Errata

Title & Document Type: **8003A Pulse Generator Operating and Service Manual**

Manual Part Number: **08003-90003**

Revision Date: **October 1974**

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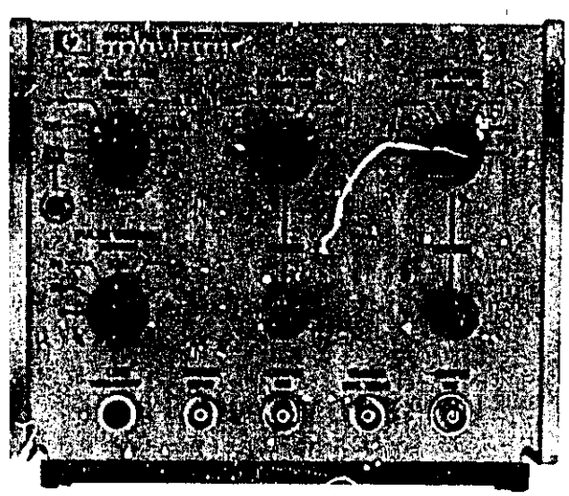
OPERATING AND SERVICE MANUAL

8003A PULSE GENERATOR



HEWLETT hp PACKARD

OPERATING AND SERVICE MANUAL

HP Part Number: 08003-90003

MODEL 8003A

PULSE GENERATOR

SERIALS PREFIXED: 933—

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Table 1-1. Specifications

OUTPUT PULSE

SOURCE IMPEDANCE: 50Ω ±3% shunted by typically 20 pF at any output voltage.

PULSE SHAPE: (Measured at 5 V across 50Ω)
Rise and Fall time: Less than 5 ns
Overshoot and Ringing: Less than 5% of pulse amplitude.
Preshoot: Less than 5% of pulse amplitude.

AMPLITUDE: (Positive and negative output can be independently set)
Maximum Output: 5V across 50Ω (10V across an open circuit). Output circuit protected, cannot be damaged by shorting. With internal load disconnected (switch provided), 10V across 50Ω with rise and fall time less than 7 ns.
Attenuator: Provides 7 steps from 0.05V to 5V in a 1, 2.5, 5 sequence.
Vernier: Provides continuous adjustment between ranges, minimum output less than 0.02V across 50Ω.

POLARITY: Positive and negative simultaneously. Delay between pulses approximately 5 ns.

PULSE WIDTH: 30 ns to 3 s in five ranges; vernier provides continuous adjustment between ranges.
Maximum Duty Cycle:
Greater than 90% from 0.3Hz to 1MHz
Greater than 50% from 1MHz to 10MHz
Width Jitter: Less than 0.1% of pulse width at any width setting.

DELAY: Approximately 150ns fixed delay between Trigger Output and both Pulse Outputs. Internal slide switch permits removal of delay line, reducing delay to about 10 ns.

REPETITION RATE AND TRIGGER

FREE-RUNNING:
Repetition Rate: 0.3Hz to 10MHz in five ranges; vernier provides continuous adjustment between ranges.
Period Jitter: < 0.1% of period at any repetition rate setting.

TRIGGERING:
Trigger Input: DC coupled. Sine waves or pulses of either positive or negative polarity up to 10MHz.
Sensitivity: Sine waves, 2V pk-pk minimum. External Pulses, at least 1V and at least 15ns wide, Maximum input ±10V.
External Trigger Delay: Approximately 35ns between trigger input and trigger output.
Manual: Push button for single pulse.

TRIGGER OUTPUT PULSE (Suitable for triggering another Model 8003A).
Width: 15ns ±5ns at 50% amplitude points.
Amplitude: Greater than 2V across 50Ω.
Polarity: Positive.

SYNCHRONOUS GATING: Gating signal turns generator "on"; pulse repetition rate, amplitude, polarity, and width determined by panel control settings; first pulse is coincident with the leading edge of the gate, last pulse is completed even if gate ends during the pulse.

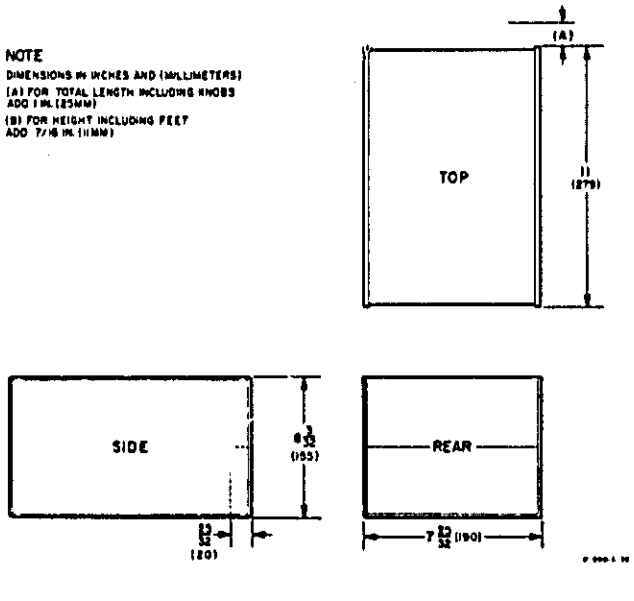
Minimum Gating Signal: -2V.
Maximum Input: -20V.
Input Impedance: Approximately 1kΩ.

GENERAL

POWER 115V or 230V +10% -15%, 50Hz - 400Hz, 30W.

WEIGHT: Net 9 lb (4 kg)
Shipping 13 lb (6 kg).

DIMENSIONS:



OPTION 01: Remote programming.

SECTION I
GENERAL INFORMATION

1-1. DESCRIPTION

1-2. The HP Model 8003A is a general-purpose pulse source providing positive and negative pulses with fast rise times and a wide range of repetition rate and pulse width. Complete specifications of performance are given in Table 1-1. Both positive and negative pulses are simultaneously available from 50 ohm sources with 5 ns rise and fall times. Two seven-step attenuators and two verniers provide continuous and independent control of the amplitude of either output from 0.02 volt to 5 volts across 50 ohms. The internal load of either pulse output may be disconnected by a slide switch provided within the instrument, supplying twice the output voltage across 50 ohms. The frequency range of the instrument from 0.3 Hz to 10 MHz is covered in 5 ranges, with a vernier providing continuous adjustment.

1-3. Trigger output pulses for synchronizing external circuits or instruments have a pulse width of less than 20 nanoseconds and an amplitude of at least 2 volts across 50 ohms. The trigger output is approximately 150 nanoseconds in advance of the main output pulses. Delay may be switched off by a slide switch; the residual delay is then approximately 10 nanoseconds. Gating signals, applied to a rear panel connector, will gate the instrument "on" to produce pulse trains and bursts, determined by the front-panel controls.

1-4. ACCESSORIES AVAILABLE

1-5. Electronic test equipment, cables, connectors, adapters, and other accessory items are available from Hewlett-Packard. For more information on specific items consult the Hewlett-Packard Catalog or Sales/Service Office.

1-6. MANUAL IDENTIFICATION

1-7. Hewlett-Packard uses a two-section eight-digit serial number (000-00000). This serial number may be also preceded by a letter. If the first three digits of the serial number, found on the rear panel of the instrument, do not agree with those on the title page of this manual, change sheets supplied with the manual will define differences between your instrument and the Model 8003A described in this manual. To obtain correct manual information for any instrument, contact the nearest Hewlett-Packard Sales/Service Office; always specify the model number and complete serial number.

1-8. ORDERING ADDITIONAL MANUALS

1-9. One manual is shipped with each pulse generator. Additional manuals may be purchased from your local Hewlett-Packard field office (see list at rear of this manual for addresses). Specify the model number, complete serial number prefix, and HP stock number provided on the title page.

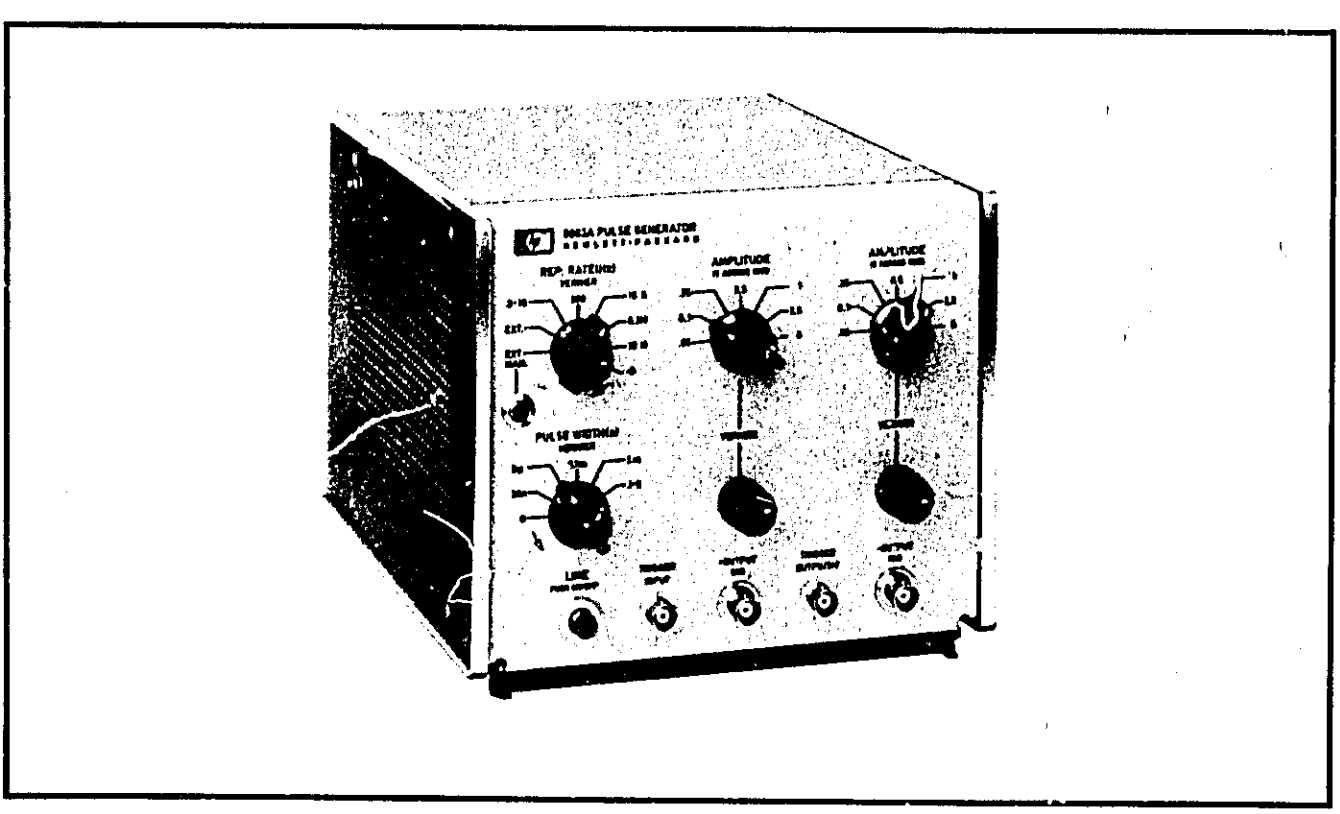


Figure 1-1. HP Model 8003A Pulse Generator

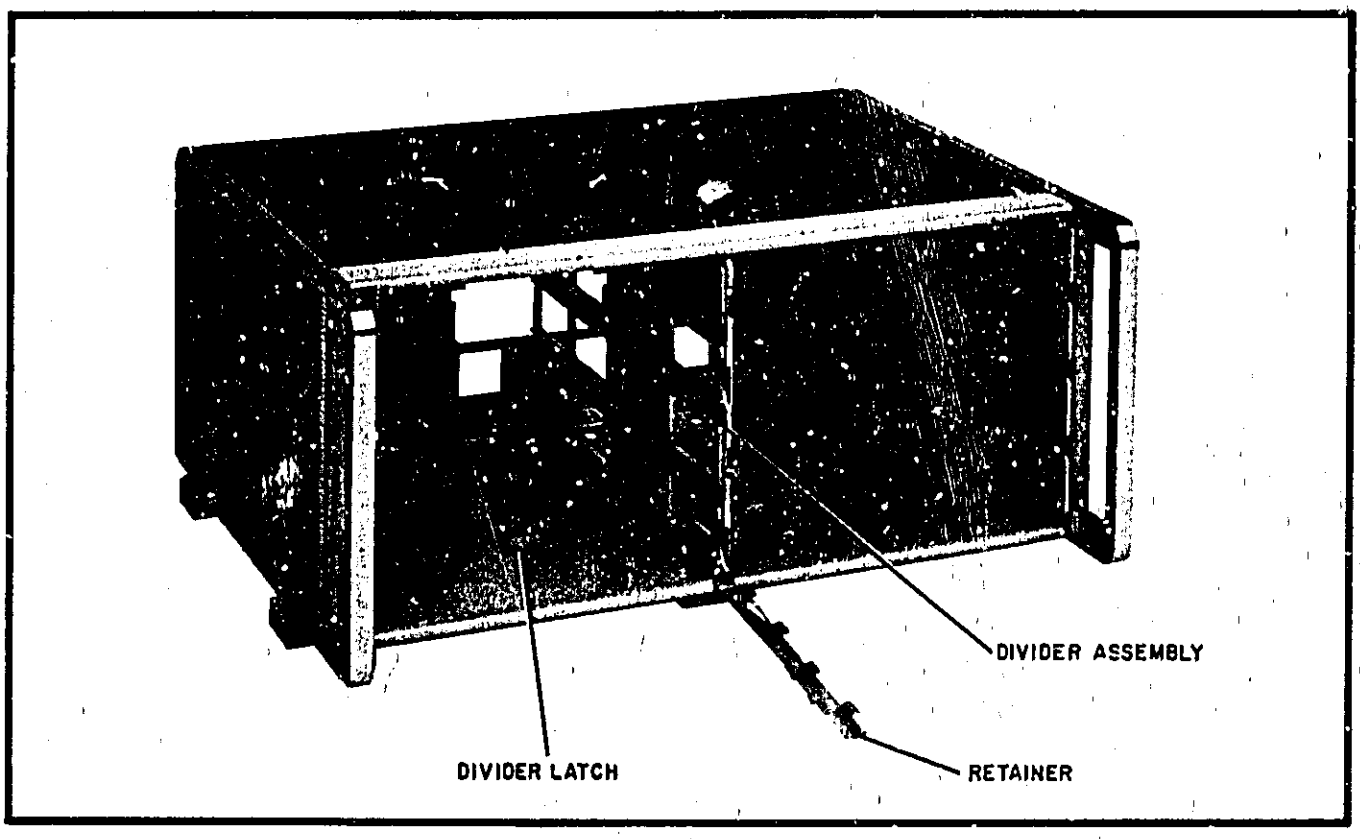


Figure 2-1 The Combining Case

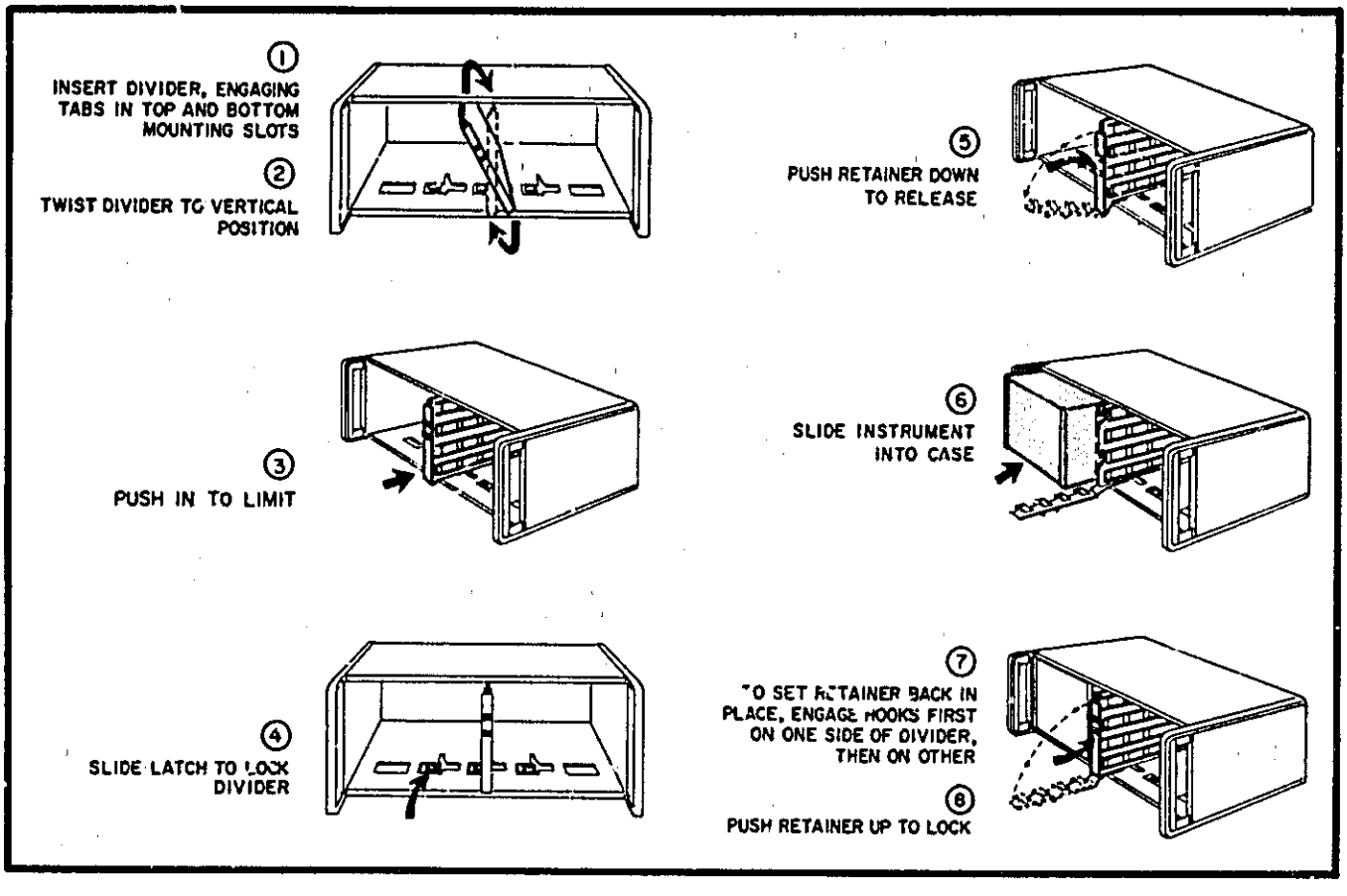


Figure 2-2 Steps to Place Instrument in Combining Case

SECTION II
INSTALLATION

2-1. INITIAL INSPECTION

2-2. Inspect the instrument for physical damage and check its operation as soon as possible after delivery. Table 5-2 contains performance check procedures which will verify instrument operation within the published specifications. This check is suitable for incoming quality control inspection. If physical damage is evident or if the instrument does not meet specifications when received, notify the carrier and the nearest Hewlett-Packard Sales/Service Office (see list at rear of this manual). The Sales/Service Office will arrange for repair or replacement without waiting for settlement of a claim with the carrier. The certification and warranty statements for all HP instruments are on the inside front cover of this manual.

2-3. PREPARATION FOR USE

2-4. POWER SOURCE REQUIREMENTS

2-5. The HP Model 8003A may be operated from an ac source of 115 or 230 volts +10%, -15%, at 50 to 400 Hz. Power dissipation is approximately 30 W. When the instrument is shipped from the factory, it is ready for 230 volt operation. For 115 volt operation move the rear panel slide switch, with the instrument power cable disconnected, until the number 115 is visible. A narrow-blade screwdriver may be used to operate this switch.

CAUTION

Be sure that the number visible on the voltage slide switch and the fuse value correspond to the line voltage used before operating the instrument; otherwise, the instrument may be damaged.

2-6. FUSE REPLACEMENT

2-7. The fuse is located on the rear panel. Fuse F1 should be 0.5 ampere slow blow for 115 volt operation or 0.25 ampere slow blow for 230 volt operation.

2-8. POWER CABLE

2-9. The HP Model 8003A is equipped with a 3-wire power cable, which, when connected to an appropriate receptacle, grounds the instrument, cabinet and panel. To preserve the protection feature when operating the instrument from another type of outlet without ground, use an appropriate adapter and connect the ground lead to an external ground.

