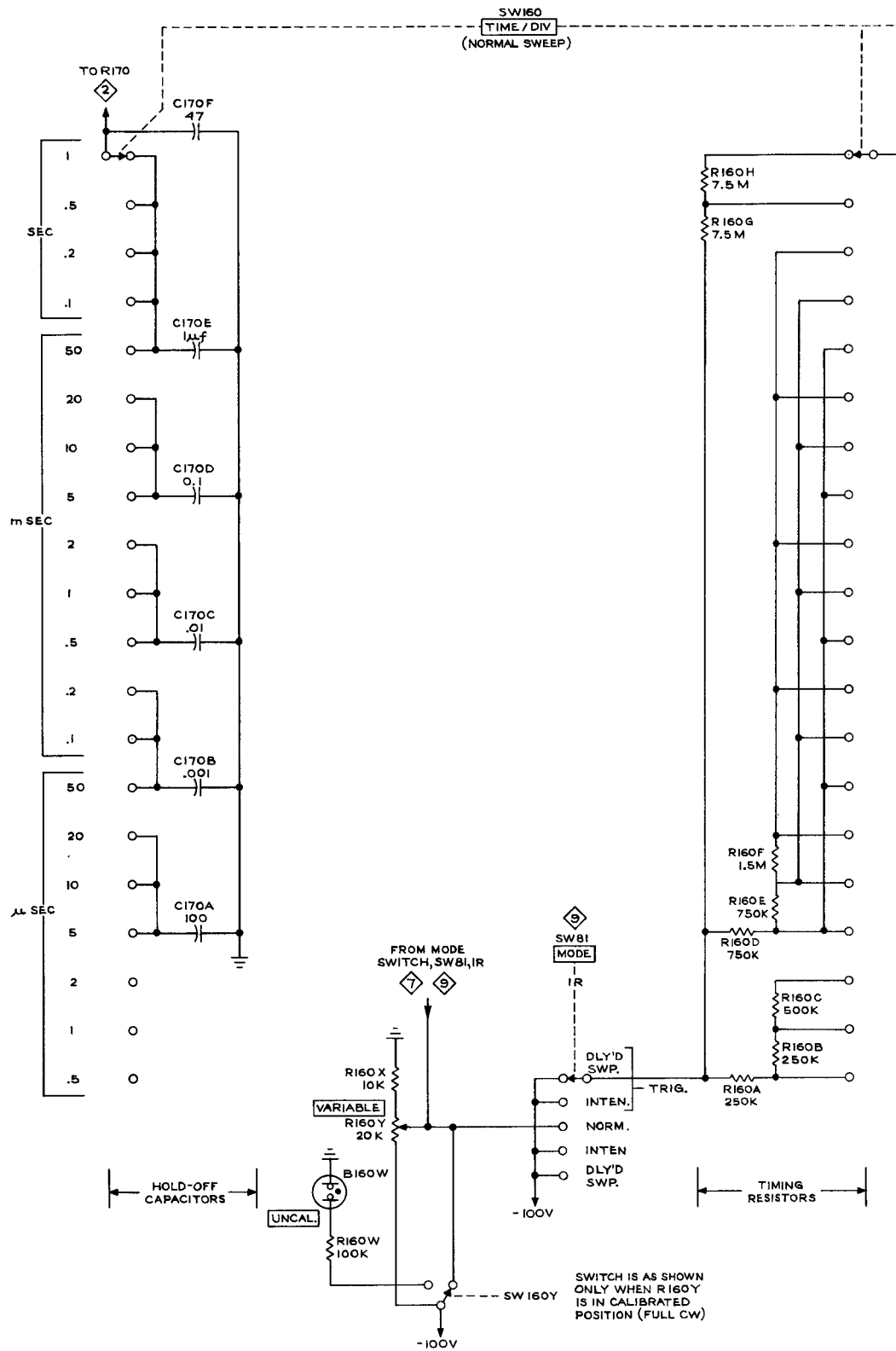


C<sub>2</sub>

## NORMAL SWEEP GENERATOR

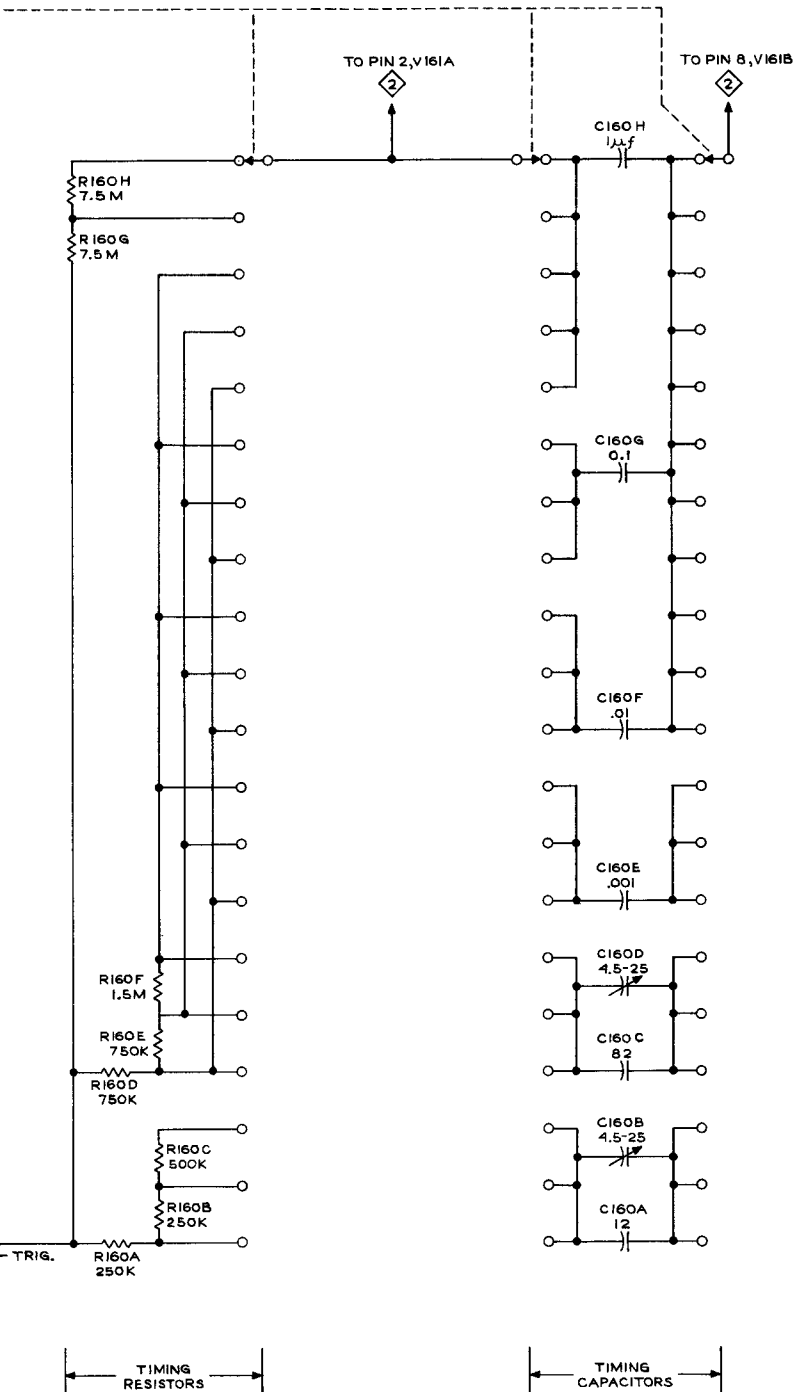
CIRCUIT NUMBERS  
