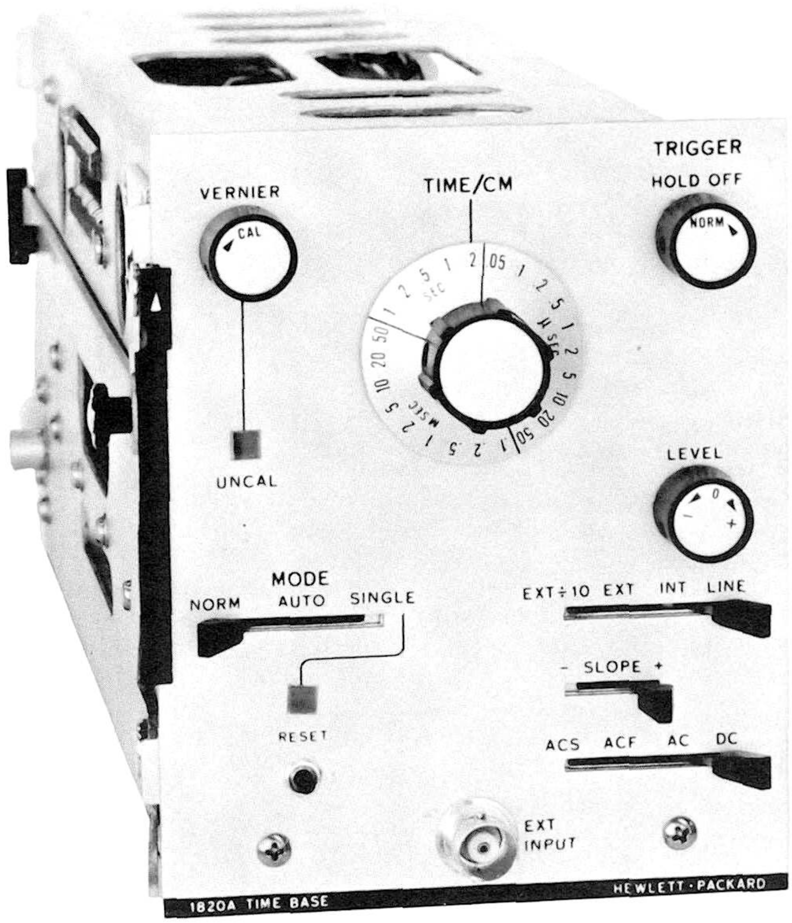


Figure 1-1. Model 1820A Time Base

SECTION I
GENERAL INFORMATION

1-1. INSTRUMENT DESCRIPTION.

1-2. The Hewlett-Packard Model 1820A Time Base (shown in Figure 1-1) is a linear sweep generating plug-in unit for the hp Model 180-series Oscilloscopes. Twenty-four ranges provide calibrated sweep speeds from 0.05 μsec/cm to 2 sec/cm in a 1, 2, 5 sequence. Also, the slowest sweep range can be extended beyond 5 sec/cm and sweep speeds in between ranges can be continuously varied by means of a vernier. The fastest sweep range can be expanded to 5 nsec/cm by the horizontal magnifier on the Model 180-series Oscilloscopes.

1-3. The sweep can be triggered by an internal siganl from the vertical plug-in or by an external signal from DC to 90 MHz. Front panel controls allow trigger slope, level, coupling, hold-off time, and sweep speed selection. By operating in automatic, a bright baseline is present even in the absence of a trigger. Transient waveform photogarphy is possible by using single sweep operation. Variable hold-off, another feature, allows stable viewing of repetitive complex waveforms. Refer to Table 1-1 for a complete listing of specifications.

1-4. INSTRUMENT IDENTIFICATION.

1-5. Hewlett-Packard uses an eight-digit serial number (000-00000) to identify instruments. The first three digits are called "serial prefix" and are used to classify a group of instruments. The serial number plate is located on the rear panel. Give the complete instrument serial number when corresponding with a Hewlett-Packard Sales/Service Office.

1-6. SCOPE OF MANUAL.

1-7. This manual provides information for the operation and maintenance of the hp Model 1820A Time Base and supplements the manual for the hp Model 180-series Oscilloscopes. For information on other plug-ins, refer to the specific manual for that plug-in.

1-8. MANUAL CHANGES.

1-9. If the serial prefix (see Paragraph 1-5) of your instrument does not correspond to the serial prefix on the title page of this manual, refer to the attached "Manual Changes" sheet or Section VII which describes the changes necessary to adapt this manual for proper coverage. If further information on either the instrument or manual is needed, contact the nearest hp Sales/Service Office (addresses are listed at the rear of this manual).

Table 1-1. Specifications

RANGE:

0.05 μsec/cm to 2 sec/cm, 24 ranges in a 1, 2, 5 sequence; accuracy ±3%; vernier provides continuous adjustment between ranges and extends slowest range to at least 5 sec/cm; horizontal Magnifier, on Model 180-series Oscilloscopes, expands fastest range to 10 nsec/cm (X5) or 5 nsec/cm (X10) with 5% accuracy.

TRIGGERING:

NORMAL:

Internal: see manual for Vertical Plug-In.

External: 0.5v pk-pk from dc to 50 MHz, increasing to 1 v pk-pk at 90 MHz.

Line: power-line waveform is used for triggering.

Slope: selectable, positive or negative.

Trigger Point: adjustable ±5v over selected trigger signal; ±50v in EXT÷10.

Trigger Coupling: DC, AC, ACF, ACS; AC attenuates signals below approximately 20 Hz; AC F attenuates signals below approximately 15 kHz; ACS attenuates signals above approximately 30 kHz.

