Errata

Title & Document Type: **1421A Time Base and Delay Generator Operating and Service Manual**

Manual Part Number: **01421-90905**

Revision Date: **April 1968**

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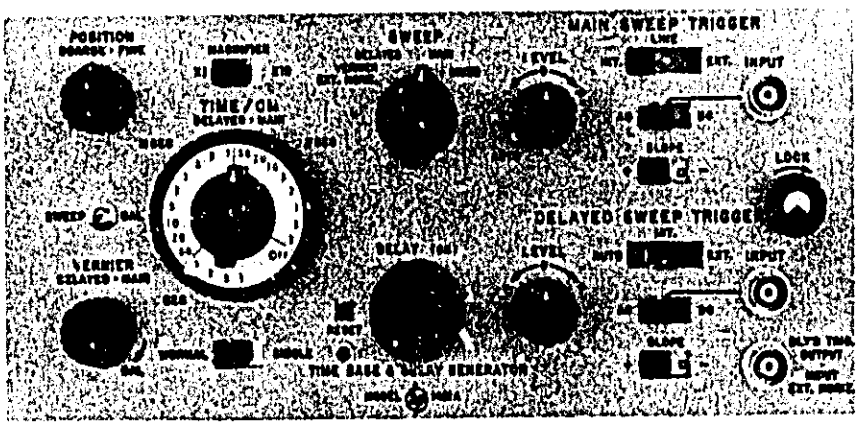
Agilent Technologies

OPERATING AND SERVICE MANUAL

TIME BASE AND DELAY GENERATOR

1421A



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CERTIFICATION

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.

WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

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OPERATING AND SERVICE MANUAL

HP Part Number: 01421-90905

MODEL 1421A
TIME BASE AND DELAY GENERATOR

Microfiche Number: 01421-90805

SERIALS PREFIXED: 803-

See Section I For Instruments
With Other Serial Prefixes.

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PRINTED: APR 1968

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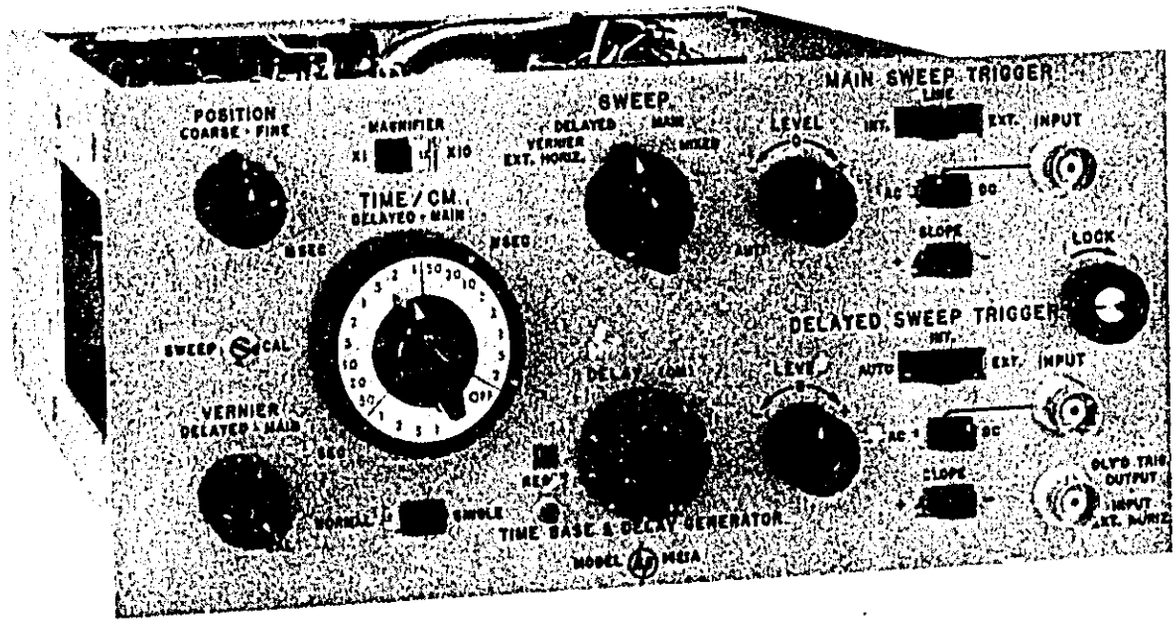


Figure 1-1. Model 1421A Time Base and Delay Generator

Table 1-1. Specifications

MAIN SWEEP For displaying signals vs time where sweep delay is not required; employs only the main time base.

RANGE: 21 ranges, 0.2 μsec/cm to 1 sec/cm in a 1, 2, 5 sequence. Accuracy is 3%. Vernier provides continuous adjustment between ranges and extends slowest sweep to at least 2.5 sec/cm.

TRIGGERING (1421A used with 1402A Dual Trace Amplifier):

Amplitude Selection:

Internal: Approximately 10 cps to 15 Mc from signals causing 0.5 cm or more vertical deflection, to 20 Mc from signals causing 1 cm or more deflection; also from line signal.

External:

DC: DC to 20 Mc from signals 0.5 v p-p or more.

AC: Approximately 5 cps to 20 Mc from signals 0.5 v p-p or more.

Trigger Point and Slope: Controls allow selection of level and positive or negative slope. Trigger level of external sync signal adjustable from -5 to +5 volts.

Automatic: Bright base line displayed in absence of an input signal. Triggers internally down to 40 cps on signals having 1 cm or more vertical deflection; also on line signal. Triggers externally down to 40 cps on signals 1 v p-p or more. Trigger slope selectable, positive or negative.

INTENSIFIED MODE: Used for setting up Delayed or Mixed sweep mode by increasing in brightness that part of Main sweep which will be expanded to full screen in Delayed Sweep or made magnified part of display in Mixed sweep. Rotating Delayed sweep time switch from OFF position activates intensified mode.

DELAYED SWEEP Delayed time base sweeps after a time delay set by the Main sweep and Delay controls.

RANGE: 17 ranges, 0.2 μsec/cm to 50 msec/cm in a 1, 2, 5 sequence. Accuracy is 3%. Vernier provides continuous adjustment between ranges and extends slowest sweep to at least 125 msec/cm.

SECTION I
GENERAL INFORMATION

1-1. SCOPE OF MANUAL.

1-2. This manual provides information for operating and servicing the Hewlett-Packard Company Model 1421A Time Base and Delay Generator. The information in this manual supplements that presented in the Operating and Service Manual for the hp Model 140 Oscilloscope and its other plug-in units. For information on the other plug-in units, refer to the Operating and Service Manual for that particular unit.

1-3. DESCRIPTION.

1-4. The hp Model 1421A Time Base and Delay Generator (Figure 1-1) is a sweep generating plug-in unit for the Model 140 Oscilloscope. The plug-in unit provides the Oscilloscope with normal (main) sweep time speeds of from 0.2 μsec/cm to 1 sec/cm and with delayed sweep speeds of from 0.2 μsec/cm to 50 msec/cm. The main or delayed sweep speeds may be used either separately or combined to obtain a dual sweep-speed display. A vernier provided for each sweep time selector permits continuous adjustment between ranges and extends the slowest main sweep speed to at least 2.5 sec/cm and the slowest delayed sweep speed to at least 125 msec/cm.

1-5. A single sweep function is also provided in the Model 1421A; this feature, usable in any of the three modes of operation and at any sweep speed, is useful for transient waveform photography. A X10 magnifier function (also usable in any mode) expands the trace and increases the maximum sweep speed to 20 nsec/cm.

1-6. The delayed sweep feature of the Model 1421A permits accurate time measurement between a reference signal and a point of interest on a complex waveform or pulse train; it also allows for exact time interval measurement between consecutive pulses in a pulse train or burst. The length of delay before the start of the delayed sweep is adjustable and indicates the exact starting point of the delayed sweep. The mixed sweep feature permits viewing simultaneously the whole character of a complex waveform and an expanded portion of the same waveform.

Table 1-1. Specifications (Cont'd)

DELAY (before start of Delayed Sweep):
- Time: Continuously variable from 0.5 μsec to 10 sec.
- Accuracy: ±1%. Linearity is ±0.2%. Time jitter is less than 1 part in 20,000.
- Trigger Output (at end of delay time): Approximately +4 volts with less than 150 nsec rise time, from 1K output impedance.

TRIGGERING (applies to intensified Main, Delayed, and Mixed sweep modes):
- Automatic: Delayed sweep starts precisely at end of delay period.
- Internal: Delayed sweep triggered by vertical signal after end of delay period; signals must be approximately 10 cps to 15 Mc causing 0.5 cm or more vertical deflection, to 20 Mc from signals causing 1 cm or more deflection.
- External: Delayed sweep triggered by external signal after end of delay period.
  - DC: DC to 20 Mc from signals 0.5 v p-p or more.
  - AC: Approximately 5 cps to 20 Mc from signals 0.5 v p-p or more.
- Trigger Point and Slope (internal and external): Controls allow selection of level and positive or negative slope. Trigger level of external sync signal adjustable from -5 to +5 volts.

MIXED SWEEP Dual sweep-speed display in which Main sweep drives first portion of display and the Delayed sweep completes display at sweep speeds up to 100 times faster. Change-over point determined approximately by delay setting.

TRIGGERING: Same as for Delayed sweep.

HORIZONTAL INPUT
- SENSITIVITY: Approximately 0.3 v/cm (magnifier X10) or 3 v/cm (magnifier X1). Vernier provides continuous adjustment and extends minimum sensitivity to approximately 30 v/cm.
- BANDWIDTH: Typically better than 500 kc.
- INPUT: DC coupled with a positive signal moving beam from left to right. Impedance is 1 megohm shunted by less than 20 pf.

SINGLE SWEEP Any display can be operated in single sweep.

MAGNIFIER Expands any display by 10 times; total sweep accuracy is 5%. Increases fastest sweep to 20 nsec/cm.

GENERAL
- WEIGHT: Net 5 lbs (2, 3kg); shipping 7 lbs. (3, 2kg).

1-7. A typical display presented on the CRT of the Model 140 Oscilloscope for each mode of operation of the Model 1421A is shown in Figure 1-2. Complete specifications of performance for the Model 1421A when installed in a Model 140 are given in Table 1-1.

1-8. MANUAL IDENTIFICATION.

1-9. Information in this manual applies directly to Model 1421A Time Base and Delay Generators with a serial prefix of 803-. The serial prefix is the first three digits of the eight-digit serial number (000-00000) used to identify each hp instrument. If the serial prefix of a Model 1421A is not 803-, a change sheet supplied with the manual or Appendix I at the rear of this manual will define the differences between that Model 1421A and the one described in this manual. Corrections to the manual, due to any errors that existed when it was printed, are called Errata and appear only on the change sheet (if any) supplied with the manual. For information pertaining to change sheets, contact the nearest Hewlett-Packard Sales/Service Office.

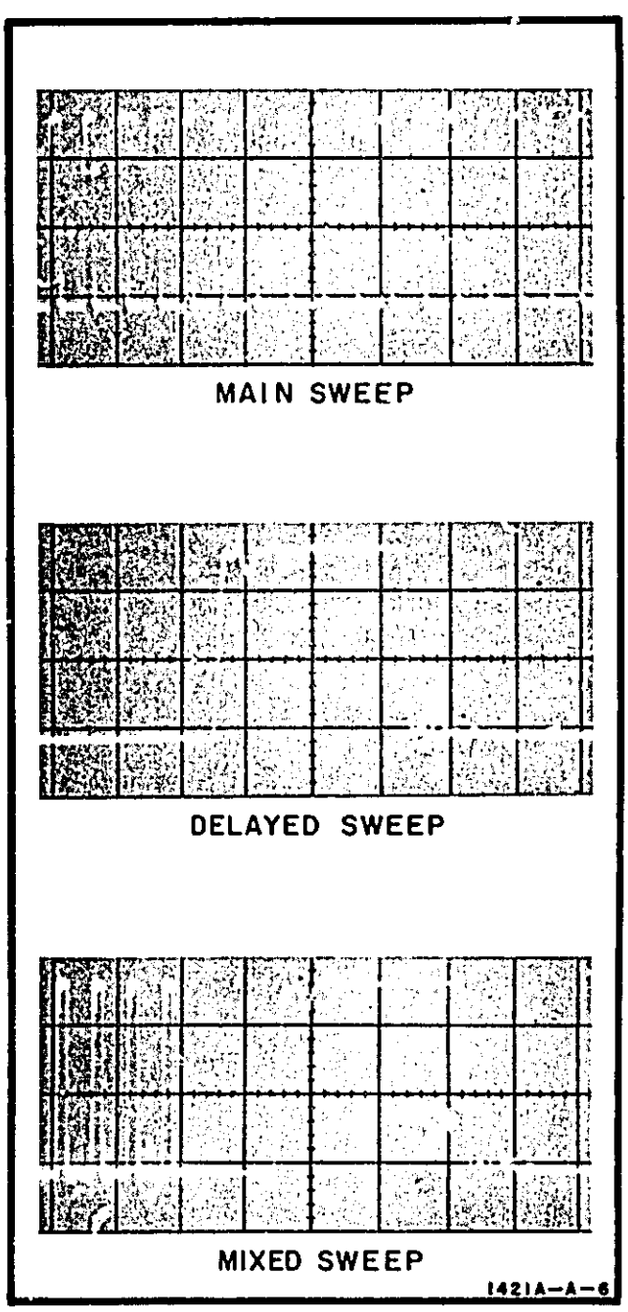


Figure 1-2. Typical Displays Available with Model 1421A

SECTION II
INSTALLATION

2-1. INITIAL INSPECTION.

2-2. MECHANICAL CHECK. Inspect the Model 1421A upon receipt for any damage which may have occurred in transit. Check for external damage such as broken knobs, bent or broken connectors, and dents or scratches on the panel surface. If damage is found, refer to Paragraph 2-6 for recommended claim procedure. Retain packing material for possible future use.

2-3. ELECTRICAL CHECK. Check the electrical performance of the Model 1421A as soon as possible after receipt; see Paragraph 5-5 for recommended performance checks. These checks, when performed, verify that the Model 1421A is operating within its specifications listed in Table 1-1. The performance checks are good test procedures for incoming quality-control inspection. Initial performance and accuracy of the instrument are certified as stated on the inside front cover of this manual. If the Model 1421A does not operate as specified, refer to Paragraph 2-6 for claim procedure.

2-4. PREPARATION FOR USE.

2-5. The Model 1421A Time Base and Delay Generator is a plug-in unit for the Model 140 Oscilloscope. The unit fits into the upper front-panel compartment of the Model 140. To install the Model 1421A, slide it into the upper compartment and rotate the LOCK knob (on front panel) clockwise until the unit is secure. Power for the plug-in unit is supplied by the Oscilloscope and is applied through the mating connector at the rear of the Oscilloscope plug-in compartment.

2-6. CLAIMS.

2-7. The warranty statement applicable to all Hewlett-Packard Company instruments and products is provided inside the front cover of this manual. If physical damage is found or if operation is not as specified when the instrument is first received, notify the carrier and the nearest Hewlett-Packard Sales/Service Office immediately (see list in back of manual for addresses). The Sales/Service Office will arrange for repair or replacement without waiting for settlement of the claim with the carrier.

2-8. REPACKAGING FOR SHIPMENT.

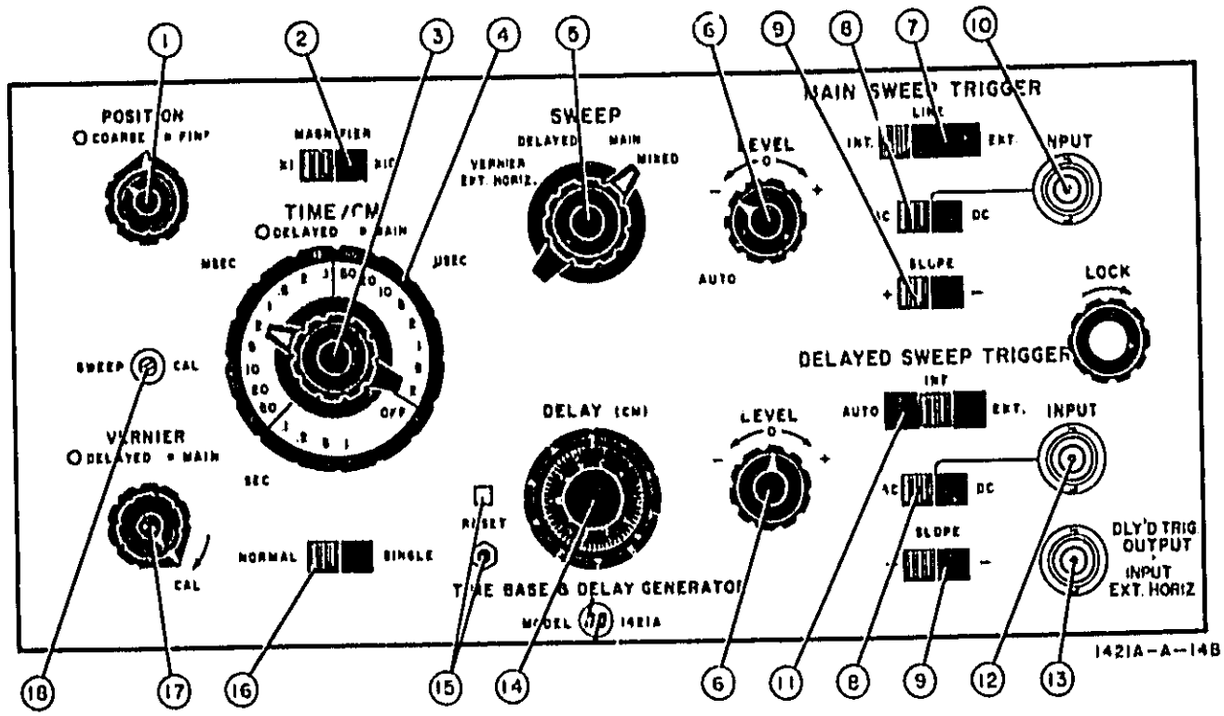
2-9. RETURNING FOR SERVICE OR REPAIR.

2-10. If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office for service or repair, attach a tag showing owner (with address), instrument model number, full serial number (all eight digits), and service or repair required.

2-11. PACKAGING SUGGESTIONS.

2-12. To ensure safe shipment of the Model 1421A, it is recommended that packaging designed for the instrument be used whenever possible. The original shipping carton and packaging material, with the exception of accordion-pleated pads, may be reusable. The nearest Hewlett-Packard Sales/Service Office will also provide information and recommendations on materials to be used if the original packaging material is not available or reusable. Materials used should include: 1) a double-walled carton (check with a freight carrier for required test strength), 2) heavy paper or sheets of cardboard to protect all instrument surfaces; use extra material around projecting parts, 3) at least four inches of tightly-packed shock-absorbing material around instrument, and 4) heavy-duty tape for securing the outside of the carton.

OPERATION



(1) POSITION. Adjust horizontal position of trace.

(2) MAGNIFIER. In X10 position, increases sweep speed by factor of ten, or amplifies EXT. HORIZ INPUT by factor of ten (see Paragraph 3-8).

(3) TIME/CM, MAIN. Selects sweep speed of main time base.

(4) TIME/CM, DELAYED. Selects sweep speed of delayed time base.

(5) SWEEP. Selects type of sweep to be displayed on CRT or external horizontal input capability. Positions of switch are DELAYED sweep, MAIN sweep, MIXED sweep (combination of main and delayed), and EXT. HORIZ. VERNIER. Permits adjustment of horizontal sensitivity when SWEEP is in EXT. HORIZ. position.

(6) LEVEL. Selects triggering point on trigger signal. Main sweep LEVEL control has an AUTO position (see Paragraph 3-11).

(7) MAIN SWEEP TRIGGER. Selects method of triggering main sweep. Positions of switch are INT., LINE, and EXT.

(8) AC-DC. Selects capacitive (AC) or direct (DC) coupling for externally applied trigger signals.

(9) SLOPE. Position selected (+ or -) determines whether triggering occurs on positive-going or negative-going slope of trigger signal.

(10) INPUT. Connector for externally applied main sweep trigger signals.

(11) DELAYED SWEEP TRIGGER. Selects method of trigger delayed sweep. Positions of switch are INT., EXT., and AUTO (see Paragraph 3-10).

(12) INPUT. Connector for externally applied delayed sweep trigger signals.

(13) OUTPUT - INPUT. Connector for delayed trigger output pulse (see Paragraph 3-18), or input for external horizontal signal.

(14) DELAY. Selects time delay in cm before start of delayed sweep (see Paragraph 3-12).

(15) RESET. Push button permits arming sweep circuits for single sweep operation. Lamp, if lit, indicates sweep is armed; lamp extinguishes at end of sweep.

(16) NORMAL-SINGLE. Selects normal sweep or single sweep operation.

(17) VERNIER. Permits selection of sweep times between calibrated steps of TIME/CM selector. When in detent (CAL) position, sweep time is read directly in time/cm.

(18) SWEEP CAL. Adjustment used to calibrate main sweep time (see Paragraph 3-16).

Figure 3-1. Control and Connector Descriptions

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. The Model 1421A Time Base and Delay Generator, a horizontal plug-in unit for the Model 140, provides linear time sweeps for the Oscilloscope. Two separate time sweeps (MAIN and DELAYED) or a combination of both time sweeps (MIXED) are available from the Model 1421A. Each sweep generator within the instrument has controls which determine the triggering conditions and the sweep time per centimeter of display.

3-3. CONTROLS AND CONNECTORS.

3-4. The controls and connectors of the Model 1421A are briefly described by function in Figure 3-1. Additional information on some controls is given in Paragraphs 3-5 through 3-10; these descriptions in some cases apply to the control for both the main and delayed sweep generators.

3-5. POSITION. This control permits centering of any part of the displayed waveform. If the trace is displaced off-screen, press the BEAM FINDER switch on the front panel of the Model 140, and rotate the POSITION control to bring the trace on-screen; for vertical displacement of the trace, use the POSITION control(s) on the front panel of the vertical plug-in unit.

3-6. TIME/CM.

a. MAIN. This selector provides sweep times from 0.2 μsec/cm to 1 sec/cm for displaying signals vs. time where only the main time base is required. For main sweep operation only, the DELAYED TIME/CM selector should be set to its OFF position.

b. DELAYED. This selector provides sweep times from 0.2 μsec/cm to 50 msec/cm for displaying signals vs. time after a specified time delay period. The MAIN and DELAYED selectors are interlocked such that the setting of the DELAYED selector can not equal or exceed the setting of the MAIN selector.

3-7. VERNIER. This control permits setting up sweep times between the calibrated steps of the TIME/CM selector. When the control is set to the detent (CAL) position, sweep time can be read directly in time/cm. The VERNIER control has a total range of approximately 2.5:1. If the MAIN VERNIER is set fully ccw and the MAIN TIME/CM selector is set to 1 SEC/CM, the main sweep time is increased to at least 2.5 sec/cm; if the DELAYED VERNIER is set fully ccw and the DELAYED TIME/CM selector is set to 50 MSEC/CM, the delayed sweep time is increased to at least 125 msec/cm.

3-8. MAGNIFIER. The X10 position of this switch can be used in any mode of operation and increases the sweep speed selected by a factor of 10. With this switch set to X10, divide the MAIN or DELAYED TIME/CM setting (both settings in MIXED operation) by 10 to determine the exact sweep time. Use POSITION controls to place any part of magnified sweep on screen. With SWEEP set to EXT. HORIZ., X10 gives a ten times amplification for an external input.

3-9. MAIN SWEEP TRIGGER. This switch allows selection of any one of three ways to trigger the main sweep generator in the Model 1421A. The three positions of the switch are INTernal, LINE frequency, and EXTernal. In the INT. position, the trigger signal is that signal applied to the vertical plug-in unit; in LINE position, the trigger is at the AC line frequency applied from the Model 140; in EXT., the trigger must be applied to the main sweep trigger INPUT connector on the front panel.

3-10. DELAYED SWEEP TRIGGER. This switch allows selection of any one of three ways of triggering the delayed sweep generator when used. They are INTernal, EXTernal, and AUTOmatic. In the INT. position, the trigger signal is again that signal applied to the vertical plug-in unit; in EXT. position, the trigger must be applied to the delayed sweep trigger INPUT connector on the front panel. In the third position of the switch, AUTO, the sweep is triggered by a signal automatically generated within the Model 1421A.

3-11. LEVEL. This control permits selection of the triggering point on the incoming trigger signal. The LEVEL control for the main sweep also has an AUTO position (detent at extreme ccw position). In the AUTO position a bright trace is present at any setting of the MAIN TIME/CM sweep selector in the absence of a triggering signal. For most purposes, AUTO (free running sweep) is the most convenient position, however, in this position the triggering point is not selectable and the lower frequency limit is 40 cps. If an internal or external trigger signal is applied when the LEVEL control is set to the AUTO position, the trigger overrides the free-running sweep and synchronizes the sweep with the trigger signal.

Note

At some frequencies of an internal or external trigger signal, the trigger may not properly override the free-running sweep in AUTO position, resulting in an unstable (non-synchronous) trace. If this occurs, the LEVEL control should be removed from AUTO position and adjusted for a stable sweep.

3-12. DELAY. The setting of this control determines the time delay, measured in centimeters along the main sweep, before the start of the delayed sweep. The time delay is the product of the setting of the MAIN TIME/CM selector and the DELAY (in cm) control.

For example: If the MAIN TIME/CM selector is set to 5 MSEC/CM and the DELAY control is set to 4.6 cm, the total time delay before the start of the delayed sweep will be 23 milliseconds. Any period of time delay between 0.5 μsec and 10 sec is available by proper setting of the MAIN TIME/CM selector and the DELAY control.

3-13. The delayed sweep starts precisely at the end of the time delay period when the DELAYED SWEEP TRIGGER switch is set to the AUTO position. When using either INT. or EXT. positions of the DELAYED SWEEP TRIGGER switch, the delayed sweep is triggered by the first signal following the end of the selected delay period; therefore, in these positions the selected delay is only an approximation rather than an exact time delay.

3-14. TRIGGERING CONDITIONS.

3-15. Trigger source requirements for the Model 1421A are listed in Table 3-1. The table provides frequency range, amplitude required, and trigger point information for each possible triggering situation.

3-16. SWEEP TIME CALIBRATION.

3-17. Sweep time calibration should be checked and performed, if necessary, each time the Model 1421A is installed in a different Model 140 Oscilloscope. This check and adjustment is required due to deflection plate sensitivity variations in different CRT's. Perform the sweep time calibration following the procedure given in Figure 3-6.

