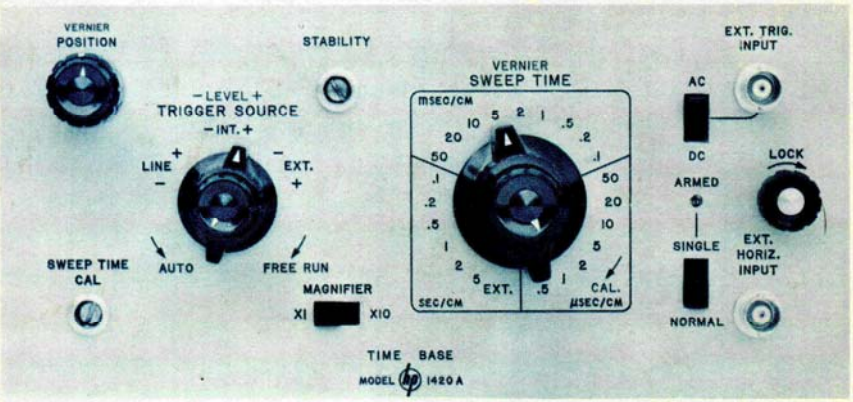
OPERATING AND SERVICE MANUAL

TIME BASE
1420A



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The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

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OPERATING AND SERVICE MANUAL

MODEL 1420A
TIME BASE

SERIALS PREFIXED: 801-

See Section I For Instruments
With Other Serial Prefixes

01653-5

PRINTED: APR 1968

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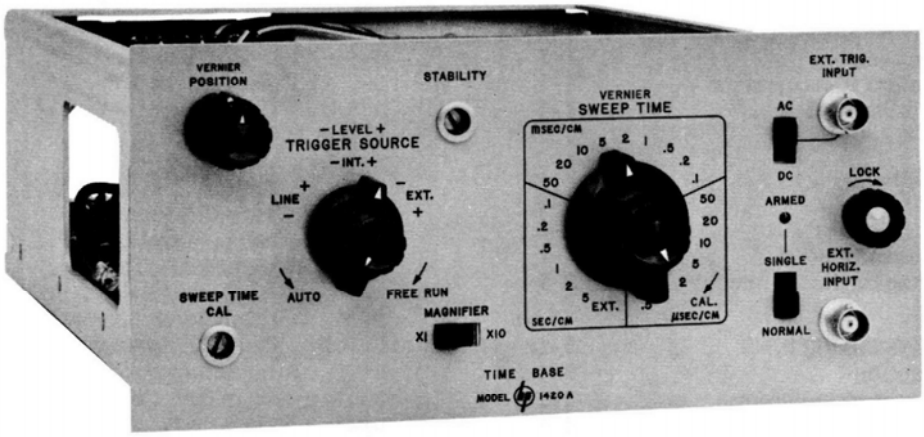


Figure 1-1. Model 1420A Time Base

Table 1-1. Specifications

Internal Sweep:
22 ranges, 0.5 μsec/cm to 5 sec/cm, accuracy within ±3%. Vernier provides continuous adjustment between ranges and extends slowest sweep to at least 12.5 sec/cm.

Magnification:
X10, accuracy ±5%. Expands fastest sweep to 50 nsec/cm.

Automatic Triggering:
Base line displayed in the absence of an input signal.

Internal: 40 cps to 500 kc, 0.5 cm vertical deflection required; also from line voltage.

External: 40 cps to 500 kc, 0.5 volts peak-to-peak required.

Trigger slope: Positive or negative slope of external trigger source signals or internal vertical deflection signals.

Amplitude Selectable Triggering:
Internal: 10 cps to 10 Mc; 0.5 cm vertical deflection required to 10 Mc.

External:
DC coupled: DC to 10 Mc; 0.5v peak-to-peak required to 10 Mc.

AC coupled: 10 cps to 10 Mc; 0.5v peak-to-peak required to 10 Mc. Input capacitor rating is 600 volts DC plus peak AC.

Trigger Point and Slope: Internally from any point of the vertical waveform presented on screen or continuously variable from +7 volts to -7 volts on external signal; positive or negative slope.

Single Sweep:
Front panel switch permits single sweep operation.

Horizontal Input:
Sensitivity: Approximately 50 mv/cm (MAGNIFIER X10) or 0.5 v/cm (MAGNIFIER X1). VERNIER provides continuous adjustment between ranges, and extends minimum sensitivity to less than 5 v/cm.

Bandwidth: Typically better than 1.5 Mc.

Input: DC couples with a positive signal moving the beam from left to right. Impedance is 1 megohm shunted by less than 50 pf.

Weight: Net, 5 lb (2, 3 kg); shipping, 7 lb (3, 2 kg).

Power: Supplied by oscilloscope

SECTION I
GENERAL INFORMATION

1-1. DESCRIPTION.

1-2. The hp Model 1420A Time Base is a horizontal plug-in unit for the Model 140-series oscilloscopes, and includes sweep, triggering, and horizontal amplifier functions.

a. Sweep. The Model 1420A provides the oscilloscope with 22 calibrated sweep speeds from 5 seconds/cm to 0.5 microseconds/cm. A sweep time vernier permits continuous adjustment between ranges, and extends the slowest sweep to at least 12.5 seconds/cm. A X10 sweep magnifier can be used with any position of the sweep time switch, and increases maximum sweep speed to 50 nanoseconds/cm. A single-sweep function is provided, with manual arming of the sweep required for each observation.

b. Triggering. A front panel control (LEVEL) provides a selection of triggering modes. In automatic triggering a base line is displayed whether or not a trigger signal is connected. Alternatively, the sweep may be set to start at any point on the waveform displayed on the CRT; or it may be set to free run. Triggering may be accomplished from an internal, external, or line signal.

c. Amplifier. The horizontal amplifier applies the sweep directly to the oscilloscope CRT deflection plates. Provision is also made for external horizontal input, with deflection sensitivity of about 0.5 volt/cm or, if the X10 magnifier is used, 0.05 volt/cm.

1-3. INSTRUMENT IDENTIFICATION.

1-4. Information in this manual applies directly to Model 1420A instruments with a serial prefix of 801-. The serial prefix is the first three digits (e. g. 000-00000) of the eight digit serial number used to identify each hp instrument. If the serial prefix is a lower number, Appendix I or a different manual will provide information. If the serial prefix is a higher number, a manual change sheet will provide the additional information. Corrections to this manual due to known errors in print are called Errata and will appear only on the change sheet, if any. For information regarding manual coverage on any hp instrument, contact the nearest Hewlett-Packard Sales/Service Office and specify the model and serial number.

1-5. SCOPE OF MANUAL.

1-6. This manual supplies operating and maintenance instructions for the hp Model 1420A Time Base. The information in this manual supplements the manuals for the hp Model 140-series oscilloscopes. If an amplifier or other plug-in unit is used in combination with the Model 1420A, refer also to the manual for that plug-in.

SECTION II
INSTALLATION

2-1. INSPECTION.

2-2. Upon receipt of the Model 1420A, check contents of the carton and inspect the instrument for any obvious damage received in shipment. If damage is evident, file a claim with the carrier (for instructions see Warranty at front of manual). Keep packing material until an operational check (Paragraph 2-5) has been completed.

2-3. PREPARATION FOR USE.

2-4. The Model 1420A is a time-base plug-in unit for the Model 140-series oscilloscopes, and is intended to be used in the upper (horizontal) compartment of the oscilloscope. To install the Model 1420A, slide the unit into place in the upper compartment, and tighten LOCK. All necessary power for the Model 1420A is supplied by the oscilloscope.

2-5. OPERATIONAL CHECK.

2-6. Paragraphs 5-3 to 5-16 give performance check procedures for verifying that operation is within listed specifications (Table 1-1). The performance check is recommended for inclusion in incoming quality-control inspection. As a method of checking basic operation, however, make the sweep time calibration adjustment (see Figure 3-6). If the time base can be calibrated it is unlikely that any electrical damage has occurred in shipment.

2-7. REPACKAGING FOR SHIPMENT.

2-8. If you find it necessary to repack the instrument, use the original shipping carton and packing material. If these have been discarded or are not re-usable, a new carton and packing materials can be obtained through your Hewlett-Packard Engineering Representative or from Customer Service; refer to Paragraph 6-4 for ordering information. General packing instructions follow:

a. Wrap in heavy paper or plastic.

b. Use ample packing material around all sides of the instrument. Protect the panel with cardboard strips.

c. Pack in heavy cardboard shipping carton, and seal with heavy tape.

d. Mark the carton, "FRAGILE-DELICATE INSTRUMENT".

e. Insure the shipment.

Table 3-1. Triggering Data

AUTOMATIC				AMPLITUDE-SELECTABLE			
	INT	EXT	LINE	INT	EXT		LINE
					DC	AC	
Frequency Range	40 CPS to 500 kc	40 CPS to 500 kc	Line Frequency	10 CPS to 10 Mc	DC to 10 Mc	10 CPS to 10 Mc	Line Frequency
Required Amplitude	> 0.5 cm Vertical Deflection	> 0.5 volt p-p	No Requirement	0.5 cm vertical deflection required.	0.5 v pk-pk required.		No Requirement
Trigger Point	Fixed	Fixed	Fixed	Selectable, any point on screen	Selectable, - 7 v to + 7 v on waveform		Selectable, any point on line waveform
				Not continuously variable for signals above 1 Mc			

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. The Model 1420A Time Base combines a calibrated sweep generator and horizontal amplifier in one plug-in unit. Also included are triggering, sweep-magnifier, and single-sweep function.

3-3. CONTROLS AND INDICATORS.

3-4. Figure 3-1 identifies the operating controls of the Model 1420A, and gives a short description of the function of each.

3-5. OPERATING PROCEDURES.

3-6. Figures 3-2 to 3-8 give step-by-step procedures for operating the Model 1420A. Additional information is given in Paragraphs 3-7 to 3-23.

3-7. SWEEP TIME CALIBRATION.

3-8. Because CRT deflection plate sensitivity will vary from one instrument to another, a front panel screwdriver adjustment (SWEEP TIME CAL) has been provided. Calibrate sweep according to the procedure of Figure 3-6 whenever the Model 1420A is transferred from one oscilloscope to another. The SWEEP TIME CAL control has no effect on amplifier gain when an external input is used.

3-9. TRIGGERING.

3-10. The internal sweep of the Model 1420A may be triggered by any one of three sources selected with the TRIGGER SOURCE switch: the signal applied to the vertical plug-in (INT), a signal applied to EXT TRIG INPUT on the Model 1420A panel (EXT), or the line waveform (LINE). With all three sources, TRIGGER SOURCE also determines whether triggering occurs on the positive-going or negative-going slope of the trigger signal (e.g., +INT or -INT). The LEVEL control, used in conjunction with TRIGGER SOURCE, provides: 1) automatic triggering (AUTO), where a base line is displayed until a trigger signal takes over to automatically synchronize the sweep; 2) amplitude-selectable triggering, where the LEVEL control is used to select the point on the trigger-signal waveform at which the sweep is triggered; and 3) a free-running sweep (FREE RUN), where the sweep operates continuously without synchronization. Operating information for both TRIGGER SOURCE and LEVEL controls is given in Paragraphs 3-11 to 3-19.

Note

At certain discrete frequencies, when using AUTO triggering, double triggering (two traces) may occur. This is a normal occurrence and can be eliminated by removing the LEVEL control from AUTO position and adjusting it for proper triggering.

3-11. TRIGGER SOURCE.

3-12. INTERNAL. For internal triggering, the trigger-signal source is the vertical signal derived internally from the vertical plug-in. No external connection to the Model 1420A is needed. The required signal amplitude for triggering is a vertical deflection of at least 0.5 cm on the CRT screen. With TRIGGER SOURCE set to +INT, the sweep begins on a positive-going portion of the displayed waveform. The actual sweep-starting point on this positive-going slope may be selected by use of the LEVEL control (see Paragraph 3-18), or, if AUTO triggering is selected, is at a fixed point on the slope.

3-13. EXTERNAL. To synchronize the sweep with an external signal, connect the signal to EXT TRIG INPUT, and set TRIGGER SOURCE to +EXT (to trigger the sweep on the positive-going slope of the waveform) or to -EXT (to trigger the sweep on the negative-going slope of the waveform). Set the AC/DC coupling switch to AC to block large DC voltage components, or to DC for triggering on signals below 10 CPS. Required trigger-signal amplitude is at least 0.5 v p-p. As with internal triggering, either automatic or amplitude-selectable triggering may be used (see Paragraph 3-15).

3-14. LINE. To synchronize the sweep with the line frequency, set TRIGGER SOURCE to +LINE (to trigger on the positive-going slope of the line waveform) or to -LINE (to trigger on the negative-going slope). There is no minimum-amplitude requirement, and no external connections are necessary. Both automatic and amplitude-selectable triggering are available with the LEVEL control.

3-15. LEVEL.

3-16. The LEVEL control provides automatic, amplitude-selectable, and free run modes of sweep operation. For most purposes automatic triggering (LEVEL at AUTO) is the most convenient; however, this triggering mode is not available over as wide a frequency range as amplitude-selectable triggering (LEVEL control rotated to some mid-range position). Frequency limits for both types of triggering are listed in Table 3-1. Paragraphs 3-17 to 3-19 discuss further operating considerations.

3-17. AUTO. Automatic triggering is set up by turning LEVEL to the extreme counterclockwise (AUTO) position. In this position, with no input trigger signal, a base line sweep is displayed on the CRT screen which is triggered by an internal generator operating at a frequency of about 40 CPS. When an internal or external trigger signal of proper amplitude and frequency (between approximately 40 CPS and 500 kc) is applied, the sweep automatically synchronizes with this signal. Triggering of the sweep takes place at a fixed point on the waveform, on either the positive-going or negative-going slope as determined by the setting of the TRIGGER SOURCE switch (see Paragraph 3-11).

3-18. AMPLITUDE-SELECTABLE. Rotation of the LEVEL control permits the trigger point to be set to any point on the waveform presented on screen when

internal triggering is used, or from -7 volts to +7 volts on external trigger signals. Clockwise rotation of LEVEL moves the triggering point to a more positive portion of the waveform. The slope on which triggering occurs depends on whether TRIGGER SOURCE is set to a positive or negative position.

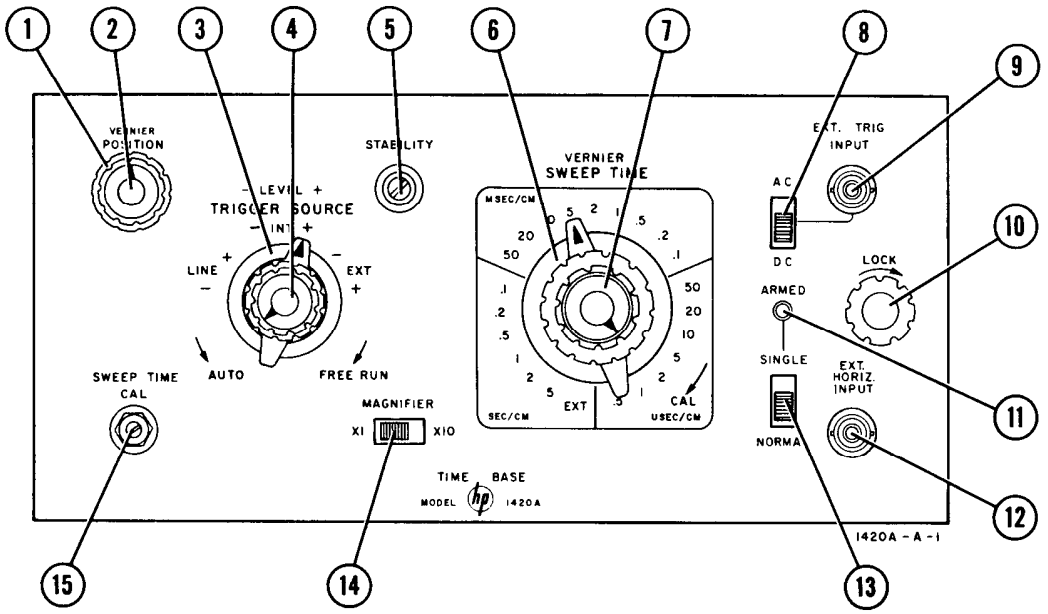
3-19. FREE RUN. Set LEVEL fully clockwise when it is desired to free-run the sweep. Sweep repetition rate increases with faster sweep speeds (unlike AUTO operation), thus giving a bright base line at the fastest sweep speeds.

3-20. SWEEP MAGNIFICATION.

3-21. The MAGNIFIER (X10) expands the sweep, effectively increasing sweep speed by a factor of ten. Any part of the sweep can be positioned on screen by the POSITION controls; use POSITION VERNIER for fine positioning. Divide SWEEP TIME by ten when MAGNIFIER is used. When the X10 MAGNIFIER is used with exteranl horizontal input, sensitivity of the horizontal amplifier is increased from about 0.5 volt/cm to about 0.05 volt/cm.

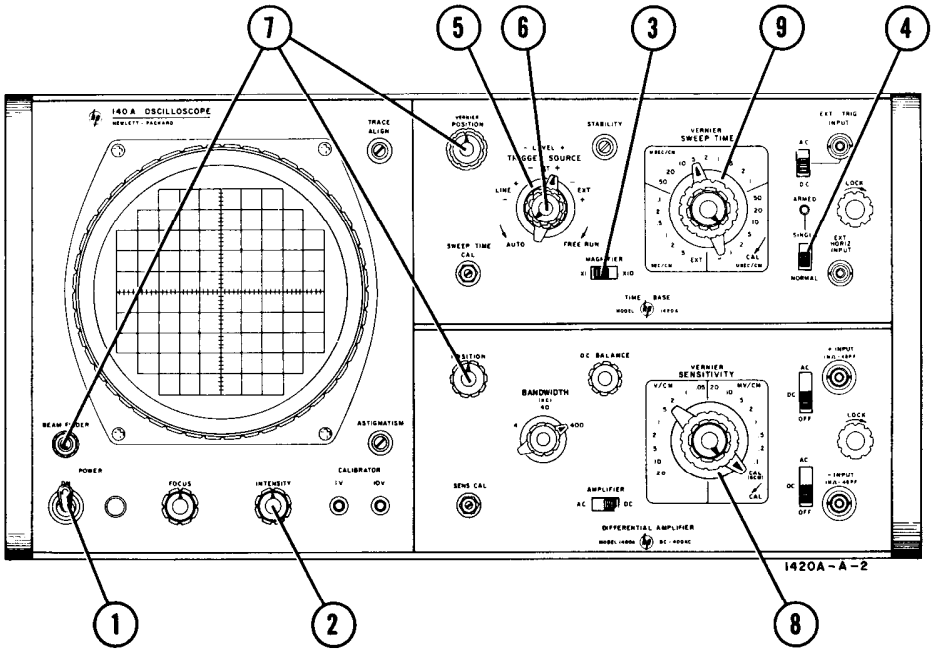
3-22. BEAM FINDER.

3-23. To locate a trace that is deflected off-screen, depress the BEAM FINDER switch on the front panel of the oscilloscope to bring the trace on screen. If the trace is seen to be off to the left or right, use the POSITION control on the Model 1420A to center; if the trace is vertically displaced, use the POSITION control on the vertical plug-in unit (lower plug-in) to center. If, after pressing the BEAM FINDER switch, no trace appears, it may be that intensity is set too low or that the NORMAL/SINGLE switch is not in the NORMAL position.



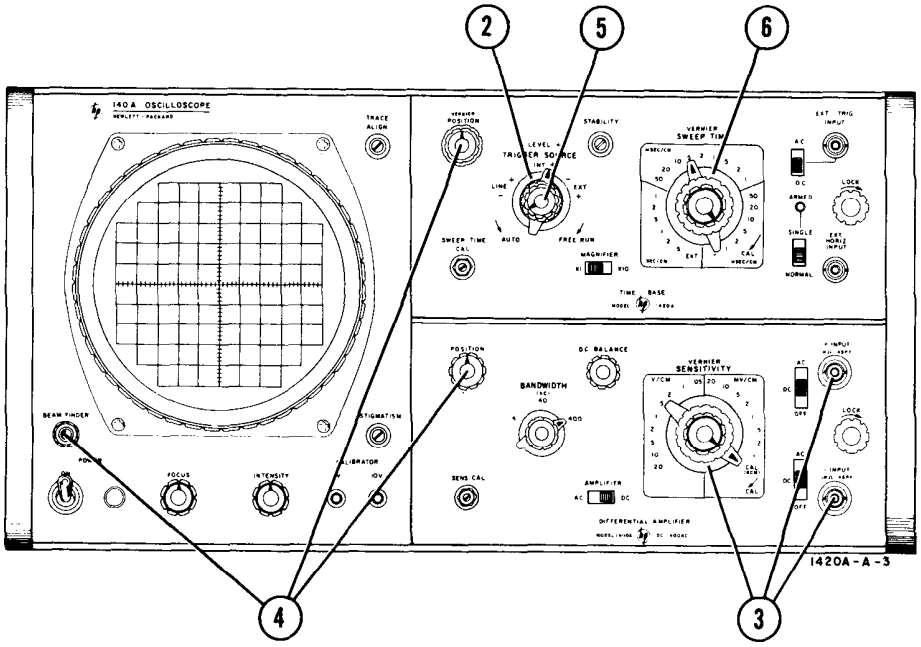
1. Positions display horizontally on CRT.
2. Provides fine position control.
3. Selects source (external, internal, or line) for triggering; also determines whether triggering occurs on negative-going or positive-going slope of triggering waveform.
4. Determines level on waveform at which triggering occurs. Switch positions at extreme ends provide automatic triggering or free-running sweep.
5. Varies triggering and sensitivity; free running sweep at clockwise end of control. Primarily for optimizing high-frequency triggering.
6. Selects sweep speed for time base.
7. Provides continuous adjustment between calibrated steps of SWEEP TIME switch.
8. Selects AC-coupling or DC-coupling when using external trigger signals.
9. Connection for external trigger.
10. Locks plug-in unit in place.
11. Indicates (when on) that sweep is armed and may be triggered.
12. Connection for external horizontal input.
13. Selects normal sweep or single sweep function.
14. Expands trace when set to X10.
15. Adjusts gain of horizontal amplifier for calibrating sweep time.

Figure 3-1. Operating Controls



1. Turn instrument on.
2. Turn INTENSITY to a normal setting, about midrange.
3. Set MAGNIFIER to X1.
4. Set NORMAL/SINGLE switch to NORMAL.
5. Set TRIGGER SOURCE to +INT (or -INT).
6. Set LEVEL fully counterclockwise to AUTO.
7. Center trace on screen, using BEAM FINDER if necessary.
8. Adjust vertical plug-in as desired (refer to specific instrument manual).
9. Set SWEEP TIME to display desired number of cylces on CRT screen.

Figure 3-2. Initial Setup, Automatic Triggering



1. Follow steps 1 to 4 of Figure 3-2.

2. Set TRIGGER SOURCE to desired slope, +INT or -INT. Or, if desired, use -LINE or +LINE to synchronize with line frequency.

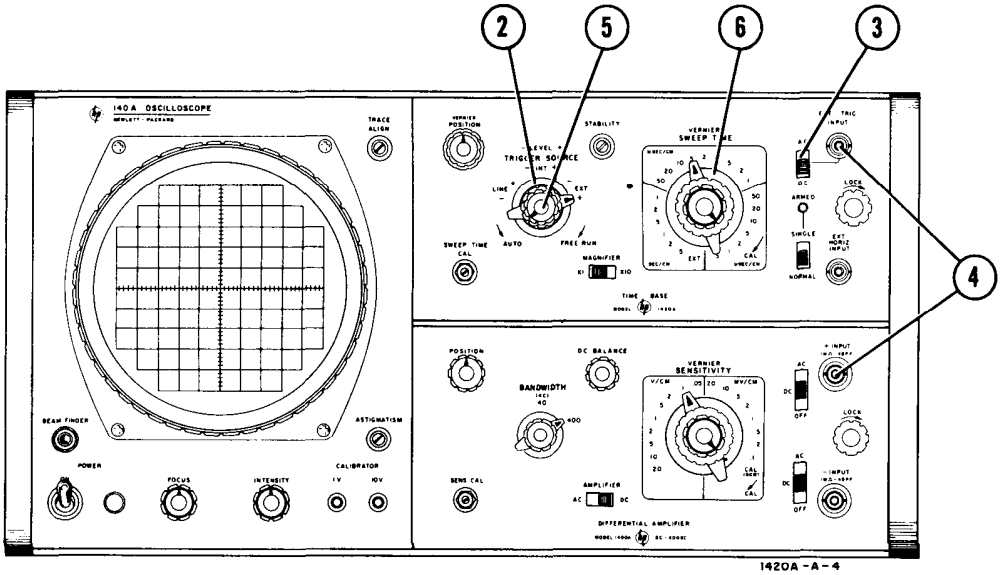
3. Apply vertical signal (use of CAL signal is illustrated), and adjust SENSITIVITY to appropriate setting.

4. Center trace, using BEAM FINDER if necessary.

5. From a counterclockwise position, rotate LEVEL until triggering occurs at the desired level on the waveform.

6. Set SWEEP TIME to display the desired number of cycles on the CRT.

Figure 3-3. Triggering Internally



1. Follow steps 1 to 4 of Figure 3-2.

2. Set TRIGGER SOURCE to desired trigger slope, +EXT or -EXT.

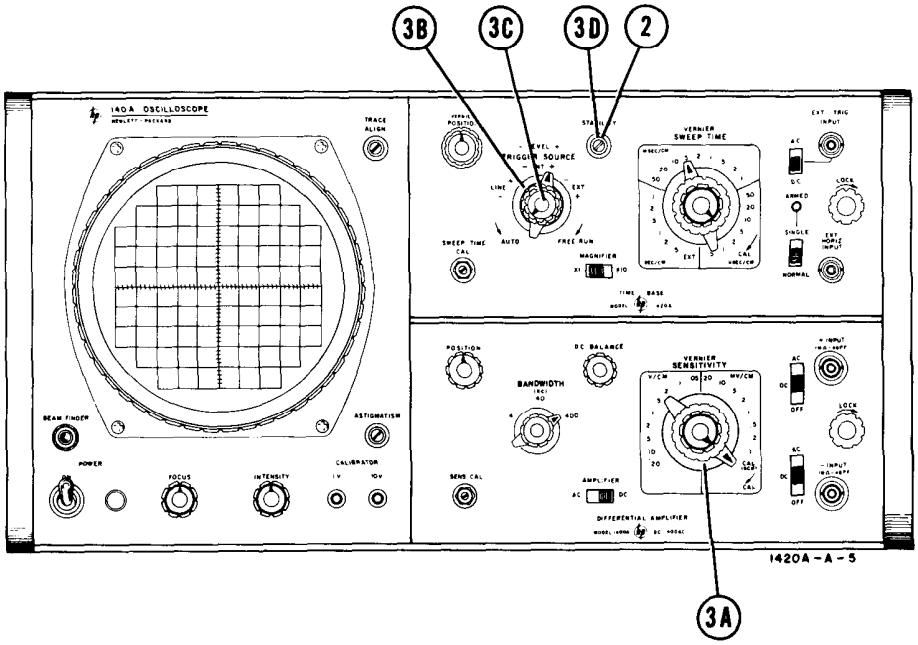
3. Set AC/DC switch as required by the signal used.

4. Apply a vertical signal to the vertical plug-in, and a triggering signal of the same or a related frequency to EXT. TRIG. INPUT.