2-10. TEMPERATURE REQUIREMENTS

2-11. The HP Model 8003A uses solid-state components and requires no special cooling. The instrument operates within specifications when the ambient temperature is between 0°C (32°F) and 55°C (131°F). The pulse generator may be stored between -40°C (-40°F) and 75°C (167°F).

2-12. REPACKING

2-13. The original shipping carton and packing material can be used for reshipment. The Hewlett-Packard Sales/Service Office will also provide information and recommendations on material to be used if the original packing material is not available or damaged. If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office for repair, attach a tag showing owner, model, serial number, and repairs required.

2-14. RACK MOUNTING

2-15. The HP Model 8003A is a submodular unit that, when used alone, can be bench-mounted only. However, when used in combination with other submodular units, it can be bench and/or rack-mounted. The HP combining case and adapter frame are designed specifically for this purpose.

2-16. COMBINING CASE (HP 1051A or 1052A)

2-17. The combining case is a full-module unit which accepts various combinations of submodular units. Being a full-module unit, it can be bench or rack-mounted as any full-module instrument. An illustration of the combining case is shown in Figure 2-1. Instructions for installing the HP Model 8003A in a combining case are given in Figure 2-2.

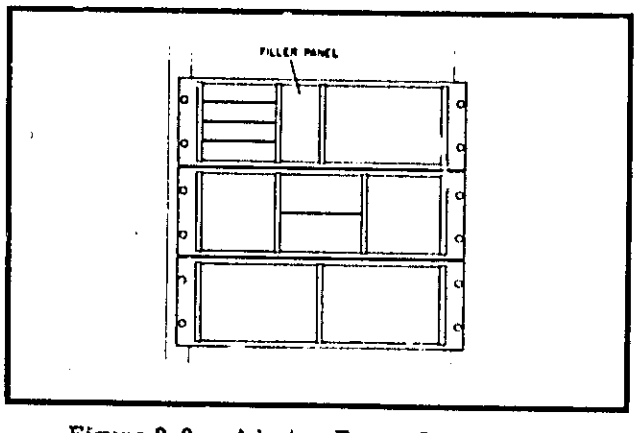


Figure 2-3. Adapter Frame Instrument Combinations

2-18. ADAPTER FRAME

2-19. The adapter frame is a rack frame that accepts any combination of submodular units. It can be rack-mounted only. An illustration of the adapter frame is given in Figure 2-3. To assemble, refer to Figure 2-4 and proceed as follows:

a. Place the adapter frame (1) on edge of bench as illustrated.

b. Stack the submodular units (2) in the frame.

c. Place the spacer clamps (3) between instruments.

d. Place the spacer clamps (4) on the two ends of the rack-mounted instruments.

e. Push the combination into the frame.

f. Insert screws (5) on both sides of frame and tighten until submodular instruments are secure in frame.

g. The complete assembly is ready for rack-mounting.

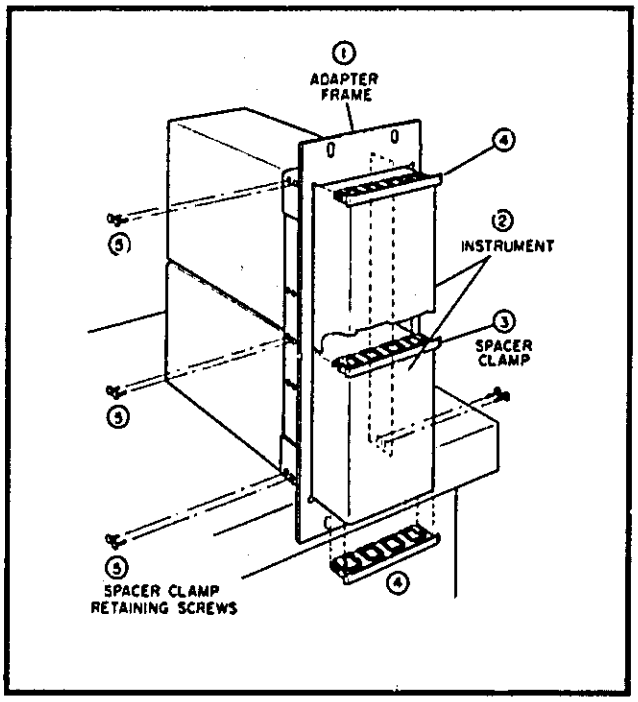


Figure 2-4. Two Half Modules In Rack Adapter

OPERATING PROCEDURES

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION

3-2. This section contains the operating instructions for the HP Model 8003A Pulse Generator. Figure 3-2 identifies and briefly describes the purpose of each panel control and connector on the instrument. Operating limits of the HP Model 8003A are as specified in Table 1-1.

3-3. TRIGGER MODES

3-4. INTERNAL TRIGGER MODE

3-5. The HP Model 8003A will generate internally any repetition rate from 0.3 Hz to 10 MHz. The repetition rate is established by setting the REP. RATE selector to any of the five internal ranges and then adjusting the REP. RATE VERNIER to the specific rate desired.

3-6. EXTERNAL TRIGGER MODE

3-7. With the REP. RATE selector set to EXT.+ or EXT.-, external signals may be used to initiate pulses in the Model 8003A. Trigger signals, which will cause one pulse out for each trigger in, may be sine waves or pulses of either positive or negative polarity up to 10 MHz. Sine waves must be of at least 2 volts peak to peak amplitude, and pulses must be at least 1 volt peak and at least 15 nanoseconds wide. Maximum allowable input signal is ±10 volts peak.

3-8. MANUAL TRIGGER MODE

3-9. With the REP. RATE selector set to the EXT.+/MAN position, a single output pulse is generated by the Model 8003A each time the MANUAL push button is pressed.

3-10. GATING MODE

3-11. The HP Model 8003A may be gated by an external signal when the OPER. MODE switch is set to GATED. In this mode output pulses occur only when the gating signal is at least -2 volts (refer to Figure 3-1). The maximum allowable gate signal level is -20 volts. If operation does not require the use of the gating feature, be sure that the OPER. MODE switch, situated on the rear panel, is set to the NORMAL position.

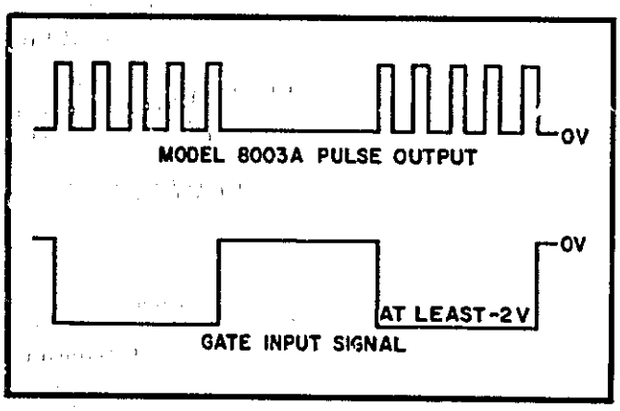


Figure 3-1. Gating Pulse Output

3-12. REMOTE PROGRAMMING

3-13. Remote programming of the Model 8003A is possible with the Option 01 when the REP. RATE, PULSE WIDTH, and AMPLITUDE VERNIER controls are set to the asterisk (*) positions. In the standard Model 8003A these asterisk (*) positions are connected to their adjacent positions. For Option 01 operation refer to Appendix A 1.

3-14. BASIC OPERATION PROCEDURE

3-15. Initial settings are given to obtain a complete pulse for someone unfamiliar with the operation of the Model 8003A. It is important that the PULSE WIDTH and REP. RATE controls be compatible; otherwise, the output signal may be incorrectly interpreted. The following control settings are recommended to obtain a visible rectangular pulse on a high-frequency oscilloscope with sweep time at 50 μs/cm and with sensitivity at 2 V/cm.

8003A	REP. RATE (Hz)	0.3M
	VERNIER (R.R.)	ccw
	PULSE WIDTH (s)	3μ
	VERNIER (P. WIDTH)	center
	AMPLITUDE (±)	5V
	VERNIER (AMPL.±)	cw
	OPER. MODE	Normal

Rotation of the various verniers demonstrates the effect the controls have on the output pulse.

3-16. For regular use, proceed as follows:

a. Set OPER. MODE slide switch, located on the rear panel, for the desired operation mode (NORMAL or GATED).

NOTE

No output pulse will be generated for normal use if the OPER. MODE slide switch is in GATED position.

b. Connect either OUTPUT connector to an external test circuit using a 50 ohm coaxial cable and a 50 ohm termination resistor.

c. Turn instrument on with LINE button.

d. Set REP. RATE selector switch and its VERNIER for the desired triggering mode and frequency.

e. Set PULSE WIDTH selector switch and VERNIER for the desired output pulse width.

NOTE

The pulse width should be narrower than the output pulse period.

f. Set AMPLITUDE and its VERNIER for desired amplitude.

3-17. INTERNAL CONTROLS

3-18. DELAY SWITCH

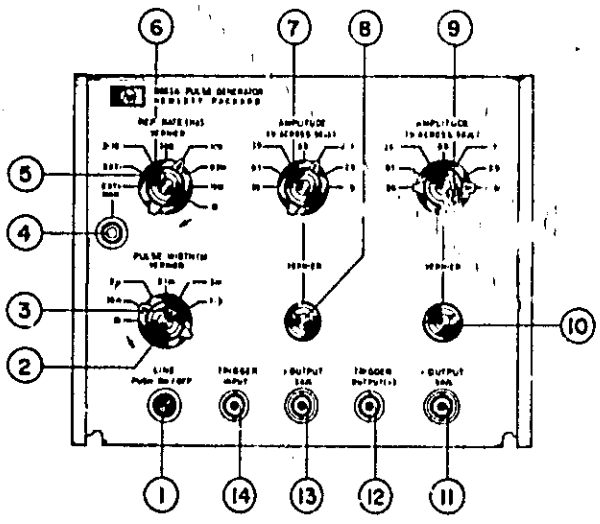
3-19. The HP Model 8003A is shipped with an approximate 150 nanoseconds fixed delay between the trigger output pulse and the output pulse. This delay may be reduced to approximately 10 nanoseconds. This is accomplished by removing the instrument bottom cover and by moving the front slide switch on the circuit board into the ND (non-delayed) position. The D (delayed) position is for an approximate 150 nanoseconds delay.

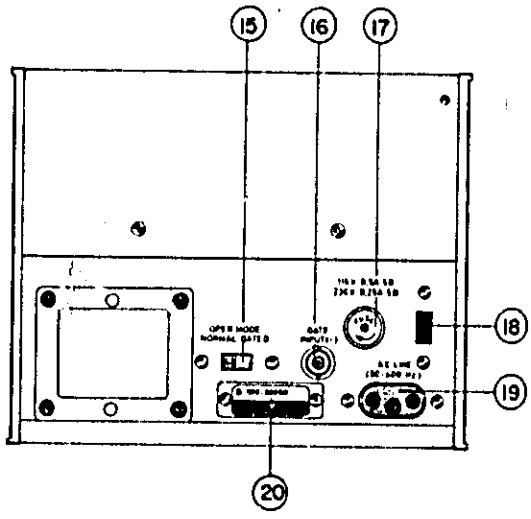
3-20. TERMINATION SWITCH

3-21. The pulse generator is shipped so that a maximum output pulse amplitude of 5 volts across 50 ohms may be obtained for both positive and negative pulses. When a greater amplitude is required, either pulse may be doubled by switching out the appropriate internal 50 ohm resistor. This is accomplished by removing the bottom cover and by setting the inner rear slide switch on the circuit board to the +10 V position for positive output or by setting the outer rear slide switch on the circuit board to the -10 V position for negative output.

NOTE

Be sure that the termination slide switches are in the +5 V and -5 V position when no external load is connected to the instrument; otherwise it may be damaged.





1. LINE: On/Off switch, glows red when on.
2. PULSE WIDTH (s): Selector switch selects output pulse width range. The asterisk (*) position on the standard Model 8003A is connected to the 30n (seconds) range; this extra position may be wired for other needs (refer to Paragraph 5-19). On the Option 01 this position is for remote programming.
3. PULSE WIDTH (s) VERNIER: Vernier adjusts output pulse width within the limits set by PULSE WIDTH selector switch.
4. MAN: Push button provides a single pulse when REP. RATE selector switch is set to EXT. +/MAN. position.
5. REP. RATE (Hz): Selector switch selects internal repetition rate, external triggering, or manual triggering. The asterisk (*) position on the standard Model 8003A is connected to the 10M(Hz) range; this extra position may be wired for other needs (refer to Paragraph 5-17). On the Option 01 this position is for remote programming.
6. REP. RATE (Hz) VERNIER: Vernier adjusts internal repetition within limits set by REP. RATE selector switch.
7. AMPLITUDE (V ACROSS 50Ω): Switch selects amplitude range of positive output pulse.
8. AMPLITUDE VERNIER: Vernier adjusts the amplitude of the positive output pulse within limits set by AMPLITUDE selector switch. Clockwise adjustment selects the maximum amplitude.
9. AMPLITUDE (V ACROSS 50Ω): Switch selects amplitude range of negative output pulse.
10. AMPLITUDE VERNIER: Vernier adjusts the amplitude of the negative output pulse within limits set by AMPLITUDE selector switch. Clockwise adjustment selects the maximum amplitude.
11. -OUTPUT/50Ω: Female BNC connector supplies a negative output pulse.
12. TRIGGER OUTPUT (+): Female BNC connector supplies a positive trigger pulse.
13. +OUTPUT/50Ω: Female BNC connector supplies a positive output pulse.
14. TRIGGER INPUT: Female BNC connector accepts external triggering signals.
15. OPER. MODE: Switch selects normal or gated mode of operation. In NORMAL, all front-panel controls operate as described. In GATED, output signals, either internally or externally triggered, are generated only during the time that the gating signal is applied.
16. GATE INPUT (-): Female BNC connector accepts pulse control signal; -2 volt pulse turns the instrument repetition rate generator on. DC coupled.
17. FUSE: Line fuse (1/2 A SB for 115 V ac or 1/4 A SB for 230 V ac). Use only properly-rated fuse.
18. 115 V/230 V: Switch selects ac line voltage.
19. AC LINE: Receptacle for power cable.
20. SERIAL NUMBER: Reference number identifies instrument.

Figure 3-2. Front and Rear Panel Controls and Connectors

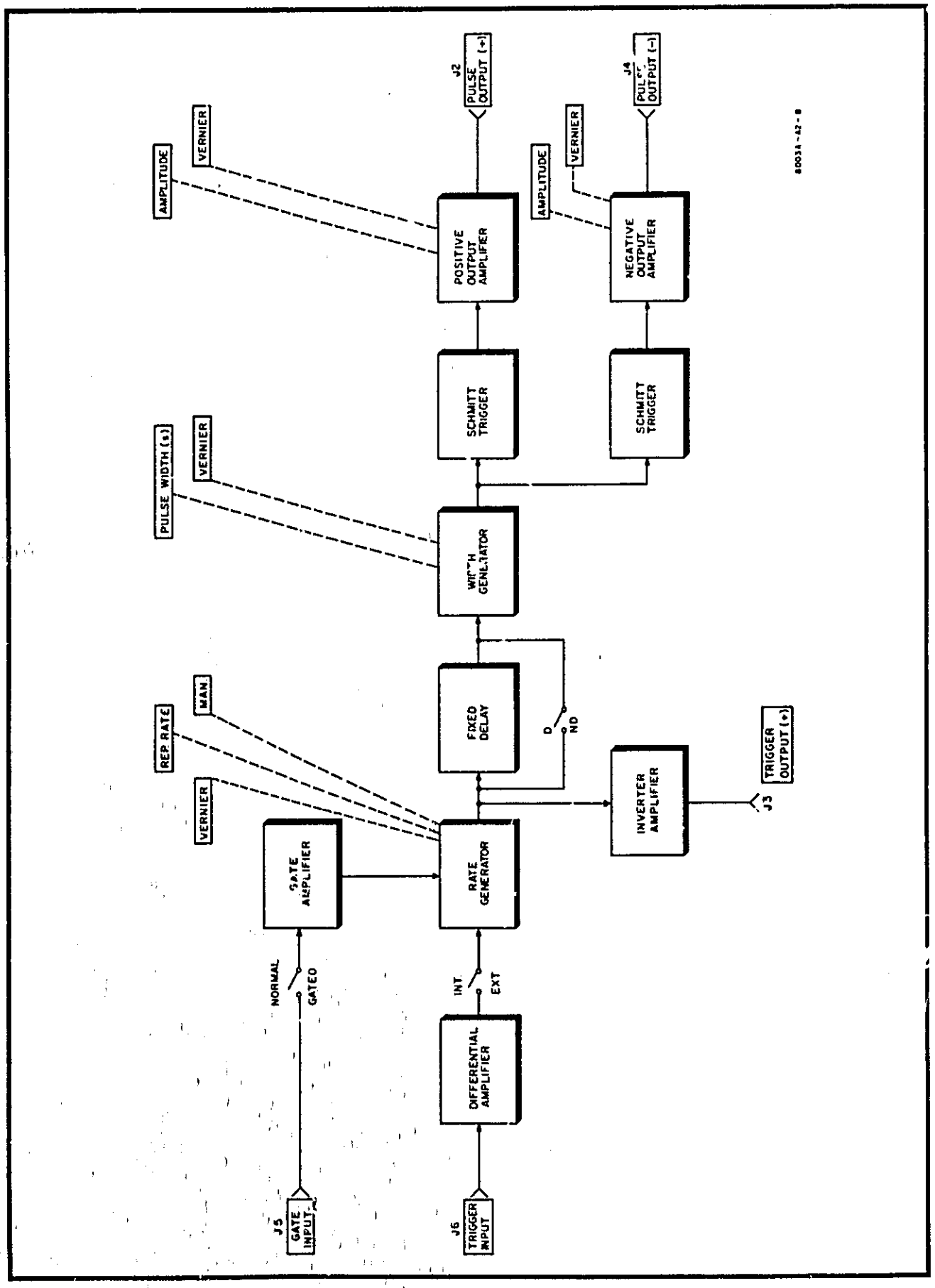


Figure 4-1. Overall Block Diagram

SECTION IV
PRINCIPLES OF OPERATION

4-1. INTRODUCTION

4-2. This section contains the basic principles of operation for the HP Model 8003A Pulse Generator. The basic functions are shown in the block diagram Figure 4-1. The output pulses are formed in the following general sequence. The repetition rate is generated internally or is established by an external triggering source. The signal then passes through the delay circuit which sets up a delay of the output signal with respect to the trigger output signal. The delay may be switched off. Pulse width is then established before the signal goes through both output circuits and their associated attenuators which control the respective pulse amplitudes. The repetition rate circuit also supplies a negative pulse through an inverter amplifier for a positive trigger output. The following paragraphs and diagram provide a more detailed discussion of each basic circuit.

4-3. REPETITION RATE CIRCUIT

4-4. Mode of operation for the Model 8003A is established in this circuit (i.e. internal, external or manual triggering), depending on the setting of S4 REP. RATE selector switch. Refer to Figures 4-2 and 7-1.