3-18. DELAYED TRIGGER OUTPUT.

3-19. A delayed trigger is available at the front-panel DLY'D TRIG. OUTPUT · INPUT EXT. HORIZ. connector with the SWEEP selector set to DELAYED, MAIN, or MIXED. At the end of the selected time delay, a positive pulse is generated and applied to this connector for use in triggering external equipment.

3-20. EXTERNAL HORIZONTAL INPUT.

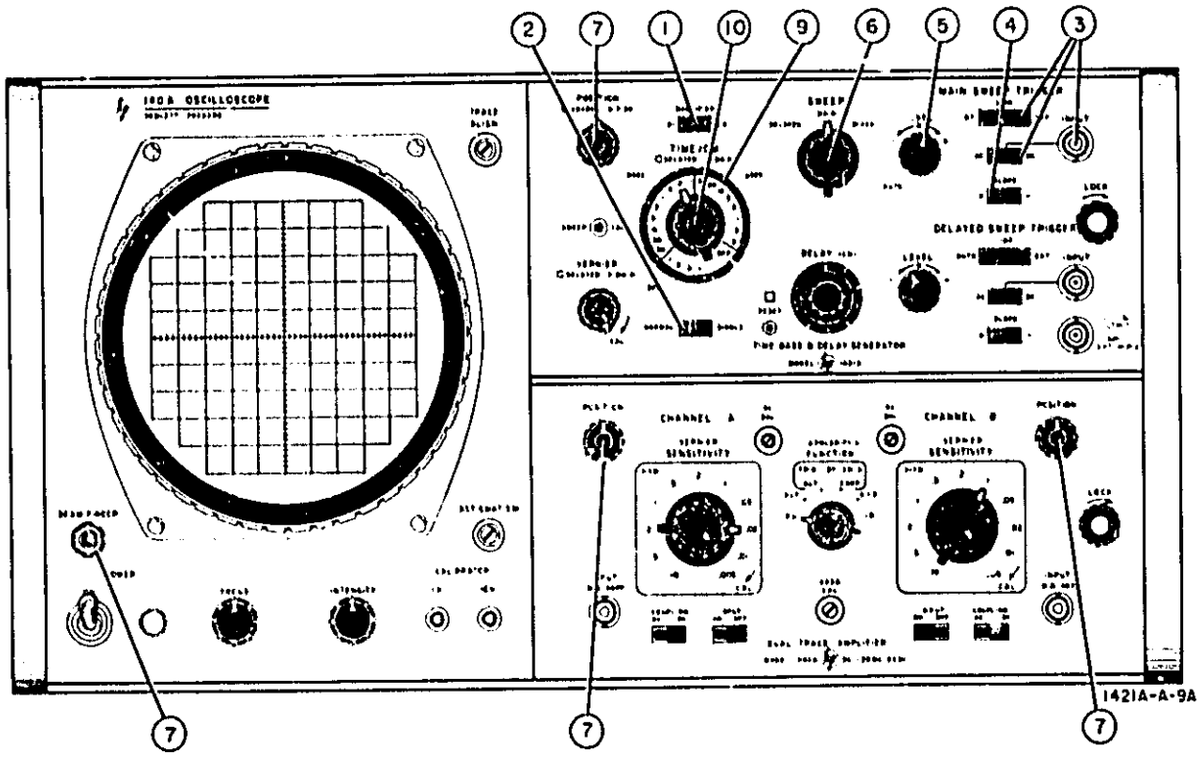
3-21. An external horizontal signal can be applied to the Model 1421A to obtain an X-Y display. The external signal (the X component of the display) is applied through the DLY'D TRIG. OUTPUT · INPUT EXT. HORIZ. connector. Bandwidth of the horizontal input is typically greater than 500kc. SWEEP control must be set to the EXT. HORIZ. position when using an external horizontal input. Sensitivity is then variable with the VERNIER control; the variable range depends on the MAGNIFIER setting. With MAGNIFIER set to X1, sensitivity can be varied from 30v/cm (VERNIER fully ccw) to 3 v/cm (VERNIER fully cw). With MAGNIFIER set to X10, sensitivity can be varied from 3 v/cm (VERNIER fully ccw) to 0.3 v / cm (VERNIER fully cw).

3-22. OPERATING PROCEDURES.

3-23. Operating instructions for the Model 1421A are given in Figures 3-2 through 3-5. Each figure includes a front-panel illustration of the Model 140 Oscilloscope, the vertical plug-in unit (for the purpose of illustration, the Model 1402A is shown), and the Model 1421A. Where a control or connector is used in a procedural step of the instructions, the step number is called out from the control or connector on the illustration.

Table 3-1. Trigger Source Requirements

				Frequency Range	Minimum Amplitude	Trigger Point
MAIN	SELECTABLE LEVEL	INT.		10 cps to 15 Mc	0.5 cm Deflection	Selectable
				10 cps to 20 Mc	1 cm Deflection	
		EXT.	DC	DC to 20 Mc	0.5 v p-p	Selectable, -5 to +5 v
			AC	5 cps to 20 Mc		
		LINE		Line Frequency	None	Selectable
	AUTO LEVEL	INT.		Down to 40 cps	1 cm Deflection	Fixed
		EXT.		Down to 40 cps	1 v p-p	Fixed
		LINE		Line Frequency	None	Fixed
DELAYED	AUTO			Sweeps automatically at end of delay period		
	INT.			10 cps to 15 Mc	0.5 cm Deflection	Selectable
				10 cps to 20 Mc	1 cm Deflection	
	EXT.		DC	DC to 20 Mc	0.5 v p-p	Selectable, -5 to +5 v
			AC	5 cps to 20 Mc		



(1) Set MAGNIFIER switch to X1.

(2) Set NORMAL-SINGLE switch to NORMAL.

(3) Set MAIN SWEEP TRIGGER switch for desired triggering. If EXT. position is selected, required trigger signal (see Table 3-1) must be connected to INPUT connector and AC-DC switch should be set as desired.

(4) Set SLOPE switch as desired.

(5) Set LEVEL control as desired. AUTO. position (detent fully ccw) gives automatic sweep without trigger signal (see Paragraph 3-11).

Note

At some frequencies of an internal or external trigger signal, the trigger may not properly override the free-running sweep in AUTO position, resulting in an unstable (nonsynchronous) trace. If this occurs, the LEVEL control should be removed from AUTO position and adjusted for a stable sweep.

(6) Set SWEEP switch to MAIN.

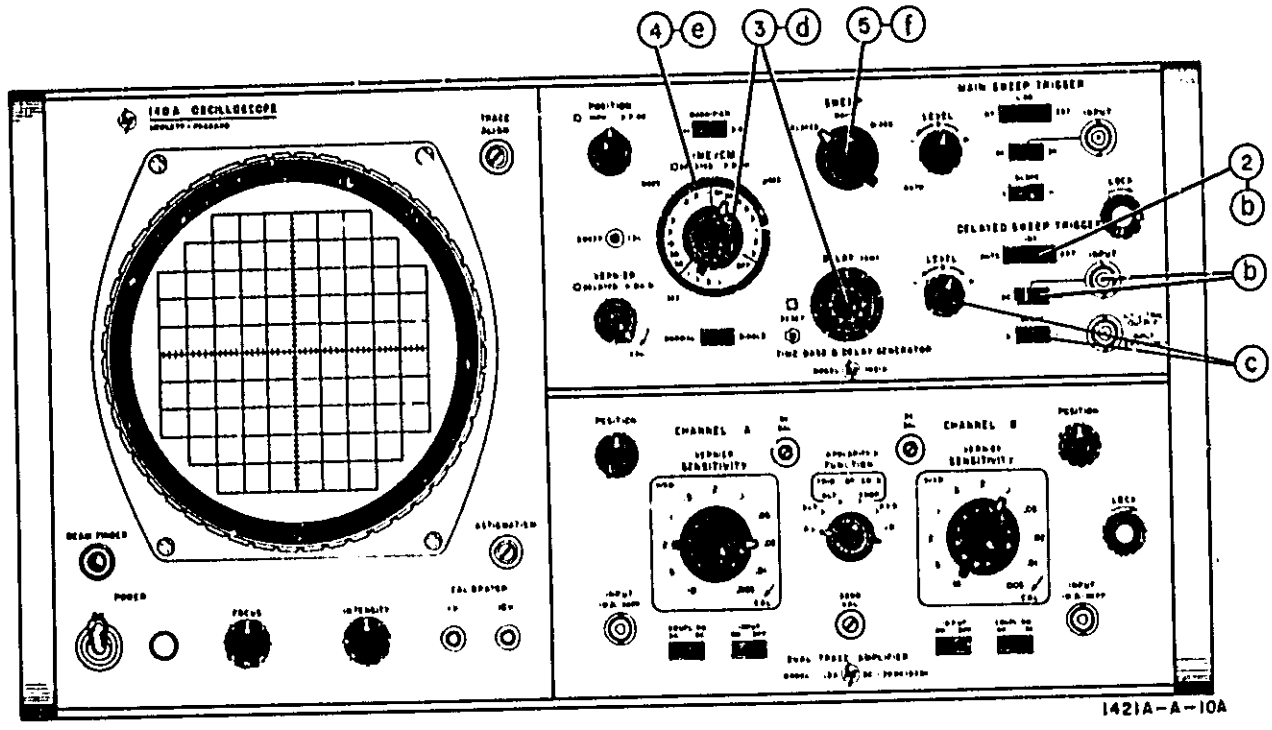
(7) Center trace on screen with horizontal and vertical POSITION controls; use BEAM FINDER switch if necessary.

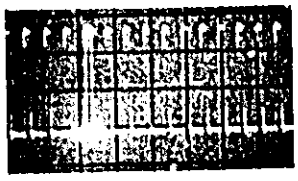
8. Set controls of vertical plug-in unit as desired (refer to operating instructions in manual of vertical plug-in used).

(9) Set DELAYED TIME/CM selector to OFF.

(10) Set MAIN TIME/CM selector to display desired waveform.

Figure 3-2. Main Sweep Operation





AUTOmatic Triggering

1. Perform steps 1 through 8 given in Figure 3-2.

(2) Set DELAYED SWEEP TRIGGER switch to AUTO.

(3) Select desired delay time with MAIN TIME/CM selector and DELAY control (time/cm x delay in cm = delay time).

(4) Select delayed sweep speed with DELAYED TIME/CM selector (intensified portion of waveform as shown in example above will be expanded to full screen).

(5) Set SWEEP switch to DELAYED.

INTernal or EXTernal Triggering

a. Perform steps 1 through 8 given in Figure 3-2.

(b) Set DELAYED SWEEP TRIGGER switch to INT. or EXT. If EXT. position is selected, required trigger signal (see Table 3-1) must be connected to INPUT connector and AC-DC switch should be set as desired.

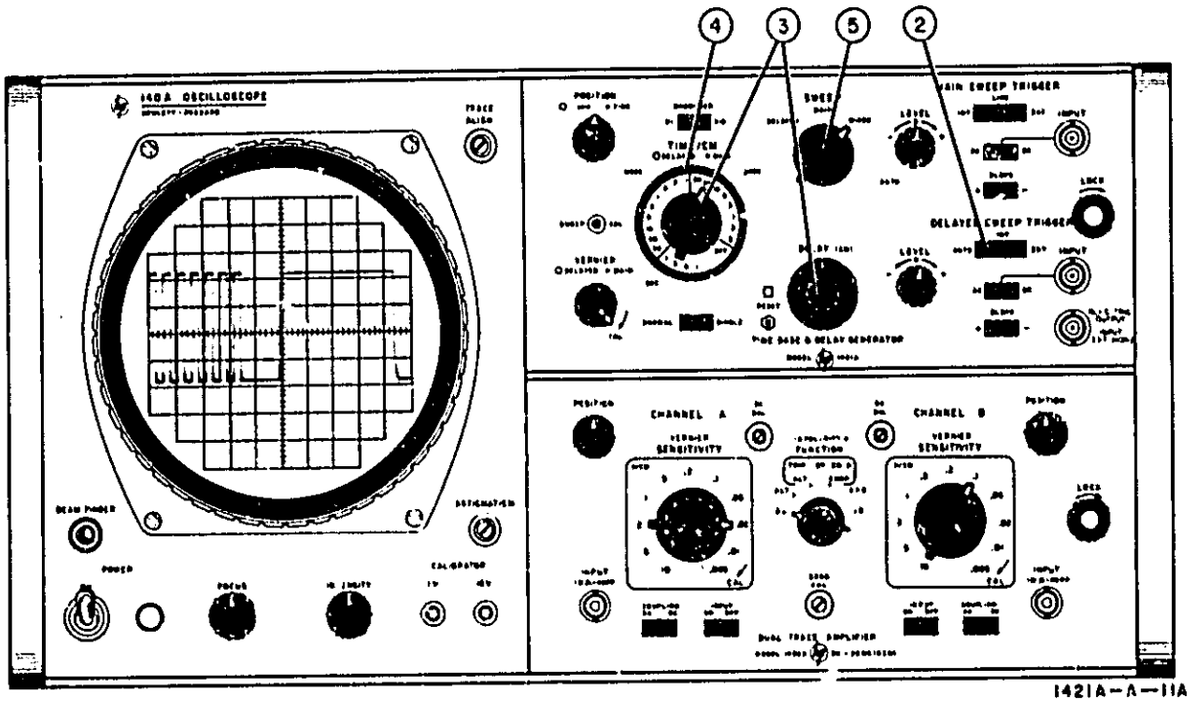
(c) Set SLOPE switch and LEVEL control as desired.

(d) Select desired delay time with MAIN TIME/CM selector and DELAY control (time/cm x delay in cm = delay time).

(e) Select delayed sweep speed with DELAYED TIME/CM selector (intensified portion of waveform as shown in example above will be expanded to full screen).

(f) Set SWEEP switch to DELAYED.

Figure 3-3. Delayed Sweep Operation



1. Perform steps 1 through 8 given in Figure 3-2.

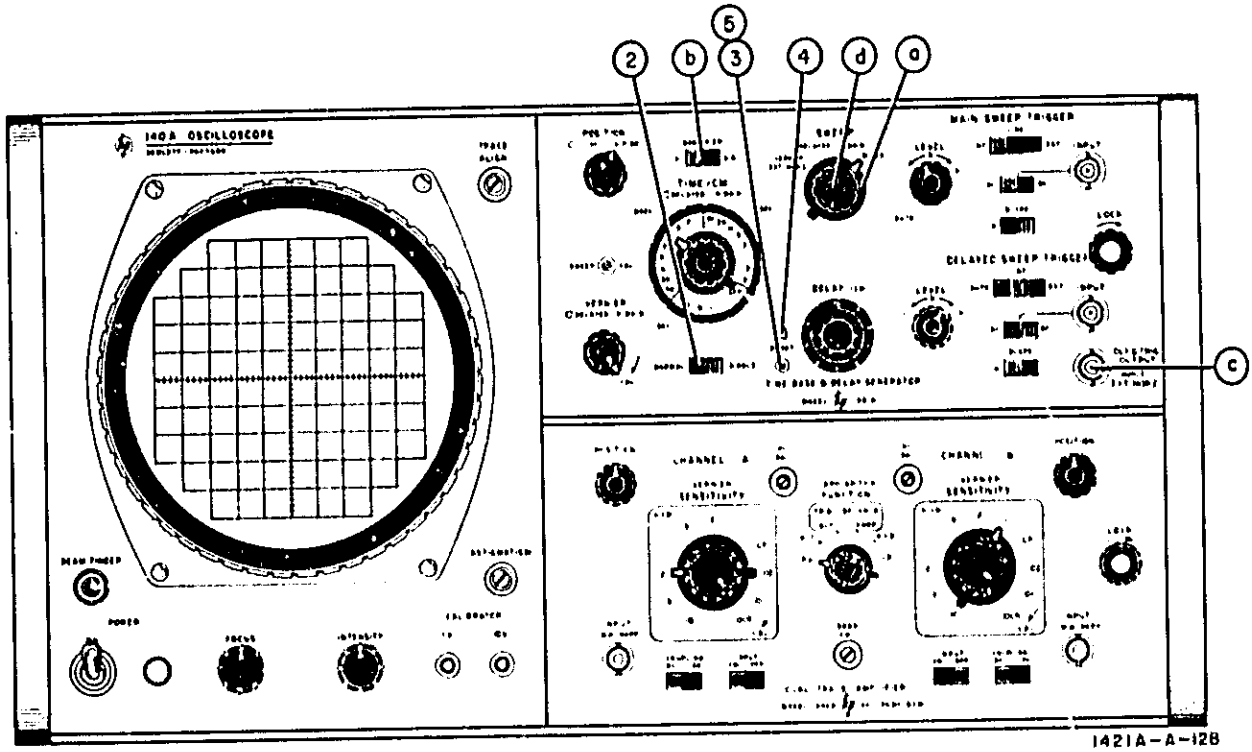
(2) Set DELAYED SWEEP TRIGGER switch for desired triggering.

(3) Select desired delay time with MAIN TIME/CM selector and DELAY control (time/cm x delay in cm = delay time).

(4) Select delayed sweep speed with DELAYED TIME/CM selector. Intensified portion of waveform is approximately equal to expanded portion of mixed waveform.

(5) Set SWEEP switch to MIXED. (A typical mixed sweep waveform is shown on CRT in illustration above.)

Figure 3-4. Mixed Sweep Operation



Single Sweep

1. Perform instructions given for any one of the three basic modes of operation; Figure 3-2 covers main sweep operation, Figure 3-3 covers delayed sweep, and Figure 3-4 covers mixed sweep.

(2) Set NORMAL-SINGLE switch to SINGLE.

(3) Press RESET push button to arm sweep.

(4) RESET indicator will light indicating sweep is armed and may be triggered; indicator extinguishes at end of sweep.

(5) Press RESET push button again to rearm sweep.

External Horizontal Input

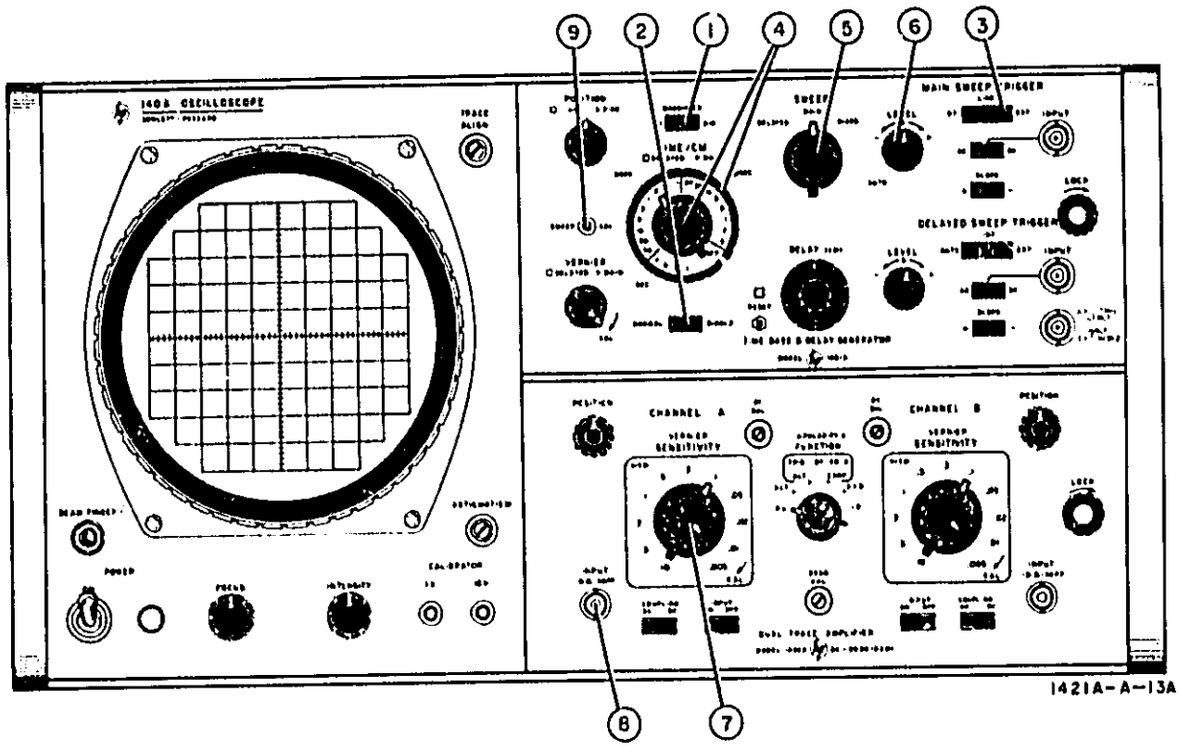
(a) Set SWEEP switch to EXT. HORIZ.

(b) Set MAGNIFIER as desired.

(c) Connect horizontal input to DLY'D TRIG. OUTPUT - INPUT EXT. HORIZ. connector.

(d) Set VERNIER for desired level of deflection.

Figure 3-5. Single Sweep and External Horizontal Input Operation



(1) Set MAGNIFIER switch to X1.

(2) Set NORMAL-SINGLE switch to NORMAL.

(3) Set MAIN SWEEP TRIGGER switch to INT.

(4) Set MAIN TIME/CM selector to 5 MSEC/CM and DELAYED TIME/CM selector to OFF.

(5) Set SWEEP switch to MAIN.

(6) Set LEVEL control as desired.

(7) Select desired channel and set its SENSITIVITY selector to .1 V/CM.

(8) Connect a Time Mark Generator to INPUT connector of selected channel; set Generator controls for 5 millisecond markers.

(9) Adjust SWEEP CAL control to obtain one marker per vertical graticule line.

Figure 3-6. Sweep Time Calibration

THEORY

MAINTENANCE

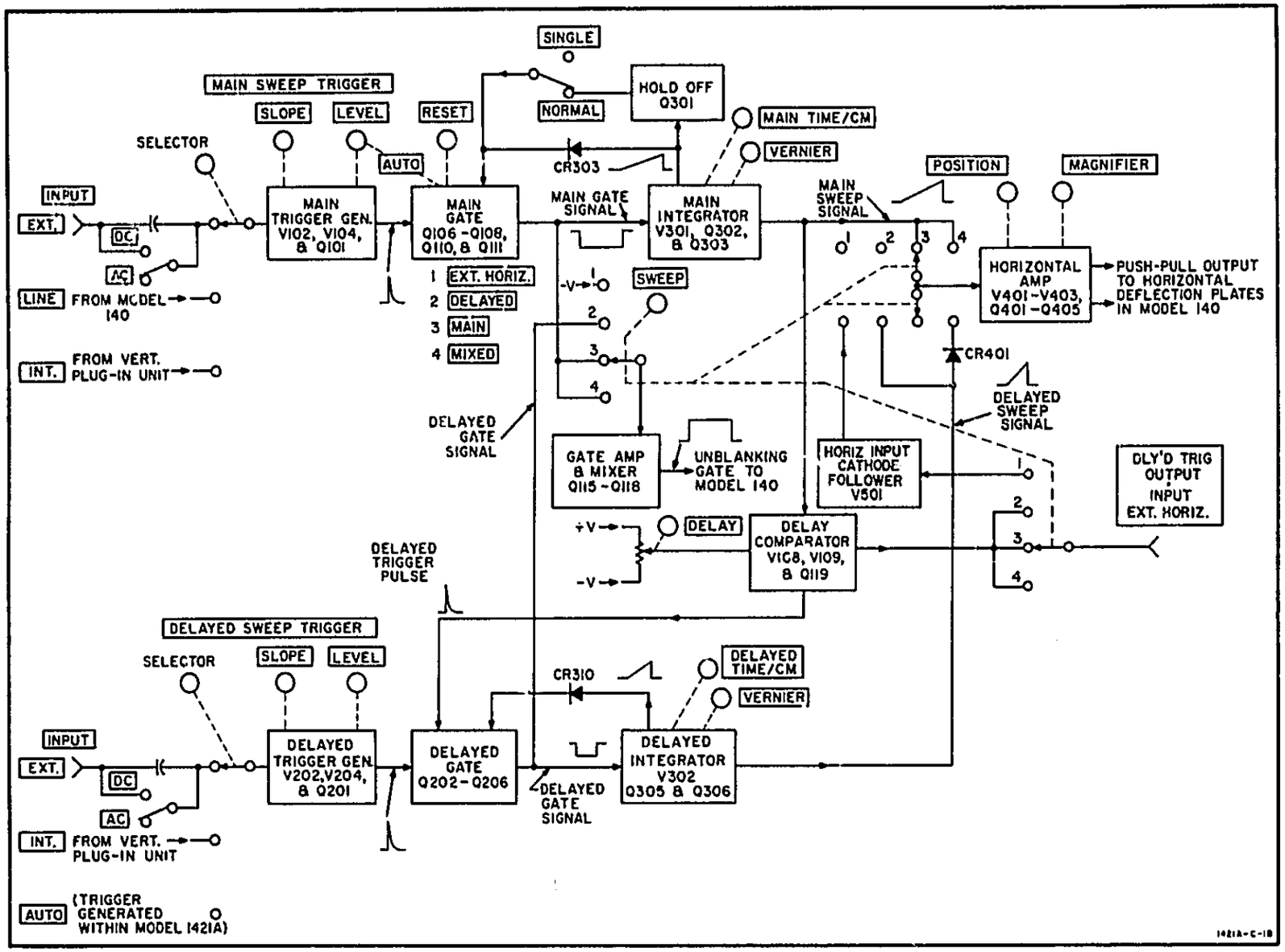


Figure 4-1. Overall Block Diagram

SECTION IV
PRINCIPLES OF OPERATION

4-1. INTRODUCTION.

4-2. The Model 1421A Time Base and Delay Generator, a horizontal plug-in unit for the Model 140 Oscilloscope, generates two types of sweeps, main and delayed. Either sweep (or a combination of both) is selectable by front panel controls on the Model 1421A. The type of sweep selected is applied to the Model 140 to drive the CRT horizontal deflection plates. All necessary operating voltages for the plug-in unit are applied from the Model 140 through a plug on the rear panel of the Model 1421A. Figure 4-1 is an overall block diagram of the Model 1421A showing the main circuits and their relationship.

4-3. The Model 1421A consists basically of a main sweep generator, a delayed sweep generator, and a horizontal amplifier. The main sweep generator produces a linear sweep signal which in main sweep mode of operation is amplified by the horizontal amplifier and then applied to the CRT horizontal deflection plates. This main sweep signal is also applied to a delaying (comparator) circuit in all modes of operation. The delaying circuit provides a control signal for operating the delayed sweep generator.