100 THRU 199

MRH  
565



TYPE 3B3 PLUG-IN

A

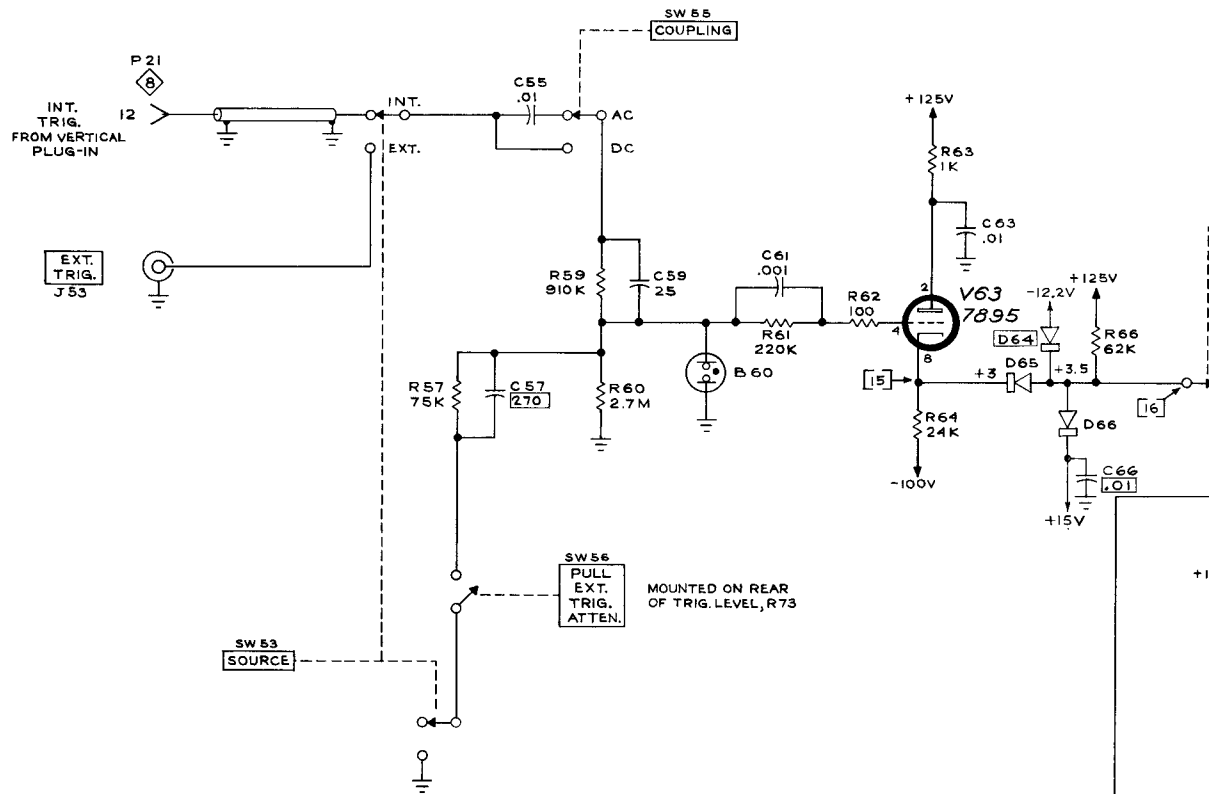


AS SHOWN  
EN R160Y  
BRATED  
(FULL CW)