5. From a counterclockwise position, rotate LEVEL until triggering occurs at the desired level on the waveform.

6. Set SWEEP to display the desired number of cycles on the CRT.

Figure 3-4. Triggering Externally



1. Follow the procedures of Figure 3-3 or Figure 3-4 for internal or external triggering.

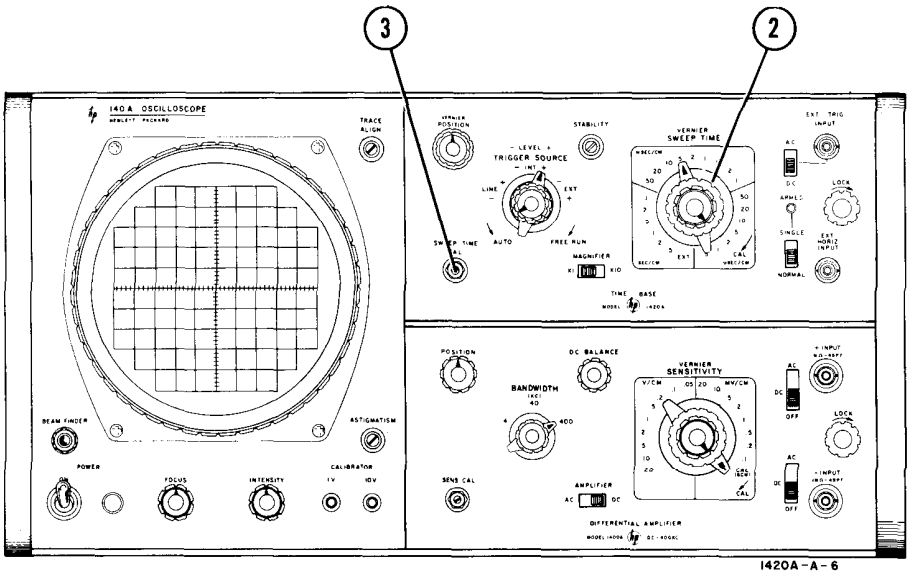
2. If triggering is insufficiently stable, rotate STABILITY slightly clockwise (increasing triggering sensitivity) until triggering is stable. Readjust LEVEL as necessary.

3. To return STABILITY to original setting:
   a. Set SENSITIVITY of vertical plug-in to CAL.
   b. Set TRIGGER SOURCE to +INT.
   c. Set LEVEL to AUTO.
   d. Turn STABILITY counterclockwise until sweep stops, then slowly clockwise until sweep starts again and is stable. Leave at this setting.

Note

For a more exact setting of STABILITY see Paragraph 5-24 in the maintenance section of this manual.

Figure 3-5. High-Frequency Triggering



1. Follow procedure in Figure 3-3 to obtain a display of CAL signal.

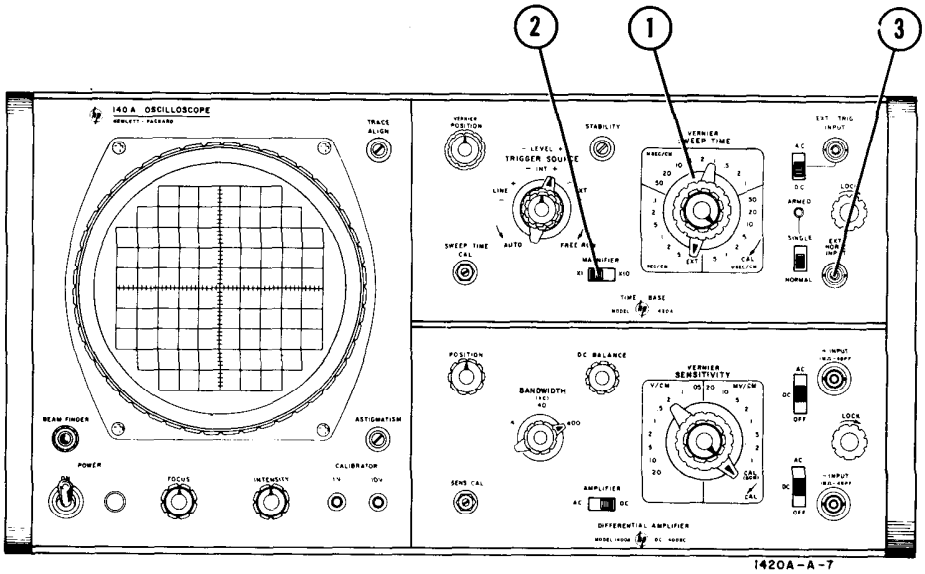
2. a. If line frequency is 60 cps, set SWEEP TIME to 5 MSEC/CM.

   b. If line frequency is 50 cps, set SWEEP TIME to 2 MSEC/CM.

3. a. If line frequency is 60 cps, adjust SWEEP TIME CAL for exactly 3.0 cycles in 10 cm.

   b. If line frequency is 50 CPS, set SWEEP TIME CAL for exactly 1.0 cycle in 10 cm.

Figure 3-6. Sweep Time Calibration

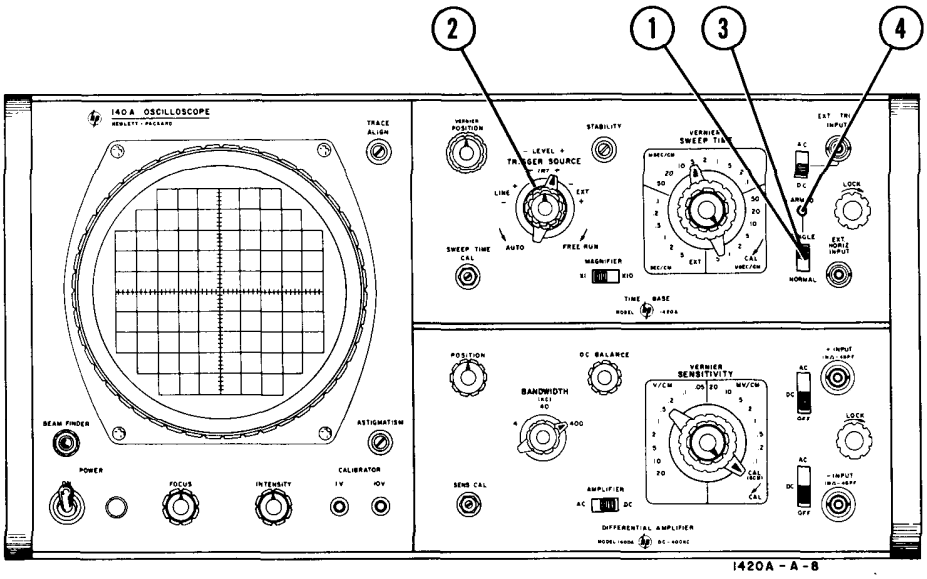


1. Set SWEEP TIME to EXT.

2. Set MAGNIFIER to X1 (approximately 0.5 volt/cm) or X10 (approximately 0.05 volt/cm). Use VERNIER for continuous sensitivity adjustment, if desired.

3. Connect external signal to EXT HORIZ INPUT.

Figure 3-7. Operation for External Horizontal Input



1. Set NORMAL/SINGLE switch to SINGLE.

2. Set TRIGGER SOURCE to type of signal used.

3. Arm sweep by switching to NORMAL and back to SINGLE.

4. ARMED indicator will light, indicating that the sweep is armed and can be triggered. A triggering signal applied to the Model 1420A produces a single sweep. At the end of the sweep, ARMED indicator goes off.

5. Repeat step 3 to rearm sweep.

Figure 3-8. Single Sweep Operation

SECTION IV
PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. Three complete functional circuits comprise the Model 1420A Time Base unit: a trigger generator, a sweep generator, and a horizontal amplifier. The relationship of these circuits is shown in Figure 4-1. The horizontal amplifier is used to amplify the sweep signal, or can accept an external signal for horizontal display on the CRT of the oscilloscope. Trigger signals can be applied externally, or can be accepted internally either from the vertical plug-in used with the oscilloscope or from the line voltage.

4-3. BASIC OPERATION.

4-4. Figure 4-2 is a functional block diagram illustrating basic operation of both the trigger generator and the sweep generator. The trigger generator includes all functions to the left of T101, and the sweep generator includes all those to the right of T101.

4-5. TRIGGER GENERATOR.

4-6. TRIGGER SOURCE. The trigger generator accepts a synchronizing signal from any one of three sources, and converts this signal to a negative-going fast-rise pulse which is required to operate the gate generator in the sweep circuit. The input signal, which can be the line waveform (derived internally), an externally applied input, or an internal vertical signal (derived from the vertical plug-in), can be of any wave shape. Selection of input is made by the TRIGGER SOURCE switch.

4-7. AMPLIFIER AND TUNNEL DIODE. Differential amplifier V101 is used differentially with internal triggering (only one half is used for external or line). This amplifier drives tunnel diode trigger generator CR101, which switches state whenever the current supplied by V101 crosses the diode hysteresis limits. The output from the tunnel diode is a square wave of the same frequency as the input to the amplifier (up to approximately 1 Mc, where count-down occurs).

4-8. AUTOMATIC TRIGGER. When automatic triggering is used, auto trigger amplifier Q101 applies the output of the tunnel diode through a frequency-determining RC network (see Paragraph 4-21) back to the differential amplifier. With the fed-back signal on the V101B grid, tunnel diode CR101 is caused to switch continuously without an input signal, at a repetition rate of about 40 CPS. Thus triggers are generated and a base line is displayed on the CRT until an input synchronizing signal of appropriate amplitude and frequency takes over to operate the trigger generator. In the AUTO triggering mode the variable LEVEL control is not used.

4-9. The square-wave output from the tunnel diode is differentiated into positive-going and negative-going pulses at the input to trigger amplifier Q102. Both pulses are amplified by Q102, and applied to the gate generator through transformer T101; however, only the negative-going pulses are used (see Paragraph 4-11).

4-10. SWEEP GENERATOR.

4-11. The negative-going pulses coupled through T101 are used to operate the gate generator, and positive-going pulses are clipped by CR102. The gate generator has two outputs: one to unblank the CRT at the start of the trace (see Paragraph 4-38), the other to open sweep disconnect diode CR105. When this diode switch is opened, the grid of integrator V105A is freed to go negative; however, the positive-going output of the integrator is fed back through sweep output cathode follower V105B and the sweep timing capacitor to the grid of V105A. As a result, the voltage at the grid of the integrator remains almost constant. This action results in linear charging of the sweep timing capacitor, and thus a linear sweep output voltage. The slope of the waveform, or speed of the trace, is determined by the time constant of the sweep timing resistor and capacitor switched into the circuit by the SWEEP TIME switch.

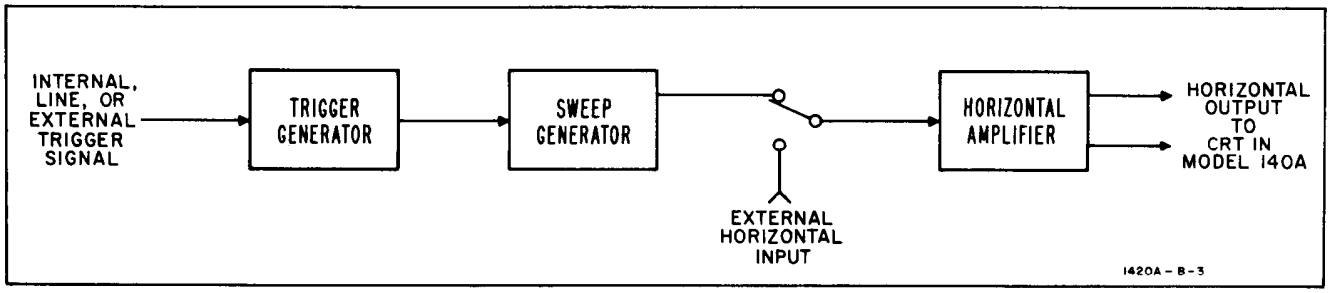


Figure 4-1. Model 1420A Block Diagram

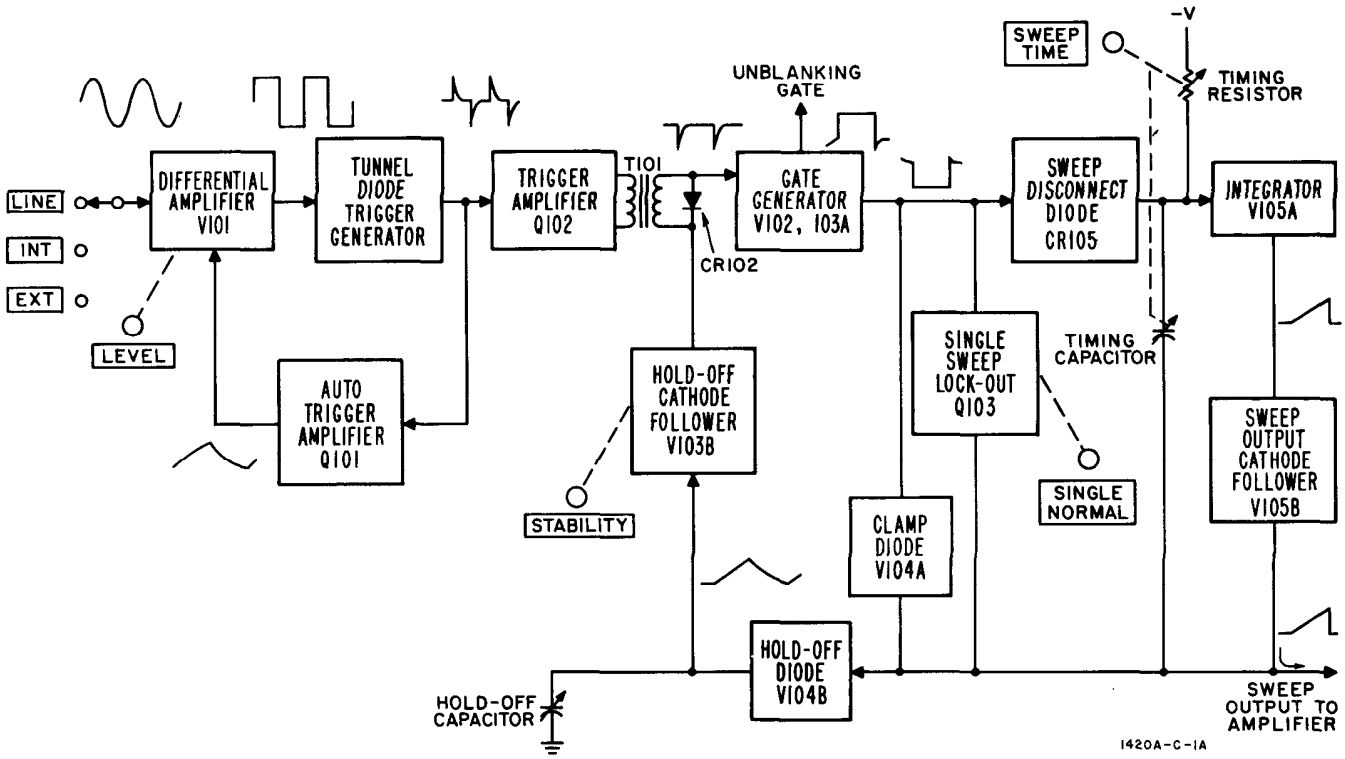


Figure 4-2. Trigger and Sweep Generator Block Diagram

4-12. The sweep is terminated by feeding the sweep voltage back through hold-off cathode follower V103B to the gate generator, which switches back to its original state at a predetermined level of the sweep. Timing components in the hold-off circuit prevent the gate from being operated again until all parts of the sweep circuit have had a chance to recover from the previous sweep. The appropriate hold-off timing capacitor is selected by the SWEEP TIME switch. (See Paragraph 4-38.)

4-13. The operation for single sweep is similar, except that single-sweep lock-out Q103 keeps diode switches V104A and CR105 biased off after the sweep has started, and prevents the gate generator from turning them on at the end of the gate period. Integrator V105A thus continues integrating to saturation, and is restored to the armed condition only when the NORMAL/SINGLE switch is set to NORMAL. Returning this switch to SINGLE prepares the circuit for another single sweep.

4-14. CIRCUIT DETAILS.

4-15. The schematic diagrams for the trigger generator and sweep generator are given in Figures 5-4 and 5-6. Figure 5-11 is the schematic diagram for the horizontal amplifier. The following discussions will refer to these three figures.

4-16. TRIGGER GENERATOR.

4-17. The desired triggering signal is selected by TRIGGER SOURCE switch S101 and applied to differential amplifier V101. If LINE or EXTernal triggering is used, the signal is applied only to one grid of V101. Differential triggering signals are used with INTernal triggering and are applied differentially to V101. Differential action prevents noise and hum from causing erratic triggering thus is of particular value when very sensitive vertical plug-ins are used with the Model 140-series oscilloscope, or when triggering at high frequencies. Capacitor C105 equalizes capacitive loading on the output stage of the vertical plug-in when the internal triggering is not used. AC coupling only is used with internal triggering (C101 and C103). With external triggering either DC or AC coupling (C102) can be selected by a front panel switch, S102. TRIGGER SOURCE switch S101 selects the section of the differential amplifier to which the trigger signal is applied, thereby determining on which slope of the input waveform triggering will occur; switching the input trigger from V101A grid to V101B grid inverts the signal applied to tunnel diode CR101.

4-18. TUNNEL DIODE. Tunnel diode CR101 is used to generate the fast rise triggers required by the sweep generator for stable synchronization. Figure 4-3 shows a simplified circuit diagram of the tunnel diode triggering circuit used in the Model 1420A. Also shown is an operational composite characteristic curve for the circuit, which includes the effects of the tunnel diode V-I curve and the shunt circuit. The negative resistance region between points D and E on the curve is a characteristic of the tunnel diode. The Trigger Sensitivity adjustment controls the shunt

current around the diode, and therefore affects the shape of the composite curve. If, for example Trigger Sensitivity were almost shorted, the curve would be very nearly a vertical line, and there would be no negative resistance region; if open, there would be a greater vertical separation point D and E than there is with the shunt circuit. The Trigger Sensitivity adjustment therefore determines the current hysteresis limits or current switching limits at D and E. The current flowing through the tunnel diode is determined partly by V101 and partly by the setting of Trigger Symmetry. The Trigger Symmetry adjustment is set so that, with LEVEL control at zero, the current required to switch the diode on (C-D) is the same as that required to switch it off (F-E). The actual position of bias line C-F depends on the setting of LEVEL control R101. Thus the effect of the LEVEL control is to determine how high the input waveform must rise before triggering occurs. For the description of operation in Paragraph 4-19 and for the bias line shown in Figure 4-3, LEVEL is assumed to be zero volts (midrange), where the circuit is most sensitive. The inductance in the diode shunt circuit increases switching speed and determines the maximum triggering rate.

4-19. In typical operation the diode circuit is biased at point C with no signal. Assume a 400-cycle sine wave is the input triggering signal. The positive-going portion of the signal applied to the grid increases current from point C to point D, where the diode enters its negative resistance region. Diode current attempts to decrease, but the current supplied by the tube continues to increase, forcing the diode to switch rapidly to a higher voltage at point G. Actual rise time of this voltage depends on diode characteristics and circuit time constants. Current now continues to increase to a point H, which is dependent on the amplitude of the input signal. When the input signal decreases from its positive peak to zero, current decreases from point H to point F, where it would again be stable; the negative backswing of the input signal, however, carries the current to point E, where the diode is forced to switch to a lower voltage at point B. The current now continues to decrease to point A, which is dependent on the negative peak amplitude of the input signal. When the negative swing decreases to zero, current returns to the original bias point at point C. The result of these operations is thus a switching action between two voltage states, and the output of the circuit is a square wave of approximately 350 millivolts amplitude, peak-to-peak. The square-wave frequency is the same as that of the input, except at high frequencies, when the L/R time constant of the shunt circuit provides a countdown operation which limits the maximum triggering rate to about 1 megacycle. For trigger signals above 1 megacycle, it is necessary to vary the LEVEL control as frequency or amplitude is changed. This is because of changes in the countdown rate and ambiguity between triggers at the gate generator input. The LEVEL control varies the countdown rate for triggering signals above 1 Mc. Thus LEVEL cannot be varied continuously when using high-frequency signals. Because of the countdown operation, the external trigger signal should not exceed 5 volts p-p for frequencies above 10 Mc.

4-20. AUTOMATIC TRIGGERING. In the automatic triggering mode, the tunnel diode is caused to generate triggers in the absence of an input signal at a rate of above 40 CPS. When an input signal is received, the trigger circuit must synchronize with this signal. When LEVEL is set to AUTO, switch S103 connects the output of Q101 to the input of V101B. This completes a feedback circuit involving V101, CR101, and Q101. Circuit action is described in Paragraphs 4-21 and 4-22.

4-21. Starting first with automatic operation with no input, assume tunnel diode CR101 has just switched to its lower voltage state (point A in Figure 4-3) giving a positive step at tunnel diode output. This produces a negative-going change in voltage at the collector of Q101 of about 10 volts, which is divided to about 5 volts at the junction of R132/R133. However, an RC time constant, primarily determined by R131 and C115, causes the voltage to decay slowly at this junction converting the square-wave output of the tunnel diode to a triangular waveform. The negative-going slope at the

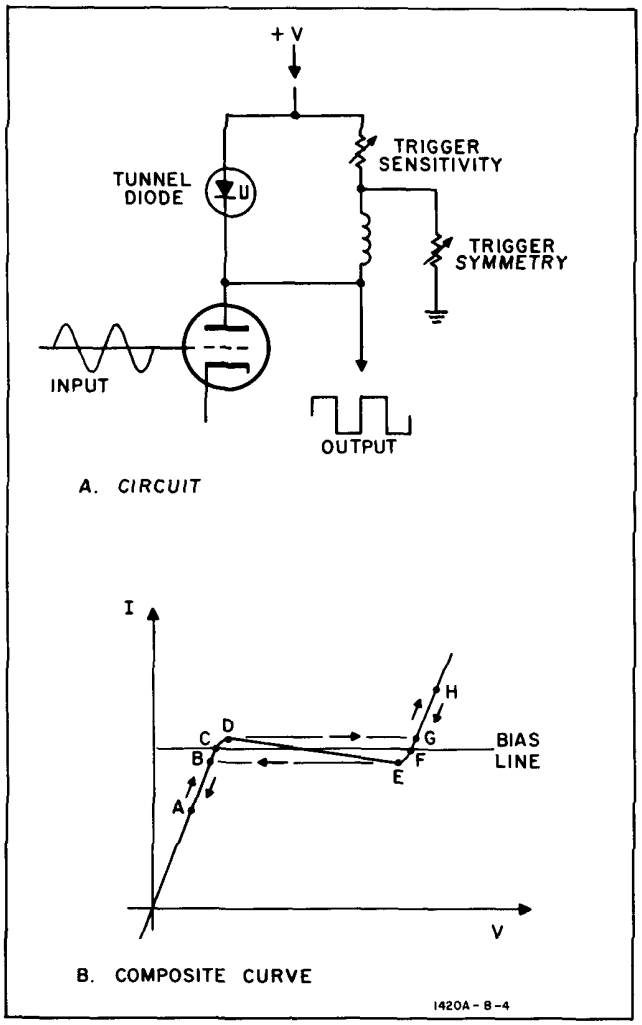


Figure 4-3. Tunnel Diode Operation

grid of V101B causes the cathodes of V101 to go more negative, increasing the current through V101A. When the increasing current crosses the tunnel diode switching point (point D in Figure 4-3), the diode switches to its higher voltage state (point G), producing a negative-going step at the base of Q101. The process is now repeated, with opposite polarities as before, and when CR101 returns to its low-voltage state a new cycle of operation begins. Resistor R113 is returned to -100 volts to center the triangular waveform at the grid of V101B around the 0-volt DC level, where the trigger circuit is most sensitive. All trigger signals are AC-coupled into V101, blocking any DC component, to assure that the signal will pass through zero. The variable LEVEL control (R101) is disconnected when in AUTO.

4-22. When an input triggering signal is received, the tunnel diode will be triggered by this signal, since the feedback voltage does not have time to reach the level required to switch the tunnel diode. The automatic mode is best used for frequencies above 40 CPS, but triggering can take place with lower-frequency signals if their amplitude is greater than 0.5 volt peak-to-peak.

4-23. The square wave output of the tunnel diode is differentiated by C122 and the input resistance of Q102 into sharp positive and negative pulses. These are amplified by Q102 and passed through transformer T101, which further shapes the pulses.

4-24. SWEEP GENERATOR.

4-25. GATE GENERATOR. Gate generator V102/V103A is a Schmitt circuit with wide hysteresis limits. Between sweeps V102A is conducting, V103A is off, and hold-off cathode follower V103B holds the bias at the input of the gate generator just above the lower hysteresis limit. Positive trigger pulses applied by Q102 to transformer T101 are clipped by CR102, and have no effect. But a negative pulse drives the grid of V102A below the lower hysteresis limit and causes the gate generator to change state. The plate of V102A rises rapidly toward +250 volts but is clamped at +100 volts by diode CR103. As a result a fast-rising voltage step is provided. The positive output through cathode follower V111A is applied to the grid circuit of the CRT in the oscilloscope to unblank the trace. An attenuated gate waveform is used as a synchronizing signal in dual-trace plug-ins. The output at the plate of V103A goes negative from ground to -6.8 volts, being clamped at this value by breakdown diode CR104. This action turns off diode switches V104A and CR105, permitting integrator V105A to begin generation of the sweep.

4-26. INTEGRATOR. Once diodes V104A and CR105 are turned off, the grid of integrator V105A is freed to go negative. However, the positive-going signal at the plate of V105A is fed back through V105B and the sweep timing capacitor to the grid of integrator V105A, causing the voltage there to be almost constant. Thus the voltage across the sweep timing resistors will also remain constant, and the constant current through this resistance charges the sweep capacitor at a linear rate. As this capacitor charges, the voltage across it increases linearly with time, and this voltage is the sweep output. The slope of the waveform is determined by the value of resistors (R301 to R309) and capacitor (C301 to C307) used on a given SWEEP TIME range. VERNIER control R130 provides a fine adjustment of sweep time by altering the DC voltage to which the timing resistor is returned. Neon lamp V106 is used to reduce the center level of sawtooth swing to a less positive value, so that the lower end of the sweep may be clamped to zero volts.

4-27. HOLD-OFF CIRCUIT. Termination of the sweep is accomplished by feeding back the positive-going sweep voltage through hold-off diode V104B (which is conducting during the sweep) and hold-off cathode follower V103B to the input of the gate generator. When the feedback voltage crosses the upper hysteresis limit of the gate generator, the generator changes state, and the positive voltage step at the plate of V103A causes diodes V104A and CR105 to conduct. The sweep timing capacitor discharges quickly through clamp diode V104A, producing the retrace portion of the sweep waveform. The clamp diode returns the sweep output to the same reference level as the grid of integrator V105A. Hold-off diode V104B is cut off by the fast negative drop of the retrace, and instead of a rapid decrease in voltage at the grid of hold-off cathode follower V103B, the voltage here decays at a rate determined by the value of hold-off capacitor used on a given sweep-time range of R160. Thus a high positive bias is maintained on the input grid (V102A) of the gate generator, which prevents the incoming negative triggers from changing the state of the generator until the hold-off bias drops to a low enough value. The hold-off time allows all parts of the sweep circuit to recover from the previous sweep before another is started. On the four fastest sweep ranges, stray circuit capacitance is used as the hold-off capacitor, and R316 is switched in parallel with R160 to give the sweep a faster repetition rate.

4-28. STABILITY CONTROL. R158 is a front panel screwdriver adjustment. Variation of this control changes the hold-off bias, and thus determines which trigger in a series will be effective in switching the gate. When a high-frequency synchronizing signal is used, the triggers at the input grid of the gate generator are very closely spaced. In such a case, the use of this control can be helpful in eliminating triggering ambiguity.

4-29. FREE RUN OPERATION. When LEVEL control R101 is in the fully clockwise position, switch S103 applies a negative bias to the input grid of the gate generator, which sets the resting bias below the lower hysteresis limit. This holds V102A cut off after the sweep retrace, and a sweep starts without any trigger being received.