4-4. The delayed sweep generator when used produces a linear sweep signal the start of which is delayed in time with reference to the start of the main sweep signal. This delay time is controlled by the main sweep signal and the comparator circuit. The delayed sweep signal in delayed sweep mode is amplified by the horizontal amplifier and then applied to the CRT horizontal deflection plates.

4-5. In mixed sweep mode of operation, both sweep generators are operating (as in delayed sweep mode), and the output of each generator is applied to the horizontal amplifier. This results in a combined (mixed) amplified signal at the CRT horizontal deflection plates.

4-6. OVERALL DESCRIPTION.

4-7. MAIN SWEEP GENERATOR.

4-8. The main sweep generator consists of the main trigger generator, main gate, main integrator, and hold-off circuits shown in Figure 4-1. The main sweep generator can be triggered or set for free run operation. When triggered operation is employed, the required trigger signal is applied to the main trigger generator circuit and is obtained from one of three sources; they are: 1) an external signal applied to the main sweep INPUT connector, 2) the AC line signal (50 to 60 cps) from the Model 140 Oscilloscope, or 3) the signal applied to the vertical plug-in unit. The trigger source is selected by the MAIN SWEEP TRIGGER selector. Free run operation is selected by setting the main sweep LEVEL control to its AUTO position; in this position the main sweep generator operates without the need of a trigger signal. The SLOPE control of the main trigger generator circuit selects triggering on either the positive- or negative-going slope on an incoming trigger signal; the LEVEL control selects the triggering point on the incoming signal. The output of the main trigger generator circuit is a positive pulse which triggers the main gate circuit.

4-9. The main gate circuit, when triggered by the main trigger generator output pulse, generates the main gate signal (a negative rectangular pulse). The main gate signal is applied to the main integrator and through the SWEEP switch, in MAIN and MIXED positions, to the gate amplifier and mixer circuit.

4-10. The main integrator circuit is normally clamped such that its output is at a constant dc voltage. The main gate signal unclamps the integrator which starts generating the main sweep signal (a positive-going sawtooth wave). The main sweep signal is applied to the delay comparator and through the SWEEP switch, in MAIN and MIXED positions, to the horizontal amplifier.

4-11. A portion of the main sweep signal is also applied to the anode of reverse-biased diode CR303 and to the hold-off circuit. CR303 remains reverse biased until the voltage level of the sweep signal increases to a predetermined value. The time lapse between the start of the sweep signal and the forward biasing of CR303 is determined by the setting of the MAIN TIME/CM selector. When the diode conducts, a positive voltage is applied back to the main gate circuit causing the main gate signal (a rectangular pulse) to terminate. When the main gate pulse ends, the integrator output returns to a constant dc voltage level and is again clamped. The hold-off circuit, after a slight delay, produces a negative voltage which is applied to the main gate circuit. This negative signal resets the main gate circuit. Once the main gate is reset, it is then ready for another trigger signal. When the NORMAL-SINGLE switch is set to the SINGLE position, the negative reset signal from the hold-off circuit is not available and the RESET push button must be pressed to return the main gate circuit to its pretrigger condition.

4-12. DELAY COMPARATOR.

4-13. The delay comparator (V108, V109, and Q119) compares the main sweep signal with a dc voltage determined by the positon of the DELAY control. When the positive-going sweep signal equals the dc voltage, a positive delayed trigger pulse is generated. This trigger pulse is applied to the delayed gate circuit and to an output connector through the SWEEP switch. This trigger pulse is for triggering external equipment when needed. The pulse generated by the delay comparator represents approximately the time delay in cm between the start of the main sweep signal and the start of the delayed sweep signal.

4-14. DELAYED SWEEP GENERATOR.

4-15. The delayed sweep generator consists of the delayed trigger generator, delayed gate, and delayed integrator circuits shown in Figure 4-1. Operation of the delayed sweep generator is very similar to that of the main sweep generator as explained in Paragraphs 4-7 through 4-11. However, there are three basic differences between the two sweep generators. The delayed sweep generator 1) cannot be free run, 2) has only two sources of external triggering, and 3) does not have a hold-off circuit for resetting the gate circuit. The effects upon the operation of the delayed sweep generator due to these differences are explained in more detail in Paragraph 4-16.

4-16. The DELAYED SWEEP TRIGGER selector has an AUTOmatic triggering position which, when selected, eliminates the need for an external trigger source. When the selector is set to this position, triggering of the delayed gate circuit is accomplished by the delayed trigger pulse from the delay comparator circuit (Paragraph 4-12). This results in the start of the delayed sweep signal (a positive-going sawtooth wave); the duration of the delayed sweep signal is controlled by the DELAYED TIME/CM selector. Sometime after the conclusion of the delayed sweep signal, the delayed gate circuit is both reset and retriggered by the next delayed trigger pulse from the delay comparator, thus the result is an automatic triggering operation. When the DELAYED SWEEP TRIGGER selector is set to either EXT. or INT. positions, the delayed trigger pulses only reset the delayed gate circuit. In these switch positions, the required triggers are applied from an external source through the delayed trigger generator circuit.

4-17. GATE AMPLIFIER AND MIXER.

4-18. When the SWEEP switch is set to DELAYED, the delayed gate signal, a negative pulse, is applied through the switch to the gate amplifier and mixer circuit (Q115-Q118). In MAIN and MIXED positions of the switch, the main gate signal, also a negative pulse, is applied through the switch. The negative pulse applied is amplified and inverted by the gate amplifier and mixer circuit. The amplified positive pulse is applied to the Model 140 to unblank the CRT trace during the sweep.

4-19. HORIZONTAL AMPLIFIER.

4-20. The sweep signals are applied to the horizontal amplifier through the SWEEP switch. The position of the switch determines which sweep signal is applied to the amplifier; in the MIXED position, the sweep is a combination of both signals. The amplifier is basically a differential amplifier providing a push-pull output to drive the horizontal deflection plates of the CRT in the Model 140. The push-pull signal is applied directly to the deflection plates.

4-21. CIRCUIT DETAILS.

4-22. DIFFERENTIAL DRIVERS.

4-23. The desired triggering signal for the main sweep differential driver, V102/V104 (see Figure 5-9), is selected by switch S102. If either EXT. or LINE position of the switch is selected, the trigger signal is applied to only the grid of V102; the grid of V104 is grounded through the switch in these positions. In the INT. position of the switch, differential triggering signals are supplied to V102/V104.

4-24. Tunnel diode CR102 is used to generate fast rise triggers which are required for stable synchronization of the sweep generator. The increase in current through V102 and CR102, caused by the positive-going portion of the incoming trigger signal switches the tunnel diode to its high voltage state. When this occurs, a fast rising negative pulse is generated at the junction of CR102 and the base of amplifier Q101.

4-25. Operation of the differential driver, V202/V204, in the delayed sweep generator (see Figure 5-11) is similar to that of the main sweep generator differential driver previously explained.

4-26. MAIN GATE CIRCUIT.

4-27. TRIGGERED OPERATION. The positive trigger pulse applied to the base of trigger pulse amplifier Q106 (see Figure 5-9) is amplified and inverted. The negative pulse on the collector of Q106 is applied to the junction of tunnel diode CR108 and the base of gate amplifier Q107. Prior to the trigger pulse, CR108 is biased in its low voltage state (just below peak current) by the current supplied from conducting transistor Q110. When the negative trigger pulse is appled to CR108, the tunnel diode switches to its high voltage state and a fast-rising negative pulse is generated at the base of Q107. The fast-rising pulse is amplified and inverted by Q107 and just inverted by Q108. The amplified pulse is applied to the junction of CR304 and CR305 in the integrator circuit to start the main sweep signal and is also applied through the SWEEP switch to gate input amplifier Q115.

4-28. At the end of the main sweep, Q111 of the Schmitt trigger is turned on by a positive voltage applied to its base from the integrator circuit. The current increase through Q111 results in a more negative voltage on the base of Q110, the other half of the Schmitt trigger. Q110 is turned off by the negative voltage. Without a current source, CR108 stops conducting, and the negative gate pulse at the base of Q107 ends. At the end of the hold-off period (explained in Paragraph 4-37), a negative voltage is applied to the base of Q111 and the Schmitt trigger returns to its pre-trigger condition (Q110 conducting; Q111 turned off). During this same time the vertical pulse is applied through A103 to three points. A negative voltage is applied through CR317 to the Hold-Off Emitter Follower where it is used to hold Q111 on. At the same time, it feeds a negative voltage to the bases of Q106 and Q202, holding them off. It is also applied to Q115 to keep the CRT blanked.

4-29. FREE RUN (AUTO) OPERATION. During triggered operation, free run lockout transistor, Q104, is conducting and its negative collector voltage, coupled through CR107, keeps free run gate generator Q105 turned off. However, when the LEVEL control is set to its AUTO position, a negative supply voltage applied through part of S104 and CR103 turns off Q104. With Q104 off, the base of Q105 is free to follow any voltage change on the collector of Q111. At the end of the hold-off period, the collector voltage of Q111 moves in a positive direction; this voltage change is applied to the

bases of Q110 and Q105. Transistor Q110 conducts and again supplies the bias current to tunnel diode CR108. Free run gate generator Q105 also conducts and its collector current is enough to switch tunnel diode CR108 to its high voltage state. Thus, the negative gate pulse required to start the sweep is generated, and free run operation is achieved.

4-30. If a trigger is applied during free run operation, the negative trigger pulse on the collector of Q106 is coupled through CR106 to the base of Q103 (part of the auto multivibrator). This negative pulse turns on Q103, and its collector voltage moves in a positive direction, reverse biasing CR103. Free run lockout Q104 starts conducting, and the base of Q105 is again clamped through CR107 to the collector of Q104. Transistor Q105 is now removed as a current source for tunnel diode CR108, and the next trigger pulse will switch the tunnel diode and start the sweep.

4-31. C109 in the collector circuit of Q103 is discharged by the trigger pulse through the transistor. The capacitor starts recharging at the end of the trigger, but charging time is long (approximately 140 milliseconds). If the next trigger does not occur within the charging period, the auto multivibrator, Q102/Q103, resets itself, and the gate circuit returns to free run operation.

4-32. DELAYED GATE CIRCUIT.

4-33. The delayed gate circuit operates basically the same as the main gate circuit as described in Paragraph 4-26, except for the differences explained in Paragraph 4-15. The fast-rising negative gate pulse generated at the cathode of CR206 (see Figure 5-11), after passing through Q203 and Q204, is applied to the delayed integrator circuit. This pulse starts the delayed sweep signal. The delayed gate pulse is also applied through the SWEEP switch to gate input amplifier Q115.

4-34. The positive delayed trigger pulse from the delay comparator (Figure 5-10) is coupled to the base of Q205 in all triggering modes. For either type of external triggering (EXT. or INT.), the pulse resets the Schmitt trigger circuit so that the next incoming external trigger can start the delayed sweep. In the AUTOmatic triggering mode, the delayed trigger pulse resets the Schmitt trigger and is also coupled through CR204 to the base of Q202. The amplified pulse (now negative) on the collector of Q202 switches tunnel diode CR206; this results in the required negative gate for starting the delayed sweep and automatic triggering operation is accomplished.

4-35. INTEGRATORS AND HOLD OFF.

4-36. Switch diode CR304 and clamp diode CR305 (see Figure 5-10) are forward biased prior to the negative gate pulse from Q108. In this condition, the grid voltage level of V301 and the voltage level at the cathode of CR306 are constant. When the negative gate pulse reverse biases CR304 and CR305, the grid voltage of V301 starts moving negatively since the grid is connected to a negative supply through sweep time resistors R320-R328 (Figure 5-12). This negative-going change is coupled through cathode follower V301 to integrator Q302. The resulting positive-going signal on the collector of Q302 is applied back to the grid of V301 through Q303 and sweep time capacitors C310-C317 (Figure 5-12). This opposite-going signal results in a voltage change of only 0.3 volts at the grid of V301 during the entire sweep. Voltage across the sweep time resistors changes by about 0.3%, and the current through these resistors changes by the same amount. The current through the sweep time resistors is the charging current for the sweep time capacitors. Therefore, the voltage increase across the sweep time capacitors changes linearly with time and the resulting sweep signal is a nearly linear positive-going sawtooth wave. The sweep signal is coupled through CR306 to the SWEEP switch at the input to the horizontal amplifier and is the main sweep generator output. The main sweep signal is also applied to the grid of V109 in the delay comparator circuit. The slope of the output sweep signal is determined by the values of the sweep time resistors and capacitors selected by the TIME/CM switch.

4-37. A portion of the positive-going main sweep signal is applied to the base of hold-off emitter follower Q301. The emitter of Q301 follows its changing base voltage, and when the emitter voltage forward biases CR302, the negatively charged hold-off capacitors, C301-C305 (Figure 5 - 12), start to discharge. A portion of the main sweep signal is also applied to reverse biased diode CR303. When the sweep signal forward biases CR303, the Schmitt trigger changes states, the negative gate pulse applied to CR304 and CR305 ends, and the main sweep signal terminates. The removal of the sweep signal from the base of Q301 permits the hold-off capacitor in its emitter circuit to recharge; the capacitor charges slowly through R301. When the increasing negative voltage at the junction of the hold-off capacitor and R301 forward biases CR301, the base of Q111 is tied to this junction. As the hold-off capacitor continues to charge, the base voltage of Q111 increases negatively until the transistor stops conducting and the Schmitt trigger resets to its pre-trigger condition. The sweep generator is then ready for the next trigger signal.

4-38. The delayed integrator circuit (see Figure 5-11) operates the same as the main integrator circuit described in Paragraph 4-36. The hold-off circuit in the main integrator circuit also provides the required hold-off period for the delayed integrator as the delayed sweep generator is reset after the start of the main sweep signal.

4-39. HORIZONTAL AMPLIFIER.

4-40. The horizontal amplifier (see Figure 5-13) provides a push-pull output to drive the horizontal deflection plates of the CRT. The sweep signal selected by S401 is applied to the emitter of Q401 through the SWEEP CAL control. This control is adjusted to provide the proper current to Q401 for calibrated sweep times. The POSITION controls, FINE and COARSE, adjust the dc voltage level at the collector of Q401, thus changing the dc level at the output of the horizontal amplifier. Horizontal input amplifier Q401 drives the differential amplifier stage, V401, Q403, and Q405, through emitter follower Q402.

4-41. The differential amplifier converts the single-ended sweep signal to a balanced push-pull output. Emitter follower Q404 is provided to balance the base circuit impedance of Q403 and Q405. The signal at the emitter of Q402 and the base of Q403 is a positive-going sweep. This signal is amplified and inverted by Q403 and is further amplified without inversion by

V401A. At the same time the current to the emitter of Q403 is increasing, the current to the emitter of Q405 is decreasing. This decrease of current through Q405 results in an increase in its collector voltage. The positive-going voltage waveshape on the plate of V401B is of equal amplitude but opposite in direction to that on the plate of V401A. These equal, but opposite-going, signals are coupled through the output cathode followers, V403A and V403B, to the horizontal deflection plates.

4-42. The Magnifier Centering adjustment, R425, should be set for balanced current through Q403 and Q405 to assure that any waveform at center screen remains centered when the trace is magnified. When the MAGNIFIER switch, S402, is set to the X10 position, the impedance between the emitter of Q403 and Q405 is reduced by a factor of 10, and thus the output signal is increased by the same factor. X10 gain adjustment, R423, is provided to obtain the 10:1 impedance ratio when the MAGNIFIER switch is set to X10.

4-43. When the BEAM FINDER push button, on the front panel of the Model 140, is depressed, current to the differential amplifier is reduced by inserting R431 in series with the supply voltage. The difference between plate voltages of V401A and V401B during reduced current operation is small. This results in an on-screen trace regardless of the POSITION control setting.

Table 5-1. Required Test Equipment

Recommended Instrument		Required Characteristics	Ref Par	Required For
Type	Model			
Oscillator	HP 200 CD	Frequency Range: 40 cps to 600 kc Output Voltage: 10 v p-p	5-8 5-9 5-16	Triggering Check, Trigger Point Check, Trigger Symmetry Adjustment
DC Voltmeter	HP 412A	Voltage Range: 1 to 300 mv		DC Voltage Checks
Time Mark Generator	Tektronix 180A	Markers: from 1 μsec to 5 sec Accuracy: 0.05%	5-10 thru 5-12 5-17 thru 5-20	Sweep Time and Magnifier Checks, Sweep Time and Delay Adjustments
Constant Amp Signal Generator	Tektronix 190B	Frequency Range: 1 to 20 Mc Output Voltage: at least 1 v p-p	5-8	Triggering Check,
High Frequency Oscilloscope	HP 175A with 1750B and 1780A	Bandwidth: 20 Mc Sensitivity: 50 mv	5-15 5-16	Gate Level and Compensation, Trigger Symmetry, Waveform Observation

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. This section provides maintenance and service information for the Model 1421A Time Base and Delay Generator. Adjustment procedures, troubleshooting information, component identification illustrations, and schematic diagrams are all in this section of the manual. Performance Checks which verify proper instrument operation are also included.

5-3. REQUIRED TEST EQUIPMENT.

5-4. Test equipment required for maintaining and checking the performance of the Model 1421A is listed in Table 5-1. Other pieces of equipment having similar characteristics can be substituted for the equipment listed in the table.

5-5. PERFORMANCE CHECKS.

5-6. The performance checks verify whether the Model 1421A, when installed in a Model 140 Oscilloscope with a vertical plug-in unit, is operating within its specifications listed in Table 1-1. These checks may be used as part of incoming quality control inspection, as a periodic operational check, or after repair or adjustments have been made on the instrument. When performing these checks, use recently calibrated equipment; any equipment required to perform these checks is listed in Table 5-1. To check the specifications of the Model 140 or the vertical plug-in unit, refer to the performance checks listed in the Operating and Service Manual for that particular unit. The performance checks should be made in the order given i ; Paragraphs 5-7 through 5-12.

Note

In order to check the high frequency triggering performance of the Model 1421A, the Model 1402A Dual Trace Amplifier which has a 20-Mc bandwidth must be used.

5-7. HORIZONTAL BANDWIDTH.

a. Connect a test oscillator, set to 50-kc, to INPUT EXT. HORIZ.

b. Set SWEEP to EXT. HORIZ.

c. Adjust amplitude of test oscillator to obtain a 10-cm trace on CRT.

d. Set test oscillator to 500-kc; at least a 7-cm trace should be visible on CRT.

5-8. TRIGGERING.

a. Connect a test Oscillator to channel A INPUT of vertical plug-in, to main sweep trigger INPUT, and to delayed sweep trigger INPUT.

b. Set channel A controls of Model 1402A as follows:

SENSITIVITY . . . . . 1 V/CM
INPUT . . . . . ON
COUPLING . . . . . AC

c. Set Model 1402A function selector to channel A.

d. Adjust Oscillator controls to obtain a 40-cps signal of 0.5-cm amplitude.

e. Set Model 1421A SWEEP switch to MAIN.

f. Adjust main sweep LEVEL control to obtain stable triggering with MAIN SWEEP TRIGGER switch set to INT. and EXT. positions.

g. Set SWEEP switch to DELAYED and DELAYED TIME/CM selector to any sweep speed.

h. Adjust delayed sweep LEVEL control to obtain stable triggering with DELAYED SWEEP TRIGGER switch set to INT. and EXT. positions.

i. Set DELAYED SWEEP TRIGGER to AUTO positions; stable triggering should be obtained.

j. Disconnect test Oscillator and connect a Signal Generator to same INPUTs.

k. Adjust Signal Generator controls to obtain a 15-Mc signal of 0.5-cm amplitude.

m. Repeat steps e through h above.

n. Adjust Signal Generator controls to obtain a 20-Mc signal of 1-cm amplitude.

p. Repeat steps e through h above.

5-9. TRIGGER POINT AND SLOPE.

a. Connect a test Oscillator to channel A INPUT of vertical plug-in and to both main sweep trigger and delayed sweep trigger INPUTs.

b. Set channel A controls of Model 1402A as follows:

SENSITIVITY . . . . . 1 V/CM
INPUT . . . . . ON
COUPLING . . . . . AC

c. Set Model 1402A function selector to channel A.

d. Adjust Oscillator controls to obtain a 1-kc signal of 10 v p-p.

e. Set MAIN SWEEP TRIGGER and DELAYED SWEEP TRIGGER switches to EXT.

f. Set SWEEP switch to MAIN.

g. Stable triggering should occur as main sweep LEVEL control is rotated from full ccw to full cw.

h. Set SWEEP switch to DELAYED and DELAYED TIME/CM selector to 0.2 MSEC.

i. Stable trigger should occur as delayed sweep LEVEL control is rotated from full ccw to full cw.

5-10. MAIN SWEEP TIME.

a. Perform procedure given in Figure 3-6.

b. Check each main sweep time setting given in left column of Table 5-2 by setting Time Mark Generator controls to obtain time marker indicated in right column. Time markers appearing on CRT should be within ±3 mm of vertical graticule lines 1, 3, 5, 7, 9, and 11.

Table 5-2. Main and Delayed Sweep Time Accuracy

MAIN TIME/CM	DELAYED* TIME/CM	Time Markers
.5 μSEC	.5 μSEC	1 μSEC
5 μSEC	5 μSEC	10 μSEC
50 μSEC	50 μSEC	100 μSEC
5 MSEC	.5 MSEC	10 MSEC
50 MSEC	5 MSEC	100 MSEC

* For main sweep time check, DELAYED TIME/CM is OFF.

5-11. DELAYED SWEEP TIME.

a. Set Model 1421A controls as follows:

MAGNIFIER X1
MAIN SWEEP TRIGGER . . . . . INT.
DELAYED SWEEP TRIGGER . . . . . INT.
MAIN TIME/CM . . . . . 1 μSEC
DELAYED TIME/CM . . . . . .5 μSEC
SWEEP . . . . . DELAYED

b. Set Model 1402A channel A SENSITIVITY to .1 V/CM and function selector to A.

c. Connect a Time Mark Generator to channel A INPUT.

d. Check each delayed sweep time setting given in center column of Table 5-2 by setting Time Mark Generator controls to obtain time markers indicated in right column. Time markers appearing on CRT should be within ±3 mm of vertical graticule lines 1, 3, 5, 7, 9, and 11.

NOTE
The MAIN TIME/CM selector will be rotated and set to the proper range as the DELAYED TIME/CM selector is turned to the next higher range given in the table.

5-12. MAGNIFIER.

a. Set Model 1421A controls as follows:

MAGNIFIER X10
MAIN SWEEP TRIGGER . . . . . INT.
MAIN TIME/CM . . . . . 1 MSEC/CM
DELAYED TIME/CM . . . . . OFF
SWEEP . . . . . MAIN

b. Set Model 1402A channel A SENSITIVITY to .1 V/CM and function selector to A.

c. Connect Time Mark Generator to channel A INPUT, and adjust Generator controls for 100 μsec time markers.

d. Adjust main sweep LEVEL for stable triggering.

e. Position first marker on left vertical graticule line. Last marker (eleventh) should be within ±5 mm of right line.

5-13. ADJUSTMENTS.

5-14. Procedures for adjusting the Model 1421A are described in Paragraphs 5-15 through 5-20. The internal adjustments are identified and their location shown in Figure 5-1. The adjustments can be made only after removing the top cover of the Model 140 Oscilloscope in which the plug-in unit is installed; this allows access to the adjustments. For optimum results, check and adjust, if necessary, the power supply voltages of the Model 140 used with the Model 1421A. Equipment required to perform the adjustments is listed in Table 5-1.

5-15. GATE LEVEL AND COMPENSATION ADJUSTMENT.

a. Set Model 1421A controls as follows:

SWEEP . . . . . MAIN
MAIN TIME/CM . . . . . 20 μSEC
DELAYED TIME/CM . . . . . 2 μSEC
Main LEVEL . . . . . AUTO
DELAY . . . . . 5 cm
DELAYED SWEEP TRIGGER . . . . . AUTO

b. Connect compensated probe of a High Frequency Oscilloscope to gate output, using TP101.

c. Set test Oscilloscope sensitivity to 2 v/cm and sweep time to 20 μsec/cm.

d. Adjust Gate Level (R179), starting from full cw position, until top of gate moves down 2 volts from maximum level. Gate including positive pedestal should be approximately 50 volts amplitude.

e. Adjust Gate Compensation (C134) for best square corners on pulse.

5-16. TRIGGER SYMMETRY ADJUSTMENT.

a. Set Model 1421A controls as follows:

MAIN TIME/CM . . . . . 2 MSEC
SWEEP . . . . . MAIN
MAIN SWEEP TRIGGER . . . . . EXT.
AC-DC . . . . . AC
SLOPE . . . . . +

b. Connect Oscillator to vertical plug-in INPUT and to main sweep trigger INPUT.

c. Adjust Oscillator controls to obtain a 500 mv p-p, 1-kc signal. Measure 500 mv p-p amplitude on CRT of Model 140.

d. Connect compensated probe of High Frequency Oscilloscope to case of CR102.

e. Set test Oscilloscope sensitivity to 0.5 v/cm and coupling switch to AC.

f. Adjust Trigger Symmetry (R114) for symmetrical waveform. Check symmetry of waveform with SLOPE set to -.

5-17. SWEEP TIME & MAGNIFIER ADJUSTMENTS.

a. Rotate Main Sweep Length (R314) fully cw, then back ccw to obtain a stable, free-running sweep displayed on the CRT.

b. Perform step 1 through 9 of Figure 3-6.

c. Set MAGNIFIER to X10 and position first marker on first vertical graticule line.

d. Adjust X10 Gain (R423) until second marker is on eleventh line.

e. Set main LEVEL control to fully cw position and MAGNIFIER to X10.

Table 5-3. Main Sweep Timing Adjustments

MAIN TIME/CM	and Adjust	Time Markers	Markers/10 cm
.2 µSEC		1 µsec	3
.5 "	C316	1 "	6
1 "		1 "	11
2 "		10 "	3
5 "	C314	10 "	6
10 "		10 "	11
20 "		100 "	3
50 "	R338	100 "	6
.1 MSEC		100 "	11
.2 "		10 msec	3
.5 "	R337	10 "	6
1 "		10 "	11
20 "		100 "	3
50 "	R335	100 "	6
.1 SEC		100 "	11
.2 "		1 sec	3
.5 "		1 "	6
1 "		1 "	11

f. Center spot on CRT with POSITION controls, and set MAGNIFIER to X1.

g. Adjust Magnifier Centering (R425) until spot is centered again. As MAGNIFIER is switched between X1 and X10, spot should move less than 2 mm.