AUTOMATIC:

Bright baseline displayed in absence of trigger signal. Triggering is same as normal except lower frequency limit of trigger signal is 40 Hz.

VARIABLE HOLD-OFF:

Permits stable displays of repetitive-complex waveforms.

SINGLE SWEEP:

Front panel controls permit single sweep operation.

WEIGHT:

Net, 2-3/4 lbs. (1, 3 kg). Shipping, 5-1/4 lbs. (2, 4 kg).

SECTION IV
PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. The Model 1820A Time Base is a sweep generating plug-in for the Model 180-series Oscilloscopes. The Model 1820A can be triggered by external signals, internal signals from the vertical plug-in, or power line frequency signals. The output signal is used for horizontal deflection in the Oscilloscope.

4-3. OVER-ALL DESCRIPTION.

4-4. The Model 1820A Time Base consists of trigger, gate, and sweep circuits (refer to block diagram, Figure 4-1). The sweep circuit can be triggered or set for free-run. When triggered operation is used, the required trigger signal is coupled to the trigger generator from one of three sources: EXT, INT, or LINE. Free-run operation is selected by setting the MODE switch to AUTO. In this position, the sweep generator operates without a trigger signal, but if a trigger signal is applied, it will override the free-run operation and control the sweep. The Trigger Coupling switch determines the type of coupling for the incoming trigger signal. The SLOPE switch selects triggering on either the positive or negative-going portion of the incoming trigger signal, while the LEVEL control sets the triggering voltage point on the selected slope of the incoming signal. The output of the trigger generator is a fast rise negative spike which starts the gate generator.

4-5. When triggered, the gate generator produces a negative rectangular pulse which is applied to the oscilloscope for unblanking the CRT, and to the integrator in the sweep circuit.

4-6. The integrator circuit is normally clamped so that its output is a constant dc voltage. The negative gate signal unclamps the integrator which starts generating the sweep, a positive-going sawtooth signal. This sweep signal is applied to the Oscilloscope for horizontal deflection.

4-7. A portion of the sweep signal is also applied to the Schmitt trigger and hold-off circuits. When the ramp reaches a predetermined amplitude, the Schmitt trigger changes state, turning the gate generator off and stopping the ramp. After a time delay starting at the end of the ramp, the hold-off circuit generates a negative signal which switches the Schmitt trigger circuit back to its pretrigger state. The duration of this time delay is determined by the hold-off control. This action resets the gate generator so that the next negative spike from the trigger generator will trigger the gate generator, repeating the cycle.

4-8. When operating in AUTO, the auto circuit is triggered by the Schmitt trigger at the same time that the gate generator is reset. The auto circuit then produces a negative signal which triggers the gate generator. This action forces the sweep to free-run at a rate determined by the TIME/CM switch. If, however, a signal 40 Hz or greater is applied to the trigger generator, it will override the auto circuit and control the sweep.

4-9. When the MODE switch is in the SINGLE position, the hold-off circuit is disconnected from the Schmitt trigger. The gate generator must now be reset by manually switching the Schmitt trigger to its pretrigger state at the end of each sweep.

4-10. CIRCUIT DETAILS.

4-11. The following paragraphs explain the principles of operation of the Model 1820A in detail. Refer to the schematic diagrams, Figure 8-5 and 8-7, while reading the text.

4-12. NORMAL SWEEP OPERATION.

4-13. TRIGGER CIRCUIT. Three sources of trigger signals can be used, as selected by Trigger Source switch S101. External triggers are applied through J101, a front panel BNC connector. In EXT÷10, voltage divider R103/R104 attenuates the external input signal ten times. Internal triggers are received through P2 from the Vertical Plug-In and are coupled through emitter followers Q101 and Q102. When LINE is selected as a trigger, a 20v pk-pk power line signal is applied to P1 pin 31 from the Model 180-series Oscilloscope, and is attenuated to 10v pk-pk by voltage divider R101/R102. From S101 the desired trigger signal is fed to Trigger Coupling switch S102 which permits direct (DC), capacitive (AC), low pass filter (ACS), or high pass filter (ACF) coupling of the trigger signal to source follower Q103. Diode CR103 protects Q103 from excessive negative voltage. Q103 acts as a high input impedance for the trigger signal and couples it to trigger comparator Q104/Q105.

4-14. LEVEL control R121, through emitter follower Q106, controls the bias for Q104 and Q105. When the signal voltage at the base of Q104 exceeds the potential at the base of Q105, tunnel diode CR106 is switched to its high voltage state by either Q104 or Q105, depending upon the setting of SLOPE switch S103. When S103 is set to + (positive), some positive amplitude on the trigger signal, as determined by the LEVEL control, will overcome the bias on Q104; Q104 conducts through CR107 to CR106, switching it to its high voltage state. If S103 is switched to - (negative), some negative amplitude on the trigger signal will overcome the bias on Q105. Q105 will conduct through CR108 to CR106, switching it to its high voltage state.

4-15. The negative-going rectangular wave produced by CR106 is coupled by C120 to the emitter circuit of Q107. The output of Q107 is differentiated by C121 and the input circuit of Q108. Since Q108 is biased at cut-off, only the positive pulses are amplified and inverted.

