INSTRUCTION MANUAL

3B1

PLUG-IN UNIT

MANUFACTURERS OF CATHODE-RAY OSCILLOSCOPES

INSTRUCTION MANUAL

Serial Number 4275

3B1

PLUG-IN UNIT

Tektronix, Inc.
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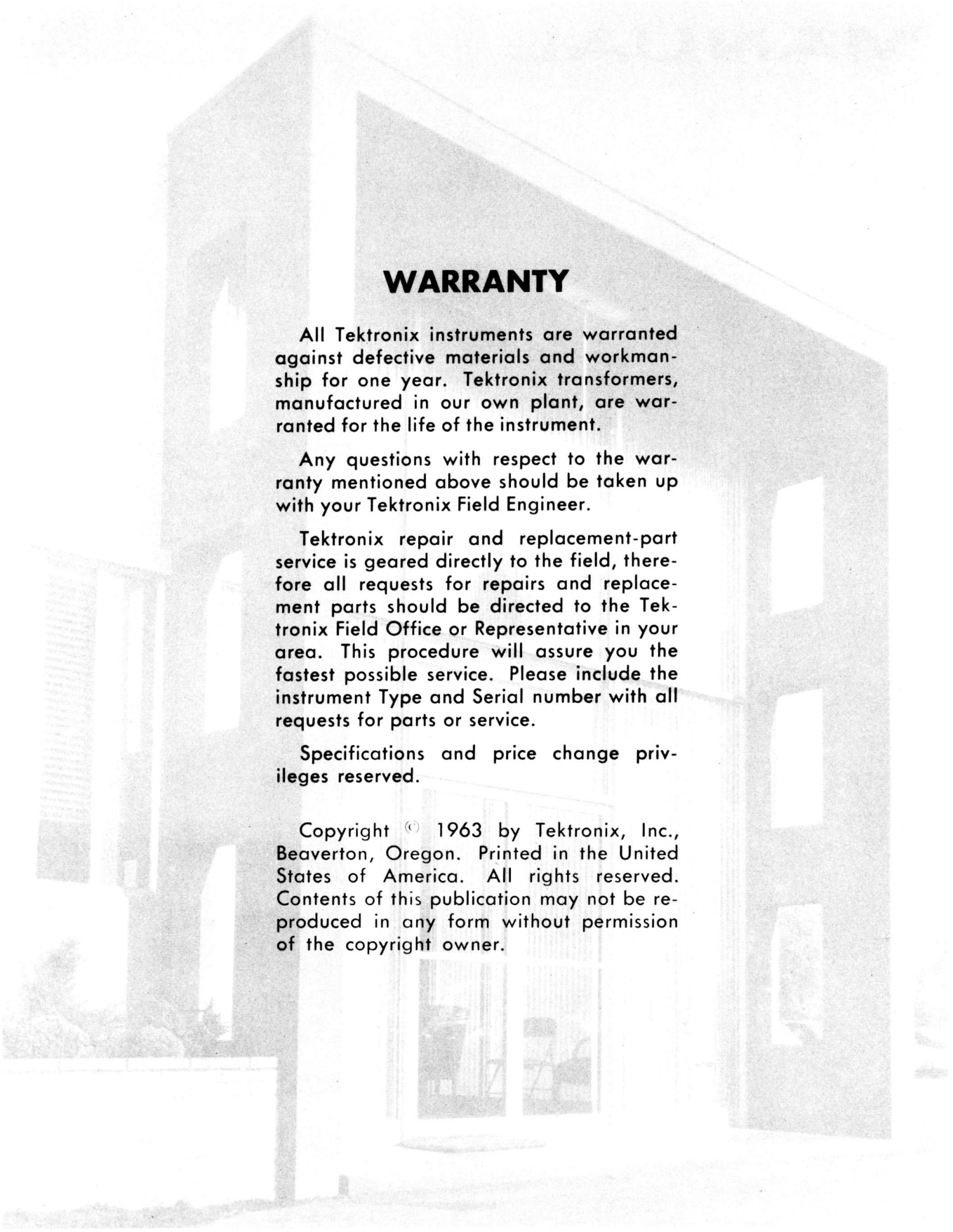

WARRANTY

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.

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

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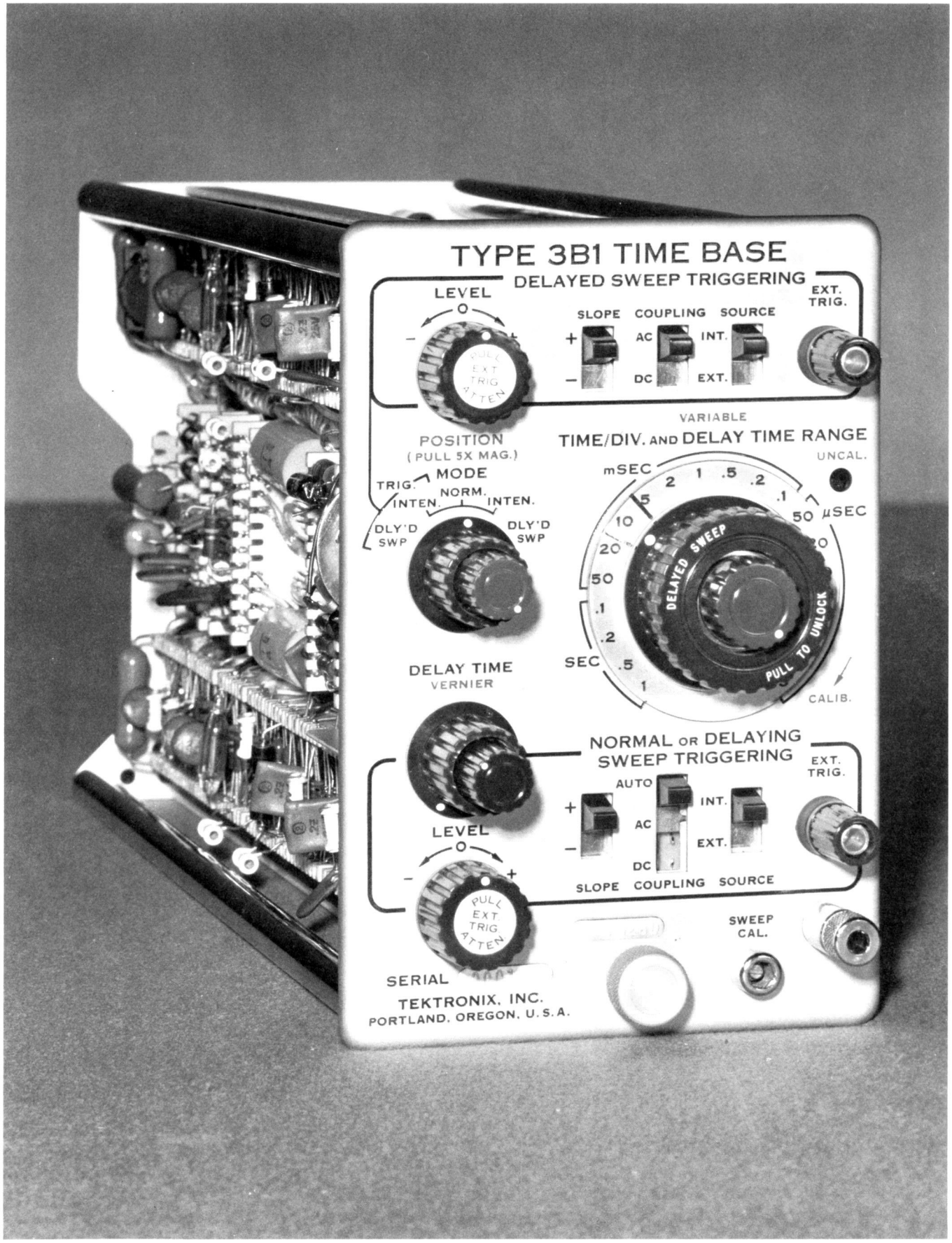

TYPE 3B1 TIME BASE
DELAYED SWEEP TRIGGERING
LEVEL
SLOPE
COUPLING
SOURCE
EXT. TRIG.
AC
DC
INT.
EXT.
VARIABLE
POSITION
(PULL 5X MAG.)
TIME/DIV. AND DELAY TIME RANGE
UNCAL.
MODE
TRIG.
INTEN.
NORM.
INTEN.
DLY'D SWP
DLY'D SWP
mSEC
μSEC
SEC
DELAYED SWEEP
PULL TO UNLOCK
CALIB.
DELAY TIME
VERNIER
NORMAL OR DELAYING
SWEEP TRIGGERING
AUTO
SWEEP
CAL.
SERIAL
TEKTRONIX, INC.
PORTLAND, OREGON, U.S.A.

Type 3B1

SECTION 1

CHARACTERISTICS

General

The Type 3B1 Time Base plug-in unit is designed for use with Tektronix Type 561A, 564, or 567 Oscilloscope. It provides normal or delayed sweeps at 20 calibrated rates from 0.5 microseconds per division to 1 second per division. In addition, special circuits in the Type 3B1 give continous variable sweep delay from 0.5 microsecond to 10 seconds.

Sweep Rates

Normal sweep 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 about 3 seconds per division.

Delayed sweep from 0.5 microsecond per division to 1 second per division in 20 calibrated steps.

Calibrated sweep rates are typically within 1%, and in all cases, within 3% of the TIME/DIV. switch setting.

5X Magnifier (calibrated)

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

Sweep Delay

The sweep delay is continuously variable from 0.5 microsecond to 10 seconds. Time jitter is less than 1 part in 20,000.

Triggering Modes

Normal Sweep: Automatic, ac- or dc-coupled, + or — slope, internal or external source.

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

Triggering Signal Requirements

Internal Triggering: From Dc to 5 mc. A signal that produces 2 minor divisions of vertical deflection. From 5 mc to 10 mc. The requirements rise to a signal that produces .5 major division of vertical deflection. Applies to both normal and delayed sweep.

External Triggering: Dc to 5 mc. Minimum of 0.5 volt. A front-panel attenuator switch is used for triggering signals between 15 and 150 volts. Rises to 1.25 volts at 10 mc.

Trigger Frequency: Dc to 10 megacycles.

Mechanical

Construction: Aluminum-alloy chassis.

Finish: Anodized panel.

Accessories

Information on accessories for use with this instrument is included at the rear of the mechanical parts list.

NOTES

SECTION 2

OPERATING INSTRUCTIONS

General

This section describes the operation of the front-panel controls and gives step-by-step instructions on how to display a signal. Measurements that can be made with the Type 3B1 are described in the applications section of this manual. The Type 3B1 should be inserted in the right-hand (X-axis) opening of a Tektronix Type 561A, 564, or 567 Oscilloscope. A vertical amplifier plug-in unit such as the Type 3A1 (or any series '2' or '3' non-sampling vertical amplifier) should be inserted in the left-hand (Y-axis) opening.

FUNCTIONS OF CONTROLS AND CONNECTORS

Delayed Sweep Triggering Group

LEVEL — This dual-purpose control sets the point on the slope of the waveform at which the delayed sweep is triggered. When the control is pulled out an external trigger attenuator is switched in.

EXT. TRIG. ATTEN. — When the LEVEL control is pulled out, an attenuator is connected into the external trigger circuit. The attenuator is used when the external trigger voltage is between 15 and 150 volts.

SLOPE + OR — — Selects the waveform slope that will trigger the sweep.

COUPLING AC-DC — In the DC position, the trigger signal passes directly to the trigger circuits. In the AC position, a capacitor blocks any dc component of the signal.

SOURCE INT.-EXT. — This switch is pushed up for internal triggering and pushed down for external triggering.

EXT. TRIG. — Jack used to connect an external trigger signal to the delayed sweep trigger circuits.

MODE Switch

NORM. — Position for normal sweep at rate set by the TIME/DIV. switch and triggered by the NORMAL SWEEP TRIGGERING controls.

INTEN. — Intensifies a portion of the display. The width of this portion depends on the DELAY TIME RANGE switch setting. The position on the display is set by the DELAY TIME control.

DLY'D SWP — Expands the intensified portion of the display across the full crt width. The time per division is set by the DELAYED SWEEP knob.

TRIG. INTEN. — The triggered delayed sweep shows as an intensified portion of the display. The position of the intensified portion depends on the Delayed Sweep Triggering LEVEL control and the setting of the DELAY TIME control.

TRIG. DLY'D SWP — Expands the intensified portion of the display set in the TRIG. INTEN. position of the MODE switch. The time per division of the display is set by the DELAYED SWEEP knob.

POSITION — This red knob mounted on the MODE switch moves the display horizontally.

5X MAG. — The POSITION control also serves as the 5X MAG. switch; pull out for 5 times magnification.

TIME/DIV. and DELAY TIME RANGE — This is two switches in one. The large black knob has a white dot on its edge. When this dot is between the two black stripes on the clear plastic ring, the switches lock together and the knob sets the time per division for both the normal and delayed sweep. When the black knob is pulled out and turned, it sets the time per division of the delayed sweep and the delay time range. The TIME/DIV. of the normal sweep (clear plastic ring) remains in its position, and the DELAYED SWEEP knob can be adjusted independently.

VARIABLE TIME/DIV. — This control (red knob) is mounted on the TIME/DIV. switch. It clicks into the CALIB. position when turned fully clockwise. When this control is not in the CALIB. position, the UNCAL. neon indicator will light. The control gives a continuously variable sweep rate from 0.5 micro-seconds to 2.5 seconds per division (uncalibrated). When the MODE switch is in the NORM. position, the VARIABLE TIME/DIV. control varies the time per division of the normal sweep. In all other positions of the MODE switch, the control varies the time per division of the delayed sweep.

DELAY TIME — Sets the point on the display where the delayed sweep starts (beginning of the intensified portion of the display).

VERNIER — A fine adjustment for the DELAY TIME control.

Normal or Delaying Sweep Triggering Group

LEVEL — This dual-purpose control sets the point on the slope of the waveform at which the sweep is triggered. When the control is pulled out, an external attenuator is switched in.

EXT. TRIG. ATTEN. — When the LEVEL control is pulled out, an attenuator is switched into the external trigger circuit for use when the external trigger voltage is between 15 and 150 volts.

SLOPE + or — — Selects the waveform slope that will trigger the sweep.

COUPLING AUTO-AC-DC — In the AUTO position, the sweep free-runs in the absence of a trigger signal. A suitable trigger, however, will override the AUTO circuitry and trigger the sweep. In the DC position, the trigger signal passes directly to the trigger circuit. In the AC position, a capacitor blocks any dc component of the signal.

SOURCE INT.-EXT. — This switch is pushed up for internal triggering and pushed down for external triggering.

EXT. TRIG. — This jack is used to connect the external trigger signal to the normal sweep trigger circuit.

SWEEP CAL. — Adjust to compensate for variation between indicators.

First-Time Operation

The following steps will help you become familiar with the instrument operation. They cover the control groups; how and when to use them, and the expected results.

The first 10 steps cover the controls in the NORMAL SWEEP TRIGGERING group located at the bottom of the Type 3B1.

1. Preset the Type 3B1 controls as follows:

   MODE — NORM.

   POSITION — Center of range and pushed in. 5 msec (set white dot between black lines on plastic ring).

   VARIABLE — CALIB.

   Normal Sweep Triggering Group

   LEVEL — Center of range and pushed in.

   COUPLING — AUTO

   SOURCE — INT.

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 vertical amplifier plug-in for several divisions of vertical deflection.

4. You should now have several cycles of a steady (triggered) calibrator waveform.

5. 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.

6. Push 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.

7. Push the COUPLING switch to AC; the controls should work the same as described in step 6.

8. Notice that the display starts at either the bottom or the top of a pulse. Push the SLOPE switch to the opposite polarity; the trace should reverse and start opposite to its first condition.

9. Connect a cable from the calibrator to the Normal Sweep Triggering EXT. TRIG. jack. Push the SOURCE switch to EXT.

10. Repeat steps 5 through 8. Notice that the trigger controls work the same as for internal trigger signals except the LEVEL adjustment may be more critical. External trigger signals are used in certain applications, and these are explained later in the text.

The preceding steps covered the normal sweep circuits; the following steps cover the delayed sweep.

1. Set the Normal Sweep Triggering SOURCE switch to INT., the COUPLING switch to AUTO, and adjust the controls for a steady display.

2. Set the DELAY TIME and VERNIER controls to the center of their range and turn the MODE switch to INTEN. (to the right of NORM.).

3. Pull the DELAYED SWEEP knob 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 will move across the crt.

4. Turn the DELAYED SWEEP knob further to the right. Each click will make the intensified display smaller although it can still be moved by the DELAY TIME control.

5. Turn the MODE switch to DLY'D SWP (on the right). The intensified zone observed 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 switch is turned to DLY'D SWP.

The following steps cover controls in the Delayed Sweep Triggering group located at the top of the Type 3B1.

1. Return the MODE switch to NORM. and the TIME/DIV. and DELAY TIME RANGE switches to 5 mSEC.

2. Set the Delayed Sweep Triggering group controls as follows:

LEVEL	Fully counterclockwise
SLOPE	+
COUPLING	AC
SOURCE	INT.

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

Triggering

The choice of triggering depends on the type and portion of the signal you want to see. For example, if the display starts on the leading edge of the signal and you want to start on the trailing edge, push the SLOPE switch to the other position.

The AUTO position of the COUPLING switch works well from 15 cps to 10 mc. It also 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 switch is the same as the AUTO Position except the display does not free-run. Both the AUTO and AC positions reject any dc component present in the signal from the vertical amplifier plug-in. Adjusting the POSITION control on the vertical amplifier plug-in does not affect triggering in the AUTO or AC positions.

In the DC position of the COUPLING switch, 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.

External triggering should be used when signals are checked at 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, if you want to examine a small pulse, 5 microseconds from the start of a pulse train from a computer circuit, use the TIME/DIV. and the DELAYED SWEEP switches and the TRIG. DLY'D SWP position of the MODE switch to expand the display to show only the small pulse. Then adjust the Delayed Sweep LEVEL control for a steady 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 switches work the same as their counterparts in normal-sweep operation. The proper position for these switches depends on the type of waveform being examined. A full description of the delayed sweep and trigger circuits will be found in section 4, Circuit Description.

Sweep Magnification

The display can be expanded to 5 times its normal width by pulling out the 5X MAG. switch (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 μSEC 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 Calibration

Sweep calibration should be checked and adjusted, if necessary, whenever the Type 3B1 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 ccps, since this frequency is used to synchronize the calibrator.

Check and adjust sweep calibration as follows:

1. Set the MODE switch to NORM.
2. Set the TIME/DIV. switch to 5 mSEC (be sure the 5X MAG. switch (POSITION control) 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 steady display.
4. There should be exactly 3 cycles of the calibrator signal across the 10 divisions of the graticule; if not, adjust the front panel SWEEP CAL. control until there is.

NOTES

SECTION 3

APPLICATIONS

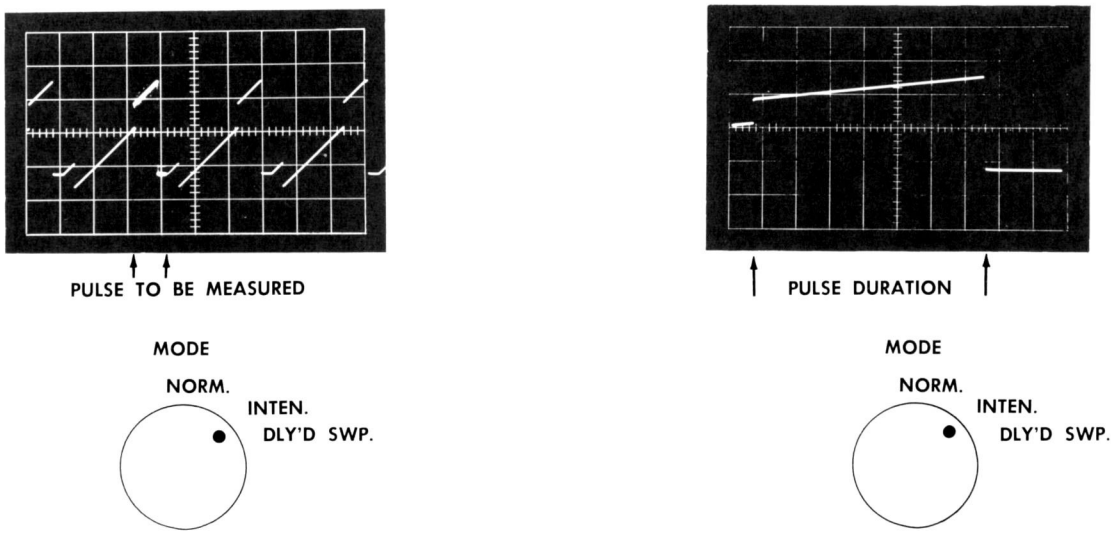


Fig. 3-1. Pulse Duration Measurement.

General

This section describes typical applications for the Type 3B1 Time Base unit. Since the number of applications for the Type 3B1 is large, this section covers only a few. Included are measurements of time, frequency, phase-shift, and waveform jitter.

Time Measurements

Since the Type 3B1 sweeps are calibrated, any horizontal distance on the crt represents 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 width of the pulse appearing in the 4th division.

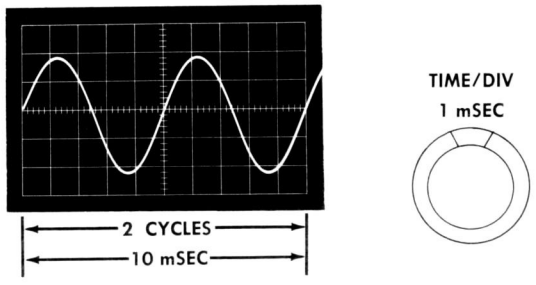
1. Make sure the VARIABLE control is set to CALIB., and pull out the DELAYED SWEEP knob and turn it two clicks to the right.
2. Set the MODE switch to INTEN., and adjust the oscilloscope intensity for an intensified zone on the display.
3. Turn the DELAY TIME control until the desired pulse is intensified.
4. Turn the MODE switch to DLY'D SWP 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 knob (setting of white dot on large black knob).

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.

With any sweep rate, the number of cycles displayed across 10 graticule divisions depends on the frequency of the waveform (see Fig. 3-2). 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 10 graticule divisions.
3. Divide this number by 10 times the TIME/DIV. switch setting. This is the frequency of the waveform.



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

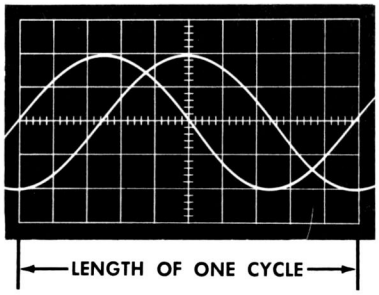
$$\frac{2}{10 \times 1\ \text{mSEC} = 10\ \text{mSEC}} = \frac{2}{.01} = 200\ \text{CYCLES PER SECOND}$$

Fig. 3-2. Frequency Measurement.

Phase-Shift Measurement

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

1. Set up the Type 3B1 for normal-sweep operation and connect a triggering signal 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 input signal is displayed on the crt.
3. Vertically center and horizontally position the display so one of the positive slopes crosses the centerline at the left side of the graticule (see Fig. 3-3).



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

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

Fig. 3-3. Phase Measurement.

4. Measure the time of one complete cycle.
5. Without making any adjustments, disconnect the first sine wave from the vertical amplifier and substitute the second. (Normally this can be done by moving the probe from one signal source to the other.) 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.)
7. Divide the distance measured in step 6 by the distance measured in step 4 and multiply the result by 360. This is the phase difference between the two sine waves.

Pulse Jitter Measurements

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

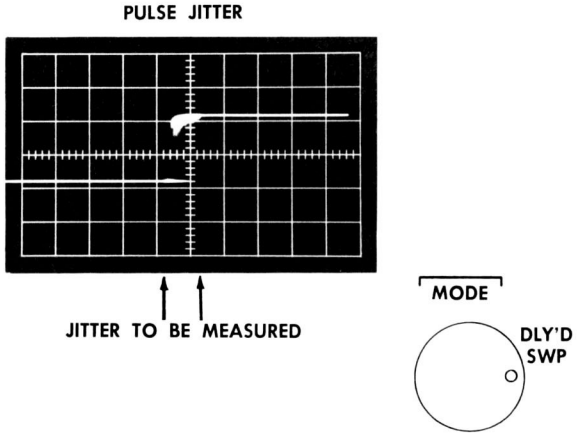


Fig. 3-4. Measurement of Pulse Jitter.

1. Turn the MODE switch to INTEN. (to the right). Pull out the DELAYED SWEEP knob and turn 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 switch to DLY'D SWP (to the right) and adjust the DELAY TIME VERNIER Control to place the intensified pulse at the center of the crt.
4. The leading edge of the intensified pulse will then show any jitter present. The amount of jitter can be measured (in time) by multiplying the horizontal distance in divisions (of the jitter area; (see Fig. 3-4) by the setting of the DELAYED SWEEP knob (setting of white dot on large black knob).

SECTION 4

CIRCUIT DESCRIPTION

Introduction

The Type 3B1 is a conventional time-base plug-in unit with delayed sweep. Fig. 4-1 shows the relationship of the major circuits. The schematic diagrams at the rear of this manual fold out for easy references when studying this circuit description.

The Normal Sweep Trigger circuit receives a signal from either the vertical Amplifier plug-in unit or an external source. The Normal Sweep Trigger circuit converts the signal to a trigger for the Normal Sweep Generator. The 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) reverts 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 sweep ramp from the Normal Sweep Generator 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, the normal sweep is not connected to the Horizontal Amplifier.

The Horizontal Amplifier converts the sweep ramp to a push-pull output and applies it to the horizonal 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 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.

When the MODE switch is set to either DLY'D SWP position, the delayed sweep ramp drives the Horizontal Amplifier.

Thus, in 3 positions (NORM., INTEN., AND TRIG. INTEN.) of the MODE switch, the Normal Sweep Generator furnishes the sweep, and in 2 positions (DLY'D SWP and TRIG. DLY'D SWP) the Delayed Sweep Generator furnishes the sweep.

The two INTEN. positions of the MODE switch intensify an area of the display that represents both the delayed sweep length and its position on the normal sweep.

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 C5 in the AUTO or AC positions and bypasses C5 in the

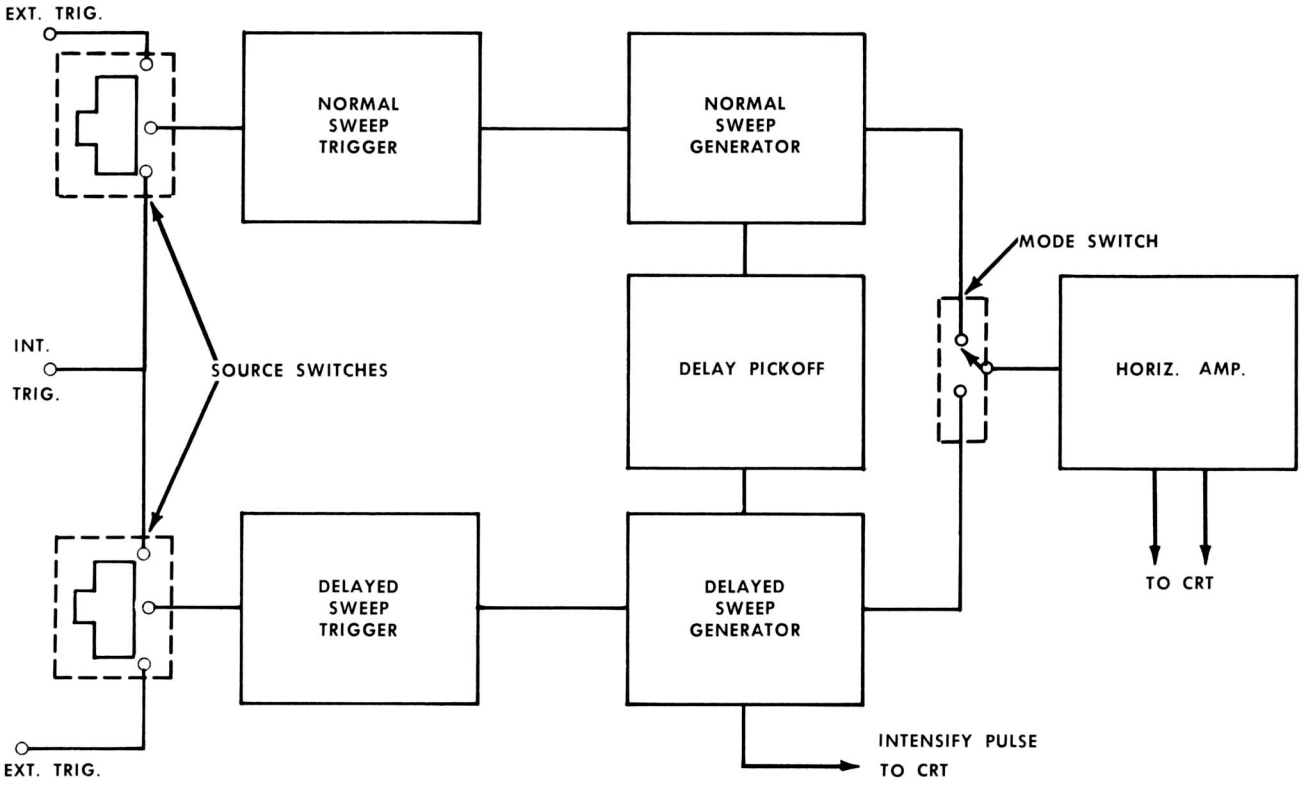


Fig. 4-1. Block diagram showing relationship between major circuits.

DC position. R9 and R10 attenuate the signal and present a high impedance to the signal source to prevent loading.

When the SOURCE switch is in the EXT. position and the EXT. TRIG. ATTEN. (LEVEL control) switch is pulled out, R7 is paralleled across R10 and the network becomes a 10:1 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 D15 to the SLOPE switch. 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 through Q23) on the other base. 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

Generating the Sweep Ramp

A trigger pulse coupled through T101 causes tunnel diode D105 to switch. This puts a positive pulse on the base of Q114 and this transistor turns on. As Q114 conducts its collector drops, carrying with it the plates of V152. As V152 cuts off, Timing Capacitor C160 starts to charge toward -100 volts through Timing Resistor R160. As the grid of V161A starts to drop, it allows the plate voltage to rise. The resulting positive voltage swing is coupled through D162 and V161B to the top of C160. This increases the charging voltage with each increment of charge on C160, effectively straightening the capacitor charge curve. The positive swing at the top of C160 also tends to keep the lower side from dropping. This keeps the voltage across R160 essentially constant, providing a constant-current charging source for C160. The result is an extremely linear sawtooth ramp at the cathode of V161B, which is then applied to the Horizontal Amplifier.

