INSTRUCTION MANUAL

Serial Number_____

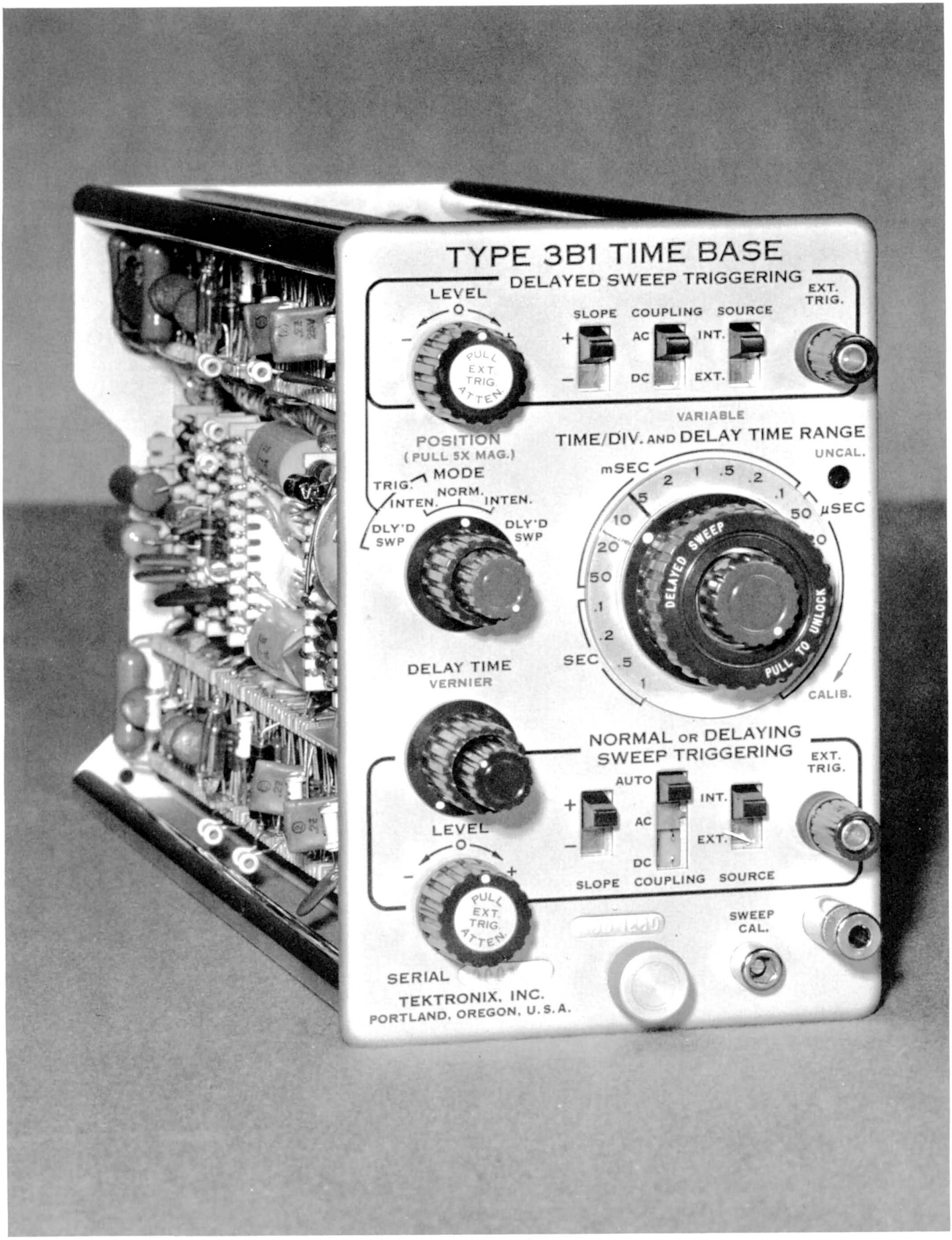
3B1

PLUG-IN UNIT

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

Tektronix International A.G.
Terrassenweg 1A ● Zug, Switzerland ● PH. 042-49192 ● Cable: Tekintag, Zug Switzerland ● Telex 53.574

070-344


TYPE 3B1 TIME BASE
DELAYED SWEEP TRIGGERING
LEVEL
SLOPE
COUPLING
SOURCE
EXT. TRIG.
AC
DC
INT.
EXT.
PULL EXT. TRIG. ATTEN
VARIABLE
POSITION
(PULL 5X MAG.)
TIME/DIV. AND DELAY TIME RANGE
UNCAL.
TRIG. MODE
NORM.
INTEN.
INTEN.
DLY'D SWP
DLY'D SWP
mSEC
2
1
.5
.2
.1
5
10
20
50
.1
.2
.5
1
50
μSEC
20
SEC
DELAYED SWEEP
PULL TO UNLOCK
CALIB.
DELAY TIME
VERNIER
NORMAL OR DELAYING
SWEEP TRIGGERING
AUTO
AC
DC
INT.
EXT.
SLOPE
COUPLING
SOURCE
EXT. TRIG.
LEVEL
PULL EXT. TRIG. ATTEN
SWEEP CAL.
SERIAL
TEKTRONIX, INC.
PORTLAND, OREGON, U.S.A.

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 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: Photo-etched, anodized panel.

Weight: 5 pounds, 1 ounce.