4-16. GATE CIRCUIT. The negative spike from Q108 is coupled to tunnel diode CR201. Prior to this incoming signal, CR201 is biased in a low voltage state and

Q211 is conducting, but not enough to put CR201 in its high voltage state. When the incoming trigger arrives at the cathode of CR201, it provides enough additional current to put the diode in its high voltage state. After the trigger pulse ends, the current from Q211 alone is sufficient to keep CR201 in this state. Tunnel diode CR201 produces a negative signal which is amplified by Q201 and Q202. Diodes CR202 through CR204 keep Q201 from saturating. The negative pulse at the collector of Q202 is fed through P1 pin 17 to the Model 180-series Oscilloscope for CRT unblanking; to P1 pin 14 and through the Oscilloscope to a rear panel BNC connector; and to the junction of CR206/CR207.

4-17. SWEEP CIRCUIT. The negative pulse from Q202 reverse biases diode switch CR206/CR207, permitting the timing capacitor (C302-C312) to charge through the timing resistor (R301-R310) to the negative potential on the wiper of R214. The TIME/CM switch, by selecting various time constants and controlling the bias for Q203, determines the slope of the negative-going ramp at the gate of Q204. The VERNIER control (R214) adjusts the charge rate between the calibrated steps of the TIME/CM switch.

4-18. The negative sweep is coupled through Q204 to the base of Q205. Q204 provides a high input impedance for the sweep and R221 adjusts the quiescent operating point of the circuit. The negative sweep is amplified and inverted by Q205 and coupled through emitter follower Q206.

4-19. From the emitter of Q206, the positive sweep is applied to P1 pin 1 for horizontal deflection in the Model 180-series Oscilloscope; P1 pin 11, through the Oscilloscope to a rear panel BNC connector; and fed back to the selected timing capacitor to assure a linear sweep output.

4-20. A portion of the sweep signal is applied to emitter follower Q207 and sent on to the Schmitt trigger circuit. The sweep voltage at the base of Q212 goes positive until it reaches the upper hysteresis limit of the Schmitt trigger turning Q212 on and cutting Q211 off. The amount of sweep time for this action to occur is controlled by sweep length adjustment R232. When Q211 ceases to conduct, the current to CR201 is removed and the tunnel diode switches to its low voltage state. The negative gate ceases; CR206 and CR207 are forward biased, ending the ramp and discharging the selected timing capacitor. Since CR201 is no longer receiving current from Q211, any further incoming triggers have no effect.

4-21. As the sweep was generated, a portion of the positive sweep was also fed to the hold-off emitter follower Q214. The positive-going emitter of Q214 forward biases CR219, permitting the negatively charged hold-off capacitor (C320-C350) to discharge. When the ramp ends, CR219 is again reverse-biased and the hold-off capacitor begins to charge negatively. Hold-off time (charge time of the capacitor) is determined by the RC time constant of R263 and the particular hold-off capacitor selected. R265 permits calibration of the hold-off time.

4-22. When the hold-off capacitor has charged to some predetermined negative potential, this negative voltage, coupled through Q213, forward biases CR218. With diode CR218 forward biased, a negative voltage is applied to the base of Q212. This negative potential cuts Q212 off, and its positive-going collector voltage coupled to the base of Q211 turns Q211 on. With Q211 conducting, tunnel diode CR201 regains its arming current and returns the circuit to a standby condition. Upon receipt of another incoming trigger signal, the entire operation recycles. Whenever Q211 is on, Q210 is also on, shorting R242 and lighting DS201 which indicates that CR201 is reset.

4-23. AUTO SWEEP OPERATION.

4-24. During NORM operation, free-run lockout transistor Q112 is conducting and its negative collector voltage, coupled through CR114, keeps free run gate generator Q109 cut-off. In AUTO operation, a negative supply voltage applied to Q112 base through S104 and CR117, keeps Q112 cut-off. With Q112 cut-off, the base of free run gate generator Q109 is free to follow any voltage change on Q212 collector. At the end of the hold-off period, the collector voltage of Q212 moves in a positive direction and this voltage change is applied to the base of Q211 and Q109. Transistor Q211 conducts and again supplies current to tunnel diode CR201. Free run gate generator Q109 also conducts and its collector current is enough to switch CR201 to its high voltage state. With CR201 at a high voltage state, the negative gate required to start the sweep is generated and free-run operation is achieved.

4-25. If a trigger signal 40 Hz or faster is applied during AUTO operation, the negative trigger pulse on the collector of Q108 is coupled through CR116 to Q111 base. This negative pulse turns on Q111 and its collector moves in a positive direction, reverse biasing CR117 allowing free-run lockout Q112 to conduct. Q109, is now cut-off by the negative voltage from the collector of Q112. With Q109 cut-off, the current source for CR201 is removed, and an incoming trigger signal is required to switch the tunnel diode to a high voltage state and start the sweep.

4-26. Capacitor C125 in the collector of Q111 is discharged by the trigger pulse through Q111. The capacitor starts charging at the end of the trigger, but charging time is long. If the incoming frequency is approximately 40 Hz or faster, C125 will remain only partially charged and the circuits will synchronize with the incoming trigger. However, if the trigger frequency is less than approximately 40 Hz, or is removed, C125 will charge enough to forward bias CR117 cutting off Q112 and permitting Q109 to conduct. Once again the operation is free-run.

4-27. SINGLE SWEEP OPERATION.

4-28. Circuit theory remains the same in SINGLE operation as in NORMAL with one exception The negative voltage from the hold-off circuit that returns the Schmitt trigger to its armed condition is removed by S104. Therefore, the Schmitt trigger will switch to its unarmed state and end the sweep as previously described. This state will continue until the RESET push-button switch is pressed.

4-29. When RESET is pressed, a negative voltage is applied to the base of Q212. This turns Q212 off, permitting Q211 to conduct. With Q211 conducting, CR201 is armed and will permit one sweep upon receipt of an incoming trigger.