Ending the Sweep Ramp

The sweep ramp ends when the voltage applied to the base of Q134 from R168 (NORMAL SWEEP LENGTH control) reaches +15 volts. Fig. 4-2 shows the waveform on the base of Q143 with the condition of associated diodes. Fig. 4-3 shows the condition of D105 (tunnel diode) during a sweep cycle.

The sweep ramp voltage from R168 starts at about -30 volts and rises in a positive direction. D171 remains back-biased and the ramp voltage cannot reach the base of Q143 until the sweep ramp voltage reaches +1 volt, D171 is forward-biased and the ramp voltage is applied to the base of Q143. The voltage on the emitter of Q143 follows the base voltage. When the emitter rises to ground, D134 is back-biased and no longer supplies current to Q143. The reduced current through Q143 also reduces current through D105. When the emitter of Q143 reaches +15 volts, D143 is forward-biased and Q143 turns off, which forces D105 to point D on the diagram of Fig. 4-3.

When D105 switches, the negative charge turns Q114 off, and its collector goes positive. Disconnect diodes V152, turn on and discharge Timing Capacitor C160, and the sweep ramp ends.

Sweep Holdoff Period

A holdoff period is necessary between each sweep to allow time for the crt beam to retrace to its starting point. This holdoff period is developed by the charge and dis-

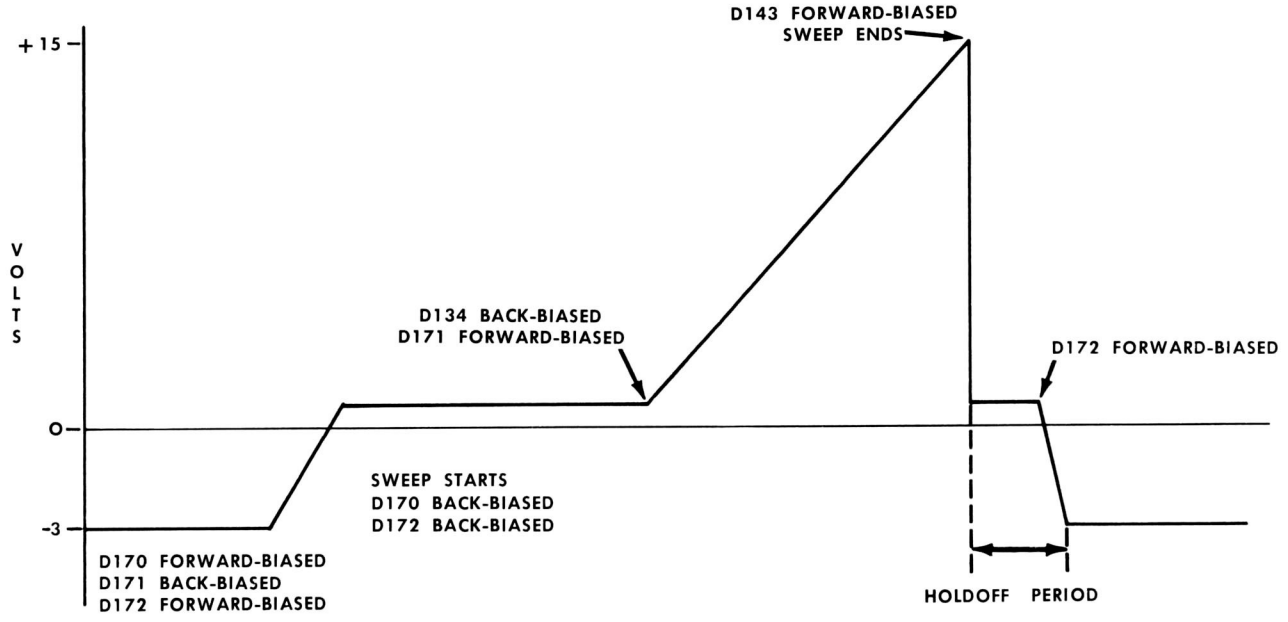


Fig. 4-2. Waveform at base of Q143 during sweep with condition of each associated diode.

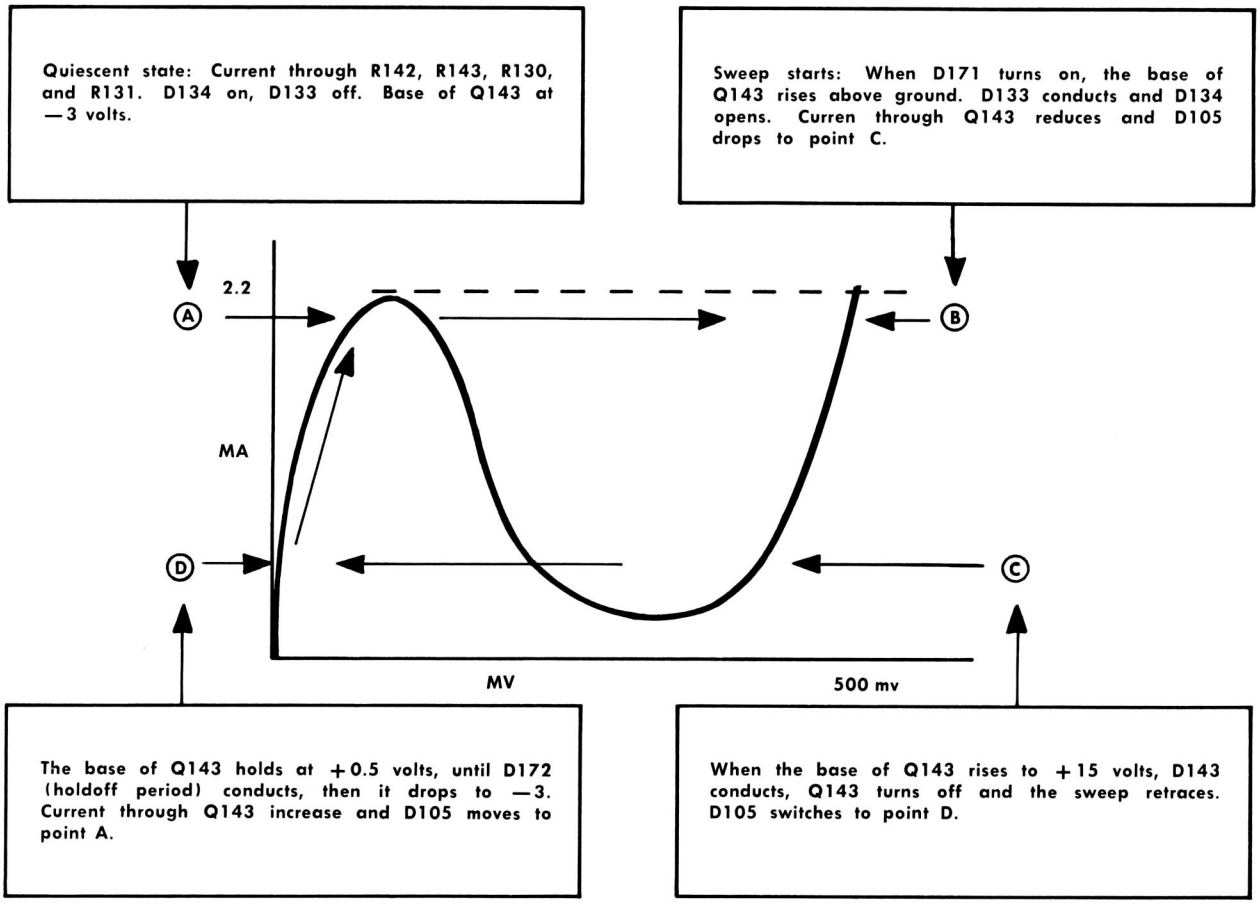


Fig. 4-3. Condition of tunnel diode D105 during sweep and holdoff periods.

charge of Holdoff Capacitor C170. The circuit works as follows:

During sweep run-up, the sweep voltage couples across D170 and charges C170. When the sweep ends, C170 discharges on an RC curve. When the capacitor charge drops to about -3 volts, D172 becomes forward-biased and this voltage is applied to the base of Q143. Current through Q143 increases and the current through D105 moves to point A on the tunnel diode diagram (Fig. 4-3).

Automatic Sweep

If the COUPLING switch is set to AUTO, a third source of current supplies Q143 through Q134 and D132. This added current switches D105 (at the end of the holdoff period) and the sweep free-runs. To trigger in the AUTO position, tunnel diode D115 is switched by trigger pulses from T101. When D115 switches (to its high state), Q124 turns on and Q134 turns off. This removes Q134 as a current source for Q143 and the circuit is set for normal triggered operation.

If a trigger pulse does not switch D105 withi nabout 5 milliseconds, the circuit will reset itself and free-run the sweep. When Q124 turns on, the voltage across C122 starts to drop toward -12 volts. Before it reaches -12 volts, D122 becomes forward-biased and reduces current through D115. D115 switches to its low state, Q124 turns off, C122 charges through R125 and R122 until the emitter of Q134 is +0.3 volts, Q134 then turns on, and the sweep free-runs. Because of the reset feature of the AUTO circuit, the sweep will not trigger at a repetition rate slower than about 15 cps.

Crt Unblanking

The electron beam in the crt is unblanked by a negative pulse coupled from the plate of V194A through pin 13 of the interconnecting plug to the blanking plates in the crt. The unblanked period conicides 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 the collector of Q114 is applied to the base of Q183. This transistor is connected as an emitter follower and the negative pulse passes from the emitter to the MODE switch. From the MODE switch, the negative pulse passes to the base of Q194 (when normal sweep is used) 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.

The direct coupling from the collector of Q194 to D105 (through R103 and C103) ends the normal sweep ramp when the MODE switch is in either DLY'D position. When delayed sweep is used, the unblanking signal comes from the Delayed Sweep Generator circuit. When the positive pulse on the grid of V194A ends, its trailing edge is coupled back through C103 and R103 to switch D105 and ends the sweep.

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. In all other positions of the MODE switch the Delayed Sweep Trigger circuit is inoperative.

Delayed Sweep Generator

The Delayed Sweep ramp circuit operates the same as in the Normal Sweep Generator. The major difference between the two sweep generators is the method of starting the sweep. With the MODE switch in the INTEN. or DLY'D SWP. position, current for Q234 and tunnel diode D205 comes from three sources in the sweep-gating network. The tunnel diode is set at the ready point and is switched by a pulse through R203 from the Delay Pickoff circuit.

When the MODE switch is in the TRIG. INTEN. or TRIG. DLY'D SWP position, R229 in the Sweep Gating network is removed. The remaining current through Q243 plus the pulse from the Delay Pickoff circuit raises the tunnel diode to the ready point. A trigger pulse coupled through T201 is needed to switch the tunnel diode and start the delayed sweep. In this condition the delayed sweep is triggered.

The negative pulse (during sweep) at the collector of Q214 passes directly to the base of Q283. This emitter follower sends the pulse in three directions: (1) to Q294 to intensify the display; (2) to the Delay Pickoff circuit to reset D445; (3) to the MODE switch for unblanking the crt.

Delay Pickoff Circuit

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. At the start of a normal sweep, V414B is conducting and V414A is cut off. V194B is the current source for the comparator. When the normal sweep voltage applied 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 lower state and puts a sharp pulse on the base of Q424. The pulse is inverted in polarity by the transistor and coupled from the collector through C424 and D425 to the cathode of tunnel diode D445. This tunnel diode switches and its cathode drops to —0.5 volts. This voltage change passes through R451 to the base of Q453.

The junction of R453 and R455 in the collector circuit of Q453 quiescently sits at —15 volts. This forward-biases D455 and holds D205 in the Delayed Sweep Generator circuit at —12 volts. When the —0.5 volt signal is applied to the base of Q453, the junction of R453 and R455 rise to —10 volts.

This change back-biases D455, and tunnel diode D205 can be switched (switches immediately in free-run or by the next trigger pulse in a triggered mode). This condition will remain as long as tunnel diode D445 is in its high state. At the end of a delayed sweep, a positive pulse is coupled through C445 and R445 to reset tunnel diode D445. This pulse comes from Q283 in the Delayed Sweep Generator circuit and is formed from the trailing edge (positive-going) of the unblanking pulse.

With the MODE switch in either DLY'D SWP position, —100 volts is connected to R441. This voltage back-biases D444 and prevents the Normal Sweep Generator pulse from resetting D445. In this condition, the delayed sweep will always run-up to the length set by R268 (DELAYED SWEEP LENGTH control).

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 is attenuated by R310 and R312 (SWP. CAL. control) and applied to the emitter of Q314. The POSITION control is also connected to this emitter. Since the amplifier is completely dc-coupled, a voltage change by the POSITION control passes through the circuits to the output.

Q314 is a ground-base amplifier and the sweep voltage appears in the collector circuit (no change in polarity). The sweep voltage then drives the base of Q323 (emitter follower) and passes from its emitter to the base of Q354. (Q333 balances any changes in Q323 due to temperature drift.)

The positive-going ramp voltage drives Q354, which in turn, drives V383A (grounded-grid amplifier). The output circuit is a paraphase amplifier with single-ended input and push-pull output.

As the sweep voltage rises, the current through Q354 and V383A increases. This causes the voltage at the plate of V383A to decrease. The emitter of Q354 follows the base and rises from about —12 to —5 volts. The voltage drop across R364, connected between the emitters of Q354 and Q364 increases as the sweep voltage increases. The positive-going increase at the emitter of Q364 decreases current through Q364 and V383B and the plate of this tube rises toward +300 volts. The result is a push-pull output from the plates of V383A and V383B.

The gain of the paraphase amplifier depends on the size of the common-emitter resistor, R364. When this resistor is made smaller, the gain increases, and the amplifier output swing becomes greater. This is the basis of the 5X magnifier. The 5X MAG. switch connects R354 and R355 (5X GAIN control) across R364 and increases the amplifier gain 5 times. (calibrated by the 5X GAIN adjustment).

The capacitors C364, C354, and C355 across R364 compensate for distributed capacitance at the output tube plates that affects the sweep VOLTAGE at fast-ramp rates.

The push-pull output VOLTAGE from the plates of V383A and V383B pass 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 VARIABLE TIME/CM. control R160Y. In the NORM. position of the MODE switch, the control (R160Y) is connected to Normal Sweep Timing Resistor R160. In all other positions of the MODE switch the control is connected to Delayed Sweep Timing Resistor R260.

The VARIABLE TIME/CM. control (R160Y) extends the sweep time by reducing the voltage supplied to the Timing Resistors. When this control is fully clockwise SW160Z switches a short across it and -100 volts is applied to the Timing Resistors. Any other position of the control reduces the —100 volts and reduces the sweep rate. SW160Z also removes the voltage from R160W and the NE-2 (B160W) so the lamp is off in the calibrated position.

NOTES

SECTION 5

MAINTENANCE

PREVENTIVE MAINTENANCE

Cleaning the Outside

A soft brush should be used to remove loose dust from the front panel controls. For stubborn dirt, use a cloth dampened with water and a small amount of mild detergent. Avoid abrasive cleaners.

Cleaning the Inside

Remove the instrument from the oscilloscope cabinet. Use a compressed air jet to remove free dust from within the chassis. Apply contact cleaner to each wafer of the rotary switches while you manually turn these switches.

Visual Inspection

Look for loose or broken connections, cracks in components, improperly seated tubes or transistors, and scorched wires or components. For most visual defects the repair method is obvious, but if you find burnt wires or components they are usually caused by other defects in the circuit. Find and correct the cause of overheating, then install new parts.

Calibration

The Type 3B1 is a stable instrument and should provide many hours of trouble-free operation. To insure trouble-free performance, the calibration should be checked after each 500 hours of operation (or every six months if used intermittently). This recalibration checks each circuit and minor defects that do not show up in normal use are often found. A step-by-step procedure for calibrating the instrument is included in section 6 of this manual.

REMOVAL AND REPLACEMENT OF PARTS

General Information

Replacement of parts in the Type 3B1 is standard and detailed instructions are not required. The technique described under ceramic strips should be used when these parts are replaced. When certain critical components are replaced you must re-calibrate portions of the instrument to be sure of proper operation. Refer to the calibration procedure.

Replacing Tubes and Transistors

Do not change tubes or transistors unless they are defective. When you remove a tube or transistor from a socket, be sure and return it to the same socket, otherwise you may need to recalibrate the instrument. Use pretested high quality tubes and transistors when replacement is necessary.

Replacing Switches

Methods for removal of defective switches are, for the most part, obvious and only a normal amount of care is required. Single wafers are normally not replaced on the switches used in the Type 3B1 and if one wafer is defective, the entire switch should be replaced. Switches may be ordered from Tektronix either wired or unwired.

Soldering Precautions

In Tektronix instruments a special silver-bearing solder is used to establish a bond. This bond may be broken by repeated use of ordinary tin-lead solder. However, occasional use of ordinary solder will not break the bond if excess heat is not used. If you maintain several Tektronix instruments you should have a stock of solder that contains about 3% silver. This type of solder is used in etched-circuit work and is generally available locally. It can be purchased from Tektronix in one-pound rolls; order by part number 251-514.

The proper technique for soldering short-lead components is: (1) Use needle-nose pliers between the soldering point and the component to act as a heat shunt; (2) use a very hot iron for a short time, and (3) be careful. Many of the small components have weak leads.

Many of the components in your Tektronix instrument are mounted on ceramic terminal strips. The notches in these strips are lined with a silver alloy. Because of the shape of the terminals, use a wedge-shaped tip on your soldering iron when you install or remove parts from the strips. Be sure to file smooth all surfaces of the iron to be tinned. This prevents solder from building up on rough spots where it will oxidize.

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

1. Use a soldering iron with about a 75-watt rating.
2. Tin only the first $1/16$ to $1/8$ of the tip. Use solder containing about 3% silver.
3. Touch one corner of the iron tip to the notch where you want to solder.
4. Apply just enough heat to make the solder flow freely.
5. Do not fill the notch with solder; instead, apply just enough solder to cover the wires.

Replacing Ceramic Strips

Unsolder all connections, then use a plastic or hard rubber mallet to knock the yokes out of the chassis. Use the mallet to hit the ends of the yoke that protrude through the chassis. The strip with the two yokes can then be removed as a unit. The spacers will probably come out with the yokes. If not, they can be pulled out separately.

Another way to remove the terminal strip is to use diagonal cutters to cut off the side of the yoke that holds the strip. The strip is removed and the yokes pulled from the chassis with a pair of pliers. Since replacement ceramic strips are supplied with yokes, the old yokes need not be salvaged. When the damaged strip and yoke assembly has been removed, place the spacers into the holes in the chas-

sis. Then set the ends of the new yoke pin down through the spacers. Be sure that these pins are driven completely through the spacers. Use a pair of diagonal cutters and cut off any portion of the yoke pin that protrudes through the spacers. Fig. 5-1 shows how the ceramic strip parts fit together.

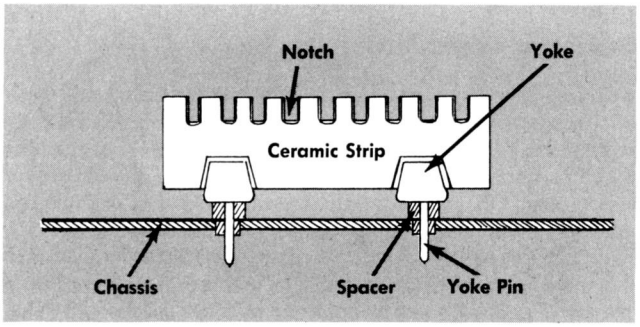


Fig. 5-1. Ceramic strip assembly details.

Replacement Parts

Standard Parts

Replacement parts can be obtained from Tektronix at current net prices. However, since most of the components are standard parts they can usually be purchased locally. When you order parts, be sure to check the parts list to determine the tolerance required. The parts list gives the value, tolerance, rating, and Tektronix part number for all components used in the instrument.

Tektronix-Manufactured Parts

Tektronix manufactures almost all of the mechanical parts and some of the electronic components used in the Type 3B1. When you order parts, be sure to describe the part completely to prevent delays in filling your order.

The Tektronix-manufactured electronic components are noted in the parts list. These parts and all mechanical parts must be ordered directly from Tektronix or from your Tektronix Field Office, since they cannot be obtained from other sources.

Parts Ordering Information

Each component in this instrument has a six-digit Tektronix part number. This number, together with a description of the part, will be found in the parts list. Be sure to include the following information when ordering parts.

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

For example, a certain resistor would be ordered as follows: R54, 3.9K, 1/4 watt fixed, 5%, part number_____, for Type 3B1 Time-Base plug-in, serial number 109. When parts are ordered in this way, we are able to fill your orders promptly and delays that might result from transposed part numbers are avoided.

TROUBLESHOOTING

Introduction

If trouble occurs, the following information will help you troubleshoot the Type 3B1. While troubleshooting, you should compare information from this section with information from other parts of the manual, particularly the circuit description and calibration sections.

Be sure the front-panel controls are set properly. Operate the front-panel controls to see what effect they have on the trouble. The normal or abnormal operation of a control will help you establish the trouble symptoms. (The cause of trouble symptoms that occur only in certain control positions can usually be found immediately).

Once the trouble symptoms are established, look for the obvious cause. Check to see that the power is on, feel for irregularities in control operation, listen for unusual sounds, and visually check the entire instrument. The type of symptom should show the checks to make.

In general, troubleshooting consists of circuit isolation and circuit troubleshooting. In many cases, the general procedure will help you isolate the defective circuit. However, if the use of the circuit isolation procedure does not locate the faulty circuit, other checks will be required. When the faulty circuit has been found, a detailed check within the circuit will usually lead to the cause of the trouble.

Transistors

Trouble in the Type 3B1 may be due to transistor failure. Transistors may be checked by replacing a suspected one with one of the same type or by using a transistor-curve display instrument, such as the Tektronix Type 575 Transistor-Curve Tracer.

Transistors can also be checked with an ohmmeter if no other method is available. However, resistance readings of transistors of the same type may vary. Therefore, resistance readings are valid only when checking for opens and shorts. Avoid using the RX1 or RX10 scale of the ohmmeter because the high currents of these scales could damage a good transistor.

Circuit Diagrams

Separate diagrams for each circuit are included in the back of this manual. The reference designation of each component (C39, R44, etc.) is shown on the diagrams as well as important voltages and waveforms. The following is a list of reference designations for each different circuit.

Reference Designation	Circuit
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 459	Delay Pickoff

Switch-Wafer Code

Switch wafers shown on the circuit diagrams are coded to indicate their 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 indicate whether the contacts are on the front or rear of the wafer.

Test Equipment Required

1 Wideband Oscilloscope, such as Tektronix Type 540 series.

1 Ohmmeter, 20,000 ohms/volt.

1 Plug-in Extension, Tektronix Part No. 013-034.

Circuit Isolation

The following table lists possible trouble symptoms and the individual circuits that may be the cause. When the trouble has been pinned down to a particular circuit, use the table that applies to that circuit. See Fig. 5-2 for location of test points.

Trouble Symptom	Circuit to Check
1. No sweep in any position of front-panel controls.	Horizontal Amplifier Normal Sweep Generator
2. No sweep in either DLY'D SWP. position of MODE SWITCH.	Delayed Sweep Generator Delay Pickoff
3. No intensified area on display in either INTEN. position of MODE switch.	Delayed Sweep Generator
4. Sweep too short in both normal and delayed sweep.	Horizontal Amplifier
5. Sweep is short only in delayed sweep.	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 position of the normal sweep trigger COUPLING switch.	Normal Sweep Trigger
10. No delayed sweep in either TRIG. Position of MODE switch.	Delayed Sweep Trigger

NOTE

Because the normal and delayed sweep are similar, trouble can often be isolated to one or the other by operating each one independently. The delayed sweep can be operated without the normal sweep by intermittently shorting across R243 in the Delayed Sweep Generator circuit.

NORMAL SWEEP GENERATOR

Trouble Symptom	Check
1. No sweep	1. Crt may not be unblanked. Check V194, Q183, and Q194. 2. If B164 is turned on, check V161. 3. Miller circuit check: Turn the TIME/DIV. switch to 1 SEC. Short the collector terminal of Q114 to —12 volts; the voltage at test point (6) should start to rise (remove short when voltage reaches +15 volts). If it does not, check V161 and D171. 4. Sweep gating check: Remove Q114, connect dc voltmeter across R144 (test point 7 and 8). Set COUPLING switch to AUTO, voltmeter should read between +5 and +6 volts. If not, check Q143. Turn LEVEL control to mid-range, voltage should drop to +4 volts. If not, check D105. Set COUPLING switch to DC and LEVEL control fully clockwise. Connect test scope probe to test point (8). Intermittently short across R143; switching action of D105 should be seen.
2. Sweep appears in AUTO coupling only.	1. Check D102
3. Sweep will not trigger in AUTO coupling.	1. Check D119 and D115.

HORIZONTAL AMPLIFIER

Trouble	Check
1. No sweep.	1. Measure voltage at test point 13, vary POSITION control, voltage should change from —5 to —13 volts. 2. Voltage at test point 14 should change from —5 to —13 when POSITION control is turned. Voltage at test points 15 and 16 should vary between +2 and +7 as POSITION control is turned. 3. Connect test scope to test points 17 and 18. Waveform shown on schematic should be seen.
2. Sweep will not cover width of crt.	1. Check Q354, Q364, and V383.

NORMAL TRIGGER CIRCUIT

Trouble	Check
1. Display cannot be triggered.	1. Use test scope to check for triggering signal at test point (1) and (2). 2. Voltage at test point (3) should vary from -10 to +14 volts as LEVEL control is turned through its range. 3. Voltage at test point (4) should vary from -9 to +3 volts as LEVEL control is turned throughout range. 4. Move the SLOPE switch to the opposite polarity and repeat measurement at test point (4). The two measurements at test point (4) check Q24 and Q34. 5. Measure about -12.5 volts at test point (5). This checks Q44. 6. Connect test scope to test point (5). Should be 0.5 volt squarewave as shown on schematic. This checks D35.
2. Triggers only on large signals.	V13 weak. D35 open.
3. Triggering unstable.	Check power supply regulation.

DELAYED SWEEP TRIGGER

Trouble	Check
1. Delayed Sweep cannot be triggered.	1. Use test scope to check for triggering signal at test points 19 and 20. 2. Voltage at test point 21 should vary from -10 to +14 as the Delayed Sweep LEVEL control is turned through its range. 3. Voltage at test point 22 should vary from -9 to +3 volts as the Delayed Sweep LEVEL control is turned through its range. (be sure MODE switch is in TRIG. DLY'D SWP). 4. Measure about -12.5 volts at test point 23. This checks Q94. Connect the test scope probe to test point 23. Should be a .5 volt square-wave as shown on schematic. This checks D85.
2. Triggers only on large signals.	1. V63 possibly weak. D85 open.

DELAYED SWEEP GENERATOR

Trouble	Check
1. No Delayed Sweep.	1. If B264 is turned on, check V261. 2. Miller circuit check: Turn DELAYED SWEEP SWITCH to 1 SEC. Short the collector terminal of G214 to —12 volts. Voltage of test point (24) should start to rise (remove short when voltage reaches +15 volts). If it does not, check V161 and D171. 3. Short collector of Q214 to —12 volts. 4. Sweep Gating check. Connect test scope probe to test point 25. Intermittently short test point 26 to ground, switching of D205 should be seen. If it is not, Q243 may be open, or D205 defective.
2. No Delayed Sweep in TRIG DLY'D SWP position of MODE switch.	1. Check D202 and D201.
3. Delayed Sweep free-runs, will not trigger.	1. D243 or D233 may be shorted.
4. Delayed Sweep non-linear at all sweep rates.	1. Check V261 for non-linear amplification.
5. Delayed Sweep non-linear at only one sweep rate.	1. Check particular timing capacitor for leakage.
6. No holdoff period on sweep waveform.	1. D270 possibly open.
7. Trace not intensified in INTEN. position of MODE Switch.	1. Q294 defective.

DELAY PICKOFF

Trouble	Check
1. No delayed sweep.	1. Voltage at test point 9 should be between -12 and -15 volts and should change as the trigger LEVEL control is turned. If it does, check D455. If it does not, check Q453. 2. Adjust controls for a normal display. Connect test scope probe to test point 10, waveform shown on schematic should be seen. 3. Check for waveform at test point 11. 4. Connect test scope to test point 12. Vary DELAY control, amplitude of waveform should change from .5 volts P-P to 2 volts, P-P.