4-5. INTERNAL TRIGGERING

4-6. For this mode of operation, REP. RATE switch S4 is set to any of the five internal rate settings. Initially, transistors A1Q29 and A1Q30 are not conducting. Then the ramp capacitor, corresponding to the selected range, at the emitter of A1Q30 is charged through the current source A1Q31. The voltage on the capacitor goes negative until it becomes about 0.7 V more negative than the base voltage of A1Q30. Then transistor A1Q30 begins to conduct, and the voltage drop across diodes A1CR12, A1CR13, and A1R87 appears on the base of A1Q29. (Diodes A1CR12 and A1CR13 increase loop gain for low current through A1Q30, and capacitor A1C38 increases loop gain for high frequencies). Transistor A1Q29 also starts conducting, and the voltage drop across A1R89 causes A1Q30 to conduct still more. This process continues until both transistors go into saturation. Now the ramp capacitor is charged positively through A1Q30, A1R87, and the diodes A1CR12 and A1CR13. When the current from the ramp capacitor is no longer sufficient to keep A1Q29 saturated, A1Q29 comes out of saturation and hence starts turning A1Q30 off. Again regeneration occurs, and both A1Q29 and A1Q30 turn off. This action produces a negative timing pulse on the emitter of A1Q29. Thus, the repetition rate depends upon the voltage change across the ramp capacitor, the ramp capacitance,

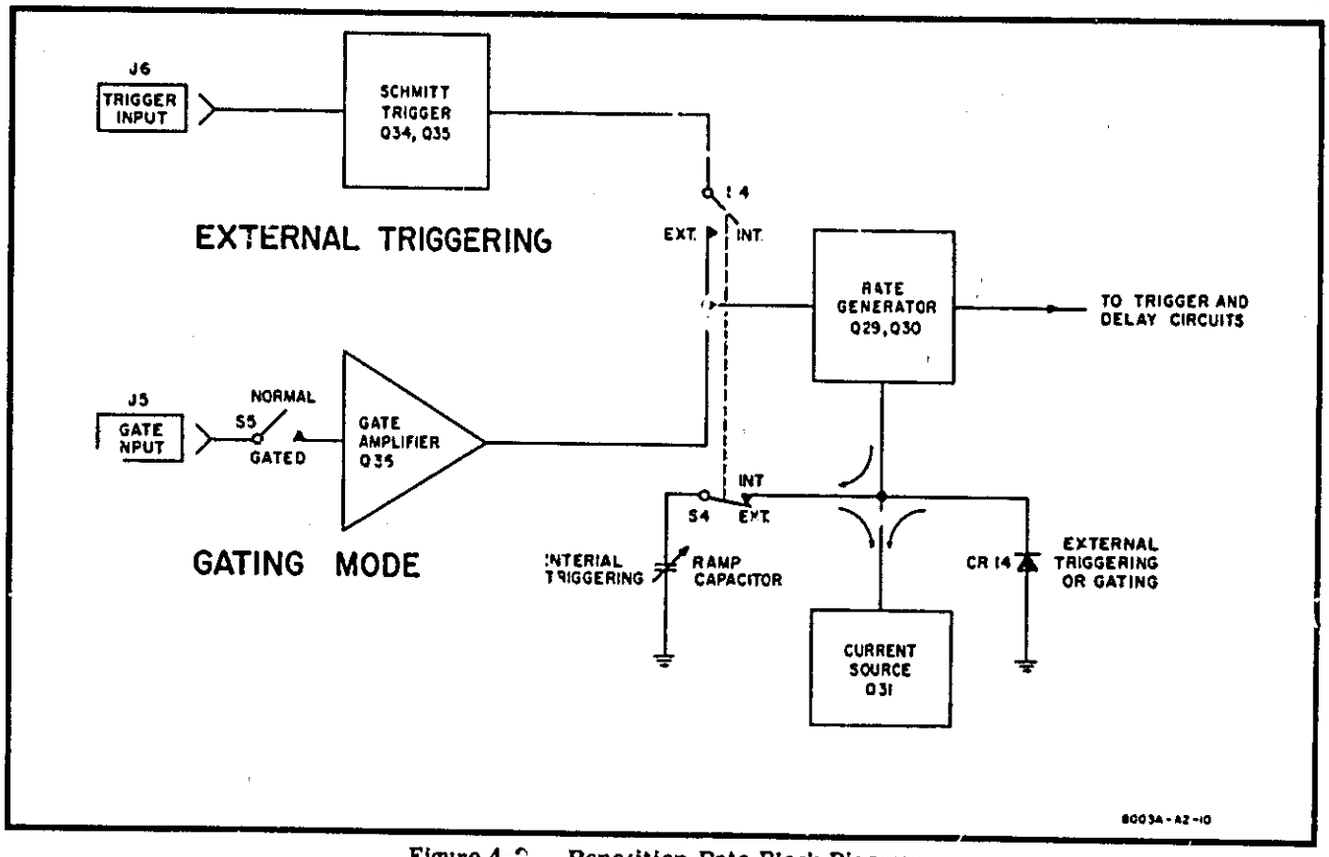


Figure 4-2. Repetition Rate Block Diagram

and the charging current. Current through current source A1Q31 can be adjusted by the vernier control R3 to change the repetition rate.

4-7. During internal triggering operation diodes A1CR26 and A1CR27 clamp the collectors of transistor A1Q32 and A1Q33 to a voltage level of approximately 11 volts established by Zener diode A1CR28. This assures that no other collector voltage can be developed and no signal is passed to the Schmitt trigger A1Q34/A1Q35 during internal triggering in the event that an external signal is applied to J6.

4-8. EXTERNAL TRIGGERING

4-9. For this mode of operation REP. RATE switch S4 is set to either EXT. - or EXT. +/MAN. When S4 is set to EXT. -, the Model 8003A is triggered by the negative-going slope of the negative external triggering signal; when S4 is set to EXT. +, the instrument is triggered by the positive-going slope of the positive triggering signal. The external trigger is applied through J6 to a differential amplifier A1Q32/A1Q33. Diodes A1CR16/A1CR17 protect A1Q32 and A1Q33 against reverse-bias breakdown in the event of excessive negative trigger levels.

4-10. In the EXT. - position A1R98 is connected to +20 volts, and A1CR26 is reverse-biased. When there is a large enough negative triggering signal, A1Q32 conducts less, and the voltage increases positively on the collector of A1Q32 and through A1CR24 onto the base of A1Q34. This signal at A1Q34 causes the Schmitt trigger A1Q34/A1Q35 to switch and thereby generates a positive-going spike on inductor A1L2.

4-11. In the EXT + position A1R99 is connected to +20 volts, and A1CR27 is reverse-biased. When there is no external positive triggering signal, A1Q32 and A1Q33 conduct. During this time A1Q34 is cut off. When there is a large enough external positive triggering signal, A1Q33 conducts less, and the voltage increases positively on the collector of A1Q33 and through A1CR25 onto the base of A1Q34. This signal at A1Q34 causes the Schmitt trigger A1Q34/A1Q35 to switch and thereby generates a positive-going spike on inductor A1L2.

4-12. In either of the external positions the REP. RATE selector switch S4 connects A1R111 to -20 volts. Then the A1Q30 base voltage is held slightly negative, about -1 volt. Diode A1CR14 prevents the emitter of A1Q30 from going more negative than its base. (The current from current source A1Q31 flows through A1CR14 to ground). Thus the rate generator A1Q29 and A1Q30 remain cut off until a positive spike from the Schmitt trigger passes through A1CR18 and momentarily cuts off A1CR19. During this period A1Q30 base voltage rises; transistor A1Q30 and hence A1Q29 switch on as in the internal triggering operation, therefore giving a negative pulse at the emitter of A1Q29 for each trigger pulse.

4-13. MANUAL TRIGGERING

4-14. For this mode of operation REP. RATE switch S4 is set to EXT. +/MAN. When the MANUAL push button S3 is pressed, A1C46 begins to charge, giving a positive voltage on the base of the Schmitt trigger. This operation produces a single pulse. Releasing the button discharges A1C46 through A1R94.

4-15. GATING MODE

4-16. When the gate switch S5 (refer to Figure 7-1) is in its NORMAL position, the base of A1Q36 is held negative, and the transistor will not conduct. Diodes A1CR20 and A1CR21 prevent the base of A1Q36 from going more negative than -1.4 volts. In the GATED position the base potential of A1Q36 rises to zero volts, and current flows through the transistor. As in external operation, the base voltage of A1Q30 goes negative and keeps A1Q30 turned off; A1CR14 conducts, passing the current from current source A1Q31 to ground. Now a negative signal, applied to the GATE input, cuts off A1Q36, and the current flow is routed through A1CR20 and A1CR21 as before. The base voltage of A1Q30 rises, and the rate generator circuit functions as in the internal operation, producing a train of pulses at the repetition rate setting until the GATE inout signal is removed. The leading edge of the first output pulse is synchronized with the leading edge of the gate input signal.

4-17. Gating is also possible in both external positions. An output pulse is produced only when both the trigger input and gate input signals are present.

4-18. TRIGGER OUTPUT AND DELAY CIRCUIT

4-19. The negative pulse from the rate generator is fed to the base of inverter amplifier transistor A1Q38 (refer to Figure 7-2). The signal is inverted, and the positive trigger pulse is taken from the collector and is fed to the TRIGGER OUTPUT (+) connector.

4-20. The negative pulse is also fed to the base of A1Q37, part of the delay circuit. In the non-delayed mode the negative pulse, present on A1Q37 emitter, is fed by A1S1 (delay switch) to the width generator. In the delayed mode the amplified positive pulse from A1Q37 collector is delayed 140 ns by delay line A1DL1, amplified once more by A1Q39, and differentiated by A1L5. Diode A1CR29 removes the positive pulse, and the negative pulse is fed by A1S1 to the width generator.

4-21. WIDTH GENERATOR

4-22. This circuit establishes the width of the output pulse. The pulse width is controlled by the setting of PULSE WIDTH selector switch S6 and PULSE WIDTH VERNIER R6 (refer to Figure 7-2). The width circuit receives the signal developed in the delay circuit to switch Schmitt trigger A1Q23/A1Q24. Initially A1Q23 is cut off, and A1Q24 is conducting, which results in a voltage drop across A1R72; consequently, A1Q25 conducts. Thus, the current from current source A1Q26 flows through A1Q25. At the same

time A1Q27 of the Schmitt trigger is held off while A1Q28 conducts. The incoming negative pulse from the delay circuit changes the state of Schmitt trigger A1Q23/A1Q24, causing A1Q23 to conduct and A1Q24 to cut off. Now A1Q25 cuts off, and the selected width capacitor is linearly charged by the current source A1Q26 to a level of about +4 volts. At this level Schmitt trigger A1Q27/A1Q28 changes state. A1Q28 collector goes positive, turns off A1Q23, and returns the circuit to its original condition. The output waveform is taken from Schmitt trigger transistor A1Q23 collector, is differentiated, and is fed as positive and negative spikes to the output circuit.

4-23. POSITIVE AND NEGATIVE OUTPUT CIRCUITS

4-24. The output circuits form the output pulses and drive an output load. With reference to the negative output (refer to Figure 7-3), driver and output amplifier transistors A1Q17 through A1Q20 (a cascode amplifier) are initially held cut off by switching transistor A1Q16, which is conducting heavily. The positive portion of the width generator output changes the state of Schmitt trigger A1Q14/A1Q15. Transistor A1Q14 cuts off, and A1Q15 conducts. Hence, the collector voltage of A1Q14 becomes more negative, switching off A1Q16. The switching action is very fast, and immediately the base potentials of A1Q17 and A1Q18 become less negative and the transistors feed a current of about 105 mA to the emitters of A1Q19 and A1Q20 respectively. A1Q19 and A1Q20 collector voltage goes more negative, and this fall is passed to the output attenuator. The circuit remains in this state until the negative signal from the width generator switches the circuit to its original condition. Voltage source, A1Q21 and A1Q22, regulates the base potentials of the driver and output amplifier transistors, this provides the AMPLITUDE VERNIER control. The positive output circuit functions in a similar manner. Schmitt trigger transistor A1Q5 is switched on by the positive input pulse, and the voltage rise on A1Q6 collector controls the switching transistor A1Q7; the resultant output of the circuit is a positive pulse. The output attenuators consist of 3 resistive networks with attenuation of 1, 2.5 and 5, which are used individually or in series to provide stepped attenuation of the outputs.

4-25. POWER SUPPLY

4-26. The power supply operates from either 115 or 230 volts ac, which is rectified and regulated to provide dc outputs of -20 and +20 volts. Two separate primary windings of transformer T1 are switched by S2 in parallel for 115 volt operation or in series for 230 volt operation (refer to Figure 7-4). Both negative and positive supplies operate in a similar manner. With reference to the positive supply, error amplifier transistor A1Q4 senses and amplifies any change in the output voltage. The change is applied through driver transistor A1Q3 to the series regulator Q2, which acts as a variable series resistor in the current path.

MAINTENANCE

Table 5-1. Required Test Equipment

Recommended Instrument		Required Characteristics	Required For
Type	Model		
High Frequency Oscilloscope	HP 180A with HP 1801A and 1821A	Band Width: 50 MHz Vertical Sensitivity: 0.05-2 V/cm Dual Trace Operating Mode Sweep Delay Capability	Performance Check and Troubleshooting
Sampling Oscilloscope	HP 140A with HP 1410A and HP 1424A	Band Width: 1 GHz Sweep Time: 10 ns/cm - 5 µs/cm	Performance Check and Adjustments
Square Wave Generator	HP 217A	Rise Time: < 10 ns Repetition Rate: 10 kHz Amplitude: -2 V	Performance Check and Troubleshooting
Test Oscillator	HP 651B	Frequency Range: 10 kHz to 10 MHz Output Amplitude: 2 V pk-pk	Performance Check
DC Volt-Ohmmeter	HP 412A	Voltage Range: 1 to 30 V Accuracy: ±1 % on 30 V scale Input Resistance: ≥ 1 MΩ Resistance Range: 100 kΩ	Adjustment and Troubleshooting
AC Voltmeter	HP 400D	Range: 1 to 250 V Accuracy: ±3% Input Impedance: 10 MΩ with 15 pF	Troubleshooting
Digital Voltmeter	HP 3430A	Voltage Range: ±20 V Ground: Floating Accuracy: 0.1% Input Resistance: ≥10 MΩ	Adjustments
50Ω Attenuator (2 required)	HP 8491A	Band Width: 1 GHz Attenuation: 20 dB	Performance Check and Adjustments
Tee (2 required)	HP 10221A	50Ω System	Perf. Check and Adjustments
Feed-Through Termination (2 required)	HP 11048B	50Ω (±1 ohm) Load	Performance Check
BNC Tee	UG - 274B/U 74868		Performance Check
Termination (2 required)	GR 874-W50B	Resistance: 50Ω Power Rating: 1 W Minimum	Performance Check and Adjustments
Adapter (2 required)	GR 874	Type N to GR	Performance Check
Cable Assembly (4 required)	HP 10120A	3 Ft 50Ω coax. terminated at both ends. with BNC male connectors	Performance Check and Adjustments
Cable Assembly (2 required)	HP 10122A	3 Ft 50Ω coax cable BNC - N type	Performance Check and Adjustments

SECTION V
MAINTENANCE

5-1. INTRODUCTION

5-2. This section provides maintenance and service information for the Model 8003A Pulse Generator. Performance check, adjustment procedures, troubleshooting, and repair and replacement information are covered in this section. A minimum instrument warm-up time of 15 minutes should be allowed before attempting the performance check or the adjustments. Pulse characteristics terminology used in this section is illustrated in Figure 5-1. Schematic diagrams are included at the rear of the manual.

5-3. TEST EQUIPMENT

5-4. Test equipment required for maintaining and checking the performance of the Model 8003A is listed in Table 5-1. Test equipment having characteristics similar to those listed in the table may be substituted for the equipment listed.

5.5 PERFORMANCE CHECK

5-6. The performance check presented in Table 5-2 is a procedure designed to compare the operation of the Model 8003A with its specifications. These checks can be incorporated in a periodic maintenance, post-repair, and incoming quality control inspection. A performance check test card is provided in Table 5-3 for a record of the performance check results. Also an instrument calibration and component replacement record is given in Table 5-4.

5-7. INSTRUMENT COVER REMOVAL

5-8. The top, bottom, and all side covers are separately removable. Each cover is held in place by screws. The top and bottom covers slide toward the rear panel to free the curved portion before lifting off. Always disconnect the power cord before removing the instrument covers. Removal of bottom cover provides access to all components on circuit board A1 except A1Q10, A1Q11, A1Q19, and A1Q20, which are accessible by removal of the top cover.

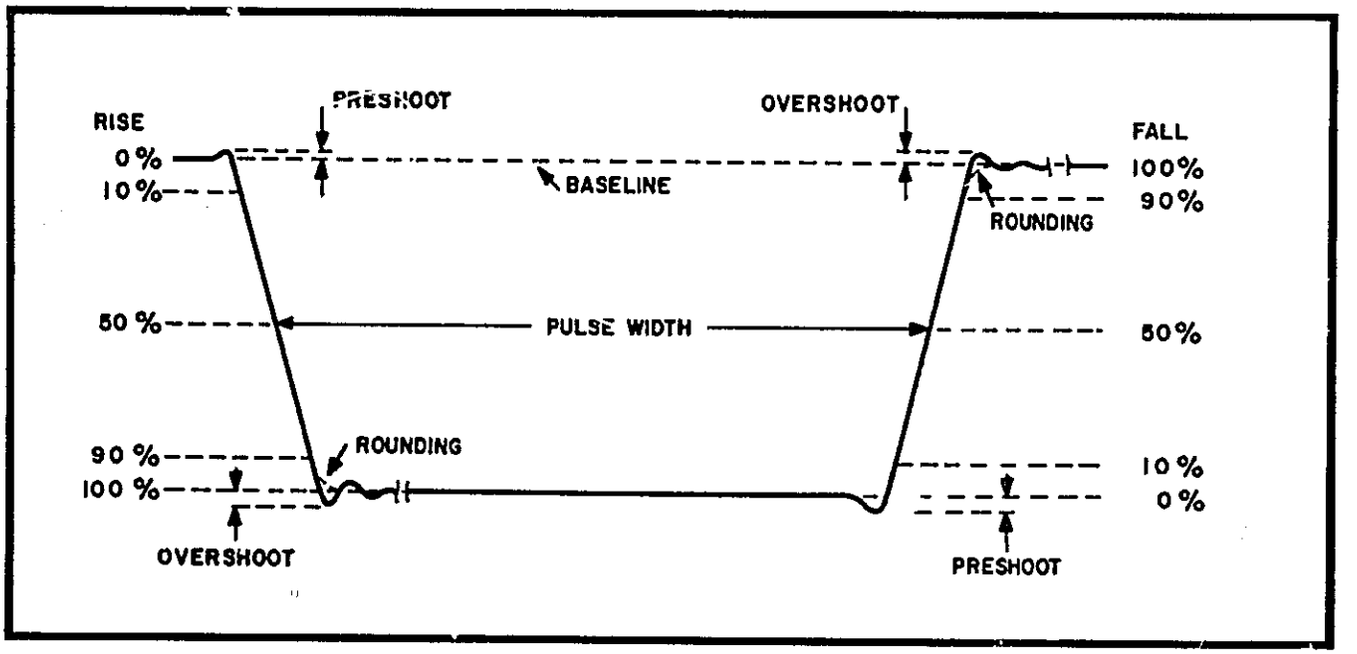
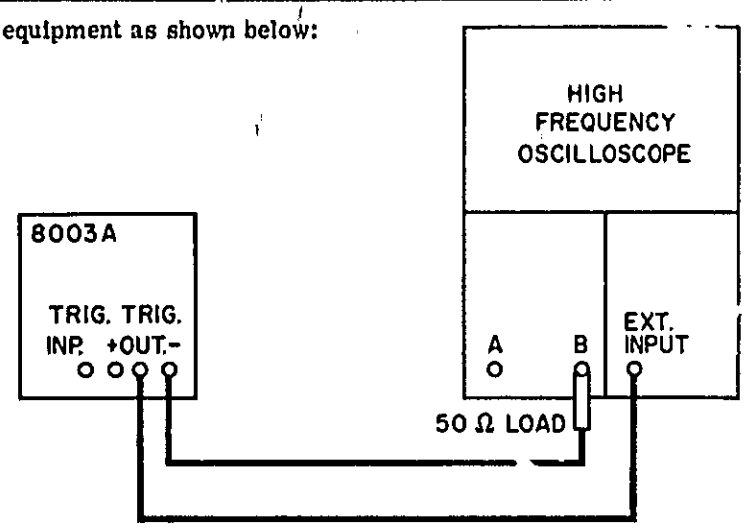


Figure 5-1. Definition of Output Pulse Characteristics

Table 5-2. Performance Check

1. FREE RUNNING REPETITION RATE: 0.3 Hz to 10 MHz in five ranges; vernier provides continuous adjustment between ranges.

a. Connect the equipment as shown below:



b. Set controls as follows:

8003A	REP. RATE (Hz)	10 M
	VERNIER (R.R.)	cw
	PULSE WIDTH (s)	30 n
	VERNIER (P. WIDTH)	ccw
	AMPLITUDE (-)	5 V
	VERNIER (AMPL.-)	cw
	OPER. MODE	normal
High Frequency Oscilloscope	SWEEP TIME	0.1 μs/cm
	TRIGGER SOURCE	Ext. DC
	TRIGGER SLOPE	positive
	SENSITIVITY CH. B	2 V/cm
	INPUT CH. B	DC
	POLARITY	positive

c. Set leading edge of the first pulse to the first line on the screen. The leading edge of the eleventh pulse should be seen at 10 cm or less on the screen.

d. Set the 8003A REP. RATE, VERNIER (R.R.), PULSE WIDTH, and the oscilloscope SWEEP TIME as shown in the table below. the PULSE WIDTH VERNIER should remain in its ccw position. The pulse period should be as shown in the right-hand column in the table below.