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

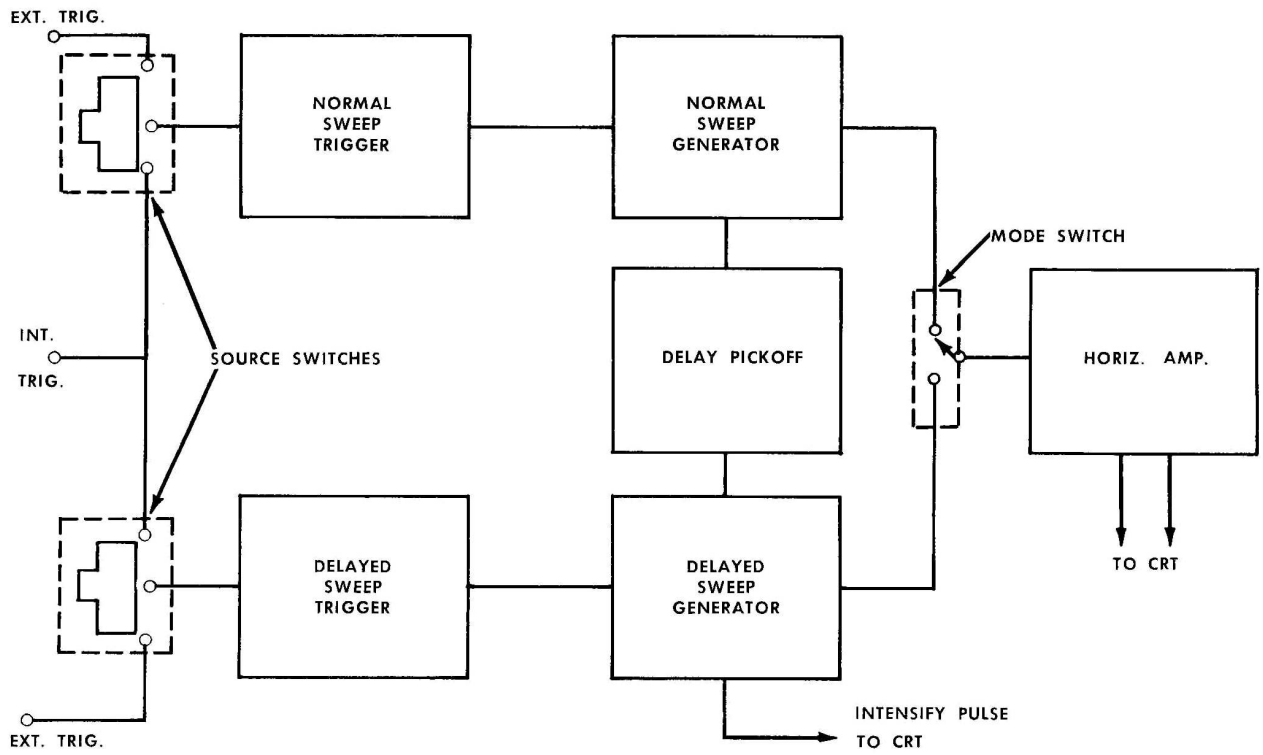


Fig. 4-1. Block diagram showing relationship between major circuits.

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-

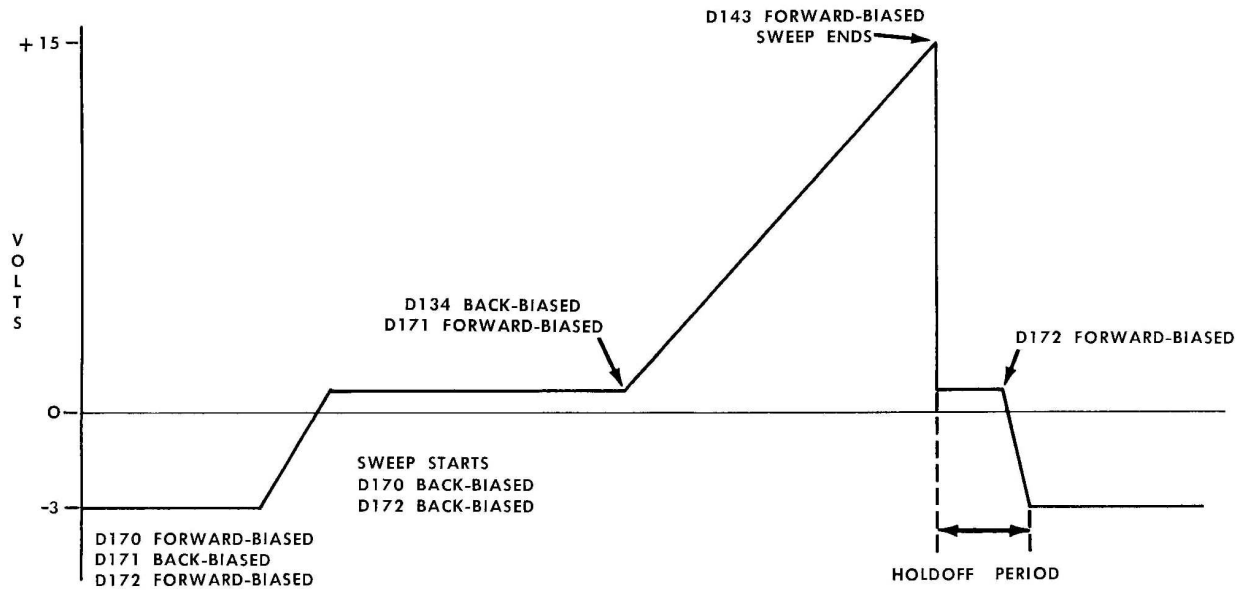


Fig. 4-2. Waveform at base of Q143 during sweep with condition of each associated diode.

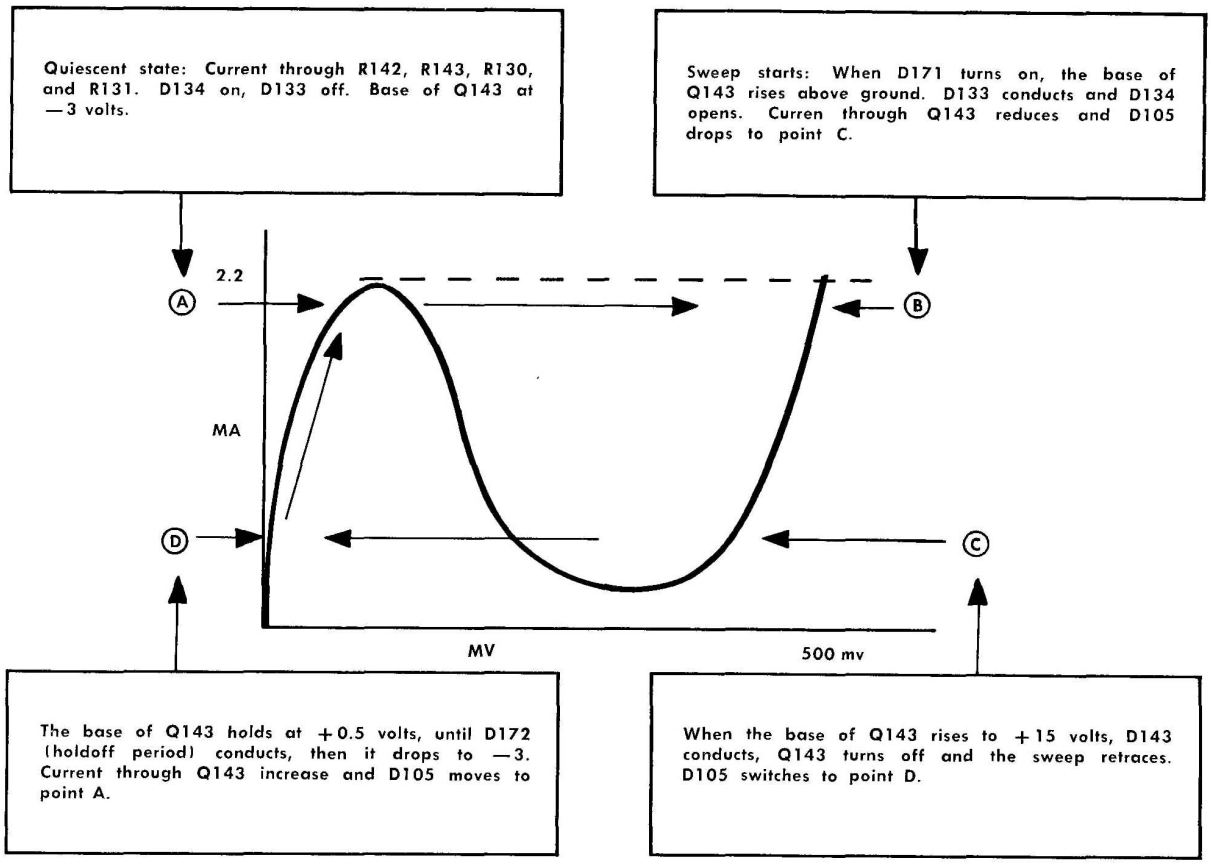


Fig. 4-3. Condition of tunnel diode D105 during sweep and holdoff periods.