CMD  
853

A

NORMAL SWEEP TIMING SWITCH



#### REFERENCE DRAWINGS

- 6 DELAYED SWEEP GENERATOR
- 8 HORIZONTAL AMPLIFIER
- 9 MODE SWITCH DIAGRAM

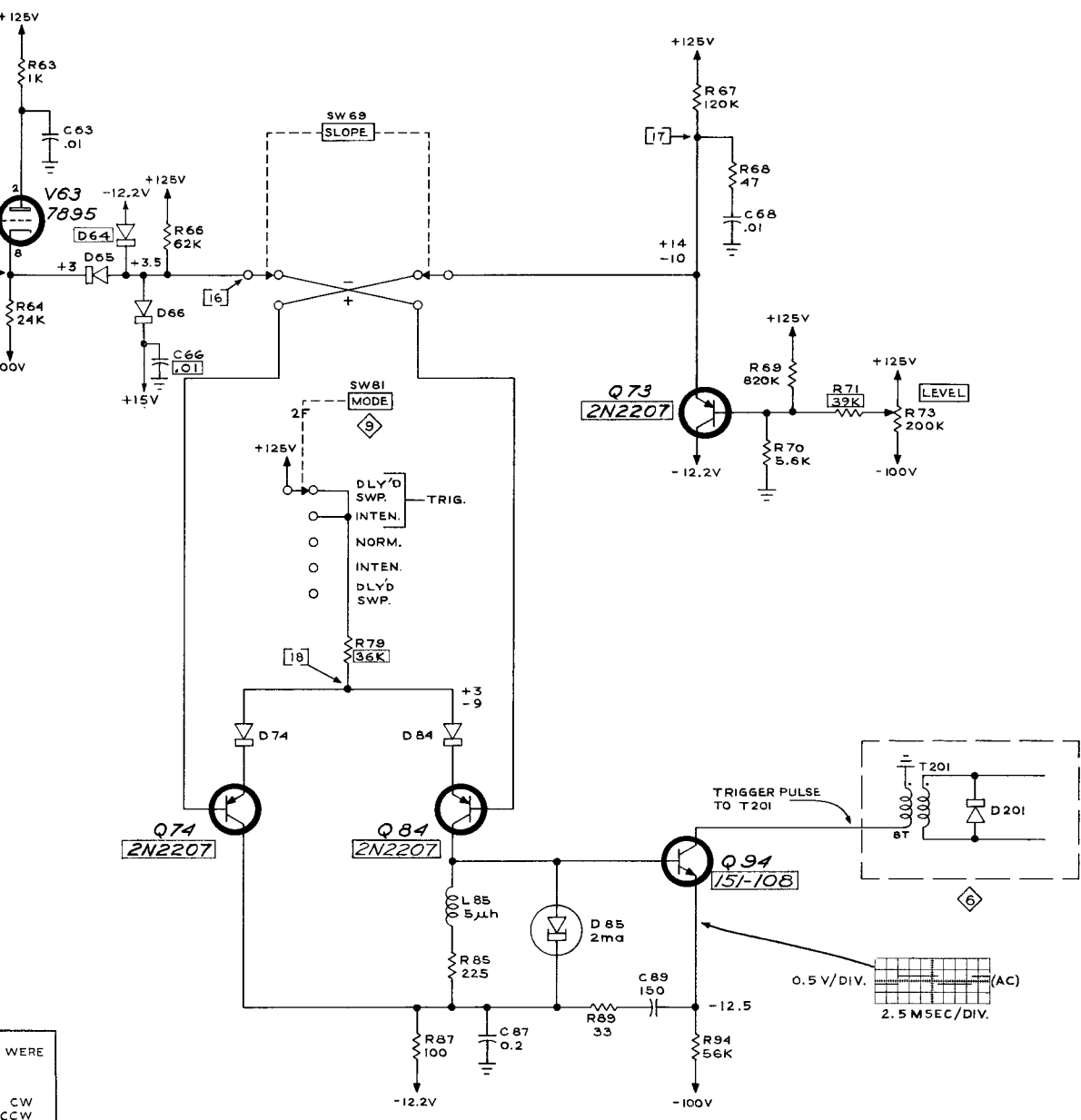
WAVEFORMS & VOLTAGE READINGS WERE OBTAINED UNDER FOLLOWING CONDITIONS:

LEVEL:  
 UPPER VOLTAGE READINGS . . . . . CW  
 LOWER VOLTAGE READINGS . . . . . CCW  
 MODE . . . . . DLY'D  
 SOURCE . . . . . LINE  
 SLOPE . . . . . +

SEE IMPORTANT NOTE ON NORM. SWR TRIG. DIAG.

SEE PARTS LIST FOR VALUES AND S/N CHART. PARTS MARKED WITH OUTLINE

TYPE 3B3 PLUG-IN



+

WERE  
CW  
CCW  
DLY'D  
LINE  
+  
DIAG.

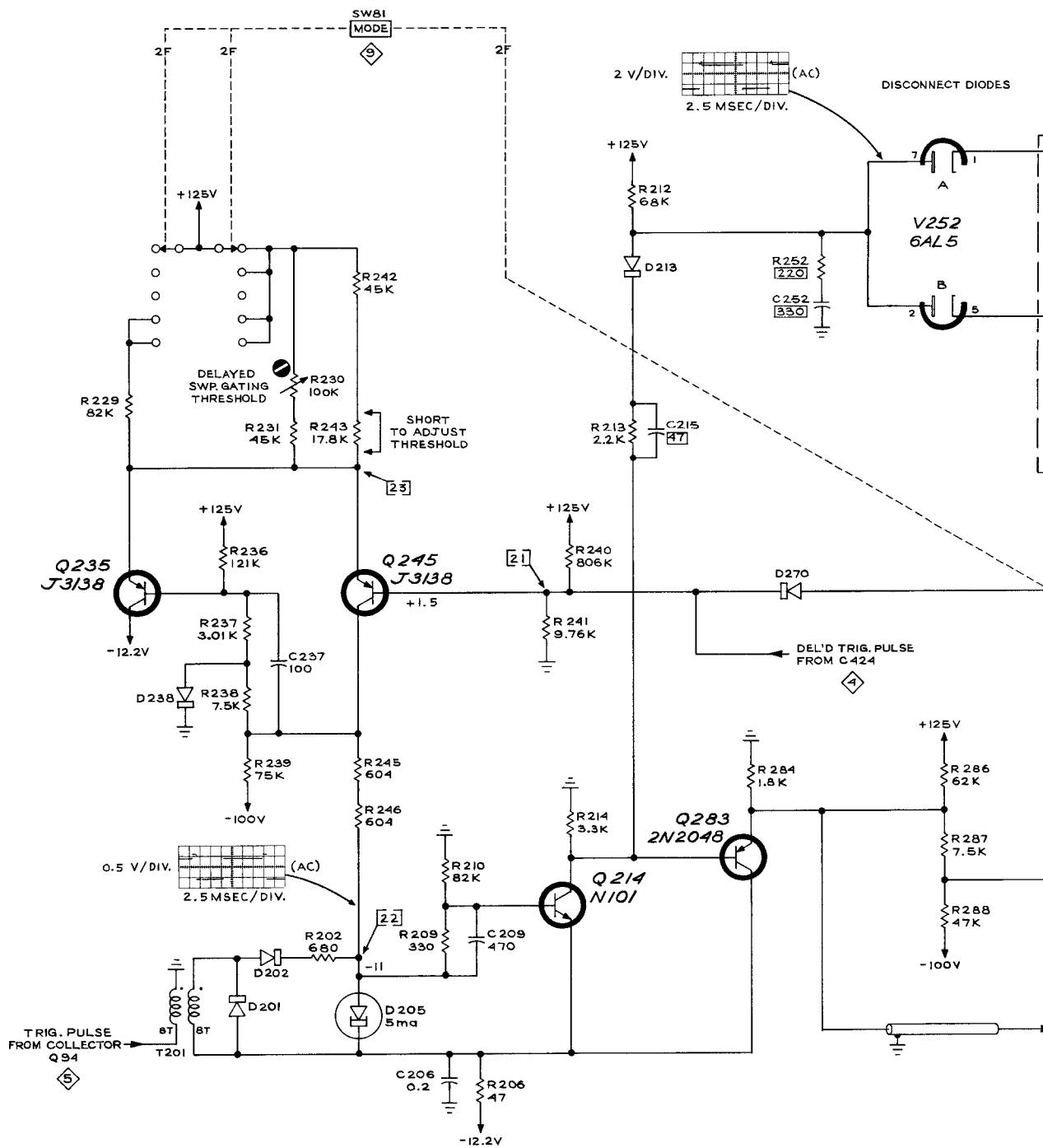
SEE PARTS LIST FOR EARLIER  
VALUES AND S/N CHANGES OF  
PARTS MARKED WITH BLUE  
OUTLINE