5-18. SWEEP LENGTH ADJUSTMENTS.

NOTE

Before performing the sweep length adjustments, perform the sweep time adjustment given in Paragraph 5-17.

a. Set Model 1421A controls as follows:

MAIN TIME/CM . . . . . 5 MSEC
MAIN SWEEP TRIGGER . . . . . INT.
SWEEP . . . . . MAIN
DELAYED SWEEP TRIGGER . . . . . INT.
DELAYED TIME/CM . . . . . OFF

b. Set vertical plug-in sensitivity to 0.1 v/cm.

c. Connect a Time Mark Generator to vertical plug-in INPUT, and set Generator control for 1-msec markers.

d. Adjust main LEVEL control for shortest displayed sweep.

e. Adjust Main Sweep Length (R314) for a 10.2 cm sweep.

f. Set SWEEP to DELAYED position and DELAYED TIME/CM to .1 MSEC.

g. Adjust delayed LEVEL control for shortest displayed sweep.

h. Adjust Delayed Sweep Length (R359) for an 11.5 cm sweep.

5-19. SWEEP TIMING ADJUSTMENTS.

NOTE

Before performing the Sweep Timing adjustments, perform the adjustments given in Paragraphs 5-17 and 5-18.

Table 5-4. Delayed Sweep Timing Adjustments

DELAYED TIME/CM	and Adjust	Time Markers	Markers/10 cm
.2 µSEC		1 µsec	3
.5 "	C335	1 "	6
1 "		1 "	11
2 "		10 "	3
5 "	C333	10 "	6
10 "		10 "	11
20 "		100 "	3
50 "	R387	100 "	6
.1 MSEC		100 "	11
.2 "		1 msec	3
.5 "	R386	1 "	6
1 "		1 "	11
2 "		10 "	3
5 "	R385	10 "	6
10 "		10 "	11
20 "		100 "	3
50 "		100 "	6

a. Set Model 1421A controls as follows:

MAIN TIME/CM . . . . . .2 µSEC
DELAYED TIME/CM . . . . . OFF
MAIN and DELAYED SWEEP TRIGGER . . INT.
SWEEP . . . . . MAIN

b. Set vertical plug-in sensitivity to 0.1 v/cm.

c. Connect a Time Mark Generator to vertical plug-in INPUT.

d. Adjust main LEVEL control for stable sweep.

e. Set MAIN TIME/CM selector to each position given in first column of Table 5-3, adjusting on all ranges indicated and checking accuracy, which is ±3%, of all other ranges. The next lower and higher ranges to that adjusted are affected by the adjustment, except the 50 MSEC range which affects all higher ranges. Time Mark Generator controls should be set to obtain time markers as indicated in second column. Number of markers displayed for each range of TIME/CM selector is given in third column.

f. Set SWEEP to DELAYED, MAIN TIME/CM to .5 µSEC, and DELAYED TIME/CM to .2 µSEC.

g. Check accuracy (±3%) and adjust each indicated position of DELAYED TIME/CM selector as given in Table 5-4.

NOTE

The MAIN TIME/CM selector is rotated and set to the proper range as the DELAYED TIME/CM selector is turned to the next higher range.

5-20. DELAY CM ADJUSTMENTS.

a. Set Model 1421A controls as follows:

MAIN TIME/CM . . . . . 1 MSEC
DELAYED TIME/CM . . . . . 10 µSEC
SWEEP . . . . . DELAYED
MAIN SWEEP TRIGGER . . . . . INT.
DELAYED SWEEP TRIGGER . . . . . AUTO
MAGNIFIER X1
SLOPE . . . . . +
DELAY . . . . . 0 cm

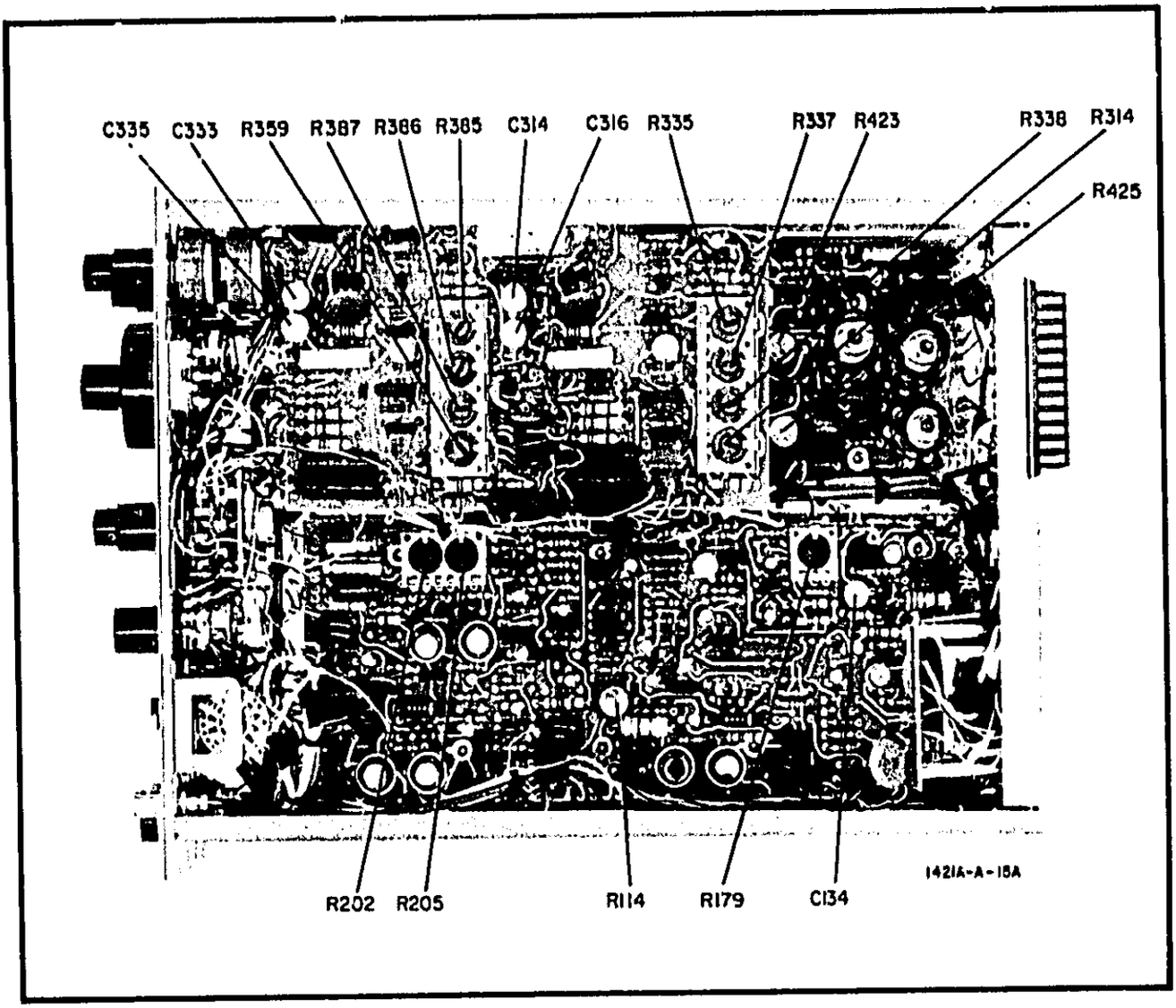


Figure 5-1. Location of Internal Adjustments

b. Connect a Time Mark Generator to vertical plug-in INPUT, and set Generator controls for 1-msec markers.

c. Set DELAY to 1.00 cm and adjust 1 CM DELAY (R205) until peak of second marker is on second graticule line.

d. Set DELAY to 9.00 cm and adjust 9 CM DELAY (R202) until peak of tenth marker is on second graticule line. R205 and R202 interact and must be repeated if necessary.

5-21. TROUBLESHOOTING.

5-22. The best procedure for locating trouble in the instrument is to start with a thorough visual inspection. Look for burned-out or loose components, loose connections or wires, or any other similar condition which suggests a source of trouble.

5-23. Use the block diagram, Figure 4-1, the typical waveforms illustrated in Figure 5-7, and the information presented in Tables 5-5 through 5-7 as aids for isolating the trouble.

5-24. SERVICING ETCHED CIRCUIT BOARDS.

5-25. The Model 1421A has etched circuit boards which are plated-through type. When servicing this type of board, components may be removed or replaced by unsoldering from either side of the board. When removing large components, such as potentiometers, rotate the soldering iron tip from lead to lead while applying pressure to the part to lift it from the board. Service Note M-20D contains additional information on the repair of etched circuit boards, however, the important considerations are as follows:

a. Do not apply excessive heat.

b. Apply heat to component lead and remove lead with a straight pull away from board.

c. Use a toothpick or wooden splinter to clean hole.

d. Do not force leads of replacement component into holes.

5-26. If the plated metal surface (conductor) lifts from the board, it may be cemented back with a quick-drying acetate base cement (use sparingly) having good insulating properties. An alternate method of repair is to solder a good conducting wire along the damaged area.

5-27. COMPONENT IDENTIFICATION.

5-28. All electrical components in the Model 1421A not mounted on printed circuit boards are identified in Figures 5-2 and 5-3. Components mounted on printed circuit boards are identified in Figures 5-4 through 5-6. These figures should be used for quick identification of any part.

Table 5-5. System Troubleshooting

With Sweep		
Operative	**Nonoperative**	**Action**
MAIN-AUTO	MAIN-EXT.	Check Main Trigger Amplifier (V102, V104, and Q101)
MAIN-EXT.	MAIN-AUTO	Check Auto Multivibrator (Q102 and Q103)
MAIN	DELAYED-AUTO	Check Delayed Trigger Gen (V108, V109, and Q119) and Delayed Gate and Sweep Circuits
MAIN	DELAYED-INT.	Check Delayed Trigger Amp (V202, V204, and Q201)
MAIN	DELAYED-EXT.	Check DELAYED SWEEP TRIGGER Switch
MAIN & DELAYED	MIXED	Check SWEEP switch

Without Sweep		
Symptom	**Trouble Area**	**Action**
Dim Spot Left Side of CRT	Auto Multivibrator (Q102, Q103)--Free Run Lock Out (Q104)--Gate Amp (Q107, CR108)--Gate Inverter (Q108)--Main Integrator (Q302, Q303, V301)	Check dc voltages
Sweep starts at Center screen	Hold Off (Q301)	
Bright Spot Left Side of CRT	Integrator (Q302, Q303, V301)--Hold-off Emitter Follower (Q301)	
Dim Spot Right Side of CRT	Integrator (Q302, Q303, V301)	
Bright Spot Right Side of CRT	Schmitt Trigger (Q110, Q111)-Integrator (Q302, Q303, V301)-Gate Amplifiers (Q107, Q108)	

Table 5-6. Delayed Sweep Voltages

NOTE: To obtain dc voltages listed in this table, the Model 1421A controls must be set as given under Conditions of Waveform Measurements, Figure 5-7.

Waveform Test Point	Ground base of Q203	Attach base of Q203 thru 1K Ω to -12.6 v
10	-1.7 v	-5.6 v
11	-8.6 v	-6.8 v
12	-1.4 v	+34 v

Table 5-7. DC Voltages

NOTE: To obtain dc voltages listed in this table, the Model 1421A controls must be set as given under Conditions of Waveform Measurements, Figure 5-7.

Waveform Test Point	Ground Test Point ▽	Attach Test Point ▽ Thru 1K Ω to -12.6 v
2	-0.9 v	-5.2 v
3	-12.2 v	-6.6 v
4	+42.0 v	+86 v
5(TP101)	+41.0 v	+85 v
6	-24.5 v	-0.8 v
7	-1.6 v	+36 v
8	+88.0 v	+100 v
9	0 v	0 v
10	-0.5 v	-0.5 v
11	-8.2 v	-9 v
12	-1.4 v	-1.4 v
13	-1.2 v	+29 v
14	-9.0 v	-4.6 v
15	≈ +200 v	≈ +130 v
16	≈ +130 v	≈ +200 v

5-29. A304 OR A306 REPLACEMENT.

5-30. If a separate replacement is made for either the TIME/CM switch assembly, A304, or the sweep generator etched circuit assembly, A306, it will be necessary to re-route several leads from the switch assembly through holes in the board. Figure 5-3a indicates by wire color and switch wafer, the routing for switch leads; it also identifies other leads which connect to the circuit board. A replacement part number is also shown in Table 6-2 for A301, which includes both A304 and A306.

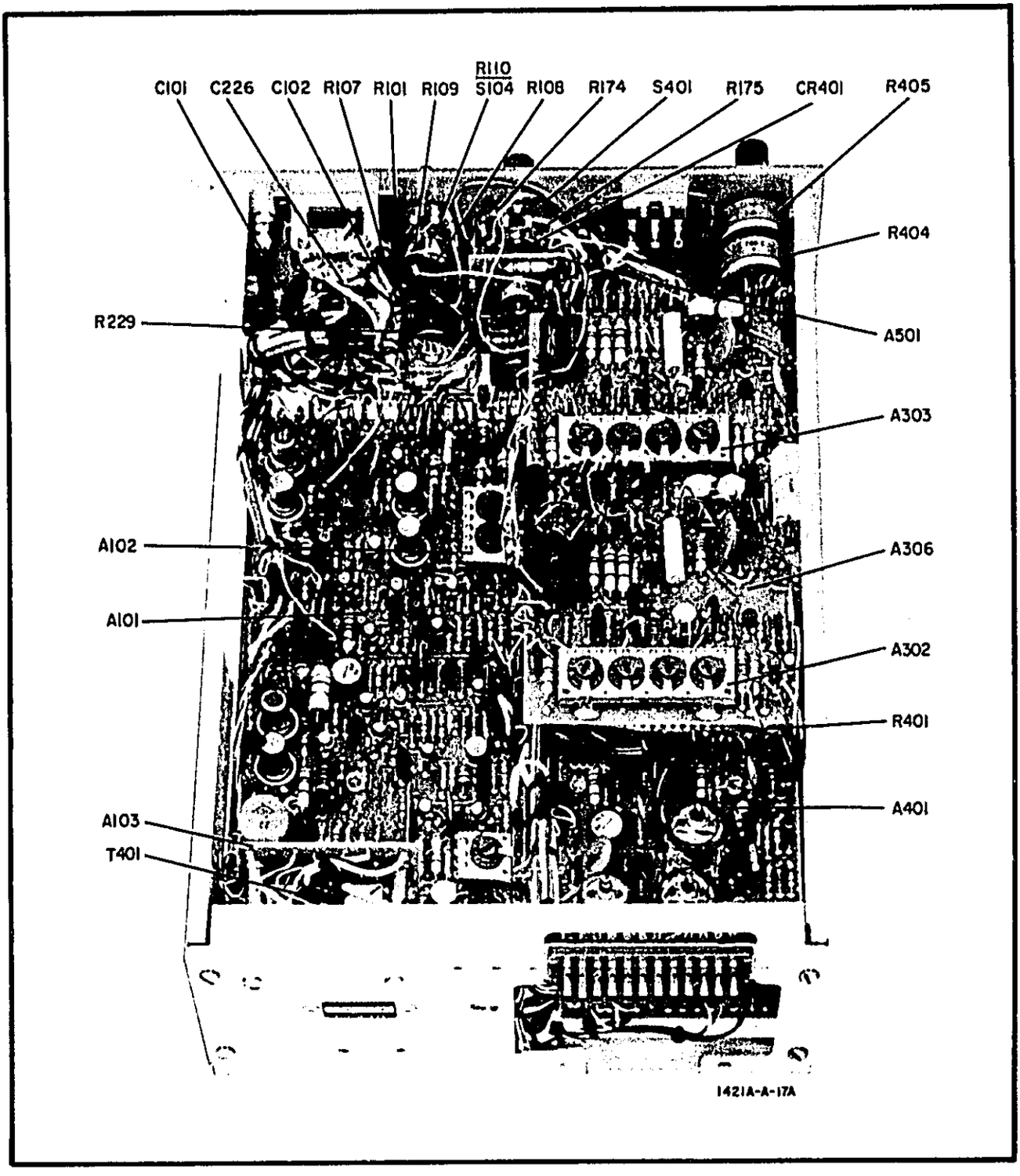


Figure 5-2. Component Identification, Top-Rear View

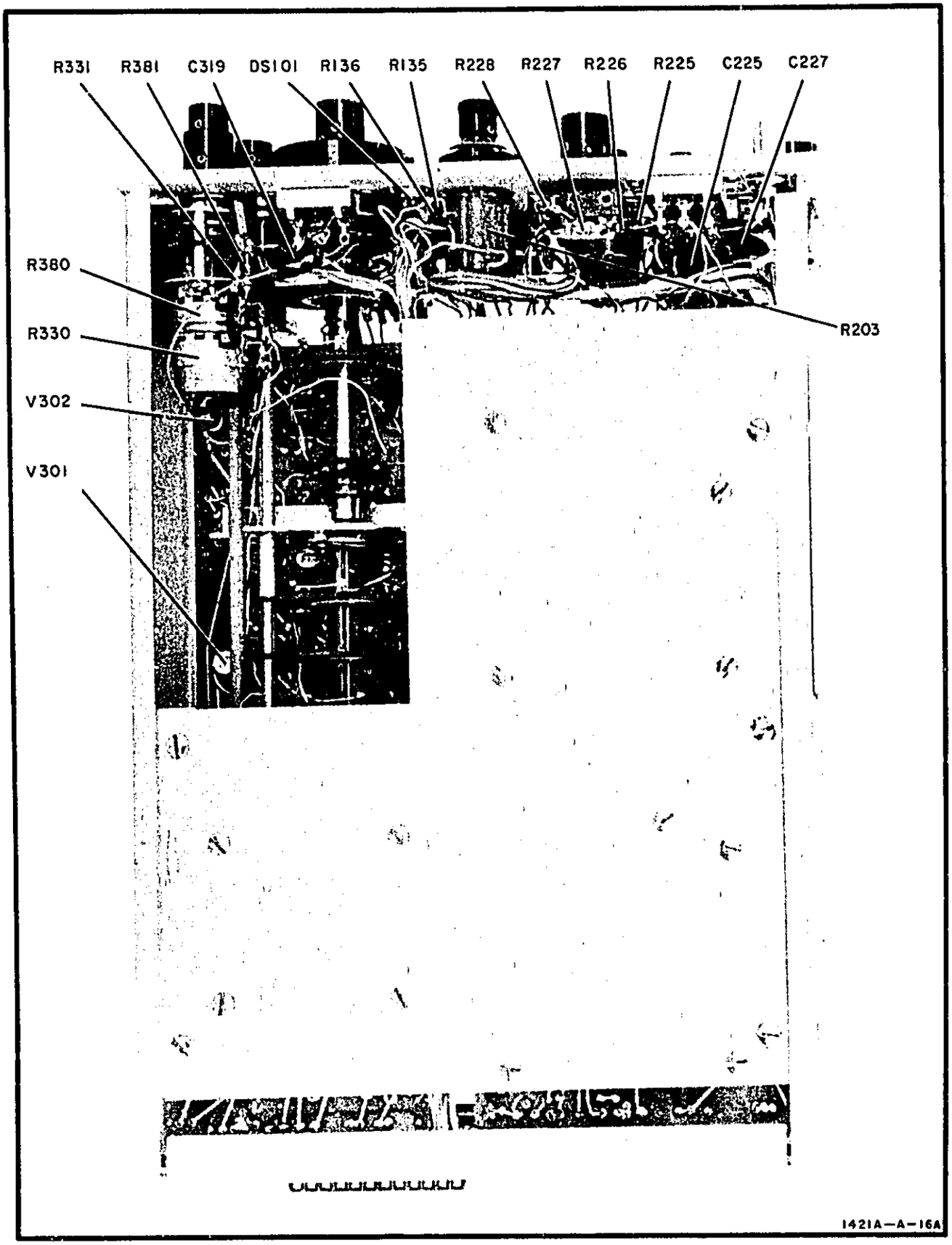


Figure 5-3. Component Identification, Bottom View

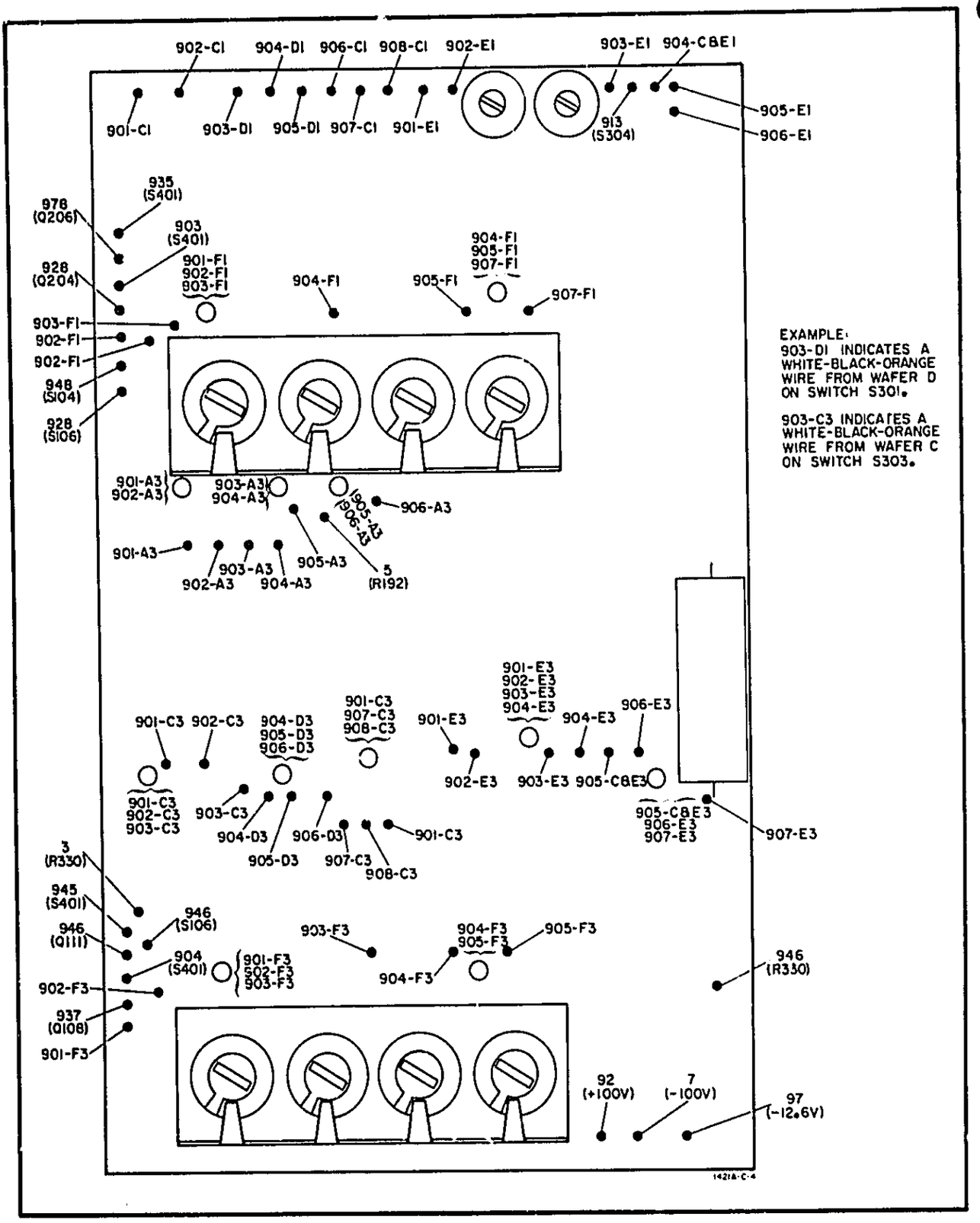


Figure 5-3a. Wiring Routing for A304 or A306 Replacement

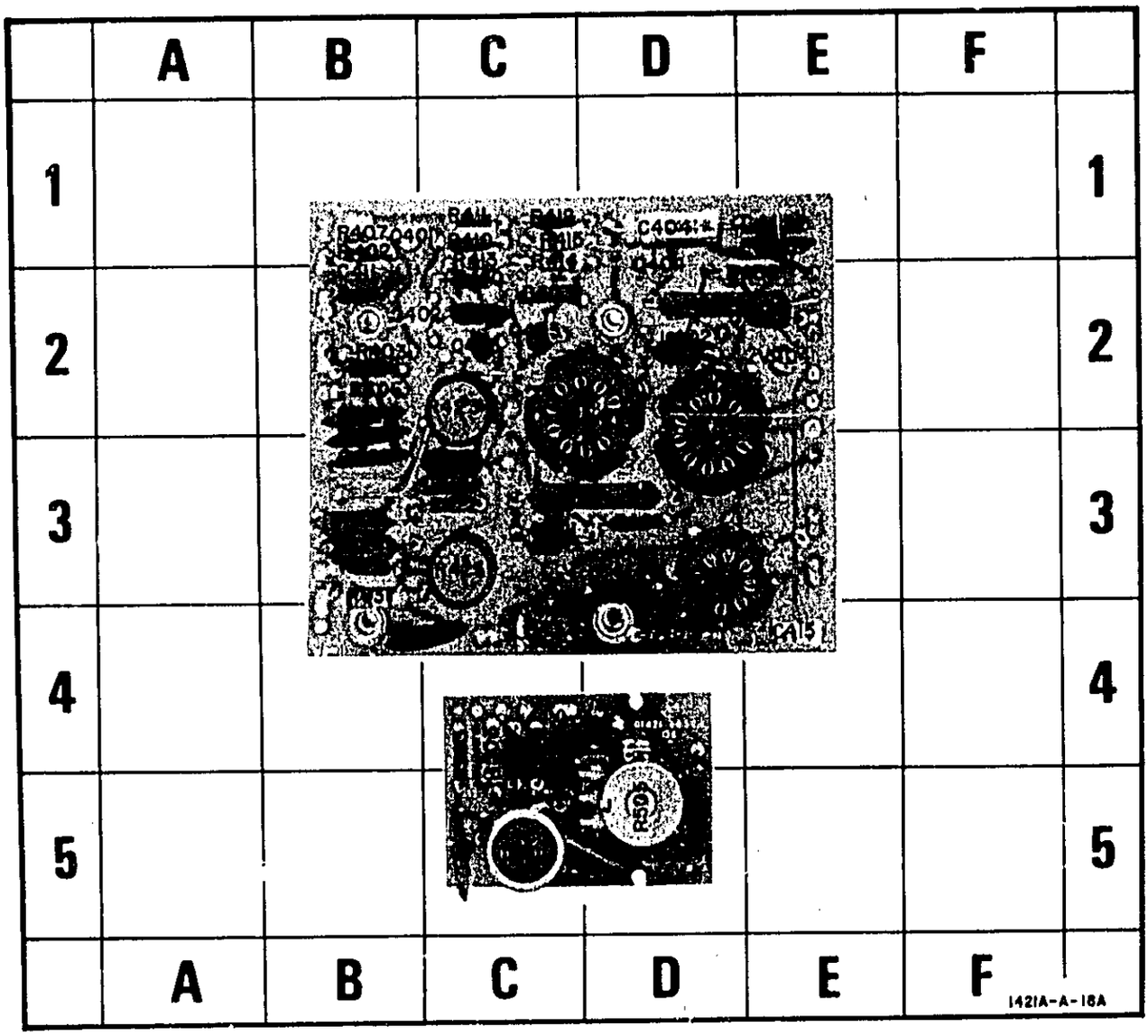


Figure 5-4. Component Identification, A401, Horizontal Amplifier (top), and A501, Horizontal Input Amplifier (lower)

Table 5-8. Component Grid Locations for Figure 5-4.