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.

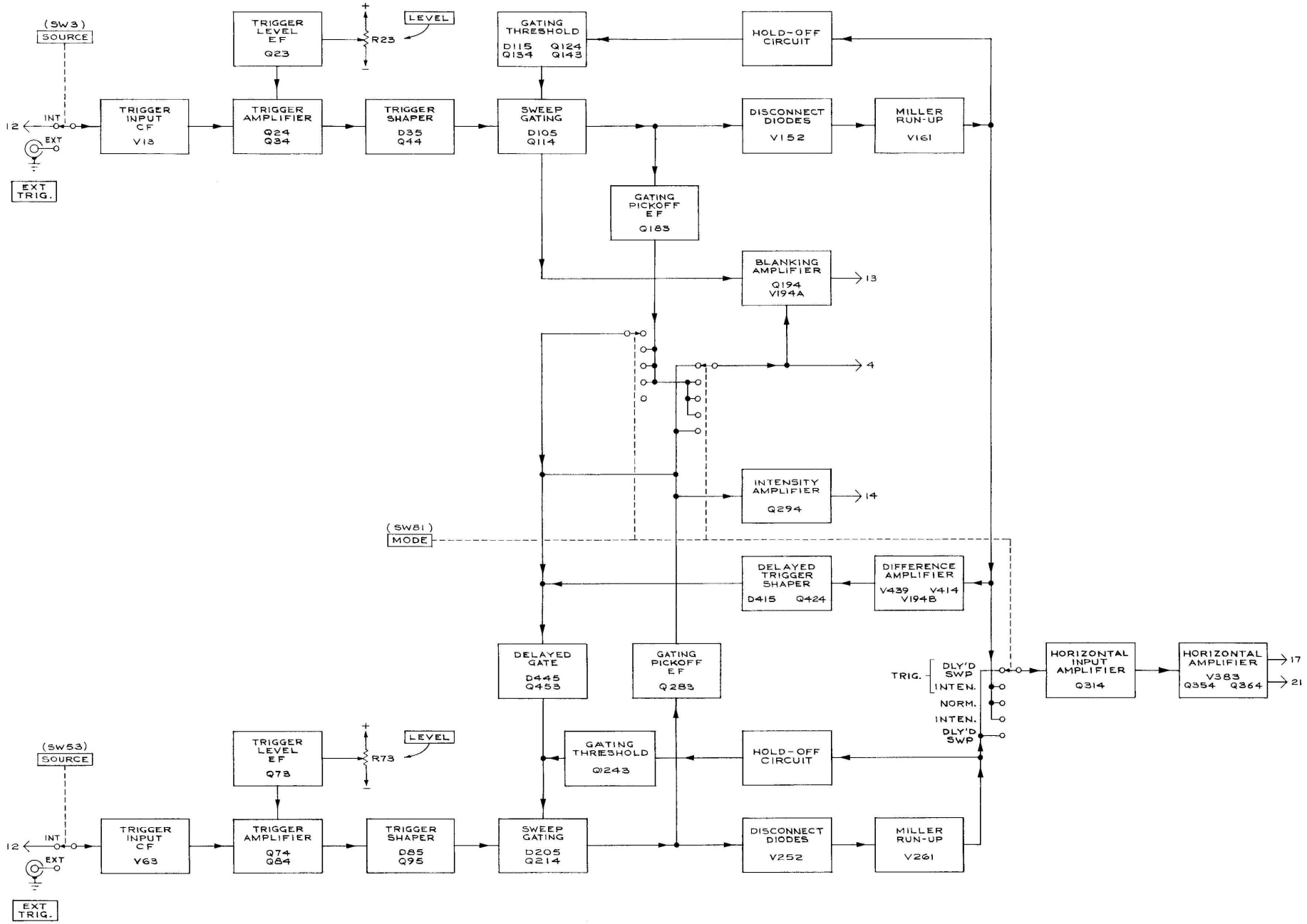
The push-pull output VOLTAGE from the plates of V383A and V383B pass directly to the crt horizontal deflection plates.

Timing Switches

The Normal and Delayed Sweep Timing Switches contain the resistors and capacitors that set the sweep rate and

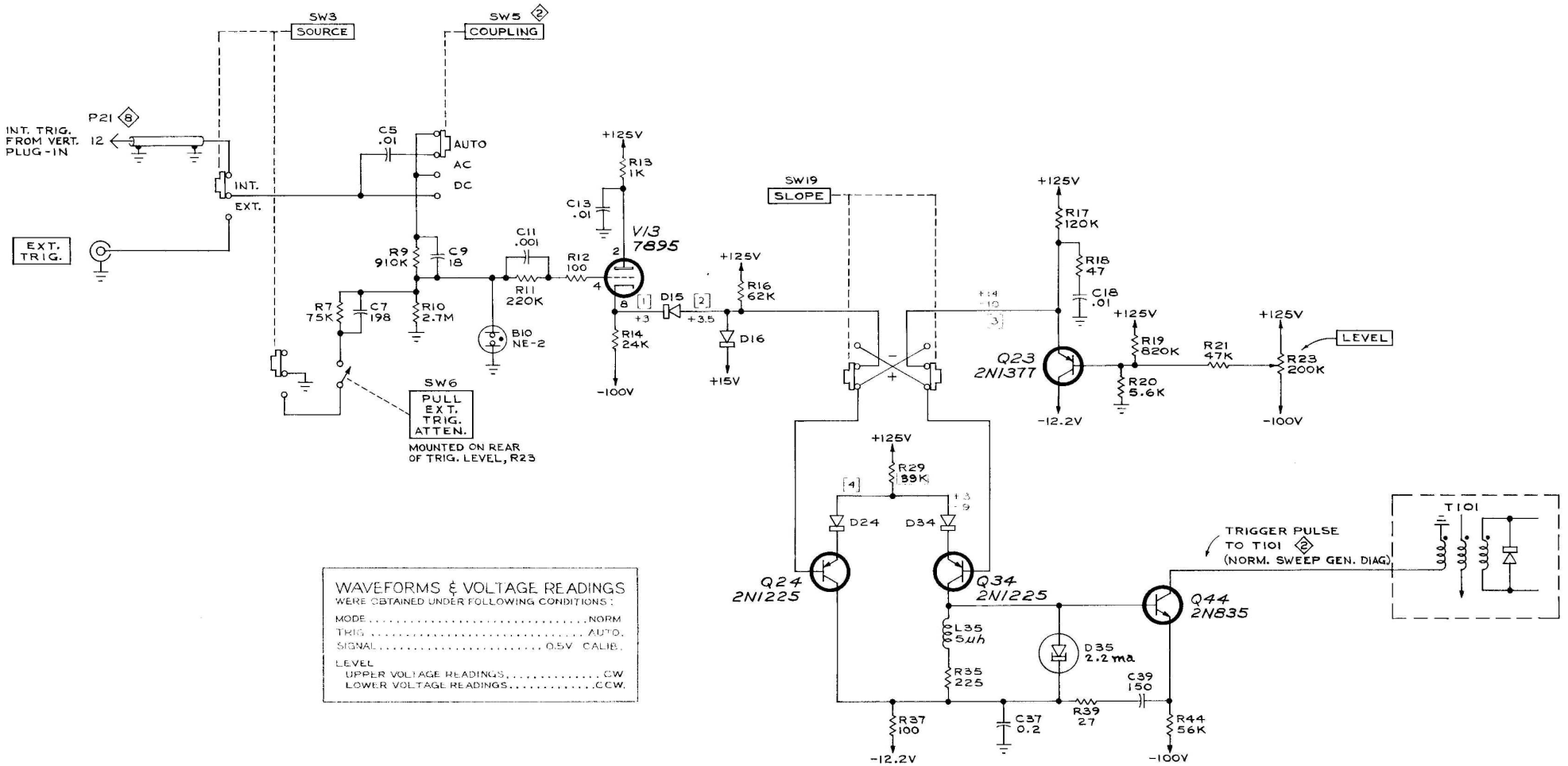
holdoff period. Both Timing Switches are the same except for VARIABLE TIME/CM. control R160Y. In the NORM. position of the MODE switch, the control (R160Y) is connected to Normal Sweep Timing Resistor R160. In all other positions of the MODE switch the control is connected to Delayed Sweep Timing Resistor 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.