CIRCUIT NUMBERS  
50 THRU 99

CMD  
1063

DELAYED SWEEP TRIGGER

B



WAVEFORMS & VOLTAGE READINGS WERE  
OBTAINED UNDER FOLLOWING CONDITIONS:

MODE . . . . . DLY'D SWEEP

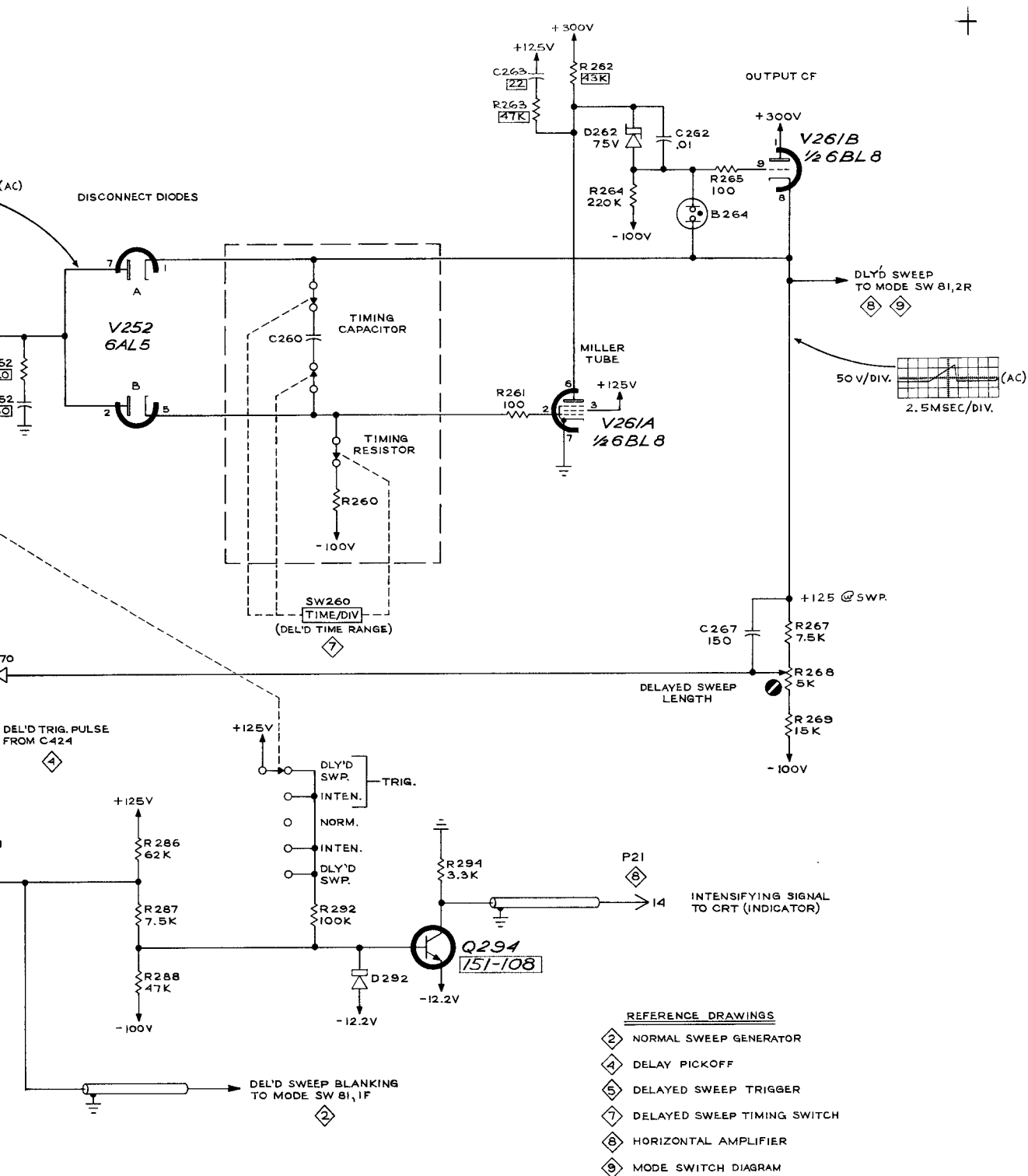
TIME/DIV . . . . . 0.5 MSEC



TYPE 3B3 PLUG-IN

SEE IMPORTANT NOTE ON NORM. SWP. TRIG. DIAG.