4-30. SINGLE SWEEP. In single sweep operation, it is desired that the sweep be triggered on the first trigger received after manual arming, and that further triggers be ineffective until the circuit is manually rearmed. This is done in the Model 1420A by preventing retrace from occurring. In NORMAL operation, SINGLE/NORMAL switch S104 returns the base of Q103 through R166 to -100 volts, making the transistor inoperative. In SINGLE operation, however, S104 switches R167 to the sweep output. At the same time, neon indicator V108 is connected to the R189/R192 divider from the +250 volt supply. Because the sweep level is at zero volts before the sweep begins, there is sufficient voltage across the indicator to cause it to light (ARMED). Assuming that S104 has just been switched into the SINGLE position, the first trigger to arrive at the gate generator starts a sweep in the normal manner. As the sweep voltage rises, the voltage across ARMED indicator V108 decreases until the light goes out. The positive-going sweep voltage is applied through R167 to the base of single-sweep lock-out transistor Q103, bringing this transistor into conduction and eventually driving it to saturation. Both V103A and Q103 conduct through CR104, which holds the anodes of V104A and CR105 at -6.8 volts. The sweep voltage is fed back through the hold-off circuit to the gate generator, which switches back to the pre-sweep condition. The plate of V103A tries to rise in a positive direction, but the saturation current of Q103 flowing through CR104 holds the voltage here at -6.8 volts. Integrator V105A therefore continues integrating until it reaches saturation. The sweep waveform rounds and levels off, remaining at this high positive value until manually re-armed. Since this positive voltage is fed back through the hold-off circuit to the input grid of the gate generator, further incoming triggers are unable to overcome this bias, and therefore cannot operate the gate. To re-arm the circuit, S104 is switched back to NORMAL. This cuts off Q103, and because V103A is also not conducting, the voltage at the anodes of V104A and CR105 rises immediately to about zero volts. V104A and CR105 conduct, and return the integrator to its pre-sweep condition. Switch S104 is set back to SINGLE if it is desired to repeat the single sweep.

4-31. HORIZONTAL AMPLIFIER.

4-32. Figure 5-11 is the schematic of the horizontal amplifier. The circuit uses four stages in amplifying the sweep, and adds a fifth stage for amplification of an external horizontal input.

4-33. The sweep voltage, rising from zero to +100 volts at the cathode of V105B, is applied to resistive divider R188, R195, R204, and then to R194 and R214 which act as a current source to drive the emitter of Q201. Resistor R204 is the front-panel SWEEP TIME CAL control, and is adjusted for the correct amount of signal current to provide calibration of sweep time. POSITION (R218A) and VERNIER (R218B) adjust DC current through the emitter of Q201, and thus affect the DC level of the output. Input amplifier Q201, a grounded base circuit, drives the differential cascode amplifier through emitter follower Q202.

4-34. When external horizontal input is used, V111B, a cathode follower, applies the signal through R207 and the SWEEP TIME switch (EXT position) to input amplifier Q201. The value of R207 is chosen to provide the specified sensitivity. The VERNIER control, R310B, provides continuous gain adjustment.

4-35. The output differential cascode amplifier (V202, Q204, Q205) provides the high gain and low compression characteristic of this type of amplifier. Emitter follower Q203 is used to make the base circuit impedance of Q205 the same as that of Q204. The positive-going sweep is amplified and inverted by Q204, and further amplified (without inversion) by V202A, the grounded-grid part of the amplifier. Differential coupling between the emitters of Q204 and Q205 produces a positive-going sweep voltage at the plate of V202B. Gain of the stage is fixed by the value of R238. Magnifier Centering adjustment R256, by adjusting the current supplied to Q205 to be equal to that supplied through R253 to Q204, assures that the trace will expand equally from center-screen. In the X10 MAGNIFIER position of S105, the impedance between emitters of Q204 and Q205 is reduced by a factor of 10, thus increasing gain by the same factor. Magnifier Gain R254 is used to adjust this impedance to the correct value.

4-36. The BEAM FINDER switch, located on the oscilloscope front panel, reduces current available to the cascode amplifier by placing R258 in series with the emitter supply (-100VF). With current thus reduced, the difference in plate voltages of V202A and V202B will be small enough to locate the trace on screen, regardless of the setting of POSITION controls R218A/B. After the trace is centered with POSITION control, the trace will remain on screen when the BEAM FINDER is released.

4-37. Output cathode followers V203A/B reduce output impedance, which minimizes the effect of deflection plate capacitance. No compensation adjustments are therefore required. Neon lamps V204 and V205 provide turn-on protection for the cathode followers.

4-38. DC-STABILIZED VERTICAL PLUG-INS.

4-39. When the Model 1420A is used as the time base for a dc-stabilized vertical plug-in (e.g. hp Models 1406A and 1407A), an inhibit pulse is applied at two places in the sweep generator circuit. This serves to blank the CRT presentation during the period of dc-stabilization. The positive-going inhibit signal is routed through CR106, inverted by Q105, and applied to V111A grid. This prevents the unblanking gate from reaching the CRT during the stabilization period. The inhibit pulse is also routed through CR107 and CR108 to the cathode of V103B. This keeps V102A conducting (between-sweep condition) to prevent the start of a sweep if a new trigger is applied while stabilization is occurring.

Table 5-1. Equipment Required for Tests and Adjustments

Recommended Instrument	Model	Required for	Ref Para	Required Characteristics
1. Signal Generator	℗ 606A	High-frequency triggering check	5-9	10 Mc; at least 200 mv output
2. Audio Oscillator	℗ 200CD	Triggering check; Trigger adjustment; Magnifier Gain adjustment	5-9, 5-10; 5-25 5-29	10 CPS to 500 kc
3. AC Voltmeter	℗ 400D/H/L	Triggering check; Trigger adjustment	5-9, 5-10; 5-25	0.1 v to 0.2 v RMS, accuracy 5%; 10 CPS to 500 kc
4. Time Mark Generator	Tektronix 180A	Sweep Time check; Sweep Calibration Sweep Compensation	5-11; 5-26 5-27	Markers from 10 Mc to 5 sec
5. DC Voltmeter	℗ 410B	Stability adjustment	5-24	-100 volt range
6. Probe	℗ 10001A	Trigger adjustment	5-25	10:1 division; 10-megohm input impedance

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section covers maintenance, troubleshooting, and adjustment of the Model 1420A Time Base. The performance check (Paragraphs 5-3 to 5-16) may be used at incoming inspection or after adjustments have been made to verify that the instrument meets its specifications (Table 1-1).

5-3. PERFORMANCE CHECK.

5-4. The performance check is intended to determine whether or not the instrument is operating within its specifications. If adjustment is required, refer to Paragraph 5-17.

5-5. TEST EQUIPMENT.

5-6. Test equipment recommended for the performance check is listed in Table 5-1, items 1 through 4. Similar instruments having the listed characteristics may be substituted.

5-7. PROCEDURE.

5-8. Install the Model 1420A Time Base in the oscilloscope (upper compartment of the Model 140A). Install an amplifier, such as the Model 1400A, in the lower compartment.

5-9. TRIGGERING.

a. Set: MAGNIFIER X1
SWEEP TIME . . . . . 10 μSEC/CM
TRIGGER SOURCE . . . . . +INT
LEVEL . . . . to trigger (midrange)

b. Connect an Audio Oscillator to vertical INPUT. Set frequency to 500 kc, and amplitude for 0.5 cm vertical deflection.

c. Vary Oscillator frequency from 500 kc to 10 cps, keeping amplitude constant at 0.5 cm, and reducing sweep speed as necessary. Stable triggering should occur over the entire frequency range.

Note

If a wide-band amplifier, such as the Model 1402A, or a 10-Mc Signal Generator are not available, omit steps d, e, and f.

d. Connect the Signal Generator to vertical INPUT, and adjust amplitude for 0.5 cm deflection.

e. Vary Signal Generator frequency up to 10 Mc, keeping amplitude at 0.5 cm. Stable triggering should occur to greater than 10 Mc.

f. Disconnect Signal Generator.

g. Set: TRIGGER SOURCE . . . . . +EXT
LEVEL . . . . . AUTO
SWEEP TIME . . . . . 1 MSEC/CM

h. A base line *should be displayed with no input* signal.

i. Connect the Audio Oscillator to the vertical INPUT and EXT TRIG INPUT. Monitor the output of the Oscillator with the AC Voltmeter.

j. Set Oscillator frequency to 500 kc, and amplitude to 0.18 VRMS.

k. Set SWEEP TIME to 10 μSEC/CM.

m. Vary the frequency of the Oscillator from 500 kc to 40 cps, keeping the amplitude constant at 0.18 VRMS, and reducing sweep time as necessary. Stable triggering should occur over the entire frequency range.

n. Set: AC/DC switch . . . . . AC
LEVEL . . . . to trigger (midrange)

p. Vary Oscillator frequency from 10 cps to 500 kc, keeping the amplitude at 0.18 VRMS. Check for stable triggering.

q. *Disconnect Oscillator.*

r. Set: TRIGGER SOURCE . . . . . +LINE
LEVEL . . . . . AUTO

s. Set vertical SENSITIVITY to CAL and cneck for a synchronized display.

5-10. TRIGGER POINT AND SLOPE.

a. Connect output of the Audio Oscillator to both vertical INPUT and EXT TRIG INPUT.

b. Set: Vertical SENSITIVITY . . . . 2 V/CM
TRIGGER SOURCE . . . . . +INT
LEVEL . . . . . AUTO
SWEEP TIME . . . . . MSEC/CM

c. Set Oscillator frequency to 100 cps, and amplitude for 10 cm vertical deflection.

d. Vary LEVEL over its range, then repeat with TRIGGER SOURCE switch to -INT, +EXT, and -EXT. Check that the start of the sweep is on the positive slope of the waveform in +INT and +EXT, and on the negative slope in -INT and -EXT. Check that operation of LEVEL allows the starting point of the sweep to be moved ±3.5 cm on the 10-cm displayed signal.

5-11. SWEEP CALIBRATION.

a. Set: SWEEP TIME . . . . . 5 MSEC/CM
MAGNIFIER X1
SWEEP TIME VERNIER . . . . CAL
TRIGGER SOURCE . . . . . +INT
LEVEL . . . . to trigger (midrange)

b. Connect CAL signal to vertical INPUT and adjust SWEEP TIME CAL for 3 cycles in 10 cm if line frequency is 60 cps; if 50 cps, refer to Figure 3-6.

c. Connect a Time Mark Generator to the vertical INPUT. Set Generator output and SWEEP TIME as shown in Table 5-2.

d. Adjust LEVEL and vertical SENSITIVITY, if necessary, for a stable display.

e. In each case, adjust horizontal POSITION to make the first marker coincide with the left graticule edge. The eleventh (or 6th or 21st) marker should be within ±0.3 cm of the right graticule edge.

Table 5-2. Sweep Time Check

Model 1420A SWEEP TIME	Time Mark Generator Output	Marks/10 cm
0.5 USEC/CM	1 usec	5
1 USEC/CM	1 usec	10
5 USEC/CM	5 usec	10
10 USEC/CM	10 usec	10
0.2 MSEC/CM	100 usec	20
5 MSEC/CM	5 msec	10
10 MSEC/CM	10 msec	10
2 SEC/CM	1 sec	20
5 SEC/CM	5 sec	10

5-12. SWEEP VERNIER.

a. Set: SWEEP TIME . . . . . 5 SEC/CM
SWEEP VERNIER . fully counterclockwise
LEVEL . . . . . FREE RUN

b. It should take at least 12.5 seconds for the spot to travel 1 cm.

5-13. MAGNIFIER.

a. Set: SWEEP TIME . . . . . 1 MSEC/CM
MAGNIFIER X10
SWEEP VERNIER . . . . . CAL

b. Connect 100μsec time marks to vertical INPUT.

c. Set the first marker on the left graticule edge. The eleventh marker should be within ±0.5 cm of the right graticule edge.

5-14. SINGLE SWEEP.

a. Set: SWEEP TIME . . . . . 10 MSEC/CM
MAGNIFIER X1
NORMAL/SINGLE . . . . . NORMAL
LEVEL . . . . . Just out of AUTO

b. Switch from NORMAL to SINGLE. The ARMED light should come on.

c. Switch LEVEL to AUTO. A single sweep should occur, and the ARMED light should go out.

d. Return switch to NORMAL.

5-15. EXTERNAL HORIZONTAL INPUT.

a. Set: SWEEP TIME . . . . . EXT
MAGNIFIER X1

b. Connect the IV CALIBRATOR output (oscilloscope front panel) to EXT HORIZ INPUT. Horizontal deflection should be approximately 2 cm.

5-16. EXTERNAL HORIZONTAL INPUT VERNIER.

a. Set: SWEEP TIME . . . . . EXT
MAGNIFIER X10
VERNIER . . . . . fully counterclockwise

b. Connect the IV CALIBRATOR output (oscilloscope front panel) to EXT HORIZ INPUT. Horizontal deflection should be less than 2 cm.

5-17. ADJUSTMENTS.

5-18. Paragraphs 5-22 to 5-29 give the adjustment procedure for the Model 1420A. A condensed procedure is given in Table 5-4. If difficulty is encountered in making any adjustment, refer to Paragraph 5-30 for troubleshooting procedures.

5-19. EQUIPMENT NEEDED FOR ADJUSTMENTS. Test equipment recommended for the adjustment procedure is listed in Table 5-1, items 2 to 6. Similar instruments having the listed characteristics may be substituted.

5-20. LOCATION OF ADJUSTMENTS. Figure 5-1 shows the location of all internal adjustments in the Model 1420A.

5-21. PROCEDURE. Install the Model 1420A in the upper plug-in compartment of the Model 140-series oscilloscope. Install an amplifier plug-in in the lower compartment. Turn on the instrument and allow several minutes of warmup.

5-22. MAGNIFIER CENTERING.

a. Set: SWEEP TIME . . . . . EXT
MAGNIFIER X10

b. Center spot horizontally with POSITION.

c. Set MAGNIFIER to X1.

d. Adjust Magnifier Centering R256 to center spot.

e. Repeat steps a through d until the spot does not shift.

5-23. VERNIER BALANCE.

a. Set: SWEEP TIME . . . . . EXT
MAGNIFIER X10
VERNIER . . . . . fully counterclockwise

b. Center spot horizontally with POSITION.

c. Set VERNIER fully clockwise.

d. Adjust Vernier Balance R209 to center spot.

5-24. STABILITY.

a. Set: SWEEP TIME . . . . . 1 MSEC/CM
TRIGGER SOURCE . . . . . +INT
LEVEL . . . . . Just out of AUTO

b. Connect a DC Voltmeter (-100v range) to the junction of R142 and pin 2 of V102A.

c. Rotate STABILITY clockwise to free run the sweep, then counterclockwise until the sweep just stops. Note voltage reading at this point (typically about -52 volts).

d. Adjust STABILITY to give a voltage which is 2.0 volts less negative than the voltage noted in step c.

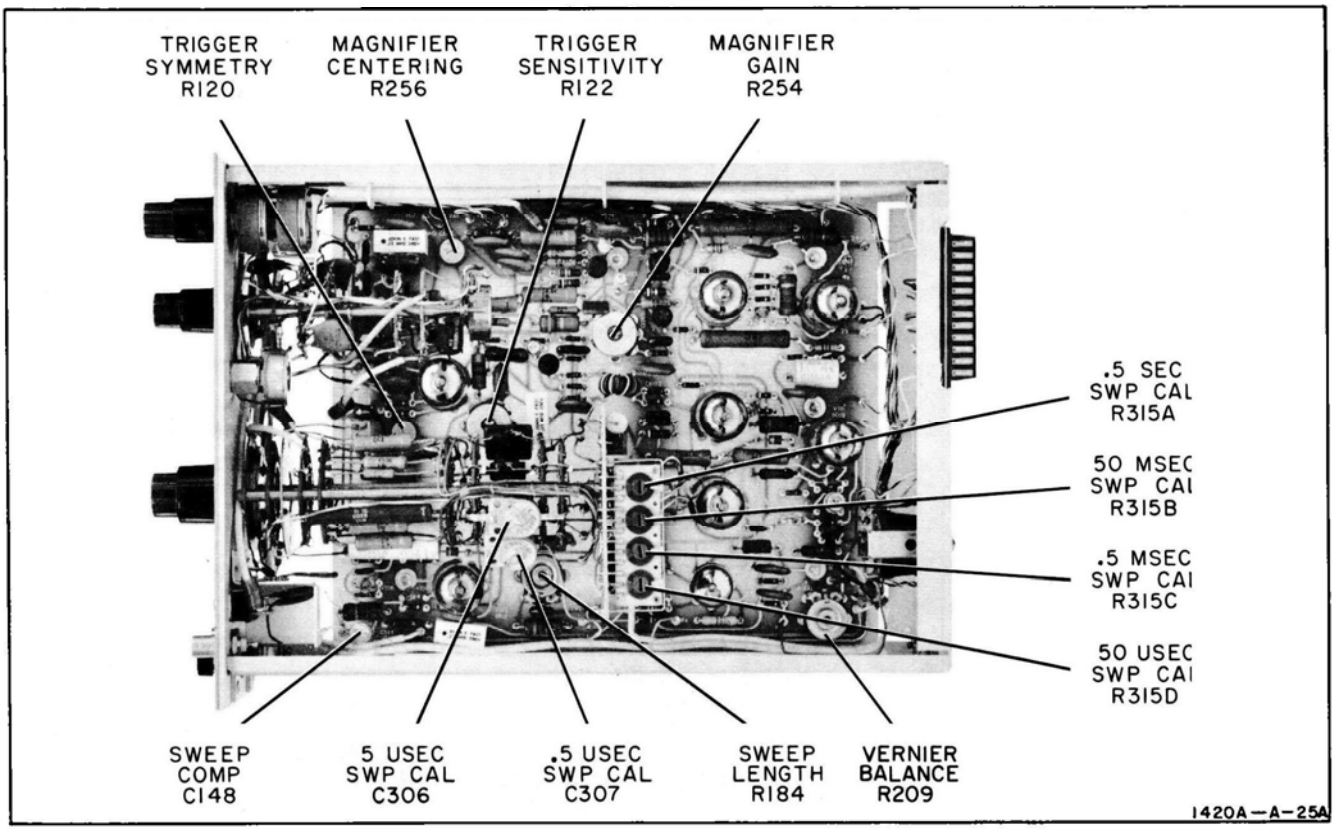


Figure 5-1. Location of Adjustments

5-25. TRIGGER SENSITIVITY AND SYMMETRY.

a. Set: Vertical INPUT . . . . . AC
Vertical SENSITIVITY . . . . . 0.05 V/CM
MAGNIFIER X1
TRIGGER SOURCE . . . . . +EXT
Trigger Coupling . . . . . AC
Trigger Symmetry (R120) . . . . . centered
Trigger Sensitivity (R122) . . . . . fully ccw
SWEEP TIME . . . . . 1 MSEC/CM

b. Connect the Audio Oscillator output, shunted by a 50-ohm resistor, to EXT TRIG INPUT. Monitor Oscillator output with the AC Voltmeter.

c. Set: Oscillator frequency . . . . . 400 CPS
Oscillator amplitude . . . . . 88 mv RMS

d. Connect the 10:1 Probe from the vertical INPUT to the case of tunnel diode CR101.

e. Rotate LEVEL until a waveform similar to the upper waveform in Figure 5-2 appears.

f. Using LEVEL to maintain the presentation, adjust Trigger Sensitivity R122 for a waveform similar to the lower waveform shown in Figure 5-2. Continue rotating R122 clockwise until the waveform is just barely obtainable with adjustment of LEVEL.

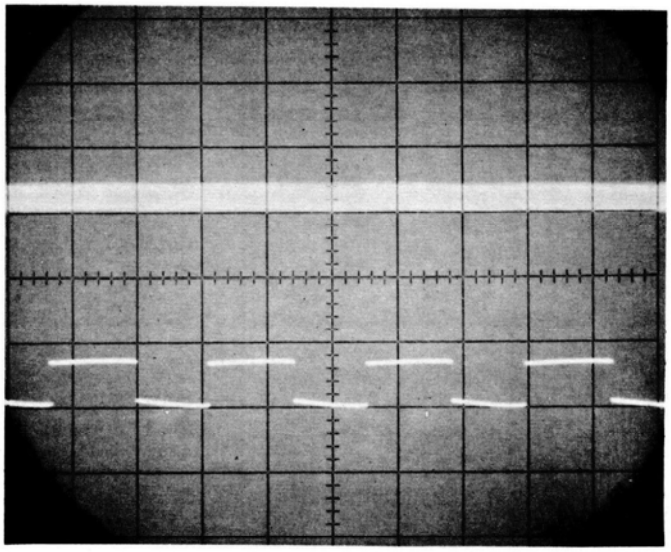


Figure 5-2. Trigger Adjustment Waveforms

g. Set Oscillator amplitude to 70 mv RMS.

h. No waveform should now appear while adjusting LEVEL. It may be necessary to adjust Trigger Sensitivity several times to obtain stable triggering at 88 mv RMS and no triggering at 70 mv RMS (steps d through h).

i. Set Oscillator amplitude to 180 mv RMS.

Table 5-3. Sweep Time Calibration

Time Mark Generator Output	Model 1420A SWEEP TIME	Adjust	Markers/10 cm
1 μsec	0.5 USEC/CM	C307	5
5 μsec	5 USEC/CM	C306	10
50 μsec	50 USEC/CM	R315D	10
500 μsec	0.5 MSEC/CM	R315C	10
50 msec	50 MSEC/CM	R315B	10
500 msec	0.5 SEC/CM	R315A	10

Table 5-4. Condensed Adjustment Procedure

Test	Ext. Equip. Required	Procedure	Adjust
1. Magnifier Centering	None	a. SWEEP · · · · · · · · EXT MAGNIFIER · · · · · · X10 b. Center spot with POSITION c. MAGNIFIER · · · · · · X1	Magnifier Centering R256 to center spot.
2. Vernier	None	a. SWEEP TIME · · · · · · EXT MAGNIFIER · · · · · · X10 VERNIER · · · · · fully ccw b. Center spot horizontally. c. Set VERNIER fully cw.	Vernier Balance R209 to center spot.
3. Stability	DC Voltmeter	a. SWEEP TIME · · 1 MSEC/CM TRIGGER SOURCE · · +INT LEVEL · · · just out of AUTO b. Rotate STABILITY cw until sweep free runs. c. Rotate STABILITY ccw until sweep just stops. Note voltage at pin 2 of V102A.	STABILITY control for 2.0 volts less negative than voltage noted in step c.
4. Trigger Sensitivity and Symmetry	10:1 probe; Audio Oscillator; AC Voltmeter	a. Vertical INPUT · · · · · AC SENSITIVITY · · · 0.5 V/CM TRIGGER SOURCE · · · +EXT Trigger Symmetry · · centered Trigger Sensitivity · · fully cw SWEEP TIME · · 1 MSEC/CM b. Connect 400-CPS signal to EXT TRIG INPUT, amplitude 88 mv RMS. c. Rotate LEVEL for free-running waveform	a. Trigger Sensitivity R122 (with LEVEL) for square wave pattern. b. Continue cw until waveform barely obtainable with LEVEL. No solid triggering should occur with 70 mv RMS input. c. Ground R102/R103 junction increase input to 180 mv RMS. d. Trigger Symmetry R120 for symmetrical square wave.
5. Sweep Calibration	Time Mark Generator	a. SWEEP TIME · · 5 MSEC/CM MAGNIFIER · · · · · · X1 VERNIER · · · · · · CAL b. Apply 5 msec time markers to INPUT.	a. SWEEP TIME CAL for 1 marker/cm. b. Calibrate sweep ranges listed in Table 5-3 above.
6. Sweep Compensation	Time Mark Generator	a. SWEEP TIME · · · 1 μSEC/CM TRIGGER SOURCE · · · +INT MAGNIFIER · · · · · X10 b. Apply 10 Mc markers to INPUT.	Sweep Comp C148 for linear 2nd and 3rd cm.
7. Sweep Length	Time Mark Generator	a. SWEEP TIME · · 5 MSEC/CM b. Connect 1 μsec time markers to vertical INPUT. c. Adjust LEVEL for shortest sweep.	Sweep Length R184 for 10.75 cm of sweep
8. Magnifier Gain	Time Mark Generator	a. Use 5 msec markers b. MAGNIFIER · · · · · X10	Magnifier Gain R254 for 2 markers in 10 cm.

j. Ground the junction of R102 and R103.

k. Adjust Trigger Symmetry R120 for a symmetrical square wave display.

5-26. SWEEP CALIBRATION.

a. Set: SWEEP TIME . . . . . 5 MSEC/CM
TRIGGER SOURCE. . . . . +INT
MAGNIFIER X1
VERNIER . . . . . CAL

b. Connect 5-millisecond markers from the Time Mark Generator to vertical INPUT, and adjust LEVEL for the shortest sweep length.

c. Adjust SWEEP TIME CAL for 1 marker/cm.

d. Set Generator and SWEEP TIME to the settings given in Table 5-3, and make the indicated adjustment.

5-27. SWEEP COMPENSATION.

a. Set: SWEEP TIME . . . . . 1 μSEC/CM
TRIGGER SOURCE. . . . . +INT
MAGNIFIER X10

b. Connect 10 Mc time markers from the Time Mark Generator to vertical INPUT.

c. Adjust Sweep Comp C148 for linear second and third centimeter of magnified (X10) sweep.

d. If vertical plug-in is not a Model 1402A, center C148.

5-28. SWEEP LENGTH.

a. Set: SWEEP TIME . . . . . 5 MSEC/CM
TRIGGER SOURCE . . . . . +INT
MAGNIFIER X1

b. Connect 1-μ sec markers from the Time Mark Generator to vertical INPUT, and adjust LEVEL for the shortest sweep length.

c. Adjust Sweep Length R184 for 10.75 cm of sweep.

5-29. MAGNIFIER GAIN.

a. Set: SWEEP TIME . . . . . 5 MSEC/CM
MAGNIFIER X10

b. Connect the Time Mark Generator to vertical INPUT, and use 5 millisecond markers.

c. Adjust Magnifier Gain R254 for 2 markers in 10 cm.

5-30. TROUBLESHOOTING.

5-31. Nominal DC voltages are given as a troubleshooting aid on the schematic diagrams. Waveforms for the trigger generator, sweep generator and amplifier are given on the pages facing the schematic. Test Points are etched on circuit board A1.

5-32. ISOLATING A FAULT.

5-33. If the sweep operates properly when the LEVEL control is in the FREE RUN position, but not in the LEVEL or AUTO position, check adjustment of Trigger Sensitivity R122 and Trigger Symmetry R120 (Paragraph 5-25), and STABILITY (Paragraph 5-24). If these adjustments do not cure the trouble, check components in the triggering circuit (V101, Q101, CR101, Q102, and CR102).

5-34. If the sweep does not operate properly with LEVEL in the FREE RUN position, apply an external input signal to determine whether the trouble is in the amplifier circuit or the sweep generator circuit.

5-35. SWEEP GENERATOR.

5-36. If the trouble is determined to be in the sweep generator, it can be best isolated by forcing the sweep to remain in one of its two states. The "Sweep Completed" state is the peak voltage at the end of the sweep. The "Reset" state is the starting level of the sweep voltage.

5-37. To troubleshoot the sweep generator, put the circuit in each of these states (see Table 5-5) and check the DC voltages against the values given in the Table. A 10% or 15% variation from these values can be expected; however, larger variations indicate a source of trouble.

5-38. HORIZONTAL AMPLIFIER.

5-39. Signal waveforms and their associated DC levels are given as a troubleshooting aid on the horizontal amplifier schematic diagram, Figure 5-11.

5-40. If unbalance is present in the differential portion of the amplifier and the trace cannot be brought on the CRT screen, the cause may be found by shorting symmetrical points of the amplifier together. Start at the output stage, shorting the cathodes of V203A and V203B together, and work back toward the input until a point is reached where the trace is returned to the CRT screen. The trouble is then between that point and the points last shorted together.

5-41. REPAIR AND REPLACEMENT.

5-42. SERVICING ETCHED CIRCUIT BOARDS.

5-43. Etched circuit boards used in the Model 1420A have components on one side of the board with a plated conductive layer of metal through component holes. ℌ Service Note M-20D also contains useful information on etched circuit repair. The important steps and considerations are:

a. Use a low heat (37 to 47.5 watts, less than 800°F idling temperature), slightly bent chisel tip (1/16 to 1/8 inch diameter) soldering iron, and a small diameter, high tin content solder. If a rosin solder is used, clean the area throughly after soldering.

b. Components may be removed by placing the soldering iron on the component lead on either side of the board, and pulling up on the lead. If heat is applied to the component side of the board, greater care is required to avoid damage to the compartment (especially true for diodes). If heat damage may occur, grip the lead with a pair of pliers to provide a heat sink between the soldering iron and component.