MRH
563

BLOCK DIAGRAM



WAVEFORMS & VOLTAGE READINGS

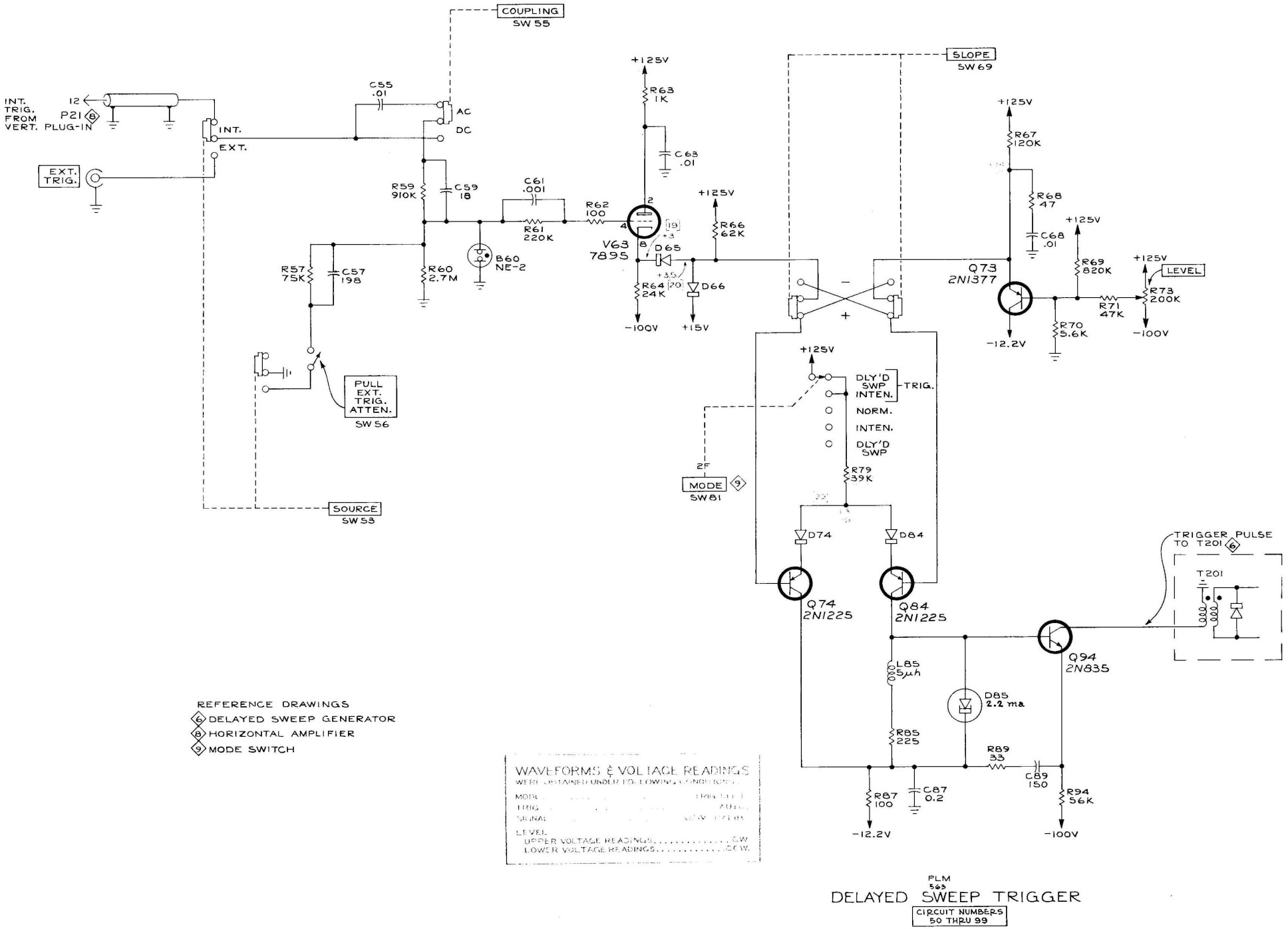
WERE OBTAINED UNDER FOLLOWING CONDITIONS :