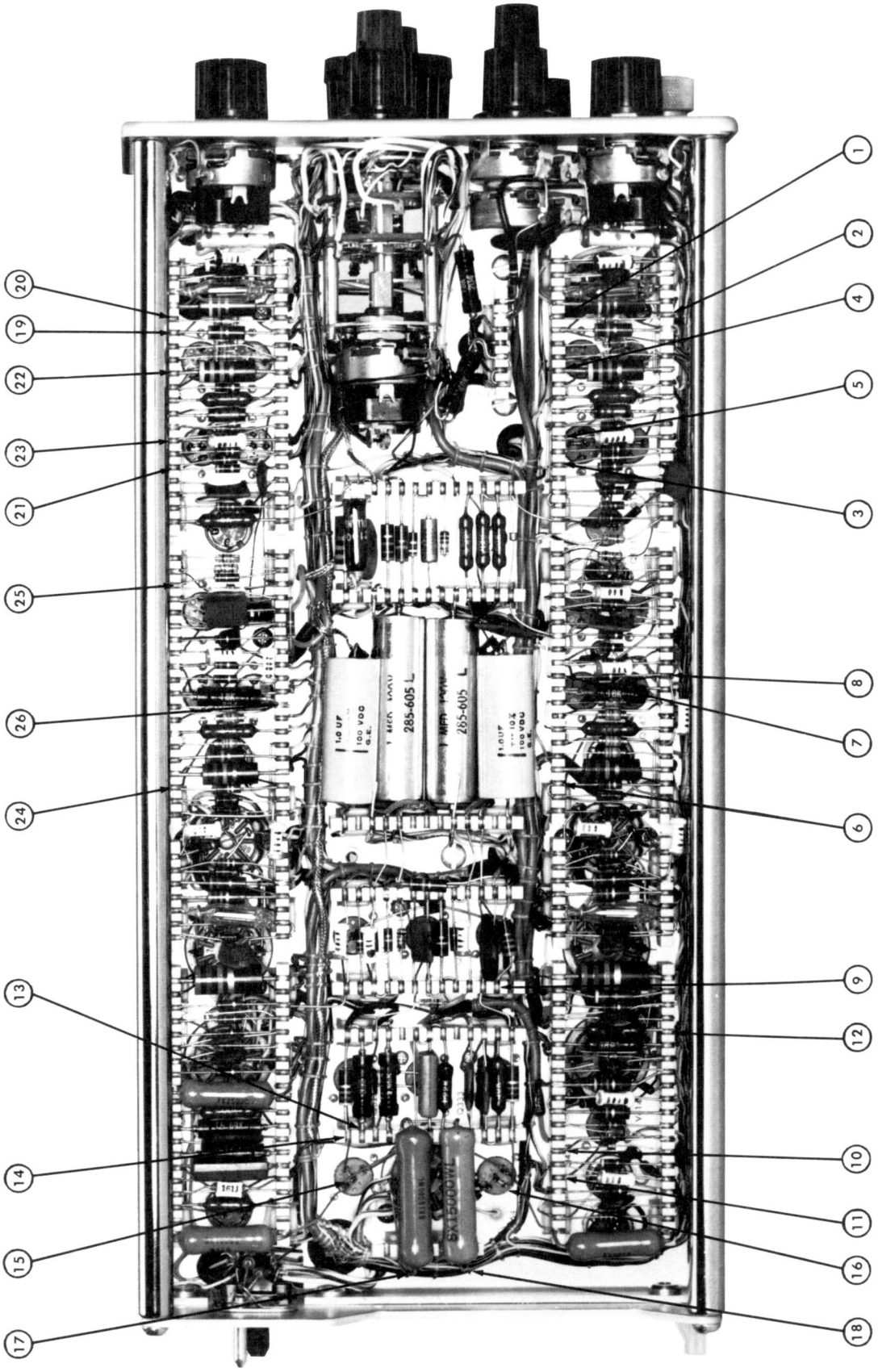


Fig. 5-2. Location of test points used in troubleshooting.

NOTES

SECTION 6

CALIBRATION

Introduction

This section describes a calibration procedure for the Type 3B1 Time Base plug-in unit. The instrument should be calibrated after each 500 hours of operation, or at least every six months if used intermittently. 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 3B1.

1. Tektronix Type 561A, or 567 Oscilloscope.

2. Vertical amplifier plug-in unit (non-sampling).

3. Time-mark generator with crystal-controlled markers at 1 μsec, 10 μsec, 50 μsec, 100 μsec, 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 coaxial cable about 3 feet long with UHF plug connectors on each end, such as Tektronix 42" 40 Ω cable, Part No. 012-001.

6. Dc voltmeter, 20,000 ohms per volt (or better), 3% accuracy.

7. Insulated screwdriver for adjusting variable capacitors, such as Jaco 1½" shank No. 125, Tektronix Part No. 003-000.

8. A 6" clip lead with a small insulated alligator clip on each end.

9. Two 18" banana-tip patch cords, such as Tektronix PC18R, Part No. 012-031.

Preliminary

Install the vertical amplifier plug-in unit into the oscilloscope. Install the Type 3B1 with the Tektronix 560-series plug-in extension. Set the Type 3B1 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.
NORMAL SWEEP COUPLING	AUTO
DELAY TIME AND VERNIER	Midrange

Turn on the oscilloscope and allow a 15-minute warmup before starting calibration.

Procedure

1. Check +15-Volt Supply

Use the dc voltmeter and measure the voltage across D398 (see Fig. 6-1).

The voltage should be +13.0 volts to 16.5 volts.

2. Adjust Normal Sweep Gating Threshold

Set the normal sweep Coupling switch to AC.

Connect the short clip lead (with insulated alligator clips) across R143 (see Fig. 6-1).

Adjust R130, the NORMAL SWP. GATING THRESHOLD control (see Fig. 6-2), to just produce a free-running sweep.

Remove the jumper from R143, the trace should disappear.

3. Adjust Delayed Sweep Gating Threshold

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 (see Fig. 6-1), to just produce a free-running sweep.

Remove the jumper from R243, the trace should disappear.

4. Adjust Sweep Calibration

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 the Normal Sweep now has a timing error equal and opposite to the Delayed Sweep timing error. The SWEEP CAL. control is adjusted properly 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 divisions. Make visual measurements between the 2nd and the 9th major graticule division.

5. Adjust Normal Sweep Length

Use the same set-up as in step 4, and adjust R168, the NORMAL SWEEP LENGTH control (see Fig. 6-2), for 10.5 major graticule divisions of horizontal deflection.

6. Adjust Delayed Sweep Length

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 (see Fig. 6-2), for 10.5 major graticule divisions of horizontal deflection.

7. Adjust MAG Gain

Set the MODE switch to NORM., and the TIME/DIV. switch to 1 mSEC. Set the time-mark generator for 1-msec and 100-μsec time marks. Adjust the Normal Sweep LEVEL control for a stable display. Pull the 5X MAG. switch out and adjust R355, the 5X GAIN Control (see Fig. 6-2) for one large time mark every 5 major graticule divisions and 2 small time marks every one major graticule division. Check linearity over the entire magnified sweep by moving the POSITION control throughout its range.

8. Adjust Sweep Magnifier Registration

Use the same set-up as in step 7. Pull the 5X MAG. switch out and position the display so the first large time mark falls on the graticule center line. Push the 5X MAG. switch in and adjust R368, the SWP. MAG. REGIS. control (see Fig. 6-2), so the first time mark again falls on the graticule center line. Repeat this adjustment until there is no shift in the start of the display when the 5X MAG. switch is pulled out.

9. Adjust Delay Stop

Push the 5X MAG. switch in. Set the MODE switch to INTEN. and turn the DELAY TIME and VERNIER controls fully clockwise. Adjust the oscilloscope intensity so the intensified part of the display is clearly visible. Adjust R435, the DELAY STOP control (see Fig. 6-2), so the intensified part of the display starts at the 2nd 100 μSEC MARKER to the RIGHT OF the 11th 1 mSEC MARKER. Turn the DELAY TIME and VERNIER controls fully counter-clockwise; the intensified part of the display should start between the first two major graticule divisions.

10. Check Normal and Delayed Sweep Rates

Set the front-panel controls as follows:

MODE ..... NORM.
TRIGGERING (Normal Sweep) ..... + AC INT.
TRIGGERING (Delayed Sweep) ..... + AC INT.
TIME/DIV. ..... 50 μsec.
DELAYED SWEEP knob ..... 50 μsec.

Set the time-mark generator for 50-μsec time marks. Adjust the Normal Sweep LEVEL control for a stable display. Check for 1 time mark at 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 at 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-Mark	Marks/Division
50 μSEC	50 μsec	1
.1 mSEC	100 μsec	1
.2 mSEC	100 μsec	2
.5 mSEC	500 μsec	1
1 mSEC	1 msec	1
2 mSEC	1 msec	2
5 mSEC	5 msec	1
10 mSEC	10 msec	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	1 sec	1

NOTE

The timing error for all sweep rates must be within 3% (1.2 minor graticule divisions). Timing checks are made over 8 major graticule divisions between the 2nd and the 9th division lines.

11. Check the 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.

Turn 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. In the two INTEN. positions, the VARIABLE TIME/DIV controls only the length of the intensified area.

12. Adjust Fast Normal Sweep Rates

Remove the plug-in extension, and install the Type 3B1 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. Switch	Time-Mark Generator	Adjustment	Marks/Div.
10 μSEC	10 μsec	C160D	1
20 μSEC	10 μsec	check	2
5 μSEC	5 μsec	check	1
1 μSEC	1 μsec	C160B	1
2 μSEC	1 μsec	check	2
.5 μSEC	1 μsec	check	per 2 div.
.5 μSEC	10 megacycles	Pull 5X MAG. switch	1 cycle/div.

13. Adjust Fast Delayed Sweep Rates

Set the MODE switch to TRIG. DLY'D SWP. Use Table 6-2 and substitute DELAYED SWEEP knob settings for the TIME/DIV. settings. At 10 μSEC, adjust C260D, and at 1 μSEC, adjust C260B. Check the 10-megacycle display the same as for the Normal Sweep.

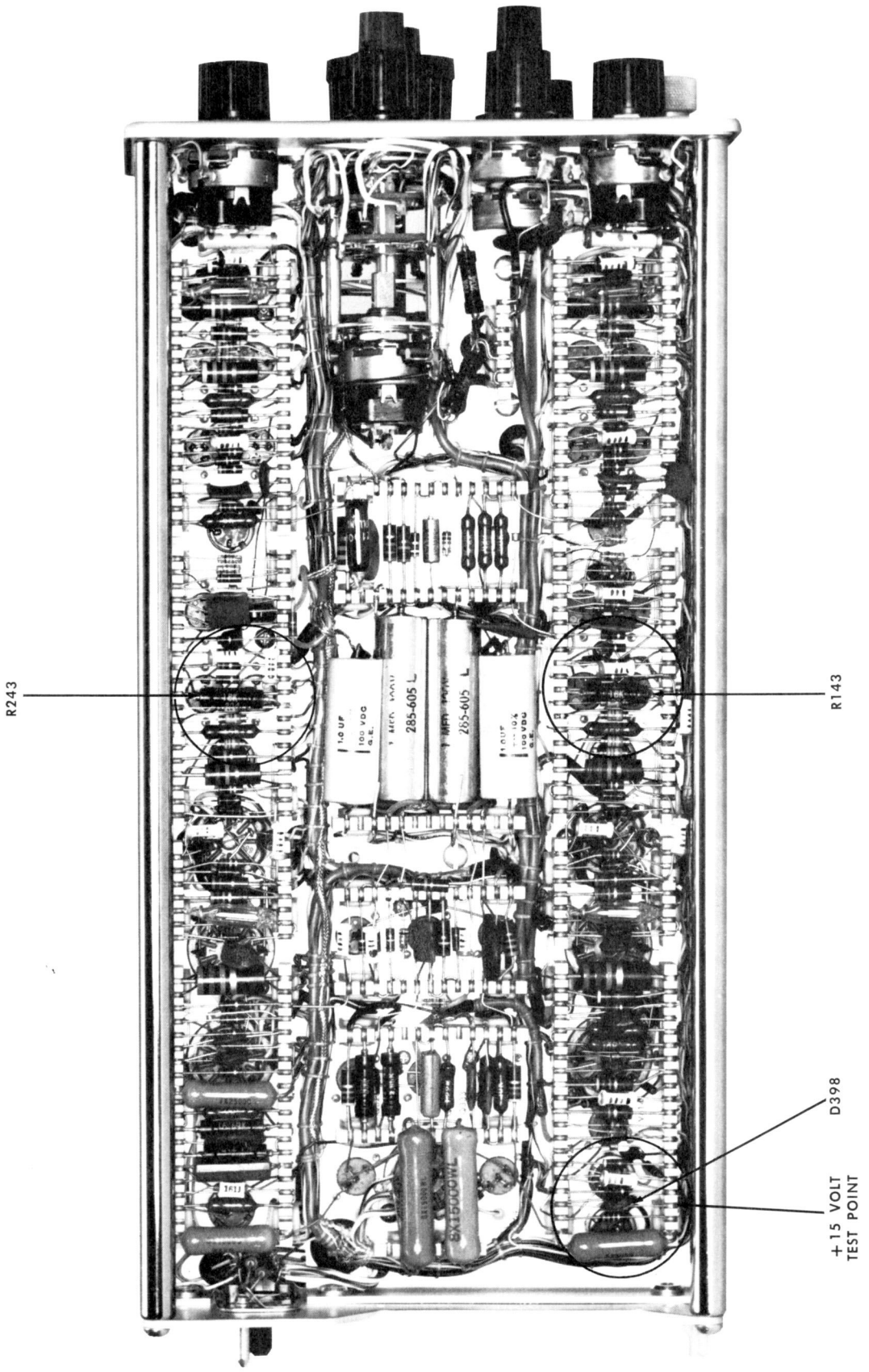


Fig. 6-1. Left side of Type 3B1. (See steps 2 and 3 of the calibration procedure.)

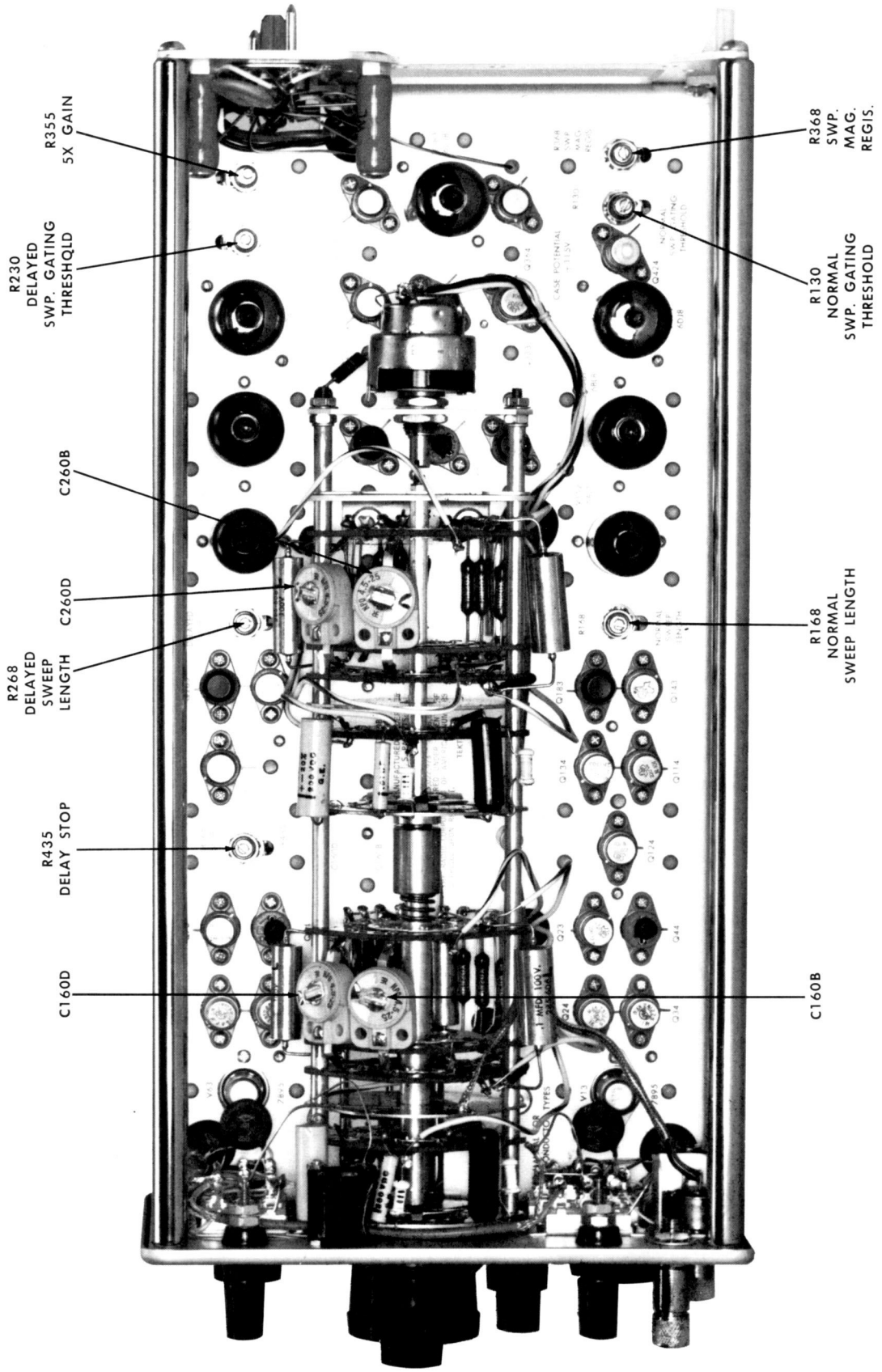


Fig. 6-2. Right side of Type 3B1 with locations of internal adjustments.

NOTES

SECTION 7

PARTS LISTS AND DIAGRAMS

PARTS ORDERING INFORMATION

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

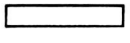
Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information 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.

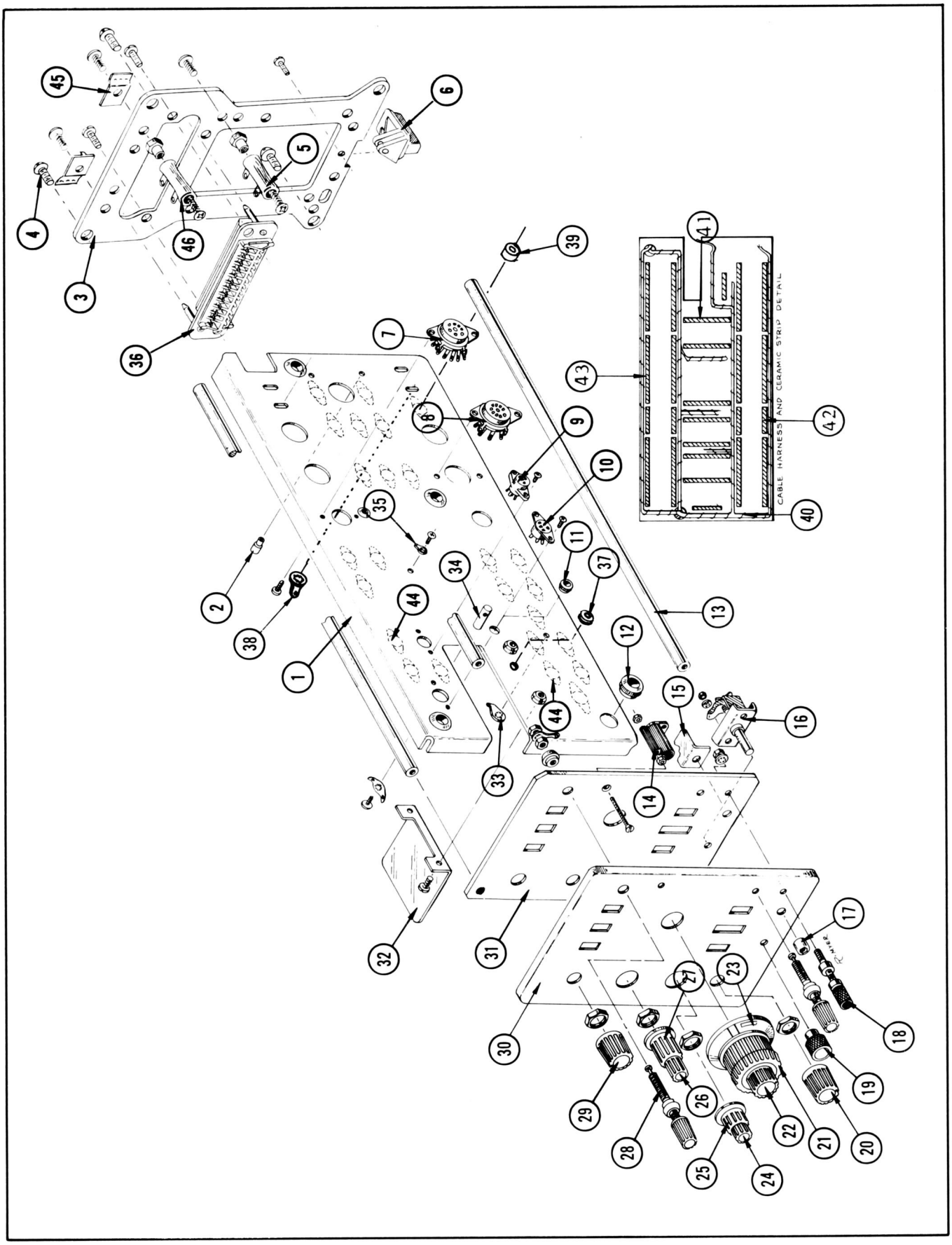
ABBREVIATIONS AND SYMBOLS

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

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.

Exploded View



Exploded View

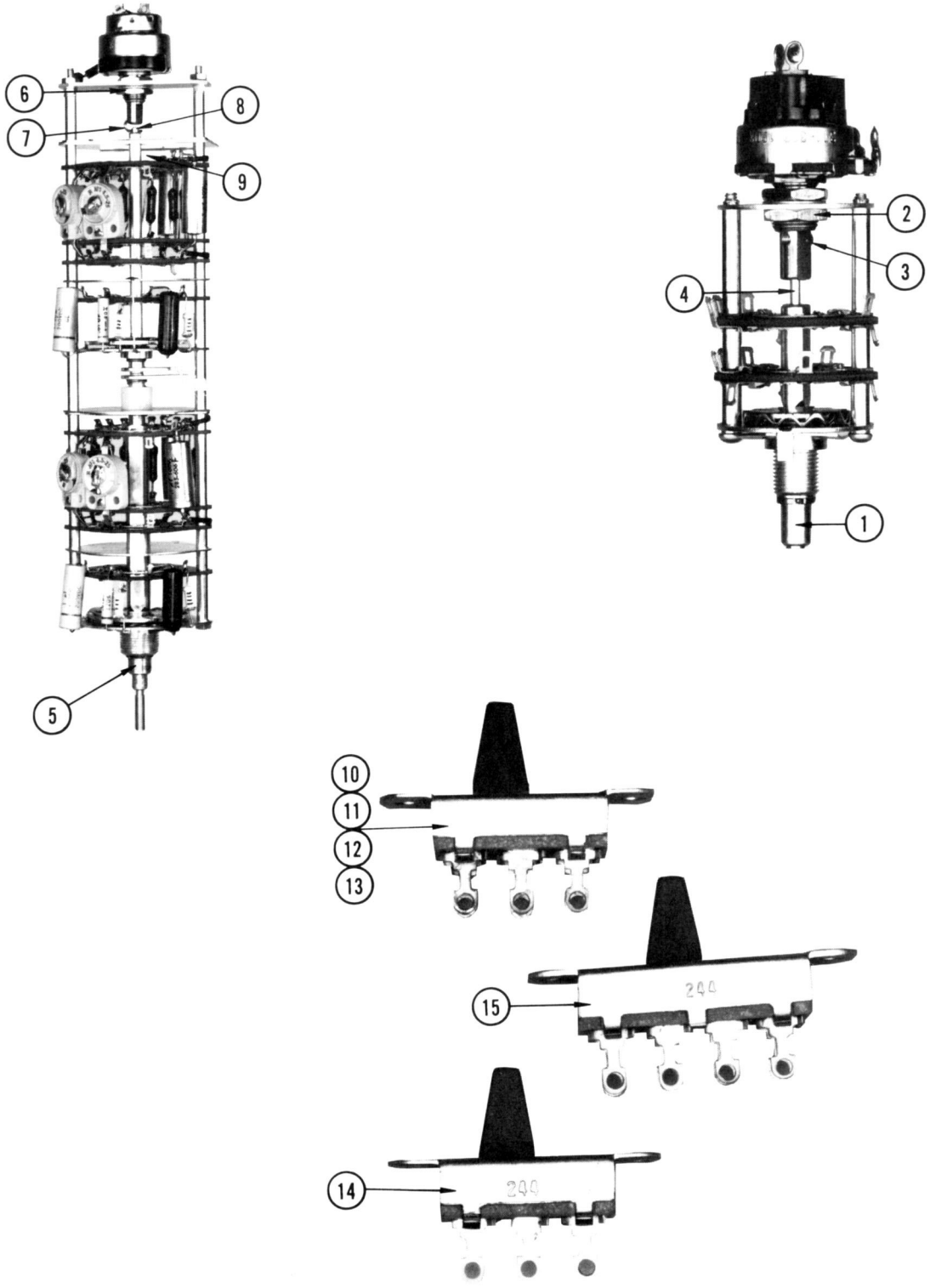
REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	441-0440-00			1	CHASSIS, aluminum
	- - - - - -			-	Mounting Hardware: (not included)
	211-0504-00			3	SCREW, 6-32 x 1/4 inch PHS
	211-0538-00			3	SCREW, 6-32 x 5/16 inch FHS, 100° CSK
2	348-0031-00			2	GROMMET, snap in
3	387-0647-00			1	PLATE, subpanel, rear
	- - - - - -			-	Mounting Hardware: (not included)
4	212-0044-00			4	SCREW, 8-32 x 1/2 inch RHS
5	- - - - - -			-	Resistor Mounting Hardware:
	210-0478-00			1	NUT, hex, 5/16 x 21/32 inch long, 5-10 watt resistor mtg.
	211-0507-00			1	SCREW, 6-32 x 5/16 inch BHS
	211-0544-00			1	SCREW, 6-32 x 3/4 inch THS
6	351-0037-00			1	GUIDE, plug-in
	- - - - - -			-	Mounting Hardware: (not included)
	210-0004-00			1	LOCKWASHER, internal #4
	210-0406-00			1	NUT, hex, 4-40 x 3/16 inch
	211-0013-00			1	SCREW, 4-40 x 3/8 inch RHS
7	136-0015-00			5	SOCKET, 9 pin
	- - - - - -			-	Mounting Hardware for each: (not included)
	213-0044-00			2	SCREW, thread forming, 5-32 x 3/16 inch PHS
8	136-0008-00			2	SOCKET, 7 pin
	- - - - - -			-	Mounting Hardware for each: (not included)
	213-0044-00			2	SCREW, thread forming, 5-32 x 3/16 inch PHS
9	136-0095-00	101	2909	19	SOCKET, 4 pin transistor
	136-0181-00	2910		19	SOCKET, 3 pin transistor
	- - - - - -			-	Mounting Hardware for each: (not included)
	213-0113-00	101	2909	2	SCREW, thread forming, 2-32 x 5/16 inch RHS
	354-0234-00	2910		1	RING, locking, transistor socket
10	136-0101-00			2	SOCKET, 5 pin
	- - - - - -			-	Mounting Hardware for each: (not included)
	213-0055-00			4	SCREW, thread forming, 2-32 x 3/16 inch PHS
11	348-0003-00			2	GROMMET, rubber, 5/16 inch
12	348-0005-00			4	GROMMET, rubber, 1/2 inch
13	384-0566-00	101	2559	4	ROD, frame, spacing
	384-0615-00	2560		4	ROD, frame, spacing
14	352-0008-00	101	609	1	HOLDER, single, neon bulb, black
	352-0053-00	610	4089	1	HOLDER, single, neon bulb, black
	352-0067-00	4090		1	HOLDER, single, neon bulb, gray
	- - - - - -			-	Mounting Hardware: (not included)
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
	211-0031-00	101	4089	1	SCREW, 4-40 x 1 inch FHS
	211-0109-00	4090		1	SCREW, 4-40 x 7/8 inch FHS
	378-0541-00	X4090		1	FILTER, lens, neon
15	337-0531-00			1	SHIELD, Calibrator
16	214-0052-00			1	FASTENER, pawl right, with stop
	- - - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
17	358-0075-00			1	BUSHING

Exploded View

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
18	129-0051-00	101	609	1	POST, binding
	129-0020-00	610		1	POST, binding
	- - - - - -			-	Post Includes:
	200-0182-00	101	609	1	CAP
	200-0072-00	610		1	CAP
	355-0507-00	101	609	1	STEM, adapter
	355-0503-00	610		1	STEM, adapter
	- - - - - -			-	Mounting Hardware: (not included w/post)
	210-0011-00	101	609	1	LOCKWASHER, internal, 1/4 inch
	210-0010-00	610		1	LOCKWASHER, internal, #10
	210-0455-00	101	609	1	NUT, hex, 1/4-28 x 3/8 inch
	210-0410-00	610		1	NUT, hex, 10-32 x 5/16 inch
19	366-0109-00			1	KNOB, plug-in, securing
	- - - - - -			-	Mounting Hardware: (not included)
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS, allen head
20	366-0191-00			1	KNOB, LEVEL, charcoal
	- - - - - -			-	Includes
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS, allen head
21	366-0194-00			1	KNOB, TIME/DIV. AND RELAY TIME RANGE, charcoal
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS, allen head
	213-0048-00			1	SCREW, set, 4-40 x 1/8 inch HSS, allen head
22	366-0038-00			1	KNOB, VARIABLE, red
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS, allen head
23	331-0092-00			1	DIAL, window knob, clear plexiglas
24	366-0192-00	101	609	1	KNOB, VERNIER, small charcoal
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS, allen head
	366-0210-00	610		1	KNOB, VERNIER, small charcoal
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS, allen head
25	366-0138-00	101	609	1	KNOB, DELAY TIME, charcoal
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS, allen head
	366-0212-00	610		1	KNOB, DELAY TIME, charcoal
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS, allen head
26	366-0189-00	101	2649	1	KNOB, POSITION, red
	366-0262-00	2650		1	KNOB, POSITION, red
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS, allen head
27	366-0175-00			1	KNOB, MODE, charcoal
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS, allen head
28	129-0065-00			1	POST, binding assembly, 5 way
	- - - - - -			-	Consisting Of:
	129-0064-00			1	POST, binding, 5 way
	210-0006-00	101	2469X	1	LOCKWASHER, internal, #6
	210-0203-00	101	2469X	1	LUG, solder
	210-0408-00	101	2469	2	NUT, hex, 6-32 x 5/16 inch
	210-0457-00	2470		1	NUT, keps, 6-32 x 5/16 inch
	358-0181-00			1	BUSHING, nylon, charcoal