A401

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C401	B-3	C411	B-2	Q403	C-2	R410	C-1	R421	D-2	R432	C-4
C402	B-2	C412	B-4	Q404	D-1	R411	C-1	R422	C-3	R433	D-2
C403	C-2	C413	C-4	Q405	C-2	R412	C-1	R423	C-2	R434	D-3
C404	D-1	C414	D-3	R402	B-1	R413	C-1	R424	B-3	R435	D-4
C405	E-1	C415	E-4	R403	B-2	R414	C-1	R425	C-3	R436	E-2
C406	B-3	L401	C-2	R406	B-2	R415	C-1	R426	B-3	V401	C-2
C407	E-1	L402	D-2	R407	B-1	R418	E-2	R429	D-3	V402	D-3
C408	C-2	Q401	B-1	R408	B-2	R419	C-3	R430	B-3	V403	D-3
C409	C-3	Q402	B-2	R409	B-2	R420	C-2	R431	B-3	V404	E-2
C410	C-3										

A501

REF DESIG	GRID LOC
C501	C-5
R501	C-4
R502	C-4
R503	C-4
R504	C-4
R505	D-5
R506	C-4
R507	D-5
V501	C-5

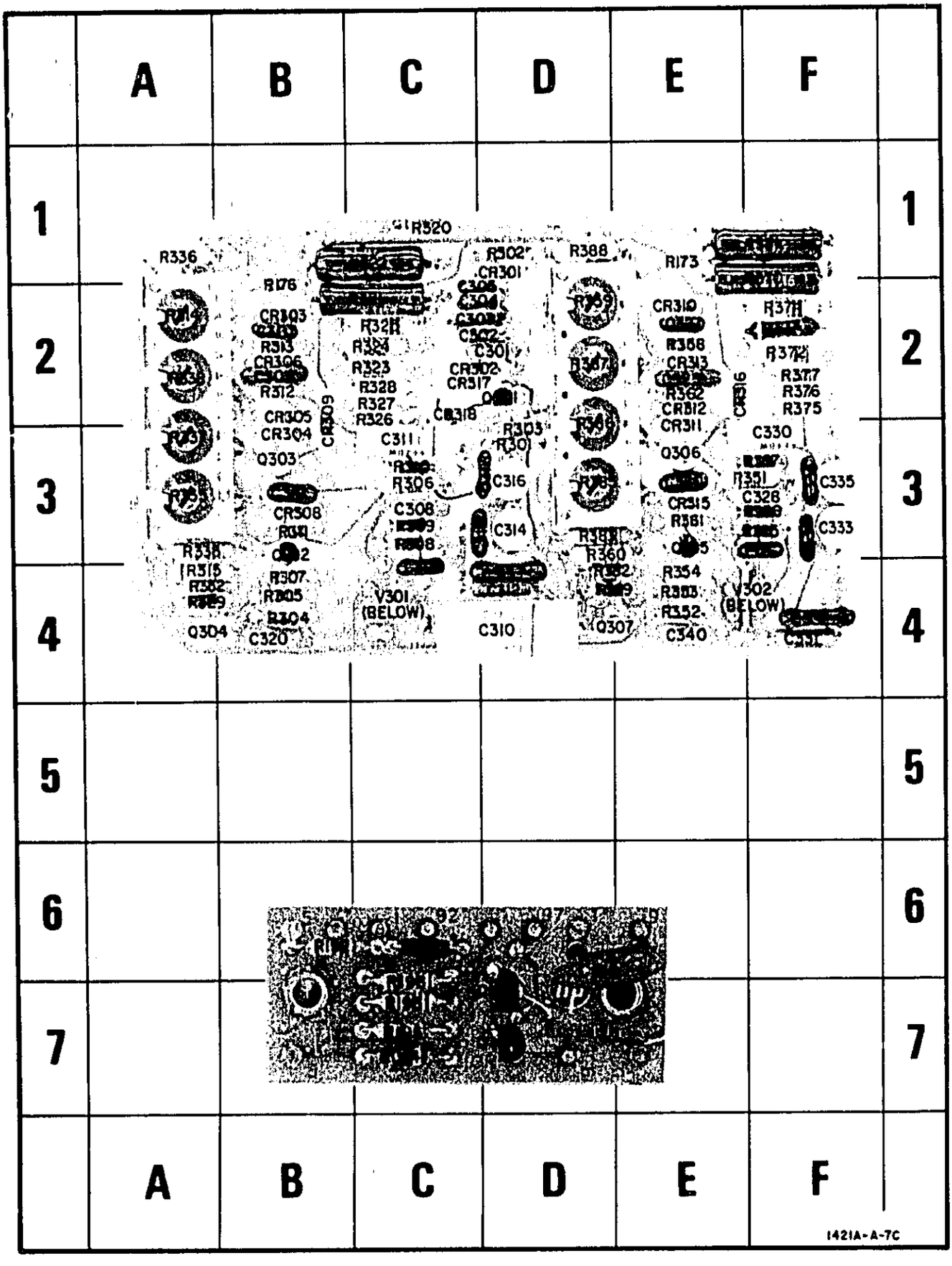


Figure 5-5. Component Identification, A306, Sweep Generator (top), and A103, Adapter (lower)

Table 5-9. Component Grid Locations for Figure 5-5

COMPONENT LOCATION

A06

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C301	D-2	CR309	B-2	R326	C-2
C302	D-2	CR310	E-2	R327	C-2
C303	D-2	CR311	E-3	R328	C-2
C304	D-2	CR312	E-2	R329	A-4
C305	D-2	CR313	E-2	R332	A-4
C306	C-3	CR315	E-3	R333	A-3
C307	B-2	CR316	E-2	R335	A-3
C308	C-3	CR317	C-2	R336	A-1
C309	B-2	CR318	C-2	R337	A-3
C310	D-4	Q301	D-2	R338	A-2
C311	C-3	Q302	B-3	R351	F-3
C312	D-4	Q303	B-3	R352	E-4
C313	D-4	Q304	A-4	R353	E-4
C314	D-3	Q305	E-3	R354	E-4
C315	C-3	Q306	E-3	R355	F-3
C316	D-3	Q307	D-4	R356	F-3
C317	D-3	R173	E-1	R357	F-3
C318	B-3	R176	B-1	R358	E-2
C320	B-4	R301	D-3	R359	D-2
C325	E-2	R302	D-1	R360	D-3
C326	F-3	R303	D-2	R361	E-3
C327	E-2	R304	B-4	R362	E-2
C328	F-3	R305	B-4	R370	F-1
C329	E-3	R306	C-3	R371	F-1
C330	F-3	R307	B-4	R372	F-2
C331	F-4	R308	C-3	R373	F-2
C332	F-4	R309	C-3	R374	F-2
C333	F-3	R310	C-3	R375	F-2
C334	F-3	R311	B-3	R376	F-2
C335	F-3	R312	B-2	R377	F-2
C336	F-3	R313	B-2	R379	D-4
C340	E-4	R314	A-2	R382	D-4
CR301	D-1	R315	A-3	R383	D-3
CR302	C-2	R320	C-1	R385	D-3
CR303	B-2	R321	C-2	R386	D-2
CR304	B-3	R322	C-2	R387	D-2
CR305	B-2	R323	C-2	R388	D-1
CR306	B-2	R324	C-2	V301	C-4
CR308	B-3	R325	C-2	V302	F-4

A103

REF DESIG	GRID LOC
C100	D-6
CR121	C-6
Q112	D-7
Q113	D-7
R192	B-6
R193	C-7
R194	C-7
R195	C-7
R196	C-7

Table 5-10. Component Grid Locations for Figure 5-6

COMPONENT LOCATION

A101

REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC	REF DESIG	GRID LOC
C103	F-5	CR118	J-3	R130	F-4	R211	D-4
C104	F-6	CR119	K-3	R131	J-5	R212	D-4
C105	E-5	CR120	K-3	R137	G-2	R213	C-2
C106	H-6	CR122	K-3	R138	G-2	R214	C-3
C109	K-5	CR200	D-5	R139	G-3	R215	B-3
C110	F-4	CR201	B-4	R140	G-3	R218	C-4
C111	F-4	CR202	C-5	R142	J-6	R219	C-4
C112	K-6	CR204	D-5	R143	J-5	R220	B-4
C114	K-4	CR205	E-5	R144	K-6	R231	B-5
C115	G-3	CR206	D-4	R145	J-6	R232	B-5
C116	G-4	CR209	E-4	R146	J-5	R233	B-6
C117	H-5	CR210	E-4	R147	H-4	R234	C-6
C118	H-5	L101	G-5	R148	J-5	R235	C-5
C119	H-5	L201	C-5	R149	F-4	R236	C-5
C121	F-3	Q101	G-5	R150	F-4	R237	B-5
C122	F-3	Q102	J-4	R151	F-3	R238	B-4
C123	F-3	Q103	J-4	R152	F-3	R239	C-5
C129	G-3	Q104	J-5	R153	F-3	R240	D-5
C130	H-3	Q105	H-4	R154	F-3	R241	D-6
C131	K-4	Q106	F-4	R157	K-4	R242	D-6
C132	J-3	Q107	F-4	R158	G-4	R243	D-5
C133	J-3	Q108	F-3	R159	G-3	R244	D-5
C134	J-3	Q109	G-3	R160	J-4	R245	D-5
C135	J-3	Q110	G-4	R161	H-4	R246	D-4
C136	K-3	Q111	G-4	R162	H-5	R247	D-4
C200	B-3	Q115	H-3	R163	H-4	R248	E-5
C201	B-2	Q116	H-4	R164	J-6	R249	E-6
C202	C-3	Q117	J-3	R165	H-5	R250	D-5
C203	B-4	Q118	K-3	R166	F-3	R251	D-3
C204	B-4	Q119	D-5	R167	F-3	R252	D-4
C205	C-4	Q120	B-4	R168	F-3	R253	D-3
C206	B-4	Q201	D-5	R169	F-4	R254	D-3
C228	B-5	Q202	D-5	R170	F-3	R255	D-3
C229	B-6	Q203	D-4	R171	F-2	R256	D-2
C230	B-4	Q204	D-3	R177	H-3	R257	E-2
C231	D-6	Q205	E-4	R178	H-3	R260	E-4
C235	D-5	Q206	E-3	R179	H-3	R261	E-3
C236	D-5	R102	F-5	R180	H-4	R262	E-4
C237	E-5	R103	F-5	R181	H-2	R263	E-5
C238	E-5	R104	F-6	R182	J-2	R264	E-3
C239	E-4	R105	F-6	R184	J-4	R265	E-3
C240	E-3	R111	G-5	R185	K-3	R266	E-3
C241	E-4	R112	G-5	R186	J-4	TP101	J-3
C242	E-3	R113	F-5	R187	J-3	V101	F-5
C245	D-4	R114	F-5	R188	J-3	V102	F-5
C246	D-3	R115	E-5	R189	J-2	V103	G-6
C247	F-2	R117	G-4	R190	K-2	V104	G-5
CR102	G-4	R118	G-5	R191	K-3	V105	J-6
CR103	J-4	R119	F-5	R197	F-4	V107	B-4
CR104	K-4	R120	H-6	R198	K-2	V108	C-4
CR105	F-4	R122	J-4	R200	B-3	V109	D-4
CR106	F-4	R123	J-5	R201	C-3	V110	D-3
CR107	H-5	R124	K-5	R202	C-3	V201	B-5
CR108	F-3	R125	J-4	R204	C-3	V202	B-5
CR109	G-4	R126	K-4	R205	D-3	V203	B-5
CR115	H-3	R127	H-4	R206	D-3	V204	C-5
CR116	H-3	R128	F-4	R210	B-4	VR201	B-3
CR117	H-3	R129	F-4				

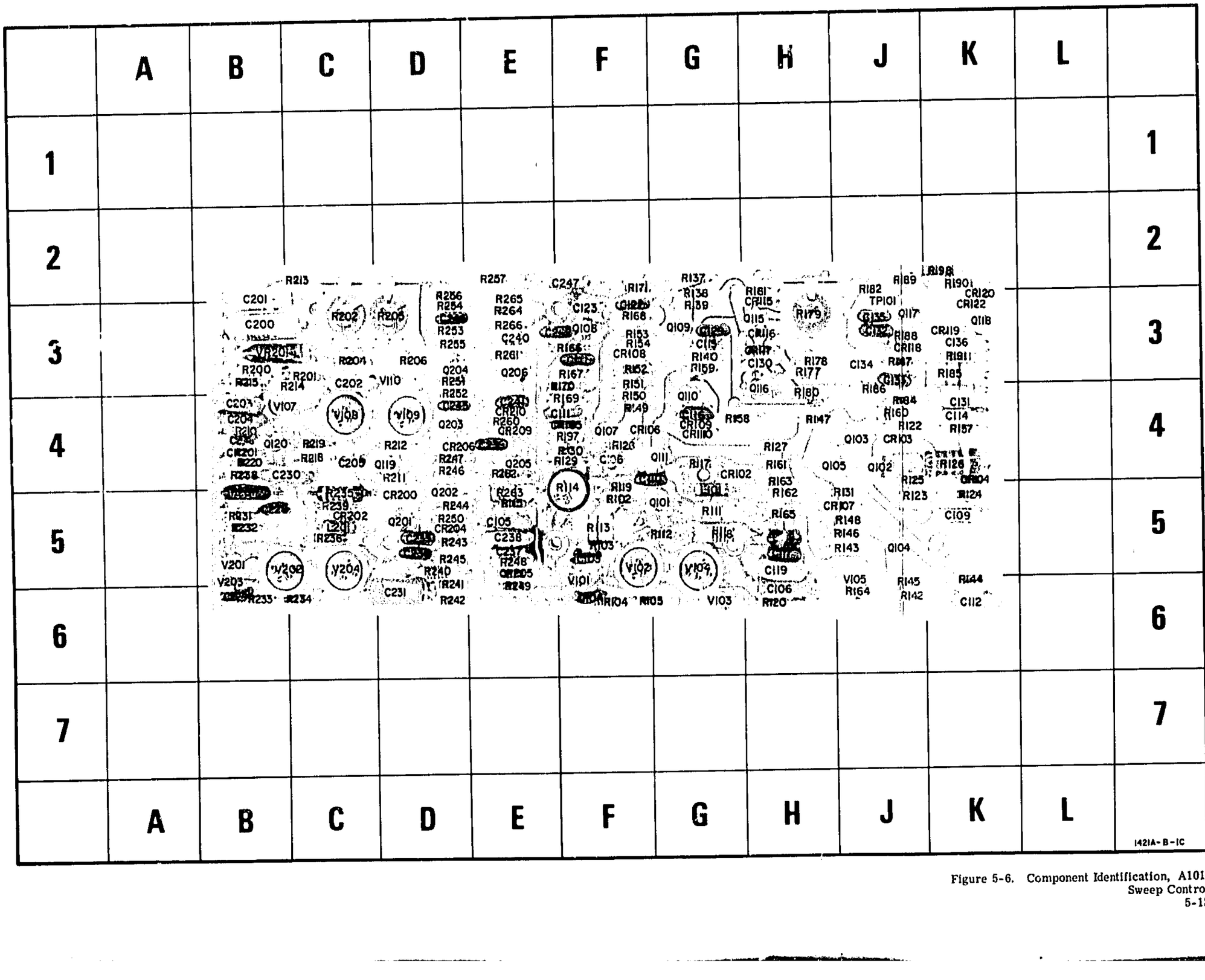


Figure 5-6. Component Identification, A101, Sweep Control

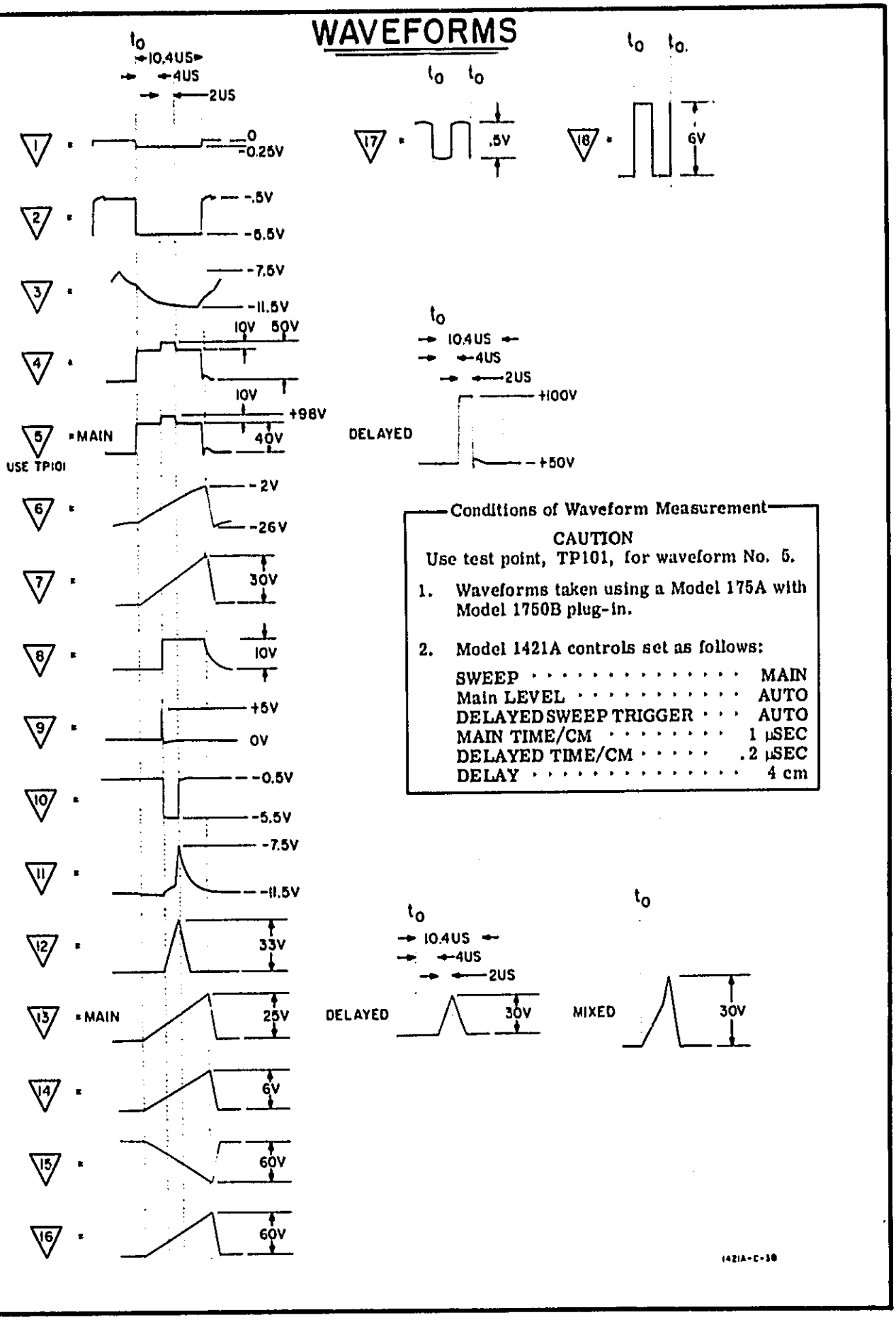


Figure 5-7. Typical Waveforms

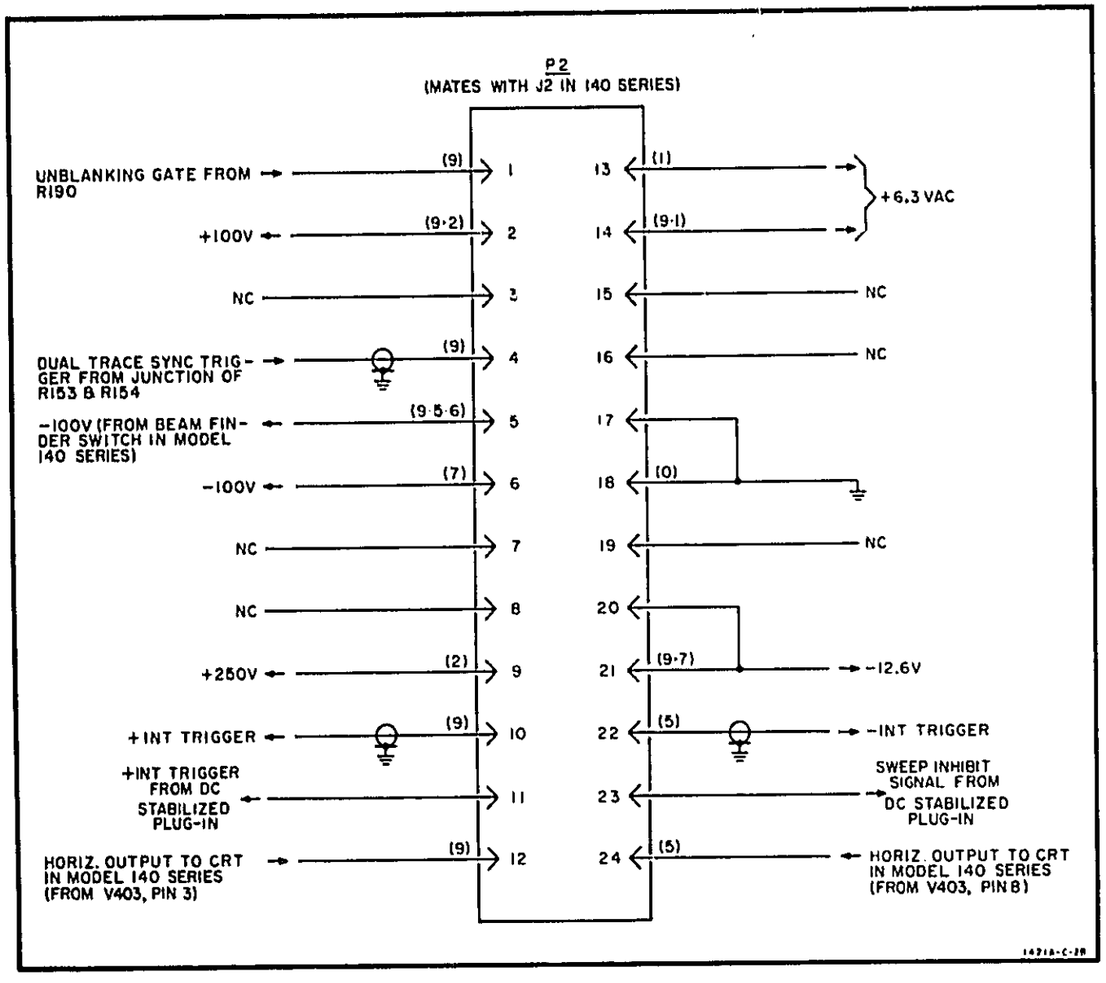


Figure 5-8. Rear Panel Connector, P2

Table 5-11. Schematic Diagram Notes

1. Components connected by short dashes (---) are given for reference only. These components actually appear on the sweep time switch schematic.
2. Each wafer of S301, S303, and S401 is identified by a letter starting with the wafer nearest the front panel (A=front side of first wafer; B = rear side of first wafer; C = front side of second wafer; etc.)
3. DC Voltage measurement conditions:

   NOTE: DC voltages given are typical and may vary slightly from one instrument to another.

   a. For all schematics, except Horizontal Amplifier, voltages given are an average with both sweeps operating; front panel controls should be set as given in Figure 5-7.

   b. For Horizontal Amplifier voltages, front panel controls should be set as follows:

      MAIN SWEEP TRIGGER . . . . . EXT.
      POSITION . . . . . centered spot

Refer to MIL-STD-15-1A for schematic symbols not listed in this table.

Unless otherwise indicated:
capacitance in picofarads
inductance in microhenries
resistance in ohms

= Etched circuit board

= Front panel marking

= Rear panel marking

= Front panel control

= Screwdriver Adjustment

CW = Clockwise end of variable resistor

= Primary signal path

= Feedback path

= Waveform test point (with number)

= Common point (with letter)

= Avalanche (zener) diode

= Tunnel diode

= Step recovery diode

Numbers in parentheses indicate wire color using resistor color code, e.g. WHT-RED-GRN is (9·2·5).

0 - Black	5 - Green
1 - Brown	6 - Blue
2 - Red	7 - Violet
3 - Orange	8 - Gray
4 - Yellow	9 - White

P/O = Part of

* = Optimum value selected at factory, average value shown; part may have been omitted.