Table 5-5. Sweep Generator Troubleshooting Guide

Test Point	Location	Sweep Completed *	Reset **
6	V102 pin 2	-100 Volts	0 Volts
7	V102 pin 3	-33	-2.0
8	V102 pin 8	+104	+13.4
9	V111 pin 3	+108	+21.4
10	WHT-YEL-GRN wire	+13.3	+0.15
11	V103 pin 6	-6.8	-1.0
12	V105 pin 2	-7.2	-1.5
13	V105 pin 6	+207	+40
14	V105 pin 8	+126	-1.5
15	V104 pin 5	-34	-65
16	V103 pin 3	-30	0

* Sweep Completed: Lift the end of R142 that connects to CR102 (Test Point 6) and connect it to -100 volts (any violet wire).

** Reset: Connect Test Point 6 to ground.

c. If a component is obviously damaged or faulty, clip the leads close to the component and then unsolder the leads from the board.

d. Large components such as potentiometers and tube sockets may be removed by rotating the soldering iron from lead to lead and apply steady pressure to lift the part free (the alternative is to clip the leads of a damaged part).

e. Since the conductor part of the etched circuit board is a metal plated surface, covered with solder, use care to avoid overheating and lifting the conductor from the board. A conductor may be cemented back in place with a quick-drying acetate base cement (use sparingly) having good insulating properties. Another method for repair is to solder a section of good conducting wire along the damaged area.

f. Clear the solder from the circuit board hole before inserting a new component lead. Heat the solder in the hole, remove the iron, and quickly insert a pointed non-metallic object, such as a toothpick.

g. Shape the new component leads and clip to proper length. Insert the leads in the holes and apply heat and solder, preferably on the conductor side.

5-44. ADJUSTMENT FOLLOWING REPAIR.

5-45. Table 5-6 lists adjustments required following tube, transistor, or diode replacement. If another component associated with an item listed in the table is replaced, check adjustment for the listed item.

Table 5-6. Adjustments Following Tube, Transistor, and Diode Replacement

Reference Designation	Function	Adjustment and Paragraph
V101	Amplifier	Trigger Sensitivity and Symmetry (5-25)
CR101	Trigger Generator	Trigger Sensitivity and Symmetry (5-25)
Q101	Auto Trigger Amplifier	Trigger Sensitivity and Symmetry (5-25)
Q102	Trigger Amplifier	Trigger Sensitivity and Symmetry (5-25)
CR102	Clipper	None
CR103	Clamp	None
V102	Gate Generator and Gate Output Cathode Follower	Stability (5-24)
V103	Gate Generator and Hold-Off Cathode Follower	Stability (5-24)
Q103	Single Sweep Lock-Out	None
CR104	Clamp	None
V104	Clamp Diode, Hold-Off Diode	Sweep Length (5-28)
CR105	Sweep Disconnect Diode	None
V105	Integrator and Output Cathode Follower	Sweep Calibration (5-26)
V106, 107, 108, 109, 110	Protection and Indicator Neons	None
V201	Cathode Follower	None
Q201	Input Amplifier	Time Base Calibration (Figure 3-6)
Q202	Emitter Follower	Magnifier Centering (5-22)
Q203	Emitter Follower	Magnifier Centering (5-22)
Q204, 205, V202	Cascode Amplifier	Time Base Calibration (Figure 3-6), Magnifier Centering (5-22)
V203	Output Cathode Follower	None
V204, 205, 206	Protection neons	None
V111	Cathode Follower	Vernier Balance (5-23)

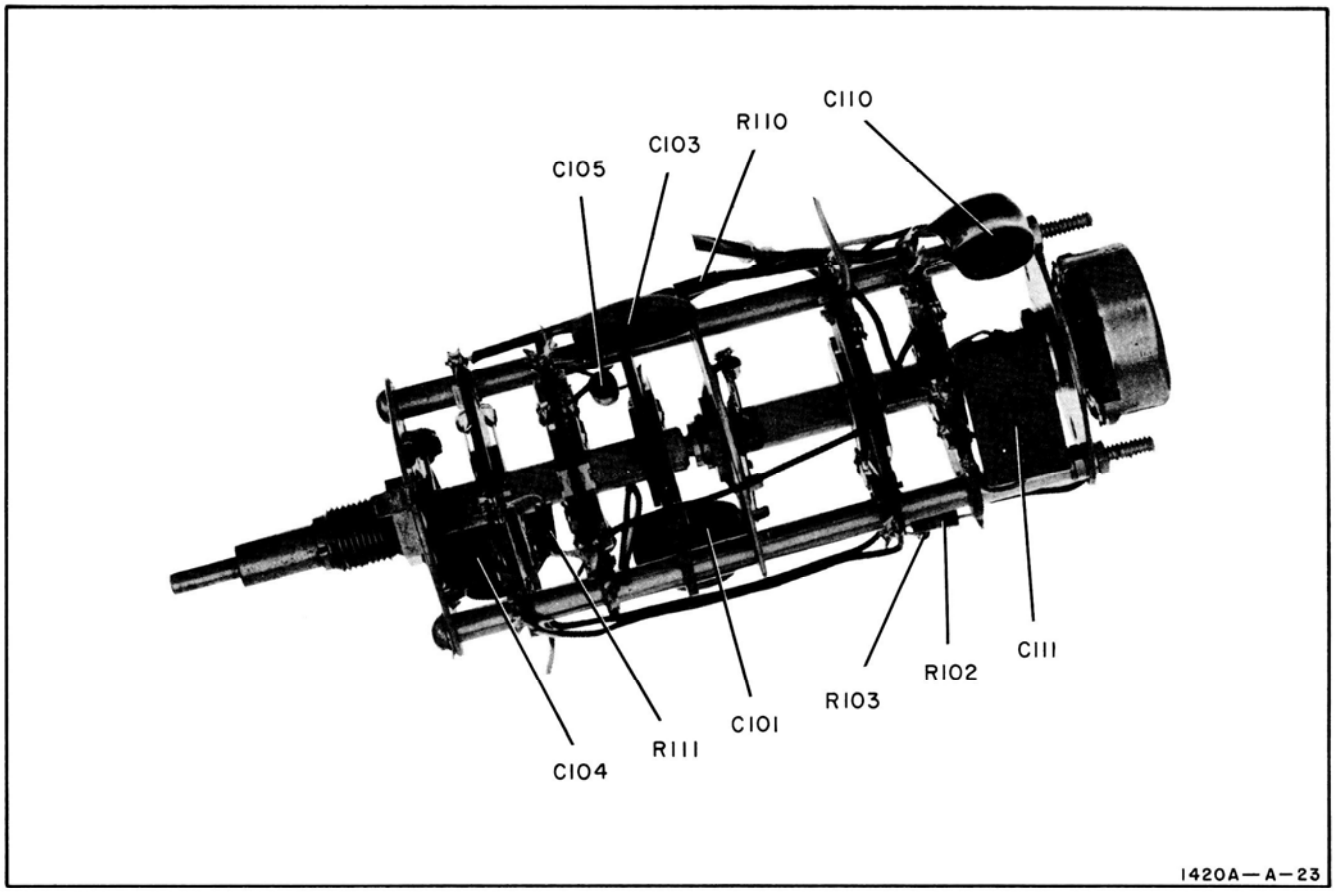


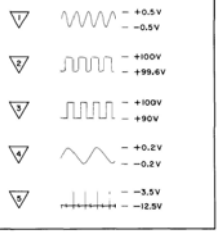
Figure 5-3. Component Locations on Trigger Source Switch

Conditions for Waveform Measurements

1. Connect a 2-kc 1-volt peak-to-peak sine wave from an audio oscillator to EXT TRIG INPUT.
2. Set: TRIGGER SOURCE . . . . . +EXT
   LEVEL . . . . . AUTO
   SWEEP TIME . . . . . 0.1 MSEC/CM
3. Adjust POSITION so the trace starts at the left graticule edge.
4. Sweep speed of test oscilloscope: 0.2 msec/cm.
5. Waveforms are shown in correct time relationship except for Test Point 4, where a 40-cps signal is observed.

Waveforms at Test Points in *Trigger Generator*

1. See conditions of waveform measurement above.
2. Waveform at Test Point 4 is 40 cps.



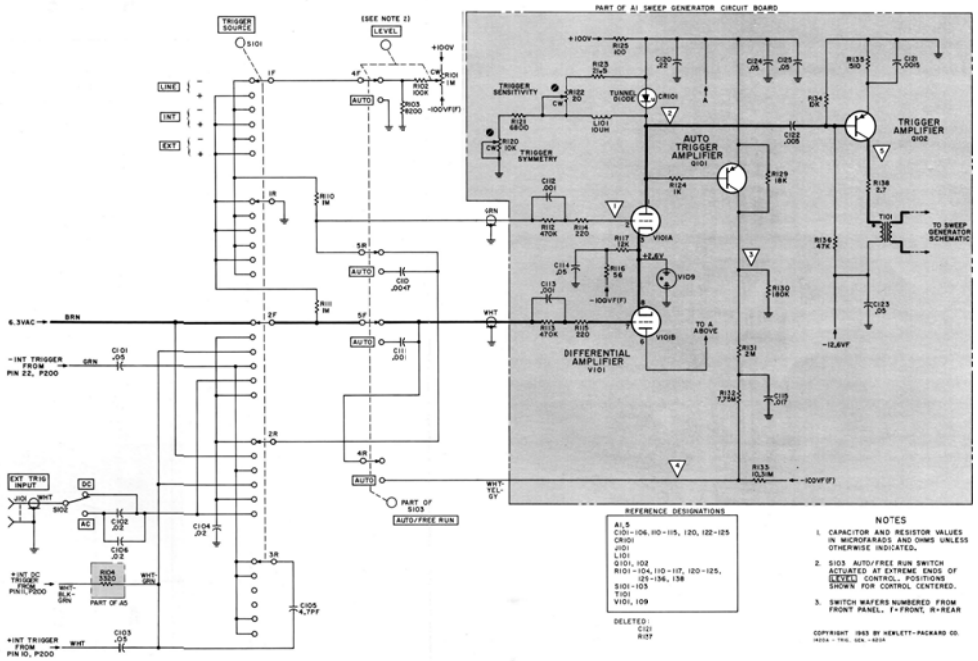


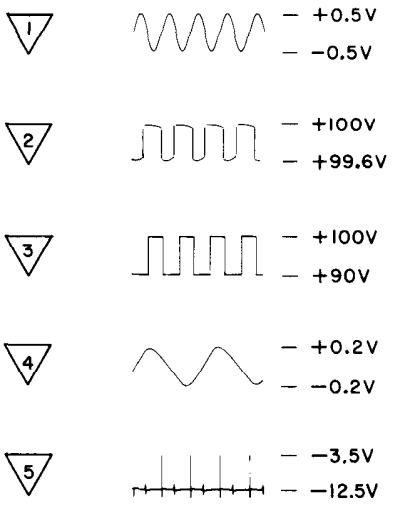
Figure 5-4. Model 1420A Trigger Generator

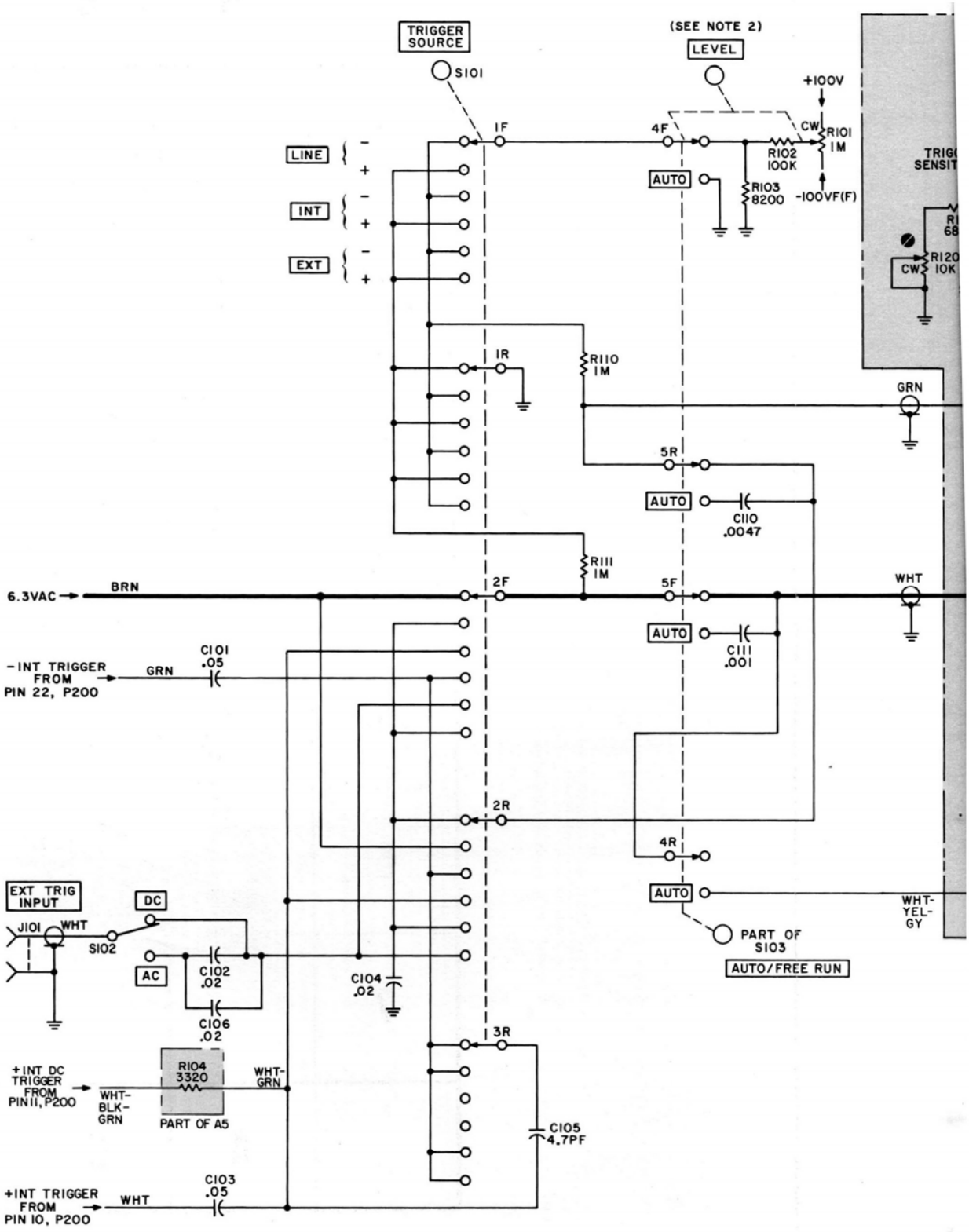
Conditions for Waveform Measurements

1. Connect a 2-kc 1-volt peak-to-peak sine wave from an audio oscillator to EXT TRIG INPUT.
2. Set:
   TRIGGER SOURCE . . . . . +EXT
   LEVEL . . . . . AUTO
   SWEEP TIME . . . . . 0.1 MSEC/CM
3. Adjust POSITION so the trace starts at the left graticule edge.
4. Sweep speed of test oscilloscope: 0.2 msec/cm.
5. Waveforms are shown in correct time relationship except for Test Point 4, where a 40-cps signal is observed.

Waveforms at Test Points in *Trigger Generator*

1. See conditions of waveform measurement above.
2. Waveform at Test Point 4 is 40 cps.




TRIGGER SOURCE
S101
(SEE NOTE 2)
LEVEL
+100V
LINE
INT
EXT
1F
4F
CW
R101 1M
R102 100K
AUTO
R103 8200
-100VF(F)
TRIG SENSIT
R120 10K
1R
R110 1M
GRN
5R
C110 .0047
R111 1M
6.3VAC
BRN
2F
5F
WHT
C101 .05
-INT TRIGGER FROM PIN 22, P200
2R
4R
EXT TRIG INPUT
J101
WHT
S102
DC
AC
C102 .02
C106 .02
C104 .02
WHT-YEL-GY
PART OF S103
AUTO/FREE RUN
3R
+INT DC TRIGGER FROM PIN 11, P200
WHT-BLK-GRN
R104 3320
WHT-GRN
PART OF A5
C105 4.7PF
C103 .05
+INT TRIGGER FROM PIN 10, P200

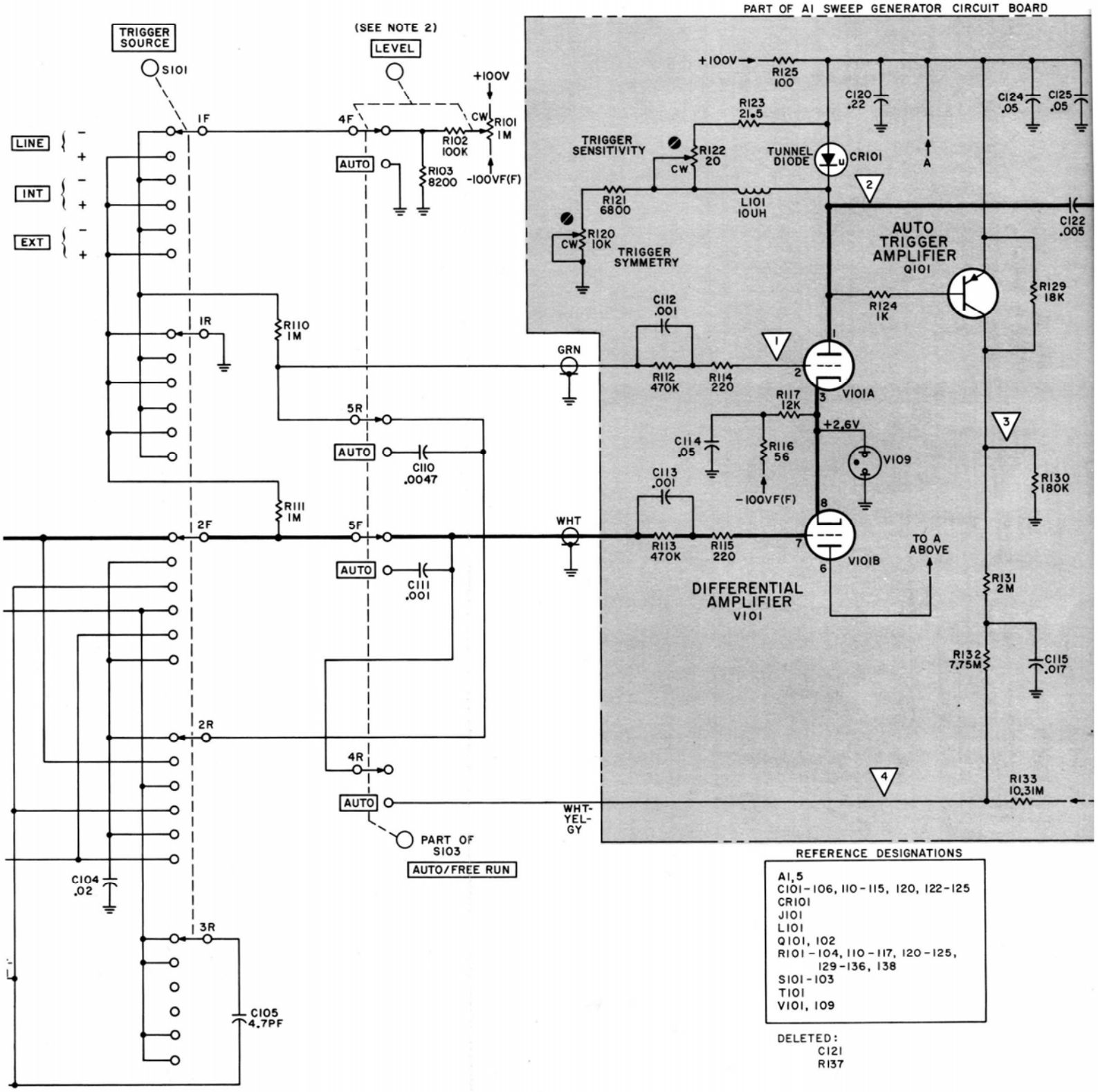
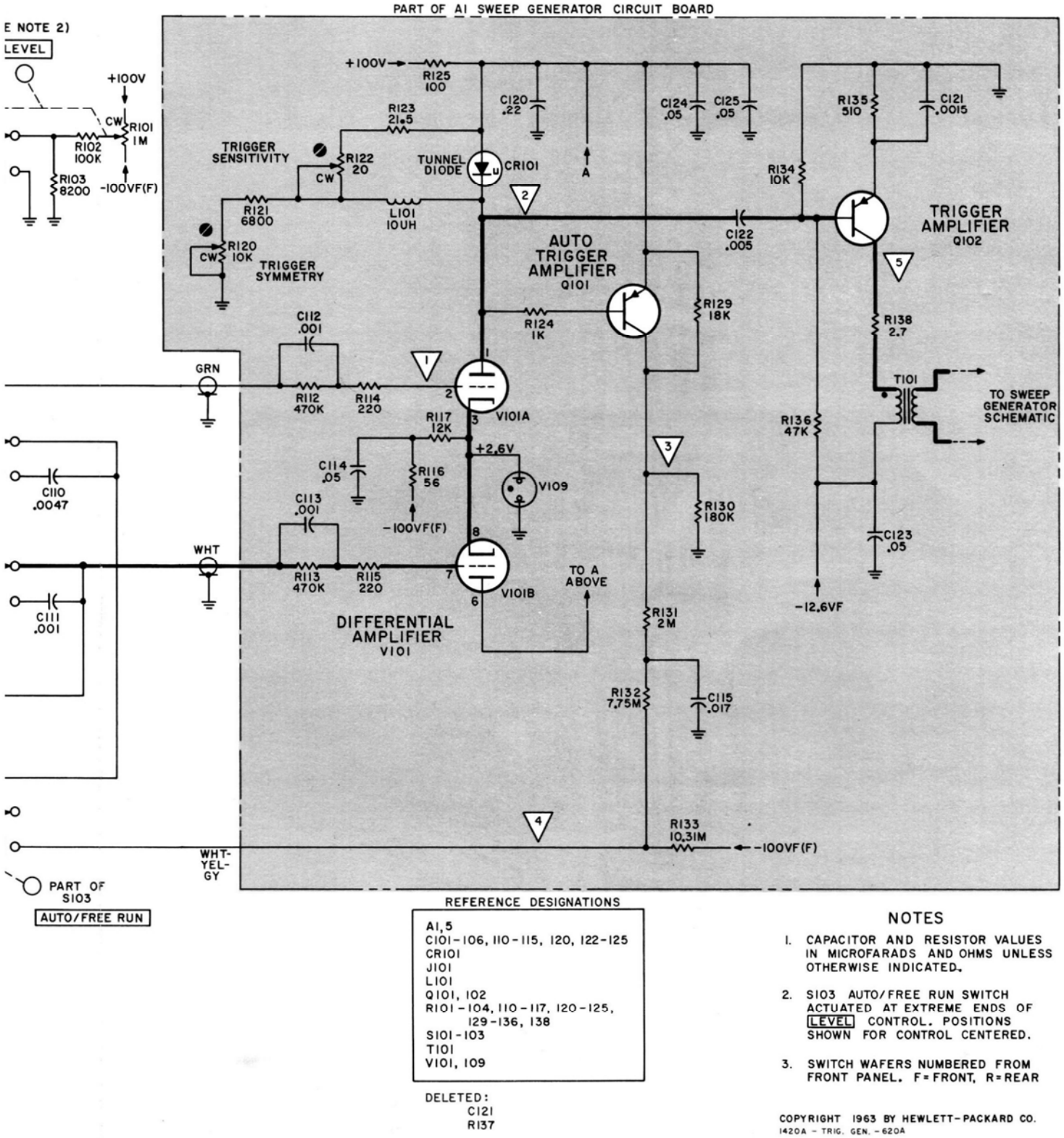

PART OF A1 SWEEP GENERATOR CIRCUIT BOARD
TRIGGER SOURCE
S101
(SEE NOTE 2)
LEVEL
+100V
LINE
INT
EXT
1F
4F
R102 100K
R101 1M
CW
AUTO
R103 8200
-100VF(F)
R125 100
R123 21.5
C120 .22
C124 .05
C125 .05
TRIGGER SENSITIVITY
R122 20
CW
TUNNEL DIODE
CR101
A
R121 6800
L101 10UH
R120 10K
CW
TRIGGER SYMMETRY
C122 .005
AUTO TRIGGER AMPLIFIER Q101
R129 18K
R124 1K
C112 .001
1R
R110 1M
GRN
R112 470K
R114 220
V101A
R117 12K
5R
C114 .05
R116 56
+2.6V
V109
C110 .0047
C113 .001
R130 180K
R111 1M
2F
5F
WHT
R113 470K
R115 220
V101B
TO A ABOVE
C111 .001
DIFFERENTIAL AMPLIFIER V101
R131 2M
R132 7.75M
C115 .017
2R
4R
R133 10.3IM
WHT-YEL-GY
PART OF S103
AUTO/FREE RUN
C104 .02
3R
C105 4.7PF
REFERENCE DESIGNATIONS
A1,5
C101-106, 110-115, 120, 122-125
CR101
J101
L101
Q101, 102
R101-104, 110-117, 120-125, 129-136, 138
S101-103
T101
V101, 109
DELETED:
C121
R137

Figure 5-



REFERENCE DESIGNATIONS

A1,5
C101-106, 110-115, 120, 122-125
CR101
J101
L101
Q101, 102
R101-104, 110-117, 120-125, 129-136, 138
S101-103
T101
V101, 109

DELETED:
C121
R137

NOTES

1. CAPACITOR AND RESISTOR VALUES IN MICROFARADS AND OHMS UNLESS OTHERWISE INDICATED.
2. S103 AUTO/FREE RUN SWITCH ACTUATED AT EXTREME ENDS OF LEVEL CONTROL. POSITIONS SHOWN FOR CONTROL CENTERED.
3. SWITCH WAFERS NUMBERED FROM FRONT PANEL. F=FRONT, R=REAR

Figure 5-4. Model 1420A Trigger Generator

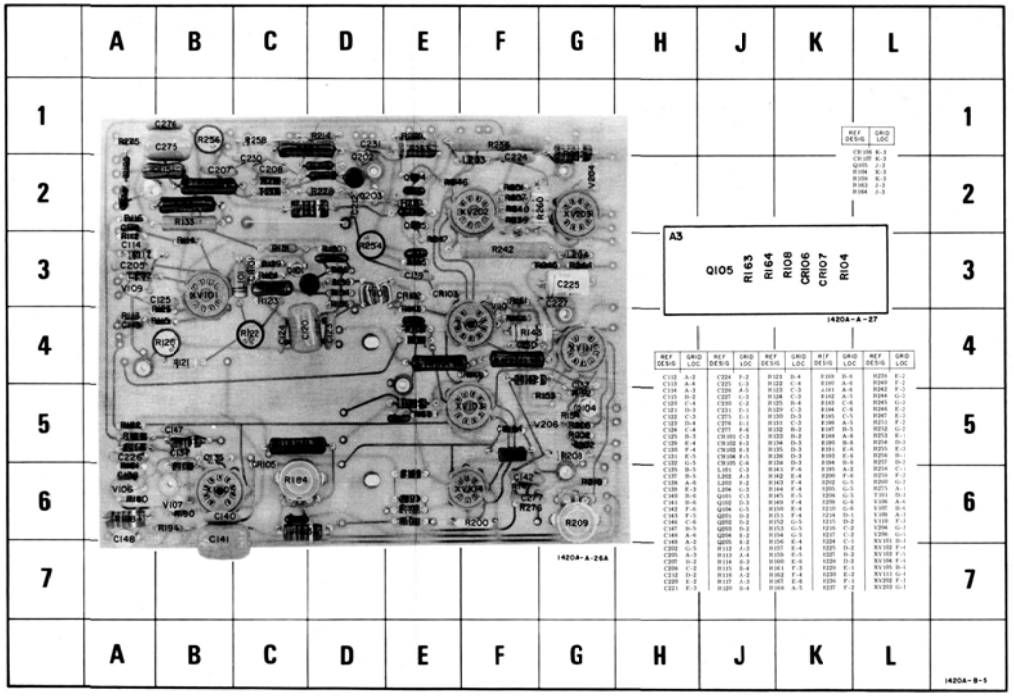
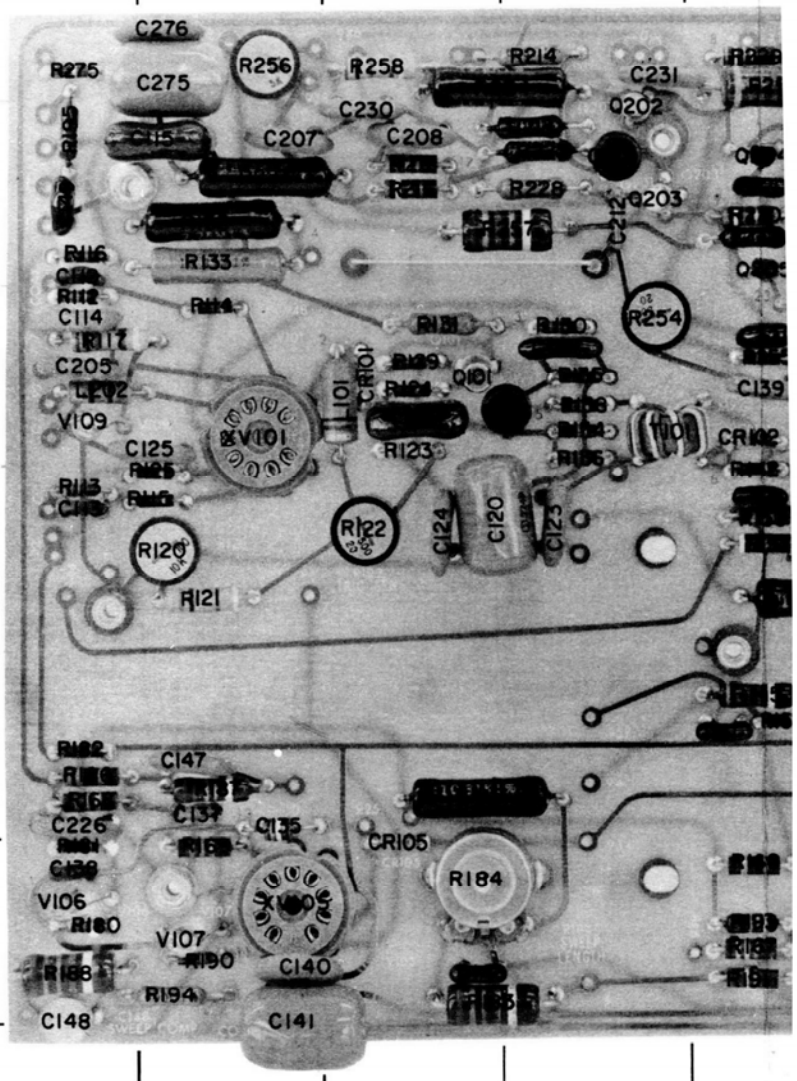


Figure 5-5. Component Locations on Circuit Boards A1 and A5.