Exploded View

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
29	366-0191-00			1	KNOB, LEVEL, charcoal
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS, allen head
30	333-0708-00			1	PANEL, front
31	387-0673-00			1	PLATE, subpanel, front
32	337-0532-00			1	SHIELD, Trigger Electrostatic
	- - - - - -			-	Mounting Hardware: (not included)
	211-0504-00			2	SCREW, 6-32 x 1/4 inch BHS
33	210-0201-00			10	LUG, solder
	- - - - - -			-	Mounting Hardware for each: (not included)
	213-0044-00			1	SCREW, thread forming, 5-32 x 3/16 inch PHS
34	385-0099-00			1	ROD, tapped 6-32 one end
	- - - - - -			-	Mounting Hardware: (not included)
	213-0044-00			1	SCREW, thread forming, 5-32 x 3/16 inch PHS
	210-0204-00			1	LUG, solder
35	210-0215-00			3	LUG, solder
	- - - - - -			-	Mounting Hardware: (not included)
	213-0055-00			1	SCREW, thread forming, 2-56 x 3/16 inch PHS
36	131-0149-00			1	CONNECTOR, chassis mount
	- - - - - -			-	Mounting Hardware: (not included)
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
	211-0008-00			2	SCREW, 4-40 x 1/4 inch BHS
37	348-0002-00			2	GROMMET, rubber, 1/4 inch
38	210-0223-00			5	LUG, solder
39	200-0385-00			1	COVER, transistor
40	179-0667-00			1	CABLE, harness
41	124-0147-00			7	STRIP, ceramic, 13 notches 2 x 7/16 inch
	- - - - - -			-	Mounting Hardware for each: (not included)
	361-0009-00			2	SPACER, nylon molded
42	124-0149-00			6	STRIP, ceramic, 7 notches, 1 5/32 x 7/16 inch
	- - - - - -			-	Mounting Hardware for each: (not included)
	361-0009-00			2	SPACER, nylon molded
43	124-0145-00			12	STRIP, ceramic, 20 notches, 3 11/16 x 7 7/16 inch
	- - - - - -			-	Mounting Hardware for each: (not included)
	361-0009-00			2	SPACER, nylon molded
44	136-0095-00	101	2909	6	SOCKET, 4 pin transistor
	136-0182-00	2910		6	SOCKET, 4 pin transistor
	- - - - - -			-	Mounting Hardware for each: (not included w/socket)
	213-0113-00	101	2909	2	SCREW, thread forming, 2-32 x 5/16 inch RHS phillips
	354-0234-00	2910		1	RING, locking, transistor socket
45	214-0276-00			2	SPRING, ground
46	- - - - - -	101	3929X	-	RESISTOR
	- - - - - -			-	Mounting Hardware: (not included w/resistor)
	211-0544-00	101	3929X	1	SCREW, 6-32 x 3/4 inch THS phillips
	210-0478-00	101	3929X	1	NUT, hex, resistor mounting
	210-0457-00	X3930		1	NUT, keps, 6-32 x 5/16 inch
	211-0507-00			1	SCREW, 6-32 x 5/16 inch BHS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Switches

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	262-0498-00	101	4089	1	SWITCH, MODE, wired
	260-0801-00	4090		1	SWITCH, MODE, unwired
	- - - - - -			-	Includes:
	210-0012-00	101	4089X	1	LOCKWASHER, pot, internal 3/8 ID x 1/2 inch OD
2	210-0413-00	101	4089X	2	NUT, hex, 3/8-32 x 1/2 inch
3	213-0048-00	101	4089X	1	SCREW, set, 4-40 x 1/8 inch HSS, allen head
4	384-0237-00	101	4089X	1	ROD, extension, 3 inch long
	260-0456-00	101	4089X	1	SWITCH, MODE, unwired
	- - - - - -			-	Mounting Hardware: (not included)
	210-0012-00			1	LOCKWASHER, pot, internal 3/8 ID x 1/2 inch OD
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
5	262-0499-00			1	SWITCH, TIME/DIV. AND DELAY TIME RANGE, wired
	- - - - - -			-	Includes:
	210-0006-00			1	LOCKWASHER, internal #6
	210-0012-00			1	LOCKWASHER, pot, internal 3/8 ID x 1/2 inch OD
	210-0202-00			1	LUG, solder
6	210-0413-00			2	NUT, hex, 3/8-32 x 1/2 inch
	210-0449-00			2	NUT, hex, 5-40 x 1/4 inch
7	376-0014-00			1	COUPLING, wire steel
8	384-0260-00			1	ROD, extension
9	386-0450-00			1	PLATE, switch mounting
	260-0455-00			1	SWITCH, TIME/DIV. AND DELAY TIME RANGE, unwired
	- - - - - -			-	Mounting Hardware: (not included)
	210-0049-00			1	LOCKWASHER, internal 5/8 inch
	210-0579-00			1	NUT, hex, 5/8-24 x 3/4 inch
	210-0803-00			2	WASHER, flat 6L x 3/8 inch
	211-0504-00			2	SCREW, 6-32 x 1/4 inch PHS
10	260-0447-00			1	SWITCH, DELAY SWEEP TRIGGERING, SOURCE, INT-EXT, unwired
	- - - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
11	260-0447-00			1	SWITCH, DELAYED SWEEP TRIGGERING, SLOPE + —, unwired
	- - - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
12	260-0447-00			1	SWITCH, NORMAL OR DELAYING SWEEP TRIGGERING, SOURCE + —
	- - - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
13	260-0447-00			1	SWITCH, NORMAL OR DELAYING SWEEP TRIGGERING, INT. EXT.
	- - - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
14	260-0449-00			1	SWITCH, DELAYED SWEEP TRIGGERING, COUPLING, AC DC
	- - - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
15	260-0450-00			1	SWITCH, NORMAL OR DELAYING SWEEP TRIGGERING COUPLING AC DC
	- - - - - -			-	Mounting Hardware: (not included)
	210-0004-00			2	LOCKWASHER, internal #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
					STANDARD ACCESSORIES
	070-0344-00			2	MANUAL, instruction (not shown)

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ELECTRICAL PARTS LIST

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description			S/N Range
		Bulbs			
B10	Use 150-027	Neon, NE-23			
B60	Use 150-027	Neon, NE-23			
B160W	Use 150-027	Neon, NE-23	UNCALIBRATED		101-4089
B160W	150-0030-00	Neon, NE-2 V	UNCALIBRATED		4090-up
B164	Use 150-027	Neon, NE-23			
B264	Use 150-027	Neon, NE-23			
		Capacitors			
Tolerance ±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%					
C5	283-002	.01 μf	Disc Type	500 v	
C7	281-560	198 pf	Cer.	500 v	10%
C9	281-578	18 pf	Cer.	500 v	5%
C11	283-000	.001 μf	Disc Type	500 v	
C13	283-003	.01 μf	Disc Type	150 v	
C16	283-003	.01 μf	Disc Type	150 v	X2470-up
C18	283-003	.01 μf	Disc Type	150 v	
C37	283-026	.2 μf	Disc Type	25 v	
C39	281-524	150 pf	Cer.	500 v	
C55	283-002	.01 μf	Disc Type	500 v	
C57	281-560	198 pf	Cer.	500 v	10%
C59	281-578	18 pf	Cer.	500 v	5%
C61	283-000	.001 μf	Disc Type	500 v	
C63	283-003	.01 μf	Disc Type	150 v	
C66	283-003	.01 μf	Disc Type	150 v	X2470-up
C68	283-003	.01 μf	Disc Type	150 v	
C87	283-026	.2 μf	Disc Type	25 v	
C89	281-524	150 pf	Cer.	500 v	
C103	281-523	100 pf	Cer.	350 v	
C104	283-026	.2 μf	Disc Type	25 v	
C106	283-026	.2 μf	Disc Type	25 v	
C109	281-525	470 pf	Cer.	500 v	
C113	281-518	47 pf	Cer.	500 v	
C122	290-167	10 μf	EMT	15 v	
C144	281-524	150 pf	Cer.	500 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.		

Capactiors *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description			S/N Range
C160E, C160F, C160G, C160H	*295-067	.001 μf, .01 μf, .1 μf, 1 μf Timing Series†			
C162	283-003	.01 μf Disc Type	150 v		
C163	281-511	22 pf Cer.	500 v	10%	X3019-up
C167	281-524	150 pf Cer.	500 v		
C170A	281-523	100 pf Cer.	350 v		
C170B	285-501	.001 μf MT	600 v		
C170C	285-569	.01 μf PTM	200 v		
C170D	285-572	.1 μf PTM	200 v		
C170E	285-576	1 μf PTM	100 v	10%	
C170F	281-518	47 pf Cer.	500 v		
C172	281-0504-00	10 pf Cer	500 v	10%	X4040-up
C188	281-573	11 pf Cer.	500 v	10%	
C195	283-004	.02 μf Disc Type	150 v		
C197	283-003	.01 μf Disc Type	150 v		
C206	283-026	.2 μf Disc Type	25 v		
C209	281-525	470 pf Cer.	500 v		
C213	281-518	47 pf Cer.	500 v		
C244	281-524	150 pf Cer.	500 v		
C252	281-546	330 pf Cer.	500 v	10%	
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, C260G, C260F, C260H	*295-067	.001 μf, .01 μf, .1 μf, 1 μf Timing Series†			
C262	283-003	.01 μf Disc Type	150 v		
C263	281-511	22 pf Cer.	500 v	10%	X3019-up
C267	281-524	150 pf Cer.	500 v		
C270A	281-523	100 pf Cer.	350 v		
C270B	285-501	.001 μf MT	600 v		
C270C	285-569	.01 μf PTM	200 v		
C270D	285-572	.1 μf PTM	200 v		
C270E	285-576	1 μf PTM	100 v	10%	
C270F	281-518	47 pf Cer.	500 v		
C303	283-026	.2 μf Disc Type	25 v		
C336	283-026	.2 μf Disc Type	25 v		
C354	Use 285-007	160 pf Glass	500 v	5%	101-3018
C354	281-605	200 pf Cer.	500 v		3019-up
C356	283-526	.001 μf Mica	500 v	1%	
C364	283-519	360 pf Mica	500 v	5%	101-3018
C364	283-551	270 pf Mica		5%	3019-up
C394	283-026	.2 μf Disc Type	25 v		
C396	283-006	.02 μf Disc Type	600 v		

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

Capactiors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description			S/N Range
C397	283-006	.02 μf	Disc Type	600 v		
C399	283-057	.1 μf	Disc Type	200 v		
C412	283-004	.02 μf	Disc Type	150 v		
C414	283-000	.001 μf	Disc Type	500 v		
C417	283-000	.001 μf	Disc Type	500 v		
C423	283-003	.01 μf	Disc Type	150 v		
C424	281-546	330 pf	Cer.	500 v	10%	
C427	Use 283-057	.1 μf	Disc Type	200 v		
C435	283-057	.1 μf	Disc Type	200 v		
C441	281-523	100 pf	Cer.	350 v		
C445	281-523	100 pf	Cer.	350 v		

Diodes

D14	152-141	Silicon	1N3605	X2470-up
D15	152-008	Germanium	T12G	101-2469
D15	*152-061	Silicon	Tek Spec	2470-up
D16	152-008	Germanium	T12G	101-2469
D16	152-141	Silicon	1N3605	2470-up
D24	*152-075	Germanium	Tek Spec	101-2469
D24	152-141	Silicon	1N3605	2470-up
D34	*152-075	Germanium	Tek Spec	101-2469
D34	152-141	Silicon	1N3605	2470-up
D35	152-081	Tunnel	TD2 2.2 MA	
D64	152-141	Silicon	1N3605	X2470-up
D65	152-008	Germanium	1N3605	101-2469
D65	*152-061	Silicon	Tek Spec	2470-up
D66	152-008	Germanium	T12G	101-2469
D66	152-141	Silicon	1N3605	2470-up
D74	*152-075	Germanium	Tek Spec	101-2469
D74	152-141	Silicon	1N3605	2470-up
D84	*152-075	Germanium	Tek Spec	101-2469
D84	152-141	Silicon	1N3605	2470-up
D85	152-081	Tunnel	TD2 2.2MA	
D101	*152-075	Germanium	Tek Spec	
D102	*152-075	Germanium	Tek Spec	
D105	152-093	Tunnel	1N3716 4.7 MA	
D113	*152-075	Germanium	Tek Spec	
D115	152-081	Tunnel	TD2 2.2 MA	
D119	*152-075	Germanium	Tek Spec	
D122	152-008	Germanium	T12G	
D132	Use *152-0185-00	Silicon	Replaceable by 1N3605	
D133	Use *152-0185-00	Silicon	Replaceable by 1N3605	
D134	Use *152-0185-00	Silicon	Replaceable by 1N3605	
D143	Use *152-0185-00	Silicon	Replaceable by 1N3605	
D162	152-091	Zener	1N982 75 v .4 w	
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	

Diodes *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description	S/N Range
D198	*152-075	Germanium	Tek Spec	
D201	*152-075	Germanium	Tek Spec	
D202	*152-075	Germanium	Tek Spec	
D205	152-093	Tunnel	1N3716 4.7 MA	
D213	152-075	Germanium	Tek Spec	
D233	Use *152-0185-00	Silicon	Replaceable by 1N3605	
D234	Use *152-0185-00	Silicon	Replaceable by 1N3605	
D243	Use *152-0185-00	Silicon	Replaceable by 1N3605	
D252	152-0246-00	Silicon	Low Leakage 0.25 w, 40 v	X4090-up
D262	152-091	Zener	1N982 75 v .4 w	
D270	*152-061	Silicon	Tek Spec	
D271	*152-061	Silicon	Tek Spec	
D292	*152-075	Silicon	Tek Spec	
D292	*152-075	Germanium	Tek Spec	
D398	152-031	Zener	1N718A 15 v	
D415	152-081	Tunnel	TD2 2.2 MA	
D425	*152-075	Germanium	Tek Spec	
D444	*152-075	Germanium	Tek Spec	
D445	152-081	Tunnel	TD2 2.2 MA	
D455	Use *152-185	Silicon	Replaceable by 1N3605	

Inductors

L35	*108-146	5 μh	
L85	*108-146	5 μh	
L303	108-249	12 μh	

Resistors

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

R7	315-753	75 k	1/4 w			5%	
R9	301-914	910 k	1/2 w			5%	
R10	301-275	2.7 meg	1/2 w			5%	
R11	315-224	220 k	1/4 w			5%	
R12	316-101	100 Ω	1/4 w				
R13	316-102	1 k	1/4 w				
R14	303-243	24 k	1 w			5%	
R16	301-623	62 k	1/2 w			5%	
R17	315-124	120 k	1/4 w			5%	
R18	316-470	47 Ω	1/4 w				
R19	316-824	820 k	1/4 w				
R20	315-562	5.6 k	1/4 w			5%	
R21	315-473	47 k	1/4 w			5%	101-2469
R21	Use 301-0393-00	39 k	1/2 w			5%	2470-up
R23†	311-311	200 k		Var.		LEVEL	
R29	Use 303-393	39 k	1 w			5%	101-2469
	303-363	36 k	1 w			5%	2470-up
R35	309-345	225 Ω	1/2 w		Prec.	1%	
R37	316-101	100 Ω	1/4 w				
R39	315-270	27 Ω	1/4 w			5%	
R44	302-563	56 k	1/2 w				
R57	315-753	75 k	1/4 w			5%	

† Concentric with SW6. Furnished as a unit.

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description				S/N Range
R59	301-914	910 k	½ w			5%	
R60	301-275	2.7 meg	½ w			5%	
R61	315-224	220 k	¼ w			5%	
R62	316-101	100 Ω	¼ w				
R63	316-102	1 k	¼ w				
R64	303-243	24 k	1 w			5%	
R66	301-623	62 k	½ w			5%	
R67	315-124	120 k	¼ w			5%	
R68	316-470	47 Ω	¼ w				
R69	316-824	820 k	¼ w				
R70	315-562	5.6 k	¼ w			5%	
R71	315-473	47 k	¼ w			5%	101-2469
R71	Use 301-0393-00	39 k	½ w			5%	2470-up
R73†	311-311	200 k		Var.		LEVEL	
R79	Use 303-393	39 k	1 w			5%	101-2469
R79	303-363	36 k	1 w			5%	2470-up
R85	309-345	225 Ω	½ w		Prec.	1%	
R87	316-101	100 Ω	¼ w				
R89	315-330	33 Ω	¼ w			5%	
R94	302-563	56 k	½ w				
R102	315-102	1 k	¼ w			5%	
R103	316-102	1 k	¼ w				
R104	316-101	100 Ω	¼ w				
R106	316-470	47 Ω	¼ w				
R109	315-331	330 Ω	¼ w			5%	
R110	315-823	82 k	¼ w			5%	
R112	302-683	68 k	½ w				
R113	316-332	3.3 k	¼ w				
R116	Use 309-409	2.4 k	½ w		Prec.	½%	
R117	309-158	1.19 k	½ w		Prec.	1%	
R118	309-090	50 k	½ w		Prec.	1%	
R119	315-681	680 Ω	¼ w			5%	
R122	316-391	390 Ω	¼ w				
R123	315-823	82 k	¼ w			5%	
R124	315-331	330 Ω	¼ w			5%	
R125	301-753	75 k	½ w			5%	
R130	311-110	100 k		Var.		NORMAL SWP. GATING THRESHOLD	
R131	309-354	45 k	½ w		Prec.	1%	
R142	309-354	45 k	½ w		Prec.	1%	
R143	309-036	18 k	½ w		Prec.	1%	
R144	316-102	1 k	¼ w				
R152	316-221	220 Ω	¼ w				
R160A	309-380	250 k	½ w		Prec.	1%	
R160B	309-380	250 k	½ w		Prec.	1%	

† Concentric with SW56. Furnished as a unit.

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description				S/N Range
R160C	309-140	500 k	½ w		Prec.	1%	
R160D	309-141	750 k	½ w		Prec.	1%	
R160E	309-141	750 k	½ w		Prec.	1%	
R160F	309-017	1.5 meg	½ w		Prec.	1%	
R160G	309-399	7.5 meg	½ w		Prec.	1%	
R160H	309-399	7.5 meg	½ w		Prec.	1%	
R160W	Use 302-104	100 k	½ w				
R160X	301-103	10 k	½ w			5%	
R160Y†	311-108	20 k		Var.	WW	VARIABLE	
R161	316-101	100 Ω	¼ w				
R162	306-683	68 k	2 w				101-3018
R162	305-433	43 k	2 w			5%	3019-up
R163	316-472	4.7 k	¼ w				X3019-up
R164	315-224	220 k	¼ w			5%	
R165	316-101	100 Ω	¼ w				
R166	323-0383-00	95.3 k	½ w		Prec	1%	X4040-up
R167	301-682	6.8 k	½ w			5%	
R168	311-310	5 k		Var.		NORMAL SWEEP LENGTH	
R169	303-183	18 k	1 w			5%	
R170	316-184	180 k	¼ w				
R172	316-104	100 k	¼ w				
R183	316-332	3.3 k	¼ w				
R184	316-182	1.8 k	¼ w				
R186	316-332	3.3 k	¼ w				
R187	315-124	120 k	¼ w			5%	
R188	315-752	7.5 k	¼ w			5%	
R190	316-152	1.5 k	¼ w				
R192	316-470	47 Ω	¼ w				
R194	308-213	25 k	7 w		WW	5%	
R195	316-102	1 k	¼ w				
R196	302-274	270 k	½ w				
R197	316-121	120 Ω	¼ w				
R198	315-162	1.6 k	¼ w			5%	
R199	316-101	100 Ω	¼ w				X3019-up
R202	Use 315-102	1 k	¼ w			5%	
R203	316-102	1 k	¼ w				
R206	316-470	47 Ω	¼ w				
R209	315-331	330 Ω	¼ w			5%	
R210	315-823	82 k	¼ w			5%	
R212	302-683	68 k	½ w				
R213	316-332	3.3 k	¼ w				
R229	301-753	75 k	½ w			5%	
R230	311-110	100 k		Var.		DELAYED SWP. GATING THRESHOLD	
R231	309-354	45 k	½ w		Prec.	1%	
R242	309-354	45 k	½ w		Prec.	1%	
R243	309-036	18 k	½ w		Prec.	1%	

† Concentric with SW160Y. Furnished as a unit.

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description				S/N Range
R244	316-102	1 k	1/4 w				
R252	316-221	220 Ω	1/4 w				
R260A	309-380	250 k	1/2 w		Prec.	1%	
R260B	309-380	500 k	1/2 w		Prec.	1%	
R260C	309-140	250 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 Ω	1/4 w				
R262	306-683	68 k	2 w				101-3018
R262	305-433	43 k	2 w			5%	3019-up
R263	316-472	4.7 k	1/4 w				X3019-up
R264	315-224	220 k	1/4 w			5%	
R265	316-101	100 Ω	1/4 w				
R267	Use 303-682	6.8 k	1 w			5%	
R268	311-310	5 k		Var.		DELAYED SWP. LENGTH	
R269	303-183	18 k	1 w			5%	
R270	316-184	180 k	1/4 w				
R272	316-104	100 k	1/4 w				
R283	316-332	3.3 k	1/4 w				
R284	316-182	1.8 k	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 309-0392-00	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	Use 260-0801-00						101-4089
R316†	311-0625-00	150 k		Var.		POSITION	4090-up
R317	309-041	60 k	1/2 w		Prec.	1%	
R318	309-201	2.85 k	1/2 w		Prec.	1/4%	
R319	309-108	80 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 Ω	1/2 w		Prec.	1%	
R355	311-169	100 Ω	1/2 w	Var.		5X GAIN	
R356	315-330	33 Ω	1/4 w			5%	
R357	308-054	10 k	5 w		WW	5%	
R364	309-347	1.22 k	1/2 w		Prec.	1%	
R367	308-053	8 k	5 w		WW	5%	

† Concentric with SW367. Furnished as a unit.

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.		Description				S/N Range
R368	311-310	5 k		Var.		SWP. MAG. REGIS.	
R381	316-101	100 Ω	¼ w				
R382	308-178	15 k	8 w		WW	5%	
R384	316-101	100 Ω	¼ w				
R385	308-178	15 k	8 w		WW	5%	
R391	301-151	150 Ω	½ w			5%	
R392	301-151	150 Ω	½ w			5%	
R393	308-0245-00	.6 Ω	2 w		WW	5%	X3930-up
R394	301-910	91 Ω	½ w			5%	
R396	308-229	4 k	5 w		WW	5%	101-3929
R396	308-0003-00	2 k	5 w		WW	5%	3930-up
R397	308-003	2 k	5 w		WW	5%	101-3929X
R398	Use 301-0274-00	270 k	½ w			5%	
R411	316-101	100 Ω	¼ w				
R412	316-101	100 Ω	¼ w				
R413	316-103	10 k	¼ w				
R414	309-118	4.23 k	½ w		Prec.	1%	
R415	309-100	10 k	½ w		Prec.	1%	
R417	316-220	22 Ω	¼ w				
R419	302-473	47 k	½ w				
R423	316-101	100 Ω	¼ w				
R424	316-222	2.2 k	¼ w				
R425	316-472	4.7 k	¼ w				
R426	309-043	82 k	½ w		Prec.	1%	
R427	309-231	16.69 k	½ w		Prec.	1%	
R428	316-101	100 Ω	¼ w				
R429	309-270	3.92 k	½ w		Prec.	1%	
R431	315-335	3.3 meg	¼ w			5%	
R432	Use 311-338	50 k		Var.		VERNIER	
R433	315-104	100 k	¼ w			5%	
R434	Use 311-338	50 k		Var.		DELAY TIME	
R435	311-310	5 k		Var.		DELAY STOP	
R437	Use 309-159	5 k	½ w		Prec.	1%	
R439	Use 305-363	36 k	½ w			5%	
R441	302-823	82 k	½ w				
R442	315-912	9.1 k	¼ w			5%	
R443	315-104	100 k	¼ w			5%	
R445	315-681	680 Ω	¼ w			5%	
R449	315-912	9.1 k	¼ w			5%	
R451	315-561	560 Ω	¼ w			5%	
R453	315-332	3.3 k	¼ w			5%	
R455	301-333	33 k	½ w			5%	

Switches

	Unwired	Wired		
SW3	260-447		Slide	SOURCE
SW5	260-450		Slide	COUPLING
SW6†	311-311			PULL EXT. TRIG. ATTEN.

†Concentric with R23. Furnished as a unit.

Switches *(Cont'd)*

Ckt. No.	Tektronix Part No. Unwired	Wired	Description		S/N Range
SW19	260-447		Slide	SLOPE	
SW53	260-447		Slide	SOURCE	
SW55	260-449		Slide	COUPLING	
SW56[1]	311-311			PULL EXT. TRIG. ATTEN.	
SW69	260-447		Slide	SLOPE	
SW81	Use 260-0801-00		Rotary	MODE	
SW160[2]	260-455	*262-499	Rotary	TIME/DIV (Normal Sweep)	
SW160Y[3]	311-108				
SW260[2]	260-455	*262-499	Rotary	TIME/DIV (Delayed Sweep)	
SW367	Use 260-0801-00			PULL 5X MAG	101-4089
SW367[4]	311-0625-00				4090-up

[1]Concentric with R73. Furnished as a unit.
[2]SW160 and SW260 furnished as a unit.
[3]Concentric with R160Y. Furnished as a unit.
[4]Concentric with R316. Furnished as a unit.

Transformers

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

Transistors

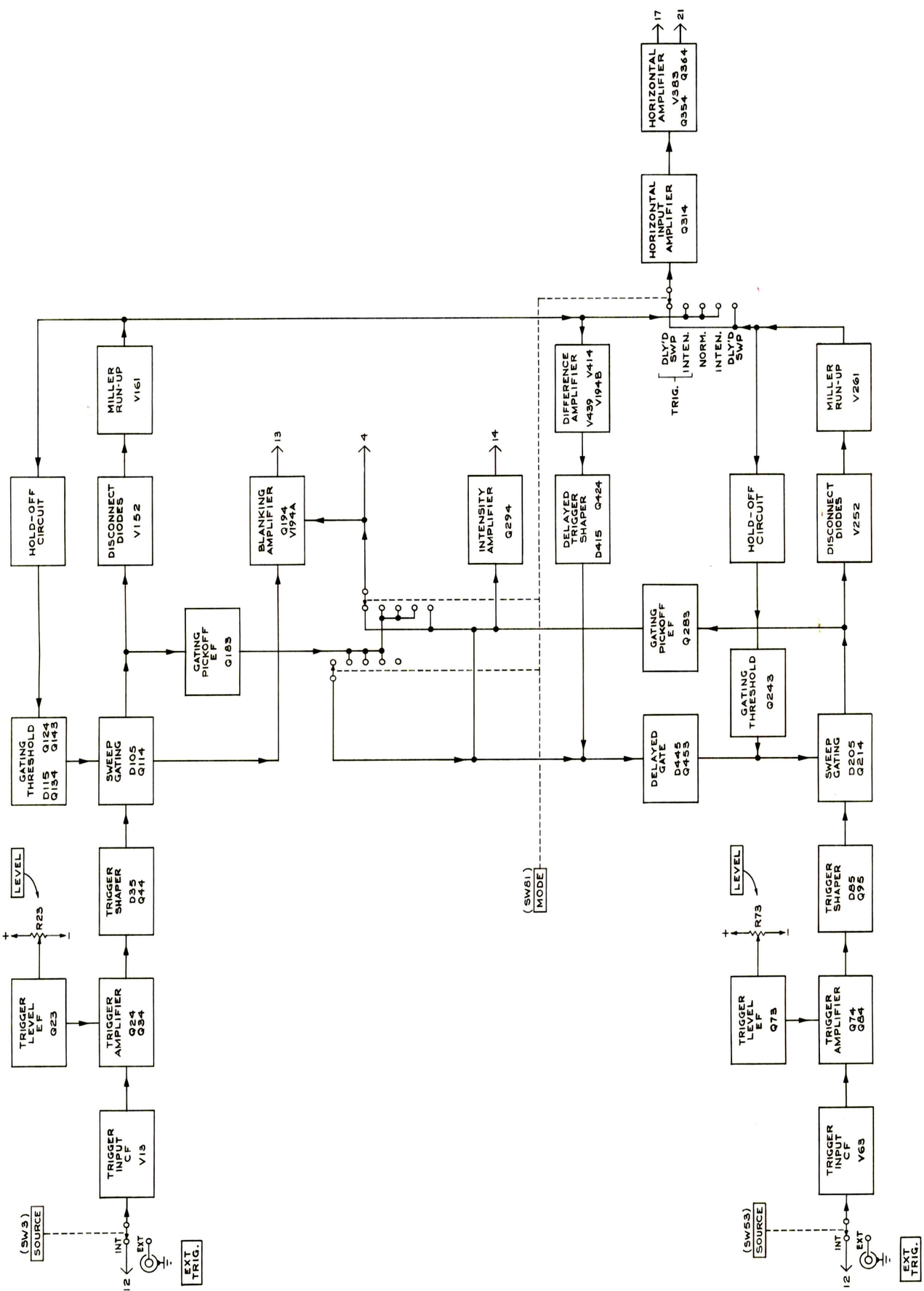
Q23	151-070	2N1377	101-2469
Q23	151-063	2N2207	2470-up
Q24	151-084	2N1225	101-2469
Q24	151-063	2N2207	2470-up
Q34	151-084	2N1225	101-2469
Q34	151-063	2N2207	2470-up
Q44	151-094	2N835	101-2469
Q44	*151-108	Replaceable by 2N2501	2470-up
Q73	151-070	2N1377	101-2469
Q73	151-063	2N2207	2470-up
Q74	151-084	2N1225	101-2469
Q74	151-063	2N2207	2470-up
Q84	151-084	2N1225	101-2469
Q84	151-063	2N2207	2470-up
Q94	151-094	2N835	101-2469
Q94	*151-108	Replaceable by 2N2501	2470-up
Q114	*151-062	Selected from TIN101	
Q124	*151-062	Selected from TIN101	
Q134	151-041	2N1303	
Q143	Use *050-0261-00	Replacement kit	101-4039
Q143	*151-087	Selected from 2N1131	4040-up
Q183	151-076	2N2048	
Q194	151-076	2N2048	
Q214	*151-062	Selected from TIN101	
Q243	*151-087	Selected from 2N1131	
Q283	151-076	2N2048	
Q294	151-094	2N835	101-2469
Q294	*151-108	Replaceable by 2N2501	2470-up
Q314	151-076	2N2048	
Q323	*151-062	Selected from TIN101	101-2469
Q323	*151-108	Replaceable by 2N2501	2470-up

Transistors *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description	S/N Range
Q333	151-062	Selected from TIN101	101-2469
Q333	*151-062	Replaceable by 2N2501	2470-up
Q354	151-058	RT5204	
Q364	151-058	RT5204	
Q424	*151-062	Selected from TIN101	
Q453	151-076	2N2048	