C



SEE PARTS LIST FOR EARLIER  
VALUES AND S/N CHANGES OF  
PARTS MARKED WITH BLUE  
OUTLINE

CIRCUIT NUMBERS  
200 THRU 299

CMD  
864

## DELAYED SWEEP GENERATOR

SW260  
TIME / DIV.  
(DELAYED SWEEP)

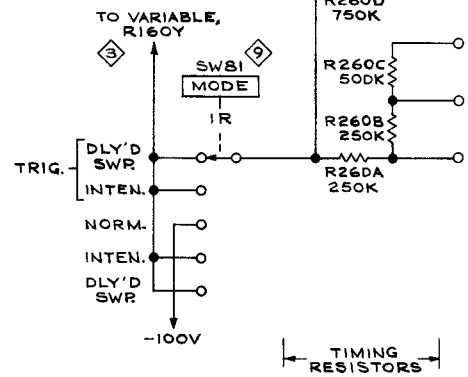
R260H  
7.5M  
R260G  
7.5M

R260F  
1.5M  
R260E  
750K  
R260D  
750K

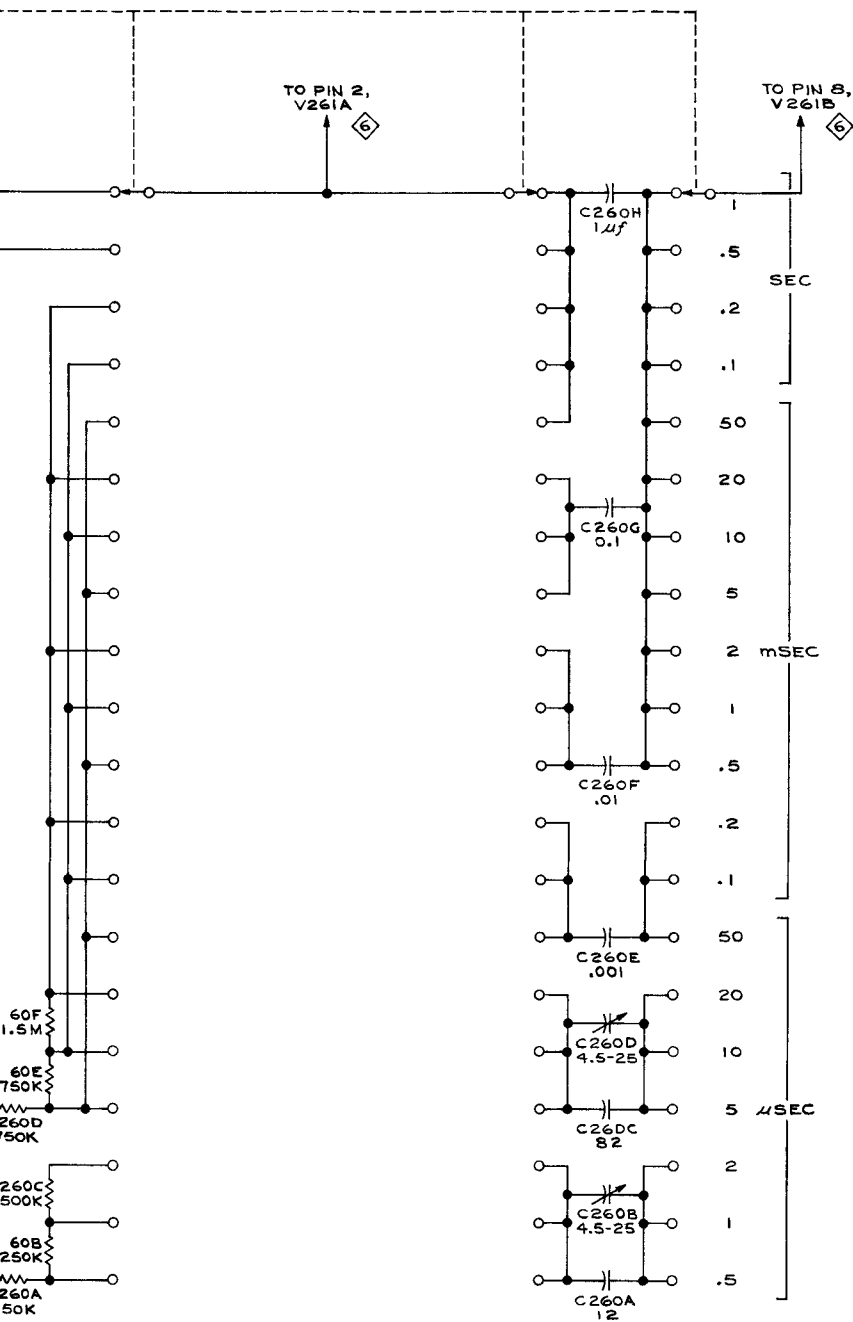
R260C  
500K  
R260B  
250K  
R260A  
250K