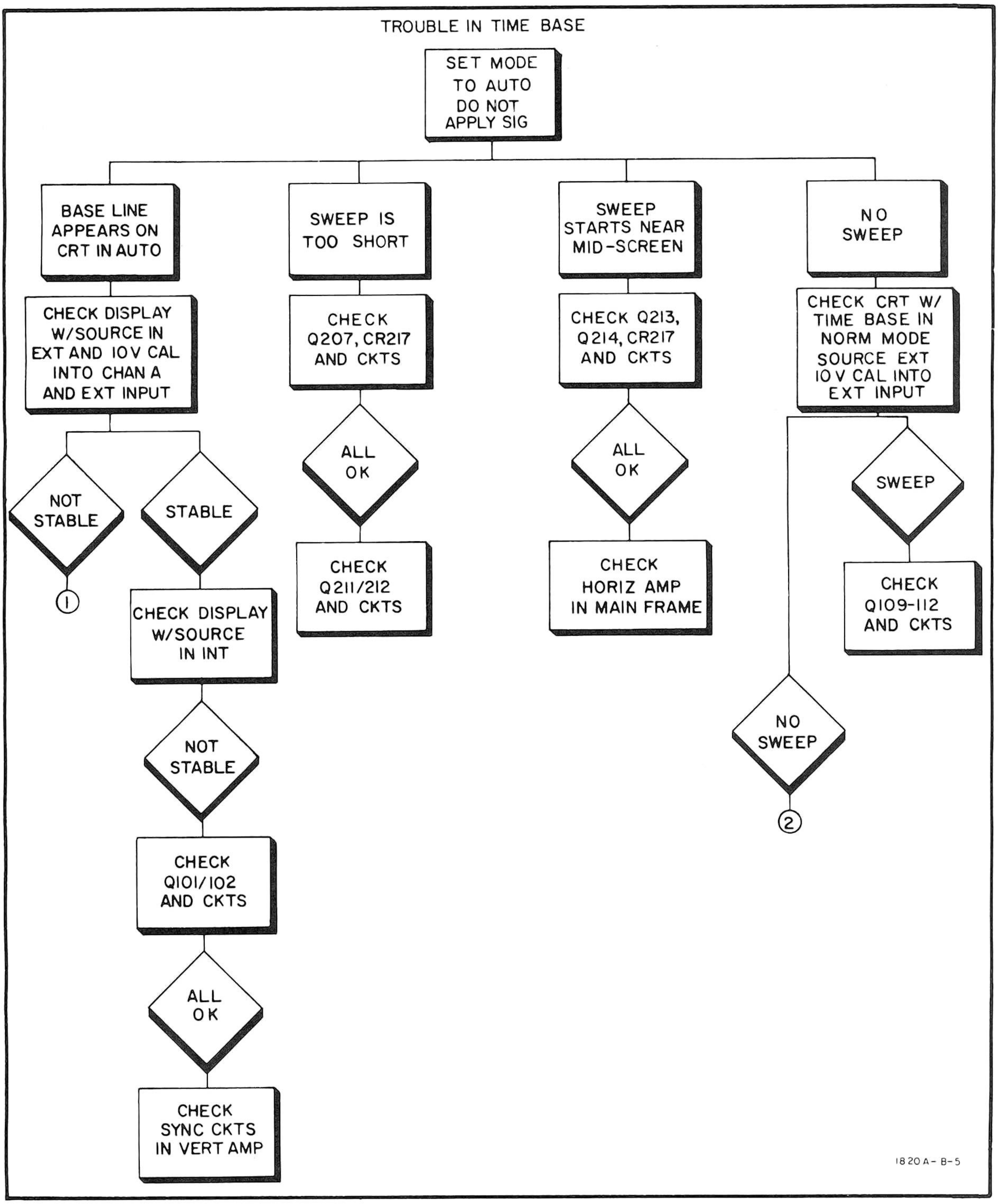


Figure 8-1. Over-all Troubleshooting Tree

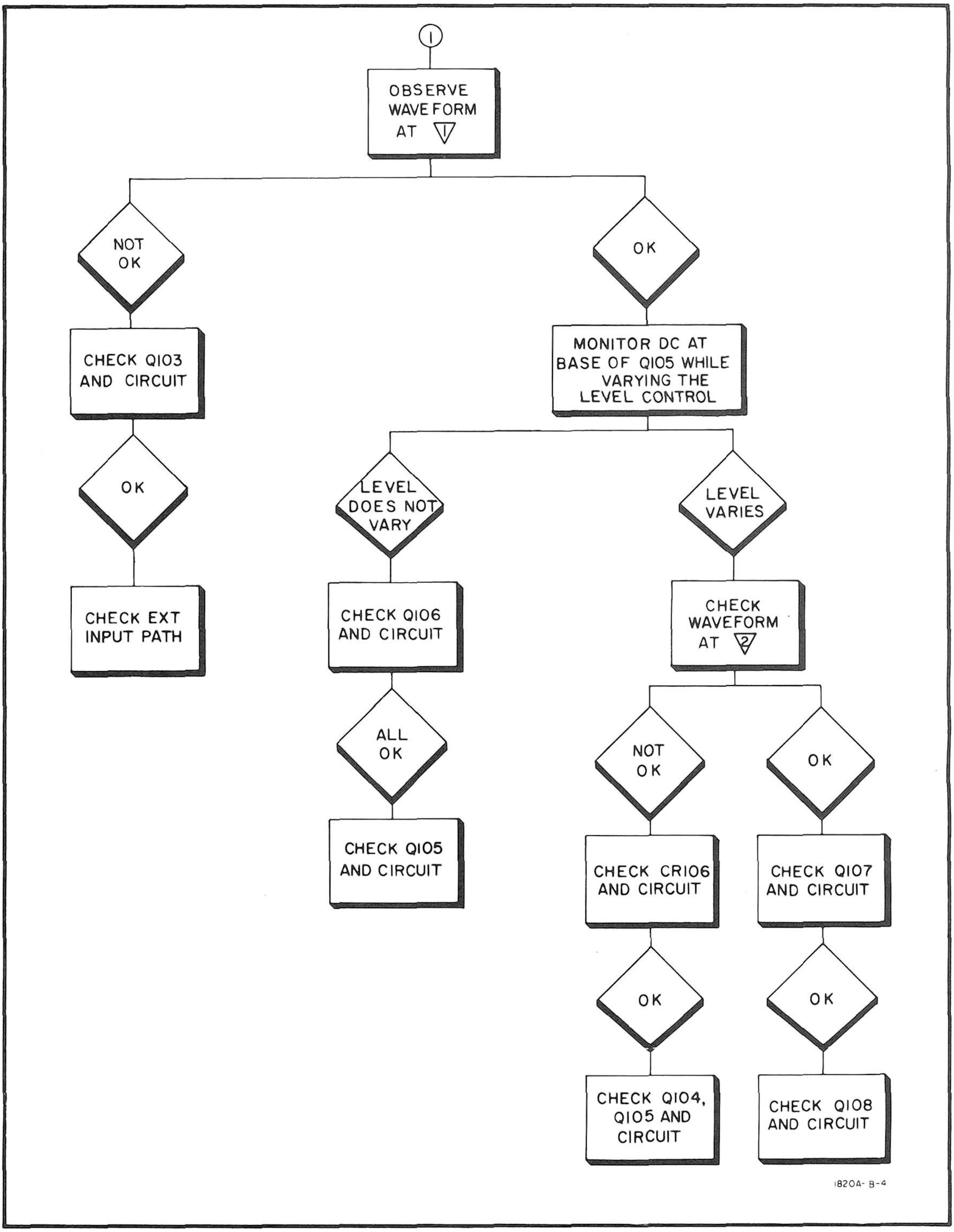


Figure 8-4. Trigger Generator Troubleshooting Tree