REP.RATE	REP. RATE VERNIER	PULSE WIDTH	Oscilloscope SWEEP TIME	PULSE PERIOD
0.3 MHz	cw	30 ns	0.5 μs/cm	≤6.6 cm
10 kHz	cw	3 μs	10 μs/cm	≤10 cm
300 Hz	cw	0.1 ms	0.5 ms/cm	≤6.6 cm
.3 - 10 Hz	cw	3 ms	10 ms/cm	≤10 cm
.3 - 10 Hz	ccw	3 ms	0.5 s/cm	≥6.6 cm
300 Hz	ccw	3 ms	20 ms/cm	≥5 cm
10 kHz	ccw	0.1 ms	0.5 ms/cm	≥6.6 cm
0.3 MHz	ccw	3 μs	20 μs/cm	≥5 cm
10 MHz	ccw	30 ns	0.5 μs/cm	≥6.6 cm

Table 5-2. Performance Check (cont'd)

2. PULSE WIDTH: 30 ns to 3 s in five ranges; vernier provides continuous adjustment between ranges.

a. Use same equipment setup as shown in Performance-Check Paragraph 1 a.

b. Set the 8003A REP. RATE VERNIER in its cw position. Set the 8003A PULSE WIDTH, VERNIER (P. WIDTH), and REP. RATE and the oscilloscope SWEEP TIME as shown in the table below. The width of the output pulse, measured at 50% of amplitude height, should be as shown in the right-hand column of the table below.

PULSE WIDTH	P. WIDTH VERNIER	REP. RATE	Oscilloscope SWEEP TIME	OUTPUT PULSE WIDTH
30 ns	ccw	10 MHz	0.1 μs/cm	≤ 3 mm
3 μs	ccw	0.3 MHz	0.5 μs/cm	≤ 6 cm
0.1 ms	ccw	10 kHz	20 μs/cm	≤ 5 cm
3 ms	ccw	300 Hz	0.5 ms/cm	≤ 6 cm
0.1 - 3 s	ccw	0.3 - 10 Hz	10 ms/cm	≤ 10 cm
3 ms	cw	0.3 - 10 Hz	20 ms/cm	≥ 5 cm
0.1 ms	cw	0.3 - 10 Hz	0.5 ms/cm	≥ 6 cm
3 μs	cw	300 Hz	20 μs/cm	≥ 5 cm
30 ns	cw	10 kHz	0.5 μs/cm	≥ 6 cm

c. Set oscilloscope sweep time to 0.5 s/cm, 8003A REP. RATE (Hz) to EXT. +/MAN., PULSE WIDTH to 0.1 - 3 s, and PULSE WIDTH (s) VERNIER cw. Press MAN. button. Pulse width should be 6 cm or more.

3. AMPLITUDE:
Seven-step attenuator reduces output to 0.05 V in a 5, 2.5, 1 sequence. Vernier provides continuous adjustment between steps and reduces minimum output to < 0.02 V. Maximum Output is 5 V (10 V across an open circuit). Internal switch permits removal of internal load, increasing output to at least 10 V across 50 ohm.

a. Use same equipment setup as shown in Performance-Check Paragraph 1 a.

b. Set 8003A REP. RATE (Hz) to 10 k, VERNIER (R. R.) ccw, PULSE WIDTH (s) to 0.1 m, and VERNIER (P. WIDTH) to ccw. Check to see that the output pulse amplitude on the Oscilloscope for each setting should be as shown in the right-hand column of the following table.

Oscilloscope Sensitivity	8003A Amplitude	Amplitude Vernier	Pulse Amplitude
1 V/cm	5 volts	cw	≥ 5 cm
0.5	2.5	cw	≥ 5 cm
0.2	1	cw	≥ 5 cm
0.1	0.5	cw	≥ 5 cm
0.05	0.25	cw	≥ 5 cm
0.05	0.1	cw	≥ 2 cm
0.05	0.05	cw	> 1 cm
0.05	0.05	ccw	< 0.4 cm
0.05	0.1	ccw	≤ 1 cm
0.05	0.25	ccw	≤ 2 cm
0.1	0.5	ccw	≤ 2 cm
0.2	1.0	ccw	≤ 2 cm
0.5	2.5	ccw	≤ 2 cm
1	5	ccw	≤ 2 cm

Table 5-2. Performance Check (cont'd)

4. MAXIMUM DUTY CYCLE: >90% for repetition rates from 0.3 Hz to 1 MHz; > 50% from 1 to 10 MHz.

a. Use same equipment setup as shown in Performance-Check Paragraph 1 a.

b. Set controls as follows:

8003A	REP. RATE (Hz)	10 M
	VERNIER (R.R.)	cw
	PULSE WIDTH (s)	30 n
	VERNIER (P. WIDTH)	ccw
	AMPLITUDE (-)	5 V
	VERNIER (AMPL.-)	cw
	OPER. MODE	normal
High Frequency Oscilloscope	SWEEP TIME	0.2 μs/cm
	SWEEP MAGNIFIER	x 10
	TRIGGER SOURCE	Ext. DC
	TRIGGER SLOPE	Positive
	CHANNEL B	2 V/cm DC
	POLARITY	Positive

c. Adjust 8003A VERNIER (REP. RATE) for two periods on the screen. Turn VERNIER (PULSE WIDTH) slowly cw. Pulse width should be at least 50 ns (2.5 cm) before the frequency counts down (one period in 10 cm).

d. Set oscilloscope sweep magnifier x 1 and sweep time to 0.2 μs/cm. Adjust 8003A VERNIER (REP. RATE) for 2 periods in 10 cm on the screen. Turn VERNIER (PULSE WIDTH) slowly cw. Pulse width should be at least 900 ns (4.5 cm) before the frequency counts down.

5. PULSE DELAY: Approximately 150 ns fixed delay between trigger and pulse. Internal switch permits removal of delay line, reducing delay to about 10 ns.

a. Connect the equipment as shown below.

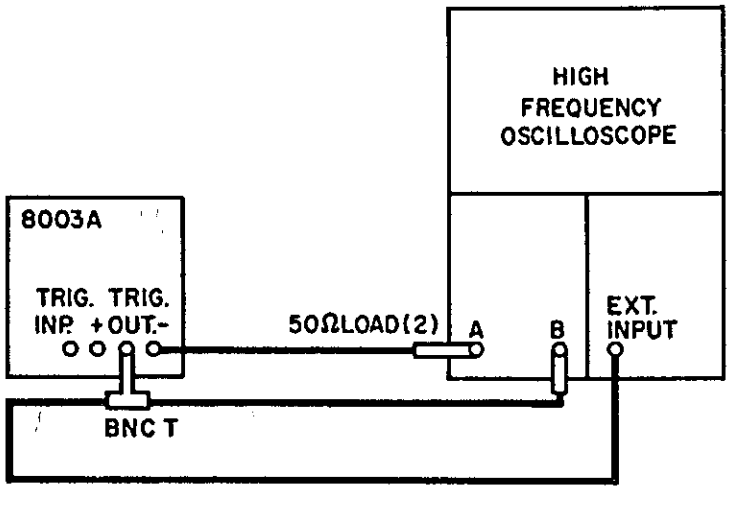


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Table 5-2. Performance Check (cont'd)

b. Set front panel controls as follows:

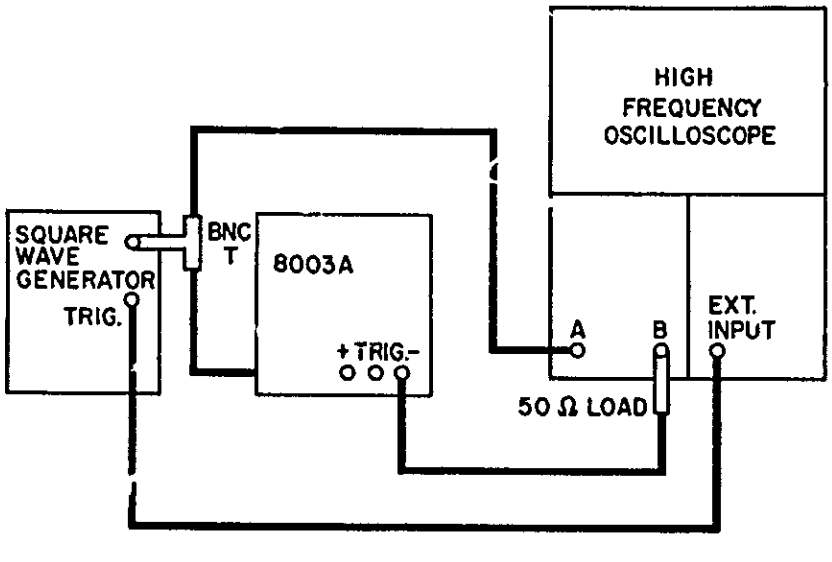
8003A	REP. RATE (Hz)	10 M
	VERNIER (R.R.)	center
	PULSE WIDTH (s)	30 n
	VERNIER (P. WIDTH)	ccw
	AMPLITUDE (-)	5 V
	VERNIER (AMPL. -)	cw
High Frequency Oscilloscope	SWEEP TIME	.1 μs/cm
	SENSITIVITY CH. A and B	2 V/cm
	CHANNEL SELECTOR	Alternate
	TRIGGER SOURCE	EXT. AC
	TRIGGER SLOPE	Positive

c. Remove the 8003A bottom cover. Set the front slide switch on the circuit board in the ND (non-delayed) position. Delay between trigger and output pulse should be approximately 10 ns (1.0 mm).

d. Set the front slide switch on the circuit board in the D (delayed) position. Delay between trigger and output pulse should be approximately 150 ns (1.5 cm). Replace bottom cover on 8003A.

6. SYNCHRONOUS GATING: Gating signal turns generator "on"; pulse repetition rate, amplitude, polarity, and width determined by panel control settings; first pulse is coincident with the leading edge of the gate, last pulse is completed even if gate ends during the pulse. Minimum gating signal: -2 V. Maximum input: -20 V.

a. Connect equipment as shown below:



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b. Set controls as follows:

8003A	REP. RATE (Hz)	0.3 M
	VERNIER (R.R.)	ccw
	PULSE WIDTH (s)	3 μs
	VERNIER (P. WIDTH)	ccw
	AMPLITUDE (-)	5 V
	VERNIER (AMPL.-)	cw
	OPER. MODE	Gated

Table 5-2. Performance Check (cont'd)

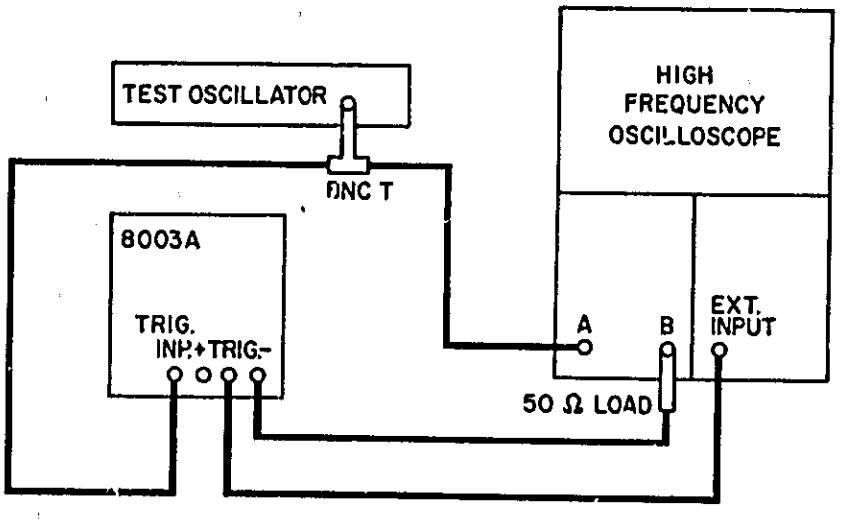
High Frequency Oscilloscope	SWEEP TIME	20 μs/cm
	TRIGGER SOURCE	Ext. DC
	TRIGGER SLOPE	Positive
	CHANNEL SEL.	Alternate
	SENSITIVITY CH. A	1 V/cm DC
	SENSITIVITY CH. B	2 V/cm DC

c. Set Square-Wave Generator for a 10 kHz output pulse with 2.0 V (2 cm) amplitude.

d. Turn 8003A VERNIER (REP. RATE) slowly cw; observe pulse burst on the screen. Pulses shall occur only during "on time" from the Square Wave Generator output pulse.

7. EXTERNAL TRIGGERING: Repetition Rate: 0 to 10 MHz. Trigger Input: Sine waves or pulses of either polarity. Sensitivity: Sine waves, ≥2 V pk-pk. Pulses, 1 V peak, at least 15 ns wide. Maximum input, ±10 V. Delay: Approximately 35 ns between trigger input and trigger output. Input Impedance: Approximately 1 kΩ, dc-coupled.

a. Connect equipment as shown below:



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b. Set controls as follows:

8003A	REP. RATE (Hz)	Ext. +
	VERNIER (R.R.)	ccw
	PULSE WIDTH (s)	30 ns
	VERNIER (P. WIDTH)	ccw
	AMPLITUDE (-)	5 V
	VERNIER (AMPL.-)	cw
	OPER. MODE	Normal
High Frequency Oscilloscope	SWEEP TIME	0.1 μs/cm
	TRIGGER SOURCE	Ext. DC
	TRIGGER SLOPE	Positive
	CHANNEL SELECTOR	Alternate
	SENSITIVITY CH. A	1 V/cm DC
	SENSITIVITY CH. B	2 V/cm DC

Table 5-2. Performance Check (cont'd)

c. Set the Test Oscillator for a 10 MHz frequency and for a 2 V peak-to-peak amplitude as shown on the Oscilloscope.

d. Center both channels vertically and observe the wave forms. Pulse should begin during the positive slope of the sine wave.

e. Set 8003A REP. RATE to EXT. -. Pulse should begin during negative slope of the sine wave.

8. MANUAL TRIGGERING: Push button for single pulse.

a. Use same equipment setup as shown in Performance-Check Paragraph 7a, except, disconnect the test oscillator lead from the 8003A. Set 8003A REP. RATE to EXT. +/MAN, PULSE WIDTH to 3 μs, and OPER. MODE to NORMAL. Switch oscilloscope sweep time to 20 μs/cm.

b. Press MAN. push-button switch and observe pulse on oscilloscope. Only one pulse should occur when the button is pushed. No pulse should occur when the button is released.

9. PERIOD JITTER: < 0.1% of period.

a. Connect the (-) OUTPUT terminal on the Model 8003A to the input B on the High Frequency Oscilloscope with a 50 Ω feed-through termination.

b. Set controls as follows:

8003A	REP. RATE (Hz)	10 K
	VERNIER (R.R.)	cw
	PULSE WIDTH (s)	3 μs
	VERNIER (P. WIDTH)	ccw
	AMPLITUDE (-)	5 V
	VERNIER (AMPL.-)	cw
	OPER. MODE	Normal
High Frequency Oscilloscope	SWEEP TIME	0.1 ms/cm
	SENSITIVITY CH. B	2 V/cm DC
	SWEEP SELECTOR	Main Sweep
	DELAYING SWEEP TIME	0.1 μs/cm
	MAIN SWEEP MODE	Internal
	DELAYED SWEEP MODE	Auto
	TRIGGER SLOPE	Negative
	DELAY LENGTH	0.5

c. Adjust VERNIER (REP. RATE) for a 0.1 ms (1 cm) period. Switch oscilloscope sweep selector delayed. Turn delay length control cw until the leading edge of the first visible pulse is at the center of the graticule. Measure the jitter on the leading edge of the pulse. Jitter should be less than 0.1 μs (1 cm).

10. PULSE WIDTH JITTER: < 0.1 % of pulse width on any width setting.

a. Use same equipment setup as described in Performance-Check Paragraph 9a.

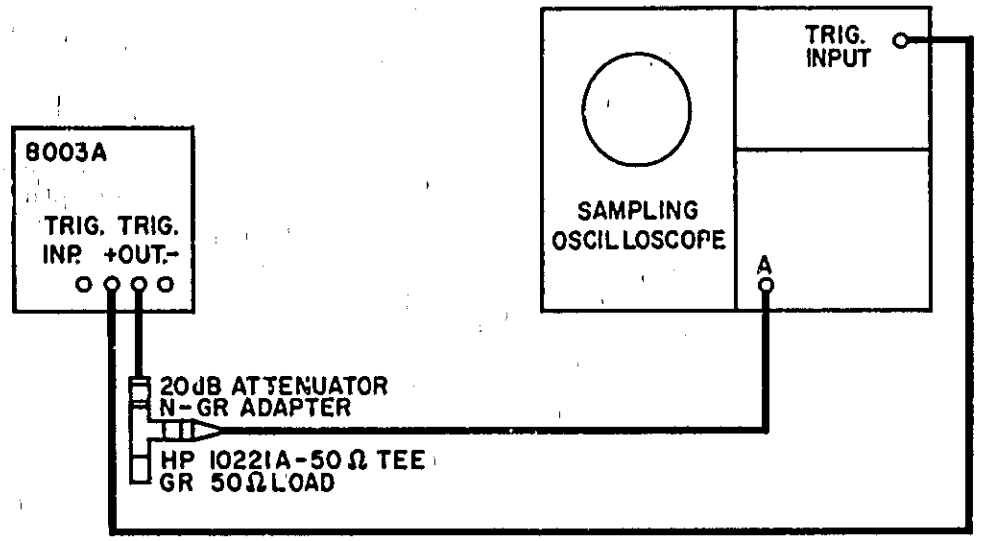
b. Set the oscilloscope sweep selector to main sweep (undelayed) and the sweep time to 0.1 ms/cm. Adjust 8003A VERNIER (REP. RATE) for a 0.2 ms period and VERNIER (P. WIDTH) for a 0.1 ms width.

c. Delay the pulse on the Oscilloscope so that the delayed sweep time is 0.1 μs/cm. Move the trailing edge of the first visible pulse with the delay length control to the center of the graticule. Measure the jitter on the trailing edge of the pulse. The pulse width jitter should be less than 0.1 μs (1 cm).

Table 5-2. Performance Check (cont'd)

11. TRIGGER OUTPUT: Amplitude: 2 V across 50 Ω. Width: 15 ns ±5 ns at 50 % amplitude points. Polarity: Positive.

a. Connect the equipment as shown below:



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b. Set controls as follows:

8003A	REP. RATE (Hz)	10 M
	VERNIER (R.R.)	cw
	PULSE WIDTH (s)	30 ns
	VERNIER (P. WIDTH)	ccw
	AMPLITUDE (+)	5 V
	VERNIER (AMPL.+)	cw
	OPER. MODE	Normal

c. Set Sampling Oscilloscope for a 10 ns/cm display with a vertical display of 50 mV/cm. Move the trigger pulse to the center of the graticule. The pulse amplitude should be greater than +2 volts (4 cm).

d. Adjust oscilloscope sensitivity vernier for a full-screen picture (10 cm). Trigger pulse width at 50 % points should be between 10 ns (1 cm) and 20 ns (2 cm).