# REFERENCE DIAGRAM

- 3 NORMAL SWEEP TIMING SWITCH
- 6 DELAYED SWEEP GENERATOR
- 9 MODE SWITCH DIAGRAM

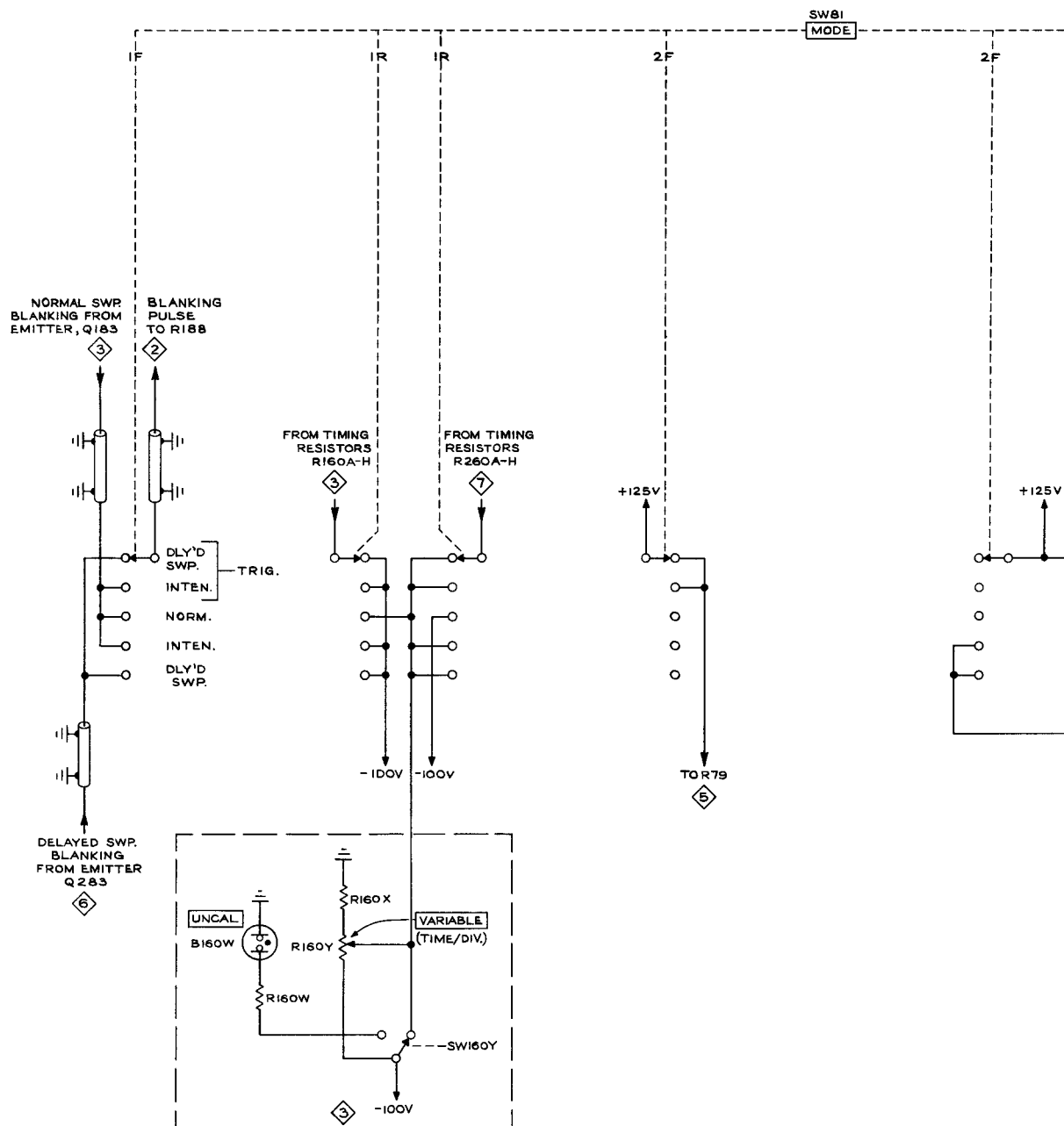




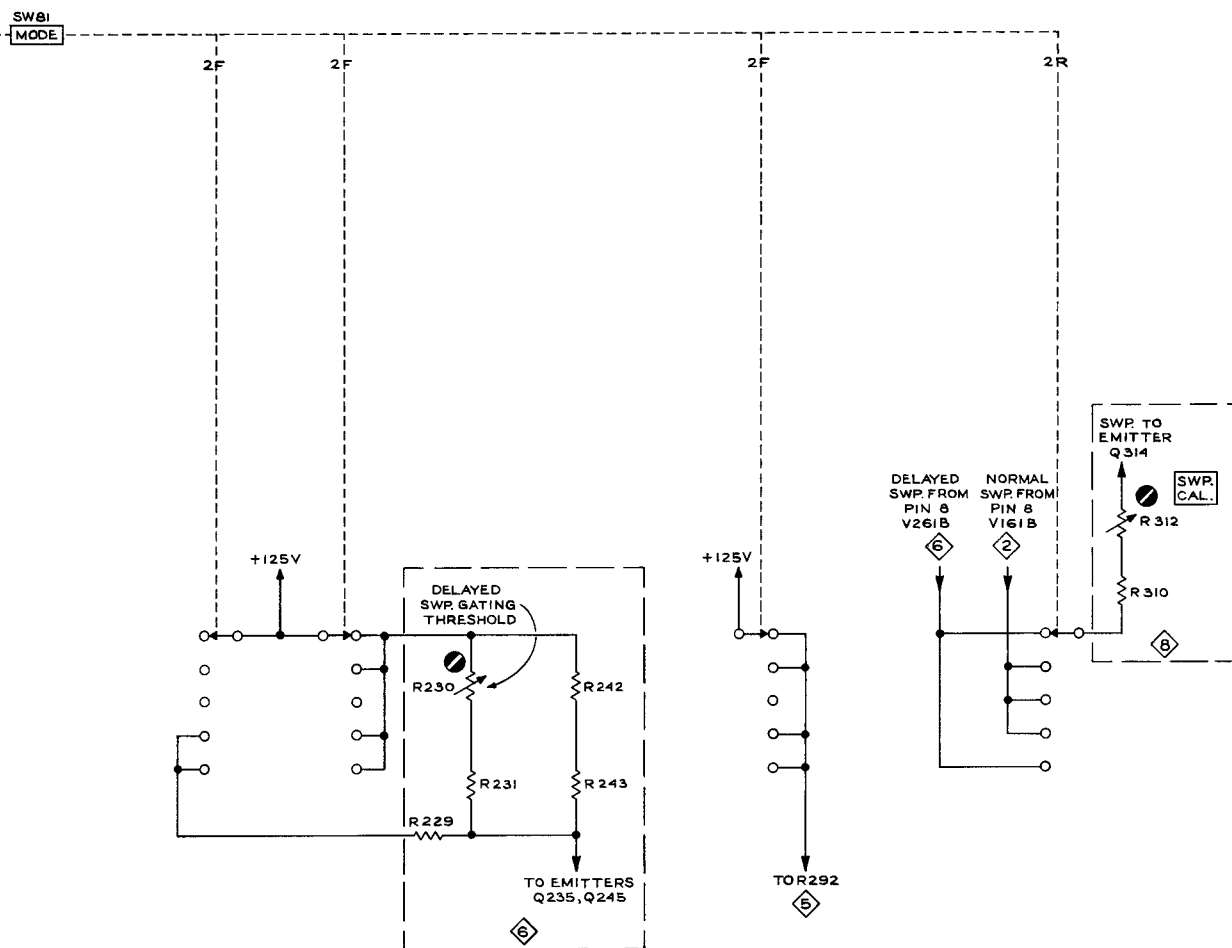


MRH  
863

DELAYED SWEEP TIMING SWITCH



TYPE 3B3 PLUG-IN



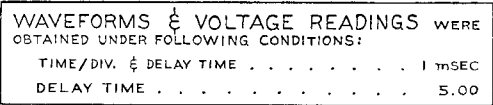
#### REFERENCE DRAWINGS

- 2 NORMAL SWEEP GENERATOR
- 3 NORMAL SWEEP TIMING SWITCH
- 5 DELAYED SWEEP TRIGGER
- 6 DELAYED SWEEP GENERATOR
- 7 DELAYED SWEEP TIMING SWITCH
- 8 HORIZONTAL AMPLIFIER