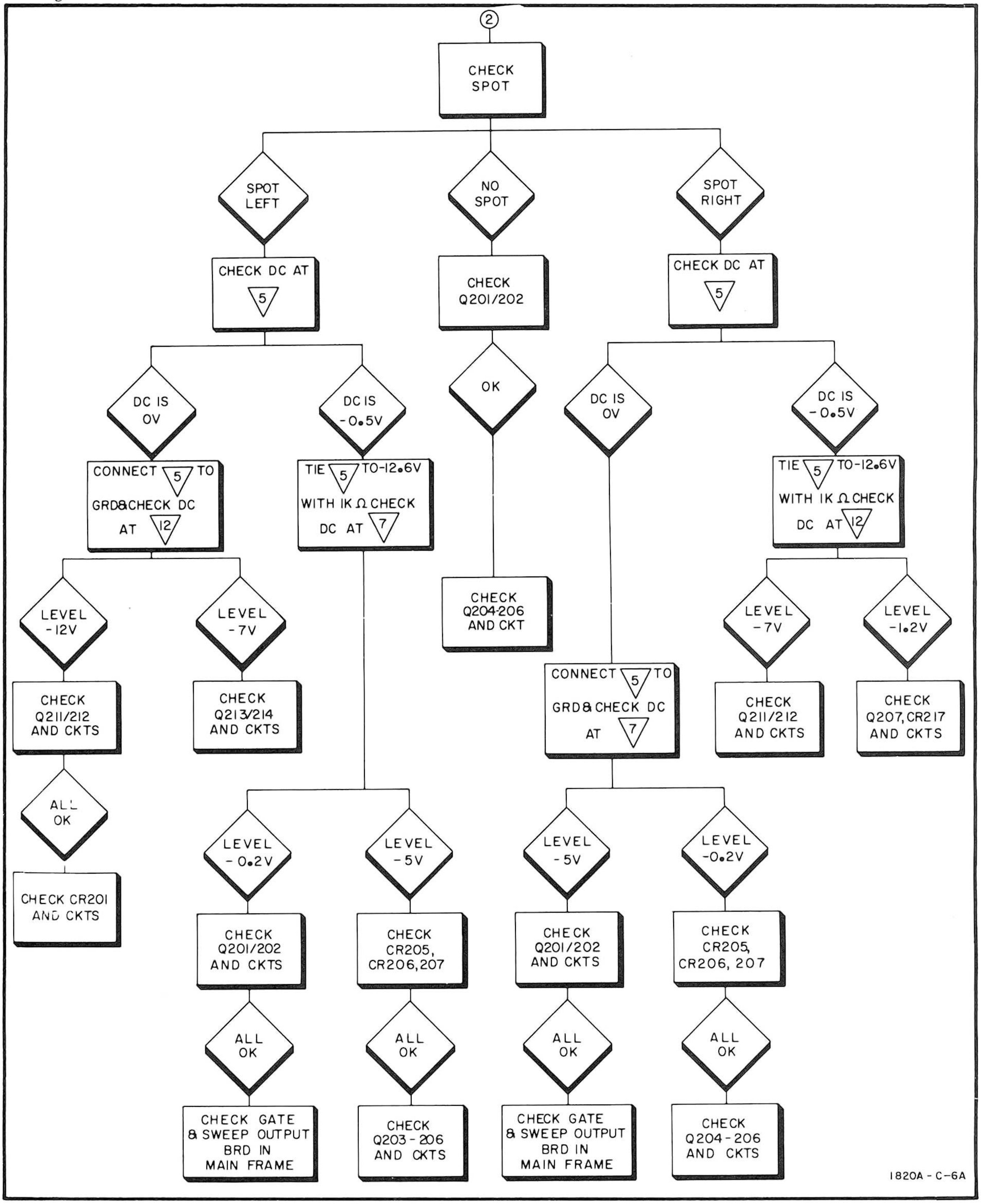
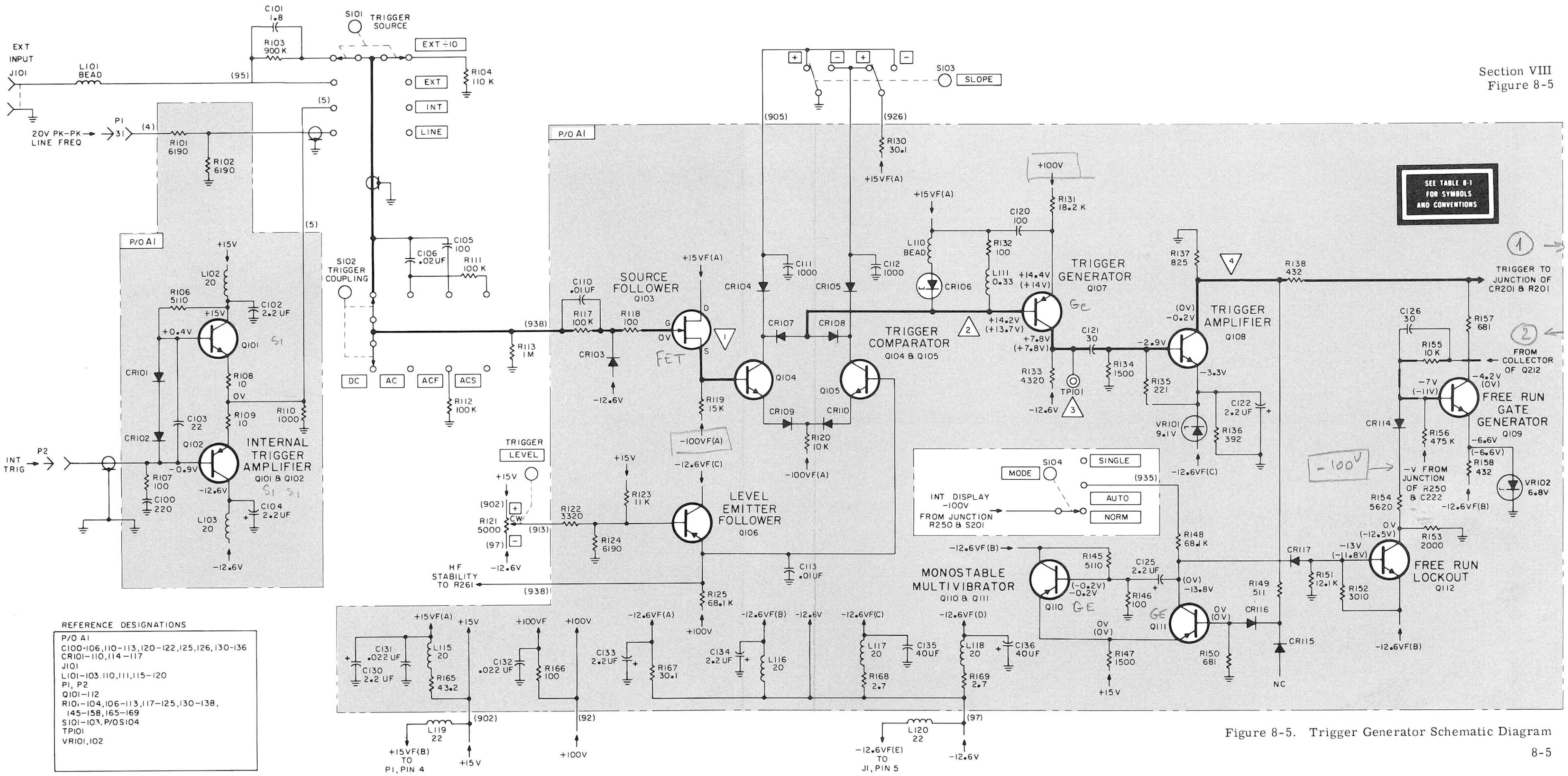


Figure 8-6. Sweep Generator Troubleshooting Tree



REFERENCE DESIGNATIONS

P/O A1
C100-106,110-113,120-122,125,126,130-136
CR101-110,114-117
J101
L101-103,110,111,115-120
P1, P2
Q101-112
R101-104,106-113,117-125,130-138, 145-158,165-169
S101-103, P/O S104
TP101
VR101,102

DELETED:

1820A-TRIGGER GENERATOR-721

Figure 8-5. Trigger Generator Schematic Diagram

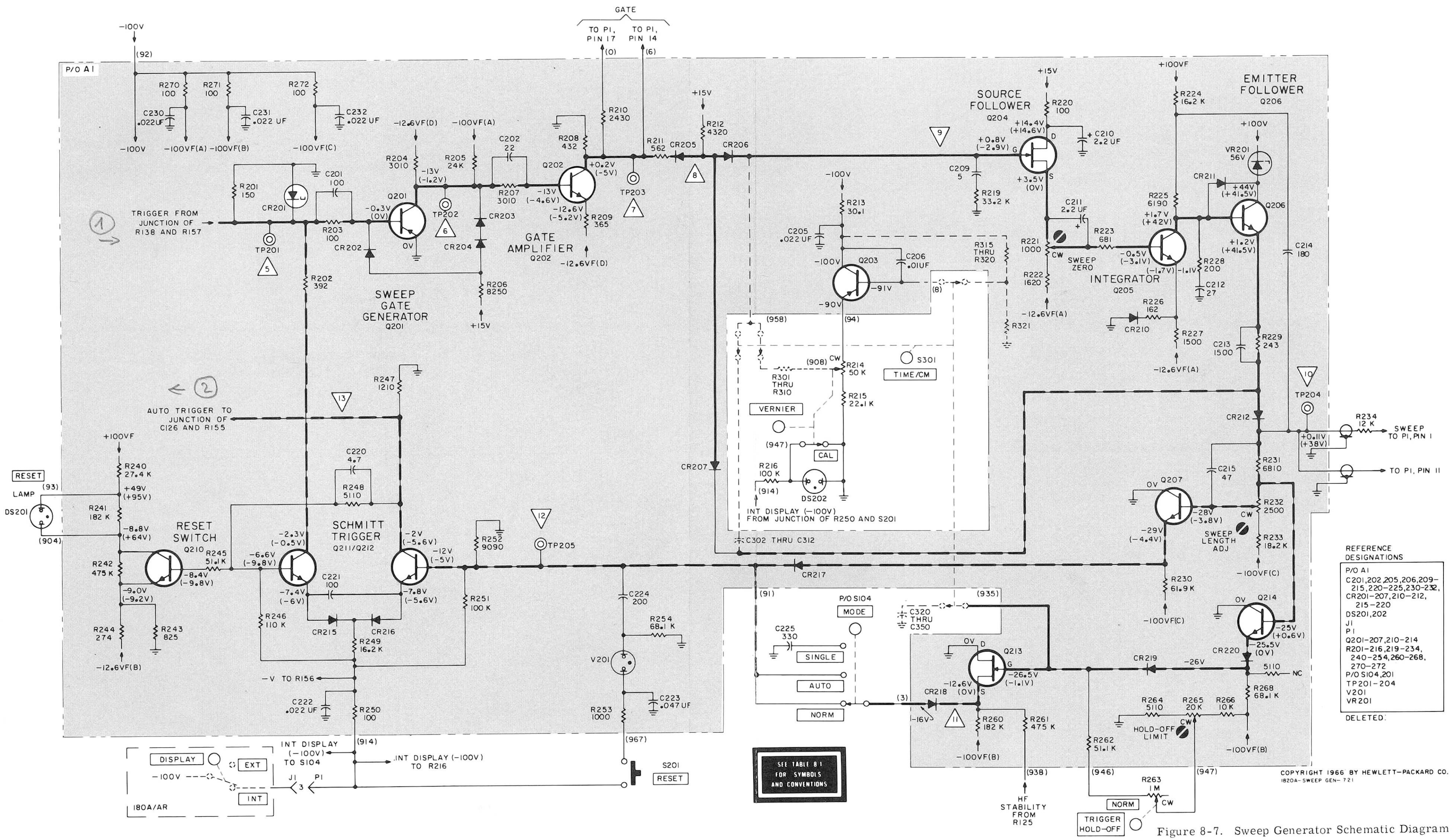


Figure 8-7. Sweep Generator Schematic Diagram