12. RISE AND FALL TIME: Less than 5 ns.

a. Connect the equipment as shown below:

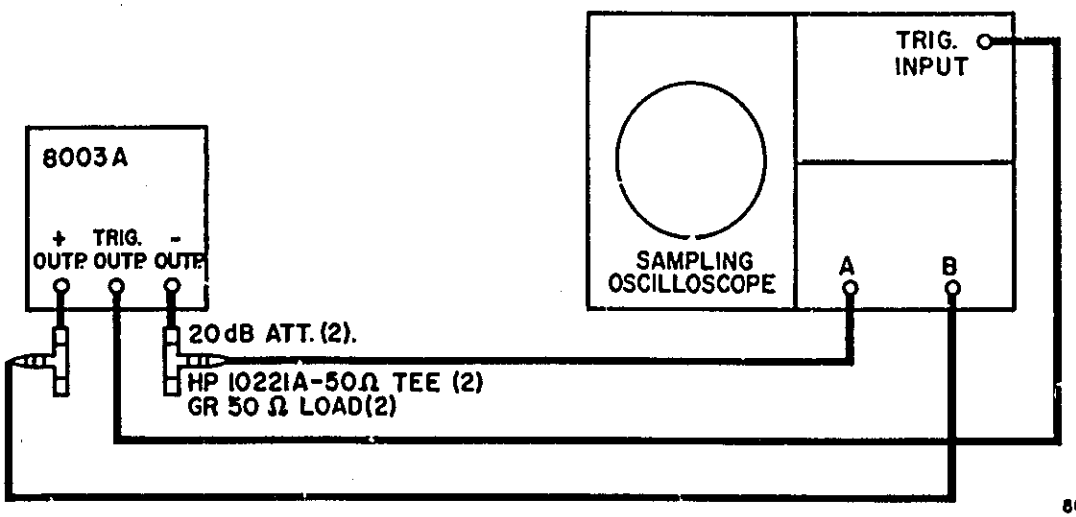

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Table 5-2. Performance Check (cont'd)

b. Set controls as follows:

8003A	REP. RATE (Hz)	10 M
	VERNIER (R.R.)	cw
	PULSE WIDTH (s)	30 n
	VERNIER (P. WIDTH)	ccw
	AMPLITUDE (+)	5 V
	VERNIER (AMPL.+)	cw
	AMPLITUDE (-)	5 V
	VERNIER (AMPL.-)	cw
	OPER. MODE	Normal
Sampling Oscilloscope	SWEEP TIME	20 ns/cm
	MAIN SWEEP MAGNIFIER	x 20
	TRIGGERING	EXT.
	TRIGGER SLOPE	+
	CHANNEL SELECTOR	B
	CHANNEL A POLARITY	- up
	CHANNEL B POLARITY	+ up
	SENSITIVITY CH. A	50 mV/cm
	SENSITIVITY CH. B	50 mV/cm
	DELAY LENGTH	0

c. Adjust oscilloscope vertical positioning control and 8003A AMPLITUDE VERNIER for a positive output pulse with a full-screen picture (10 cm).

d. Move the leading edge of the pulse to the center of the graticule with the oscilloscope delay control. The rise time should be less than 5 ns (5 cm).

e. Move the trailing edge of the pulse to the center of the graticule with the oscilloscope delay control. The fall time should be less than 5 ns (5 cm).

f. Change the oscilloscope channel selector to A. Adjust 8003A negative AMPLITUDE VERNIER for an output pulse for a full-screen picture (10 cm).

g. Repeat Paragraphs 12 d and 12 e.

13. PRESHOOT, OVERSHOOT, AND RINGING: < 5% of pulse amplitude.

a. Use same equipment setup as shown in Rise-And-Fall-Time-Performance-Check Paragraph 12 a.

b. Set front panel controls as follows:

8003A	REP. RATE (Hz)	10 M
	VERNIER (R.R.)	ccw
	PULSE WIDTH (s)	30 n
	VERNIER (P. WIDTH)	center
	AMPLITUDE (+)	5 V
	VERNIER (AMPL.+)	cw

c. Set Sampling Oscilloscope for a 20 ns/cm display with a 50 mV/cm vertical sensitivity for both channels. Set oscilloscope channel selector to B.

d. Adjust oscilloscope delay and vertical position controls until the starting point of the leading edge is centered on the crt. The preshoot before the start of the leading edge should be less than 5% (5 mm) of pulse amplitude.

e. Adjust oscilloscope vertical position control until the top of the leading edge is centered on the crt. The overshoot and ringing should be less than 5% (5 mm) of pulse amplitude.

Table 5-2. Performance Check (cont'd)

f. Adjust oscilloscope delay control until the top of the pulse trailing edge is centered on the crt. The preshoot on the trailing edge should be less than 5% (5 mm) of pulse amplitude.

g. Adjust oscilloscope vertical position control until the bottom of the trailing edge is centered on the crt. The overshoot and ringing on the pulse trailing edge should be less than 5% (5 mm) of pulse amplitude.

h. Change oscilloscope channel selector to A and repeat Performance-Check Paragraphs 13 d through 13 g.

Table 5-3. Performance Check Test Card

Paragraph Reference	Check		Required	Results	Actual
1.	Free Running Repetition Rate				
step c	10 MHz	Upper Limit	≥10 MHz	≤ 10 cm	
step d	0.3 MHz	Upper Limit	≥0.3 MHz	≤6.6 cm	
	10 kHz	Upper Limit	≥10 kHz	≤ 10 cm	
	300 Hz	Upper Limit	≥300 Hz	≤6.6 cm	
	10 Hz	Upper Limit	≥10 Hz	≤ 10 cm	
	10 Hz	Lower Limit	≤ .3 Hz	≥6.6 cm	
	300 Hz	Lower Limit	≤ 10 Hz	≥5 cm	
	10 kHz	Lower Limit	≤300 Hz	≥6.6 cm	
	0.3 MHz	Lower Limit	≤ 10 kHz	≥5 cm	
	10 MHz	Lower Limit	≤0.3 MHz	≥6.6 cm	
2.	Pulse Width				
step b	30 ns	Lower Limit	≤ 30 ns	≤ 3 mm	
	3 μs	Lower Limit	≤ 3 μs	≤ 6 cm	
	0.1 r.s	Lower Limit	≤0.1 ms	≤5 cm	
	3 ms	Lower Limit	≤ 3 ms	≤ 6 cm	
	0.1-3 s	Lower Limit	≤ 0.1 s	≤ 10 cm	
	3 ms	Upper Limit	≥0.1 s	≥5 cm	
	0.1 ms	Upper Limit	≥3 ms	≥6 cm	
	3 μs	Upper Limit	≥0.1 ms	≥5 cm	
	3 ns	Upper Limit	≥3 μs	≥6 cm	
step c	0.1-3 s	Upper Limit	≥3 s	≥6 cm	
3.	Amplitude				
step b	5 V	Upper Limit	≥5 V	≥5 cm	
	2.5 V	Upper Limit	≥2.5 V	≥5 cm	
	1 V	Upper Limit	≥1 V	≥5 cm	
	0.5 V	Upper Limit	≥0.5 V	≥5 cm	
	0.25 V	Upper Limit	≥0.25 V	≥5 cm	
	0.1 V	Upper Limit	≥0.1 V	≥2 cm	
	0.05 V	Upper Limit	≥0.05 V	≥1 cm	
	0.05 V	Lower Limit	≤0.02 V	≤4 mm	
	0.1 V	Lower Limit	≤0.05 V	≤1 cm	
	0.25 V	Lower Limit	≤ 0.1 V	≤2 cm	
	0.5 V	Lower Limit	≤0.25 V	≤2 cm	
	1.0 V	Lower Limit	≤ 0.5 V	≤2 cm	
	2.5 V	Lower Limit	≤ 1.0 V	≤2 cm	
	5 V	Lower Limit	≤ 2.5 V	≤2 cm	
4.	Maximum Duty Cycle				
step c	50% at 10 MHz		≥50 ns	≥2.5 cm	
step d	90% at 1 MHz		≥900 ns	≥4.5 cm	
5.	Pulse Delay				
step c	Not Delayed		≈ 10 ns	≈1.0 mm	
step d	Delayed		≈150 ns	≈1.5 cm	
6.	Synchronized Gating				
step d	Minimum Gating Signal: -2 V		Pulse only during square waves.		

Table 5-3. Performance Check Test Card (cont'd)

Paragraph Reference	Check	Required	Results	Actual
7.	External Triggering			
step d	Ext. +	Pulses only during sine wave positive slope.		
step e	Ext. -	Pulses only during sine wave negative slope.		
8.	Manual Triggering			
step b	Push button for single pulses	One pulse for pushed button.		
9.	Period Jitter			
step c	< 0.1%	< 0.1 μs	< 1 cm	
10.	Pulse Width Jitter			
step c	< 0.1% on any width setting	< 0.1 μs	< 1 cm	
11.	Trigger Output			
step c	Amplitude:	> +2 V	> 4 cm	
step d	Width:	15ns ±5ns	1.5cm ±0.5cm	
12.	Rise And Fall Time			
step d	Negative Rise Time	< 5 ns	< 5 cm	
step e	Negative Fall Time	< 5 ns	< 5 cm	
step g	Positive Rise Time	< 5 ns	< 5 cm	
	Positive Fall Time	< 5 ns	< 5 cm	
13.	Preshoot, Overshoot, and Ringing			
step d	Positive Leading Edge Preshoot	< 5%	< 5 mm	
step e	Positive Leading Edge Overshoot and Ringing	< 5%	< 5 mm	
step f	Positive Trailing Edge Preshoot	< 5%	< 5 mm	
step g	Positive Trailing Edge Overshoot and Ringing	< 5%	< 5 mm	
step h	Negative Leading Edge Preshoot	< 5%	< 5 mm	
	Negative Leading Edge Overshoot and Ringing	< 5%	< 5 mm	
	Negative Trailing Edge Preshoot	< 5%	< 5 mm	
	Negative Trailing Edge Overshoot and Ringing	< 5%	< 5 mm	

5-9. ADJUSTMENTS

5-10. This section gives a complete adjustment procedure for the Model 8003A. This procedure should be conducted only after it has been established that the Model 8003A does not meet its published specifications and does not require troubleshooting. Indiscriminate adjustment of internal controls to refine pulses or to correct major malfunctions may actually cause more difficulty. Since some adjustments interact with others, follow the procedures in the suggested sequence. Refer to Figure 5-2.

5-11. POWER SUPPLY

a. Measure the voltage between test point +20 V on bottom circuit board A1 and the chassis ground with a DC Digital Voltmeter. Adjust A1R19 for +20 volts.

b. Measure the voltage between test point -20 V on bottom circuit board A1 and chassis ground. Adjust A1R9 for -20 volts.

5-12. REPETITION RATE

a. Connect the -OUTPUT of the Model 8003A to the input of the High Frequency Oscilloscope, terminated at its input with a 50 ohm resistor. Connect the 8003A TRIGGER OUTPUT (+) to the oscilloscope trigger input.

b. Set controls as follows:

8003A	REP. RATE (Hz)	10 M
	VERNIER (R.R.)	cw
	PULSE WIDTH	30 ns
	VERNIER (P. WIDTH)	ccw
	AMPLITUDE (±)	5 V
	VERNIER (AMPL.±)	cw
	OPER. MODE	normal
High Freq. Oscilloscope	SWEEP TIME	0.1 μs/cm
	TRIGGER SOURCE	Ext. DC
	TRIGGER SLOPE	positive
	SWEEP SELECTOR	main sweep
	SENSITIVITY CH. B	2 V/cm DC
	POLARITY	positive

b. Set leading edge of the second pulse to the first line on the screen. Adjust A1C40 so that the leading edge of the twelfth pulse (10 periods) is seen at 9.6 cm on the screen.

5-13. PULSE WIDTH

a. Connect equipment as described in Paragraph 5-12a.

b. Set oscilloscope sweep time to 0.1 μs/cm and sweep magnifier to x10. Center picture on the screen. Adjust A1C35 until pulse width at 50% of the pulse amplitude is less than 2.8 cm.

5-14. SPECIALLY SELECTED COMPONENTS

5-15. Components A1C25, A1R56, A1C50, and A1R124 are specially selected at the factory during the testing of the instrument. Selection of the components is needed ONLY if their respective driver amplifier transistors are replaced. The selected resistors influence the output pulse rounding, and the selected capacitors influence the output pulse overshoot and ringing. The resistance range is likely to be between 56 and 100 ohms, and the capacitance range is likely to be between 15 and 39 picofarads. Selected component values, shown in the circuit diagram and listed in the replaceable parts lists, are only typical values. Actual values must be selected experimentally.

5-16. SPECIAL SWITCH CONNECTIONS FOR THE ASTERISK (*) POSITIONS

5-17. REP. RATE RANGE SWITCH

5-18. An additional repetition rate range below 10 M can be connected into the instrument for the asterisk (*) switch position. By installing a capacitor, a desired intermediate repetition rate range or a slower repetition rate other than 0.3 Hz may be selected in the asterisk (*) position. Connect the capacitor posi-

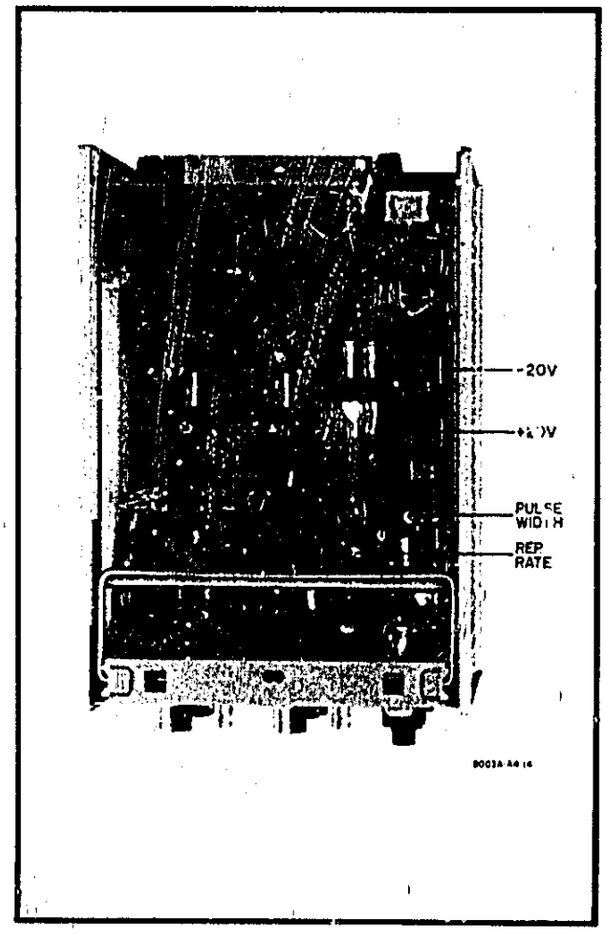


Figure 5-2. HP 8003A Adjustments

Table 5-4. Calibration and Component Replacement Record
For Hewlett-Packard Model 8003A Pulse Generator

Instrument Serial No. _____-_____

CALIBRATION

Date	Description of Calibration Made	Paragraphs Used

COMPONENT REPLACEMENT

Date	Component Designator	Nature of Failure

tive lead to terminal 12 of the REP. RATE switch S4A(F), front of the first wafer (refer to Figure 7-1). Ground the capacitor negative lead. The capacitor specifications should include a minimum dc working voltage of 10 volts and a maximum leakage current of 50 microamperes. Excessive leakage current lowers the lower limit of the REP. RATE range and can make its VERNIER inoperative over part of its range. The approximate capacitance (in microfarads) may be calculated by dividing the desired repetition rate lower limit (in Hz) into 33, i.e. c = 33/f.

5-19. PULSE WIDTH RANGE SWITCH

5-20. An additional pulse width range above 30 nanoseconds can be connected into the instrument for the asterisk (*) switch position. By installing a capacitor, a desired intermediate pulse width range or a wider pulse width other than 3 seconds can be selected in the asterisk (*) position. Connect the capacitor positive lead to terminal 2 of the PULSE WIDTH switch S6A(R), rear of the first wafer (refer to Figure 7-2). Ground the capacitor negative lead. The capacitor specifications should include a minimum dc working voltage of 10 volts, and a maximum leakage current of 50 microamperes. Excessive leakage current raises the upper limit of the PULSE WIDTH range and can make its vernier inoperative over part of its range. The approximate capacitance (in microfarads) may be calculated by multiplying the pulse width lower limit (in seconds) by 1000, i.e. c = W x 1000.

5-21. PULSE WIDTH VERNIER RATIO

5-22. The pulse generator is shipped by the manufacturer so that the asterisk (*) PULSE WIDTH position range is connected in parallel with the 30ns range. In this position the pulse width vernier ratio is 1 to 100. Opening the shorting connection between terminal 1 and 6 on the front of switch wafer S6A (F) changes the ratio to 1 to 30. An intermediate ratio between 1 to 30 and 1 to 100 may be obtained by connecting an additional resistor between switch terminal 1 and 6; this additional resistor is in parallel with R7.

5-23. TROUBLESHOOTING

5-24. GENERAL PROCEDURES

5-25. This troubleshooting information is intended as a guide in isolating a trouble first to a section of the circuitry and then to a specific circuit. The location of the circuit components on their circuit board are identified in figures near the schematic diagrams. Waveform checks and typical dc voltage measurements aid in locating a faulty circuit or component. Control settings for waveforms and typical dc voltages are given in Table 7-2. Troubleshooting test points for waveforms are indicated by numbers inside a star on the schematics. Typical dc voltage values and waveforms appear on the schematics. Refer to Table 7-1 for notes which apply to the schematic diagrams. If satisfactory operation or repairs cannot be accomplished, contact the nearest HP Sales/Service Office (list at rear of this manual).

5-26. OVERALL TROUBLESHOOTING

5-27. To locate trouble in the Model 8003A, start with a thorough visual inspection and then proceed to electrical checkout as necessary. During the visual inspection, look for burned or loose components, loose wire connections, or any other similar condition which suggests a source of trouble. Be sure to check for a blown fuse during the visual inspection. For fuse replacement with 115 volts use a 0.5 amp slow-blow fuse; with 230 volts use 0.25 amp slow-blow fuse. Repair any faulty component or connection that is isolated during the visual inspection and check instrument performance before continuing to troubleshoot the instrument.

5-28. If no obvious fault is located during the visual inspection, proceed with the electrical check out as shown in troubleshooting flow chart, Figure 5-3. This figure shows a systematic approach in locating a faulty circuit. A High Frequency Oscilloscope with a high impedance probe should be used to check the test point waveforms, shown in Figure 5-3 and also on the circuit diagrams. Control settings may be found on Figure 5-3 and in Table 7-2.

5-29. This troubleshooting procedure starts by limiting the location of the source of trouble by observing the trigger output and pulse output waveforms from the front panel. The results of these waveforms should determine which major part of the instrument is faulty. Then by checking the test point waveforms in this part of the HP Model 8003A, the source of trouble can be narrowed down to circuitry between two test points. If there is more than one cause of trouble, this procedure may be repeated until all faults are located.

5-30. The source of trouble may be narrowed down to several components by checking the circuit diagrams typical voltages with a dc voltmeter. These voltages are with respect to ground and may vary somewhat from instrument to instrument. Individual components may be checked for shorts or for open circuits with an ohmmeter.

5-31. On troubleshooting and in replacement in general, always be sure that the transistor, diode, and capacitor pins are connected in correct position as recommended by their manufacturer. Refer to Figures 5-6 and 5-7. To help with proper replacement of semiconductors, the emitter connection is identified by a small dot etched on the circuit board beside the connection point. This dot can also be found for the positive terminal of electrolytic capacitors and for the cathode of diodes. Components not on the circuit boards are located in Figure 5-5.