	A	B	C	D	
1					
2					
3					
4					
5					
6					
7					
	A	B	C	D	E



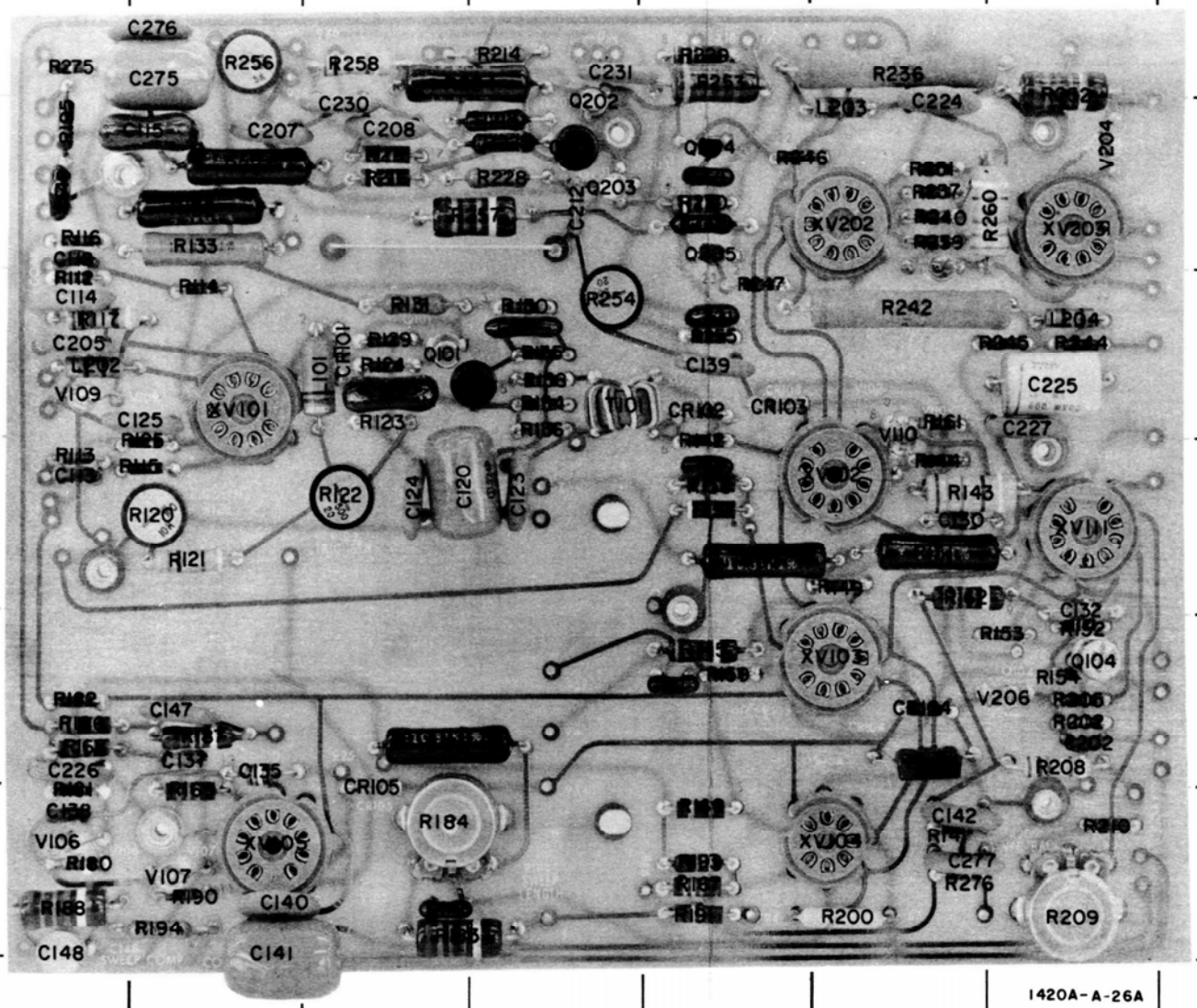
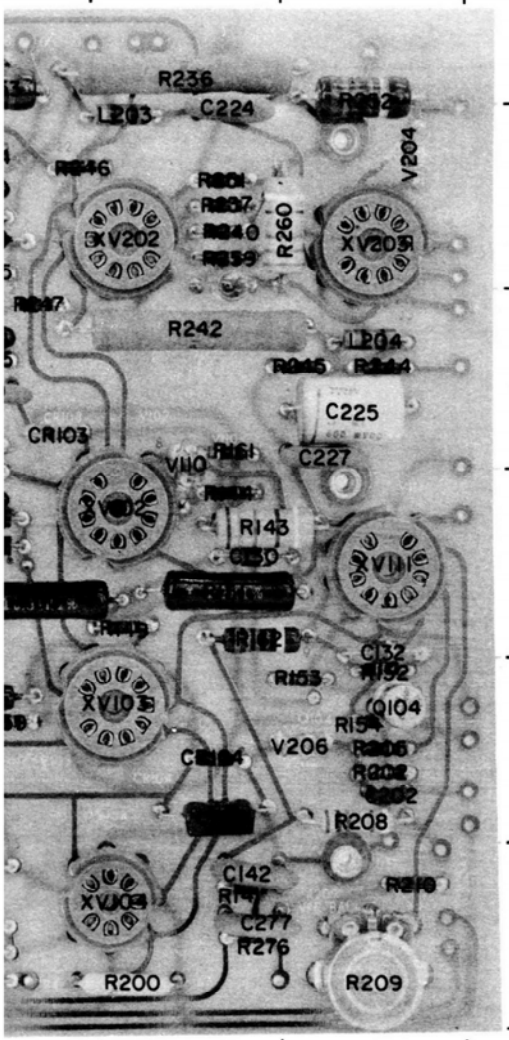


Figure 5-5. Component Locations on Circuit B



REF DESIG	GRID LOC
CR106	K-3
CR107	K-3
Q105	J-3
R104	K-3
R108	K-3
R163	J-3
R164	J-3

A3

Q105 R163 R164 R108 CR106 CR107 R104

1420A-A-27

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C112	A-2	C224	F-2	R121	B-4	R169	B-6	R238	E-2
C113	A-4	C225	G-3	R122	C-4	R180	A-6	R240	F-2
C114	A-3	C226	A-5	R123	C-3	A181	A-6	R242	F-3
C115	B-2	C227	G-3	R124	C-3	R182	A-5	R244	G-3
C120	C-4	C230	C-2	R125	B-4	R183	C-6	R245	G-3
C121	D-3	C231	D-1	R129	C-3	R184	C-6	R246	E-2
C122	C-3	C275	B-1	R130	D-3	R185	C-5	R247	E-3
C123	D-4	C276	B-1	R131	C-3	R186	A-5	R251	F-2
C124	C-4	C277	F-6	R132	B-2	R187	B-5	R252	G-2
C125	B-3	CR101	C-3	R133	B-2	R188	A-6	R253	E-1
C129	E-4	CR102	E-3	R134	D-3	R190	B-6	R254	D-3
C130	F-4	CR103	E-3	R135	D-3	R191	E-6	R255	E-3
C131	E-5	CR104	F-5	R136	D-3	R193	E-6	R256	B-1
C132	G-5	CR105	C-6	R138	D-3	R194	B-6	R257	D-2
C135	B-5	L101	C-3	R141	F-6	R195	A-2	R258	C-1
C137	B-5	L202	A-3	R142	E-4	R200	F-6	R259	F-2
C138	A-6	L203	F-2	R143	F-4	R202	G-5	R260	G-2
C139	E-3	L204	G-3	R144	F-4	R205	G-5	R275	A-1
C140	B-6	Q101	C-3	R145	E-5	R208	G-5	T101	D-3
C141	B-6	Q102	D-3	R149	F-4	R209	G-6	V106	A-6
C142	F-6	Q104	G-5	R150	E-4	R210	G-6	V107	B-6
C143	F-5	Q201	D-2	R151	F-4	R214	D-1	V109	A-3
C146	C-6	Q202	D-2	R152	G-5	R215	D-2	V110	F-3
C147	B-5	Q203	D-2	R153	G-5	R216	C-2	V204	G-2
C148	A-6	Q204	E-2	R154	G-5	R217	C-2	V206	G-5
C149	A-2	Q205	E-2	R156	E-4	R224	C-1	XV101	B-3
C202	G-5	R112	A-3	R157	E-4	R225	D-2	XV102	F-4
C205	A-3	R113	A-4	R159	E-5	R227	B-2	XV103	F-5
C207	B-2	R114	B-3	R160	E-6	R228	D-2	XV104	F-6
C208	C-2	R115	B-4	R161	F-3	R229	E-1	XV105	B-6
C212	D-2	R116	A-2	R162	F-4	R230	E-2	XV111	G-4
C220	E-2	R117	A-3	R167	E-6	R236	F-1	XV202	F-2
C221	E-3	R120	B-4	R168	A-5	R237	F-2	XV203	G-2

1420A-B-5

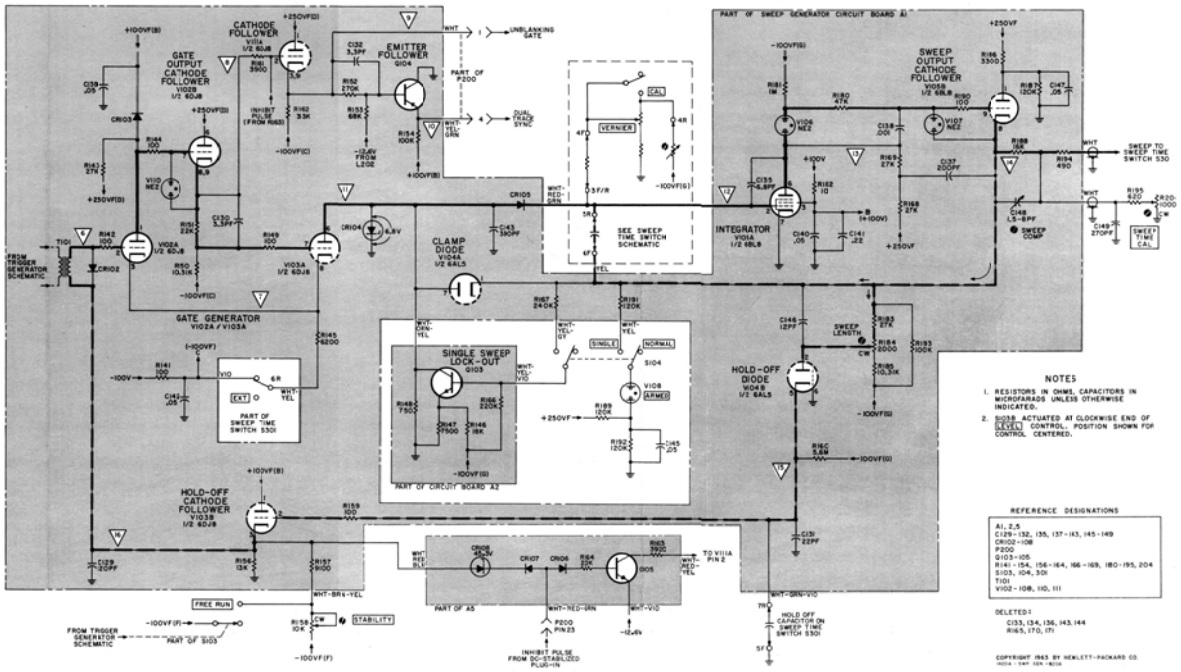
Figure 5-5. Component Locations on Circuit Boards A1 and A5.

Waveforms at Test Points in Sweep Generator

See conditions of waveform measurement on Page 5-9.

6	− −35V − −50V	
7	− −32V − −48V	
8	− +104V − +30V	
9	− +108V − +30V	
10	− +12V − 0V	
11	− −1V − −6.8V	
12	− −1.5V − −2V	
13	− +150V − +40V	
14	− +100V − 0V	
15	− −40V − −60V	
16	− −35V − −50V	

14204-8-2



NOTES

1. RESISTORS IN OHMS, CAPACITORS IN MICROFARADS UNLESS OTHERWISE INDICATED.
2. S103B ACTUATED AT CLOCKWISE END OF LEVEL CONTROL. POSITION SHOWN FOR CONTROL CENTERED.

REFERENCE DESIGNATIONS

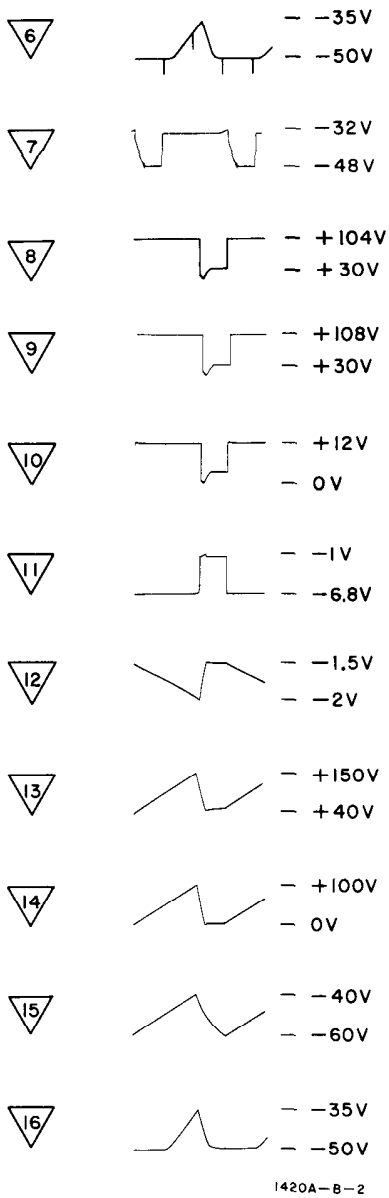
A1, 2, 5
C129-132, 135, 137-143, 145-149
CR102-108
P200
Q103-105
R141-154, 156-164, 166-169, 180-195, 204
S103, 104, 301
T101
V102-108, 110, 111

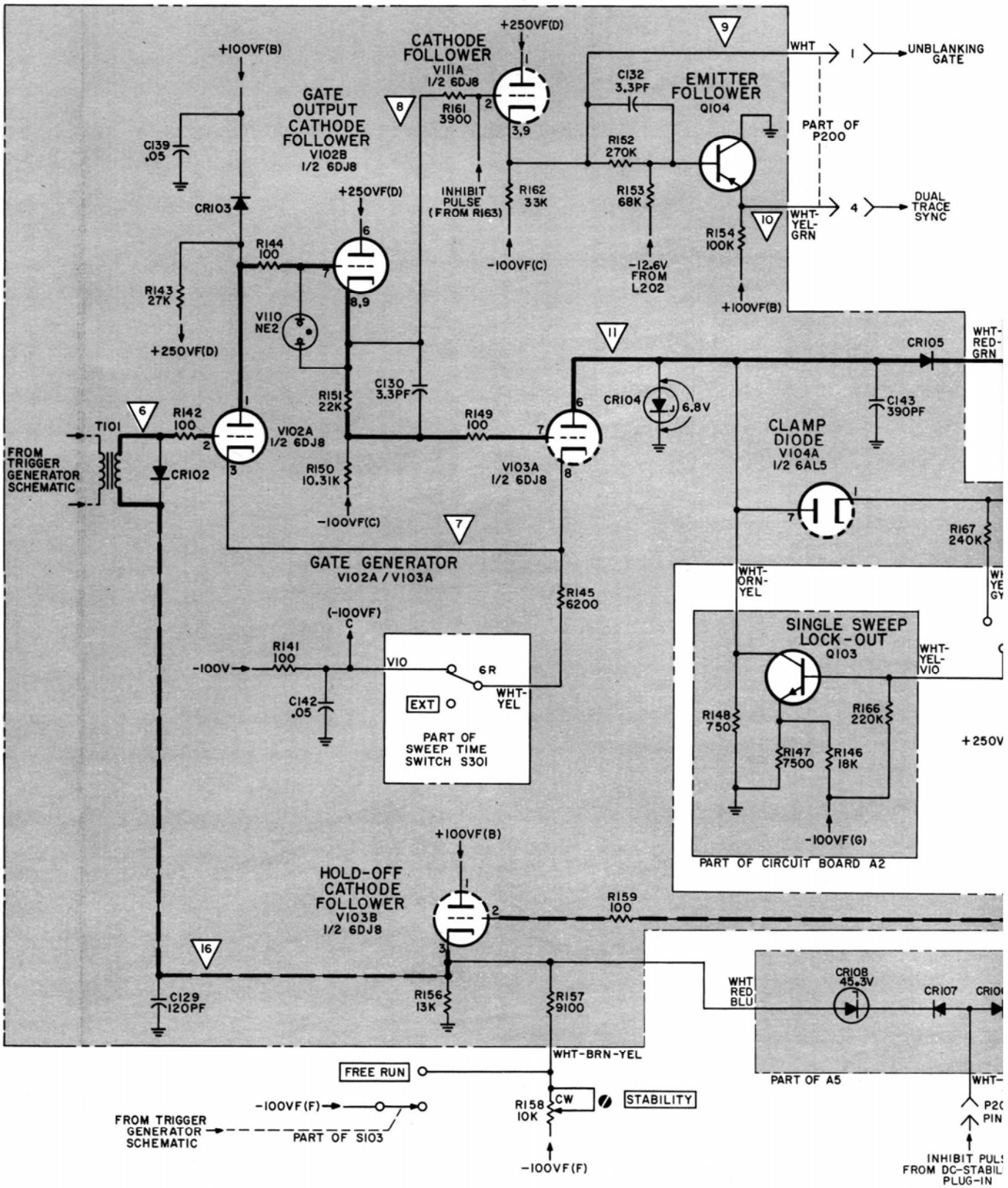
DELETED:
C133, 134, 136, 143, 144
R165, 170, 171

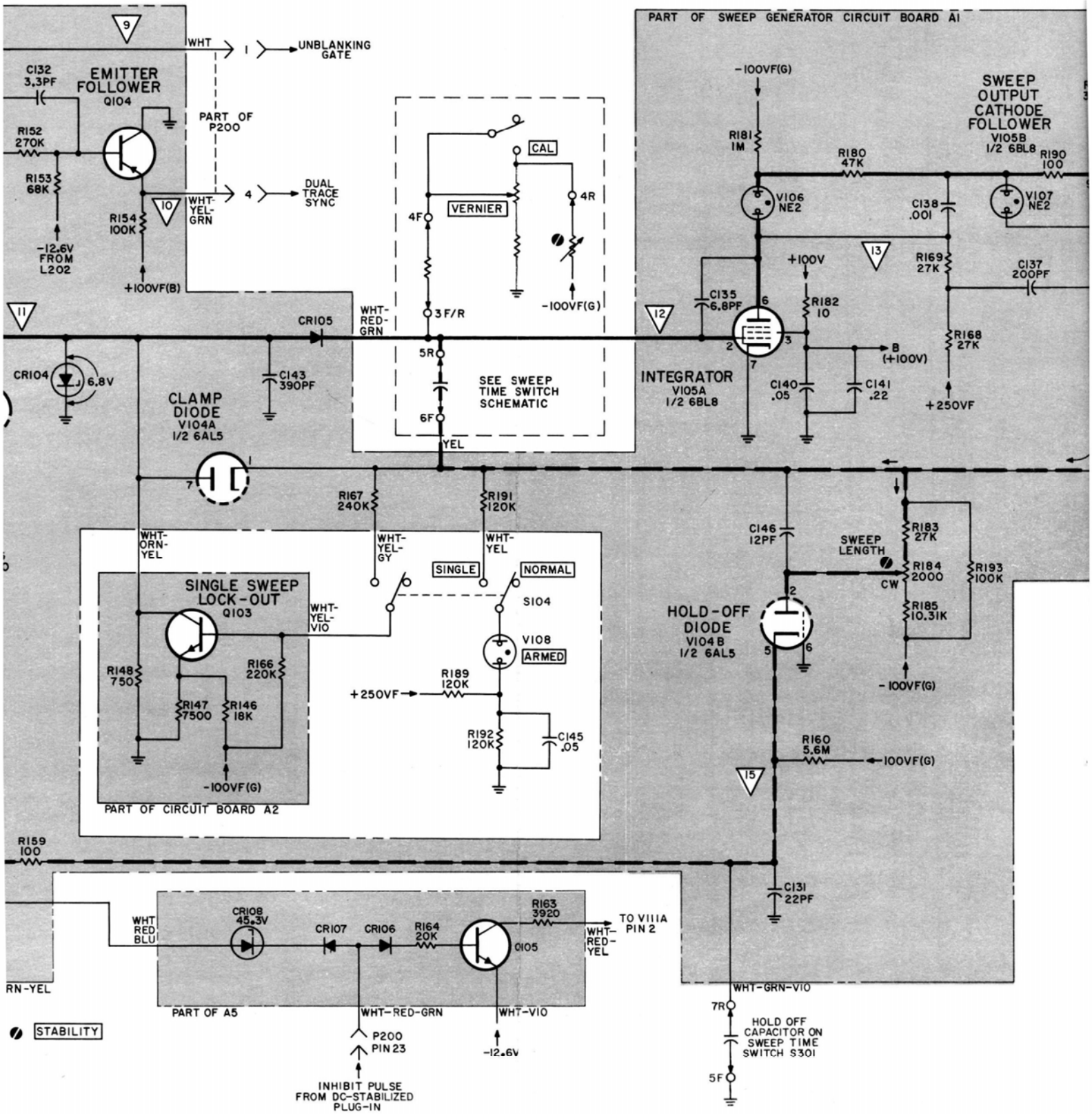
Figure 5-6. Model 1420A Sweep Generator

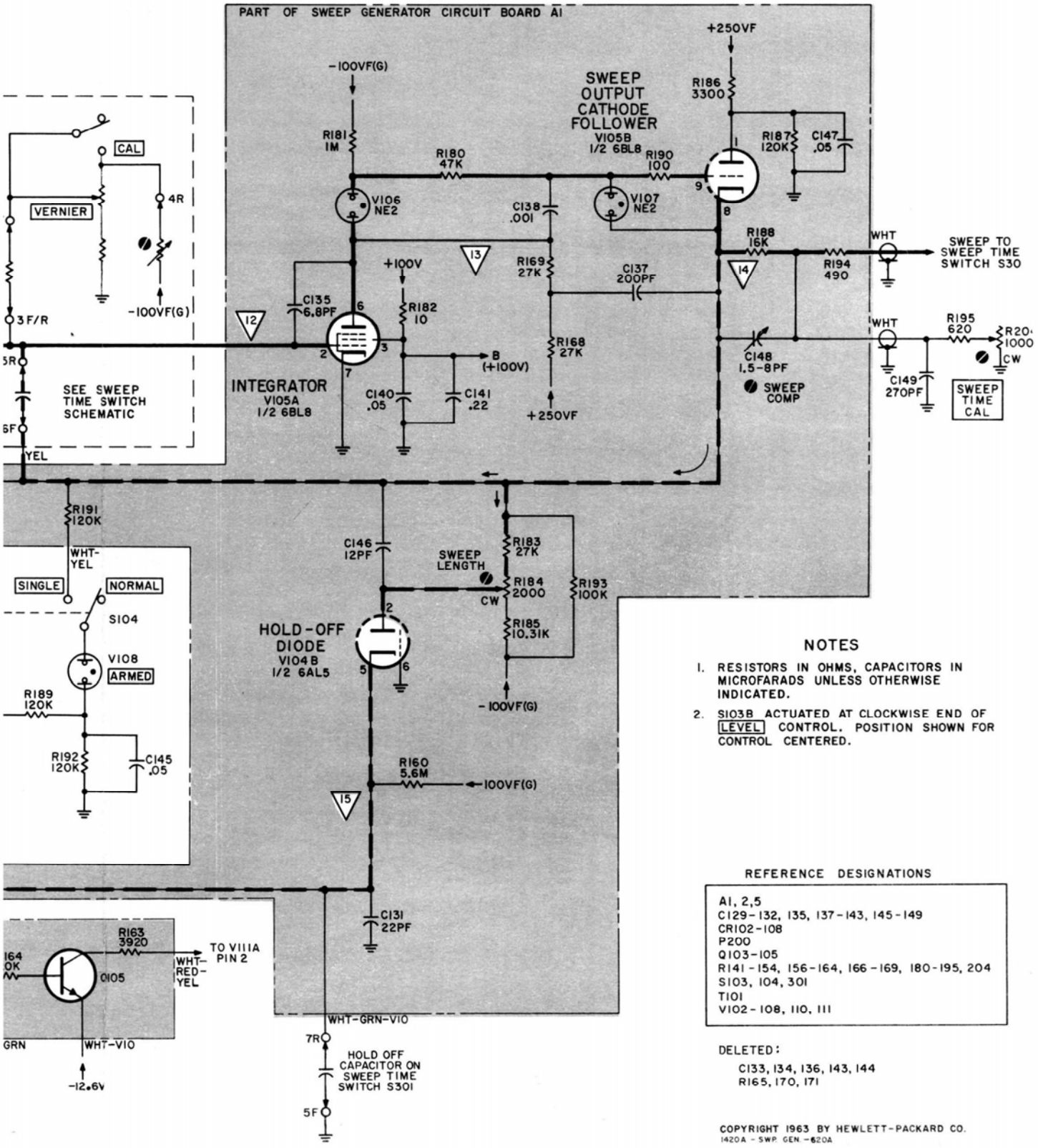
Waveforms at Test Points in Sweep Generator

See conditions of waveform measurement on Page 5-9.