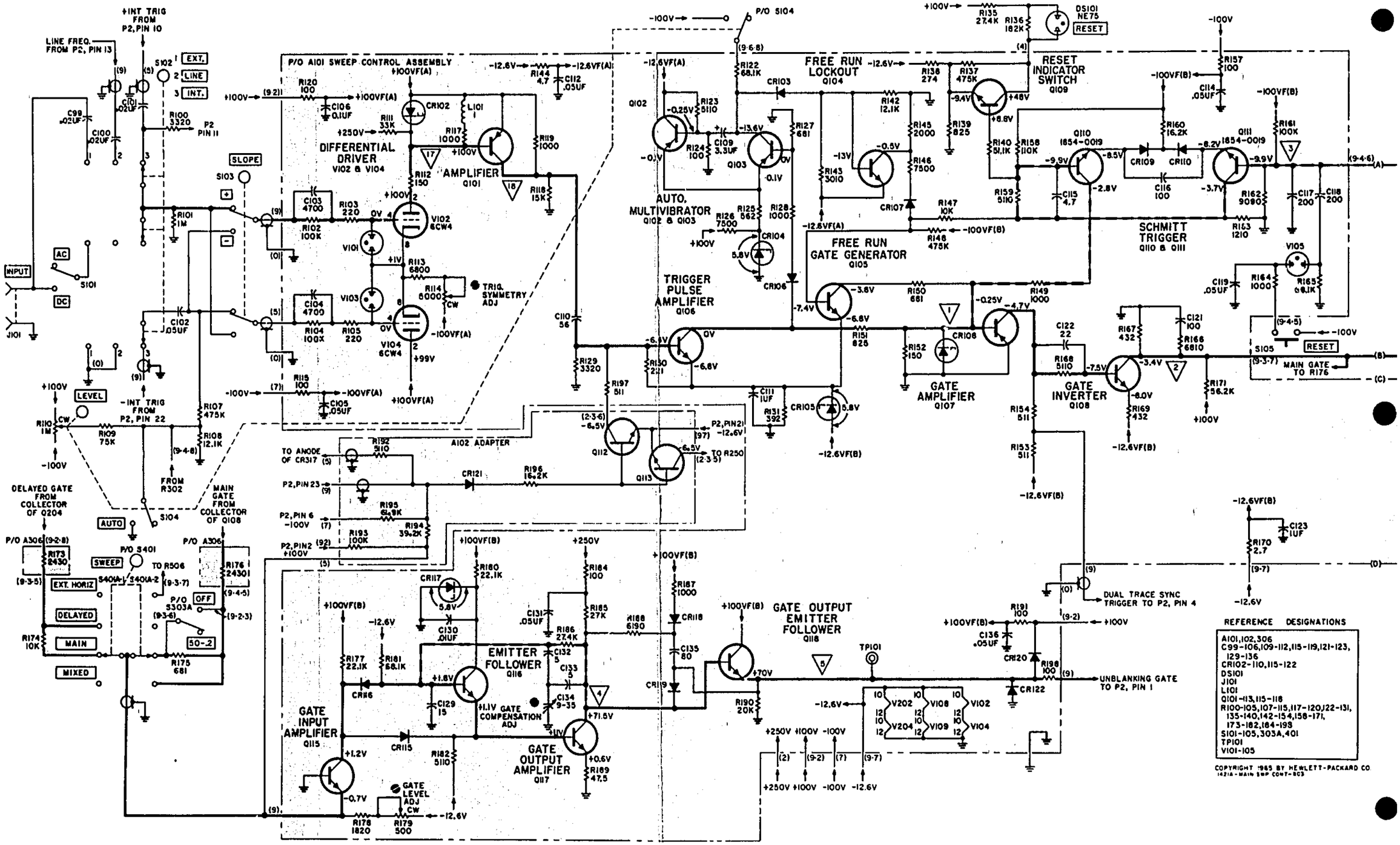


Figure 5-9. Main Sweep Control Schematic

02510-4

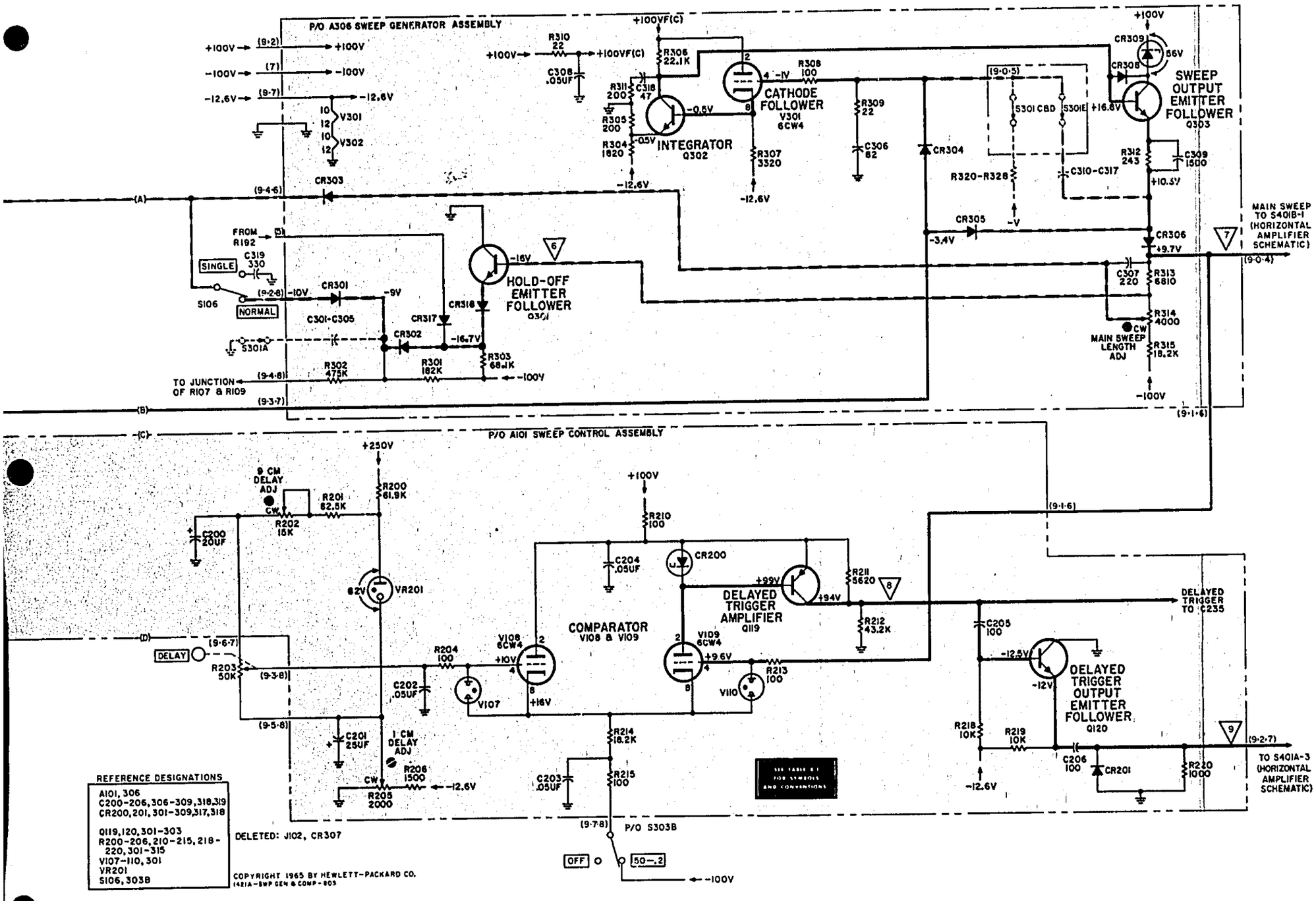


Figure 5-10. Main Sweep Generator and Comparator Schematic

REFERENCE DESIGNATIONS

A 101, 306
C 225, 227-231, 235-242, 245-247, 325-329
CR202, 204-206, 209, 210, 310-316
J 201
L 201
Q 201-206, 305, 306
R 225-229, 231-249, 250-257, 260-266, 351-362
S 201-203, 303F
V 201-204, 302

DELETED: CR314

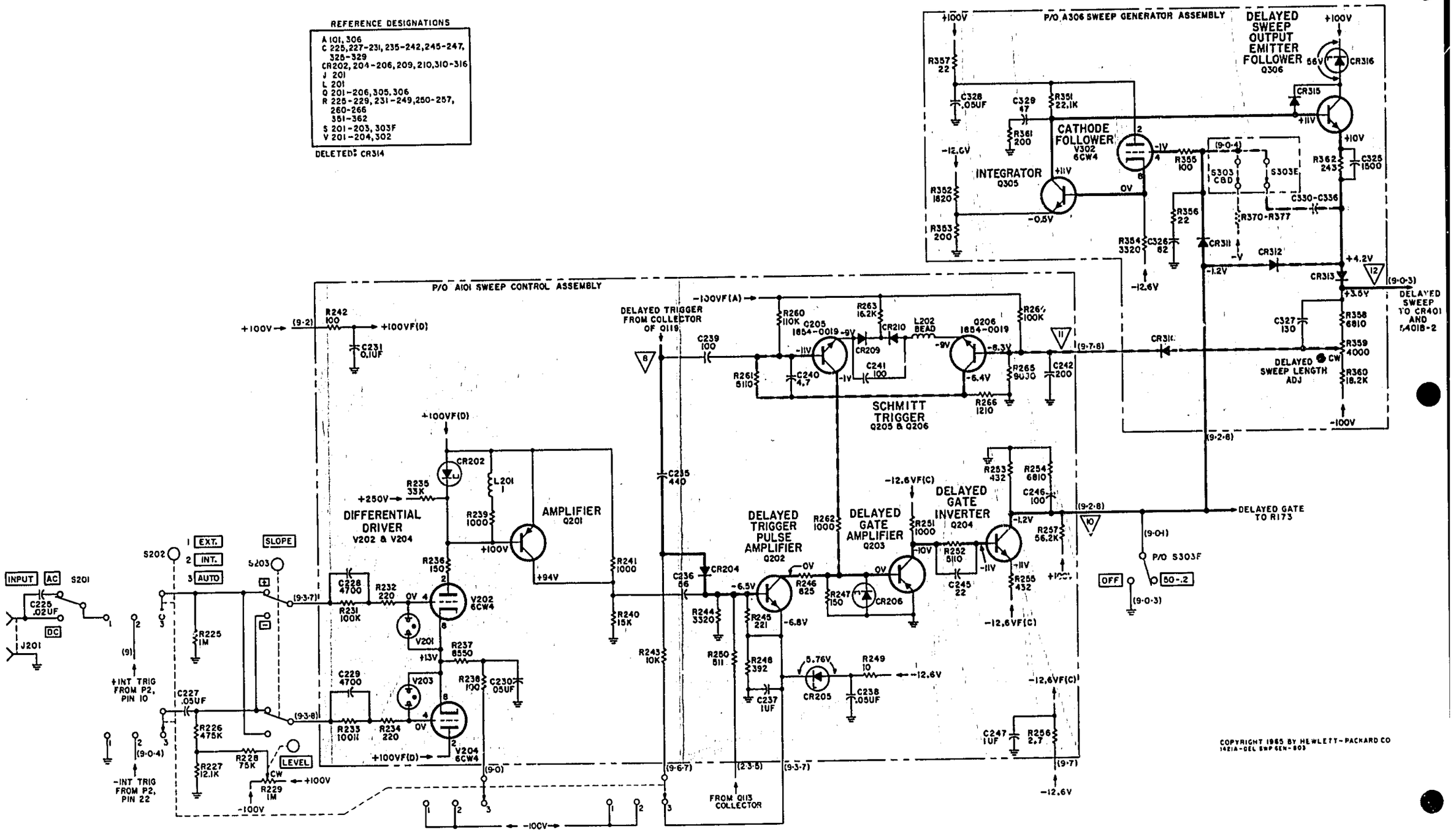
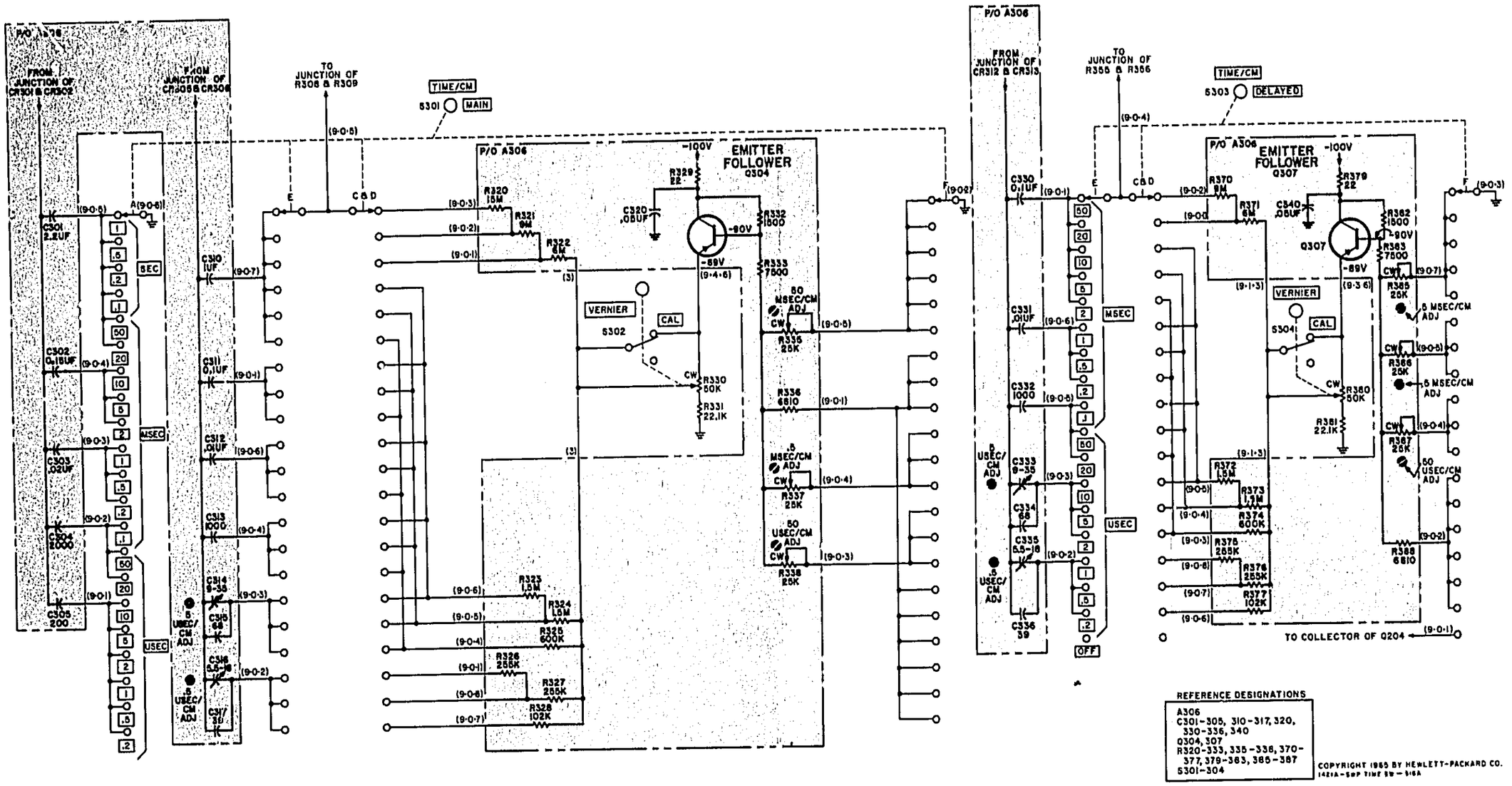


Figure 5-11. Delayed Sweep Generator Schematic

02510-5



REFERENCE DESIGNATIONS

A306
C301-305, 310-317, 320, 330-336, 340
Q304, 307
R320-333, 335-336, 370-377, 379-383, 385-387
S301-304

Figure 5-12. Sweep Time Switch Schematic

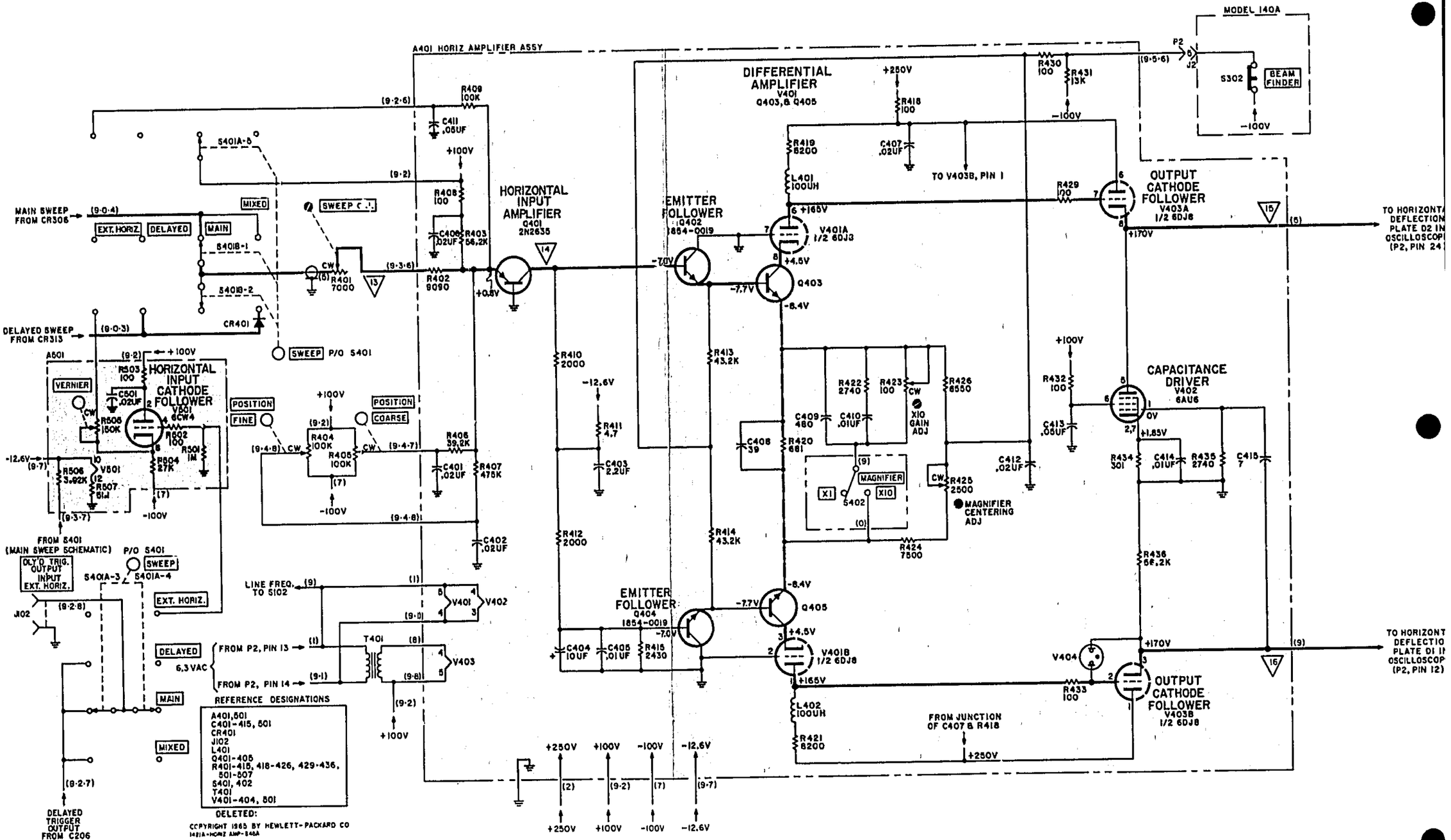


Figure 5-13. Horizontal Amplifier Schematic

02510-4

PARTS LIST

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. List of Reference Designators and Abbreviations

REFERENCE DESIGNATORS

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

ABBREVIATIONS

A	amperes	GE	germanium	N/C	normally closed	RMO	rack mount only
A.F.C	automatic frequency control	GL	glass	NE	neon	RMS	root-mean-square
AMPL	amplifier	GRD	ground(ed)	NI PL	nickel plate		
				N/O	normally open	S-B	slow-blow
B.F.O.	beat frequency oscillator	H	henries	NPO	negative positive zero (zero temperature coefficient)	SCR	screw
BE CU	beryllium copper	HEX	hexagonal			SE	selenium
BH	binder head	HG	mercury			SECT	section(s)
BP	bandpass	HR	hour(s)	NRFR	not recommended for field replacement	SEMICON	semiconductor
BRS	brass					SI	silicon
BWO	backward wave oscillator	IF	intermediate freq	NSR	not separately replaceable	SIL	silver
		IMPG	impregnated			SL	slide
CCW	counter-clockwise	INCD	incandescent			SPL	special
CER	ceramic	INCL	include(s)	OBD	order by description	SST	stainless steel
CMO	cabinet mount only	INS	insulation(ed)	OH	oval head	SR	split ring
COEF	coefficient	INT	internal	OX	oxide	STL	steel
COM	common	K	kilo = 1000	P	peak	TA	tantalum
COMP	composition			PC	printed circuit	TD	time delay
CONN	connector	LIN	linear taper	PF	picofarads = 10^{-12} farads	TGL	toggle
CP	cadmium plate	LK WASH	lock washer			TI	titanium
CRT	cathode-ray tube	LOG	logarithmic taper	PH BRZ	phosphor bronze	TOL	tolerance
CW	clockwise	LPF	low pass filter	PHL	Phillips	TRIM	trimmer
				PIV	peak inverse voltage	TWT	traveling wave tube
DEPC	deposited carbon	M	milli = 10^{-3}	P/O	part of		
DR	drive	MEG	meg = 10^{6}	POLY	polystyrene	U	micro = 10^{-6}
		METFLM	metal film	PORC	porcelain		
ELECT	electrolytic	MFR	manufacturer	POS	position(s)	VAR	variable
ENCAP	encapsulated	MINAT	miniature	POT	potentiometer	VDCW	dc working volts
EXT	external	MOM	momentary	PP	peak-to-peak		
		MTG	mounting	PT	point	W/	with
F	farads	MY	"mylar"	RECT	rectifier	W	watts
FH	flat head			RF	radio frequency	WW	wirewound
FIL H	fillister head	N	nano (10^{-9})	RH	round head	W/O	without
FXD	fixed						