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

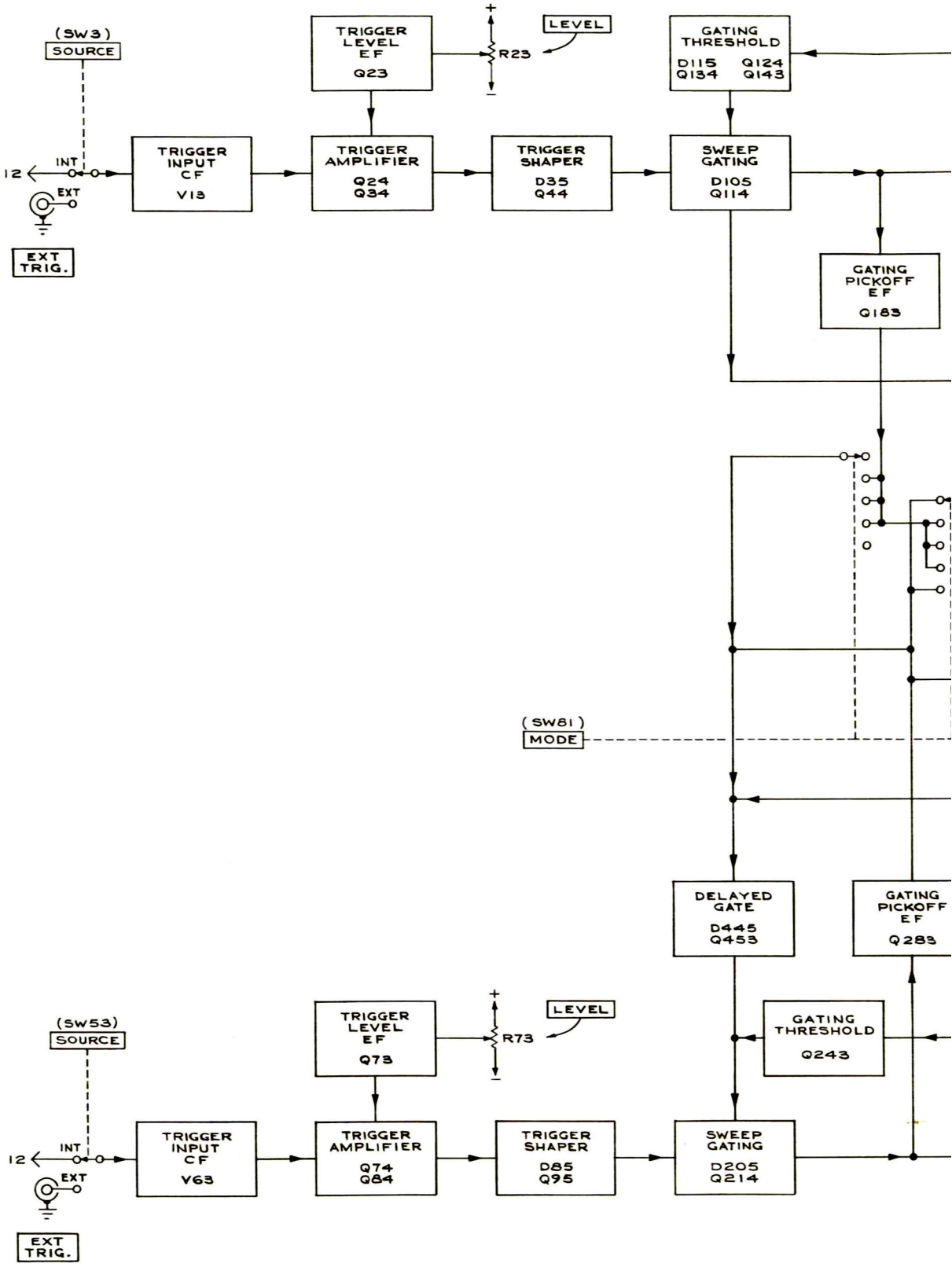


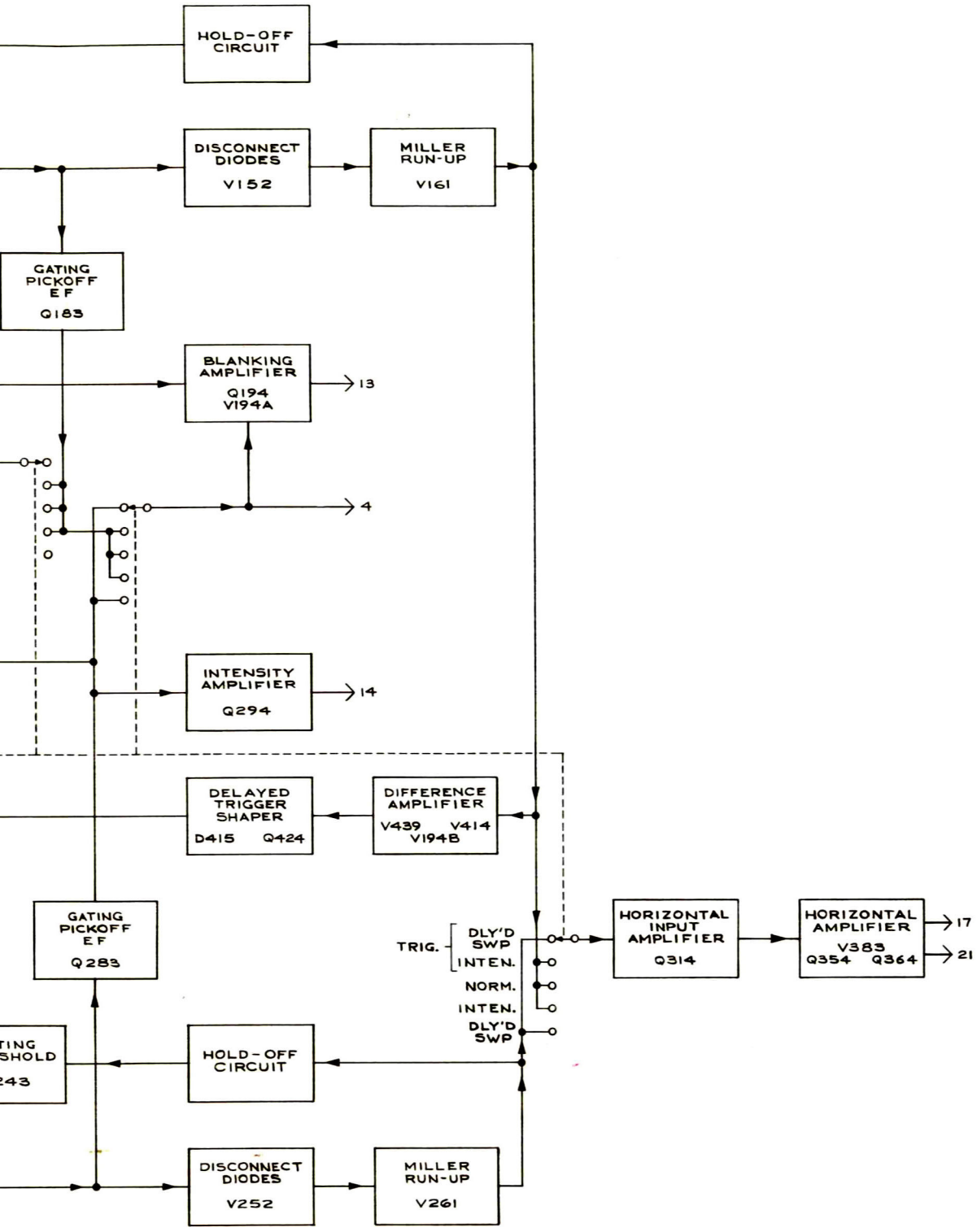
MRH
563

BLOCK DIAGRAM

A

TYPE 3B1 PLUG-IN

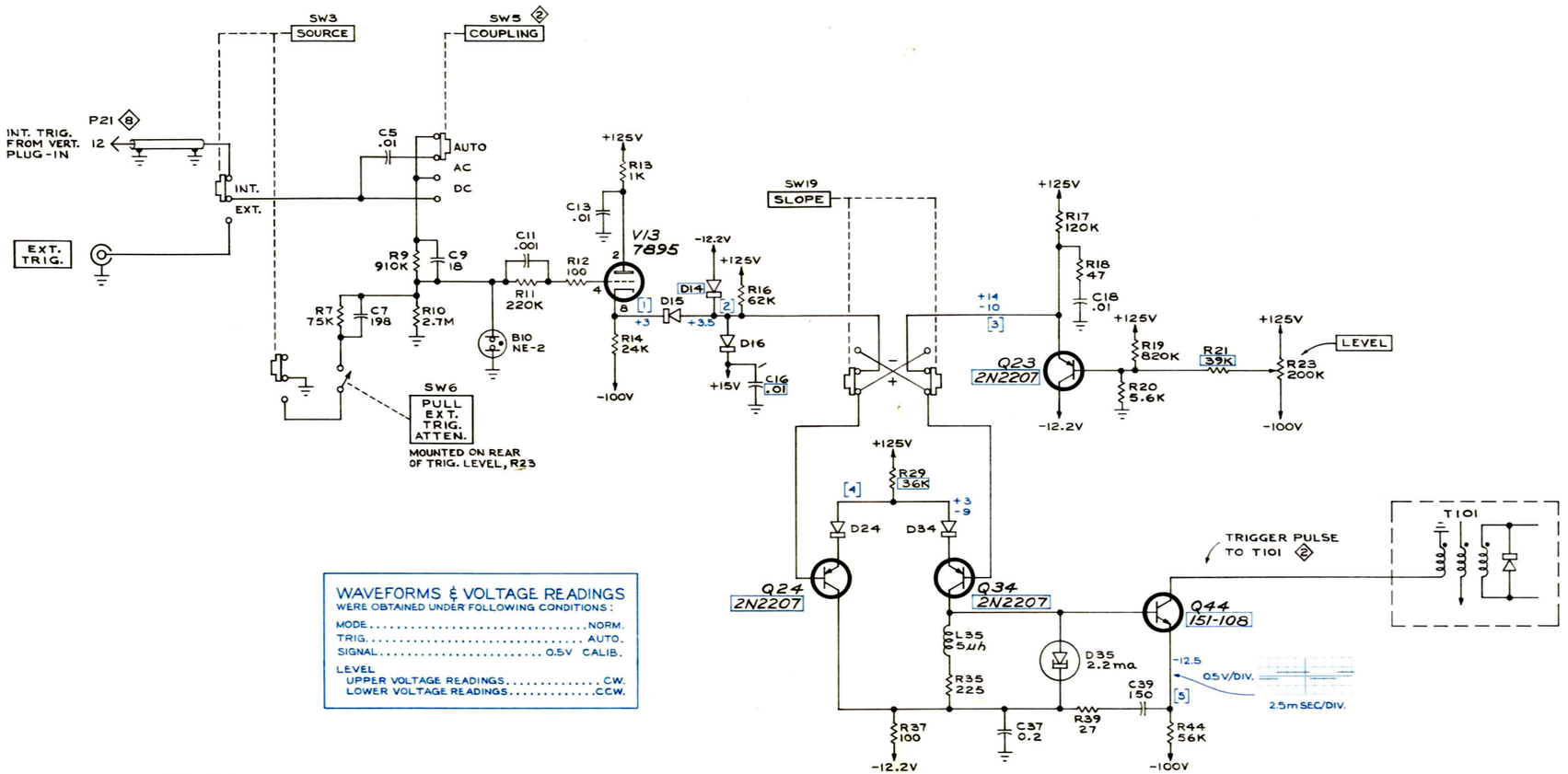

(SW3)
SOURCE
INT
12
EXT
EXT TRIG.
TRIGGER INPUT CF V13
TRIGGER LEVEL EF Q23
R23
LEVEL
TRIGGER AMPLIFIER Q24 Q34
TRIGGER SHAPER D35 Q44
GATING THRESHOLD D115 Q124 Q134 Q143
SWEEP GATING D105 Q114
GATING PICKOFF EF Q183
(SW81)
MODE
DELAYED GATE D445 Q453
GATING PICKOFF EF Q283
(SW53)
SOURCE
INT
12
EXT
EXT TRIG.
TRIGGER INPUT CF V63
TRIGGER LEVEL EF Q73
R73
LEVEL
TRIGGER AMPLIFIER Q74 Q84
TRIGGER SHAPER D85 Q95
GATING THRESHOLD Q243
SWEEP GATING D205 Q214



MRH
563

A

BLOCK DIAGRAM



WAVEFORMS & VOLTAGE READINGS

WERE OBTAINED UNDER FOLLOWING CONDITIONS:

MODE ..... NORM.
TRIG. ..... AUTO.
SIGNAL ..... 0.5V CALIB.

LEVEL
UPPER VOLTAGE READINGS ..... CW.
LOWER VOLTAGE READINGS ..... CCW.

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

REFERENCE DRAWINGS

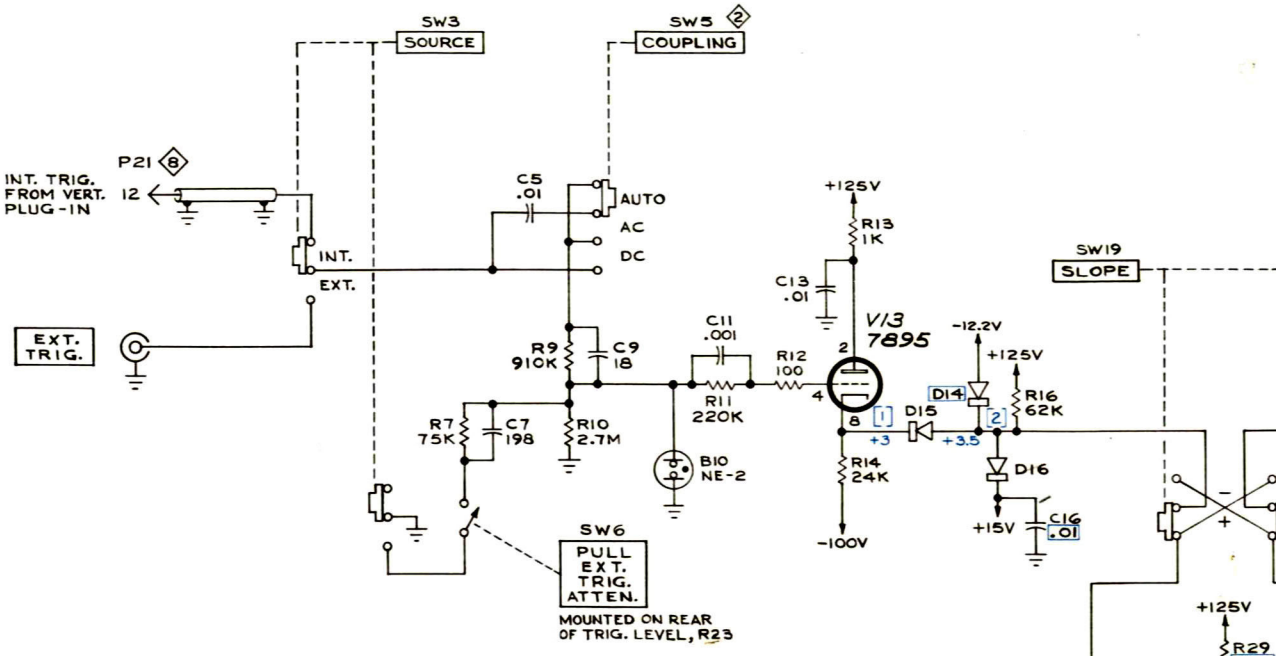
- NORMAL SWEEP GENERATOR
- HORIZONTAL AMPLIFIER

MRH
1063

NORMAL SWEEP TRIGGER

CIRCUIT NUMBERS 1 THRU 49

SWEEP TRIGGER



WAVEFORMS & VOLTAGE READINGS

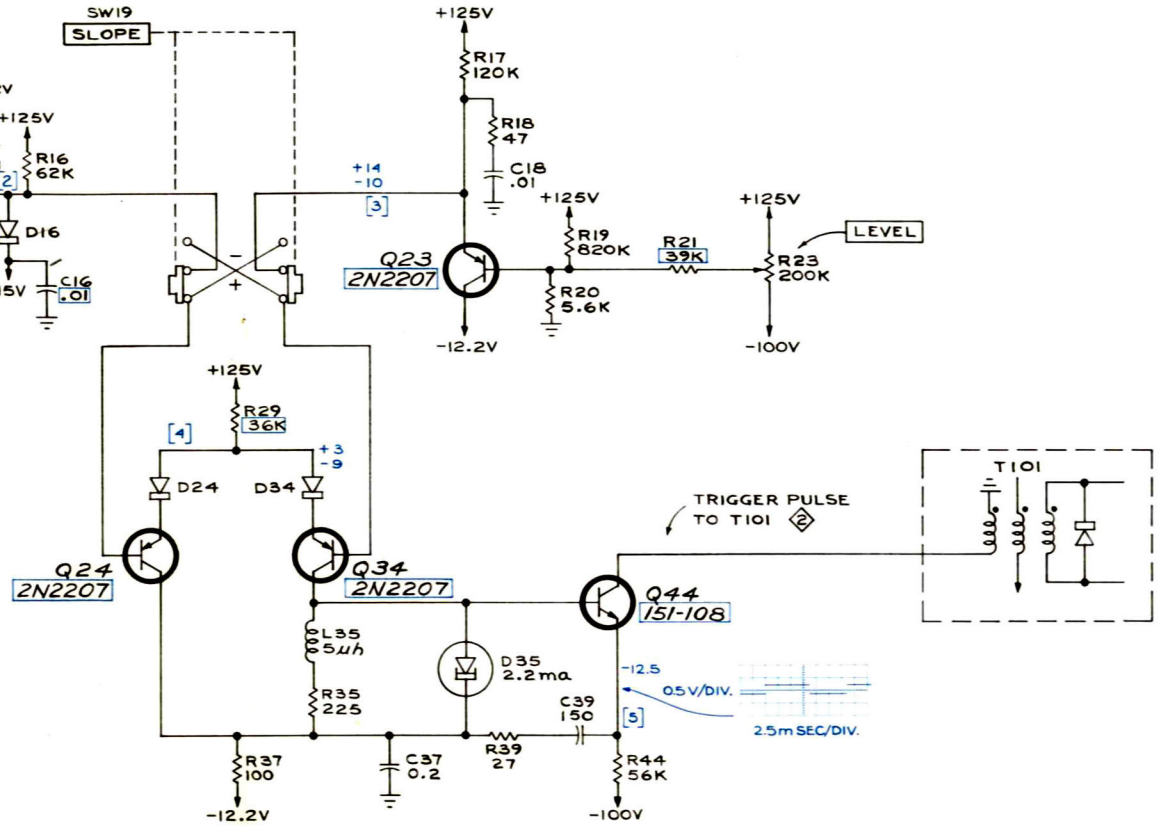
WERE OBTAINED UNDER FOLLOWING CONDITIONS:

MODE.....NORM.
TRIG.....AUTO.
SIGNAL.....0.5V CALIB.

LEVEL
UPPER VOLTAGE READINGS.....C.W.
LOWER VOLTAGE READINGS.....C.C.W.

REFERENCE DRAWINGS

◇2 NORMAL SWEEP GENERATOR
◇8 HORIZONTAL AMPLIFIER



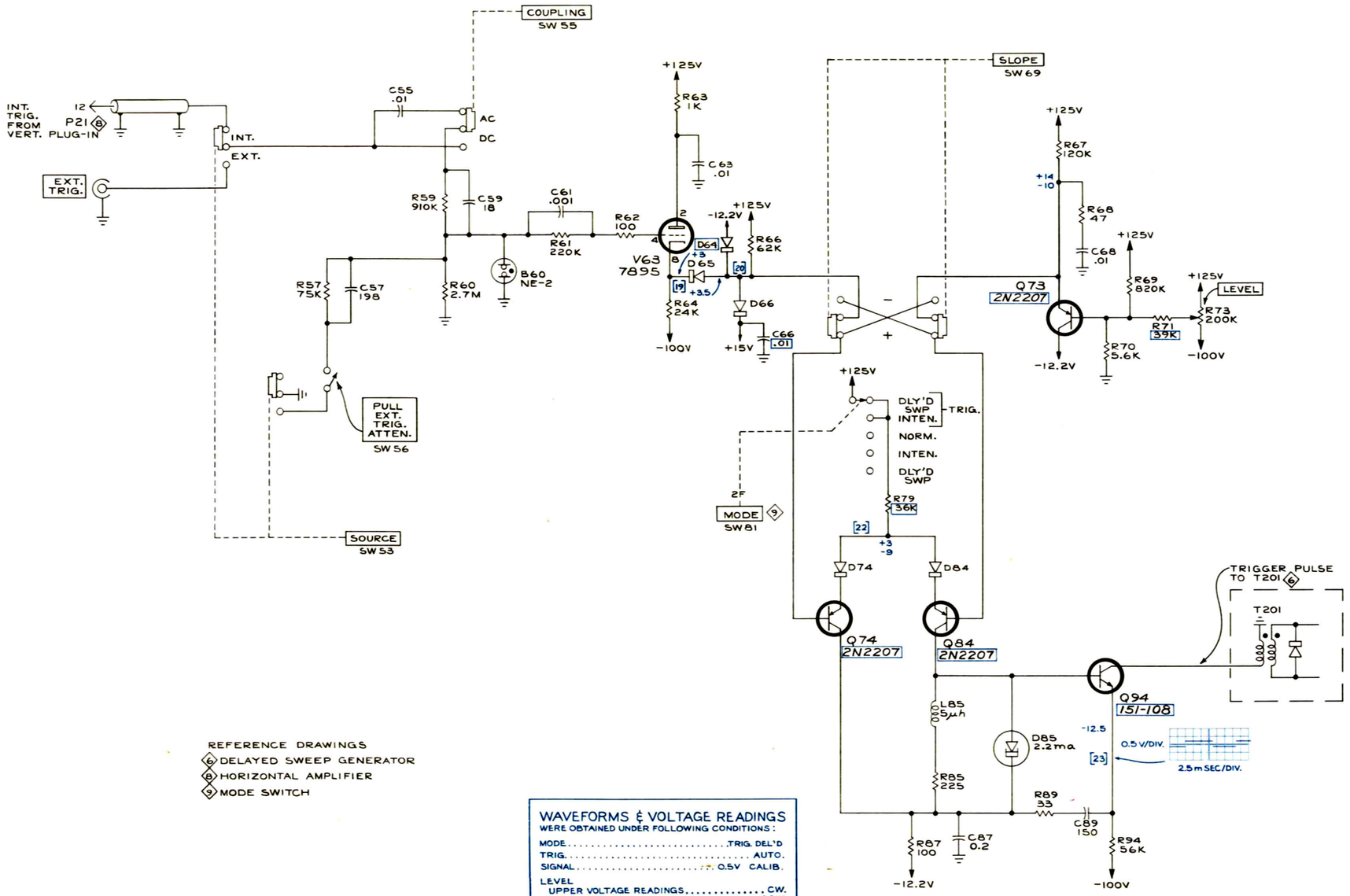
SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE

MRH
1063

B

NORMAL SWEEP TRIGGER

CIRCUIT NUMBERS
1 THRU 49



REFERENCE DRAWINGS

6 DELAYED SWEEP GENERATOR

8 HORIZONTAL AMPLIFIER

9 MODE SWITCH

WAVEFORMS & VOLTAGE READINGS
WERE OBTAINED UNDER FOLLOWING CONDITIONS :

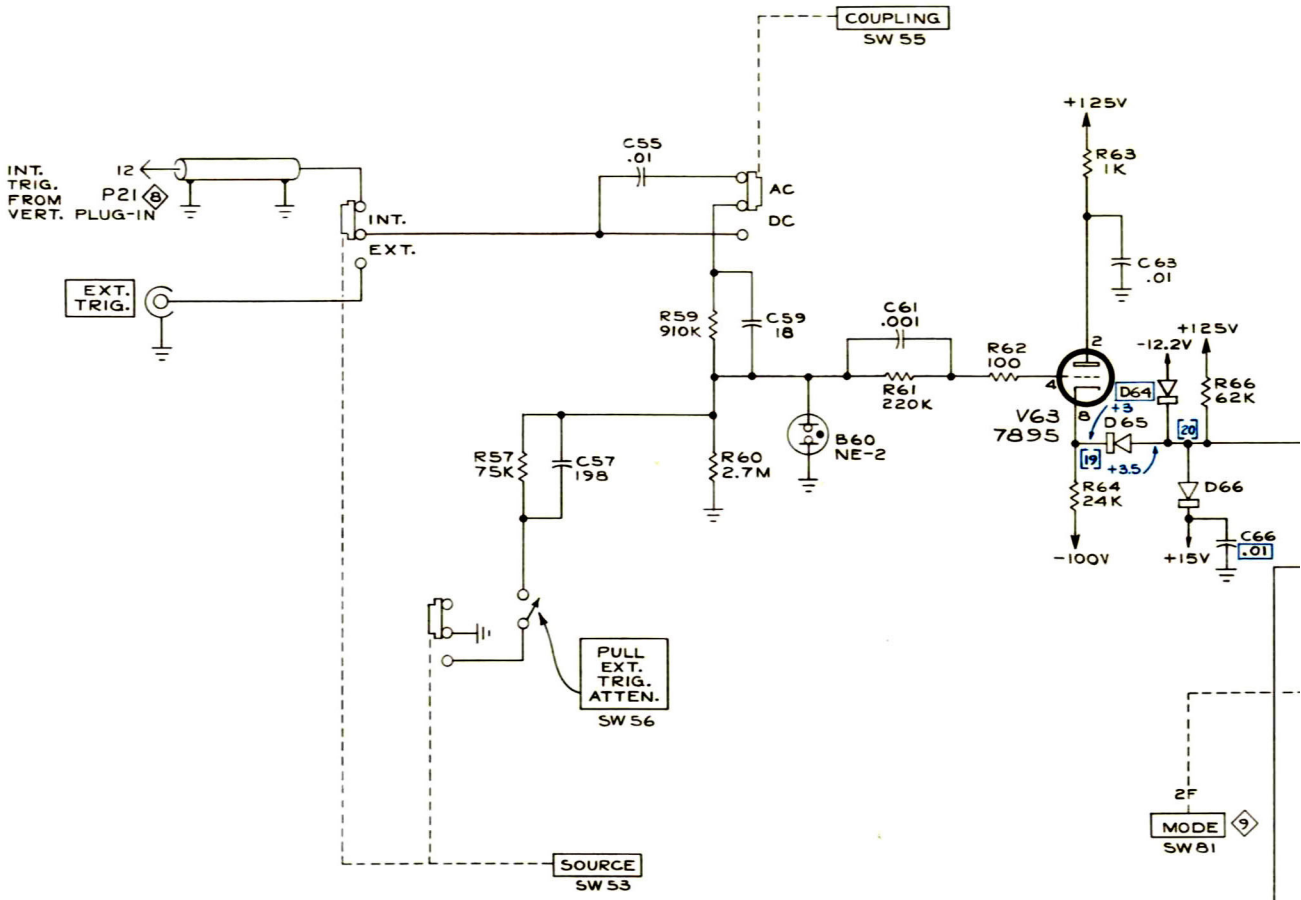
MODE ..... TRIG. DEL'D
TRIG. ..... AUTO.
SIGNAL ..... 0.5V CALIB.
LEVEL
UPPER VOLTAGE READINGS ..... C.W.
LOWER VOLTAGE READINGS ..... C.C.W.

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

PLM 1063

DELAYED SWEEP TRIGGER

CIRCUIT NUMBERS 50 THRU 99



REFERENCE DRAWINGS

6 DELAYED SWEEP GENERATOR

8 HORIZONTAL AMPLIFIER

9 MODE SWITCH

WAVEFORMS & VOLTAGE READINGS

WERE OBTAINED UNDER FOLLOWING CONDITIONS :

MODE ..... TRIG. DEL'D

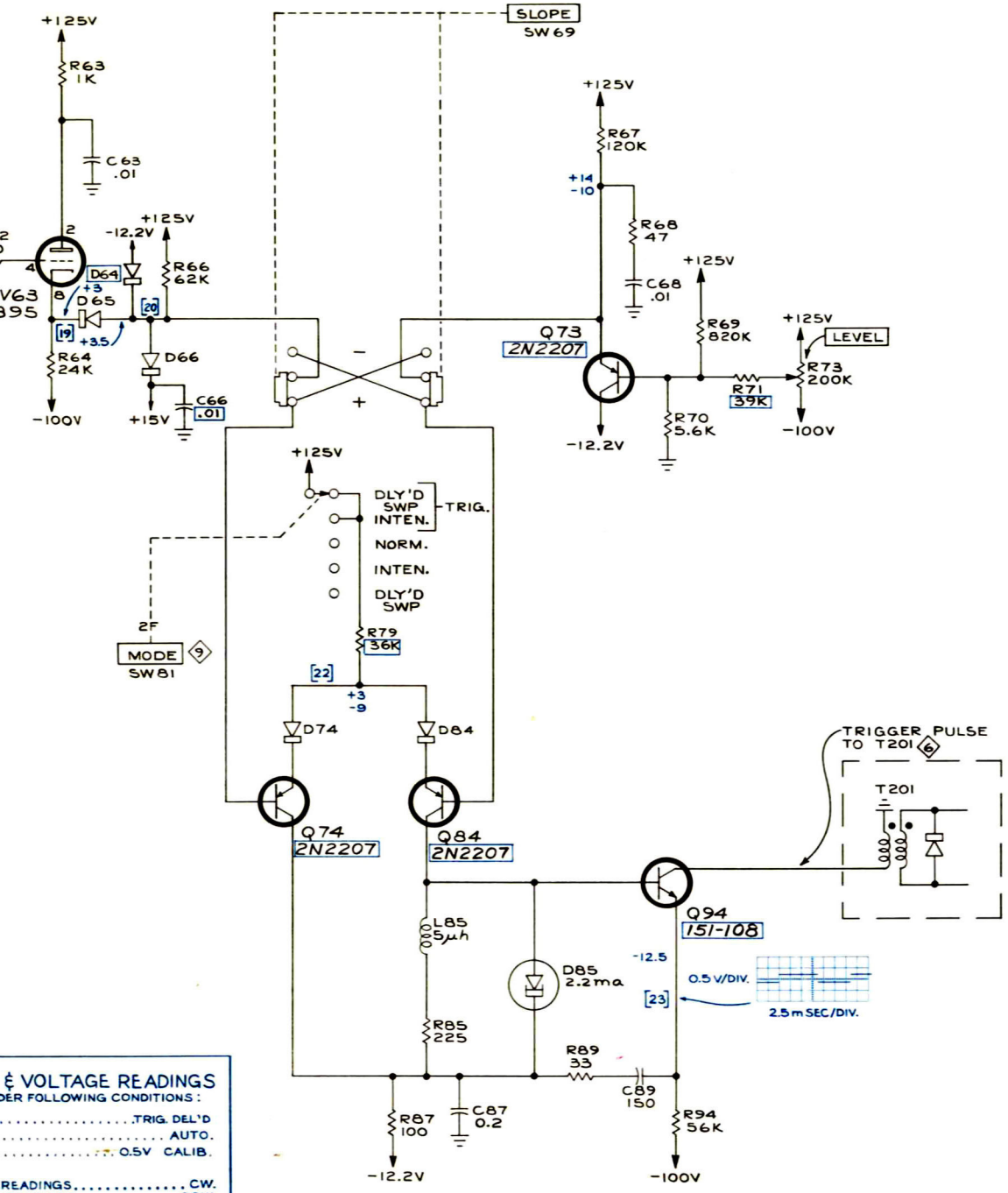
TRIG. ..... AUTO.