+100VF(B)
CATHODE FOLLOWER V111A 1/2 6DJ8
+250VF(D)
GATE OUTPUT CATHODE FOLLOWER V102B 1/2 6DJ8
EMITTER FOLLOWER Q104
C139 .05
CR103
R161 3900
C132 3.3PF
R152 270K
R153 68K
R154 100K
PART OF P200
WHT
UNBLANKING GATE
DUAL TRACE SYNC
WHT-YEL-GRN
INHIBIT PULSE (FROM R163)
R162 33K
-100VF(C)
-12.6V FROM L202
R144 100
R143 27K
V110 NE2
CR105
WHT-RED-GRN
C130 3.3PF
R151 22K
CR104 6.8V
C143 390PF
T101
R142 100
V102A 1/2 6DJ8
R149 100
V103A 1/2 6DJ8
CLAMP DIODE V104A 1/2 6AL5
FROM TRIGGER GENERATOR SCHEMATIC
CR102
R150 10.31K
R167 240K
GATE GENERATOR V102A / V103A
R145 6200
WHT-ORN-YEL
(-100VF)
R141 100
-100V
V10
6R
WHT-YEL
EXT
C142 .05
PART OF SWEEP TIME SWITCH S301
SINGLE SWEEP LOCK-OUT Q103
WHT-YEL-V10
R148 750
R166 220K
R147 7500
R146 18K
-100VF(G)
PART OF CIRCUIT BOARD A2
HOLD-OFF CATHODE FOLLOWER V103B 1/2 6DJ8
R159 100
C129 120PF
R156 13K
R157 9100
CR108 45.3V
CR107
WHT RED BLU
WHT-BRN-YEL
FREE RUN
PART OF A5
-100VF(F)
FROM TRIGGER GENERATOR SCHEMATIC
PART OF S103
R158 10K
CW
STABILITY
-100VF(F)
INHIBIT PULS FROM DC-STABIL PLUG-IN


PART OF SWEEP GENERATOR CIRCUIT BOARD A1
EMITTER FOLLOWER Q104
C132 3.3PF
R152 270K
R153 68K
R154 100K
-12.6V FROM L202
+100VF(B)
PART OF P200
WHT
1
UNBLANKING GATE
WHT-YEL-GRN
4
DUAL TRACE SYNC
CAL
VERNIER
4F
4R
3F/R
-100VF(G)
WHT-RED-GRN
CR105
5R
6F
YEL
SEE SWEEP TIME SWITCH SCHEMATIC
CR104 6.8V
C143 390PF
CLAMP DIODE V104A 1/2 6AL5
R167 240K
R191 120K
WHT-ORN-YEL
WHT-YEL-GY
WHT-YEL
SINGLE
NORMAL
S104
SINGLE SWEEP LOCK-OUT Q103
WHT-YEL-VIO
V108 ARMED
R148 750
R166 220K
R147 7500
R146 18K
R189 120K
+250VF
R192 120K
C145 .05
-100VF(G)
PART OF CIRCUIT BOARD A2
R159 100
-100VF(G)
R181 1M
R180 47K
SWEEP OUTPUT CATHODE FOLLOWER V105B 1/2 6BL8
R190 100
V106 NE2
V107 NE2
C138 .001
+100V
R169 27K
C137 200PF
C135 6.8PF
R182 10
B (+100V)
R168 27K
INTEGRATOR V105A 1/2 6BL8
C140 .05
C141 .22
+250VF
C146 12PF
SWEEP LENGTH
R183 27K
R184 2000
CW
R185 10.31K
R193 100K
HOLD-OFF DIODE V104B 1/2 6AL5
-100VF(G)
R160 5.6M
-100VF(G)
C131 22PF
CR108 45.3V
WHT
RED
BLU
CR107
CR106
R164 20K
R163 3920
Q105
TO V111A PIN 2
WHT-RED-YEL
PART OF A5
WHT-RED-GRN
WHT-VIO
P200 PIN 23
-12.6V
INHIBIT PULSE FROM DC-STABILIZED PLUG-IN
WHT-GRN-VIO
7R
HOLD OFF CAPACITOR ON SWEEP TIME SWITCH S301
5F
STABILITY



NOTES

1. RESISTORS IN OHMS, CAPACITORS IN MICROFARADS UNLESS OTHERWISE INDICATED.
2. S103B ACTUATED AT CLOCKWISE END OF LEVEL CONTROL. POSITION SHOWN FOR CONTROL CENTERED.

REFERENCE DESIGNATIONS

A1, 2,5
C129-132, 135, 137-143, 145-149
CR102-108
P200
Q103-105
R141-154, 156-164, 166-169, 180-195, 204
S103, 104, 301
T101
V102-108, 110, 111

DELETED:

C133, 134, 136, 143, 144
R165, 170, 171

Figure 5-6. Model 1420A Sweep Generator

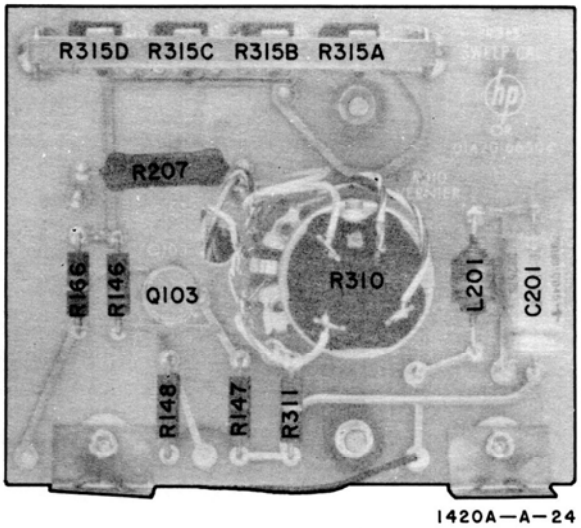


Figure 5-7. Component Locations on Circuit Board A2

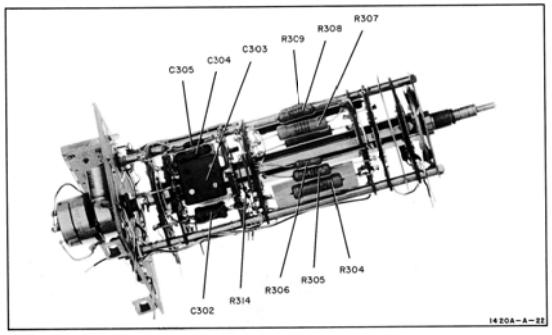


Figure 5-8. Component Locations on Sweep Time Switch, Left

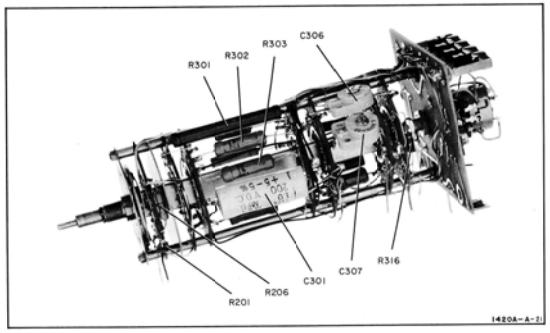


Figure 5-9. Component Locations on Sweep Time Switch, Right

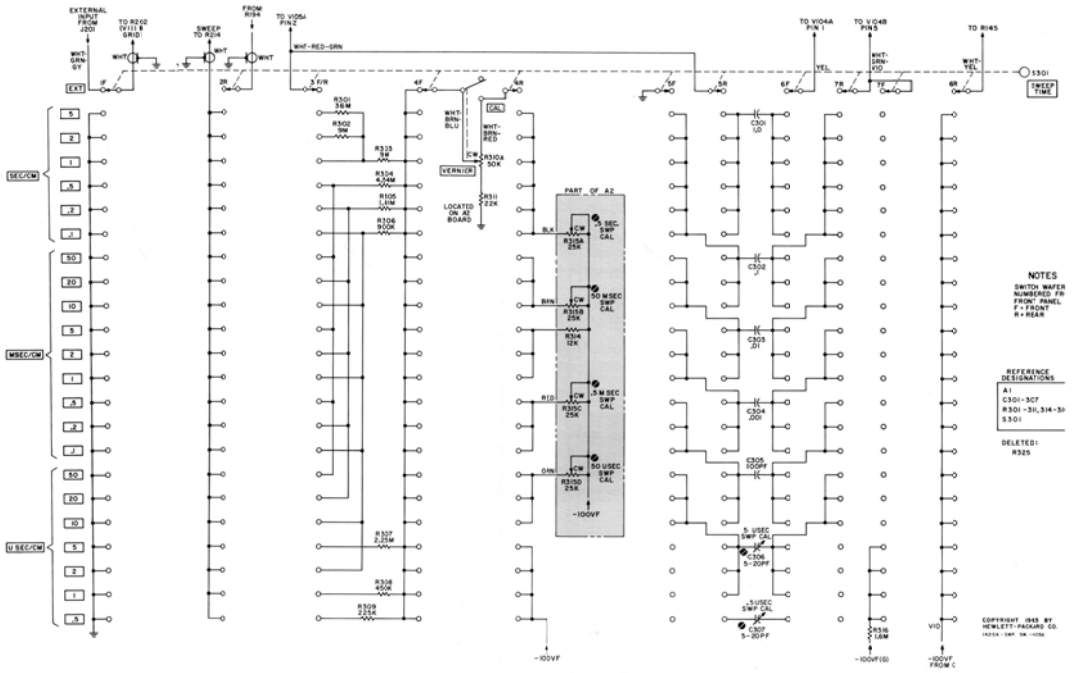


Figure 5-10. Model 1420A Sweep Time Switch

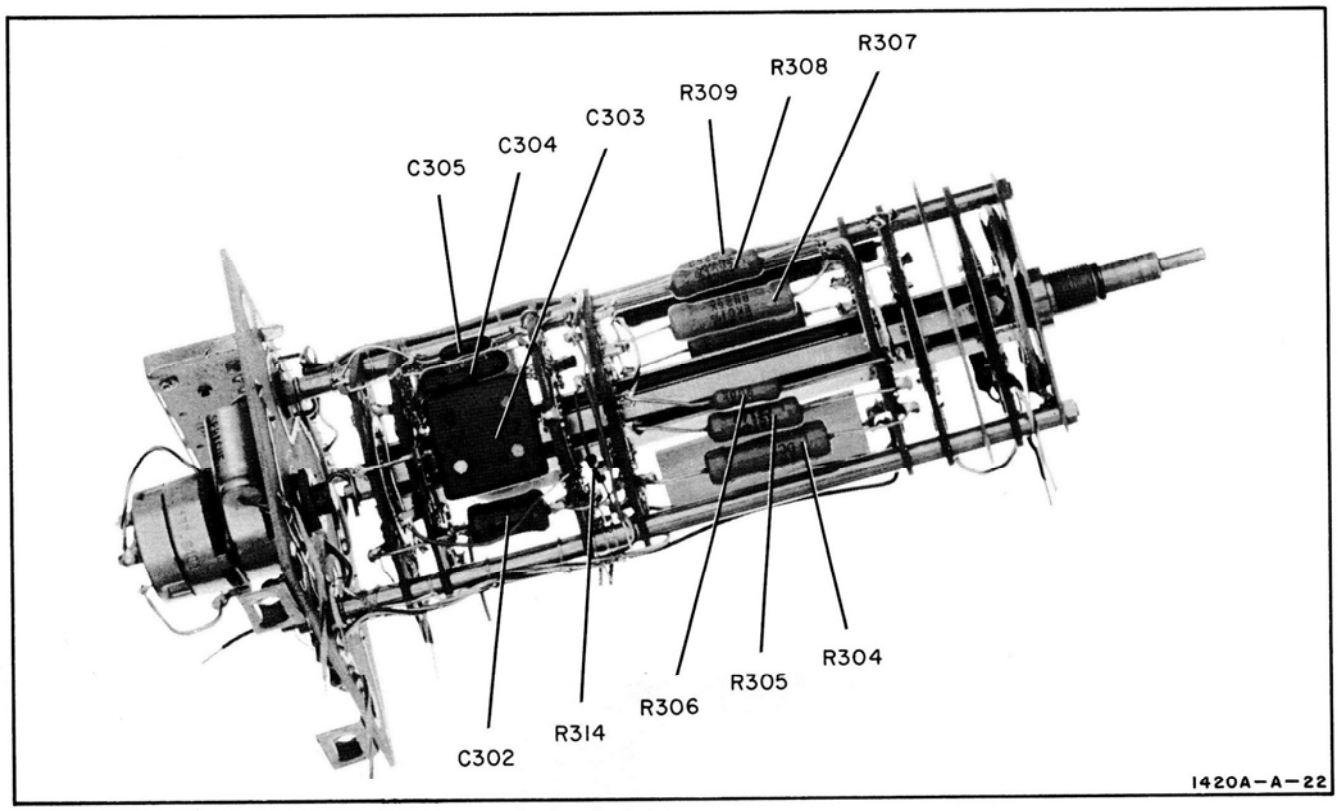


Figure 5-8. Component Locations on Sweep Time Switch, Left

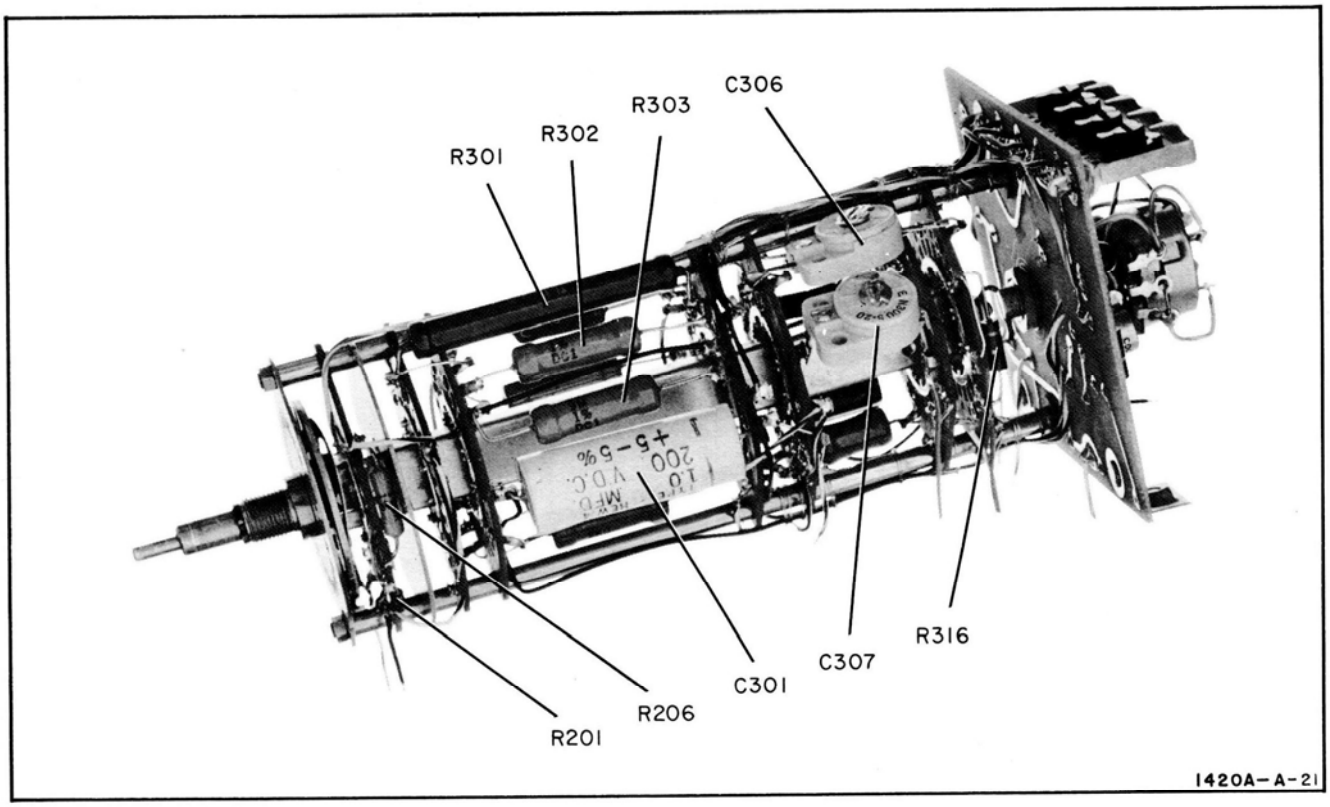
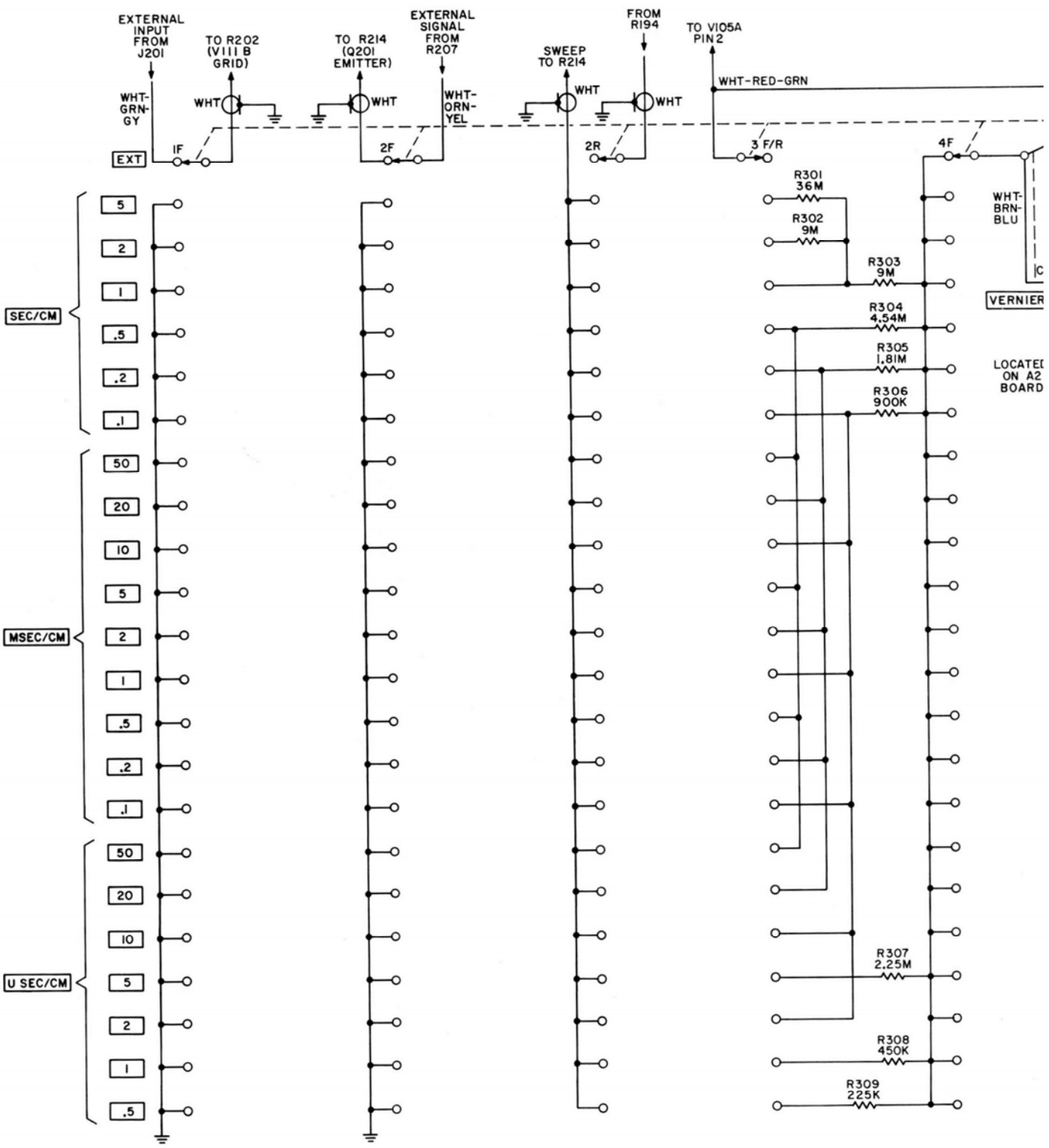
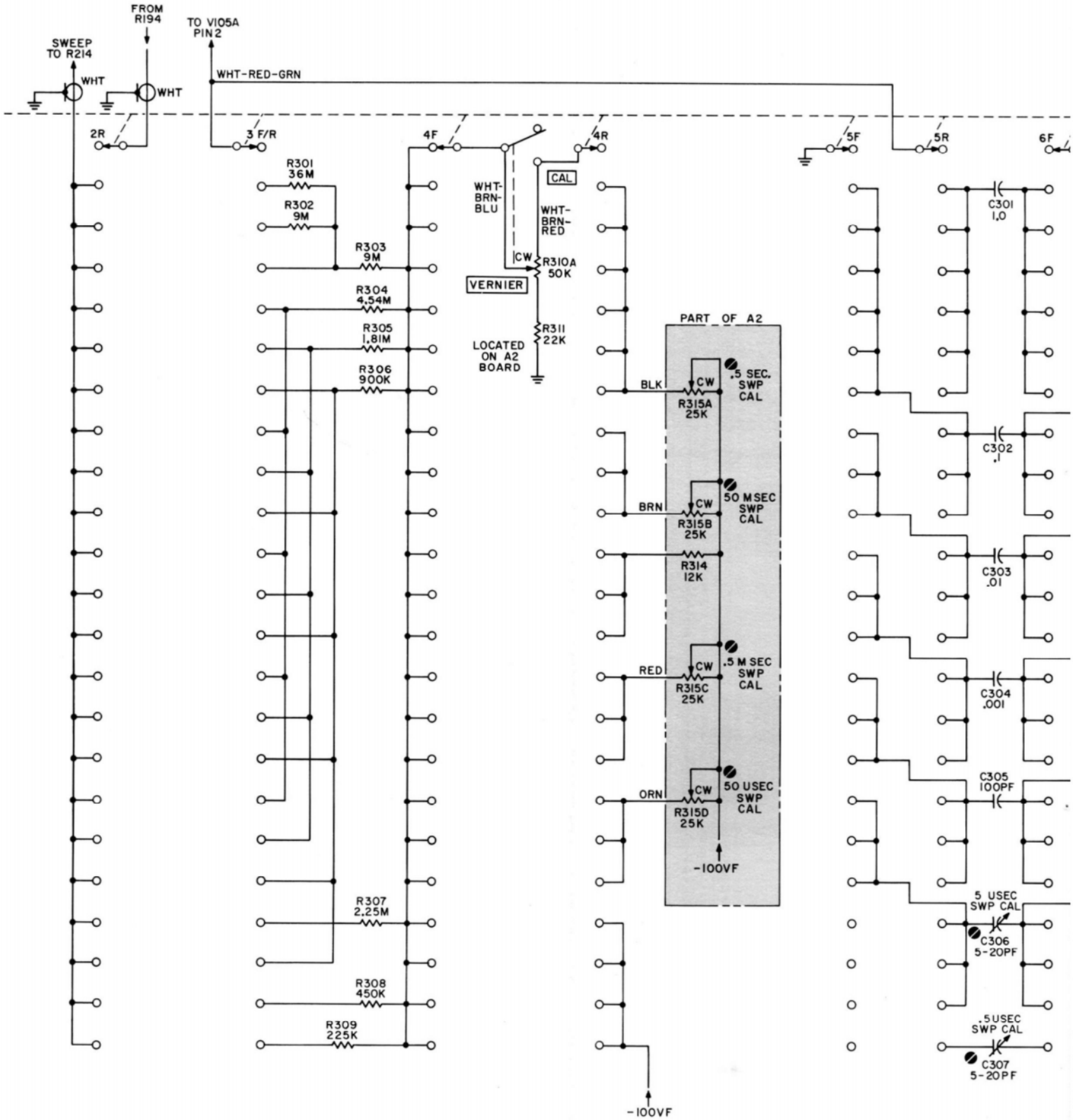


Figure 5-9. Component Locations on Sweep Time Switch, Right

01653-3


EXTERNAL INPUT FROM J201
TO R202 (V111 B GRID)
TO R214 (Q201 EMITTER)
EXTERNAL SIGNAL FROM R207
SWEEP TO R214
FROM R194
TO V105A PIN2
WHT-GRN-GY
WHT
WHT
WHT-ORN-YEL
WHT
WHT
WHT-RED-GRN
EXT
1F
2F
2R
3 F/R
4F
R301 36M
R302 9M
R303 9M
R304 4.54M
R305 1.81M
R306 900K
R307 2.25M
R308 450K
R309 225K
WHT-BRN-BLU
VERNIER
LOCATED ON A2 BOARD
SEC/CM
5
2
1
.5
.2
.1
MSEC/CM
50
20
10
5
2
1
.5
.2
.1
U SEC/CM
50
20
10
5
2
1
.5


FROM R194
TO V105A PIN 2
SWEEP TO R214
WHT
WHT
WHT-RED-GRN
2R
3 F/R
4F
4R
5F
5R
6F
R301 36M
R302 9M
R303 9M
R304 4.54M
R305 1.81M
R306 900K
R307 2.25M
R308 450K
R309 225K
WHT-BRN-BLU
WHT-BRN-RED
CAL
CW
R310A 50K
VERNIER
R311 22K
LOCATED ON A2 BOARD
PART OF A2
BLK
CW
R315A 25K
.5 SEC. SWP CAL
BRN
CW
R315B 25K
50 MSEC SWP CAL
R314 12K
RED
CW
R315C 25K
.5 M SEC SWP CAL
ORN
CW
R315D 25K
50 USEC SWP CAL
-100VF
-100VF
C301 1.0
C302 .1
C303 .01
C304 .001
C305 100PF
5 USEC SWP CAL
C306 5-20PF
.5 USEC SWP CAL
C307 5-20PF