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

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

REFERENCE DRAWINGS

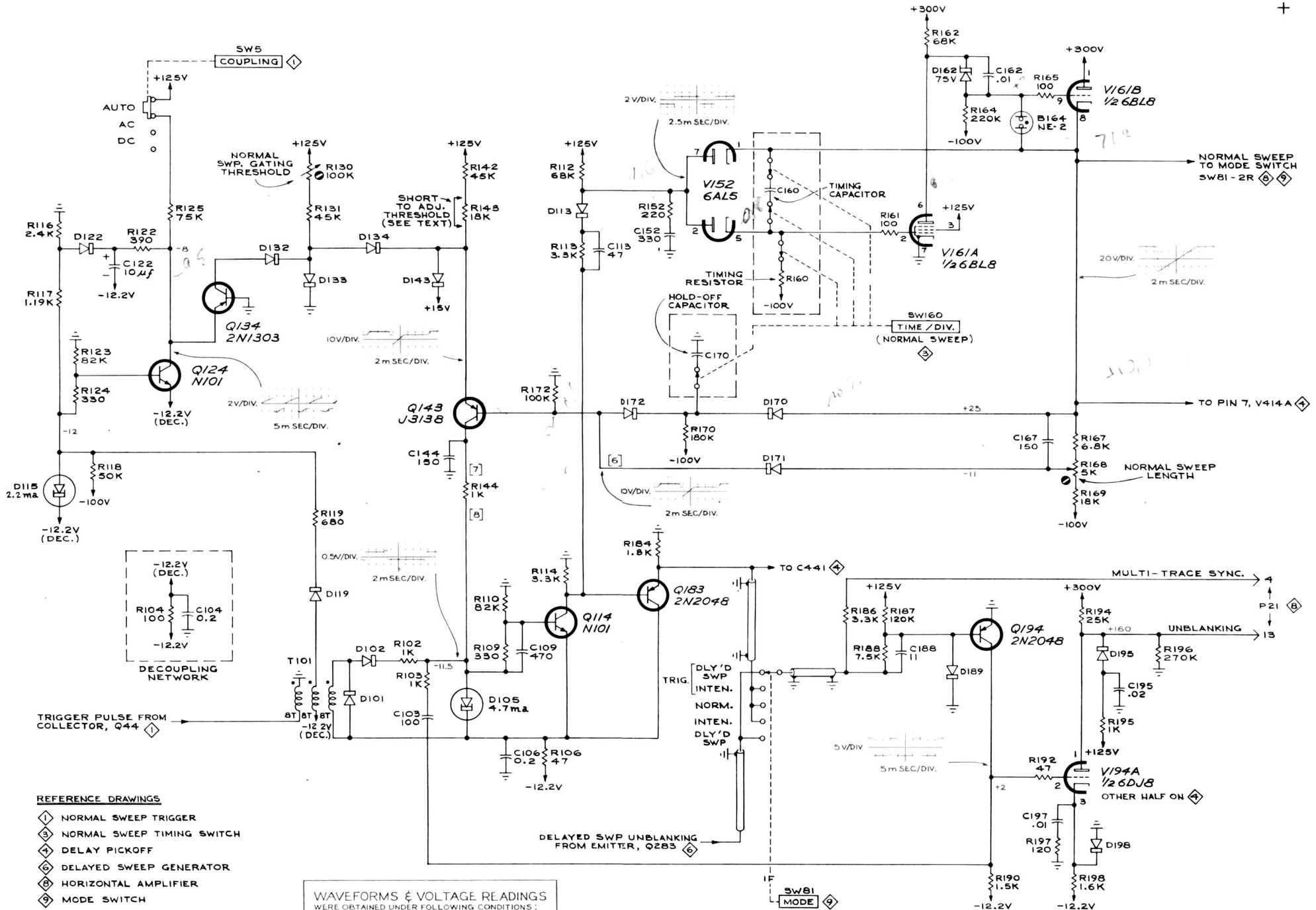
② NORMAL SWEEP GENERATOR
⑧ HORIZONTAL AMPLIFIER



PLM 563

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

WAVEFORMS & VOLTAGE READINGS
WERE OBTAINED UNDER FOLLOWING CONDITIONS:

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

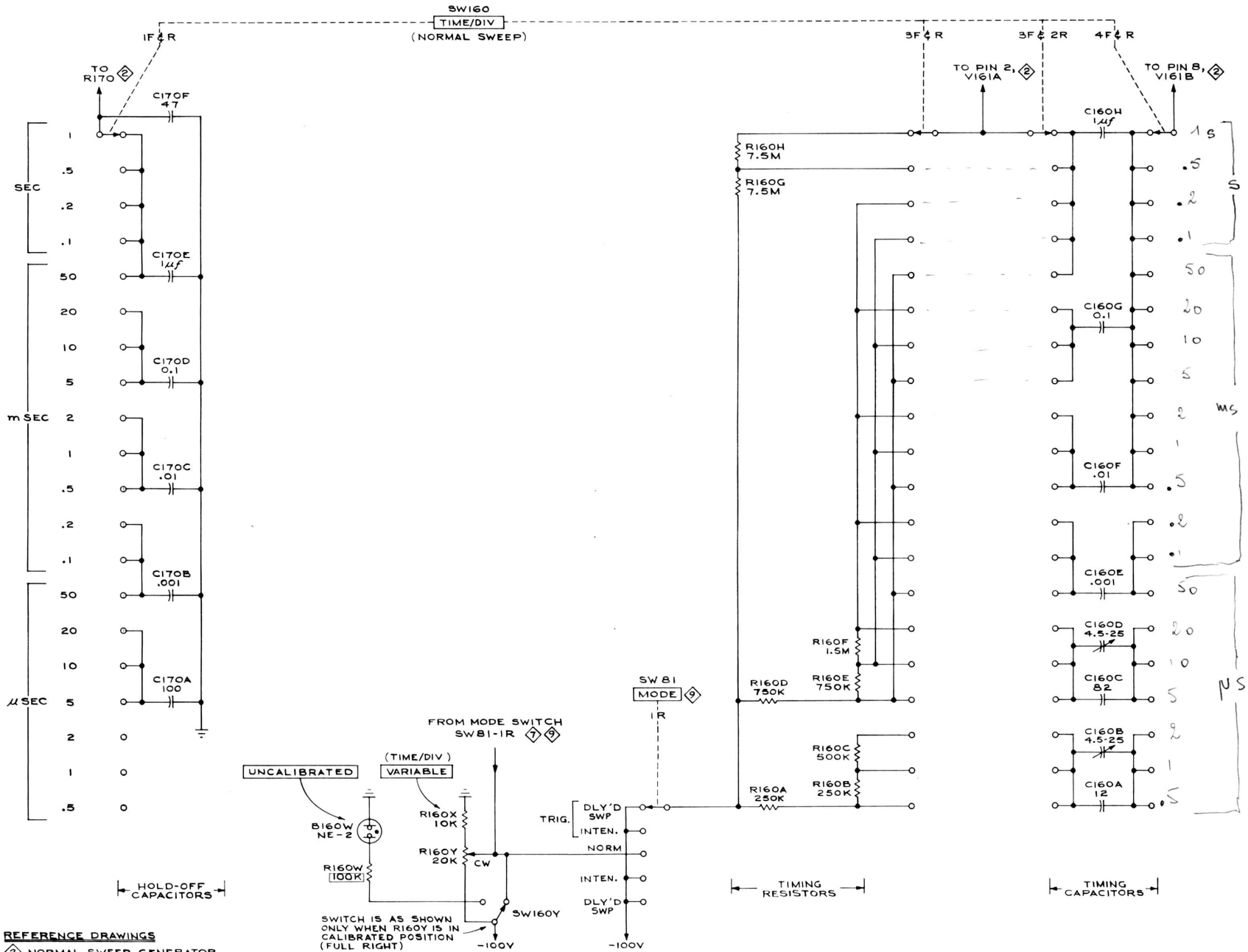
MRH
563

NORMAL SWEEP GENERATOR

CIRCUIT NUMBERS 100 THRU 199

TYPE 3B1 PLUG-IN

A



REFERENCE DRAWINGS

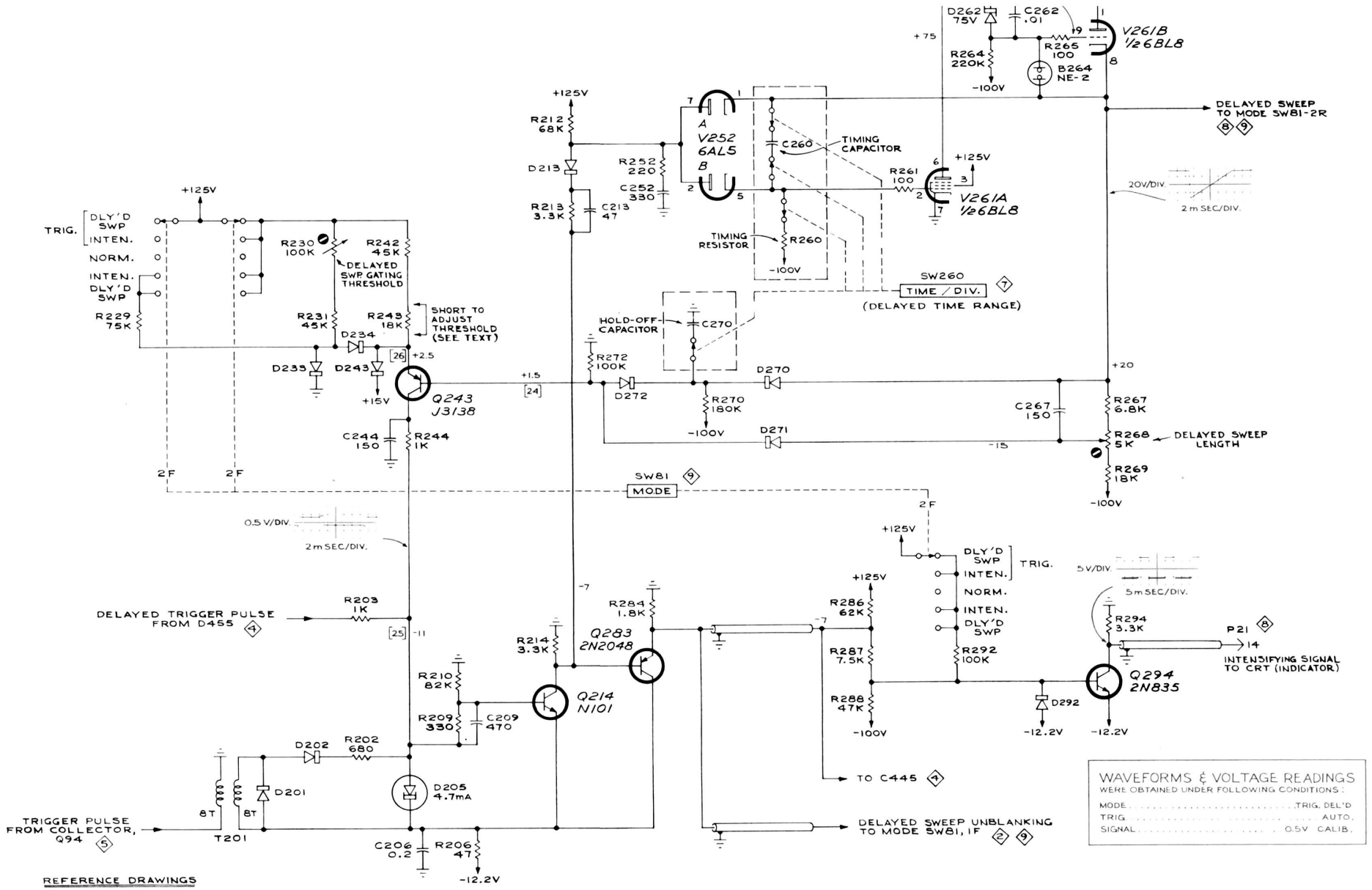
◇2 NORMAL SWEEP GENERATOR

◇7 DELAYED SWEEP TIMING SWITCH

◇9 MODE SWITCH

MRH
563

NORMAL SWEEP TIMING SWITCH



REFERENCE DRAWINGS

- 4 DELAY PICKOFF
- 5 DELAYED SWEEP TRIGGER
- 7 DELAYED SWEEP TIMING SWITCH
- 8 HORIZONTAL AMPLIFIER