SIGNAL ..... 0.5V CALIB.

LEVEL

UPPER VOLTAGE READINGS ..... CW.

LOWER VOLTAGE READINGS ..... CCW.



VOLTAGE READINGS

UNDER FOLLOWING CONDITIONS :

- ..... TRIG. DEL'D
- ..... AUTO.
- ..... 0.5V CALIB.

READINGS..... CW.
READINGS..... CCW.

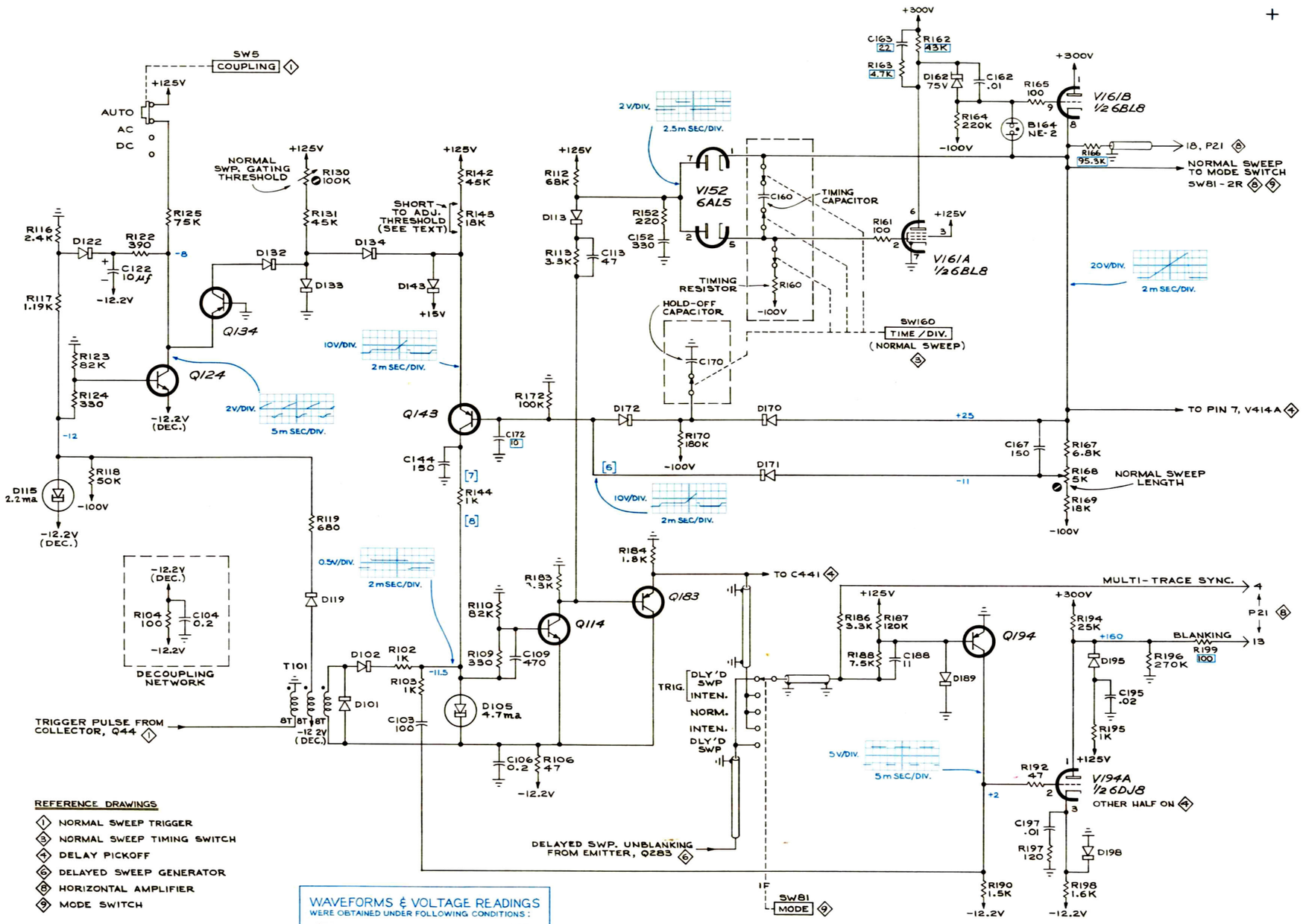
SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE

B

PLM 1063

DELAYED SWEEP TRIGGER

CIRCUIT NUMBERS 50 THRU 99



REFERENCE DRAWINGS

- 1 NORMAL SWEEP TRIGGER
- 3 NORMAL SWEEP TIMING SWITCH
- 4 DELAY PICKOFF
- 6 DELAYED SWEEP GENERATOR
- 8 HORIZONTAL AMPLIFIER
- 9 MODE SWITCH

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

WAVEFORMS & VOLTAGE READINGS
WERE OBTAINED UNDER FOLLOWING CONDITIONS:

MODE ..... NORM.
TRIG. ..... AUTO.
SIGNAL ..... 0.5V CALIB.

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

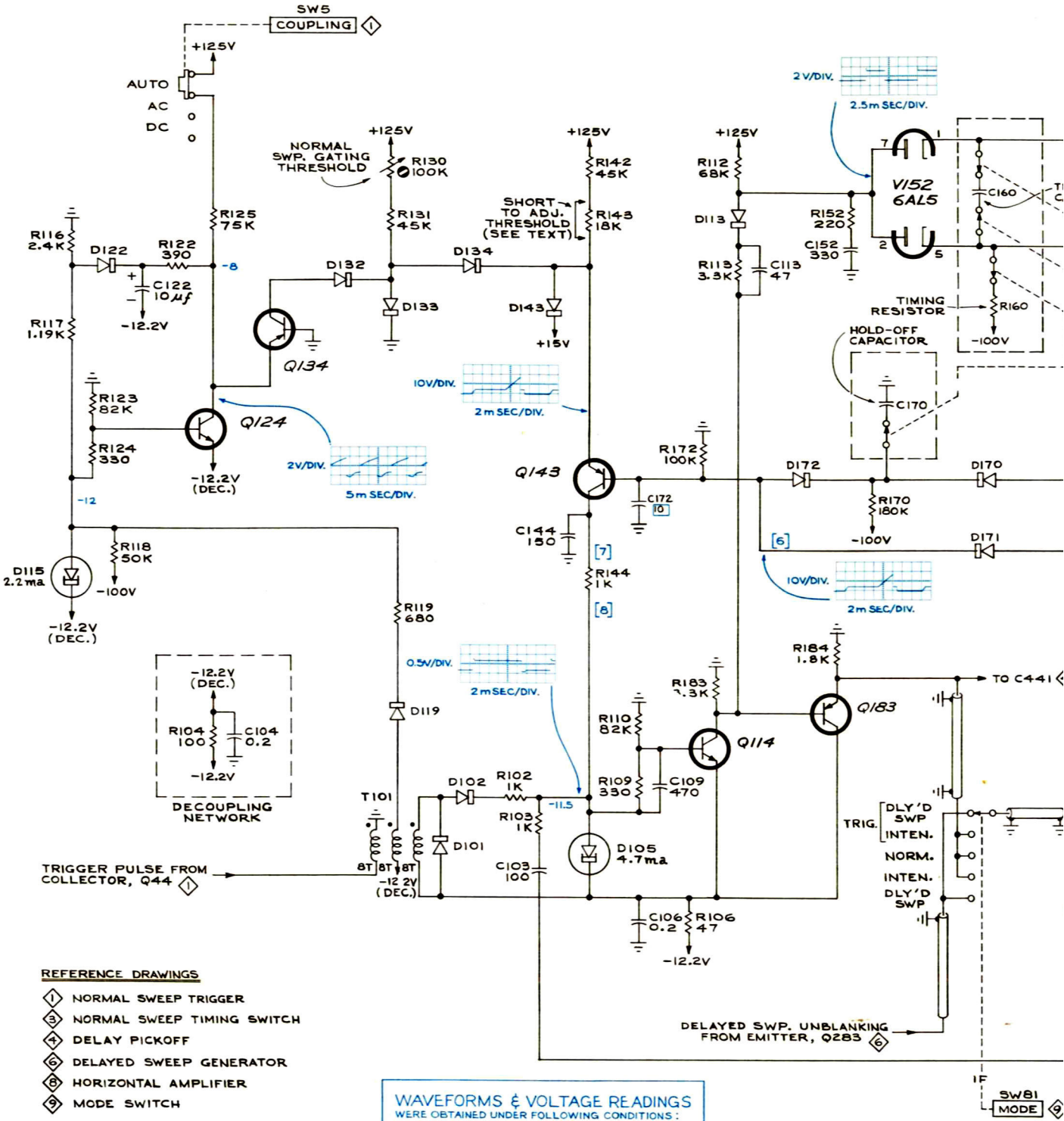
TYPE 3B1 PLUG-IN

MRH 1165 MRH

NORMAL SWEEP GENERATOR

CIRCUIT NUMBERS 100 THRU 199

SWEEP GENERATOR



REFERENCE DRAWINGS

- (1) NORMAL SWEEP TRIGGER
- (3) NORMAL SWEEP TIMING SWITCH
- (4) DELAY PICKOFF
- (6) DELAYED SWEEP GENERATOR
- (8) HORIZONTAL AMPLIFIER
- (9) MODE SWITCH

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

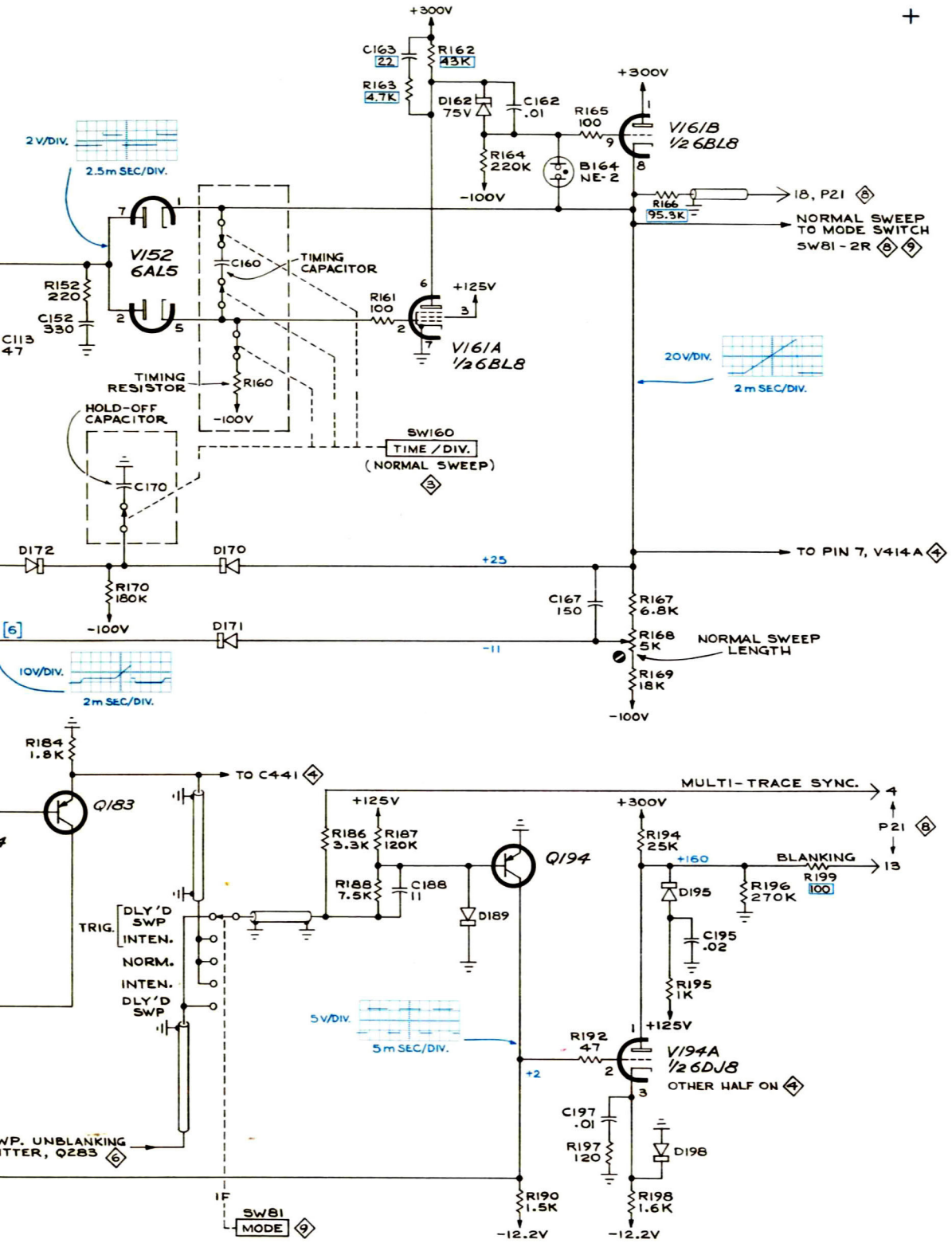
WAVEFORMS & VOLTAGE READINGS
WERE OBTAINED UNDER FOLLOWING CONDITIONS:

MODE ..... NORM.
TRIG. ..... AUTO.
SIGNAL ..... 0.5V CALIB.

SEE PARTS LIST FOR VALUES AND RANGES OF P... WITH BLUE O...

TYPE 3B1 PLUG-IN

C

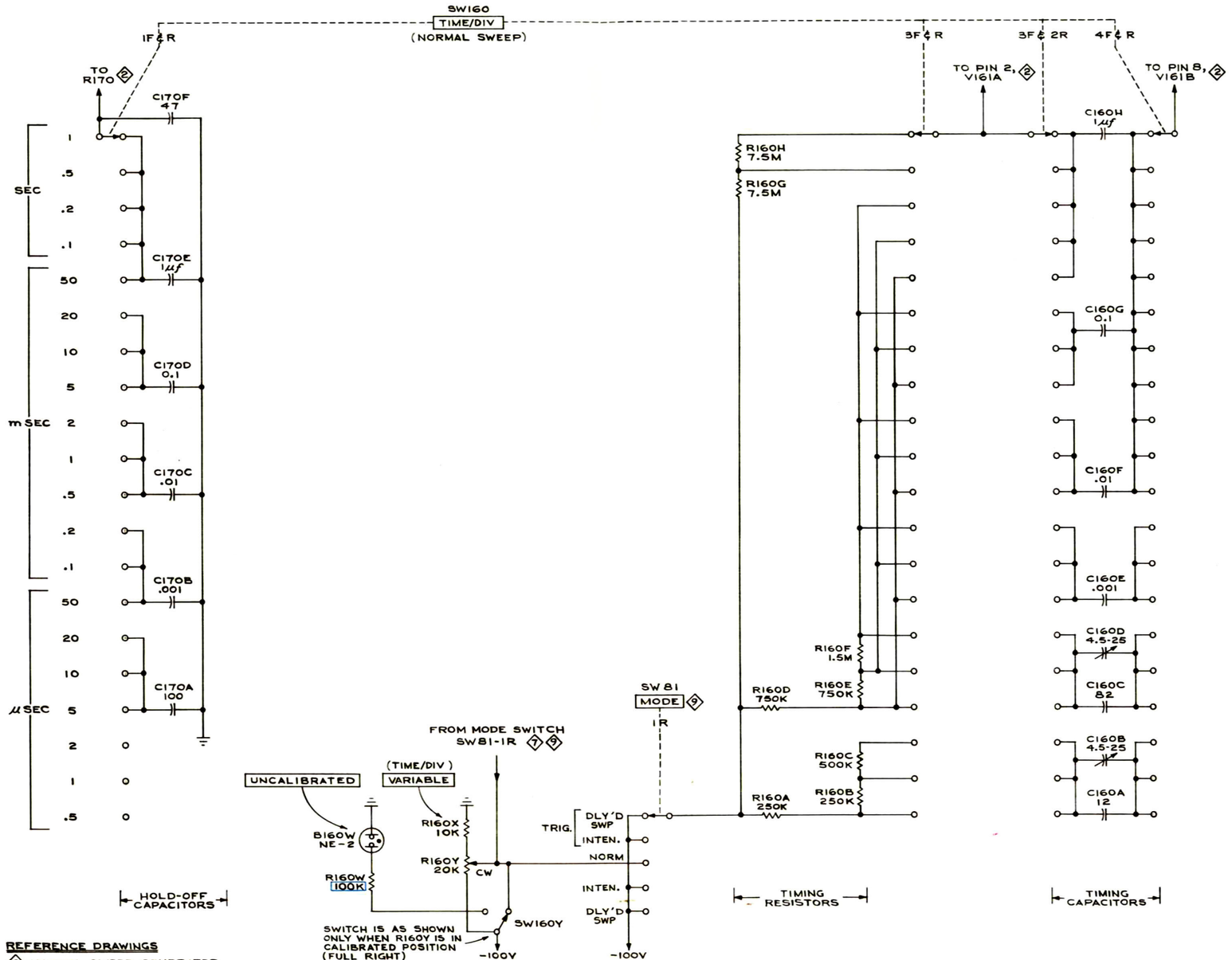


SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

MRH 1165 MRH

NORMAL SWEEP GENERATOR

CIRCUIT NUMBERS 100 THRU 199



REFERENCE DRAWINGS

② NORMAL SWEEP GENERATOR

⑦ DELAYED SWEEP TIMING SWITCH

⑨ MODE SWITCH

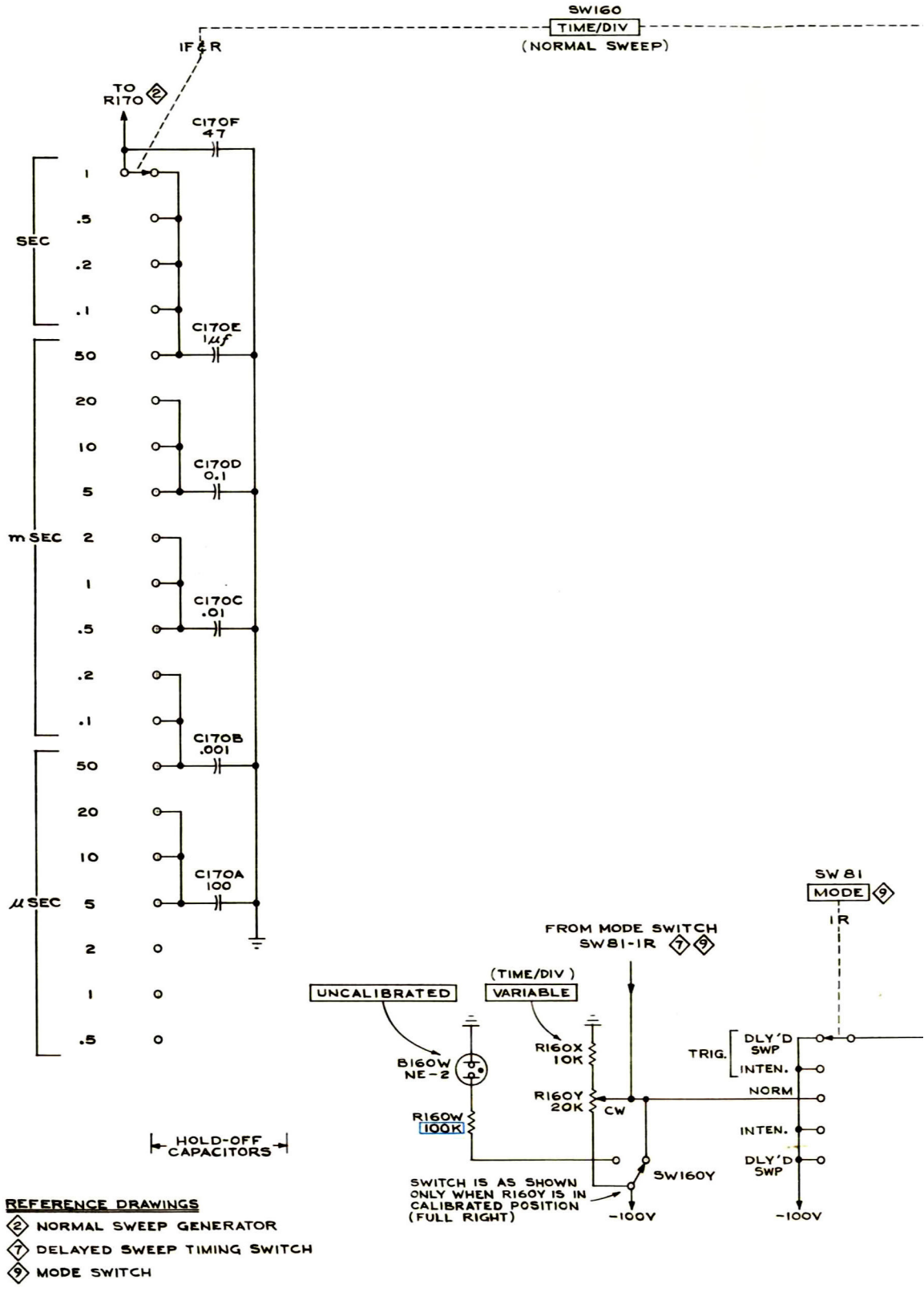
SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE

MRH
563

TYPE 3B1 PLUG-IN

A

NORMAL SWEEP TIMING SWITCH

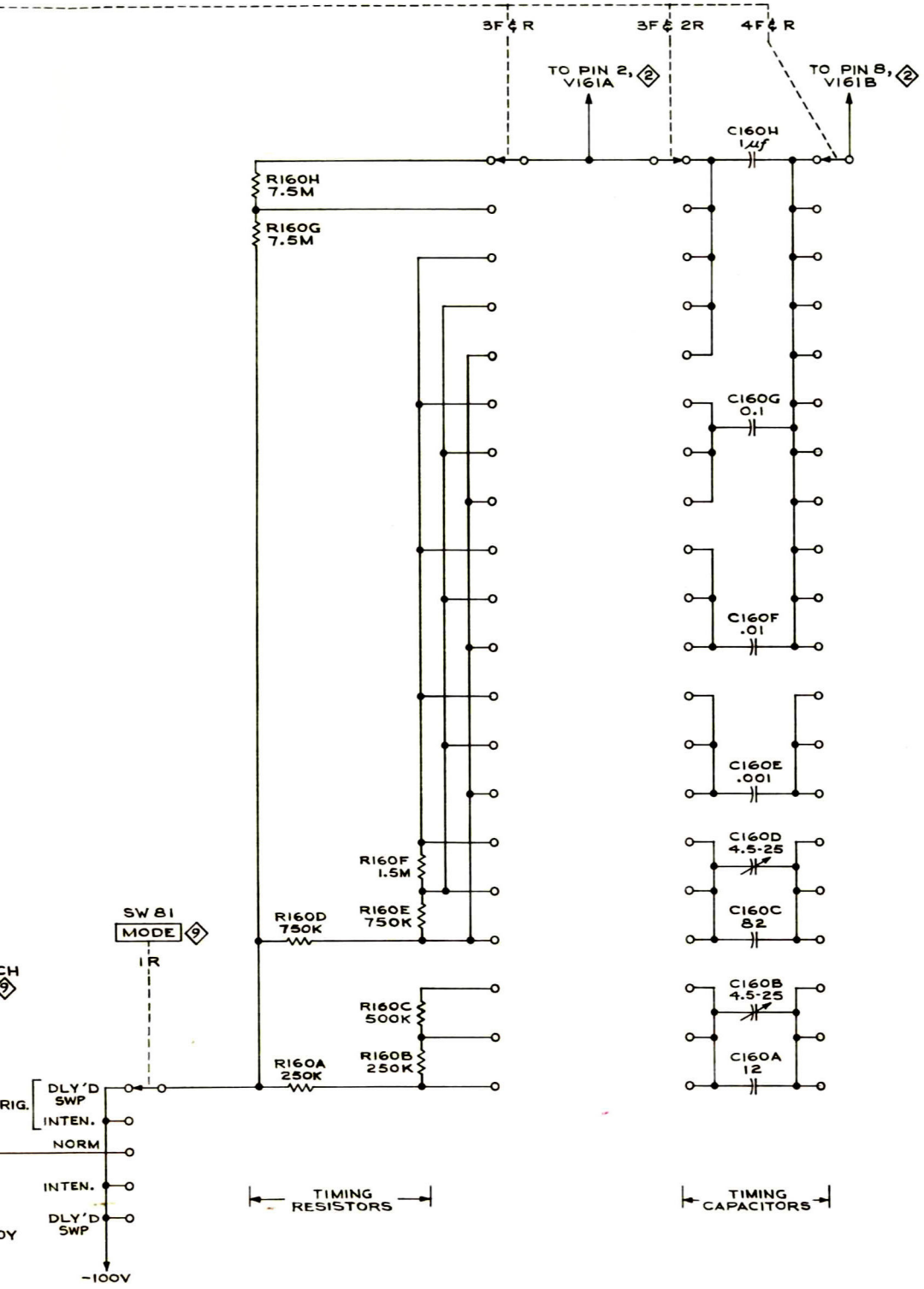


REFERENCE DRAWINGS

◇2 NORMAL SWEEP GENERATOR

◇7 DELAYED SWEEP TIMING SWITCH

◇9 MODE SWITCH

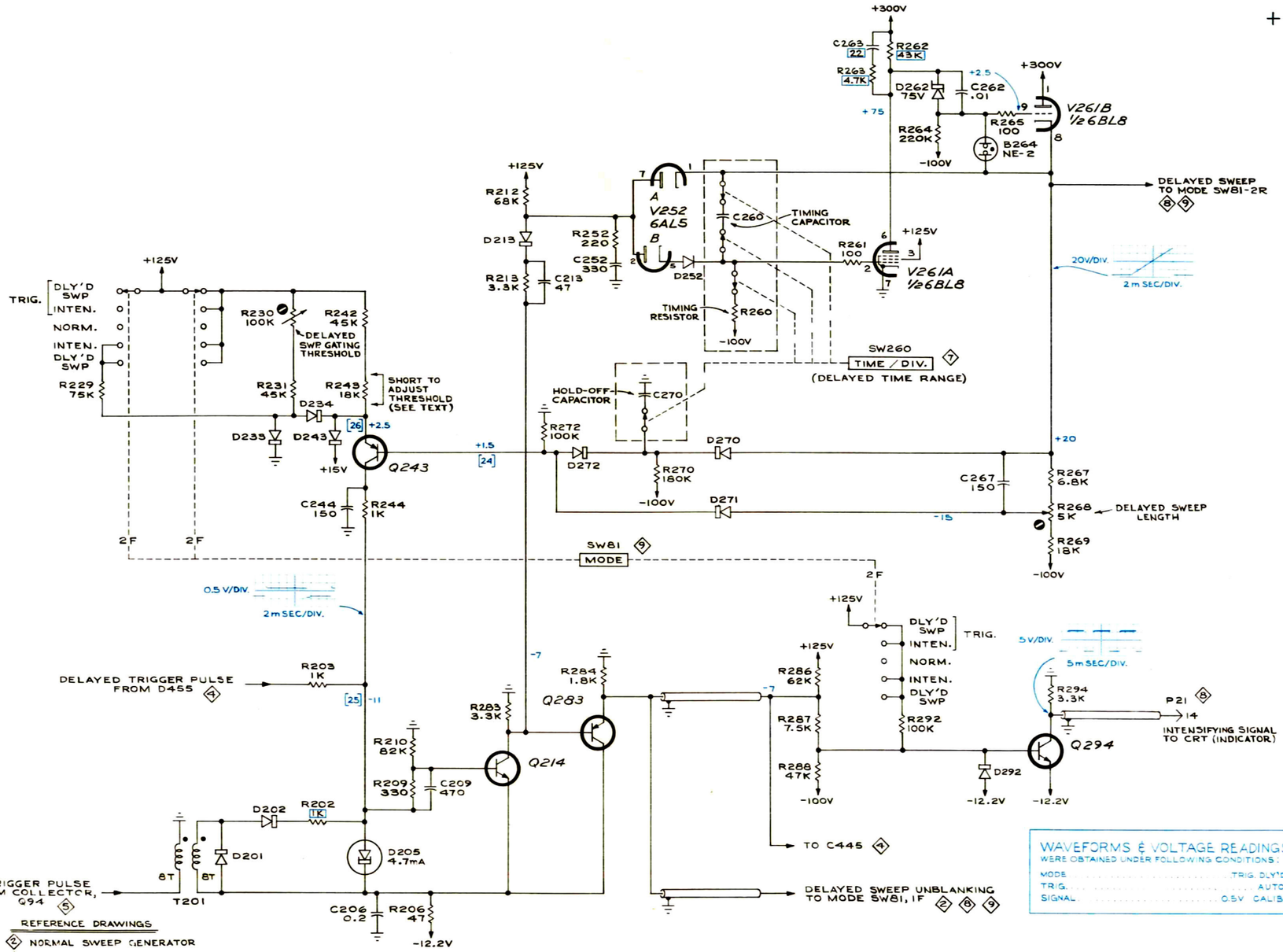


SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE

MRH
563

A

NORMAL SWEEP TIMING SWITCH



REFERENCE DRAWINGS

- 2 NORMAL SWEEP GENERATOR
- 4 DELAY PICKOFF
- 5 DELAYED SWEEP TRIGGER
- 7 DELAYED SWEEP TIMING SWITCH
- 6 HORIZONTAL AMPLIFIER
- 9 MODE SWITCH

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

WAVEFORMS & VOLTAGE READINGS
WERE OBTAINED UNDER FOLLOWING CONDITIONS:

MODE	TRIG. DLY'D
TRIG.	AUTO.
SIGNAL	0.5V CALIB.