01194-10

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
A101	01421-66507		1	A: sweep control etched circuit		
A102	2100-1444		1	A: r var lin 2 sect 2k and 15k ohms 20%		
A103	01421-66508		1	A: adapter etched circuit		
A104 - A300				Not assigned		
A301	01421-61905		1	A: includes A304 and A306		
A302	2100-1441		2	A: r var lin 4 sect 25k, 25k, 25k and 4k ohms		
A303	2100-1441			A: r var lin 4 sect 25k, 25k, 25k and 4k ohms		
A304	3100-1370		1	A: s time/cm 2 sect consists of S301 and S303		
A305	3100-0889		1	A: s vernier consists of R330/S302 & R380/S304		
A306	01421-66505			A: sweep generator etched circuit includes A302 and A303		
A401	01421-66503		1	A: horizontal amplifier etched circuit		
A402	2100-1464		1	R: var lin concentric 2 sec 100k ohms 20%		
A403 - A500				Not assigned		
A501	01421-66504		1	A: horizontal input amplifier etched circuit		
C99	0150-0024		7	C: fxd cer 0.02 µf +80%-20% 600vdcw		
C100	0150-0024			C: fxd cer 0.02 µf +80%-20% 600vdcw		
C101	0150-0024			C: fxd cer .02 µf +80% -20% 600vdcw		
C102	0150-0052		18	C: fxd cer 0.05 µf 20% 400vdcw		
C103	0150-0075		4	C: fxd cer 4700 pf +100% -20% 500vdcw		
C104	0150-0075			C: fxd cer 4700 pf +100% -20% 500vdcw		
C105	0150-0052			C: fxd cer 0.05 µf 20% 400vdcw		
C106	0170-0019		2	C: fxd my 0.1 µf 5% 200vdcw		
C107 & C108				Not assigned		
C109	0180-0161			C: fxd elect ta 3.3µf 20% 35vdcw		
C110	0140-0191		2	C: fxd mica 56 pf 5% 300vdcw		
C111	0160-0127		4	C: fxd cer 1 µf 20% 25VDCW		
C112	0150-0052			C: fxd cer 0.05 µf 20% 400vdcw		
C113				Not assigned		
C114	0150-0052			C: fxd cer 0.05 µf 20% 400vdcw		
C115	0150-0042		2	C: fxd ti 4.7 pf 5% 500vdcw		
C116	0140-0176		5	C: fxd mica 100 pf 2% 300vdcw		
C117	0140-0220		3	C: fxd mica 200 pf 1% 300vdcw		
C118	0140-0220			C: fxd mica 200 pf 1% 300vdcw		
C119	0150-0052			C: fxd cer 0.05 µf 20% 400vdcw		
C120				Not assigned		
C121	0140-0176			C: fxd mica 100 pf 2% 300vdcw		
C122	0140-0145		2	C: fxd mica 22 pf 5% 500vdcw		
C123	0160-0127			C: fxd cer 1 µf 20% 25vdcw		
C124 - C128				Not assigned		
C129	0140-0202		1	C: fxd mica 15 pf 5% 500vdcw		
C130	0150-0012		4	C: fxd cer .01 µf 20% 1000vdcw		
C131	0150-0052			C: fxd cer .05 µf 20% 400vdcw		
C132	0140-0209		2	C: fxd mica 5 pf 10% 500vdcw		
C133	0140-0209			C: fxd mica 5 pf 10% 500vdcw		
C134	0121-0046		3	C: var cer 9-35 pf 500vdcw		
C135	0140-0215		1	C: fxd mica 80 pf 2% 300vdcw		
C136	0150-0052			C: fxd cer .05 µf 20% 400vdcw		
C137 - C199				Not assigned		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
C200	0180-0049		1	C: fxd elect 20 µf 50vdcw		
C201	0180-0341		1	C: fxd elect 25 µf +75% -10% 12vdcw		
C202	0150-0052			C: fxd cer .05 µf 20% 400vdcw		
C203	0150-0052			C: fxd cer .05 µf 20% 400vdcw		
C204	0150-0052			C: fxd cer .05 µf 20% 400vdcw		
C205	0150-0073		2	C: fxd cer 100 pf 10% 500vdcw		
C206	0150-0073			C: fxd cer 100 pf 10% 500vdcw		
C207 - C224				Not assigned		
C225	0150-0024			C: fxd cer .02 µf +80% -20% 600vdcw		
C226	0150-0024			C: fxd cer .02 µf +80% -20% 600vdcw		
C227	0150-0052			C: fxd cer .05 µf 20% 400vdcw		
C228	0150-0075			C: fxd cer 4700 pf +100% -20% 500vdcw		
C229	0150-0075			C: fxd cer 4700 pf +100% -20% 500vdcw		
C230	0150-0052			C: fxd cer .05 µf 20% 400vdcw		
C231	0170-0019			C: fxd my 0.1 µf 5% 200vdcw		
C232 - C234				Not assigned		
C235	0140-0231		1	C: fxd mica 440 pf 1% 300vdcw		
C236	0140-0191			C: fxd mica 56 pf 5% 300vdcw		
C237	0160-0127			C: fxd cer 1 µf 20% 25vdcw		
C238	0150-0052			C: fxd cer .05 µf 20% 400vdcw		
C239	0140-0176			C: fxd mica 100 pf 2% 300vdcw		
C240	0150-0042			C: fxd ti 4.7 pf 5% 500vdcw		
C241	0140-0176			C: fxd mica 100 pf 2% 300vdcw		
C242	0140-0220			C: fxd mica 200 pf 1% 300vdcw		
C243 & C244				Not assigned		
C245	0140-0145			C: fxd mica 22 pf 5% 500vdcw		
C246	0140-0176			C: fxd mica 100 pf 2% 300vdcw		
C247	0160-0127			C: fxd cer 1 µf 20% 25vdcw		
C248 - C300				Not assigned		
C301	0160-0128		2	C: fxd cer 2.2 µf 20% 25vdcw		
C302	0180-0218		1	C: fxd Ta 0.15 µf 10% 35vdcw		
C303	0150-0024			C: fxd cer .02 µf +80% -20% 600vdcw		
C304	0150-0023		1	C: fxd cer 2000 pf 20% 1000vdcw		
C305	0150-0072		1	C: fxd cer 200 pf 5% 500vdcw		
C306	0140-0193		2	C: fxd mica 82 pf 5% 300vdcw		
C307	0140-0221		1	C: fxd mica 220 pf 1% 300vdcw		
C308	0150-0052			C: fxd cer .05 µf 20% 400vdcw		
C309	0140-0156		2	C: fxd mica 1500 pf 2% 300vdcw		
C310	0160-0262		1	C: fxd my 1 µf 5% 50vdcw		
C311	0160-0985		2	C: fxd my 0.1 µf 1% 100vdcw		
C312	0160-0207		2	C: fxd my .01 µf 5% 200vdcw		
C313	0140-0152		2	C: fxd mica 1000 pf 5% 300vdcw		
C314	0121-0046			C: var cer 9-35 pf 500vdcw		
C315	0140-0192		2	C: fxd mica 68 pf 5% 300vdcw		
C316	0121-0061		2	C: var cer disk 5.5-18 pf 300vdcw		
C317	0140-0190		2	C: fxd mica 39 pf 5% 300vdcw		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
C318	0140-0204		2	C: fxd mica 47 pf 5% 500vdcw		
C319	0160-2012		1	C: fxd mica 330 pf 5%		
C320	0150-0052			C: fxd cer .05 µf 20% 400vdcw		
C321 - C324				Not assigned		
C325	0140-0156			C: fxd mica 1500 pf 2% 300vdcw		
C326	0140-0193			C: fxd mica 82 pf 5% 300vdcw		
C327	0140-0195		1	C: fxd mica 130 pf 5% 300vdcw		
C328	0150-0052			C: fxd cer .05 µf 20% 400vdcw		
C329	0140-0204			C: fxd mica 47 pf 5% 500vdcw		
C330	0160-0985			C: fxd my 0.1 µf 1% 100vdcw		
C331	0160-0207			C: fxd my .01 µf 5% 200vdcw		
C332	0140-0152			C: fxd mica 1000 pf 5% 300vdcw		
C333	0121-0046			C: var cer 9-35 pf 500vdcw		
C334	0140-0192			C: fxd mica 68 pf 5% 300vdcw		
C335	0121-0061			C: var cer disk 5.5-18 pf 300vdcw		
C336	0140-0190			C: fxd mica 39 pf 5% 300vdcw		
C337 - C339				Not assigned		
C340	0150-0052			C: fxd cer .05 µf 20% 400vdcw		
C341 - C400				Not assigned		
C401	0150-0070		5	C: fxd cer .02 µf 20% 500vdcw		
C402	0150-0070			C: fxd cer .02 µf 20% 500vdcw		
C403	0160-0128			C: fxd cer 2.2 µf 20% 25vdcw		
C404	0180-0059		1	C: fxd elect 10 µf +100% -10% 25 vdcw		
C405	0150-0012			C: fxd cer .01 Qf 20% 1000 vdcw		
C406	0150-0070			C: fxd cer .02 µf 20% 500vdcw		
C407	0150-0070			C: fxd cer .02 µf 20% 500vdcw		
C408	0140-0175		1	C: fxd mica 39 pf 2% 300vdcw		
C409	0140-0233		1	C: fxd mica 480 pf 1% 300vdcw		
C410	0150-0012			C: fxd cer .01 µf 20% 1000vdcw		
C411	0150-0052			C: fxd cer .05 µf 20% 400vdcw		
C412	0150-0070			C: fxd cer .02 µf 20% 500vdcw		
C413	0150-0052			C: fxd cer .05 µf 20% 400vdcw		
C414	0150-0012			C: fxd cer .01 µf 20% 1000vdcw		
C415	0150-0074		1	C: fxd cer 7 pf 10% 500vdcw		
C416 - C500				Not assigned		
C501	0150-0024			C: fxd cer 0.02 µf +80% -20% 600vdcw		
CR102	1912-0009		2	CR: tunnel		
CR103	1901-0040		15	CR: si		
CR104	1902-0034		4	CR: avalanche 5.8 v 10%		
CR105	1902-0034			CR: avalanche 5.8 v 10%		
CR106	1901-0040			CR: si		
CR107	1901-0040			CR: si		
CR108	1912-0006		2	CR: tunnel		
CR109	1910-0016		4	CR: ge		
CR110	1910-0016			CR: ge		
CR111 - CR114				Not assigned		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
CR115	1901-0040			CR: si		
CR116	1901-0040			CR: si		
CR117	1902-0034			CR: avalanche 5.8v 10%		
CR118	1901-0040			CR: si		
CR119	1901-0040			CR: si		
CR120	1901-0029		2	CR: si		
CR121	1901-0096		6	CR: si		
CR122	1901-0029			CR: si		
CR123-CR199				Not assigned		
CR200	1912-0007		1	CR: tunnel		
CR201	1901-0040			CR: si		
CR202	1912-0009			CR: tunnel		
CR203				Not assigned		
CR204	1901-0096			CR: si		
CR205	1902-0034			CR: avalanche 5.8v 10%		
CR206	1912-0006			CR: tunnel		
CR207 & CR208				Not assigned		
CR209	1910-0016			CR: ge		
CR210	1910-0016			CR: ge		
CR211-CR300				Not assigned		
CR301	1901-0040			CR: si		
CR302	1901-0040			CR: si		
CR303	1901-0040			CR: si		
CR304	1901-0439		2	CR: si		
CR305	1901-0050		2	CR: si		
CR306	1901-0040			CR: si		
CR307				deleted		
CR308	1901-0096			CR: si		
CR309	1902-0597		2	CR: avalanche 56.2v 5%		
CR310	1901-0040			CR: si		
CR311	1901-0439			CR: si		
CR312	1901-0050			CR: si		
CR313	1901-0040			CR: si		
CR314				deleted		
CR315	1901-0096			CR: si		
CR316	1902-0597			CR: avalanche 56.2v 5%		
CR317	1901-0096			CR: si		
CR318	1901-0040			CR: si		
CR319-CR400				Not assigned		
CR401	1901-0096			CR: si		
DS101	2140-0018		9	DS: glow 1/10w		
J101	1250-0118		3	J: BNC		
J102	1250-0118			J: BNC		
J103-J200				Not assigned		
J201	1250-0118			J: BNC		
L101	9140-0096		2	L: fxd rf 1 µf 10%		
L102-L200				Not assigned		
L201	9140-0096			L: fxd rf 1 µh 10%		
L202	9170-0029		1	L: bead ferrite		
L203-L400				Not assigned		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
L401	9140-0029		2	L: fxd 100 µh 2.6 ohms		
L402	9140-0029			L: fxd 100 µh 2.6 ohms		
P2	1251-0055		1	P: 24 contant male		
Q101	1850-0164		2	Q: pnp ge		
Q102	1850-0062		1	Q: ge		
Q103	1850-0158		3	Q: pnp ge 2N2635		
Q104	1854-0019		13	Q: npn si		
Q105	1854-0019			Q: npn si		
Q106	1854-0009		2	Q: npn si 2N709		
Q107	1850-0172		2	Q: pnp ge 2N2996		
Q108	1854-0019			Q: npn si		
Q109	1854-0022		3	Q: npn si		
Q110	1854-0019			Q: npn si		
Q111	1854-0019			Q: npn si		
Q112	1854-0096		2	Q: npn si		
Q113	1854-0096			Q: npn si		
Q114				Not assigned		
Q115	1854-0019			Q: npn si		
Q116	1854-0019			Q: npn si		
Q117	1854-0271		2	Q: npn si		
Q118	1854-0271			Q: npn si		
Q119	1850-0158			Q: pnp ge 2N2635		
Q120	1854-0019			Q: npn si		
Q121 - Q200				Not assigned		
Q201	1850-0164			Q: pnp ge		
Q202	1854-0009			Q: npn si 2N709		
Q203	1850-0172			Q: pnp ge 2N2996		
Q204	1854-0019			Q: npn si		
Q205	1854-0019			Q: npn si		
Q206	1854-0019			Q: npn si		
Q207 - Q300				Not assigned		
Q301	1854-0083		3	Q: npn si		
Q302	1854-0083			Q: npn si		
Q303	1854-0022			Q: npn si		
Q304	1853-0009		2	Q: pnp si		
Q305	1854-0083			Q: npn si		
Q306	1854-0022			Q: npn si		
Q307	1853-0009			Q: pnp si		
Q308 - Q400				Not assigned		
Q401	1850-0158			Q: pnp ge 2N2635		
Q402	1854-0019			Q: npn si		
Q403	1854-0054		2	Q: npn si		
Q404	1854-0019			Q: npn si		
Q405	1854-0054			Q: npn si		
R100	0757-0433		5	R: fxd met flm 3.32k ohms 1% 1/8w		
R101	0684-1051		3	R: fxd comp 1 meg ohm 1% 1/4w		
R102	0757-0465		6	R: fxd met flm 100k ohm 1% 1/8w		
R103	0684-2211		4	R: fxd comp 220 ohm 10% 1/4w		
R104	0757-0465			R: fxd met flm 100k ohm 1% 1/8w		
R105	0684-2211			R: fxd comp 220 ohm 10% 1/4w		

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

Ref. Desig	hp Part No.		TQ	Description (See Table 6-1.)		
R106				Not assigned		
R107	0757-0481		6	R: fxd met flm 475k ohm 1% 1/8w		
R108	0757-0444		3	R: fxd met flm 12.1k ohm 1% 1/8w		
R109	0757-0462		2	R: fxd met flm 75k ohms 1% 1/8w		
R110	2100-1453		1	R: var comp 1 meg ohm 20% 1/4w		
R111	0761-0079		2	R: fxd met flm 33k ohms 5% 1w		
R112	0757-0284		4	R: fxd met flm 150 ohm 1% 1/8w		
R113	0764-0012		1	R: fxd met flm 6800 ohm 5% 2w		
R114	2100-0741		1	R: var ww 5k ohm 5%		
R115	0757-0401		18	R: fxd met flm 100 ohm 1% 1/8w		
R116				Not assigned		
R117	0757-0280		11	R: fxd met flm 1000 ohm 1% 1/8w		
R118	0757-0843		2	R: fxd met flm 15k ohm 1% 1/2w		
R119	0757-0280			R: fxd met flm 1000 ohm 1% 1/8w		
R120	0757-0401			R: fxd met flm 100 ohm 1% 1/8w		
R121				Not assigned		
R122	0757-0461		4	R: fxd met flm 68.1k ohm 1% 1/8w		
R123	0757-0438		7	R: fxd met flm 5.11k ohm 1% 1/8w		
R124	0757-0401			R: fxd met flm 100 ohm 1% 1/8w		
R125	0757-0417		1	R: fxd met flm 562 ohm 1% 1/8w		
R126	0764-0002		1	R: fxd met flm 7500 ohm 5% 2w		
R127	0757-0421		4	R: fxd met flm 825 ohm 1% 1/8w		
R128	0757-0280			R: fxd met flm 1000 ohm 1% 1/8w		
R129	0757-0433			R: fxd met flm 3.32k ohm 1% 1/8w		
R130	0757-0282		3	R: fxd met flm 221 ohm 1% 1/8w		
R131	0757-0413		2	R: fxd met flm 392 ohm 1% 1/8w		
R132 - R134				Not assigned		
R135	0757-0452		1	R: fxd met flm 27.4k ohm 1% 1/8w		
R136	0757-0471		2	R: fxd met flm 182k ohm 1% 1/8w		
R137	0757-0481			R: fxd met flm 475k ohm 1% 1/8w		
R138	0757-0409		1	R: fxd met flm 274 ohm 1% 1/8w		
R139	0757-0421			R: fxd met flm 825 ohm 1% 1/8w		
R140	0757-0458		1	R: fxd met flm 51.1 ohm 1% 1/8w		
R141				Not assigned		
R142	0757-0444			R: fxd met flm 12.1k ohm 1% 1/8w		
R143	0757-0273		1	R: fxd met flm 3.01k ohm 1% 1/8w		
R144	0683-0475		2	R: fxd comp 4.7 ohm 5% 1/4w		
R145	0757-0283		3	R: fxd met flm 2000 ohm 1% 1/8w		
R146	0757-0440		1	R: fxd met flm 7.50k ohm 1% 1/8w		
R147	0757-0442		4	R: fxd met flm 10k ohm 1% 1/8w		
R148	0757-0481			R: fxd met flm 475k ohm 1% 1/8w		
R149	0757-0280			R: fxd met flm 1000 ohm 1% 1/8w		
R150	0757-0419		3	R: fxd met flm 681 ohm 1% 1/8w		
R151	0757-0421			R: fxd met flm 825 ohm 1% 1/8w		
R152	0757-0284			R: fxd met flm 150 ohm 1% 1/8w		
R153	0757-0416		2	R: fxd met flm 511 ohm 1% 1/8w		
R154	0757-0416			R: fxd met flm 511 ohm 1% 1/8w		
R155 & R156				Not assigned		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
R157	0757-0401			R: fxd met flm 100 ohm 1% 1/8w		
R158	0757-0466		2	R: fxd met flm 110k ohm 1% 1/8w		
R159	0757-0438			R: fxd met flm 5.11k ohm 1% 1/8w		
R160	0757-0844		2	R: fxd met flm 16.2k ohm 1% 1/2w		
R161	0757-0465			R: fxd met flm 100k ohm 1% 1/8w		
R162	0757-0288		3	R: fxd met flm 9.09k ohm 1% 1/8w		
R163	0757-0274		2	R: fxd met flm 1.21k ohm 1% 1/8w		
R164	0757-0280			R: fxd met flm 1000 ohm 1% 1/8w		
R165	0757-0461			R: fxd met flm 68.1k ohm 1% 1/8w		
R166	0757-0439		4	R: fxd met flm 6.81k ohm 1% 1/8w		
R167	0757-0414		4	R: fxd met flm 432 ohm 1% 1/8w		
R168	0757-0438			R: fxd met flm 5.11k ohm 1% 1/8w		
R169	0757-0414			R: fxd met flm 432 ohm 1% 1/8w		
R170	0683-0275		2	R: fxd comp 2.7 ohm 5% 1/4w		
R171	0757-0459		4	R: fxd met flm 56.2k ohm 1% 1/8w		
R172				Not assigned		
R173	0757-0431		3	R: fxd met flm 2.43k ohm 1% 1/8w		
R174	0757-0442			R: fxd met flm 10k ohm 1% 1/8w		
R175	0757-0419			R: fxd met flm 681 ohm 1% 1/8w		
R176	0757-0431			R: fxd met flm 2.43k ohm 1% 1/8w		
R177	0757-0761		4	R: fxd met flm 22.1k ohm 1% 1/4w		
R178	0757-0429		3	R: fxd met flm 1.82k ohm 1% 1/8w		
R179	2100-1442		1	R: var comp 500 ohms 30%		
R180	0757-0761			R: fxd met flm 22.1k ohm 1% 1/4w		
R181	0757-0461			R: fxd met flm 68.1k ohm 1% 1/8w		
R182	0757-0438			R: fxd met flm 5.11k ohm 1% 1/8w		
R183				Not assigned		
R184	0757-0401			R: fxd met flm 100 ohm 1% 1/8w		
R185	0763-0018		1	R: fxd met ox 27k ohm 2% 2w		
R186	0757-0763		1	R: fxd met flm 27.4k ohm 1% 1/4w		
R187	0757-0280			R: fxd met flm 1000 ohm 1% 1/8w		
R188	0757-0196		1	R: fxd met flm 6.19k ohm 1% 1/2w		
R189	0757-0393		1	R: fxd met flm 47.5 ohm 1% 1/8w		
R190	0757-0760		1	R: fxd met flm 20k ohm 1% 1/4w		
R191	0757-0401			R: fxd met flm 100 ohm 1% 1/8w		
R192	0757-0438			R: fxd met flm 5.11k ohm 1% 1/8w		
R193	0757-0465			R: fxd met flm 100k ohm 1% 1/8w		
R194	0757-0124		1	R: fxd met flm 39.2k ohm 1% 1/8w		
R195	0757-0460		1	R: fxd met flm 61.9k ohm 1% 1/8w		
R196	0757-0447		1	R: fxd met flm 16.2k ohm 1% 1/8w		
R197	0757-0416		2	R: fxd met flm 511 ohm 1% 1/8w		
R198	0687-1011		1	R: fxd comp 100 ohms 10% 1/2w		
R199				Not assigned		
R200	0757-0771		1	R: fxd met flm 61.9k ohm 1% 1/4w		
R201	0757-0463		1	R: fxd met flm 82.5k ohm 1% 1/8w		
R202				NSR: p/o A102		
R203	2100-1443		1	R: var ww 50k ohm 5% 2w		
R204	0757-0401			R: fxd met flm 100 ohm 1% 1/8w		
R205				NSR: p/o A102		
R206	0757-0427		3	R: fxd met flm 1.50k ohm 1% 1/8w		
R207-R209				Not assigned		
R210	0757-0401			R: fxd met flm 100 ohm 1% 1/8w		
R211	0757-0200		1	R: fxd met flm 5.62k ohm 1% 1/8w		
R212	0757-0456		3	R: fxd met flm 43.2k ohm 1% 1/8w		
R213	0757-0401			R: fxd met flm 100 ohm 1% 1/8w		
R214	0757-0845		1	R: fxd met flm 18.2k ohm 1% 1/2w		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
R215	0757-0401			R: fxd met flm 100 ohm 1% 1/8w		
R216 & R217				Not assigned		
R218	0757-0442			R: fxd met flm 10k ohm 1% 1/8w		
R219	0757-0442			R: fxd met flm 10k ohm 1% 1/8w		
R220	0757-0280			R: fxd met flm 1000 ohm 1% 1/8w		
R221 - R224				Not assigned		
R225	0684-1051			R: fxd comp 1 meg ohm 1% 1/4w		
R226	0757-0481			R: fxd met flm 475k ohms 1% 1/8w		
R227	0757-0444			R: fxd met flm 12.1k ohm 1% 1/8w		
R228	0757-0462			R: fxd met flm 75k ohms 1% 1/8w		
R229	2100-0074		1	R: var comp 1 meg ohm 30% lin 1/4w		
R230				Not assigned		
R231	0757-0465			R: fxd met flm 100k ohm 1% 1/8w		
R232	0684-2211			R: fxd comp 220 ohm 10% 1/4w		
R233	0757-0465			R: fxd met flm 100k ohm 1% 1/8w		
R234	0684-2211			R: fxd comp 220 ohm 10% 1/4w		
R235	0761-0079			R: fxd met flm 33k ohm 5% 1w		
R236	0757-0284			R: fxd met flm 150 ohm 1% 1/8w		
R237	0811-0993		2	R: fxd ww 8550 ohm 1% 3w		
R238	0757-0401			R: fxd met flm 100 ohm 1% 1/8w		
R239	0757-0280			R: fxd met flm 1000 ohms 1% 1/8w		
R240	0757-0843			R: fxd met flm 15k ohm 1% 1/2w		
R241	0757-0280			R: fxd met flm 1000 ohms 1% 1/8w		
R242	0757-0401			R: fxd met flm 100 ohm 1% 1/8w		
R243	0757-0442			R: fxd met flm 10k ohm 1% 1/8w		
R244	0757-0433			R: fxd met flm 3.32k ohm 1% 1/8w		
R245	0757-0282			R: fxd met flm 221 ohm 1% 1/8w		
R246	0757-0421			R: fxd met flm 825 ohm 1% 1/8w		
R247	0757-0284			R: fxd met flm 150 ohm 1% 1/8w		
R248	0757-0413			R: fxd met flm 392 ohm 1% 1/8w		
R249	0684-1001		1	R: fxd comp 10 ohm 10% 1/4w		
R250	0757-0416			R: fxd met flm 511 ohm 1% 1/8w		
R251	0757-0280			R: fxd met flm 1000 ohm 1% 1/8w		
R252	0757-0438			R: fxd met flm 5.11k ohm 1% 1/8w		
R253	0757-0414			R: fxd met flm 432 ohm 1% 1/8w		
R254	0757-0439			R: fxd met flm 6.81k ohm 1% 1/8w		
R255	0757-0414			R: fxd met flm 432 ohm 1% 1/8w		
R256	0683-0275			R: fxd comp 2.7 ohm 5% 1/4w		
R257	0757-0459			R: fxd met flm 56.2k ohm 1% 1/8w		
R258 & R259				Not assigned		
R260	0757-0466			R: fxd met flm 110k ohm 1% 1/8w		
R261	0757-0438			R: fxd met flm 5.11k ohm 1% 1/8w		
R262	0757-0280			R: fxd met flm 1000 ohm 1% 1/8w		
R263	0757-0844			R: fxd met flm 16.2k ohm 1% 1/2w		
R264	0757-0465			R: fxd met flm 100k ohm 1% 1/8w		
R265	0757-0288			R: fxd met flm 9.09k ohm 1% 1/8w		
R266	0757-0274			R: fxd met flm 1.21k ohm 1% 1/8w		
R267 - R300				Not assigned		
R301	0757-0471			R: fxd met flm 182k ohm 1% 1/8w		
R302	0757-0481			R: fxd met flm 475k ohm 1% 1/8w		
R303	0757-0461			R: fxd met flm 68.1k ohm 1% 1/8w		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
R304	0757-0429			R: fxd met flm 1.82k ohm 1% 1/8w		
R305	0757-0407		4	R: fxd met flm 200 ohm 1% 1/8w		
R306	0757-0761			R: fxd met flm 22.1k ohm 1% 1/4w		
R307	0757-0433			R: fxd met flm 3.32k ohm 1% 1/8w		
R308	0684-1011		4	R: fxd comp 100 ohm 10% 1/4w		
R309	0683-2205		6	R: fxd comp 22 ohm 5% 1/4w		
R310	0683-2205			R: fxd comp 22 ohm 5% 1/4w		
R311	0757-0407			R: fxd met flm 200 ohms 1% 1/8w		
R312	0757-0408		2	R: fxd met flm 243 ohms 1% 1/8w		
R313	0757-0439			R: fxd met flm 6.81k ohm 1% 1/8w		
R314				NSR: p/o A302		
R315	0757-0759		2	R: fxd met flm 18.2k ohm 1% 1/4w		
R316-R319				Not assigned		
R320	0698-3170		1	R: fxd car flm 15 meg ohm 1% 2w		
R321	0730-0138		2	R: fxd depc 9 meg ohm 1% 1w		
R322	0698-3500		2	R: fxd car flm 6 meg ohm 1% 1w		
R323	0757-0156		4	R: fxd met flm 1.5 meg ohm 1% 1/2w		
R324	0757-0156			R: fxd met flm 1.5 meg ohm 1% 1/2w		
R325	0698-4077		2	R: fxd met flm 600k ohm 1% 1/4w		
R326	0698-3149		4	R: fxd met flm255k ohm 1% 1/8w		
R327	0698-3149			R: fxd met flm 255k ohm 1% 1/8w		
R328	0698-3148		2	R: fxd met flm 102k ohm 1% 1/8w		
R329	0683-2205			R: fxd comp 22 ohm 5% 1/4w		
R330				NSR: p/o A305		
R331	0757-0450		2	R: fxd met flm 22.1k ohm 1% 1/8w		
R332	0757-0427			R: fxd met flm 1.50k ohm 1% 1/8w		
R333	0757-0836		2	R: fxd met flm 7.50k ohm 1% 1/2w		
R334				Not assigned		
R335				NSR: p/o A302		
R336	0757-0760		2	R: fxd met flm 6.81k ohm 1% 1/4w		
R337				NSR: p/o A302		
R338				NSR: p/o A302		
R339-R350				Not assigned		
R351	0757-0761			R: fxd met flm 22.1k ohm 1% 1/4w		
R352	0757-0429			R: fxd met flm 1.82k ohm 1% 1/8w		
R353	0757-0407			R: fxd met flm 200 ohm 1% 1/8w		
R354	0757-0433			R: fxd met flm 3.32k ohm 1% 1/8w		
R355	0684-1011			R: fxd comp 100 ohm 10% 1/4w		
R356	0683-2205			R: fxd comp 22 ohm 5% 1/4w		
R357	0683-2205			R: fxd comp 22 ohm 5% 1/4w		
R358	0757-0439			R: fxd met flm 6.81k ohm 1% 1/8w		
R359				NSR: p/o A303		
R360	0757-0759			R: fxd met flm 18.2k ohm 1% 1/4w		
R361	0757-0407			R: fxd met flm 200 ohms 1% 1/8w		
R362	0757-0408			R: fxd met flm 243 ohms 1% 1/8w		
R363-R369				Not assigned		
R370	0730-0138			R: fxd depc 9 meg ohm 1% 1w		
R371	0698-3500			R: fxd car flm 6 meg ohm 1% 1w		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
R372	0757-0156			R: fxd met flm 1.5 meg ohm 1% 1/2w		
R373	0757-0156			R: fxd met flm 1.5 meg ohm 1% 1/2w		
R374	0698-4077			R: fxd met flm 600k ohm 1% 1/4w		
R375	0698-3149			R: fxd met flm 255k ohm 1% 1/8w		
R376	0698-3149			R: fxd met flm 255k ohm 1% 1/8w		
R377	0698-3148			R: fxd met flm 102k ohm 1% 1/8w		
R378				Not assigned		
R379	0683-2205			R: fxd comp 22 ohm 5% 1/4w		
R380				NSR: p/o A305		
R381	0757-0460			R: fxd met flm 22.1k ohm 1% 1/8w		
R382	0757-0427			R: fxd met flm 1.5k ohm 1% 1/8w		
R383	0757-0836		2	R: fxd met flm 7.50k ohm 1% 1/2w		
R384				Not assigned		
R385				NSR: p/o A303		
R386				NSR: p/o A303		
R387				NSR: p/o A303		
R388	0757-0760			R: fxd met flm 6.81k ohm 1% 1/4w		
R389-R400				Not assigned		
R401	2100-1452		1	R: var lin 7k ohm 20% 3/10w		
R402	0757-0288			R: fxd met flm 9.09k ohm 1% 1/8w		
R403	0757-0459			R: fxd met flm 56.2k ohm 1% 1/8w		
R404				NSR: p/o A402		
R405				NSR: p/o A402		
R406	0757-0766		1	R: fxd met flm 39.2k ohm 1% 1/4w		
R407	0757-0481			R: fxd met flm 475k ohm 1% 1/8w		
R408	0757-0401			R: fxd met flm 100 ohm 1% 1/8w		
R409	0757-0465			R: fxd met flm 100k ohm 1% 1/8w		
R410	0757-0283			R: fxd met flm 2000 ohm 1% 1/8w		
R411	0683-0475			R: fxd comp 4.7 ohm 5% 1/4w		
R412	0757-0283			R: fxd met flm 2000 ohm 1% 1/8w		
R413	0757-0456			R: fxd met flm 43.2k ohm 1% 1/8w		
R414	0757-0456			R: fxd met flm 43.2k ohm 1% 1/8w		
R415	0757-0431			R: fxd met flm 2.43k ohm 1% 1/8w		
R416 & R417				Not assigned		
R418	0757-0401			R: fxd met flm 100 ohm 1% 1/8w		
R419	0811-0992		2	R: fxd ww 8200 ohm 5% 5w		
R420	0757-0419			R: fxd met flm 681 ohm 1% 1/8w		
R421	0811-0992			R: fxd ww 8200 ohm 5% 5w		
R422	0757-0281		2	R: fxd met flm 2.74k ohm 1% 1/8w		
R423	2100-1450		1	R: var ww 100 ohm 5% 1w		
R424	0812-0093		1	R: fxd ww 7.5k ohm 3% 3w		
R425	2100-1451		1	R: var ww 2500 ohm 5% 1w		
R426	0811-0993			R: fxd ww 8550 ohm 1% 3w		
R427 & R428				Not assigned		
R429	0757-0401			R: fxd met flm 100 ohm 1% 1/8w		
R430	0757-0401			R: fxd met flm 100 ohm 1% 1/8w		
R431	0757-0756		1	R: fxd met flm 13k ohm 1% 1/4w		
R432	0757-0401			R: fxd met flm 100 ohm 1% 1/8w		
R433	0757-0401			R: fxd met flm 100 ohm 1% 1/8w		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
R434	0757-0410		1	R: fxd met flm 301 ohm 1% 1/8w		
R435	0757-0281			R: fxd met flm 2.74k ohm 1% 1/8w		
R436	0757-0854		1	R: fxd met flm 56.2k ohm 1% 1/2w		
R437 - R500				Not assigned		
R501	0684-1051			R: fxd comp 1 meg ohm 1% 1/4w		
R502	0684-1011			R: fxd comp 100 ohm 10% 1/4w		
R503	0684-1011			R: fxd comp 100 ohm 10% 1/4w		
R504	0758-0074		1	R: fxd met flm 27k ohms 5% 1/2w		
R505	2100-1584		1	R: var lin 150k ohms 30% 1/10w		
R506	0757-0435		1	R: fxd met flm 3.92k ohms 1% 1/8w		
R507	0757-1000		1	R: fxd met flm 51.1 ohm 1% 1/2w		
S101	3101-0069		4	S: slide spdt 1/2a 125v		
S102	3100-0856		1	S: rotary		
S103	3101-0011		2	S: slide dpdt 0.5a 125v		
S104				NSR: p/o R110		
S105	3101-0044		1	S: pushbutton spst		
S106	3101-0069			S: slide spdt 1/2a 125v		
S107 - S200				Not assigned		
S201	3101-0069			S: slide spdt 1/2a 125v		
S202	3100-0888		1	S: rotary		
S203	3101-0011			S: slide dpdt 0.5a 125v		
S204 - S300				Not assigned		
S301				NSR: p/o A304		
S302				NSR: p/o A305		
S303				NSR: p/o A304		
S304				NSR: p/o A305		
S305 - S400				Not assigned		
S401	3100-1306		1	S: rotary 1 sect 4 pos.		
S402	3101-0069			S: slide spdt 1/2a 125v		
T401	9100-0272		1	T: power		
TP101	1251-0206		1	TP: female		
V101	2140-0018		9	V: glow 1/10w		
V102	5080-0431		2	V: 6CW4 aged		
V103	2140-0018			V: glow 1/10w		
V104	5080-0431			V: 6CW4 aged		
V105	2140-0018			V: glow 1/10w		
V106				Not assigned		
V107	2140-0018			V: glow 1/10w		
V108	1921-0013		7	V: 6CW4		
V109	1921-0013			V: 6CW4		
V110	2140-0018			V: glow 1/10w		
V111 - V200				Not assigned		
V201	2140-0018			V: glow 1/10w		
V202	1921-0013			V: 6CW4		
V203	2140-0018			V: glow 1/10w		