- 9 MODE SWITCH

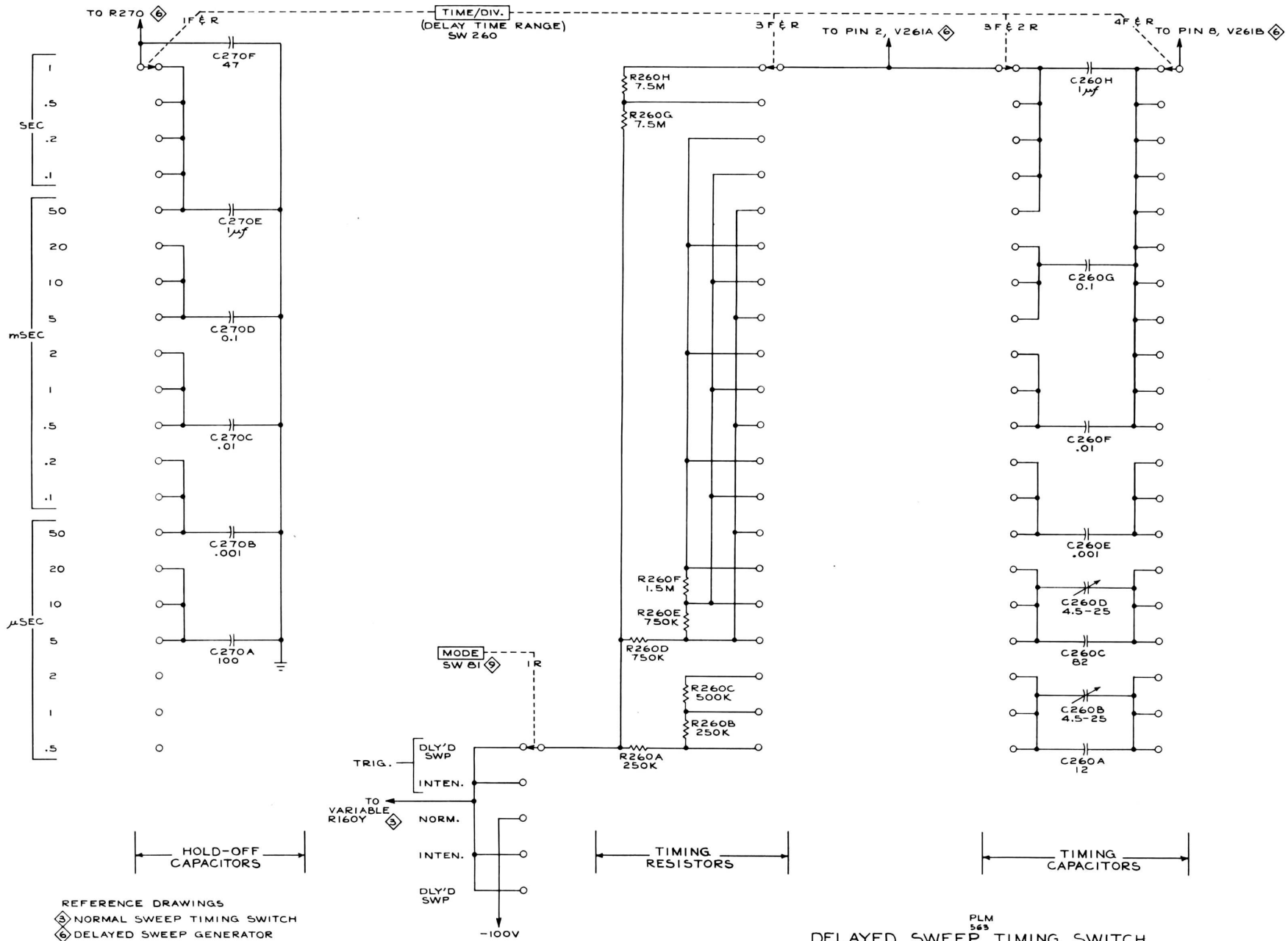
TYPE 3B1 PLUG-IN

A

MRH
5-63

DELAYED SWEEP GENERATOR

CIRCUIT NUMBERS 200 THRU 299



REFERENCE DRAWINGS

◇3 NORMAL SWEEP TIMING SWITCH

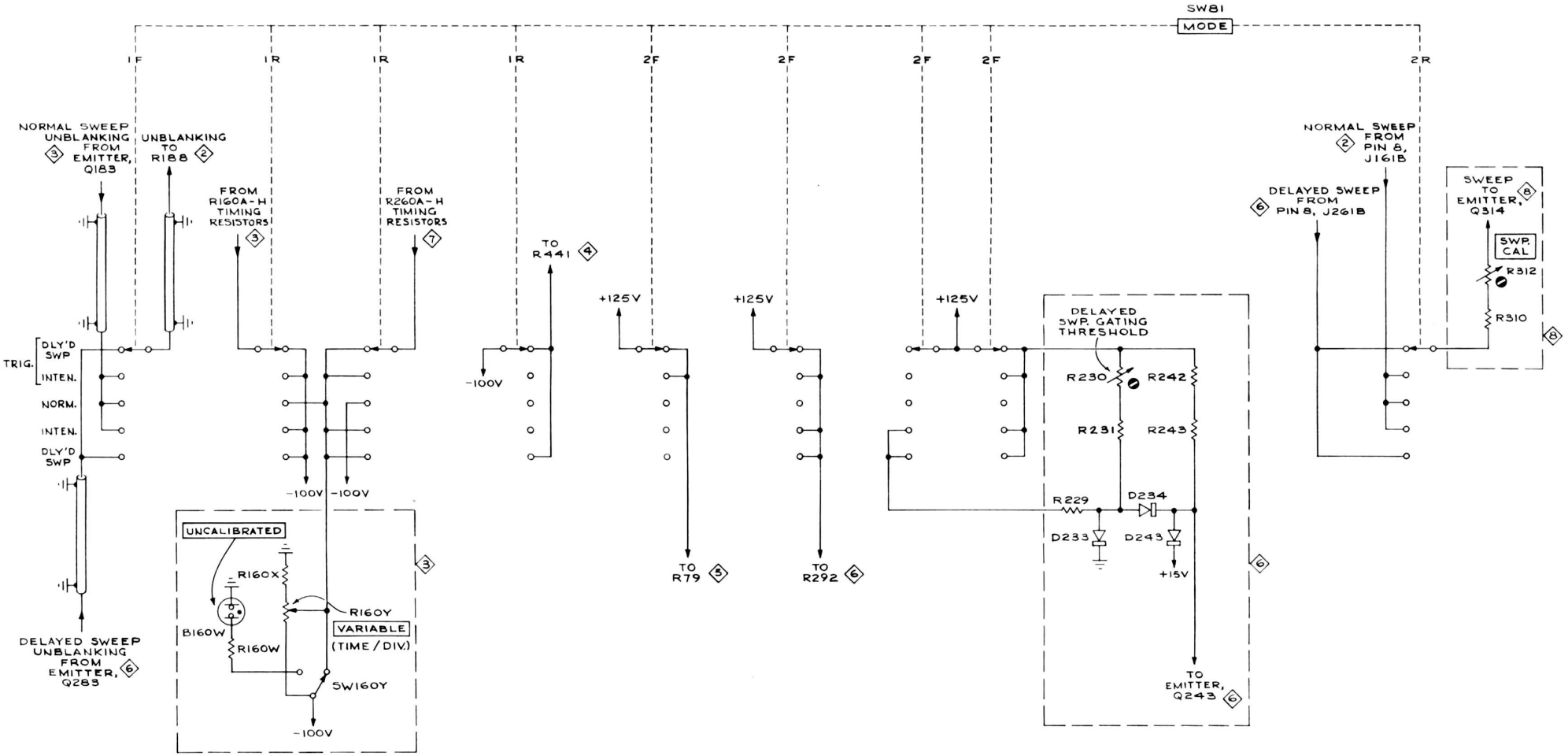
◇6 DELAYED SWEEP GENERATOR

◇9 MODE SWITCH

PLM 563

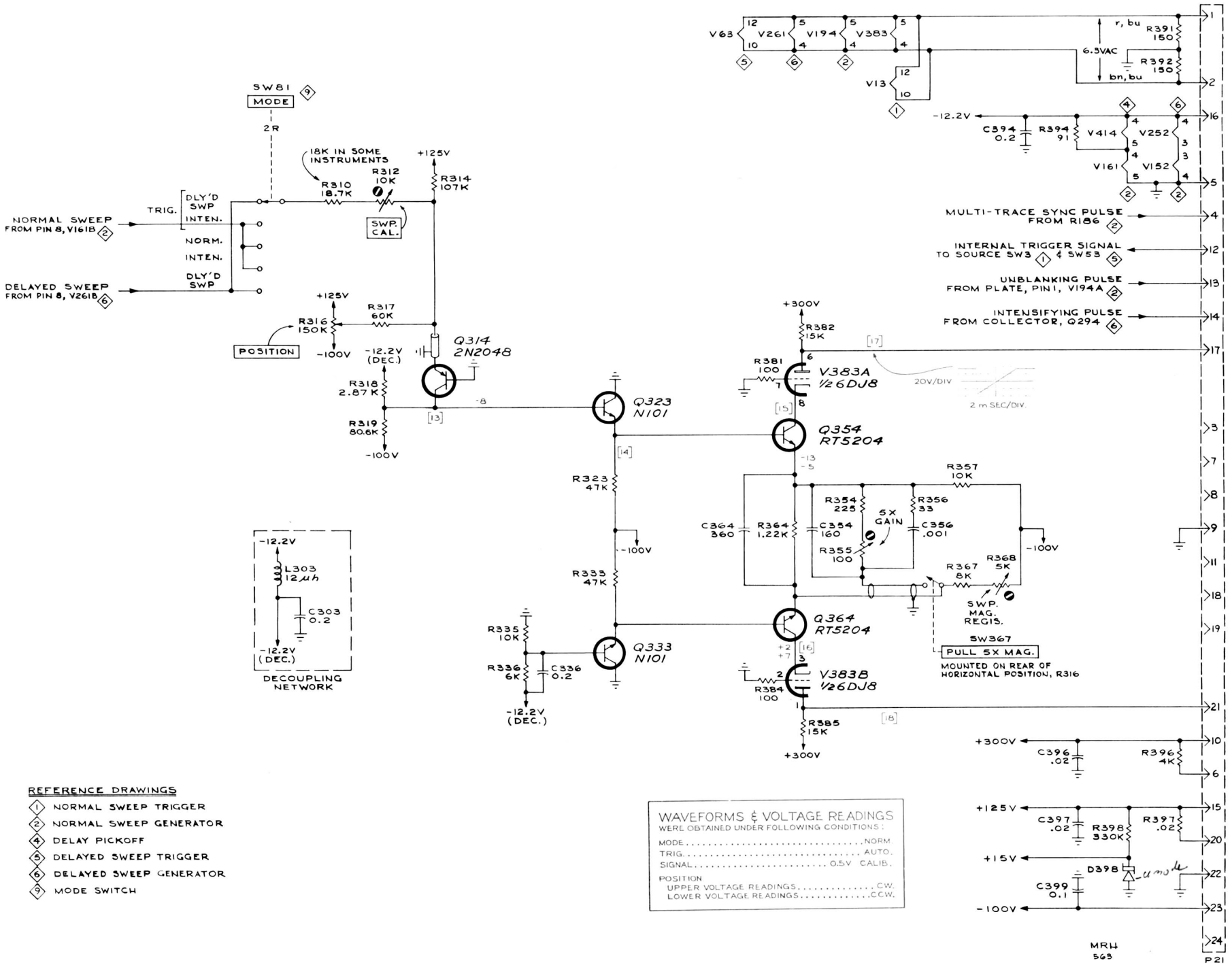
DELAYED SWEEP TIMING SWITCH

TYPE 3B1 PLUG-IN



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



REFERENCE DRAWINGS