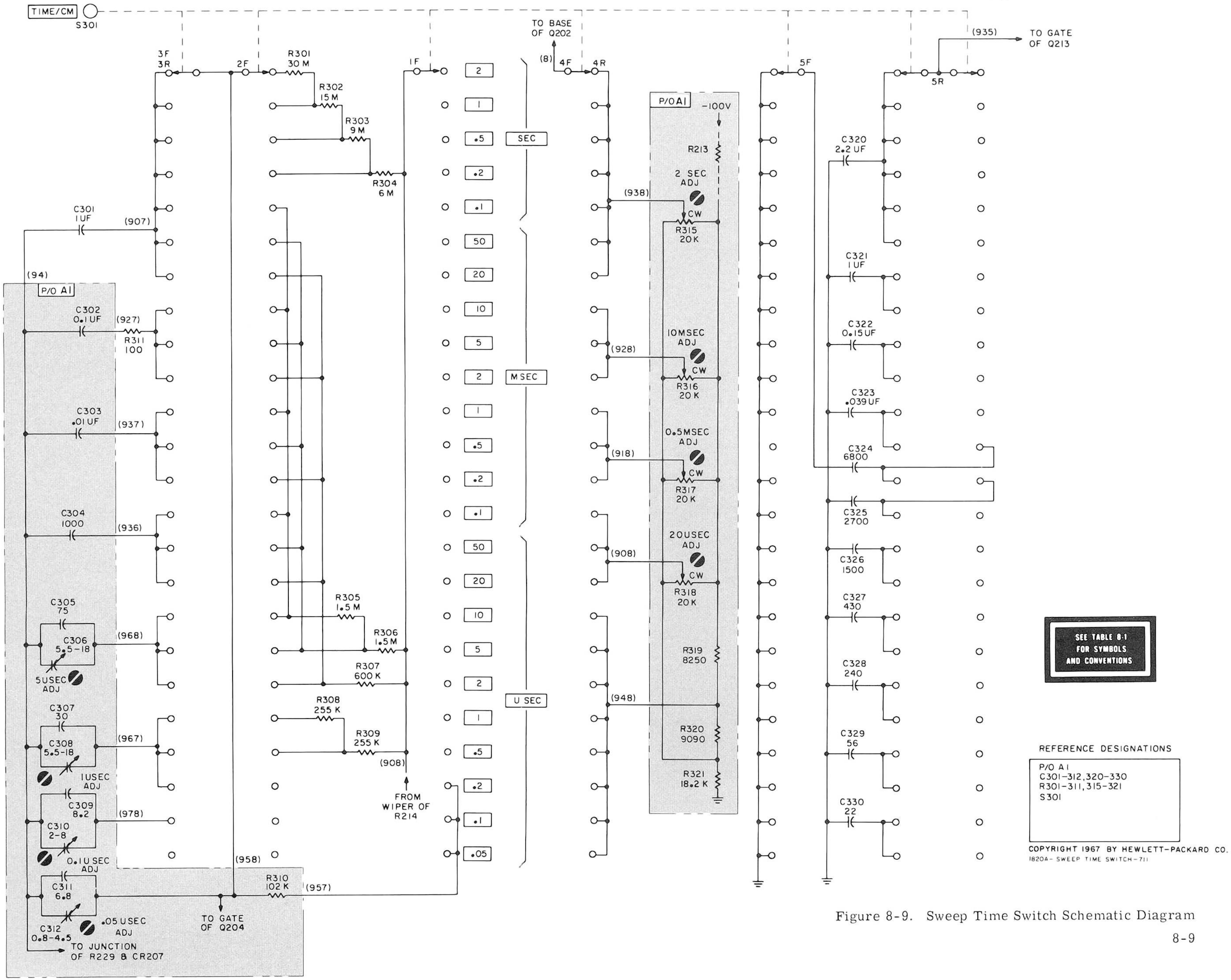


Figure 8-9. Sweep Time Switch Schematic Diagram

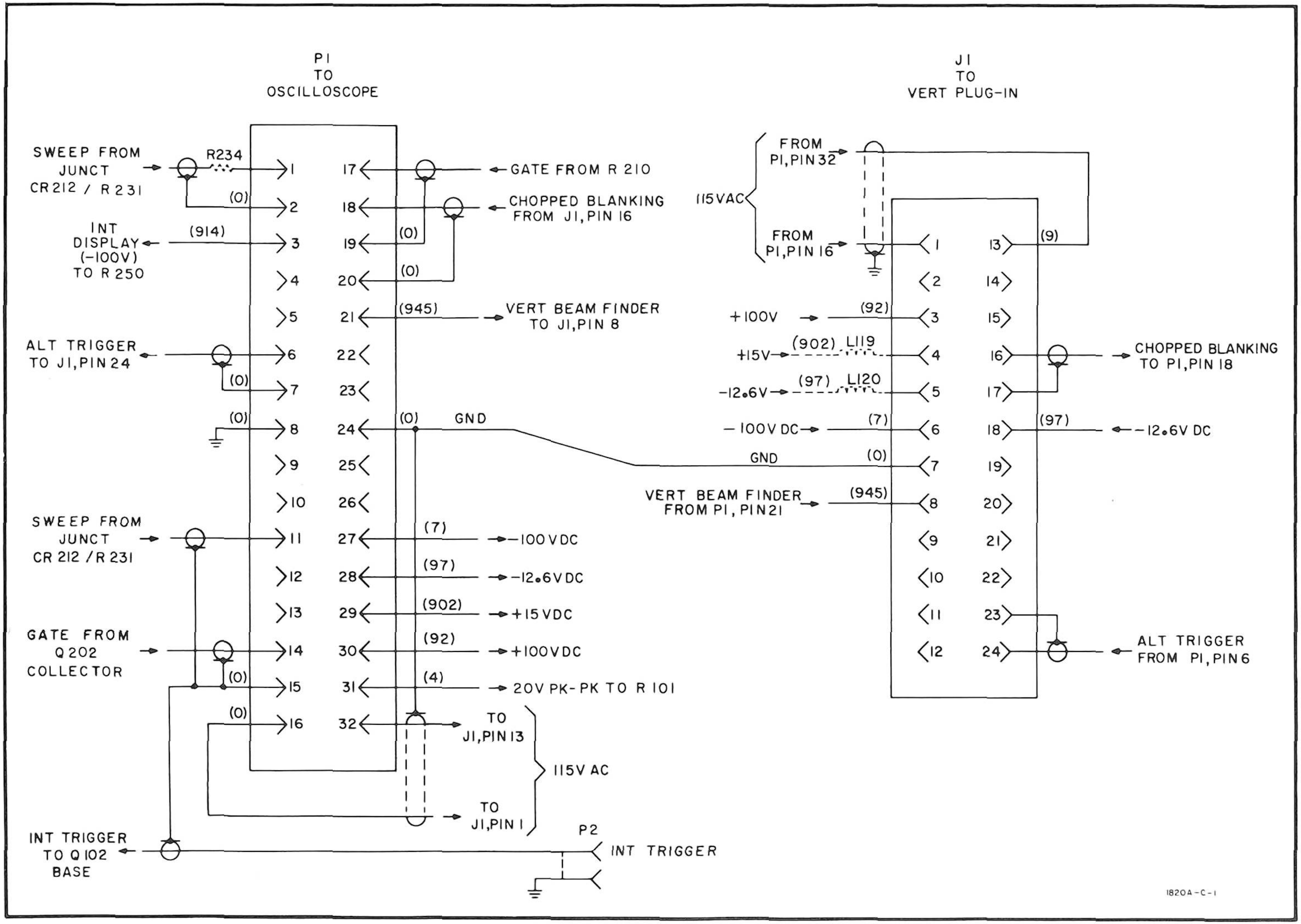


Figure 8-10. Plug Connections