5-32. LOCATING MALFUNCTIONS

a. POWER SUPPLY. If the power supply voltages are slightly out of tolerance, refer to section 5-12 for power supply adjustments. If any power supply voltages are far out of adjustment, check the applicable circuitry for unusual volt-

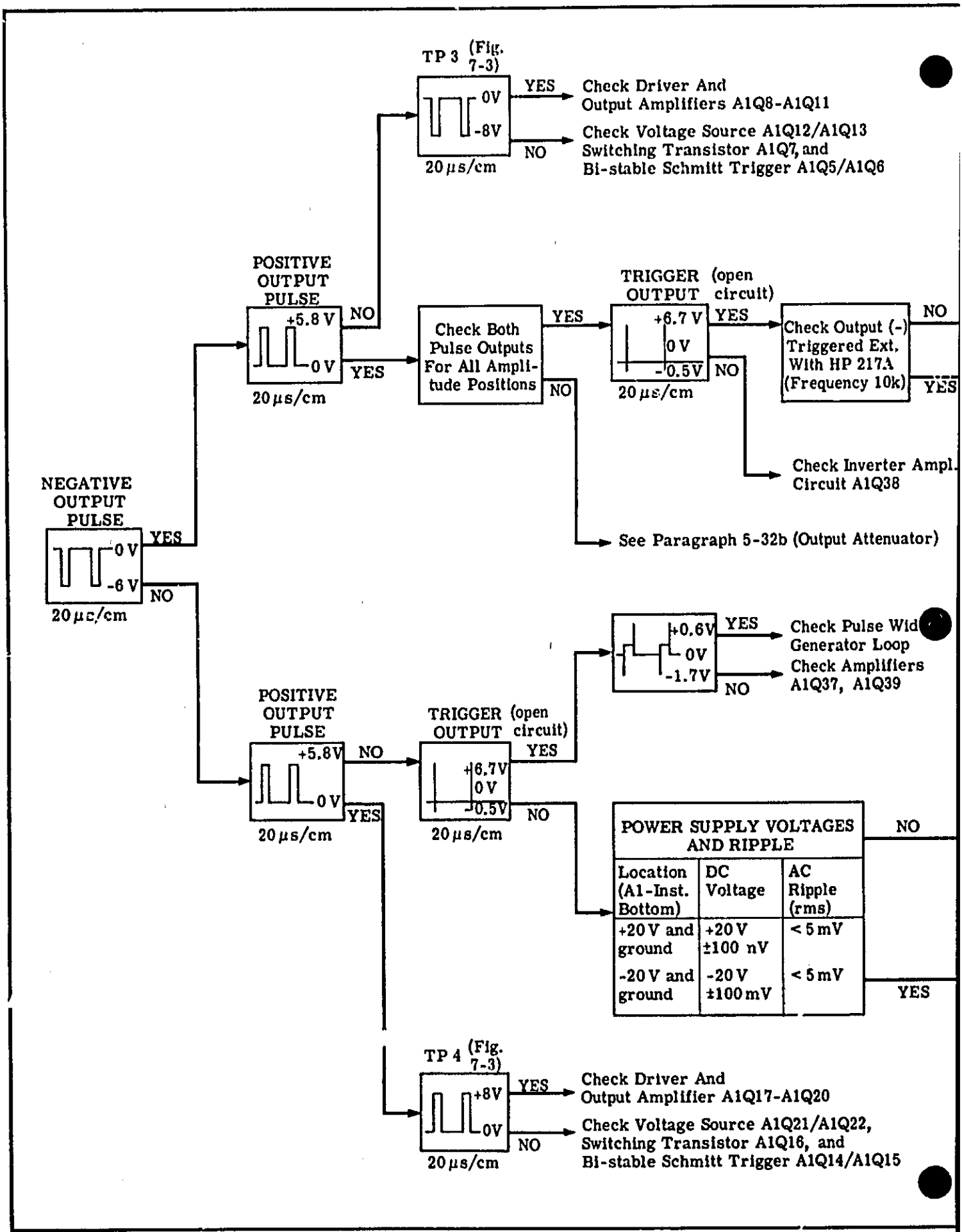
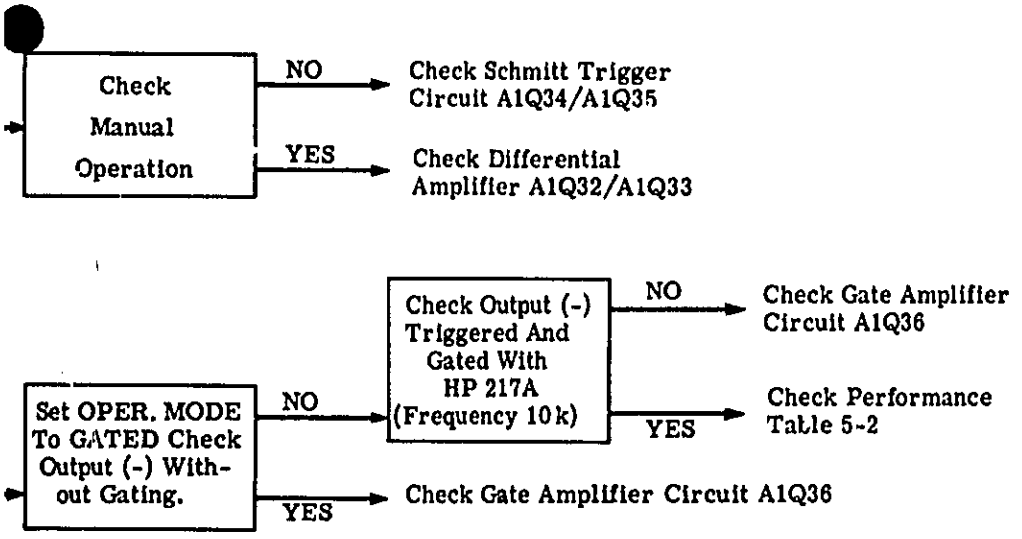


Figure 5-3. Troubleshooting Chart



→ See Paragraph 5-32a

→ Check Rate Generator Circuit A1Q29/A1Q30

Control Settings For Waveforms

8003A	REP. RATE (Hz)	0.3 M
	VERNIER (R. R.)	ccw
	PULSE WIDTH (s)	30 n
	VERNIER (P. WIDTH)	cw
	AMPLITUDE +	5 V
	VERNIER (AMPL. +)	cw
	AMPLITUDE -	5 V
	VERNIER (AMPL. -)	cw
	OPER. MODE	Normal
	Delay Switch (Internal)	D
	Term. Switch (Internal)	5 V

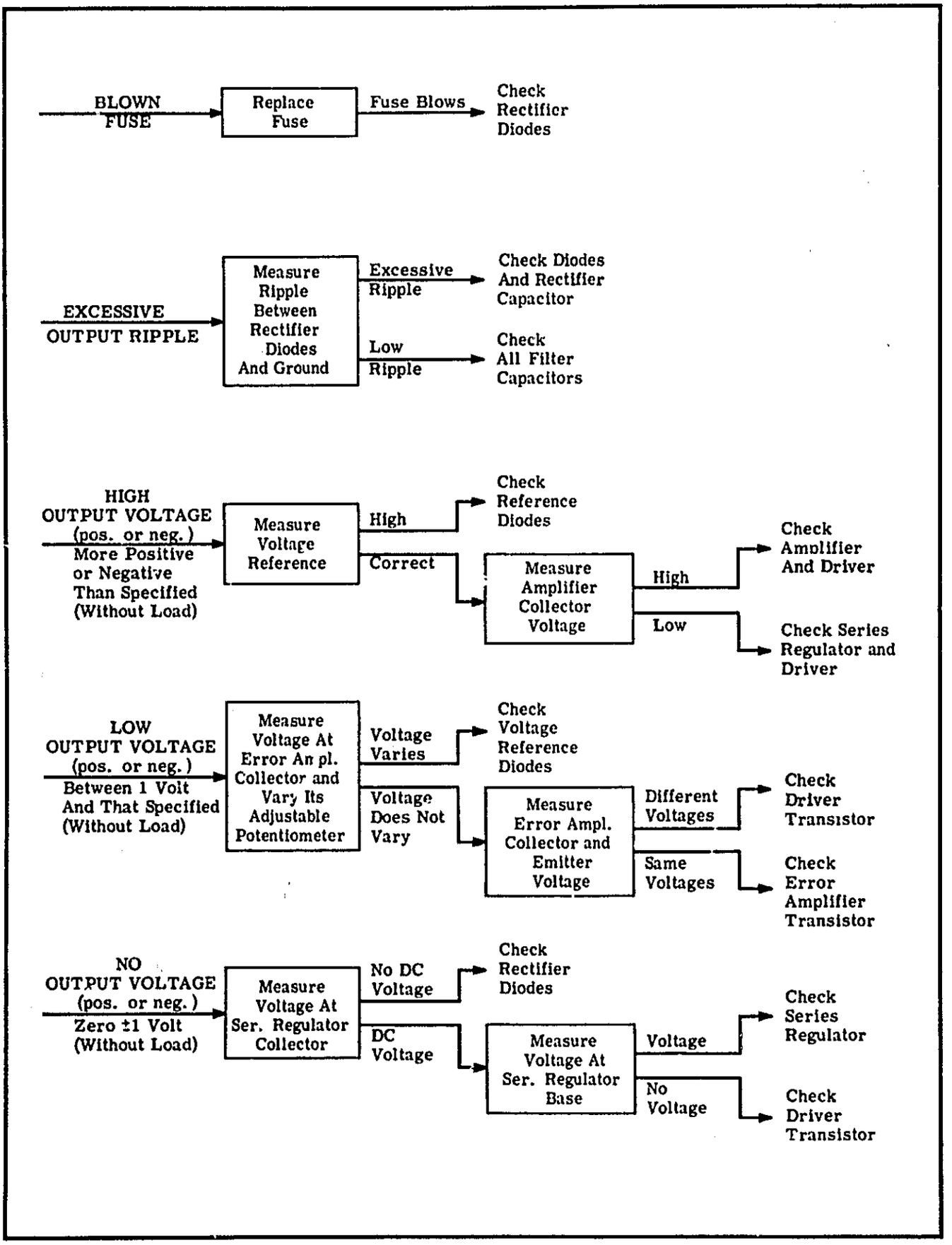


Figure 5-4. Power Supply Troubleshooting Chart

ages which do not make sense. Figure 5-4 should aid in finding defect in the power supply. With this in mind, check for faulty components with an ohmmeter. If there is a short circuit, this may be traced with an ohmmeter. The normal resistance of the power supply loads with respect to chassis ground, which may be checked at power supply inputs on top of bottom circuit board A1, is listed below:

TP +20 V	260 Ω
TP -20 V	400 Ω

NOTE

Disconnect power before checking resistances.

b. OUTPUT ATTENUATOR. Check pulse amplitude on the 2.5, 1, and 0.5 volt setting for both attenuator assemblies A2 and A3. If the pulse amplitude is incorrect on the 2.5 volt setting, the faulty resistor should be R1, R2, or R3. If the pulse amplitude is incorrect on the 1 volt setting, the faulty resistor should be R4, R5, or R6. If the pulse amplitude is incorrect on the 0.5 volt setting, the faulty resistor should be R7, R8, or R9. This assembly may be repaired by removal of its housing. Instructions for pulse attenuator disassembly are found in paragraph 5-36. Attenuator component identification is found in Figure 7-3.

5-33. REPAIR AND REPLACEMENT

5-34. GENERAL

5-35. The following paragraphs provide recommended procedures and techniques for repair or replacement of components. Refer to figures given in List of Illustrations for location and identification of components or assemblies. Section VI contains information for ordering parts.

5-36. PULSE ATTENUATOR DISASSEMBLY

a. Loosen the two Allen screws on the pulse amplitude knob and remove the knob.

b. Remove the two bracket nuts and the one bracket screw supporting the attenuator housing.

c. Remove the four clamping nuts and screws on the attenuator housing.

d. Rotate the assembly to check and to replace the components.

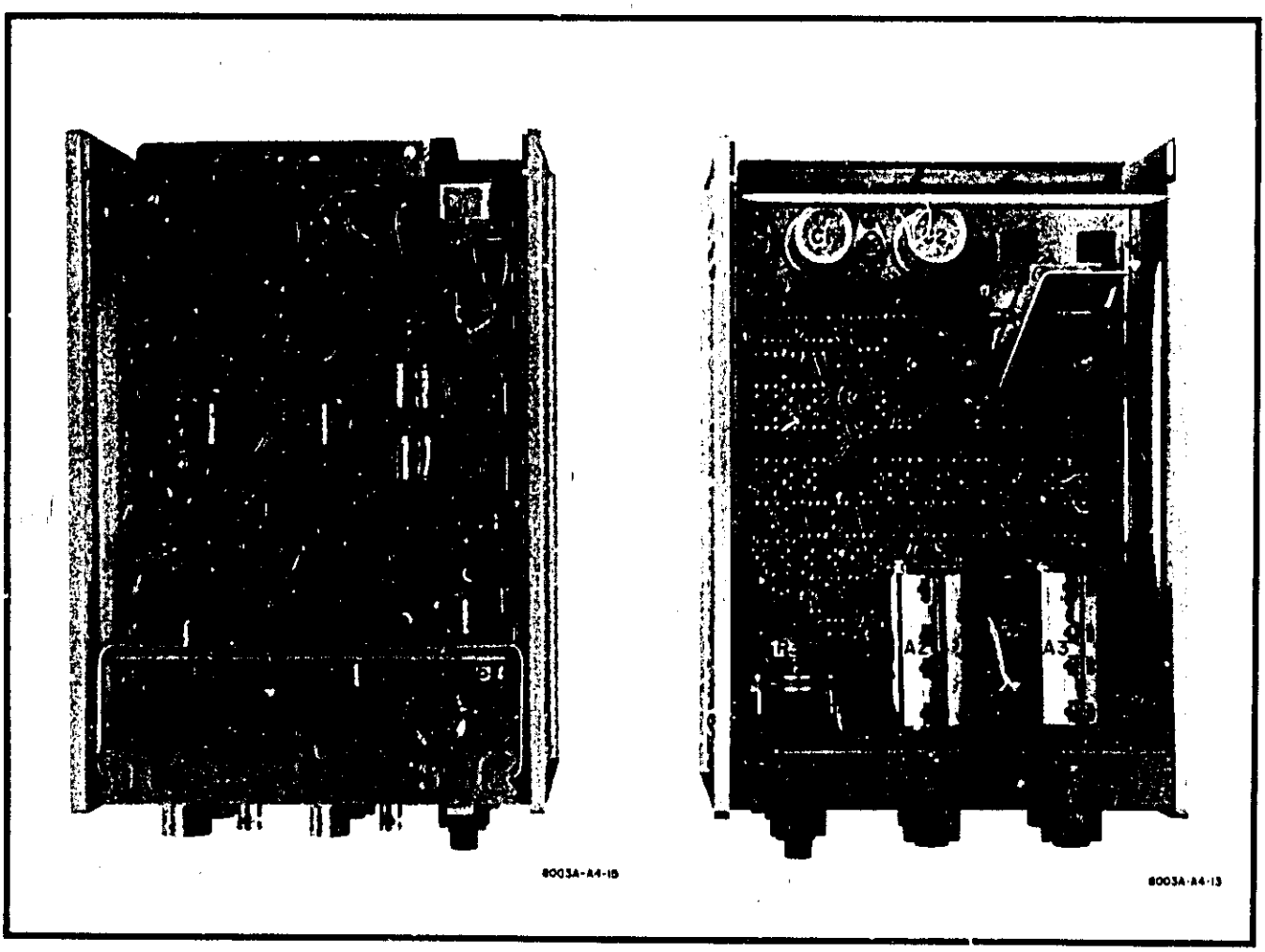


Figure 5-5. HP 8003A Assembly and Off-board Component Identification

5-37. DIODES

5-38. Solid-state diodes are manufactured in several different physical packages. Figure 5-6 shows a couple of typical diode configurations, identifying the cathode. If the cathode marking is removed or doubt exists as to polarity, an ohmmeter may be used to determine the proper connection.

5-39. TRANSISTORS

5-40. The following procedures and data are given to aid in determining whether a transistor is operational. Tests are given for both in-circuit and out-of-circuit transistors. Lead identification of common transistors with various shapes used in this instrument are shown in Figure 5-7.

5-41. IN-CIRCUIT TESTING

5-42. The common causes of transistor failures are internal short and open circuits. In transistor circuit testing the most important consideration is the transistor base-emitter junction. Like the control grid of a vacuum tube, this is the operational control point in the transistor. This junction is essentially a solid-state diode. For the transistor to conduct, the diode must conduct; that is, the diode must be forward biased. As with simple diodes, the forward-bias polarity is determined by the materials forming the junction. Use the transistor symbol on the schematic diagram to determine the bias polarity required to forward-bias the base emitter junction. Figure 5-8 shows transistor symbols with terminals labeled. Notice that the emitter arrow conventionally points toward the type N material. The other two columns of the illustration compare the biasing required to cause conduction and cut-off in transistors and vacuum tubes. If the transistor base-emitter diode (junction) is forward-biased, the transistor conducts. If the diode is heavily forward-biased, the transistor saturates. However, if the base-emitter diode is reverse-biased, the transistor is cut off. The voltage drop across a forward-biased emitter-base diode varies with transistor collector current. For example, a germanium transistor has a typical forward-bias, base-emitter voltage of 0.2 - 0.3 volts when collector current is low and of 0.4 - 0.5 volts when collector current is high. In contrast, forward-bias voltage for silicon transistors is about twice that for germanium types: about 0.5 - 0.7 volts when collector current is low, and about 0.8 - 0.9 volts when collector current is high.

5-43. When examining a transistor stage, first determine if the emitter-base is biased for conduction (forward-biased) by measuring the voltage difference between emitter and base. When using an electronic voltmeter, do not measure directly between emitter and base; there may be sufficient loop current between the voltmeter leads to damage the transistor. Instead, measure each voltage separately with respect to a voltage common point (e.g. chassis).

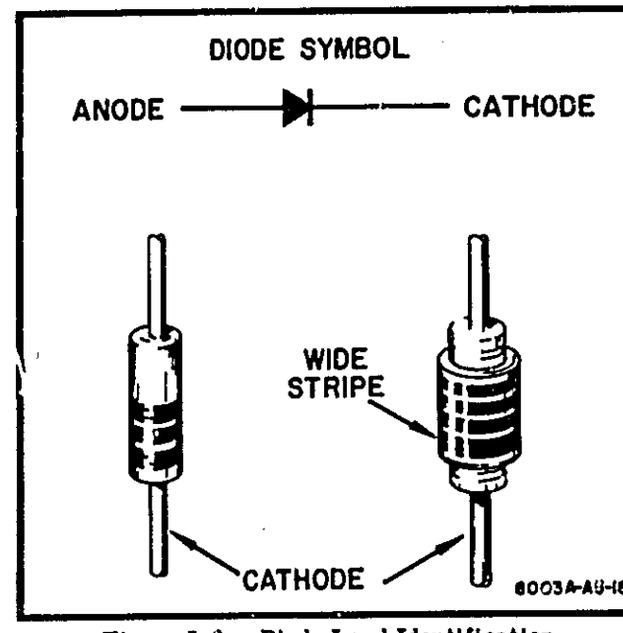


Figure 5-6. Diode Lead Identification

5-44. TESTING TRANSISTORS WITH AN OHMMETER

5-45. The two common causes of transistor failure are internal short and open circuits. Remove the transistor from the circuit and use an ohmmeter to measure internal resistance. See Table 5-5 for measurement data.

CAUTION

Most ohmmeters can supply enough current or voltage to damage a transistor. Before using an ohmmeter to measure transistor forward or reverse resistance, check open-circuit voltage and short-circuit current output ON THE RANGE TO BE USED. Open-circuit voltage must not exceed 1.5 V and short-circuit current must be less than 3 mA. See Table 5-6 for safe resistance ranges for some common ohmmeters.

5-46. ETCHED CIRCUITS

5-47. The etched circuit boards in the HP Model 8003A are a plated-through type consisting of metallic conductors bonded to both sides of insulating material. The metallic conductors are extended through the component mounting holes by a plating process. Soldering can be done from either side of the board with equally good results. Table 5-7 lists recommended tools and materials. Following are recommendations and precautions pertinent to etched circuit repair work:

a. Do not use a high-power soldering iron on etched circuit boards. Excessive heat may lift a conductor or damage the board.