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

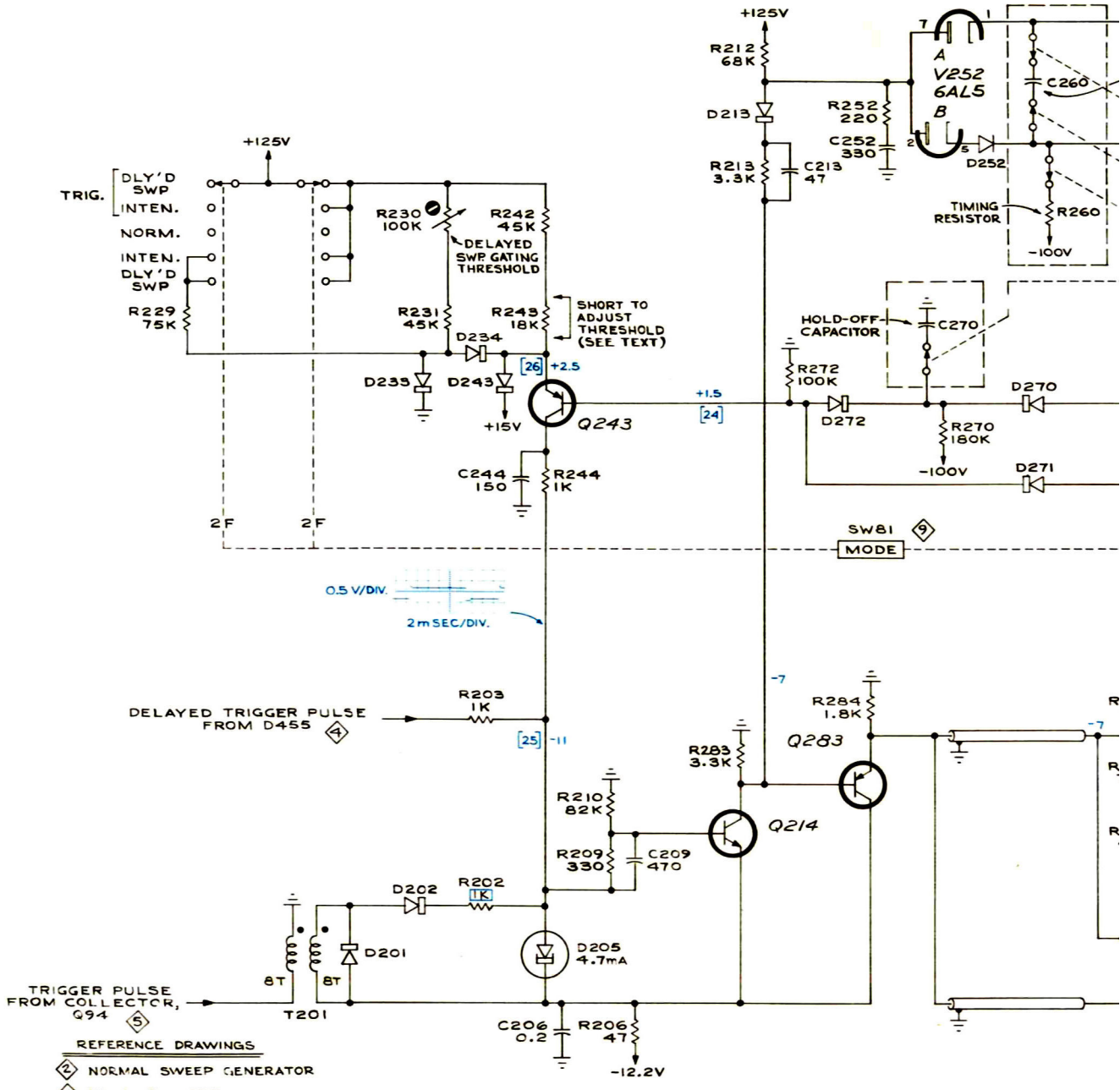
TYPE 381 PLUG-IN

E

MRH
966

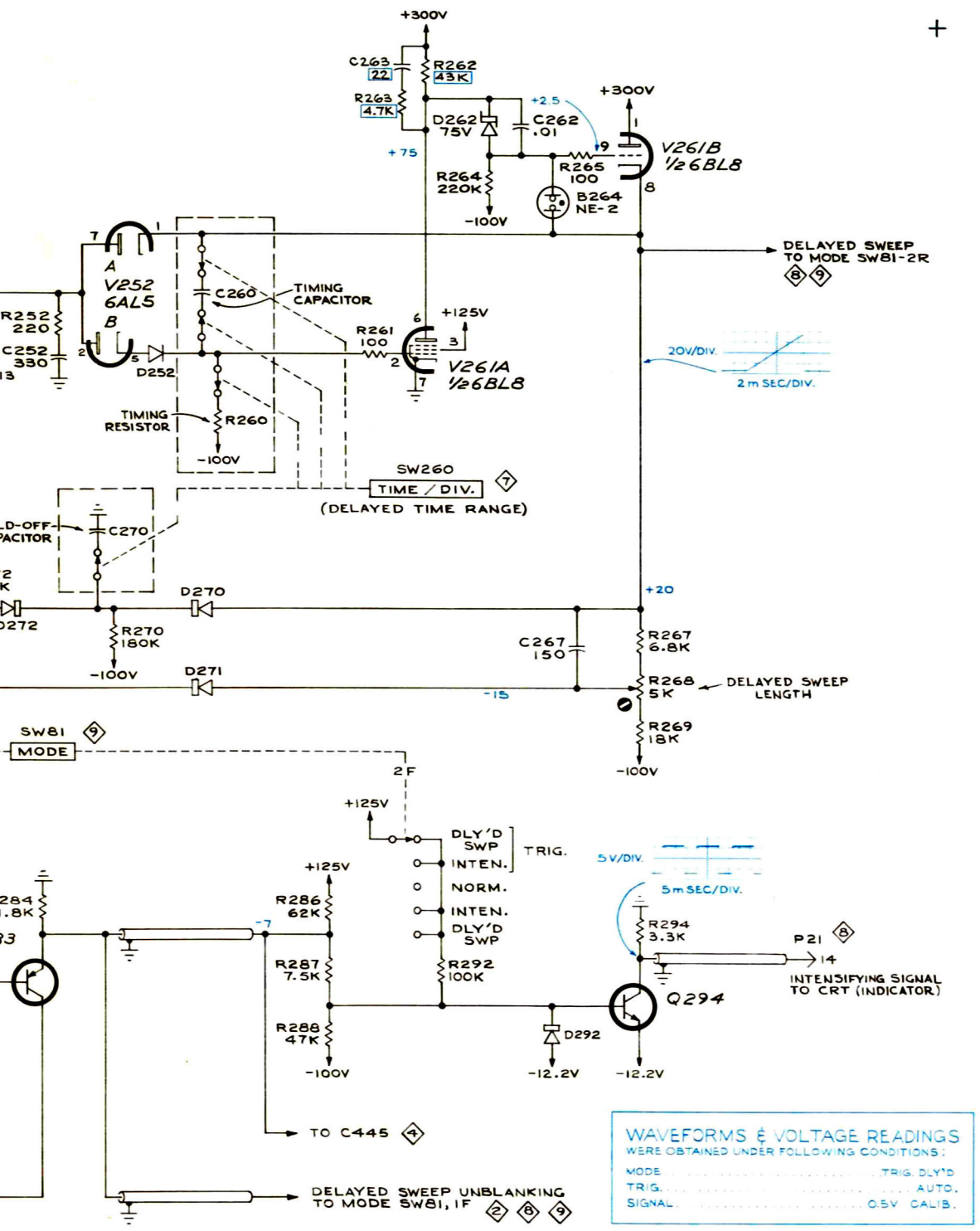
DELAYED SWEEP GENERATOR

CIRCUIT NUMBERS 200 THRU 299



TYPE 381 PLUG-IN

E



WAVEFORMS & VOLTAGE READINGS
WERE OBTAINED UNDER FOLLOWING CONDITIONS:

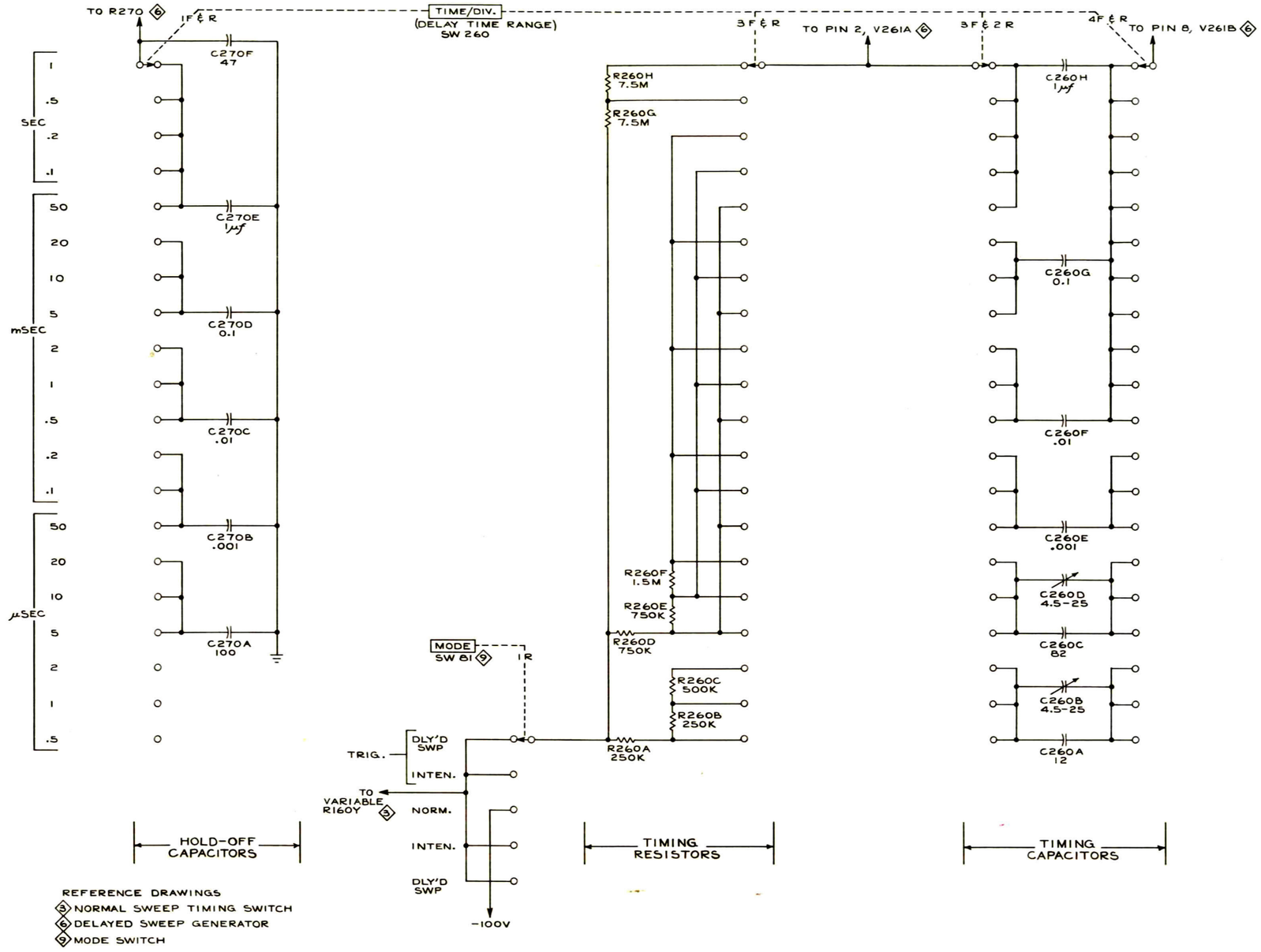
MODE	TRIG. DLY'D
TRIG.	AUTO.
SIGNAL	0.5V CALIB.

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

MRH
966

DELAYED SWEEP GENERATOR

CIRCUIT NUMBERS 200 THRU 299

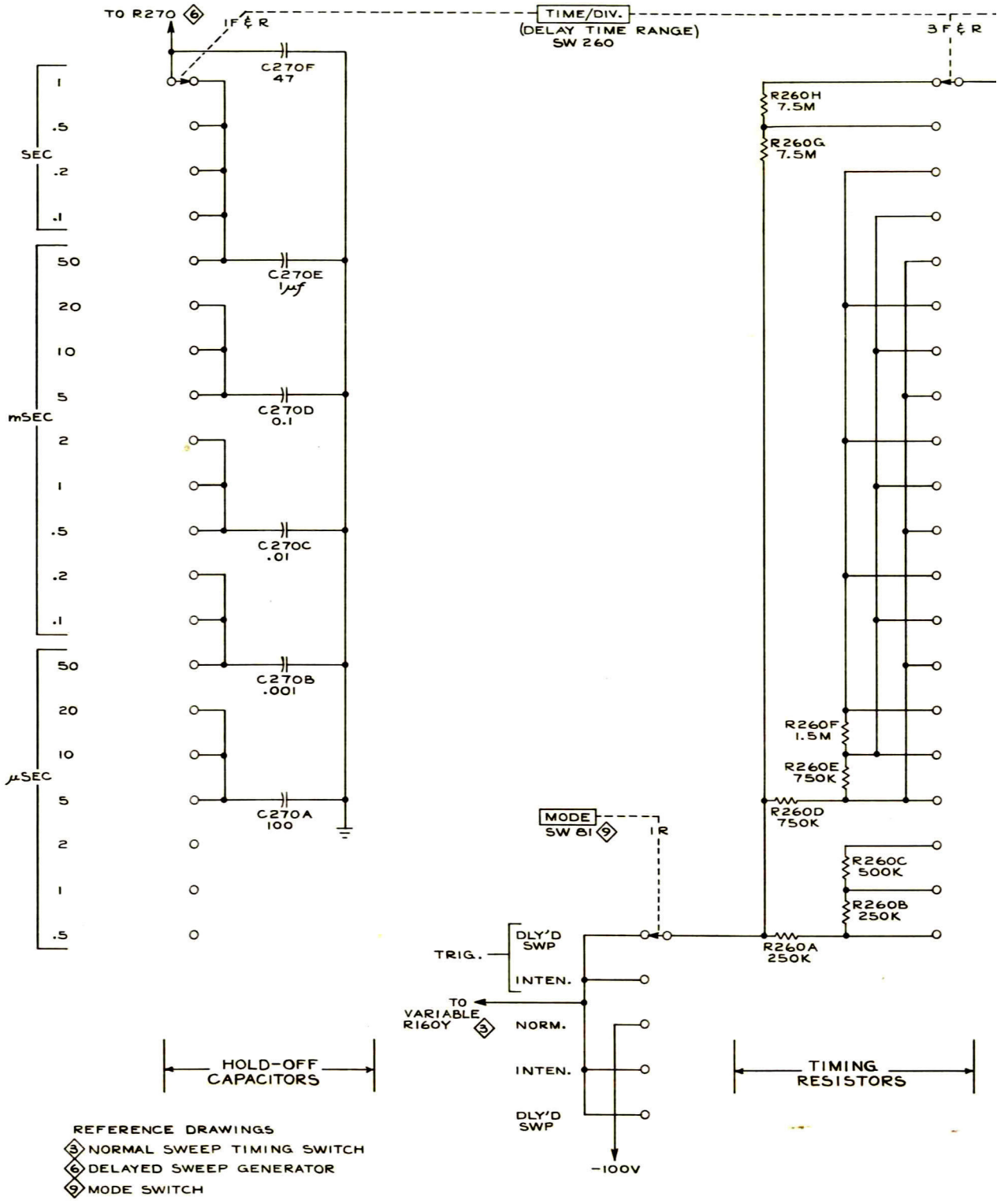


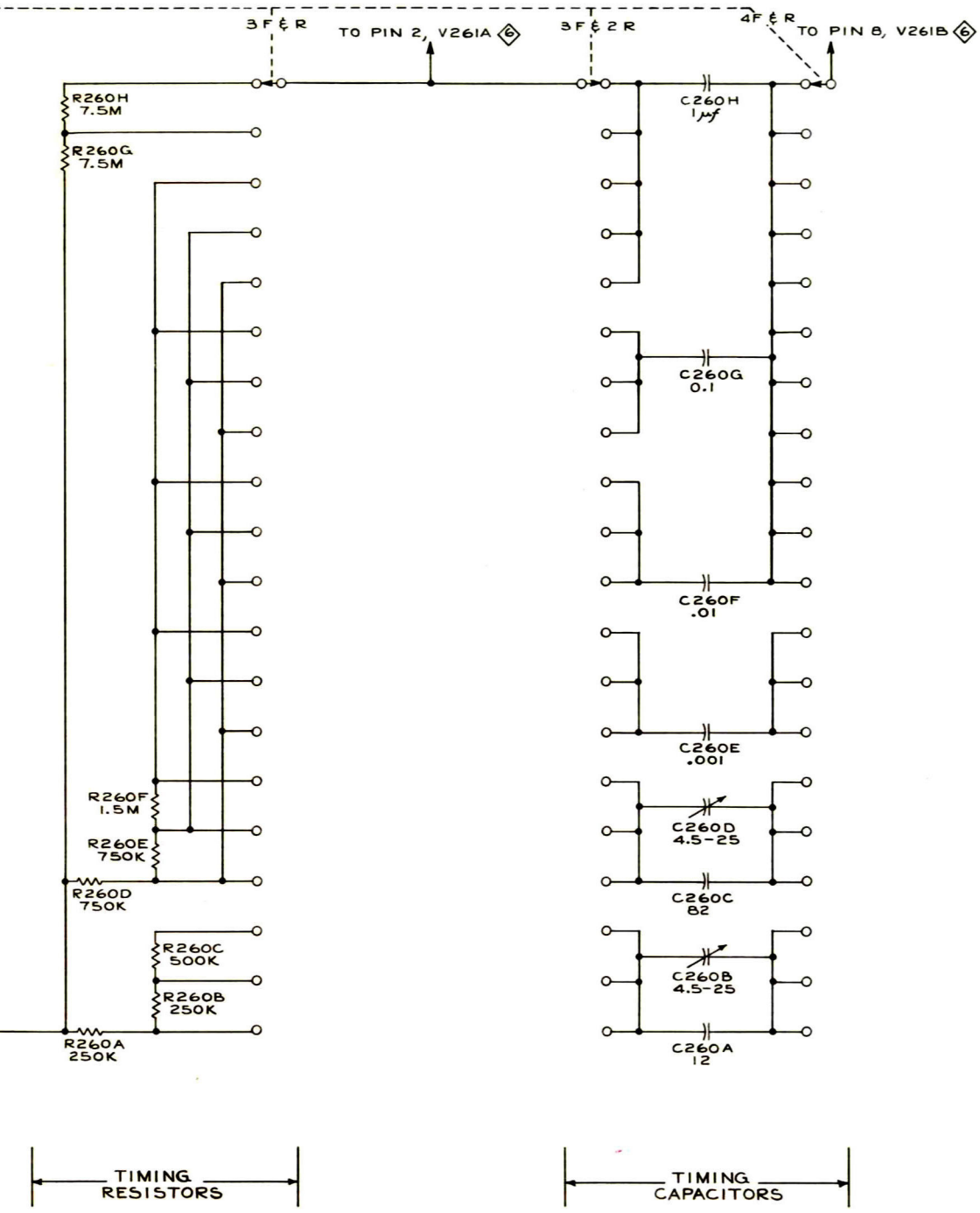
TYPE 381 PLUG-IN

A

PLM 563

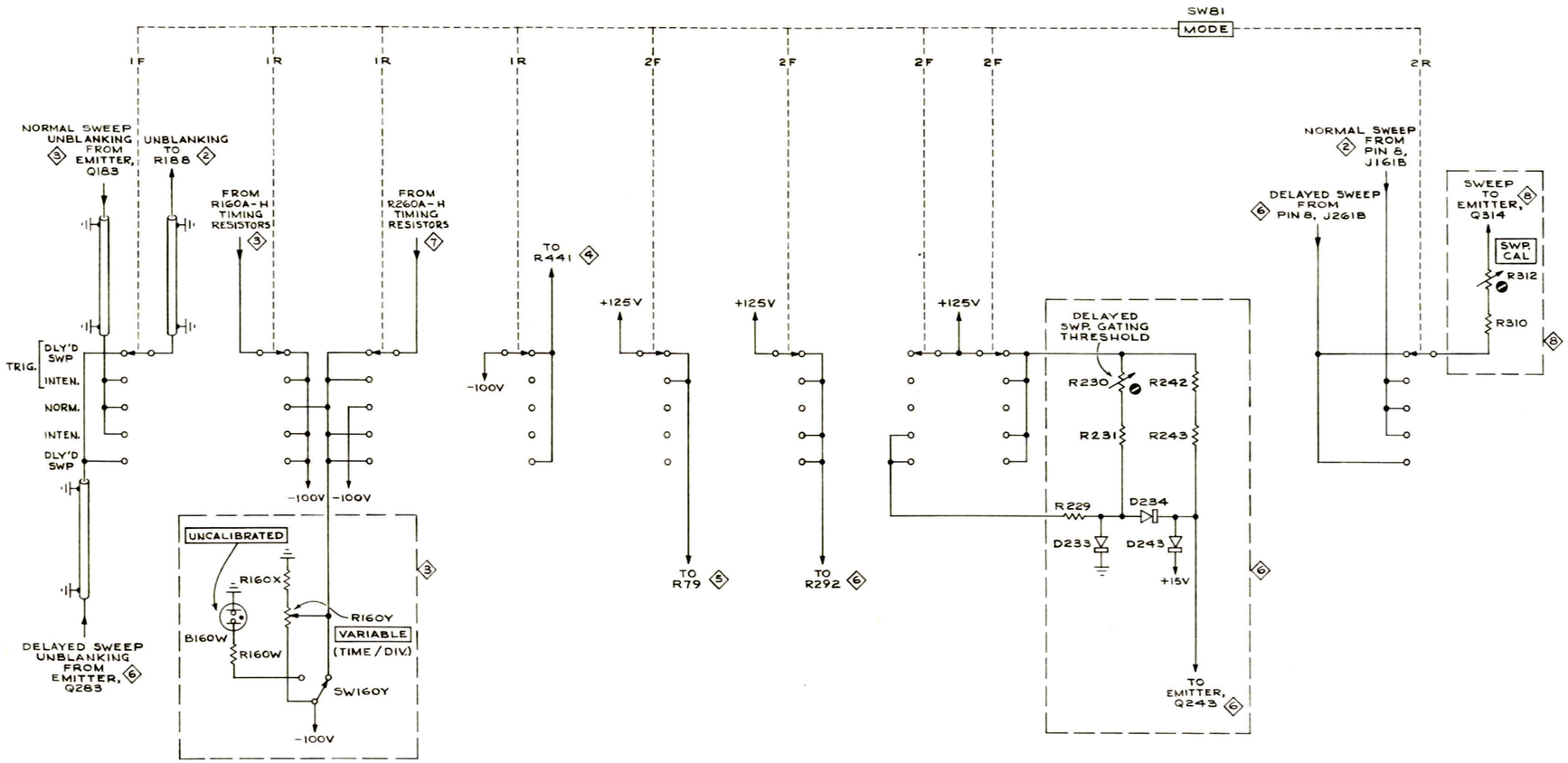
DELAYED SWEEP TIMING SWITCH


TO R270 ◇6
1F & R
TIME/DIV.
(DELAY TIME RANGE)
SW 260
3F & R
SEC
1
.5
.2
.1
mSEC
50
20
10
5
2
1
.5
.2
.1
μSEC
50
20
10
5
2
1
.5
C270F
47
C270E
1μf
C270D
0.1
C270C
.01
C270B
.001
C270A
100
R260H
7.5M
R260G
7.5M
R260F
1.5M
R260E
750K
R260D
750K
R260C
500K
R260B
250K
R260A
250K
MODE
SW 81 ◇9
1R
TRIG.
DLY'D SWP
INTEN.
TO VARIABLE R160Y ◇3
NORM.
INTEN.
DLY'D SWP
-100V
HOLD-OFF CAPACITORS
TIMING RESISTORS
REFERENCE DRAWINGS
◇3 NORMAL SWEEP TIMING SWITCH
◇6 DELAYED SWEEP GENERATOR
◇9 MODE SWITCH



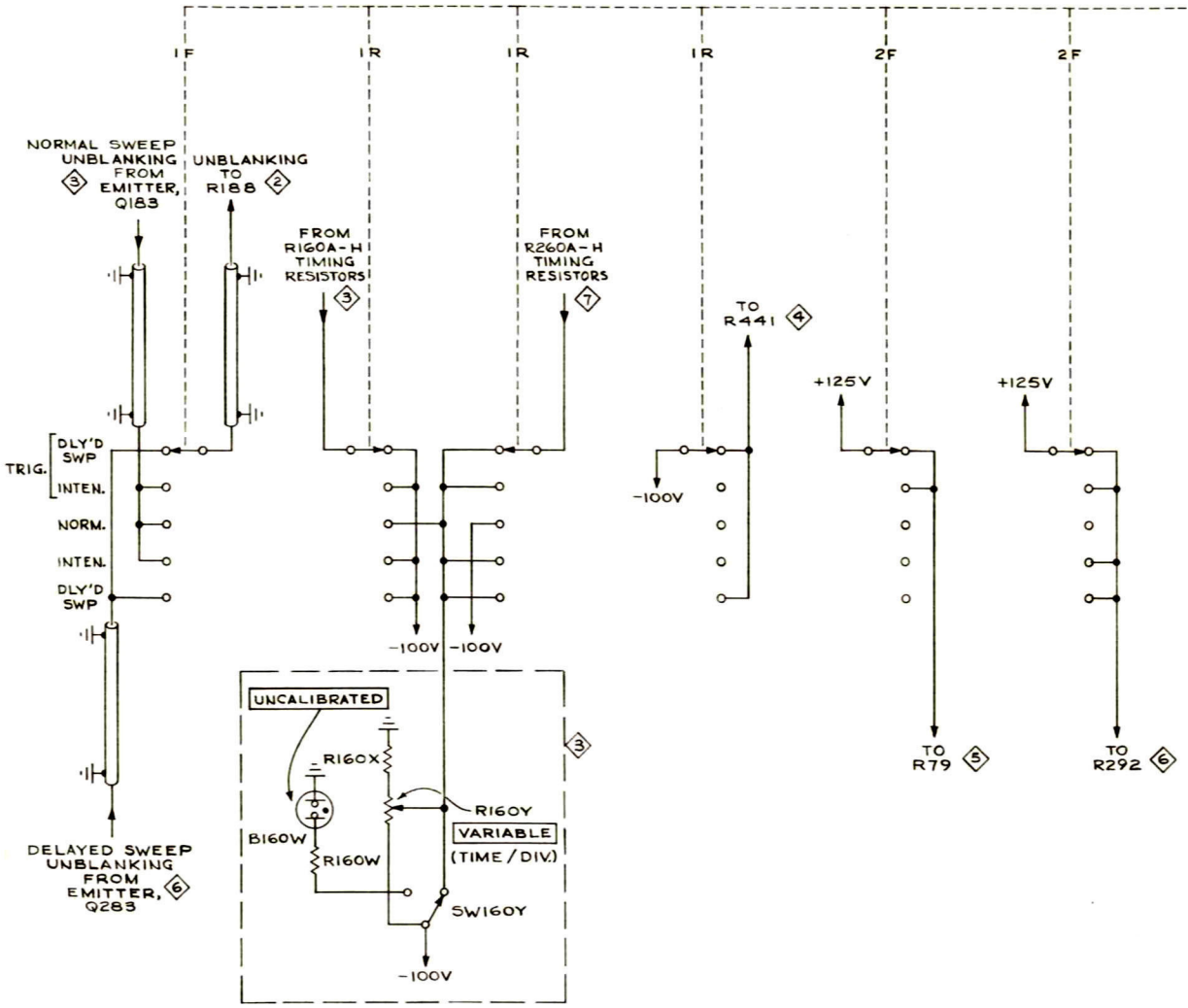
PLM 563

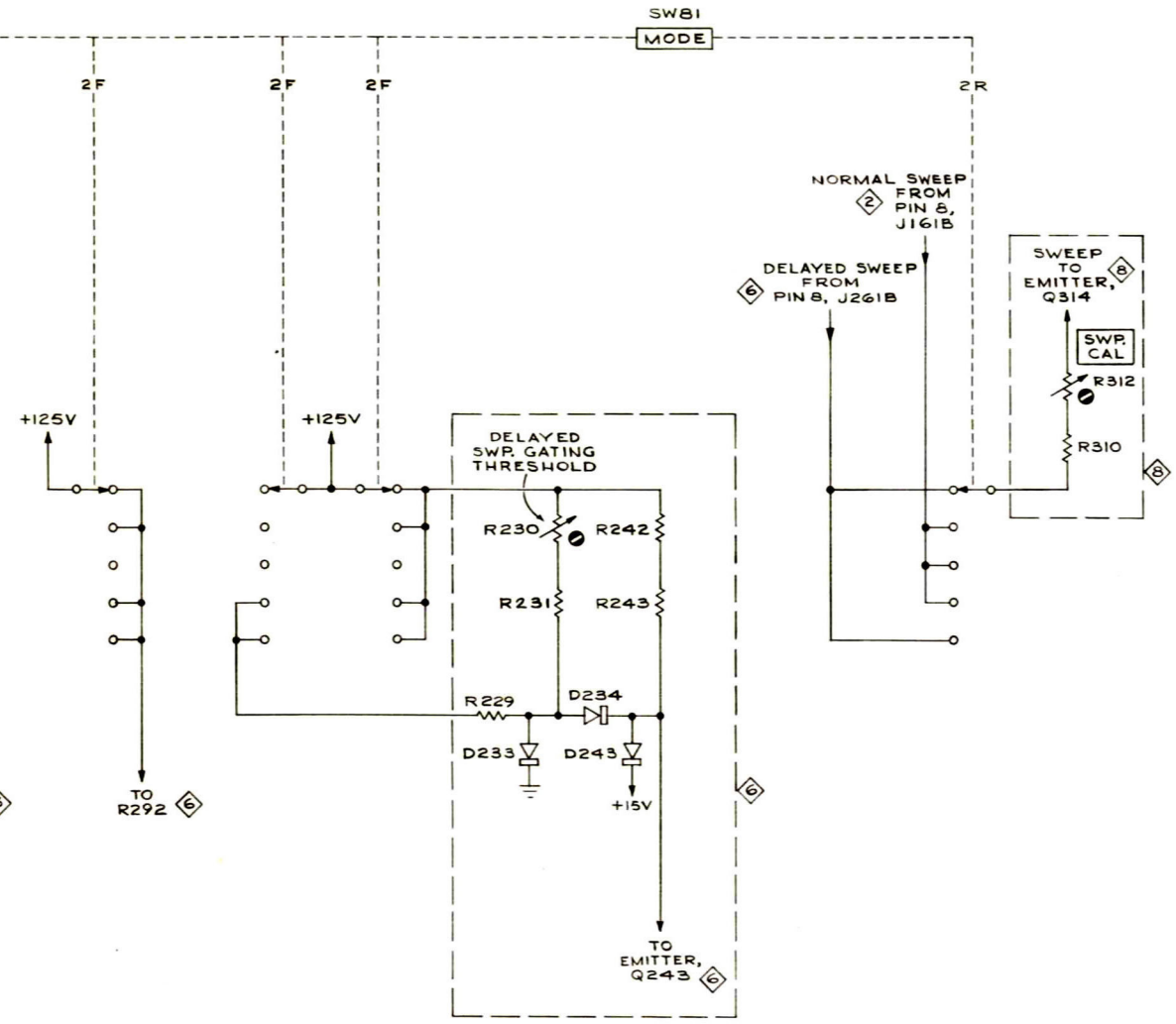
A DELAYED SWEEP TIMING SWITCH



REFERENCE DRAWINGS

2. NORMAL SWEEP GENERATOR
3. NORMAL SWEEP TIMING SWITCH
4. DELAY PICKOFF
5. DELAYED SWEEP TRIGGER
6. DELAYED SWEEP GENERATOR
7. DELAYED SWEEP TIMING SWITCH
8. HORIZONTAL AMPLIFIER