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

WAVEFORMS & VOLTAGE READINGS

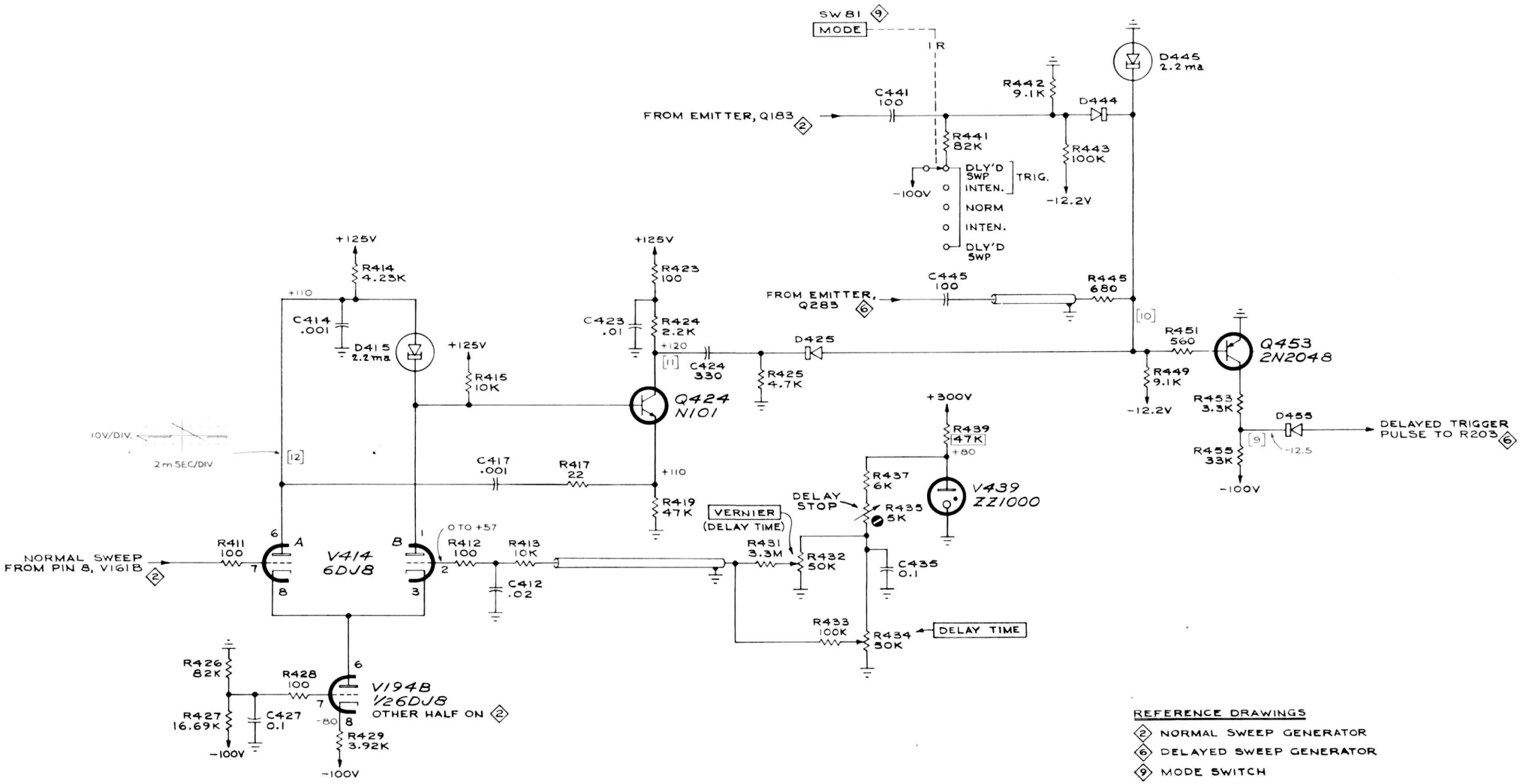
WERE OBTAINED UNDER FOLLOWING CONDITIONS:

MODE ..... NORM.
TRIG. ..... AUTO.
SIGNAL ..... 0.5V CALIB.
POSITION
UPPER VOLTAGE READINGS ..... C.W.
LOWER VOLTAGE READINGS ..... C.C.W.

MRH 563

HORIZONTAL AMPLIFIER

CIRCUIT NUMBERS 300 THRU 399



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.

MRH
563

DELAY PICKOFF

CIRCUIT NUMBERS 400 THRU 459