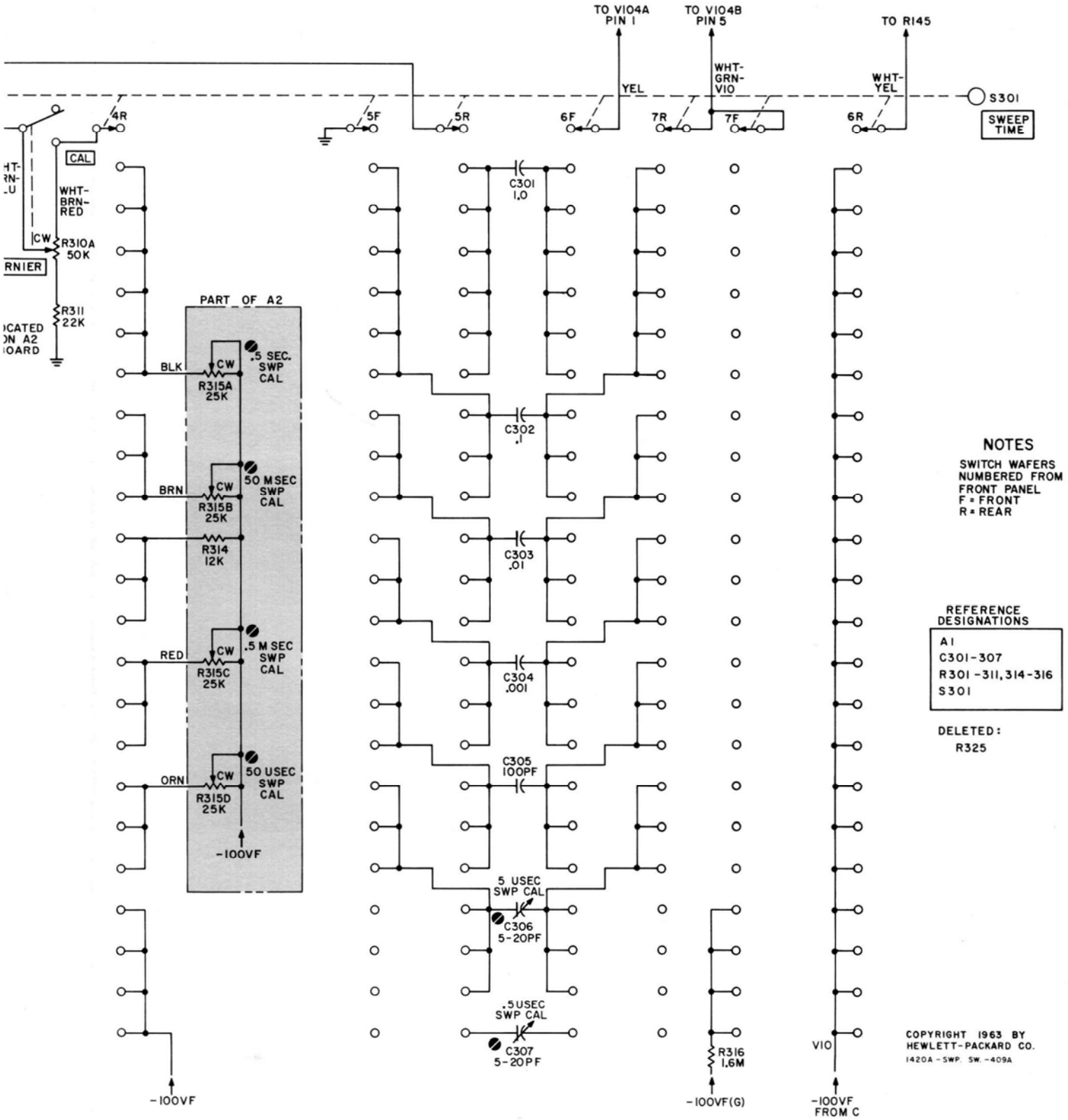


Figure 5-10. Model 1420A Sweep Time Switch

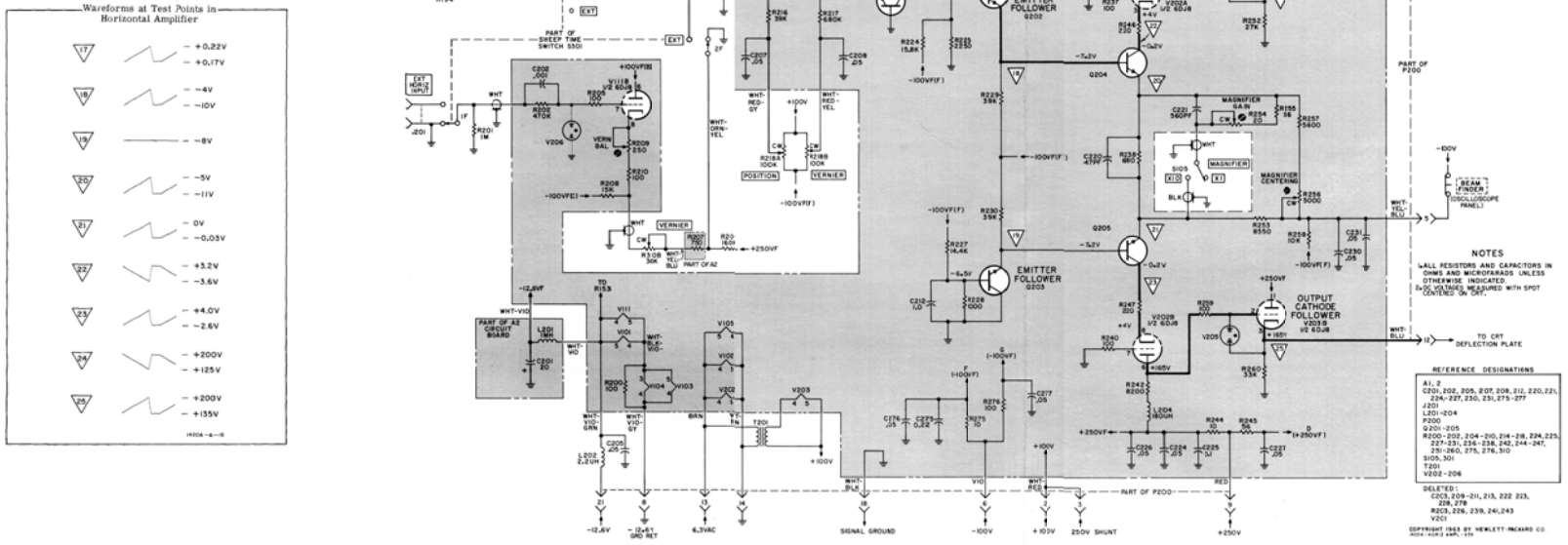
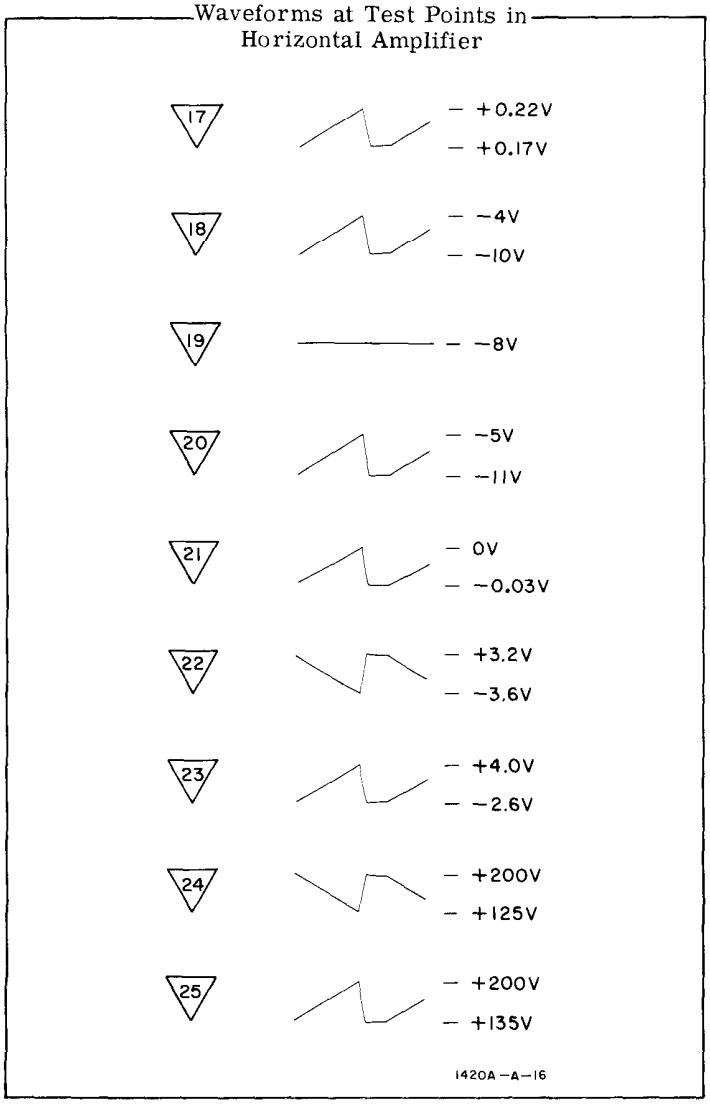
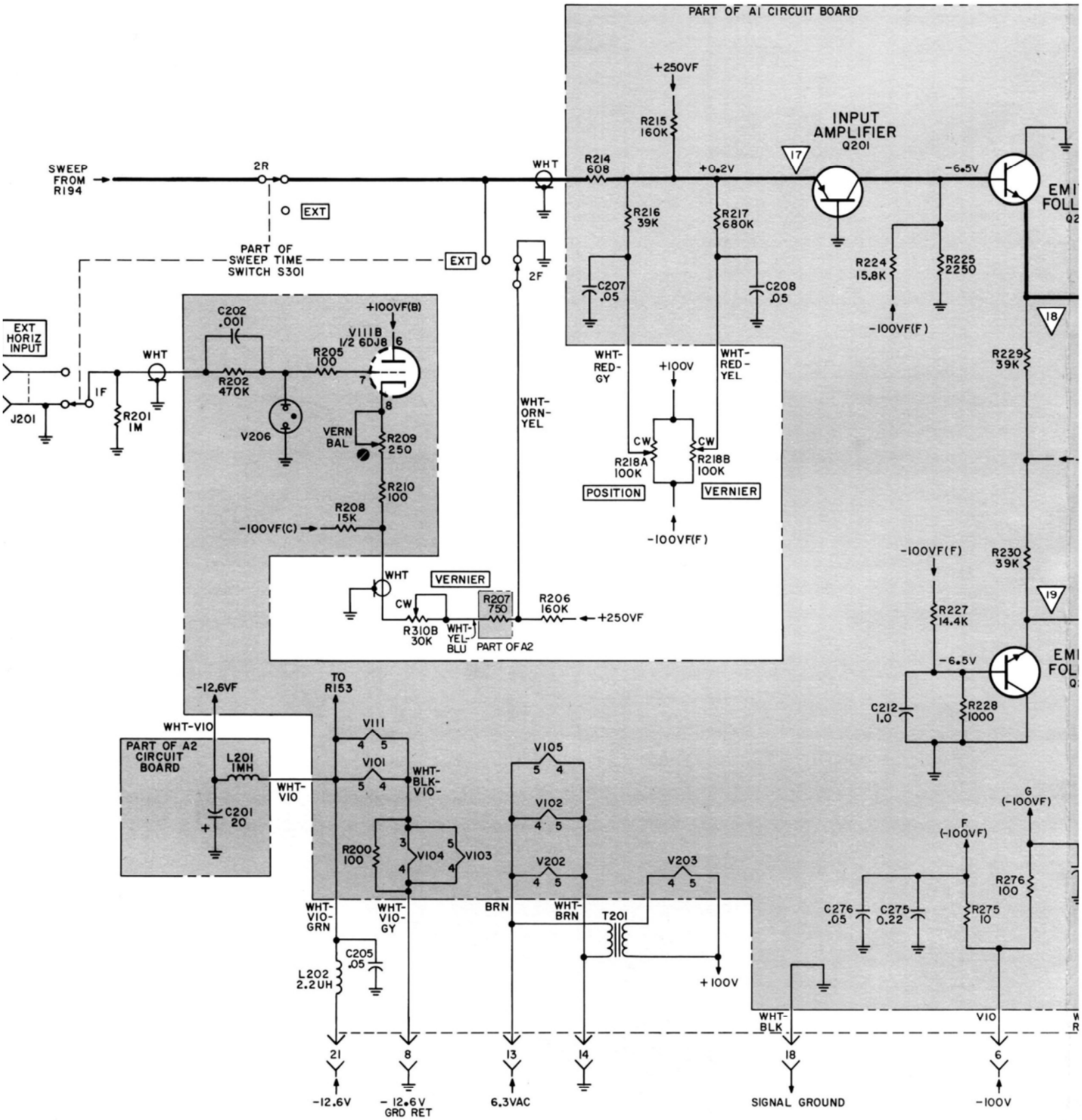


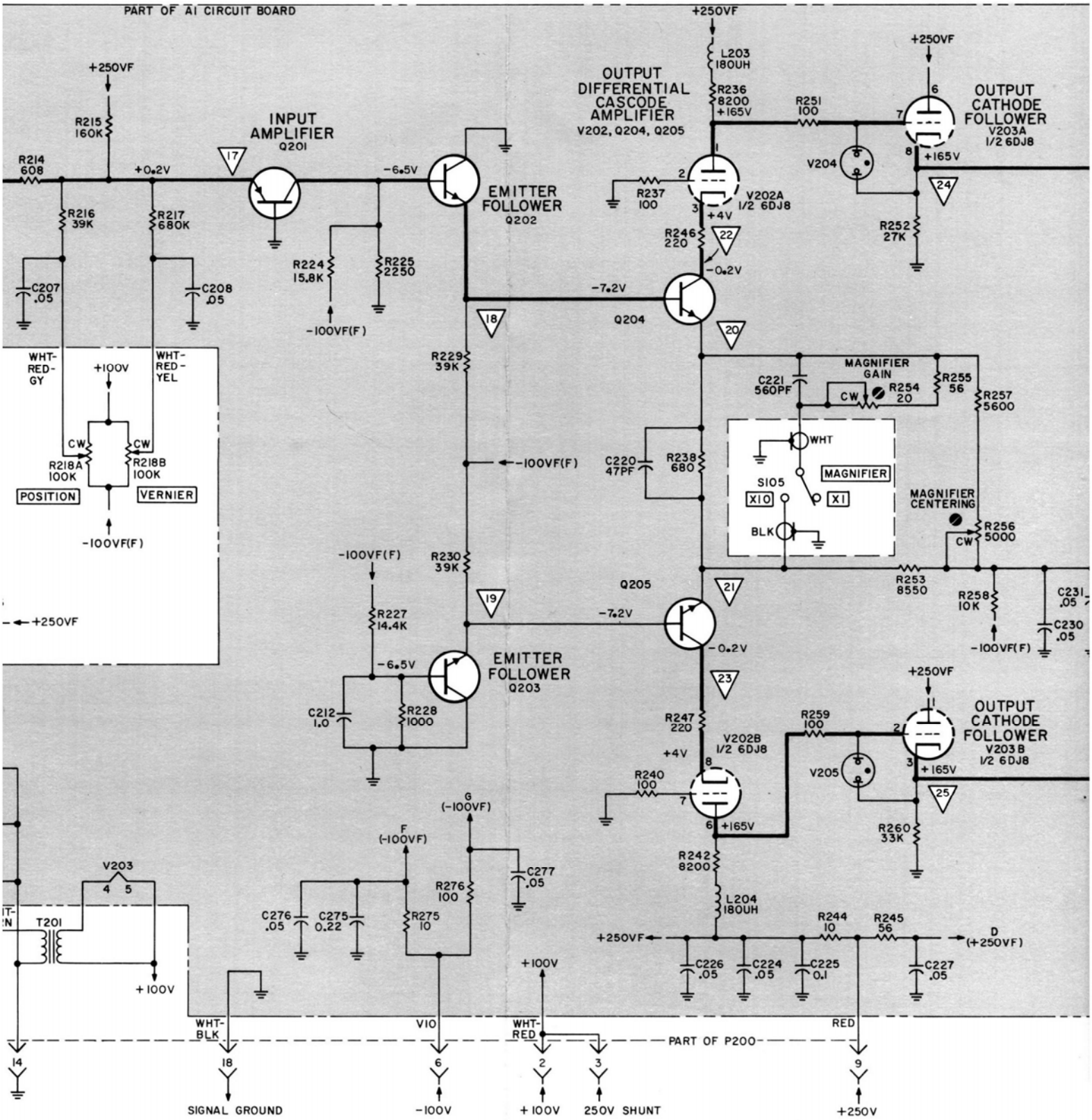
Figure 5-11. Model 1420A Horizontal Amplifier

Waveforms at Test Points in Horizontal Amplifier

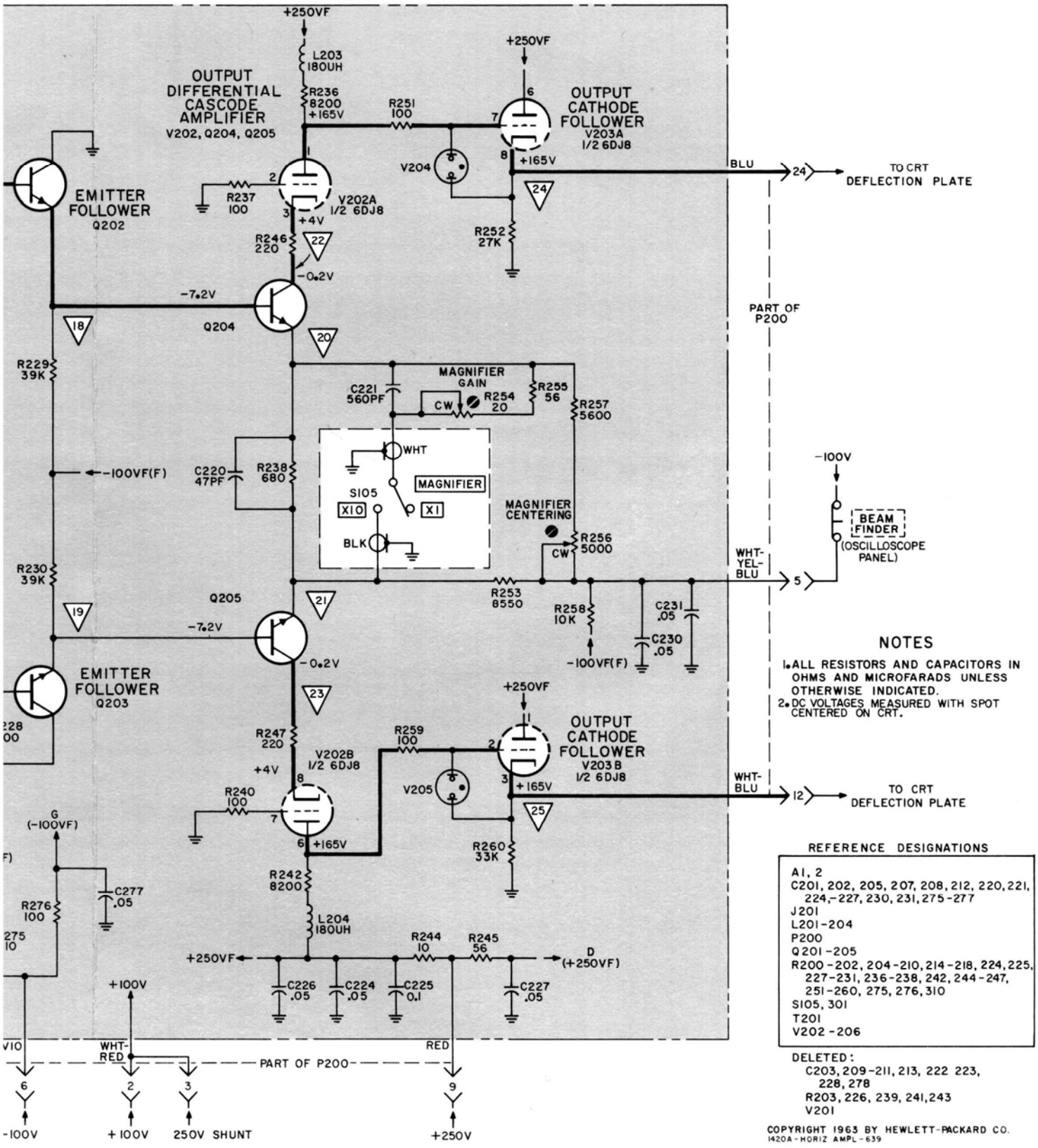


01653-4


PART OF A1 CIRCUIT BOARD
+250VF
R215 160K
INPUT AMPLIFIER Q201
17
SWEEP FROM R194
2R
EXT
WHT
R214 608
+0.2V
-6.5V
R216 39K
R217 680K
R224 15.8K
R225 2250
C207 .05
C208 .05
-100VF(F)
PART OF SWEEP TIME SWITCH S301
EXT
2F
18
EXT HORIZ INPUT
C202 .001
+100VF(B)
V111B 1/2 6DJ8
R205 100
R202 470K
WHT
1F
J201
R201 1M
V206
VERN BAL
R209 250
R210 100
R208 15K
-100VF(C)
WHT-RED-GY
WHT-RED-YEL
+100V
CW
R218A 100K
R218B 100K
POSITION
VERNIER
-100VF(F)
WHT-ORN-YEL
R229 39K
-100VF(F)
R230 39K
19
R227 14.4K
-6.5V
C212 1.0
R228 1000
WHT
VERNIER
CW
R207 750
R206 160K
+250VF
R310B 30K
WHT-YEL-BLU
PART OF A2
-12.6VF
TO R153
WHT-V10
PART OF A2 CIRCUIT BOARD
L201 1MH
C201 20
V111
V101
WHT-BLK-V10-
WHT-V10
V105
V102
V202
V203
R200 100
V104
V103
G (-100VF)
F (-100VF)
R276 100
C276 .05
C275 0.22
R275 10
WHT-V10-GRN
WHT-V10-GY
BRN
WHT-BRN
T201
+100V
C205 .05
L202 2.2UH
WHT-BLK
V10
21
8
13
14
18
6
-12.6V
-12.6V GRD RET
6.3VAC
SIGNAL GROUND
-100V


PART OF A1 CIRCUIT BOARD
+250VF
R215 160K
R214 608
+0.2V
INPUT AMPLIFIER Q201
-6.5V
EMITTER FOLLOWER Q202
R216 39K
R217 680K
C207 .05
C208 .05
R224 15.8K
R225 2250
-100VF(F)
WHT-RED-GY
+100V
WHT-RED-YEL
CW
R218A 100K
R218B 100K
POSITION
VERNIER
-100VF(F)
+250VF
R229 39K
-100VF(F)
R230 39K
R227 14.4K
-6.5V
EMITTER FOLLOWER Q203
C212 1.0
R228 1000
OUTPUT DIFFERENTIAL CASCODE AMPLIFIER V202, Q204, Q205
L203 180UH
R236 8200 +165V
R251 100
OUTPUT CATHODE FOLLOWER V203A 1/2 6DJ8
+165V
V204
R237 100
V202A 1/2 6DJ8
+4V
R246 220
-0.2V
-7.2V
Q204
R252 27K
C221 560PF
MAGNIFIER GAIN
R254 20
R255 56
R257 5600
C220 47PF
R238 680
WHT
MAGNIFIER
S105
X10
X1
BLK
MAGNIFIER CENTERING
R256 5000
CW
R253 8550
R258 10K
C231 .05
C230 .05
-100VF(F)
Q205
-7.2V
-0.2V
R247 220
V202B 1/2 6DJ8
+4V
R240 100
+165V
R259 100
V205
OUTPUT CATHODE FOLLOWER V203B 1/2 6DJ8
+165V
R260 33K
R242 8200
L204 180UH
R244 10
R245 56
D (+250VF)
+250VF
C226 .05
C224 .05
C225 0.1
C227 .05
G (-100VF)
F (-100VF)
C277 .05
R276 100
C276 .05
C275 0.22
R275 10
V203
4 5
T201
+100V
+100V
WHT-BLK
V10
WHT-RED
RED
PART OF P200
14
18
6
2
3
9
SIGNAL GROUND
-100V
+100V
250V SHUNT
+250V

Figure



NOTES

1. ALL RESISTORS AND CAPACITORS IN OHMS AND MICROFARADS UNLESS OTHERWISE INDICATED.
2. DC VOLTAGES MEASURED WITH SPOT CENTERED ON CRT.

REFERENCE DESIGNATIONS

A1, 2
C201, 202, 205, 207, 208, 212, 220, 221, 224, -227, 230, 231, 275-277
J201
L201-204
P200
Q201-205
R200-202, 204-210, 214-218, 224, 225, 227-231, 236-238, 242, 244-247, 251-260, 275, 276, 310
S105, 301
T201
V202-206

DELETED:
C203, 209-211, 213, 222 223, 228, 278
R203, 226, 239, 241, 243
V201

Figure 5-11. Model 1420A Horizontal Amplifier

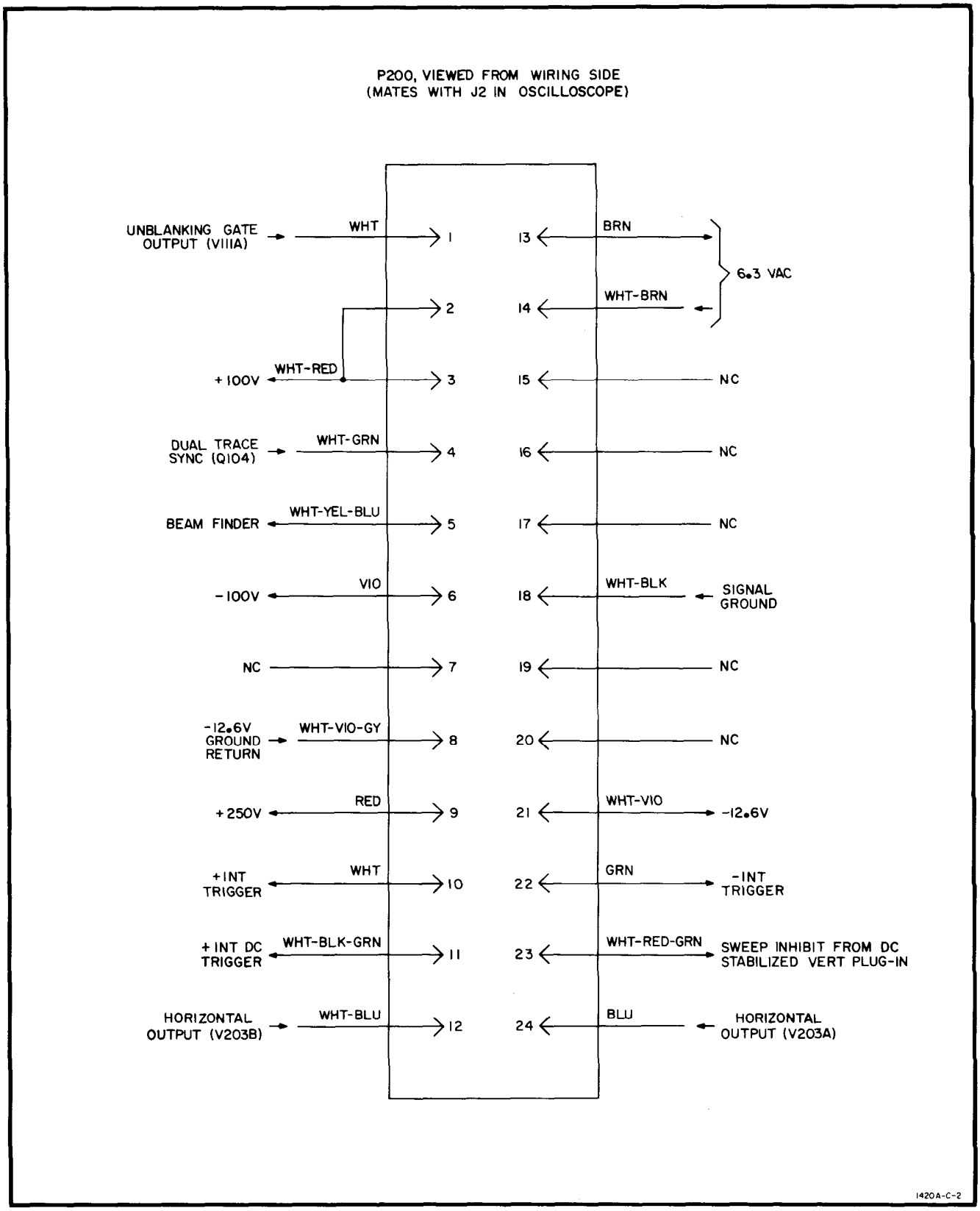


Figure 5-12. Plug-in Connector Diagram

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains the information necessary for ordering replaceable parts. Table 6-2 provides the following information:

a. hp Part Number.

b. Total Quantity (TQ) used in the instrument; given only the first time a part number is listed.

c. Description of part; see Table 6-1 for a list of the reference designators and abbreviations used.

6-3. Miscellaneous parts are listed at the end of Table 6-2.

6-4. ORDERING INFORMATION.

6-5. To order replacement part(s), direct the order or inquiry to the nearest Hewlett-Packard Sales/Service Office (see list at back of this manual). Provide the following information:

a. hp Part Number of item(s).

b. Model number and eight-digit serial number of instrument.

c. Quantity of part(s) desired.

6-6. To order a part not listed or identifiable in the table, provide the following information:

a. Model number and eight-digit serial number of instrument.

b. Part description, including function and location.

Note

Upon request, information will be supplied to allow ordering of applicable parts from manufacturers other than Hewlett-Packard. Contact the hp Sales/Service Office for details.