1F
1R
1R
1R
2F
2F
NORMAL SWEEP UNBLANKING FROM EMITTER, Q183 3
UNBLANKING TO R188 2
FROM R160A-H TIMING RESISTORS 3
FROM R260A-H TIMING RESISTORS 7
TO R441 4
+125V
+125V
TRIG.
DLY'D SWP
INTEN.
NORM.
INTEN.
DLY'D SWP
-100V
-100V
-100V
TO R79 5
TO R292 6
UNCALIBRATED
R160X
R160Y
B160W
R160W
VARIABLE
(TIME/DIV.)
SW160Y
-100V
3
DELAYED SWEEP UNBLANKING FROM EMITTER, Q283 6



REFERENCE DRAWINGS

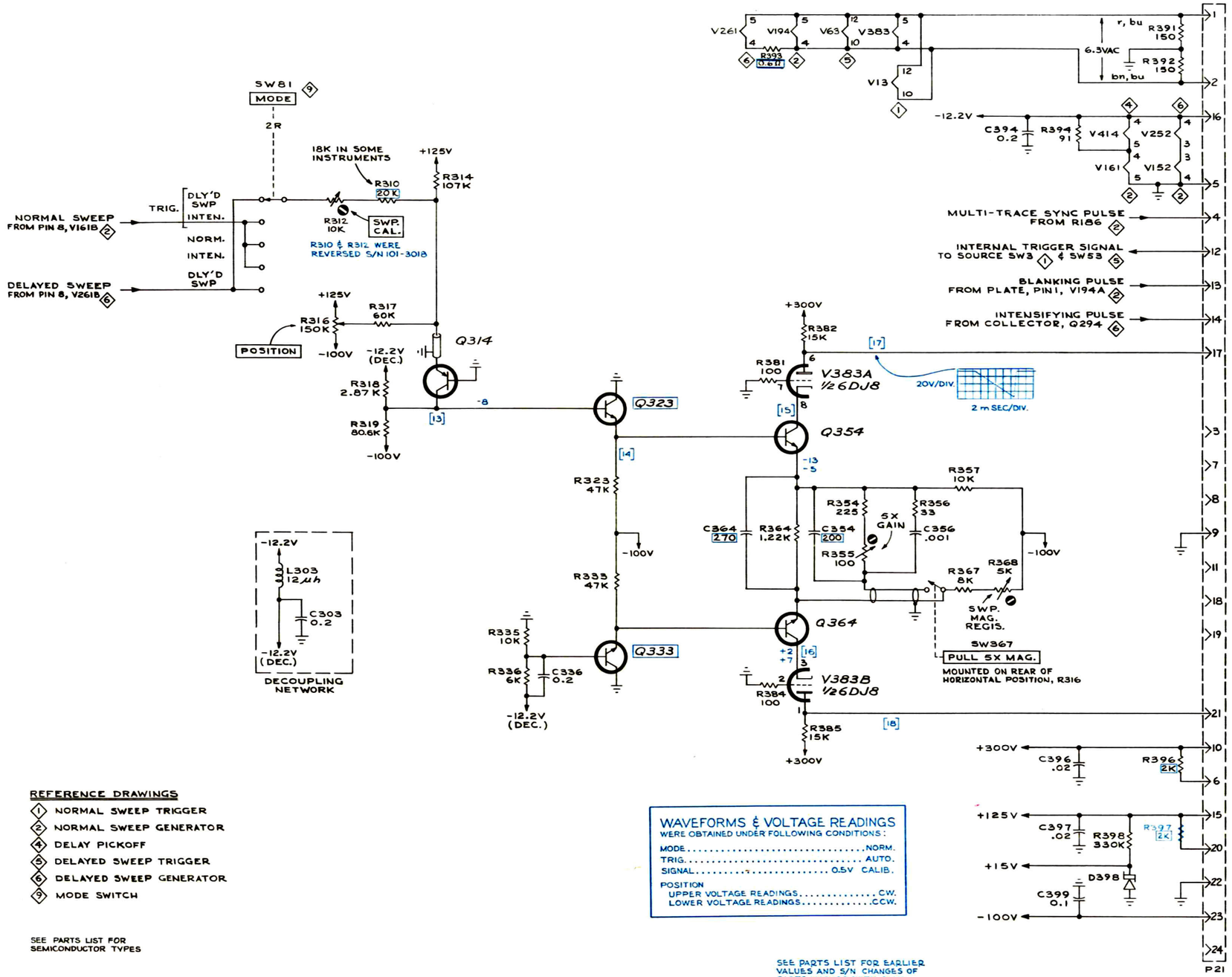
- 2 NORMAL SWEEP GENERATOR
- 3 NORMAL SWEEP TIMING SWITCH
- 4 DELAY PICKOFF
- 5 DELAYED SWEEP TRIGGER
- 6 DELAYED SWEEP GENERATOR
- 7 DELAYED SWEEP TIMING SWITCH
- 8 HORIZONTAL AMPLIFIER

MRH
563

A

MODE SWITCH

SWITCH



REFERENCE DRAWINGS

1. NORMAL SWEEP TRIGGER
2. NORMAL SWEEP GENERATOR
4. DELAY PICKOFF
5. DELAYED SWEEP TRIGGER
6. DELAYED SWEEP GENERATOR
9. MODE SWITCH

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

WAVEFORMS & VOLTAGE READINGS

WERE OBTAINED UNDER FOLLOWING CONDITIONS:

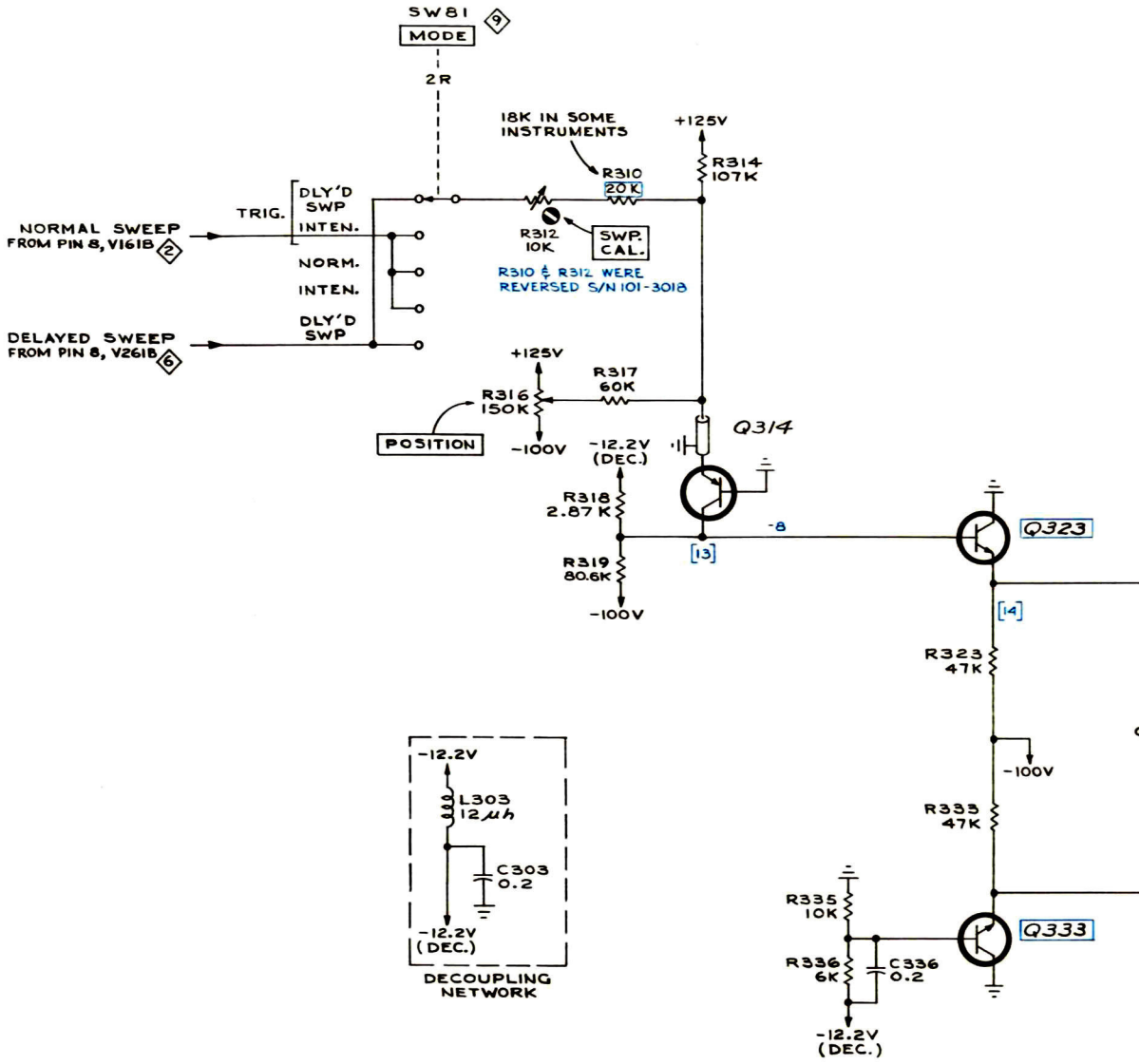
MODE ..... NORM.
TRIG. ..... AUTO.
SIGNAL ..... 0.5V CALIB.
POSITION
UPPER VOLTAGE READINGS ..... CW.
LOWER VOLTAGE READINGS ..... CCW.

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

MRH
1265

HORIZONTAL AMPLIFIER

CIRCUIT NUMBERS 300 THRU 399

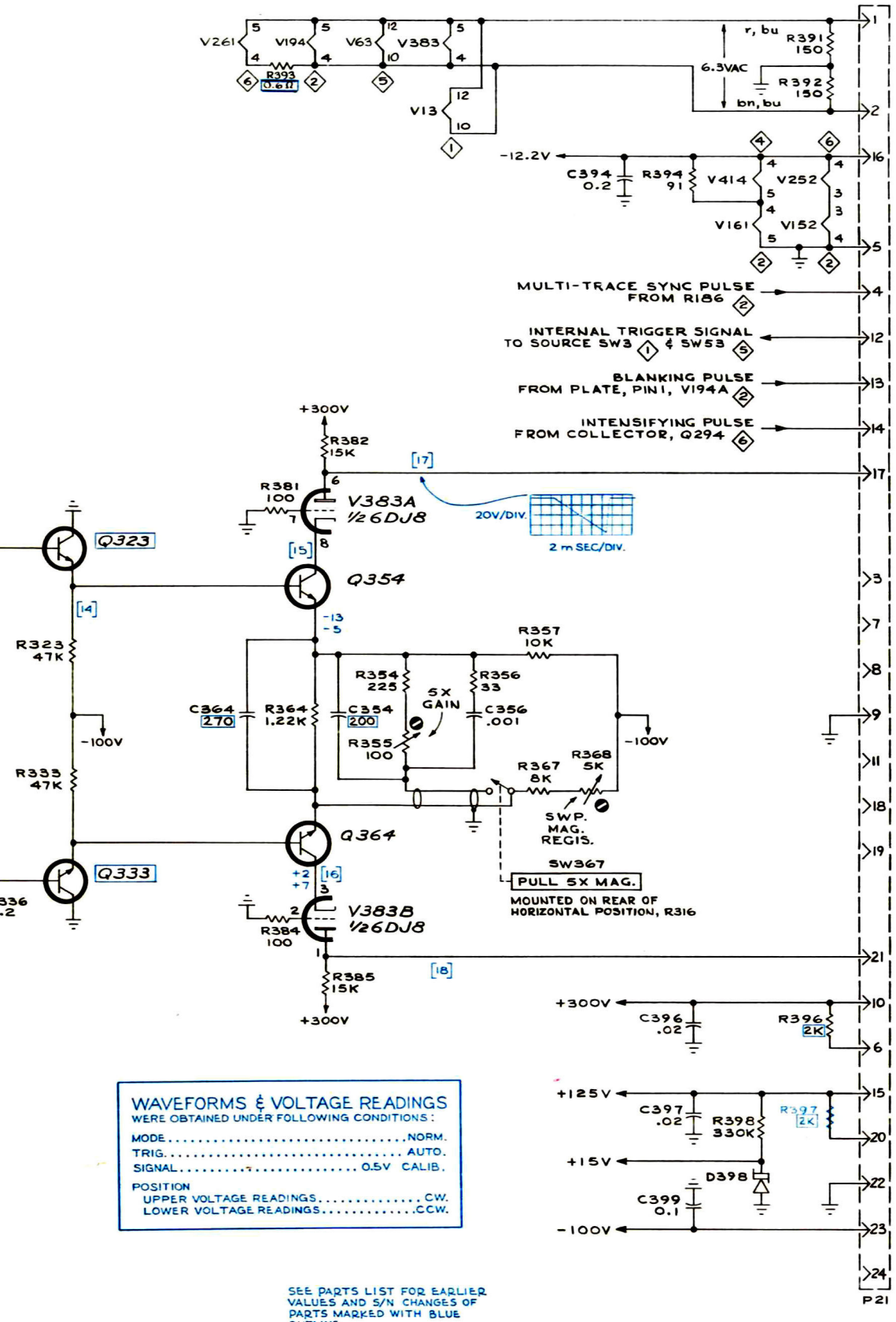


REFERENCE DRAWINGS

1. NORMAL SWEEP TRIGGER
2. NORMAL SWEEP GENERATOR
4. DELAY PICKOFF
5. DELAYED SWEEP TRIGGER
6. DELAYED SWEEP GENERATOR
9. MODE SWITCH

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

WAVEF
WERE OBT
MODE....
TRIG....
SIGNAL..
POSITION
UPPER
LOWER



WAVEFORMS & VOLTAGE READINGS

WERE OBTAINED UNDER FOLLOWING CONDITIONS:

MODE.....NORM.
TRIG.....AUTO.
SIGNAL.....0.5V CALIB.

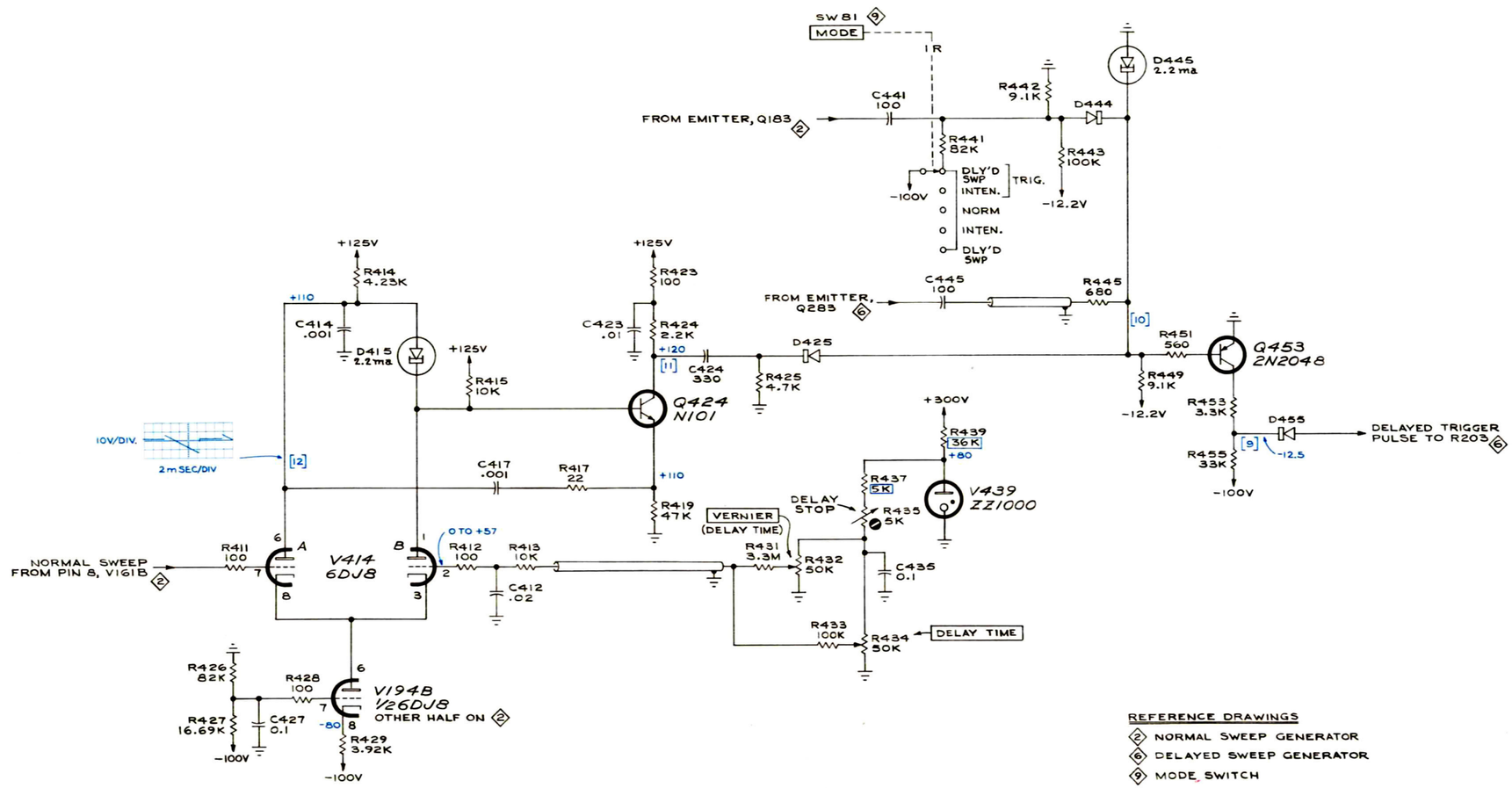
POSITION
UPPER VOLTAGE READINGS.....CW.
LOWER VOLTAGE READINGS.....CCW.

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

MRH
1265

HORIZONTAL AMPLIFIER

CIRCUIT NUMBERS 300 THRU 399



WAVEFORMS & VOLTAGE READINGS
WERE OBTAINED UNDER FOLLOWING CONDITIONS:

MODE ..... TRIG. DEL'D
TRIG. ..... AUTO.
SIGNAL ..... 0.5V CALIB.

REFERENCE DRAWINGS

- ② NORMAL SWEEP GENERATOR
- ⑥ DELAYED SWEEP GENERATOR
- ⑨ MODE SWITCH

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

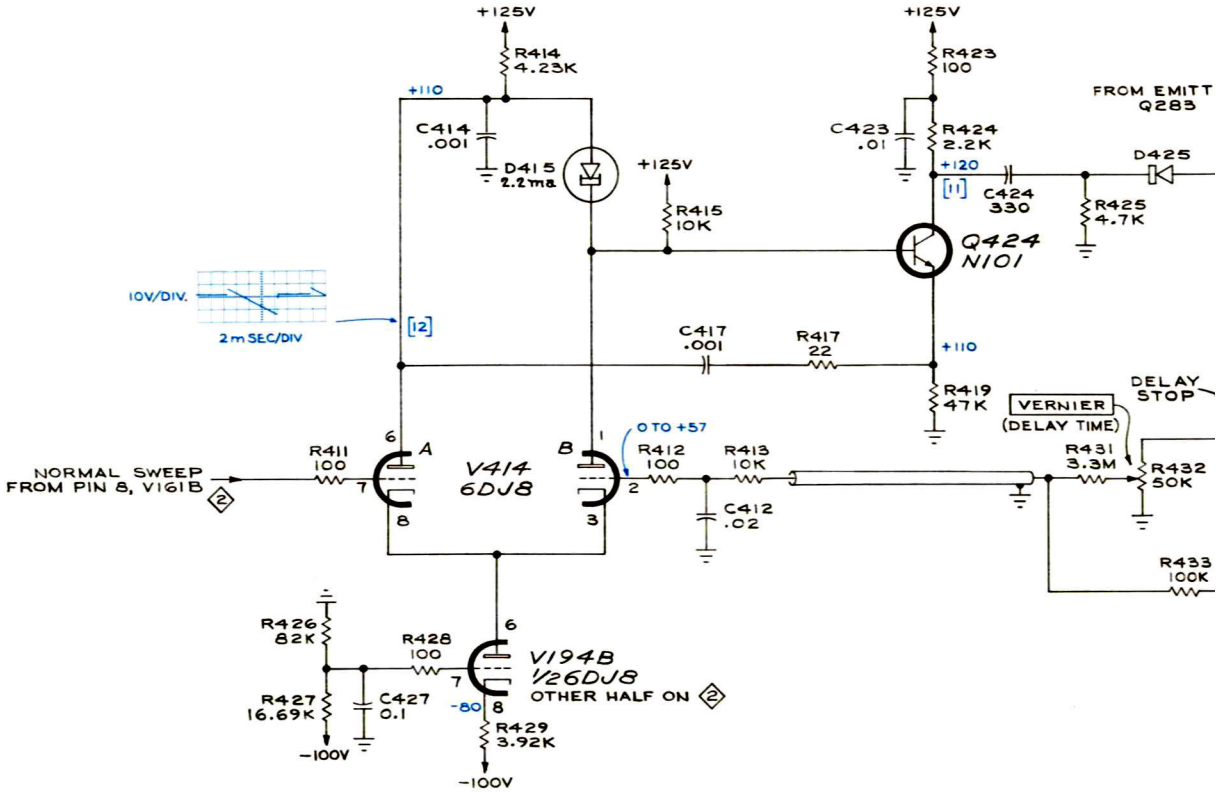
MRH
764

DELAY PICKOFF

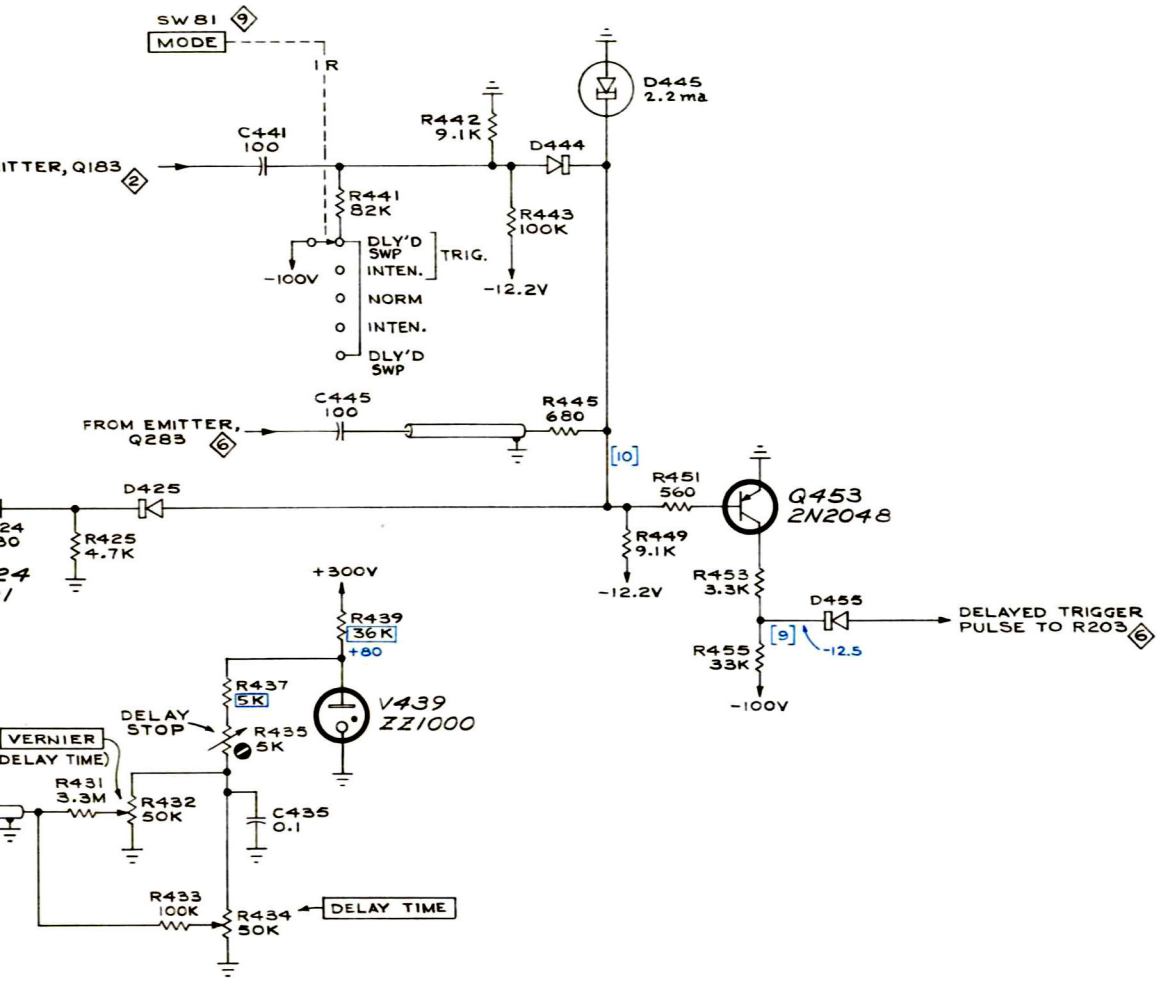
CIRCUIT NUMBERS 400 THRU 459

SW
MOD

FROM EMITTER, Q183 ◇2



WAVEF
WERE OBT
MODE....
TRIG....
SIGNAL..



REFERENCE DRAWINGS

② NORMAL SWEEP GENERATOR
⑥ DELAYED SWEEP GENERATOR
⑨ MODE SWITCH

WAVEFORMS & VOLTAGE READINGS
WERE OBTAINED UNDER FOLLOWING CONDITIONS:

MODE ..... TRIG. DEL'D
TRIG. ..... AUTO.
SIGNAL ..... 0.5V CALIB.

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

MRH
764

C

DELAY PICKOFF

CIRCUIT NUMBERS
400 THRU 459

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

TEXT CORRECTION

Section 4 Circuit Description

Page 4-2

Ending the Sweep Ramp **First paragraph**, second line

CHANGE:

Change Q134 to read Q143.

TYPE 3B1 TENT SN 4090

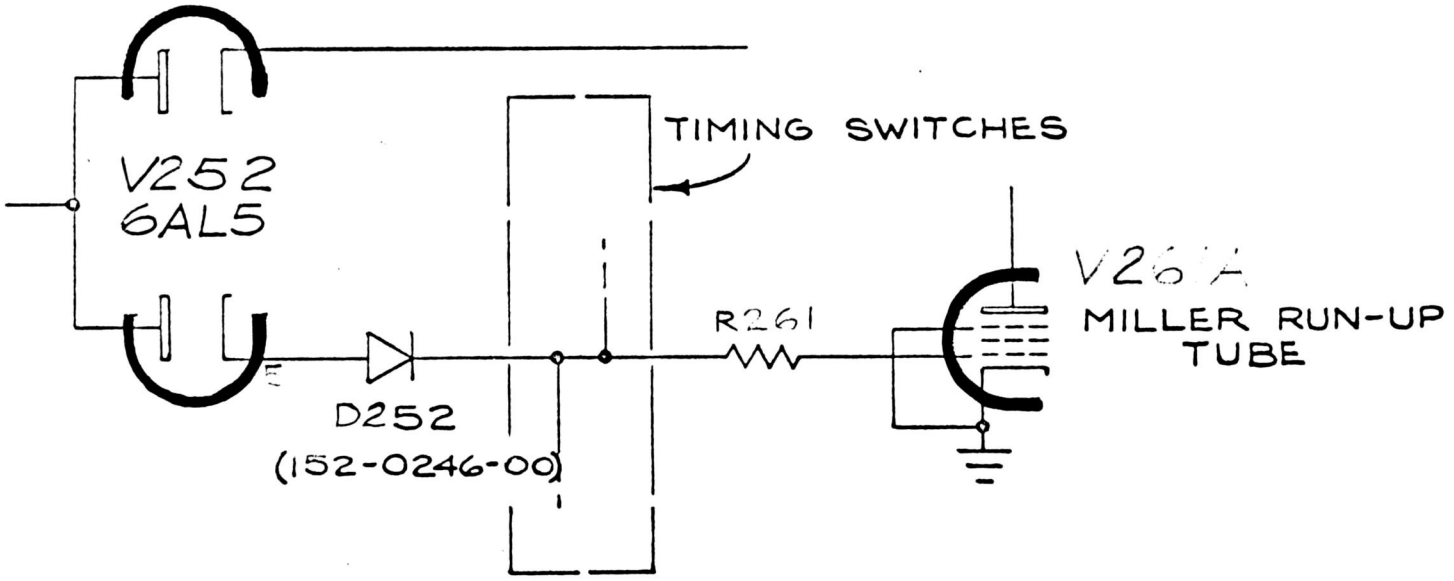
PARTS LIST CORRECTION

ADD:

D252	152-0246-00	Silicon

SCHEMATIC CORRECTION

PARTIAL DELAYED SWEEP GENERATOR



M10,189/866

TYPE 3B1 TENT SN 4090

PARTS LIST CORRECTION

CHANGE TO:

*R316	311-0625-00	Var	
SW81	260-0801-00	Rotary	MODE
*SW367	311-0625-00	SPST	PULL 5X MAG

*Furnished as a unit.

M10382/666

TYPE 3B1 TENT SN 4200

PARTS LIST CORRECTION

ADD:

R255	316-0226-00	22 meg	1/4 w	10 %

R255 is added in parallel with V252B; pins 2 - 5.

TYPE 3B1

PARTS LIST CORRECTION

ADD:

R358	302-0105-00	1 meg	1/2 w	10 %

SCHEMATIC CORRECTION