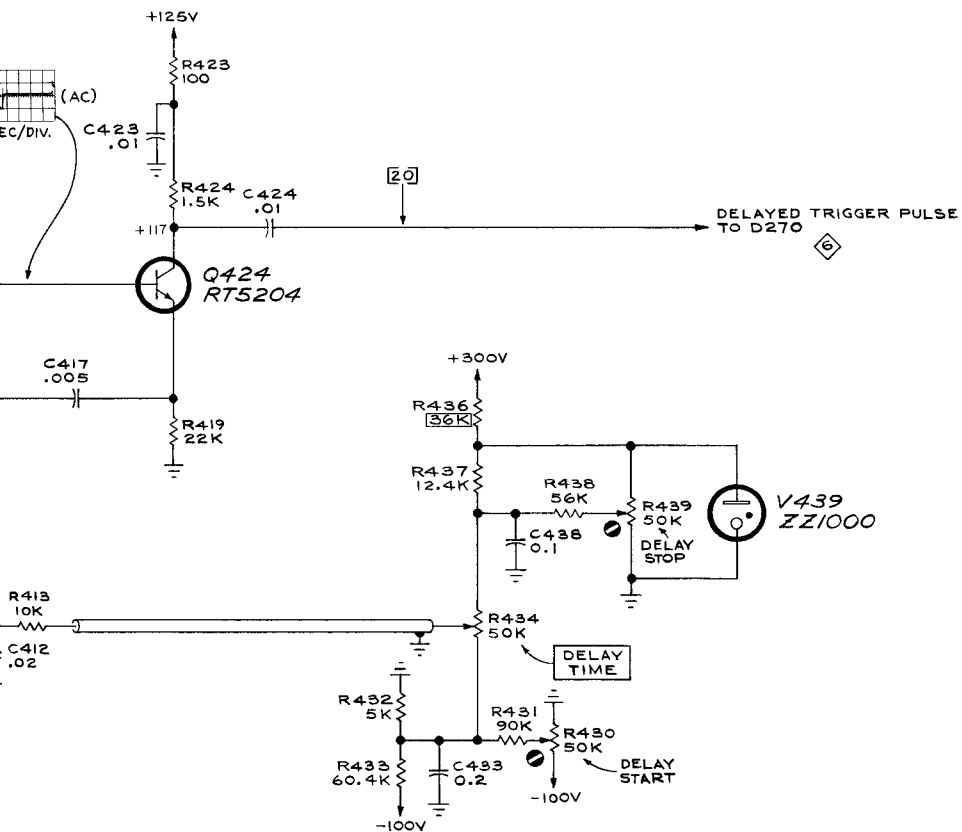
CMD  
863

MODE SWITCH DIAGRAM

A



SEE  
VAN  
RAN  
WIT



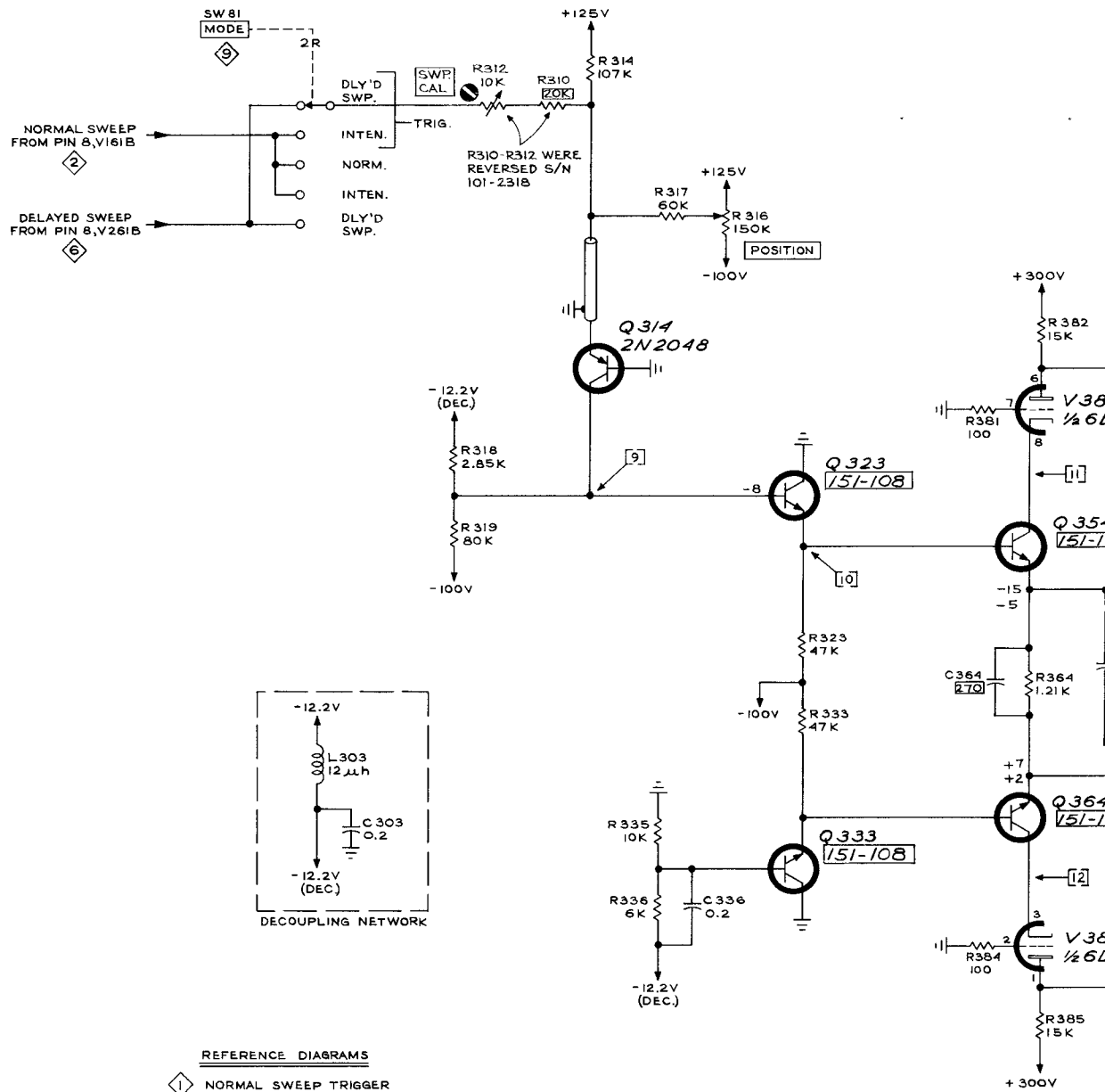
SEE PARTS LIST FOR EARLIER  
VALUES AND SERIAL NUMBER  
RANGES OF PARTS MARKED  
WITH BLUE OUTLINE.