Table 6-1. Reference Designators And Abbreviations

REFERENCE DESIGNATORS

A = assembly	F = fuse	MP = mechanical part	TP = test point
B = motor	FL = filter	P = plug	V = vacuum tube, neon bulb, photocell, etc.
C = capacitor	J = jack	Q = transistor	
CP = coupling	K = relay	R = resistor	VR = voltage regulator (diode)
CR = diode	L = inductor	RT = thermistor	
DL = delay line	LS = speaker	S = switch	W = cable
DS = device signaling (lamp)	M = meter	T = transformer	X = socket
E = misc electronic part	MC = microcircuit	TB = terminal board	Y = crystal

ABBREVIATIONS

A = amperes	GL = glass	MTG = mounting	RF = radio frequency
AMPL = amplifier	GRD = ground(ed)	MY = "mylar"	
			S-B = slow-blow
	H = henries	N = nano (10^{-9})	SCR = screw
BP = bandpass	HG = mercury	N/C = normally closed	SE = selenium
	HR = hour(s)	NE = neon	SECT = section(s)
CAR = carbon	hp = Hewlett-Packard	N/O = normally open	SEMICON = semiconductor
CCW = counterclockwise		NPO = negative positive zero (zero temperature coefficient)	SI = silicon
CER = ceramic	IF = intermediate freq.		SIL = silver
COEF = coefficient	IMPG = impregnated		SL = slide
COM = common	INCD = incandescent	NSR = not separately replaceable	SPL = special
COMP = composition	INCL = include(s)		
CONN = connector	INS = insulation(ed)		TA = tantalum
CRT = cathode-ray tube	INT = internal	OBD = order by description	TD = time delay
CW = clockwise		OX = oxide	TGL = toggle
	K = kilo = 1000		TI = titanium
DEPC = deposited carbon		PC = printed circuit	TOL = tolerance
	LIN = linear taper	PF = picofarads = 10^{-12} farads	TRIM = trimmer
ELECT = electrolytic	LOG = logarithmic taper		
ENCAP = encapsulated	LPF = low pass filter	PIV = peak inverse voltage	μ = micro = 10^{-6}
EXT = external		P/O = part of	
	M = milli = 10^{-3}	POLY = polystyrene	VAR = variable
F = farads	MEG = meg = 10^{6}	PORC = porcelain	VDCW = dc working volts
FET = field effect transistor	METFLM = metal film	POS = position(s)	
	MET OX = metal oxide	POT = potentiometer	W = with
FXD = fixed	MFR = manufacturer	PK-PK = peak-to-peak	W = watts
	MINAT = miniature		WW = wirewound
GE = germanium	MOM = momentary	RECT = rectifier	W/O = without

Table 6-2. Replaceable Parts

Circuit Reference	hp Part No.	Description	TQ	
A1	01420-66503	ASSY:ETCHED CIRCUIT	1	
A2	01420-66504	ASSY:ETCHED CIRCUIT	1	
A3	01420-61901	ASSY:TRIGGER SLOPE SWITCH	1	
A4	01420-61903	ASSY:SWEEP TIME SWITCH(INCLUDES A2)	1	
A5	01420-66505	ASSY:ETCHED CIRCUIT	1	
C101	0150-0052	C:FXD CER 0.05 UF 20% 400VDCW	21	
C102	0150-0024	C:FXD CER 0.02 UF +80-20% 600VDCW	2	
C103	0150-0052	C:FXD CER 0.05 UF 20% 400VDCW		
C104	0150-0070	C:FXD CER .02 UF 20% 500VDCW	1	
C105	0150-0042	C:FXD TI 4.7 PF 5% 500VDCW	1	
C106	0150-0024	C:FXD CER 0.02 UF +80-20% 600VDCW		
C107 THRU C109		NOT ASSIGNED		
C110	0140-0162	C:FXD MICA 4700 PF 10% 300VDCW	1	
C111	0140-0050	C:FXD MICA 1000 PF 2% 500VDCW	1	
C112	0150-0069	C:FXD CER 1000 PF 500VDCW	4	
C113	0150-0069	C:FXD CER 1000 PF 500VDCW		
C114	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C115	0140-0166	C:FXD MICA 0.017 UF 2% 300VDCW	1	
C116 THRU C119		NOT ASSIGNED		
C120	0160-2056	C:FXD MY 0.22 UF 20% 200VDCW	3	
C121	0140-0156	C:FXD MICA 1500 PF 2% 300VDCW	1	
C122	0140-0182	C:FXD MICA 0.005 UF 2% 300VDCW	1	
C123	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C124	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C125	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C126 THRU C128		NOT ASSIGNED		
C129	0140-0216	C:FXD MICA 120 PF 2% 300VDCW	1	
C130	0150-0022	C:FXD TI 3.3 PF 10% 500VDCW	2	
C131	0140-0145	C:FXD MICA 22 PF 5% 500VDCW	1	
C132	0150-0022	C:FXD TI 3.3 PF 10% 500VDCW		
C133 AND C134		NOT ASSIGNED		
C135	0150-0043	C:FXD TI 6.8 PF 5% 500VDCW	1	
C136		NOT ASSIGNED		
C137	0150-0072	C:FXD CER 200 PF 5% 500VDCW	1	
C138	0150-0069	C:FXD CER 1000 PF 500VDCW		
C139	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C140	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C141	0160-2056	C:FXD MY 0.22 UF 20% 200VDCW		
C142	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C143	0140-0037	C:FXD MICA 390 PF 5% 500VDCW	1	
C144		NOT ASSIGNED		
C145	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C146	0140-0201	C:FXD MICA 12 PF 5% 300VDCW	1	
C147	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C148	0121-0060	C:VAR CER 2-8 PF 300VDCW	1	
C149	0140-0206	C:FXD MICA 270 PF 5% 500VDCW	1	
C150 THRU C200		NOT ASSIGNED		

Table 6-2. Replaceable Parts (Cont'd)

Circuit Reference	hp Part No.	Description	TQ	
C201	0180-0045	C:FXD ELECT 20 UF 25VDCW	1	
C202	0150-0069	C:FXD CER 1000 PF 500VDCW		
C203 AND				
C204		NOT ASSIGNED		
C205	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C206		NOT ASSIGNED		
C207	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C208	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C209 THRU				
C211		NOT ASSIGNED		
C212	0160-0127	C:FXD CER 1 UF 20% 25VDCW	1	
C213 THRU				
C219		NOT ASSIGNED		
C220	0140-0204	C:FXD MICA 47 PF 5% 500VDCW	1	
C221	0140-0178	C:FXD MICA 560 PF 2% 300VDCW	1	
C222 AND				
C223		NOT ASSIGNED		
C224	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C225	0170-0022	C:FXD MY 0.1 UF 20% 600VDCW	1	
C226	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C227	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C228 AND				
C229		NOT ASSIGNED		
C230	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C231	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C232 THRU				
C274		NOT ASSIGNED		
C275	0160-2056	C:FXD MY 0.22 UF 20% 200VDCW		
C276	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C277	0150-0052	C:FXD CER .05 UF 20% 400VDCW		
C278 THRU				
C300		NOT ASSIGNED		
C301	0170-0018	C:FXD MY 1 UF 5% 200VDCW	1	
C302	0170-0019	C:FXD MY 0.1 UF 5% 200VDCW	1	
C303	0140-0070	C:FXD MICA 0.01 UF 1% 300VDCW	1	
C304	0140-0152	C:FXD MICA 1000 PF 5% 300VDCW	1	
C305	0160-0990	C:FXD MICA 100 PF 2% 300VDCW	1	
C306	0130-0006	C:VAR CER 5-20 PF 500VDCW	2	
C307	0130-0006	C:VAR CER 5-20 PF 500VDCW		
CR101	1912-0006	SEMICON DEVICE:DIODE GERMANIUM TUNNEL	1	
CR102	1901-0040	SEMICON DEVICE:DIODE SILICON	1	
CR103	1901-0096	SEMICON DEVICE:DIODE SILICON	1	
CR104	1902-0017	SEMICON DEVICE:DIODE SILICON JUNCTION	1	
CR105	1901-0439	SEMICON DEVICE:DIODE SILICON S2081	1	
CR106, CR107	1901-0025	SEMICON DEVICE:DIODE SILICON	2	
CR108	1902-0038	SEMICON DEVICE:DIODE AVALANCHE 45.3V 5%	1	
J101	1250-0118	CONNECTOR:BNC FEMALE	2	
J102 THRU				
J200		NOT ASSIGNED		
J201	1250-0118	CONNECTOR:BNC FEMALE		
L101	9140-0074	COIL:RF FXD 10 UH	1	
L102 THRU				
L200		NOT ASSIGNED		
L201	9140-0053	COIL:FXD 1 MH 10%	1	
L202	9140-0077	COIL:FXD RF 2.2 UH	1	

Table 6-2. Replaceable Parts (Cont'd)

Circuit Reference	hp Part No.	Description	TQ	
L203	9140-0138	COIL:FXD RF 180 UH	2	
L204	9140-0138	COIL:FXD RF 180 UH		
P200	1251-0055	CONNECTOR:MALE 24 CONTACT	1	
Q101	1850-0096	TRANSISTOR:GERMANIUM PNP 2N2189	1	
Q102	1850-0091	TRANSISTOR:GERMANIUM PNP 2N2048	2	
Q103	1854-0003	TRANSISTOR:SILICON NPN	1	
Q104	1850-0062	TRANSISTOR:GERMANIUM 2N404	1	
Q105	1854-0234	TRANSISTOR:SILICON NPN	1	
Q106 THRU Q200		NOT ASSIGNED		
Q201	1850-0091	TRANSISTOR:GERMANIUM PNP 2N2048		
Q202	1854-0005	TRANSISTOR:SILICON NPN 2N708	2	
Q203	1854-0005	TRANSISTOR:SILICON NPN 2N708		
Q204	1854-0054	TRANSISTOR:SILICON NPN	2	
Q205	1854-0054	TRANSISTOR:SILICON NPN		
R101	2100-0189	R:VAR COMP 1 MEGOHM 30% LIN 1/4W	1	
R102	0683-1045	R:FXD COMP 100K OHM 5% 1/4W	2	
R103	0683-8225	R:FXD COMP 8.2K OHM 5% 1/4W	1	
R104	0757-0433	R:FXD MET FLM 3.32K OHM 1% 1/8W	1	
R105 THRU R109		NOT ASSIGNED		
R110	0683-1055	R:FXD COMP 1 MEGOHM 5% 1/4W	3	
R111	0683-1055	R:FXD COMP 1 MEGOHM 5% 1/4W		
R112	0684-4741	R:FXD COMP 470K OHM 10% 1/4W	3	
R113	0684-4741	R:FXD COMP 470K OHM 10% 1/4W		
R114	0684-2211	R:FXD COMP 220 OHM 10% 1/4W	4	
R115	0684-2211	R:FXD COMP 220 OHM 10% 1/4W		
R116	0683-5605	R:FXD COMP 56 OHM 5% 1/4W	3	
R117	0761-0028	R:FXD MET OX 12K OHM 5% 1W	1	
R118 AND R119		NOT ASSIGNED		
R120	2100-0363	R:VAR WW 10K OHM 5% 1W	1	
R121	0761-0029	R:FXD MET OX 6.8K OHM 5% 1W	1	
R122	2100-1768	R:VAR WW 20 OHM 10% LIN 1/2W	2	
R123	0698-3430	R:FXD COMP 21.5 ohms 1% 1/8w	1	
R124	0683-1025	R:FXD COMP 1000 OHM 5% 1/4W	1	
R125	0684-1011	R:FXD COMP 100 OHM 10% 1/4W	13	
R126 THRU R128		NOT ASSIGNED		
R129	0683-1835	R:FXD COMP 18K OHM 5% 1/4W	1	
R130	0683-1845	R:FXD COMP 180K OHM 5% 1/4W	1	
R131	0727-0287	R:FXD DEPC 2 MEGOHM 1% 1/2W	1	
R132	0730-0132	R:FXD DEPC 7.75 MEGOHM 1% 1W	1	
R133	0730-0143	R:FXD DEPC 10.31 MEGOHM 1% 1W	1	
R134	0683-1035	R:FXD COMP 10K OHM 5% 1/4W	1	
R135	0683-5115	R:FXD COMP 510 OHM 5% 1/4W	1	
R136	0683-4735	R:FXD COMP 47K OHM 5% 1/4W	1	
R137		NOT ASSIGNED		
R138	0683-0275	R:FXD COMP 2.7 OHM 5% 1/4W	1	
R139 AND R140		NOT ASSIGNED		

Table 6-2. Replaceable Parts (Cont'd)

Circuit Reference	hp Part No.	Description	TQ	
R141	0684-1011	R:FXD COMP 100 OHM 10% 1/4W		
R142	0684-1011	R:FXD COMP 100 OHM 10% 1/4W		
R143	0763-0018	R:FXD MET OX 27K OHM 2% 2W	1	
R144	0684-1011	R:FXD COMP 100 OHM 10% 1/4W		
R145	0760-0028	R:FXD MET OX 6.2K OHM 2% 1W	1	
R146	0686-1835	R:FXD COMP 18K OHM 5% 1/2W	1	
R147	0686-7525	R:FXD COMP 7500 OHM 5% 1/2W	1	
R148	0686-7515	R:FXD COMP 750 OHM 5% 1/2W	1	
R149	0684-1011	R:FXD COMP 100 OHM 10% 1/4W		
R150	0730-0031	R:FXD DEPC 10.31K OHM 1% 1W	2	
R151	0730-0039	R:FXD DEPC 22K OHM 1% 1W	1	
R152	0684-2741	R:FXD COMP 270K OHM 10% 1/4W		
R153	0683-6835	R:FXD COMP 68K OHM 5% 1/4W	1	
R154	0683-1045	R:FXD COMP 100K OHM 5% 1/4W		
R155		NOT ASSIGNED		
R156	0686-1335	R:FXD COMP 13K OHM 5% 1/2W	1	
R157	0686-9125	R:FXD COMP 9100 OHM 5% 1/2W	1	
R158	2100-0187	R:VAR COMP 10K OHM 30% LIN 1/2W	1	
R159	0684-1011	R:FXD COMP 100 OHM 10% 1/4W		
R160	0686-5655	R:FXD COMP 5.6 MEGOHM 5% 1/2W	1	
R161	0683-3925	R:FXD COMP 3.9K OHM 5% 1/4W	1	
R162	0761-0079	R:FXD MET OX 33K OHM 5% 1W	1	
R163	0757-0435	R:FXD MET FLM 3.92K OHM 1% 1/8W	1	
R164	0757-0449	R:FXD MET FLM 20K OHM 1% 1/8W	1	
R165		NOT ASSIGNED		
R166	0686-2245	R:FXD COMP 220K OHM 5% 1/2W	1	
R167	0686-2445	R:FXD COMP 240K OHM 5% 1/2W	1	
R168	0687-2731	R:FXD COMP 27K OHM 10% 1/2W	2	
R169	0687-2731	R:FXD COMP 27K OHM 10% 1/2W		
R170 THRU R179		NOT ASSIGNED		
R180	0684-4731	R:FXD COMP 47K OHM 10% 1/4W	1	
R181	0684-1051	R:FXD COMP 1 MEGOHM 10% 1/4W	1	
R182	0684-1001	R:FXD COMP 10 OHM 10% 1/4W	3	
R183	0764-0007	R:FXD MET FLM 27K OHM 5% 2W	2	
R184	2100-0090	R:VAR COMP 2000 OHM 30% LIN 1/3W	1	
R185	0730-0031	R:FXD DEPC 10.31K OHM 1% 1W		
R186	0686-3325	R:FXD COMP 3.3K OHM 5% 1/2W	1	
R187	0761-0088	R:FXD MET OX 120K OHM 5% 1W	1	
R188	0763-0020	R:FXD MET OX 16K OHM 2% 2W	1	
R189	0687-1241	R:FXD COMP 120K OHM 10% 1/2W	1	
R190	0684-1011	R:FXD COMP 100 OHM 10% 1/4W		
R191	0686-1245	R:FXD COMP 120K OHM 5% 1/2W	1	
R192	0683-1245	R:FXD COMP 120K OHM 5% 1/4W	1	
R193	0758-0053	R:FXD MET FLM 100K OHM 5% 1/2W	1	
R194	0727-0075	R:FXD DEPC 490 OHM 1% 1/2W	1	
R195	0757-0088	R:FXD MET OX 620 OHM 2% 1/2W	1	
R196 THRU R199		NOT ASSIGNED		
R200	0757-0198	R:FXD MET FLM 100 OHM 1% 1/2W	1	
R201	0683-1055	R:FXD COMP 1 MEGOHM 5% 1/4W		

Table 6-2. Replaceable Parts (Cont'd)

Circuit Reference	hp Part No.	Description	TQ	
R202	0684-4741	R:FXD COMP 470K OHM 10% 1/4W		
R203		NOT ASSIGNED		
R204	2100-0194	R:VAR COMP 1K OHM 20% LIN 1/2W	1	
R205	0684-1011	R:FXD COMP 100 OHM 10% 1/4W		
R206	0727-0959	R:FXD DEPC 160K OHM 1% 1/2W	2	
R207	0727-0090	R:FXD DEPC 750 OHM 1% 1/2W	1	
R208	0761-0074	R:FXD MET OX 15K OHM 5% 1W	1	
R209	2100-0128	R:VAR COMP 250 OHM 20% 0.15W	1	
R210	0683-1015	R:FXD COMP 100 OHM 5% 1/4W	1	
R211 THRU R213		NOT ASSIGNED		
R214	0727-0083	R:FXD DEPC 608 OHM 1% 1/2W	1	
R215	0727-0959	R:FXD DEPC 160K OHM 1% 1/2W		
R216	0686-3935	R:FXD COMP 39K OHM 5% 1/2W	1	
R217	0686-6845	R:FXD COMP 680K OHM 5% 1/2W	1	
R218	2100-0955	R:VAR COMP 2 X 100K OHM 20% LIN 2W	1	
R219 THRU R223		NOT ASSIGNED		
R224	0730-0036	R:FXD DEPC 15.8K OHM 1% 1W	1	
R225	0727-0120	R:FXD DEPC 2.25K OHM 1% 1/2W	1	
R226		NOT ASSIGNED		
R227	0730-0034	R:FXD DEPC 14.4K OHM 1% 1W	1	
R228	0727-0100	R:FXD DEPC 1K OHM 1% 1/2W	1	
R229	0687-3931	R:FXD COMP 39K OHM 10% 1/2W	2	
R230	0687-3931	R:FXD COMP 39K OHM 10% 1/2W		
R231 THRU R235		NOT ASSIGNED		
R236	0770-0010	R:FXD MET FLM 8.2K OHM 5% 4W	2	
R237	0684-1011	R:FXD COMP 100 OHM 10% 1/4W		
R238	0727-0085	R:FXD DEPC 680 OHM 1% 1/2W	1	
R239		NOT ASSIGNED		
R240	0684-1011	R:FXD COMP 100 OHM 10% 1/4W		
R241		NOT ASSIGNED		
R242	0770-0010	R:FXD MET FLM 8.2K OHM 5% 4W		
R243		NOT ASSIGNED		
R244	0684-1001	R:FXD COMP 10 OHM 10% 1/4W		
R245	0683-5605	R:FXD COMP 56 OHM 5% 1/4W		
R246	0684-2211	R:FXD COMP 220 OHM 10% 1/4W		
R247	0684-2211	R:FXD COMP 220 OHM 10% 1/4W		
R248 THRU R250		NOT ASSIGNED		
R251	0684-1011	R:FXD COMP 100 OHM 10% 1/4W		
R252	0764-0007	R:FXD MET FLM 27K OHM 5% 2W		
R253	0763-0019	R:FXD MET FLM 8.55K OHM 2% 2W	1	
R254	2100-1768	R:VAR WW 20 OHM 20% LIN 1/2W		
R255	0683-5605	R:FXD COMP 56 OHM 5% 1/4W		
R256	2100-0741	R:VAR WW 5K OHM 5% LIN 2W	1	
R257	0764-0020	R:FXD MET OX 5.6K OHM 5% 2W	1	
R258	0761-0006	R:FXD MET OX 10K OHM 5% 1W	1	
R259	0684-1011	R:FXD COMP 100 OHM 10% 1/4W		
R260	0765-0010	R:FXD MET FLM 33K OHM 10% 2W	1	

Table 6-2. Replaceable Parts (Cont'd)

Circuit Reference	hp Part No.	Description	TQ	
R261 THRU R274		NOT ASSIGNED		
R275	0684-1001	R:FXD COMP 10 OHM 10% 1/4W		
R276	0684-1011	R:FXD COMP 100 OHM 10% 1/4W		
R277 THRU R300		NOT ASSIGNED		
R301	0733-0009	R:FXD DEPC 36 MEGOHM 1% 2W	1	
R302	0730-0138	R:FXD DEPC 9 MEGOHM 1% 1W	2	
R303	0730-0138	R:FXD DEPC 9 MEGOHM 1% 1W		
R304	0730-0162	R:FXD DEPC 4.54 MEGOHM 1% 1W	1	
R305	0727-0391	R:FXD DEPC 1.81 MEGOHM 1% 1/2W	1	
R306	0727-0261	R:FXD DEPC 900K OHM 1% 1/2W	1	
R307	0730-0174	R:FXD DEPC 2.25 MEGOHM 1% 1W	1	
R308	0727-0392	R:FXD DEPC 450K OHM 1% 1/2W	1	
R309	0727-0905	R:FXD DEPC 225K OHM 1% 1/2W	1	
R310	2100-0949	R:VAR COMP 50K/30K OHM 30% 1/3W	1	
R311	0687-2231	R:FXD COMP 22K OHM 10% 1/2W	1	
R312 AND R313		NOT ASSIGNED		
R314	0683-1235	R:FXD COMP 12K OHM 5% 1/4W	1	
R315	2100-0347	R:VAR COMP 3 X 25K OHM 30% 1/4W	1	
R316	0686-1655	R:FXD COMP 1.6 MEGOHM 5% 1/2W	1	
S101		N.S.R. PART OF A3		
S102	3101-0011	SWITCH:SLIDE DPDT	3	
S103		N.S.R. PART OF A3		
S104	3101-0011	SWITCH:SLIDE DPDT		
S105	3101-0011	SWITCH:SLIDE DPDT		
S106 THRU S300		NOT ASSIGNED		
S301		N.S.R. PART OF A4		
T101	175A-60A	TRANSFORMER:PULSE	1	
T102 THRU T200		NOT ASSIGNED		
T201	9100-0272	TRANSFORMER:POWER	1	
V101	5080-0432	ELECTRON TUBE:DUAL TRIODE (AGED 6DJ8)	1	
V102	1932-0035	ELECTRON TUBE:DUAL TRIODE 6DJ8	5	
V103	1932-0035	ELECTRON TUBE:DUAL TRIODE 6DJ8		
V104	1930-0013	ELECTRON TUBE:6AL5	1	
V105	1933-0008	ELECTRON TUBE:TRIODE PENTODE 6BL8	1	
V106	2140-0008	LAMP:NEON NE2	3	
V107	2140-0008	LAMP:NEON NE2		
V108	2140-0018	LAMP:GLOW 1/10W	1	
V109	2140-0008	LAMP:NEON NE2		
V110	2140-0055	LAMP:NEON NE86	3	
V111	1932-0035	ELECTRON TUBE:DUAL TRIODE 6DJ8		
V112 THRU V201		NOT ASSIGNED		
V202	1932-0035	ELECTRON TUBE:DUAL TRIODE 6DJ8		
V203	1932-0035	ELECTRON TUBE:DUAL TRIODE 6DJ8		

Table 6-2. Replaceable Parts (Cont'd)

Circuit Reference	hp Part No.	Description	TQ	
V204	2140-0055	LAMP:NEON NE86		
V205	2140-0055	LAMP:NEON NE86		
XV101	1200-0058	SOCKET:TUBE	7	
XV102	1200-0058	SOCKET:TUBE		
XV103	1200-0058	SOCKET:TUBE		
XV104	1200-0083	SOCKET:TUBE	1	
XV105	1200-0058	SOCKET:TUBE		
XV106 THRU XV110		NOT ASSIGNED		
XV111	1200-0058	SOCKET:TUBE		
XV112 THRU XV201		NOT ASSIGNED		
XV202	1200-0058	SOCKET:TUBE		
XV203	1200-0058	SOCKET:TUBE		
		MISCELLANEOUS		
	01420-66101	ASSY: NEON CLIP	1	
	01400-01201	BRACKET: SIDE	2	
	01420-01202	BRACKET: CABLE	3	
	1390-0035	FASTENER: LATCH	1	
	5000-0536	GUSSET: LEFT	1	
	5000-0535	GUSSET: RIGHT	1	
	0370-0114	KNOB: LEVEL	2	
	0370-0088	KNOB: LOCK	1	
	0370-0116	KNOB: POSITION	1	
	0370-0114	KNOB: POSITION VERNIER		
	0370-0037	KNOB: SWEEP TIME	1	
	0370-0113	KNOB: TRIGGER SOURCE	1	
	0370-0062	KNOB: VERNIER	1	
	01420-00201	PANEL: FRONT	1	
	6960-0016	PLUGBUTTON: NYLON	1	
	01420-00603	SHIELD: EXT TRIG.	1	
	5000-0401	SPRING: GROUND	1	

APPENDIX I
MANUAL CHANGES

This appendix contains information on changes required to adapt this manual to an instrument with a serial prefix indicated below. Check for your instrument serial prefix in the table below and make the numbered changes indicated. Note that these changes adapt the manual to cover a particular instrument as manufactured and therefore do not apply to an instrument subsequently modified in the field. Information on instruments with serial prefixes above 801- will be given in a separate manual change sheet. A different manual, hp Part No. 01420-99001, is required for instruments with serial prefix 326-.

Instrument Serial Prefix	Make Numbered Changes
749-	8
639-01976 & above	7, 8
639-	6 thru 8
620-	5 thru 8
441-	1, 5 thru 8
414-	1 thru 3, 5 thru 8
409-	1, 2, 4 thru 8

CHANGE 1

Note

Change 1 relates to a modification which must be made before the Model 1420A is operated with vertical plug-in units which are dc-stabilized. This modification can be accomplished in the field. Order hp Part No. 01420-69502, which provides complete instructions and a kit of parts required. To adapt this manual to cover instruments without the change:

Page 4-5, Paragraph 4-38,
Delete entire paragraph.
Page 5-9, Figure 5-4,
Delete R104 and the circuit connection indicated.
Page 5-11, Figure 5-6,
Delete circuit connections and components as follows:
CR106, CR107, CR108, Q105, R163, and R164.
Table 6-2,
Delete information for the following components: A5, CR106, CR107, CR108, Q105, R163, and R164.

CHANGE 2

Page 5-11, Figure 5-6,
R148: Change value to 1100 ohms.
Page 5-15, Figure 5-11,
Q204, Q205: Change transistor type to 2N2958.
R209: Change value to 500 ohms.
R210: Change value to 180 ohms.
Table 6-2,
R148: Change to hp Part No. 0686-1125; R: FXD, COMP, 1100 ohms, 5% 1/2w.
Q204, Q205: Change to hp Part No. 1854-0036; TRANSISTOR, SILICON, NPN, 2N2958.
R209: Change to hp Part No. 2100-0151; R: VAR, COMP, 500 ohms, 20%, LIN, 0.2w.
R210: Change to hp Part No. 0683-1815; R: FXD, COMP, 180 ohms, 5%, 1/4w.

CHANGE 3

Page 5-11, Figure 5-6,
C149: Change value to 100 pf.
Table 6-2,
C149: Change to hp Part No. 0140-0176; C: FXD, MICA, 100 pf, 5% 300VDCW.

CHANGE 4

Table 6-2,
C149: Change to hp Part No. 0140-0191; C: FXD, MICA, 100 pf, 5% 300VDCW.

CHANGE 5

Table 6-2,
R122: Change to hp Part No. 2100-0388; R: VAR, WW, 20 ohms, 20% LIN 2w.

CHANGE 6

Table 6-2,
R254: Change to hp Part No. 2100-0388; R: VAR, WW, 20 ohms, 20% LIN 2w.
V101: hp Part No. 5080-0432 is preferred replacement.
V102, V103, V111, V202, V203: hp Part No. 1932-0035 is preferred replacement.

CHANGE 7

Page 5-15, Figure 5-11,
R246, R247: Change value to 390 ohms.
Table 6-2,
R246, R247: Change to hp Part No. 0683-3915; R: FXD, COMP, 390 ohms, 5% 1/4w.

CHANGE 8

Table 6-2, under Miscellaneous,
hp Part No. 5000-0536: Change to hp Part No. 01420-00101.
hp Part No. 5000-0535: Change to hp Part No. 01420-00102.
hp Part No. 01400-01201: Delete.
hp Part No. 01420-01202: Delete.

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