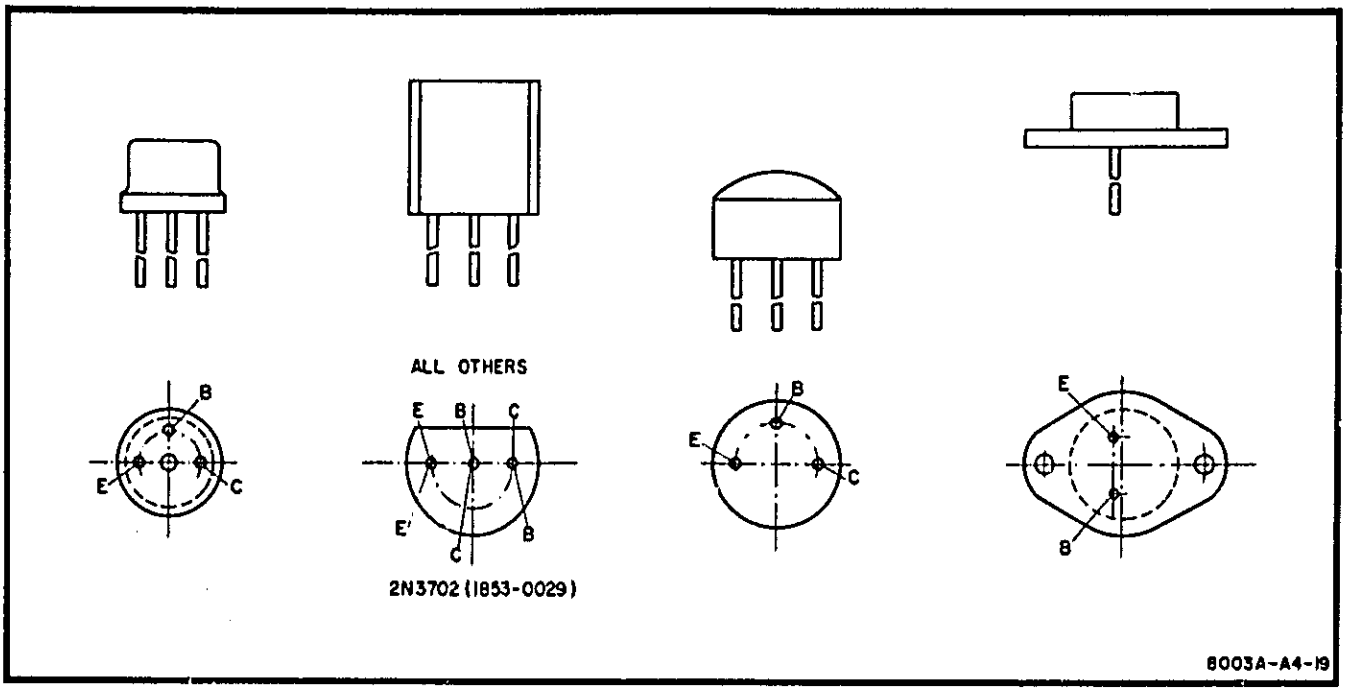


Figure 5-7. Transistor Lead Identification

DEVICE	SYMBOL	CUTOFF	CONDUCTING
VACUUM TUBE	PLATE, GRID, CATHODE	+200V(TYPICAL), -15V	+200V(TYPICAL), -3V
N P N TRANSISTOR	COLLECTOR, BASE, EMITTER	+20V(TYPICAL), 0V (OR-)	+20V(TYPICAL), +.2V TO +.9V, MAIN CURRENT, CONTROL CURRENT
P N P TRANSISTOR	COLLECTOR, BASE, EMITTER	-20V(TYPICAL), 0V (OR+)	-20V(TYPICAL), -.2V TO -.9V, MAIN CURRENT, CONTROL CURRENT

8003A-A4-16

Figure 5-8. Transistor Biasing

Table 5-5. Output- or Circuit-Transistor Measurement

Transistor Type		Connect Ohmmeter Pos. lead to	Connect Ohmmeter Neg. lead to	Measure Resistance (ohm)
PNP Germanium	Small Signal	emitter	base	200 - 500
		emitter	collector	10k - 100k
	Power	emitter	base	30 - 50
		emitter	collector	several hundred
PNP Silicon	Small Signal	emitter	base	1k - 3k
		emitter	collector	very high (might read open)
	Power	emitter	base	200 - 1000
		emitter	collector	high, often greater than 1M
NPN Silicon	Small Signal	base	emitter	1k - 3k
		collector	emitter	very high (might read open)
	Power	base	emitter	200 - 1000
		collector	emitter	greater than 1M
To test for transistor action, add collector-base short. Measured resistance should decrease.				

Table 5-6. Safe Ohmmeter Range for Transistor Resistance Measurement

Ohmmeter	Safe Range(s)	Open Ckt Voltage	Short Ckt Current	Lead Color	Lead Polarity
412A	R x 1k	1.0 V	1mA	Red	+
	R x 10k	1.0 V	100μA	Blk	-
	R x 100k	1.0 V	10μA		
	R x 1M	1.0 V	1μA		
	R x 10M	1.0 V	0.1μA		
410C	R x 1k	1.3 V	0.57mA	Red	+
	R x 10k	1.3 V	57μA	Blk	-
	R x 100k	1.3 V	5.7μA		
	R x 1M	1.3 V	0.5μA		
	R x 10M	1.3 V	0.05μA		
410B	R x 100	1.1 V	1.1mA	Blk	+
	R x 1k	1.1 V	110μA	Red	-
	R x 10k	1.1 V	11μA		
	R x 100k	1.1 V	1.1μA		
	R x 1M	1.1 V	0.11μA		
Simpson 260	R x 100	1.5 V	1mA	Red	+
				Blk	-
Simpson 269	R x 1k	1.5 V	0.82mA	Blk	+
				Red	-
Triplett 630	R x 100	1.5 V	3.25mA	Varies with Serial Number	
	R x 1k	1.5 V	325μA		
Triplett 310	R x 10	1.5 V	750μA		
	R x 100	1.5 V	75μA		

Table 5-7. Etched Circuit Soldering Equipment

Item	Use	Specification	Item Recommended
Soldering Tool	Soldering Unsoldering	Wattage rating: 37.5 Tip Temp: 750-800°F Tip Size: 1/8" OD	Ungar #776 Handle with Ungar #1237 Heating Unit
Soldering Tip, general purpose	Soldering Unsoldering	Shape: chisel Size: 1/8"	Ungar #PL113
De-soldering aid	Unsoldering multi-connection components (e.g., Tube sockets)	Suction device to remove molten solder from connection	Soldapullt by the Edsyn Company, Arleta, California
Resin (flux) solvent	Remove excess flux from soldered area before application of protective coating	Must not dissolve etched circuit base board material or conductor bonding agent	Freon Isopropyl Alcohol (100% dry) Chloroform
Solder	Component replacement Circuit board repair Wiring	Resin (flux) core, high tin content (60/40 tin/lead), 18 gauge (SWG) preferred	
Protective Coating	Contamination, corrosion protection after soldering	Good electrical insulation, corrosion-prevention properties	Krylon* #1302 Humiseal Protective Coating, Type 1B12 by Columbia Technical Corp. Woodside 77, New York
* Krylon Inc., Norristown, Pennsylvania			

b. Use a suction device (Table 5-7) or wooden toothpick to remove solder from component mounting holes. DO NOT USE A SHARP METAL OBJECT SUCH AS AN AWL OR TWIST DRILL FOR THIS PURPOSE. SHARP OBJECTS MAY DAMAGE THE PLATED-THROUGH CONDUCTOR.

c. After soldering, remove excess flux from the soldered area and apply a protective coating to prevent contamination and corrosion. See Table 5-7.

5-48. COMPONENT REPLACEMENT

a. Remove defective component from circuit board.

b. Remove solder from mounting holes using a suction desoldering device (Table 5-7) or wooden toothpick.

c. Shape leads of replacement component to match mounting hole sp

d. Insert component leads into mounting holes, and position component as the original was positioned. Do not force leads or replacement component into mounting holes. Sharp lead ends may damage plated-through conductor.

e. Using heat and solder sparingly, solder leads in place. Heat may be applied to either side of board. A heat sink (longnose pliers, commerical heat-sink tweezers, etc) should be used when replacing transistors and diodes in order to prevent conduction of excessive heat from the soldering iron to the component.

5-49. ETCHED CONDUCTOR REPAIR

5-50. A broken or burned section of conductor can be repaired in the field by bridging the damaged section with a length of tinned copper wire. Allow adequate overlap and remove any varnish from etched conductor before soldering wire into place.

PARTS LIST

SECTION VI

REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-2 lists the parts in alphanumeric order by reference designation. Reference designations for groups of identical items may be shown as TP1-TP9 followed by a single part number and description, indicating that TP1 through TP9 are separate but identical parts.

6-3. Parts consisting of several smaller, yet separately replaceable parts such as jacks or relays have all sub-parts listed so that partial replacement of these items can be accomplished.

6-4. An asterisk following the description of a part indicates optimum value selected at the factory, average value shown.

6-5. ORDERING INFORMATION.

6-6. Many parts used in Hewlett-Packard equipment are manufactured by HP or to HP specification.

6-7. To obtain replacement parts from HP, address order or inquiry to the nearest Hewlett-Packard Sales/Service Office (names and addresses in Appendix B of this manual), and supply the following information:

a. HP Part Number of item(s).

b. model number and serial number of instrument.

c. quantity of part(s) desired.

6-8. To order a part not listed in the table, provide the following information:

a. model number and serial number of the instrument.

b. discription of the part, including function and location in the instrument.

Table 6-1. Reference Designators And Abbreviations

REFERENCE DESIGNATORS

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

ABBREVIATIONS

A	= ampere(s)	Ge	= germanium	minat	= miniature	s-b	= slow-blow
ampl	= amplifier(s)	G	= giga (10^9)	mom.	= momentary	Se	= selenium
assy	= assembly	gl	= glass	mtg	= mounting	sect	= section(s)
		grd	= ground(ed)	my.	= mylar	semicon	= semiconductor(s)
bd	= board(s)					Si	= silicon
bp	= bandpass	h	= henry(ies)	n	= nano (10^{-9})	sil	= silver
c	= centi (10^{-2})	Hg	= mercury	n/c	= normally closed	sl	= slide
car.	= carbon	hr	= hour(s)	Ne	= neon	sp	= single pole
ccw	= counterclockwise	HP	= Hewlett-Packard	n/o	= normally open	spl	= special
cer	= ceramic	Hz	= hertz	npo	= negative positive zero (zero temperature coefficient)	st	= single throw
coax.	= coaxial					std	= standard
coef	= coefficient	if.	= intermediate freq				
com	= common	impg	= impregnated	nsr	= not separately replaceable	Ta	= tantalum
comp	= composition	incd	= incandescent			td	= time delay
conn	= connector(s)	incl	= include(s)			TD	= tunnel diode(s)
CRT	= cathode-ray tube	ins	= insulation(ed)	obd	= order by description	tgl	= toggle
cw	= clockwise	int	= internal	ox	= oxide	Ti	= titanium
						tol	= tolerance
d	= deci (10^{-1})	k	= kilo (10^3)	p	= pico (10^{-12})	trim.	= trimmer
depc	= deposited carbon			pc	= printed (etched) circuit(s)		
dp	= double pole	lb	= pound(s)	PGM	= program	u	= micro (10^{-6})
dt	= double throw	lev	= lever	piv	= peak inverse voltage(s)		
		lin	= linear taper	p/o	= part of	V	= volt(s)
elect.	= electrolytic	log.	= logarithmic taper	poly	= polystyrene	var	= variable
encap	= encapsulated	lp	= low-pass filter(s)	porc	= porcelain		
ext	= external			pos	= position(s)	W	= watt(s)
		m	= milli (10^{-3})	pot.	= potentiometer(s)	w/	= with
F	= farad(s)	M	= mega (10^6)	pk-pk	= peak-to-peak	w/o	= without
fet	= field-effect transistor(s)	metlm	= metal film	rect	= rectifier(s)	wVdc	= dc working volt(s)
fxd	= fixed	metox	= metal oxide	rf	= radio frequency	ww	= wirewound

Table 6-2. Replaceable Parts

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
A1	08003-66501		A: board assembly
A1C1	0180-0049		C: fxd alum 20 uF 50 wVdc
A1C2	0160-0320		C: fxd cer .05 uF −20% +80% 25 wVdc
A1C3	0180-0049		C: fxd alum 20 uF 50 wVdc
A1C4	0180-0049		C: fxd alum 20 uF 50 wVdc
A1C5	0160-0820		C: fxd cer .05 uF −20% +80% 25 wVdc
A1C6	0180-0049		C: fxd alum 20 uF 50 wVdc
A1C7	0150-0050		C: fxd cer 0.001 uF 600 wVdc
A1C8	0140-0145		C: fxd mica 22 pF 5% 500 wVdc
A1C9	0140-0192		C: fxd mica 68 pF 5% 300 wVdc
A1C10	0180-0291		C: fxd Ta 1 uF 10% 35 wVdc
A1C11	0160-2306		C: fxd mica 27 pF 5% 300 wVdc
A1C12	0180-0291		C: fxd Ta 1 uF 10% 35 wVdc
A1C13	0150-0093		C: fxd cer 0.01 uF −20% +80% 100 wVdc
A1C14	0150-0093		C: fxd cer 0.01 uF −20% +80% 100 wVdc
A1C15	0180-0291		C: fxd Ta 1 uF 10% 35 wVdc
A1C16	0180-1706		C: fxd Ta 100 uF 20% 25 wVdc
A1C17	0150-0050		C: fxd cer 0.001 uF 600 wVdc
A1C18	0140-0145		C: fxd mica 22 pF 5% 500 wVdc
A1C19	0140-0192		C: fxd mica 68 pF 300 wVdc
A1C20	0180-0291		C: fxd Ta 1 uF 10% 35 wVdc
A1C21	0180-0291		C: fxd Ta 1 uF 10% 35 wVdc
A1C22	0160-2198		C: fxd mica 20 pF 5% 500 wVdc
A1C23	0150-0093		C: fxd cer 0.01 uF −20% +80% 100 wVdc
A1C24	0150-0093		C: fxd cer 0.01 uF −20% +80% 100 wVdc
A1C25	0140-0145		C: fxd mica 22 pF 5% 500 wVdc (*)
A1C26	0180-0291		C: fxd Ta 1 uF 10% 35 wVdc
A1C27	0180-1706		C: fxd Ta 100 uF 20% 25 wVdc
A1C28	0140-0145		C: fxd mica 22 pF 5% 500 wVdc
A1C29	0150-0093		C: fxd cer 0.01 uF −20% +80% 100 wVdc
A1C30	0180-2207		C: fxd Elect 100 uF 10% 10 wVdc.
A1C31	0180-2109		C: fxd Ta 3.3 uF 5% 35 wVdc
A1C32	0170-0019		C: fxd mylar 0.1 uF 5% 200 wVdc
A1C33	0140-0174		C: fxd mica 3050 pF 1% 100 wVdc
A1C34	0140-0204		C: fxd mica 47 pF 5% 500 wVdc
A1C35	0121-0046		C: var cer 9–35 pF
A1C37	0140-0194		C: fxd mica 110 pF 5% 300 wVdc
A1C38	0140-0190		C: fxd mica 39 pF 5% 300 wVdc
A1C39	0140-0145		C: fxd mica 22 pF 5% 500 wVdc
A1C40	0121-0046		C: var cer 9–35 pF
A1C41	0140-0204		C: fxd mica 47 pF 5% 500 wVdc
A1C42	0140-0174		C: fxd mica 3050 pF 1% 100 wVdc

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
A1C43	0170-0019		C: fxd mylar 0.1 uF 5% 200 wVdc
A1C44	0180-2109		C: fxd Ta 3.3 uF 5% 35 wVdc
A1C45	0180-2207		C: fxd Elect 100 uF 10% 10 wVdc
A1C46	0180-0374		C: fxd Ta 10 uF 10% 20 wVdc
A1C47	0150-0050		C: fxd cer 0.001 uF 600 wVdc
A1C48	0150-0071		C: fxd cer 400 pF 5% 500 wVdc
A1C49	0140-0191		C: fxd mica 56 pF 5% 300 wVdc
A1C50	0140-0202		C: fxd mica 15 pF 5% 500 wVdc (*)
A1C51	0140-0201		C: fxd mica 12 pF 5% 500 wVdc
A1C52	1080-0291		C: fxd Ta 1 uF 10% 35 wVdc
A1C53	0180-0291		C: fxd Ta 1 uF 10% 35 wVdc
A1C54	0180-0291		C: fxd Ta 1 uF 10% 35 wVdc
A1C55	0180-0197		C: fxd Ta 2.2 uF 10% 20 wVdc
A1C56	0180-0291		C: fxd Ta 1 uF 10% 35 wVdc
A1C57	0150-0121		C: fxd cer 0.1 uF −20% +80% 50 wVdc
A1C58	0150-0121		C: fxd cer 0.1 uF −20% +80% 50 wVdc
A1CR1	1901-0045		CR: Si
A1CR2	1901-0045		CR: Si
A1CR3	1901-0045		CR: Si
A1CR4	1901-0045		CR: Si
A1CR5	1902-0048		VR: breakdown 6.81V 5% 400 mW
A1CR6	1901-0045		CR: Si
A1CR7	1901-0045		CR: Si
A1CR8	1901-0045		CR: Si
A1CR9	1901-0045		CR: Si
A1CR10	1902-0048		VR: breakdown 6.81V 5% 400 mW
A1CR11	1901-0040		CR: Si
A1CR12	1901-0040		CR: Si
A1CR13	1901-0040		CR: Si
A1CR14	1901-0040		CR: Si
A1CR15	1901-0040		CR: Si
A1CR16	1910-0016		CR: Ge
A1CR17	1910-0016		CR: Ge
A1CR18	1901-0040		CR: Si
A1CR19	1901-0040		CR: Si
A1CR20	1901-0040		CR: Si
A1CR21	1901-0040		CR: Si
A1CR22	1910-0016		CR: Ge
A1CR23	1910-0016		CR: Ge
A1CR24	1901-0040		CR: Si
A1CR25	1901-0040		CR: Si

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
A1CR26	1901-0040		CR: Si
A1CR27	1901-0040		CR: Si
A1CR28	1902-3150		VR: breakdown 9.09V 2% 400 mW
A1CR29	1901-0040		CR: Si
A1CR30	1901-0040		CR: Si
A1DL1	9190-0007		DL: 140 ns
A1L1	9100-1616		L: fxd 1.5 uH 10%
A1L2	9140-0111		L: fxd 3.3 uH 10%
A1L3	9140-0096		L: fxd 1 uH 10%
A1L5	9100-1616		L: fxd 1.5 uH 10%
A1MP1	08003-01101		MP: heat sink, U shaped
A1MP2–	Consists of:		MP: heat dissapator (used on Q10, Q11, Q19 and Q20)
A1MP5	1205-0007		MP: heat dissapator nut
	1205-0008		MP: heat dissapator body
A1MP6-A1MP8	1205-0011		MP: heat dissapator (used on Q12 and Q21)
A1MP9-A1MP12	1205-0037		MP: heat dissapator (used on Q1, Q2, Q3, and Q4)
A1Q1	1854-0307		Q: Si npn
A1Q2	1854-0307		Q: Si npn
A1Q3	1854-0307		Q: Si npn
A1Q4	1854-0307		Q: Si npn
A1Q5	1854-0215		Q: Si npn
A1Q6	1854-0215		Q: Si npn
A1Q7	1853-0218		Q: Si pnp
A1Q8	1853-0218		Q: Si pnp
A1Q9	1853-0218		Q: Si pnp
A1Q10	1853-0012		Q: Si pnp 2M2904A
A1Q11	1853-0012		Q: Si pnp 2M2904A
A1Q12	1854-0003		Q: Si npn 2N1711
A1Q13	1853-0020		Q: Si pnp
A1Q14	1853-0036		Q: Si pnp 2N3906
A1Q15	1853-0036		Q: Si pnp 2N3906
A1Q16	1854-0019		Q: Si npn
A1Q17	1854-0267		Q: Si npn
A1Q18	1854-0267		Q: Si npn
A1Q19	5080-1040		Q: Si npn (Selected)

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
A1Q20	5080-1040		Q: Si npn (Selected)
A1Q21	1853-0012		Q: Si pnp 2M2904A
A1Q22	1854-0307		Q: Si npn
A1Q23	1853-0036		Q: Si pnp 2N3906
A1Q24	1853-0036		Q: Si pnp 2N3906
A1Q25	1854-0019		Q: Si npn
A1Q26	1853-0034		Q: Si pnp
A1Q27	1854-0215		Q: Si npn
A1Q28	1854-0215		Q: Si npn
A1Q29	1853-0036		Q: Si pnp 2N3906
A1Q30	1854-0260		Q: Si npn 2N3227
A1Q31	1854-0215		Q: Si npn
A1Q32	1854-0215		Q: Si npn
A1Q33	1854-0215		Q: Si npn
A1Q34	1854-0215		Q: Si npn
A1Q35	1854-0215		Q: Si npn
A1Q36	1854-0215		Q: Si npn
A1Q37	1853-0034		Q: Si pnp
A1Q38	1853-0034		Q: Si pnp
A1Q39	1854-0215		Q: Si npn
A1R1	07E 0035		R: fxd metflm 3000 ohms 5% 1/4W
A1R2	0758-0005		R: fxd metflm 4700 ohms 5% 1/4W
A1R3	0758-0033		R: fxd metflm 2000 ohms 5% 1/4W
A1R4	0758-0062		R: fxd metflm 200 ohms 5% 1/4W
A1R5	0758-0048		R: fxd metflm 8200 ohms 5% 1/4W
A1R6	0758-0042		R: fxd metflm 1300 ohms 5% 1/4W
A1R7	0758-0033		R: fxd metflm 2000 ohms 5% 1/4W
A1R8	0758-0034		R: fxd metflm 2400 ohms 5% 1/4W
A1R9	2100-2795		R: var comp 470 ohms ±20% 5W
A1R10	0758-0042		R: fxd metflm 1300 ohms 5% 1/4W
A1R11	0758-0035		R: fxd metflm 3000 ohms 5% 1/4W
A1R12	0758-0005		R: fxd metflm 4700 ohms 5% 1/4W
A1R13	0758-0033		R: fxd metflm 2000 ohms 5% 1/4W
A1R14	0758-0062		R: fxd metflm 200 ohms 5% 1/4W
A1R15	0758-0048		R: fxd metflm 8200 ohms 5% 1/4W
A1R16	0758-0042		R: fxd metflm 1300 ohms 5% 1/4W
A1R17	0758-0033		R: fxd metflm 2000 ohms 5% 1/4W
A1R18	0758-0034		R: fxd metflm 2400 ohms 5% 1/4W
A1R19	2100-2795		R: var comp 470 ohms ±20% 5W
A1R20	0758-0042		R: fxd metflm 1300 ohms 5% 1/4W