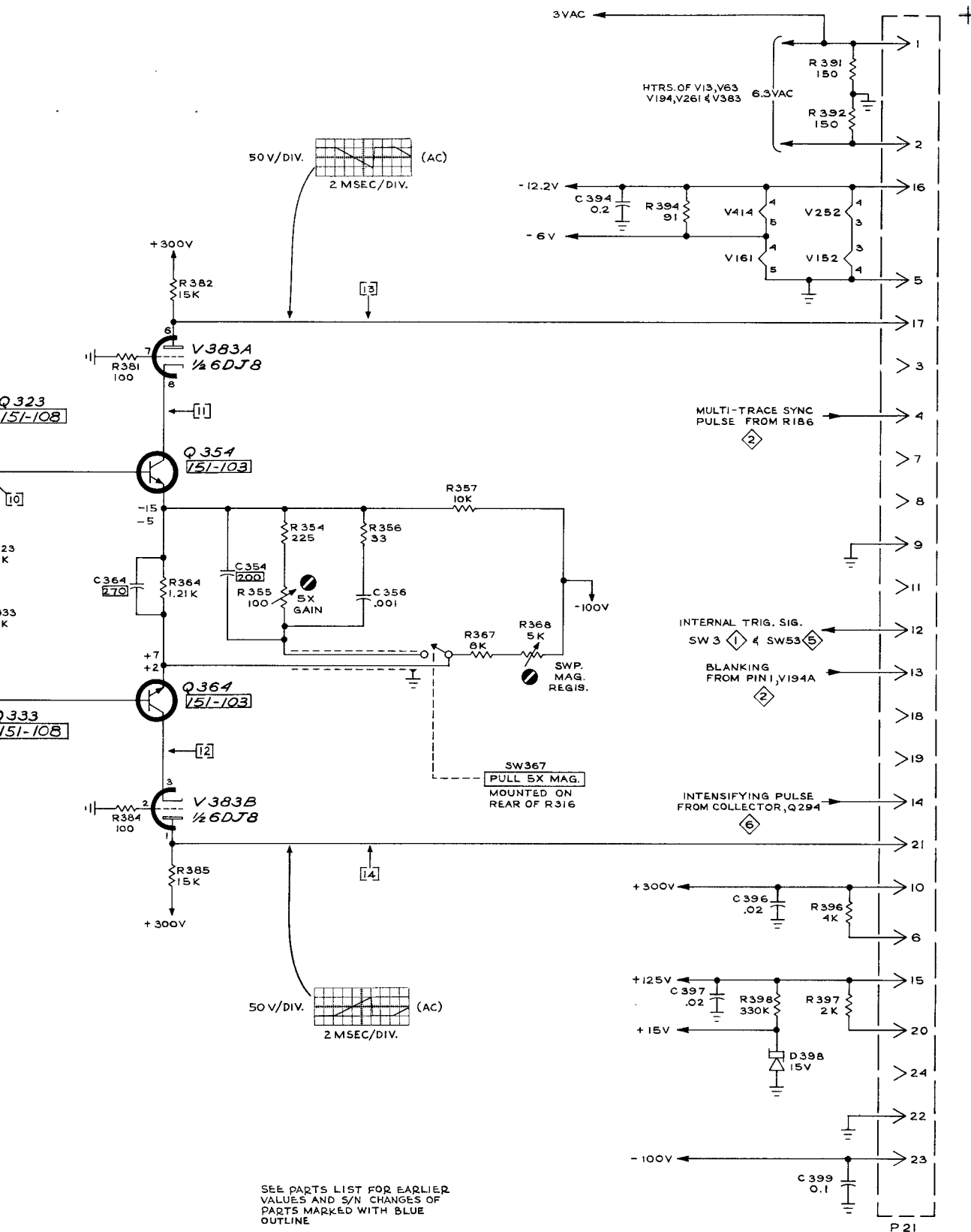
#### REFERENCE DIAGRAMS

- ② NORMAL SWEEP GENERATOR
- ⑥ DELAYED SWEEP GENERATOR

MRH  
764  
DELAY PICKOFF

CIRCUIT NUMBERS  
400 THRU 439





## **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. If it does not, your manual is correct as printed.



TYPE 3B1 -- TENT. S/N 3880

TYPE 3B3 -- TENT. S/N 3690

PARTS LIST CORRECTIONS

CHANGE TO:

R21	301-0393-00	39 k	1/2 w	5%
R71	301-0393-00	39 k	1/2 w	5%

TYPE 3B1 -- TENT. S/N 3930

TYPE 3B3 -- TENT. S/N 3840

# PARTS LIST CORRECTIONS

## REMOVE:

R397	308-0003-00	2 k	5 w	WW	5%
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## CHANGE TO:

R396	308-0003-00	2 k	5 w	WW	5%
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## ADD:

R393 <sup>1</sup>	308-0245-00	.6 $\Omega$	2 w	WW	
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<sup>1</sup> Added in series with the filament of V261.