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

Ref Desig	hp Part No.		TQ	Description (See Table 6-1.)		
V204	1921-0013			V: 6CW4		
V205 - V300				Not assigned		
V301	1921-0013			V: 6CW4		
V302	1921-0013			V: 6CW4		
V303 - V400				Not assigned		
V401	1932-0022		2	V: dual triode 6DJ8		
V402	1923-0021		1	V: 6AU6 min pentode		
V403	1932-0022			V: dual triode 6DJ8		
V404	2140-0018			V: glow 1/10w		
V405 - V500				Not assigned		
V501	1921-0013			V: electron 6CW4		
VR201	1940-0013		1	VR: voltage reference 82v ± 1v		
XV102	1200-0086			XV: nuvistor 5-pin		
XV103				Not assigned		
XV104	1200-0086			XV: nuvistor 5-pin		
XV105 - XV107				Not assigned		
XV108	1200-0086			XV: nuvistor 5-pin		
XV109	1200-0086			XV: nuvistor 5-pin		
XV110 - XV201				Not assigned		
XV202	1200-0086			XV: nuvistor 5-pin		
XV203	1200-0086			XV: nuvistor 5-pin		
XV204 - XV300				Not assigned		
XV301	1200-0086			XV: nuvistor 5-pin		
XV302	1200-0086			XV: nuvistor 5-pin		
XV303 - XV400				Not assigned		
XV401	1200-0058		2	XV: tube		
XV402	1200-0083		1	XV: tube		
XV403	1200-0058			XV: tube		
XV404 - XV500				Not assigned		
XV501	1200-0086			XV: nuvistor 5-pin		
				Miscellaneous		
	0370-0099		1	Knob: sweep		
	0370-0084		2	Knob: level		
	0370-0088		1	Knob: lock		
	0370-0100		1	Knob: vernier main		
	0370-0101		1	Knob: vernier delayed		
	0370-0107		1	Knob: position coarse		
	0370-0134		1	Knob: position fine and ext. horiz. vernier		
	0370-0170		1	Knob: time/cm main		
	0370-0171		1	Knob: time/cm delayed		
	1140-0020		1	Dial: turns counting		
	5000-0536		1	Gusset: left		
	5040-0234		1	Clamp: reset lamp		
	5040-0235		1	Base: lamp holder clamp		
	01421-00104		1	Gusset: right		
	01421-01201		1	Bracket: bottom plate left		
	01421-01202		1	Bracket: bottom plate right		
	01421-04001		1	Dial: time/cm		
	01421-23203		1	Coupler: sweep cal		

BACK DATING MANUAL CHANGES

APPENDIX I
MANUAL CHANGES

Appendix I contains information on changes required to adapt this manual to a Model 1421A Time Base and Delay Generator manufactured prior to the printing of this manual. Check for your instrument serial prefix in the left-hand column of the table below and make the numbered changes indicated. If the serial prefix of the instrument is not 803- or listed below, the information to adapt this manual to that Model 1421A will be found on the change sheet supplied with the manual. For information on Errata in the manual, refer to the change sheet.

Note

These changes adapt the manual to cover the standard instrument as manufactured and therefore do not apply to an instrument subsequently modified.

Instrument Serial Prefix	Make Changes
747-	14
709-	13, 14
642-	12 thru 14
627-	11 thru 14
613-	1, 11 thru 14
545-	2, 11 thru 14
531-	2, 3, 11 thru 14
516-	2 thru 4, 11 thru 14
510-	2 thru 5, 11 thru 14
509-	2 thru 6, 11 thru 14
507-	2 thru 7, 11 thru 14
505-	2 thru 8, 11 thru 14
503-	2 thru 9, 11 thru 14
444-	2 thru 10, 11 thru 14

CHANGE 1

Page 5-16, Figure 5-9,
Substitute Figure IA-1 of this Appendix for the input to Gate Input Amplifier Q115.
A103: Delete all components on this assembly.
Add CR101: Connect cathode to CR106 anode and connect anode to P2, Pin 23.
R124: Change to 909 ohms.
R128: Relocate on cathode side of CR106.
Add R132: 6190 ohms; connect between Q103 base and Q104 emitter.
R197: Delete (no connection).
Page 5-17, Figure 5-10,
Change label at CR317 anode to read: "From P2, Pin 23.
Page 5-18, Figure 5-11,
R250: Delete (no connection).
Table 6-2,
A101: Change to hp Part No. 01421-66506; same description.
A103: Delete.
Add CR101: hp Part No. 1901-0025; CR: si.

CR121: Delete.
Q112, Q113: Delete.
R124: Change to hp Part No. 0757-0422; R: fxd metflm 909 ohms 1% 1/8w.
Add R132: hp Part No. 0757-0290; R: fxd metflm 6.19k ohms 1% 1/8w.
R192: Change to hp Part No. 0757-0460; R: fxd metflm 61.9k ohms 1% 1/8w.
R193: Change to hp Part No. 0757-0124; R: fxd metflm 39.2k ohms 1% 1/8w.
R194: Change to hp Part No. 0757-0465; R: fxd metflm 100k ohms 1% 1/8w.
R195, R196, R197, R250: Delete.

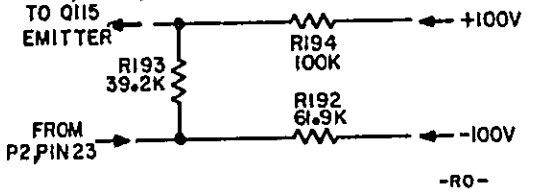


Figure IA-1. Gate Input Amplifier

CHANGE 2

Page 5-15, Figure 5-8,
Delete connections on pins 11 and 23.
Page 5-16, Figure 5-9,
A103: Delete all components on this assembly.
C99, C100: Delete (straight connection).
R100: Delete (no connection).
R127: Change to 681 ohms.
R128: Relocate on cathode side of CR106.
R197: Delete (no connection).
Page 5-17, Figure 5-10,
CR317: Delete (no connection).
CR318: Delete (straight connection).
Page 5-18, Figure 5-11,
R250: Delete (no connection).
Table 6-2,
A101: Change to hp Part No. 01421-66502; same description.
A103: Delete.
A301: Change to hp Part No. 01421-61901; same description.
C99, C100: Delete.
CR121, CR317, CR318: Delete.
Q112, Q113: Delete.
R127: Change to hp Part No. 0757-0419; R: fxd metflm 681 ohms 1% 1/8w.
R100, R192 thru R197, R250: Delete.

CHANGE 3

Page 1-1, Table 1-1,
Delete the Horizontal Input specification.
Page 3-0, Figure 3-1,
Delete EXT. HORIZ. position of the SWEEP switch and all text reference to this switch position.
Page 3-2, Paragraphs 3-20 and 3-21: Delete.
Page 3-6, Figure 3-5,
Delete procedure covering External Horizontal Input operation.
Page 4-0, Figure 4-1,
Delete position 1 (EXT. HORIZ.) of sweep switch

and Horizontal Input Cathode Follower V501.
Page 5-1, Paragraph 5-7 (Horizontal Bandwidth), Delete.
Figure 5-4,
Delete Horizontal Input Amplifier board (small assembly).
Figure 5-9,
C109: Change value to 10 µf.
Figure 5-10,
J102: Add connector at lead from C206, and label connector OUTPUT.
Figure 5-13,
Substitute Figure IA-2 of this appendix for the input section of the Horizontal Amplifier Schematic.

Note

Figure IA-2 should be cut out and permanently attached over the existing input of the horizontal amplifier circuit.

Table 6-2,
A501: Delete.
C109: Change to hp Part No. 0180-0[illegible]; C: fxd, elect, 10 µf, -10% +100%, 25vdcw.
C411: Delete.
C501: Delete.
R406: Change to hp Part No. 0757-0459; R: fxd, metflm, 56.2K ohms, 1%, 1/8W.
R409: Delete.
R501 through R507: Delete.
S401: Change to hp Part No. 3100-0887; S: rotary, 1 sect, 3 pos.
V501: Delete.
XV501: Delete.
Table 6-2, under Miscellaneous,
hp Part No. 0370-0099: Change to hp Part No. 0370-0077.

CHANGE 4

Figure 5-9,
CR120: Delete.
Figure 5-11,
C329/R361 combination: Delete.
Table 6-2,
C329: Delete.
CR120: Delete.
R361: Delete.

CHANGE 5

Figure 5-9,
R109: Change value to 82.5K ohms.
Figure 5-11,
R228: Change value to 82.5K ohms.
Figure 5-12,
C315, C334: Change value to 82 pf.
Table 6-2,
C315, C334: Change to hp Part No. 0140-0193; C: fxd, mica, 82 pf, 5%, 300vdcw.

R109, R228: Change to hp Part No. 0757-0463; R: fxd, metflm, 82.5Kohms, 1%, 1/8W.

CHANGE 6

Table 6-2,
R401: Change to hp Part No. 2100-1564; R: var, lin, 7K ohms, 20%, 3/10W.
Under Miscellaneous,
hp Part No. 01421-23202: Change to hp Part No. 01421-23201; Coupler: Sweep Cal.

CHANGE 7

Table 6-2,
CR109, CR110, CR209, CR210: Change to hp Part No. 1901-0040; CR: si.

CHANGE 8

Figure 5-9,
C102: Change value to 0.02 µf.
C103, C104: Change value to 0.001 µf.
L101/R117 combination: Delete.
R102, R104: Change value to 475K ohms.
R107: Change value to 100K ohms.
Figure 5-11,
C227: Change value to 0.02 µf.
C228, C229: Change value to 0.001 µf.
L201/R239 combination: Delete.
R226: Change value to 100K ohms.
R231, R233: Change value to 475K ohms.
Table 6-2,
C102, C227: Change to hp Part No. 0150-0024; C: fxd, cer, 0.02 µf, -20%+80%, 600vdcw.

C103, C104, C228, C229: Change to hp Part No. 0150-0050; C: fxd, cer, 0.001 µf, 600vdcw.

L101, L201: Delete.
R102, R104, R231, R233: Change to hp Part No. 0757-0481; R: fxd, metflm, 475K ohms, 1% 1/8w.
R107, R226: Change to hp Part No. 0684-1041; R: fxd, comp, 100K ohms, 10% 1/4W.

R117, R239: Delete.

CHANGE 9

Figure 5-9,
R127: Change value to 1500 ohms.
Figure 5-10,
C319: Delete.
R202: Change value to 10K ohms.
Table 6-2,
A102: Change description to read, "R: var, lin, 2 sect, 2K and 10K ohms."
C319: Delete.
R127: Change to hp Part No. 0757-0427; R: fxd, metflm, 1500 ohms, 1%, 1/8W.

CHANGE 10

Figure 5-10,
C318/R311 combination: Delete.
Table 6-2,
C318: Delete.
R311: Delete.

CHANGE 11

Figure 5-11 and Table 6-2, L202: Delete.

CHANGE 12

Table 6-2,
A301: Change to hp Part No. 01421-61904.
A304: Change to hp Part No. 3100-1301.
Table 6-2, Under Miscellaneous,
hp Part No. 5000-0536: Change to hp Part No. 01421-00102.
hp Part No. 01421-00104: Change to hp Part No. 01421-00103.
hp Part Nos. 01421-01201 and 01421-01202: Delete.
hp Part No. 01421-23203: Change to hp Part No. 01421-23202.

CHANGE 13

Page 5-19, Figure 5-12,
C302: Change value to 0.1 µf.
Table 6-2,
C302: Change to hp Part No. 0150-0121; C: fxd cer 0.1 µf +80% -20% 50vdcw.

CHANGE 14

Paragraph 5-15 (Step b), Table 5-7, and Figure 5-7,
Add the following CAUTION:
Use extreme care to avoid shorting of components in the unblanking gate output circuit. On instruments without TP101 on the circuit board, monitor gate output at pin 1 on P2, but do not short pin 1 to an adjacent pin or to the chassis.
Page 5-16, Figure 5-9,
CR122, R198, TP101: Delete.
Page 5-17, Figure 5-10,
Delete R312 and replace with CR307, 5.8V breakdown diode. Connect cathode to Q303 emitter.
C309: Delete.
Page 5-18, Figure 5-11,
Delete R362 and replace with CR314, 5.8V breakdown diode. Connect cathode to Q306 emitter.
C325: Delete.
Table 6-2,
C309, C325: Delete.
CR120: Change to hp Part No. 1901-0436.
CR122: Delete.
CR305, CR312: Change to hp Part No. 1901-0040.
Add CR307, CR314: hp Part No. 1902-0034; CR avalanche 5.8V 10%.
CR309, CR316: Change to hp Part No. 1902-0597; CR avalanche 56.2V 10%.
Q117, Q118: Change to hp Part No. 1854-0056; Q: npn si 2N3119.
R198, R312, R362, TP101: Delete.

CUT ALONG DOTTED LINE

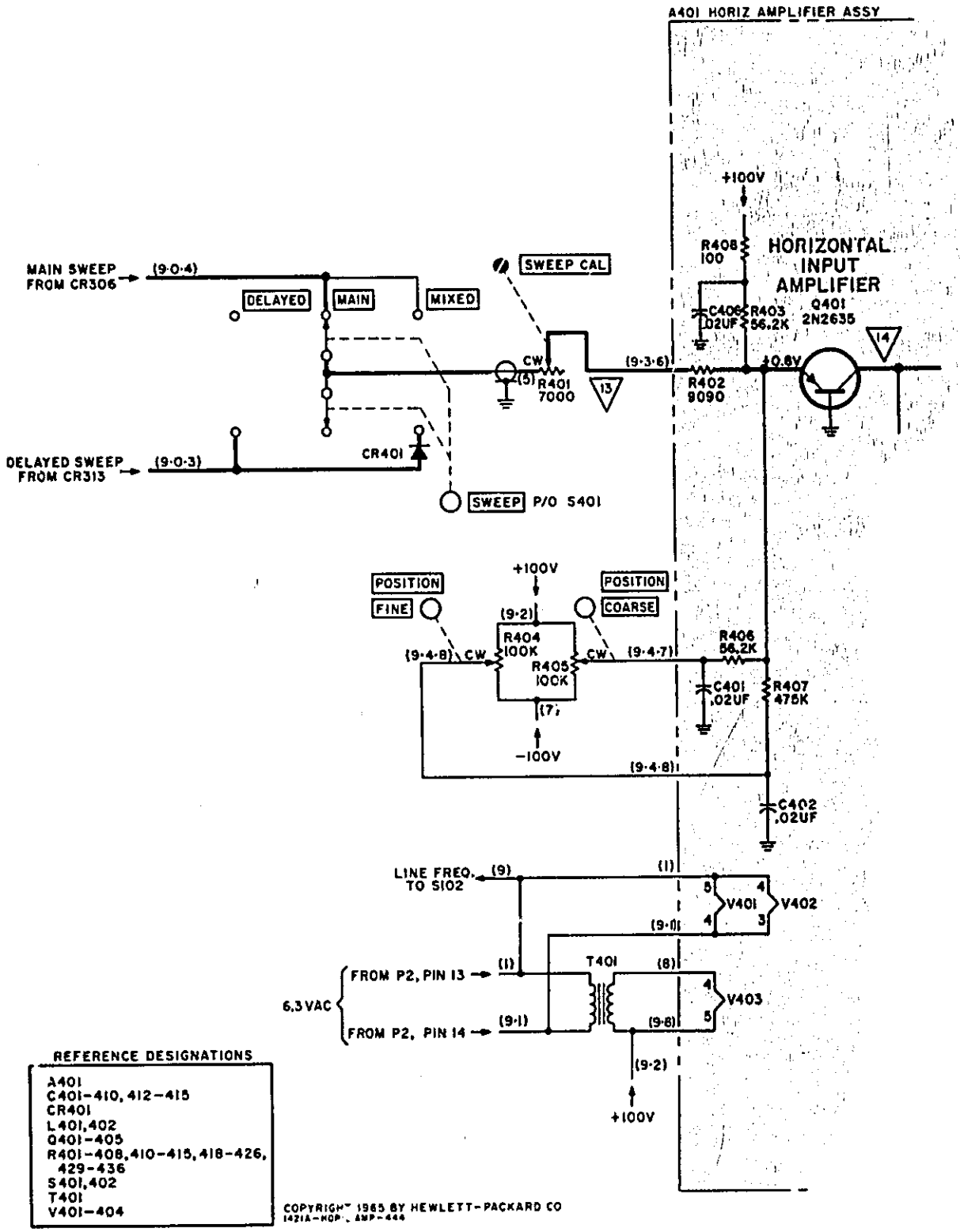


Figure IA-2. Horizontal Amplifier Input

MANUAL CHANGES

MANUAL CHANGES

MODEL 1421A

TIME BASE AND DELAY GENERATOR

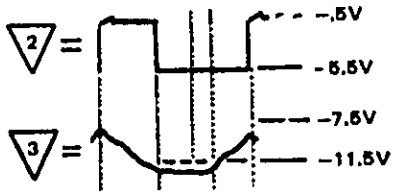
Manual Serials Prefixed: 803–
Manual Printed: APR 1968

Make all changes listed below as Errata. Check the following table for your instrument serial prefix and/or serial number and make listed change(s) to the manual:

Serial Prefix or Number	Make Changes	Serial Prefix or Number	Make Changes
927–	1		

ERRATA

Page 5-14, figure 5-7,
The time relationship of waveform ▽3 is incorrect. It should be as shown in the following illustration.



Page 5-15, figure 5-8,
Change: wire color (5) to (9) on pin 22.

Page 5-16, figure 5-9,
CR106: Move CR106 to the other side of R128. Connect anode to base of Q103, connect cathode to R128.
R127: Change value to 681 ohms.
Change: Adapter A102 to A103.
Change: wire color (2 . 3 . 6) on collector of Q112 to (9 . 3 . 6).
Change: wire color (2 . 3 . 5) on collector of Q113 to (9 . 3 . 5).
Change: part of S102 circuit to the circuit shown in Figure 1 of this change sheet.

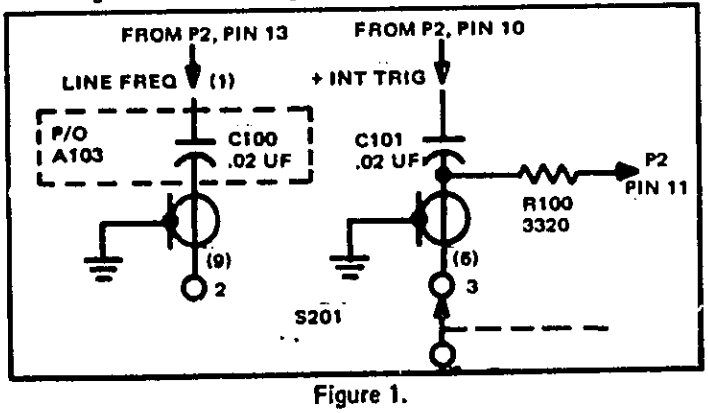


Figure 1.

Page 5-17, figure 5-10,
R307: Add a * symbol beside the reference number, and change the value to 2740.

Page 5-18, figure 5-11,
R354: Add a * symbol beside the reference number, and change the value to 2740.
Change: wire color (2 . 3 . 5) from Q113 collector to (9 . 3 . 5).
Change: Part of S202 circuit to the circuit shown in Figure 2 of this change sheet.

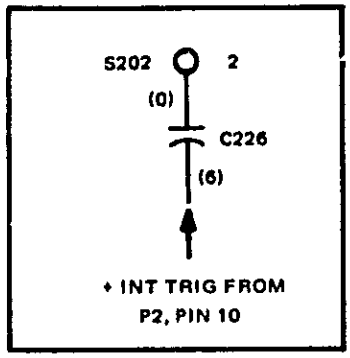


Figure 2.

21 May 1975
Δ = Latest additions to this change sheet.
This change sheet supersedes all prior change sheets for this manual.

Supplement A for
01421-90905

ERRATA (Cont'd)

Table 6-2, Replaceable Parts,
C303: Change to HP Part No. 0160-3452, C:fxd disc cer 0.02 uf 20% 100V.
C310: Change to HP Part No. 0160-3324, C:fxd met poly 1 uf 5% 100vdcw.
L101: Change value to 1 uH.
Q102, Q103: Change to HP Part No. 1853-0049, Q:pnp si.
Δ R114: Change to HP Part No. 2100-1775, R:var ww 5K ohm 5% 1W.
R118: Change to HP Part No. 0761-0074, R:fxd metox 15K ohm 5% 1W.
R127: Change to HP Part No. 0757-0419, R:fxd met flm 681 ohms 1% 1/8W.
R200: Change to HP Part No. 0757-0309, R:fxd met flm 61.9K ohm 1% 1/2W.

Table 6-2, Replaceable Parts (Cont'd),
R240: Change to HP Part No. 0761-0074, R:fxd metox 15K ohm 5% 1W.
R307, R354: Change to HP Part No. 0757-0281, R:fxd flm 2740 ohm 1% 1/8W.
S102: Change to HP Part No. 01421-61902, A:main trigger source switch assembly.
Add: S102MP1, HP Part No. 3100-0886, S:rotary wafer.
S202: Change to HP Part No. 01421-61903, A:delayed trigger source switch assembly.
Add: S202MP1, HP Part No. 3100-0888, S:rotary wafer.
V202, V204: Change to HP Part No. 5080-0431, V:6CW4 aged.

CHANGE 1

Table 6-2, Replaceable Parts,
Add: 01421-60101; Assy: Chassis.