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
A1R21	0757-0280		R: fxd metflm 1000 ohms 1% 1/8W
A1R22	0757-0429		R: fxd metflm 1820 ohms 1% 1/8W
A1R23	0757-0403		R: fxd metflm 121 ohms 1% 1/8W
A1R24	0758-0062		R: fxd metflm 200 ohms 5% 1/4W
A1R25	0758-0127		R: fxd metflm 430 ohms 5% 1/4W
A1R26	0758-0031		R: fxd metflm 680 ohms 5% 1/4W
A1R27	0757-0419		R: fxd metflm 681 ohms 1% 1/8W
A1R28	0757-0283		R: fxd metflm 2000 ohms 1% 1/8W
A1R29	0758-0028		R: fxd metflm 270 ohms 5% 1/4W
A1R30	0761-0025		R: fxd metox 120 ohms 5% 1W
A1R31	0698-5137		R: fxd metflm 47 ohms 5% 1/4W
A1R32	0761-0003		R: fxd metflm 62 ohms 5% 1W
A1R33	0761-0003		R: fxd metflm 62 ohms 5% 1W
A1R34	0760-0027		R: fxd metflm 150 ohms 2% 1W
A1R35	0760-0027		R: fxd metflm 150 ohms 2% 1W
A1R36	0758-0017		R: fxd metflm 1500 ohms 5% 1/4W
A1R37	0758-0096		R: fxd metflm 110 ohms 5% 1/4W
A1R38	0758-0003		R: fxd metflm 1000 ohms 5% 1/4W
A1R39	0758-0043		R: fxd metflm 1800 ohms 5% 1/4W (*)
A1R40			Not assigned
A1R41	0758-0031		R: fxd metflm 680 ohms 5% 1/4W (*)
A1R42	0757-0429		R: fxd metflm 1820 ohms 1% 1/8W
A1R43	0757-0280		R: fxd metflm 1000 ohms 1% 1/8W
A1R44	0758-0127		R: fxd metflm 430 ohms 5% 1/4W
A1R45	0757-0284		R: fxd metflm 150 ohms 1% 1/8W
A1R46	0758-0007		R: fxd metflm 150 ohms 5% 1/4W
A1R47	0757-0283		R: fxd metflm 2000 ohms 1% 1/8W
A1R48	0757-0419		R: fxd metflm 681 ohms 1% 1/8W
A1R49	0758-0031		R: fxd metflm 680 ohms 5% 1/4W
A1R50	0758-0028		R: fxd metflm 270 ohms 5% 1/4W
A1R51	0761-0025		R: fxd metox 120 ohms 5% 1W
A1R52	0758-0094		R: fxd metflm 62 ohms 5% 1/4W
A1R53	0758-0044		R: fxd metflm 2200 ohms 5% 1/4W
A1R54	0761-0003		R: fxd metflm 62 ohms 5% 1W
A1R55	0761-0003		R: fxd metflm 62 ohms 5% 1W
A1R56	0758-0126		R: fxd metflm 51 ohms 5% 1/4W (*)
A1R57	0760-0027		R: fxd metflm 150 ohms 2% 1W
A1R58	0760-0027		R: fxd metflm 150 ohms 2% 1W
A1R59	0758-0017		R: fxd metflm 1500 ohms 5% 1/4W
A1R60	0758-0096		R: fxd metflm 110 ohms 5% 1/4W

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
A1R61	0757-0003		R: fxd metfilm 1000 ohms 5% 1/4W
A1R62	0758-0033		R: fxd metfilm 2000 ohms 5% 1/4W (*)
A1R63			Not assigned
A1R64	0758-0031		R: fxd metfilm 680 ohms 5% 1/4W (*)
A1R65	0757-0431		R: fxd metfilm 2430 ohms 1% 1/8W
A1R66	0757-1096		R: fxd metfilm 1360 ohms 1% 1/8W
A1R67	0757-0280		R: fxd metfilm 1000 ohms 1% 1/8W
A1R68	0758-0127		R: fxd metfilm 430 ohms 5% 1/4W
A1R69	0757-0276		R: fxd metfilm 61.9 ohms 1% 1/8W
A1R70	0758-0083		R: fxd metfilm 68 ohms 5% 1/4W
A1R71	0758-0030		R: fxd metfilm 510 ohms 5% 1/4W
A1R72	0698-5891		R: fxd metfilm 43 ohms 5% 1/4W
A1R73	0757-0428		R: fxd metfilm 1620 ohms 1% 1/8W
A1R74	0757-0419		R: fxd metfilm 681 ohms 1% 1/8W
A1R75	0757-0283		R: fxd metfilm 2000 ohms 1% 1/8W
A1R76	0757-0283		R: fxd metlfm 2000 ohms 1% 1/8W
A1R77	0758-0016		R: fxd metfilm 300 ohms 5% 1/4W
A1R78			Not assigned
A1R80	0758-0025		R: fxd metfilm 160 ohms 5% 1/4W
A1R81	0757-0405		R: fxd metfilm 162 ohms 1% 1/8W
A1R82	0757-0730		R: fxd metlfm 750 ohms 1% 1/4W
A1R83	0757-0740		R: fxd metfilm 2210 ohms 1% 1/4W
A1R84	0757-0738		R: fxd metfilm 1820 ohms 1% 1/4W
A1R85	0757-0339		R: fxd metfilm 3010 ohms 1% 1/4W
A1R86			Not assigned
A1R87	0757-0726		R: fxd metfilm 511 ohms 1% 1/4W
A1R88	0757-0721		R: fxd metfilm 274 ohms 1% 1/4W
A1R89	0698-3438		R: fxd metfilm 147 ohms 1% 1/8W
A1R90	0757-1097		R: fxd metfilm 1200 ohms 1% 1/8W
A1R91	0757-0273		R: fxd metfilm 3010 ohms 1% 1/8W
A1R92	0757-0737		R: fxd metfilm 1620 ohms 1% 1/4W
A1R93			Not assigned
A1R94	0758-0024		R: fxd metfilm 100 ohms 5% 1/4W
A1R95	0758-0024		R: fxd metfilm 100 ohms 5% 1/4W
A1R96	0698-5884		R: fxd metfilm 22 ohms 5% 1/4W
A1R97	0758-0003		R: fxd metfilm 1000 ohms 5% 1/4W
A1R98	0757-0726		R: fxd metfilm 511 ohms 1% 1/4W
A1R99	0757-0726		R: fxd metfilm 511 ohms 1% 1/4W
A1R100	0758-0033		R: fxd metfilm 2000 ohms 5% 1/4W
A1R101	0758-0094		R: fxd metfilm 62 ohms 5% 1/4W

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
A1R102	0757-0354		R: fxd metflm 3650 ohms 1% 1/4W
A1R103	0757-0354		R: fxd metflm 3650 ohms 1% 1/4W
A1R104	0757-0283		R: fxd metflm 2000 ohms 1% 1/8W
A1R105	0758-0080		R: fxd metflm 75 ohms 5% 1/4W
A1R106	0758-0030		R: fxd metflm 510 ohms 5% 1/4W
A1R107	0757-1097		R: fxd metflm 1200 ohms 1% 1/8W
A1R108	0758-0070		R: fxd metflm 1200 ohms 5% 1/4W
A1R109	0757-0433		R: fxd metflm 3320 ohms 1% 1/8W
A1R110	0758-0003		R: fxd metflm 1000 ohms 5% 1/4W
A1R111	0758-0010		R: fxd metflm 3300 ohms 5% 1/4W
A1R112	0758-0045		R: fxd metflm 3900 ohms 5% 1/4W
A1R113	0758-0033		R: fxd metflm 2000 ohms 5% 1/4W
A1R114	0758-0003		R: fxd metflm 1000 ohms 5% 1/4W
A1R115	0758-0006		R: fxd metflm 10k ohms 5% 1/4W
A1R116	0698-5887		R: fxd metflm 30 ohms 5% 1/4W
A1R117	0758-0094		R: fxd metflm 62 ohms 5% 1/4W
A1R118	0758-0126		R: fxd metflm 51 ohms 5% 1/4W
A1R119	0698-5886		R: fxd metflm 27 ohms 5% 1/4W
A1R120	0758-0062		R: fxd metflm 200 ohms 5% 1/4W
A1R121	0758-0003		R: fxd metflm 1000 ohms 5% 1/4W
A1R122	0698-5887		R: fxd metflm 30 ohms 5% 1/4W
A1R123	0758-0005		R: fxd metflm 4700 ohms 5% 1/4W
A1R124	0758-0126		R: fxd metflm 51 ohms 5% 1/4W (*)
A1R125	0757-0894		R: fxd flm 56 ohms 2% 1/8W
A1R126	0757-0280		R: fxd metflm 1000 ohms 1% 1/8W
A1R127	0757-0894		R: fxd flm 56 ohms 2% 1/8W
A1R165	0760-0027		R: fxd metflm 150 ohms 2% 1W
A1R166	0760-0027		R: fxd metflm 150 ohms 2% 1W
A1R167	0761-0046		R: fxd metox 110 ohms 5% 1W
A1R168	0761-0046		R: fxd metox 110 ohms 5% 1W
A1S1	3101-0070		S: Slide dpdt
A1S2	3101-0070		S: Slide dpdt
A1S3	3101-0070		S: Slide dpdt
A2	08003-63401		A: attenuator assembly
A2R1	0757-0172		R: fxd metflm 37.4 ohms 1% 1/2W
A2R2	0757-0801		R: fxd metflm 150 ohms 1% 1/2W
A2R3	0757-0801		R: fxd metflm 150 ohms 1% 1/2W
A2R4	0757-0069		R: fxd metflm 121 ohms 1% 1/4W
A2R5	0757-0795		R: fxd metflm 75 ohms 1% 1/2W

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
A2R6	0757-0795		R: fxd metflm 75 ohms 1% 1/2W
A2R7	0757-0071		R: fxd metflm 247.5 ohms 1% 1/4W
A2R8	0757-1005		R: fxd metflm 61.11 ohms 1% 1/2W
A1R9	0757-1005		R: fxd metflm 61.11 ohms 1% 1/2W
A2S1	5060-1749		S: rotary
A3	08003-63401		A: Attenuator assembly
A3R1	0757-0172		R: fxd metflm 37.4 ohms 1% 1/2W
A3R2	0757-0801		R: metflm 150 ohms 1% 1/2W
A3R3	0757-0801		R: metflm 150 ohms 1% 1/2W
A3R4	0757-0069		R: metflm 121 ohms 1% 1/4W
A3R5	0757-0795		R: metflm 75 ohms 1% 1/2W
A3R6	0757-0795		R: metflm 75 ohms 1% 1/2W
A3R7	0757-0071		R: metflm 247.5 ohms 1% 1/4W
A3R8	0757-1005		R: metflm 61.11 ohms 1% 1/2W
A3R9	0757-1005		R: metlfm 61.11 ohms 1% 1/2W
A3S1	5060-1749		S: rotary
A4	08003-61902		A: switch assy:PULSE WIDTH (includes R2, R6 R7) and S6
A5	08003-61901		A: switch assy: REP RATE (includes R3 and S4)
C1	0180-0353		C: fxd elect alum 450 uF 50 wVdc
C2	0180-0353		C: fxd elect alum 450 uF 50 wVdc
C3	0160-3801		C: fxd cer 5000 pF 20% 3K wVdc
C4	0160-3801		C: fxd cer 5000 pF 20% 3K wVdc
DS1	1450-0106		DS: neon lamp (part of S1)
E1	0340-0162		EQ: insulator, transistor Q1
E2	0340-0162		EQ: insulator, transistor Q2
F1	2110-0008		F: cartridge 1/2A s-b (115V line)
	2110-0018		F: cartridge 1/4A s-b (230V line)
J1	1251-2357		J: connector AC power (1101A only)
J1	1251-0148		J: connector AC power
J2	1250-0140		J: BNC (+ OUTPUT 50 ohms)
J3	1250-0083		J: BNC (TRIGGER OUTPUT)
J4	1250-0140		J: BNC (– OUTPUT 50 ohms)
J5	1250-0083		J: BNC (GATE INPUT)
J6	1250-0083		J: BNC (TRIGGER INPUT)

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

Ref Desig	HP Part No.	TQ	Description (Refer to Table 6-1.)
MP1	0370-0099		MP: knob (REP RATE)
MP2	0370-0134		MP: knob (REP RATE VERNIER)
MP3	0370-0077		MP: knob (AMPLITUDE)
MP4	0370-0077		MP: knob (AMPLITUDE)
MP5	0370-0084		MP: knob (AMPLITUDE VERNIER)
MP6	0370-0084		MP: knob (AMPLITUDE VERNIER)
MP7	0370-0099		MP: knob (PULSE WIDTH)
MP8	0370-0134		MP: knob (PULSE WIDTH VERNIER)
MP9	08003-00210		MP: panel, front
MP10	1490-0032		MP: stand, tilt
MP11	5060-0728		MP: foot assembly, half module
MP12	08003-00208		MP: panel, rear (1101A only)
MP12	08003-00202		MP: panel, rear
MP13	7100-0389		MP: cover transformer
MP14	08003-00601		MP: heat sink, shield
MP15	5060-0720		MP: cover, top (1101A only)
MP15	5060-0718		MP: cover, top
MP16	5000-0717		MP: cover, bottom
MP17	5000-0567		MP: cover, side (perforated)
Q1	1854-0072		Q: Si npn 2N3054
Q2	1854-0072		Q: Si npn 2N3054
R1	0758-0049		R: fxd metflm 33k ohms 5% 1/4W
R2	0698-6802		R: fxd metflm 10 ohms 5% 1/8W
R3	2100-2684		R: var 100k ohms 10%
R4	2100-0036		R: var comp 1000 ohms 20% 1/2W
R5	2100-0036		R: var comp 1000 ohms 20% 1/2W
R6	2100-2683		R: var 100k ohms 10%
R7	0757-0428		R: fxd metflm 1620 ohms 1% 1/8W
S1	3101-0100		S: pushbutton spdt, (line)(includes DS1)
S2	3101-1234		S: slide dpdt (line voltage select) (1101A only)
S2	3101-0033		S: slide dpdt (line voltage select)
S3	3101-0124		S: pushbutton spst (MANUAL)
S4	3100-0511		S: rotary
S5	3101-0903		S: slide dpdt (GATE/NORMAL) (1101A only)
S5	3101-0011		S: slide dpdt (GATED/NORMAL)
S6	3101-0512		S: rotary
T1	9100-0525		T: power
W1	8120-0100		W: cable, AC power 7.5 feet long (SCHUKO PLUG)
W2	8120-0078		W: cable, AC power 7.5 feet long (SCHUKO PLUG)
W2	8120-1545		W: cable, AC power (1101A only)
XF1	1400-0084		XF: fuse holder

TABLE 6-3.
CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

Code No.	Manufacturer	Address
00000	U.S.A. Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N.Y.
00287	Cemco Inc.	Danielson, Conn.
00334	Humidial	Colton, Calif.
00348	Microiron Co., Inc.	Valley Stream, N.Y.
00373	Gudeck Inc.	Cherry Hill, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp. Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Co., Pickens Div.	Pickens, S.C.
00866	Gen Engineering Co.	City of Industry, Cal.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
00929	Microlab Inc.	Livingston, N.J.
01002	General Electric Co., Capacitor Dept.	Hudson Falls, N.Y.
01069	Alden Products Co.	Brockton, Mass.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	TRW Semiconductors, Inc.	Lawndale, Calif.
01295	Texas Instruments, Inc., Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01930	Amerock Corp.	Rockford, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferrocube Corp. of America	Saugerties, N.Y.
02116	Wheelock Signals, Inc.	Long Branch, N.J.
02286	Cole Rubber and Plastics Inc.	Sunnyvale, Calif.
02660	Amphenol-Borg Electronics Corp.	Chicago, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
03508	G.E. Semiconductor Prod. Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	Compton, Calif.
03818	Parker Seal Co.	Los Angeles, Calif.
03877	Transitron Electric Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, N.J.
03954	Singer Co., Diehl Div. Finderne Plant	Somerville, N.J.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Taurus Corp.	Lambertville, N.J.
04062	Arco Electronic Inc.	Great Neck, N.Y.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04354	Precision Paper Tube Co.	Wheeling, Ill.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Products, Microwave Device Div.	Mountain View, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc. Western Div.	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Ill.
04796	Sequoia Wire Co.	Redwood City, Calif.
04811	Precision Coil Spring Co.	El Monte, Calif.
04870	P.M. Motor Company	Westchester, Ill.
04919	Component Mfg. Service Co.	W. Bridgewater, Mass.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05277	Westinghouse Electric Corp. Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05397	Union Carbide Corp., Linde Div., Kemet Dept.	Cleveland, Ohio
05574	Viking Ind. Inc.	Canoga Park, Calif.
05593	Illuminonic Engineering Co.	Sunnyvale, Calif.
05616	Cosmo Plastic (c/o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.
05729	Metro-Tel Corp.	Westbury, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	Bassick Co., Div. of Stewart Warner Corp.	Bridgeport, Conn.
06090	Raychem Corp.	Redwood City, Calif.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E.T.A. Products Co. of America	Chicago, Ill.
06540	Amatom Electronic Hardware Co., Inc.	New Rochelle, N.Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06666	General Devices Co., Inc.	Indianapolis, Ind.
06751	Semcor Div. Components Inc.	Phoenix, Ariz.
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
06980	Varian Assoc. Eimac Div.	San Carlos, Calif.
07088	Kelvin Electric Co.	Van Nuys, Calif.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.
07149	Fulmohm Corp.	New York, N.Y.
07233	Cinch-Graphik Co.	City of Industry, Calif.
07256	Silicon Transistor Corp.	Carle Place, N.Y.
07261	Avnet Corp.	Culver City, Calif.
07263	Fairchild Camera & Inst. Corp. Semiconductor Div.	Mountain View, Calif.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	Bitcher Corp., The	Monterey Park, Calif.
07397	Sylvania Elect. Prod. Inc., Ml. View Operations	Mountain View, Calif.
07700	Technical Wire Products Inc.	Cranford, N.J.
07829	Bodine Elect. Co.	Chicago, Ill.
07910	Continental Device Corp	Hawthorne, Calif.
07933	Raytheon Mfg. Co., Semiconductor Div.	Mountain View, Calif.
07980	Hewlett-Packard Co., Boonton Radio Div.	Rockaway, N.J.
08145	U.S. Engineering Co.	Los Angeles, Calif.
08289	Bliss, Dalbert Co.	Pomona, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada
08524	Dzus Fastener Corp.	Los Angeles, Calif.
08664	Bristol Co., The	Waterbury, Conn.
08717	Sloan Company	Sun Valley, Calif.
08718	ITT Cannon Electric Inc., Phoenix Div.	Phoenix, Arizona
08727	National Radio Lab. Inc.	Paramus, N.J.
08792	CBS Electronics Semiconductor Operations, Div of C.B.S. Inc.	Lowell, Mass.
08984	Mal-Rain	Indianapolis, Ind.
09026	Babcock Relays Div.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Tech. Ind. Inc. Alpha Elect.	Burbank, Calif.
09250	Electro Assemblies, Inc.	Chicago, Ill.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
10214	General Transistor Western Corp.	Los Angeles, Calif.
10611	Ti-Tal, Inc.	Berkeley, Calif.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.
11242	Bay State Electronics Corp.	Waltham, Mass.
11312	Teledyne Inc., Microwave Div.	Palo Alto, Calif.
11314	National Seal	Downey, Calif.
11534	Duncan Electronics Inc.	Costa Mesa, Calif.
11711	General Instrument Corp., Semiconductor Div., Products Group	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12136	Philadelphia Handle Co.	Camden, N.J.
12361	Grove Mfg. Co., Inc.	Shady Grove, Pa.
12574	Gulton Ind. Inc. Data System Div.	Albuquerque, N.M.
12697	Clarostat Mfg. Co.	Dover, N.H.
12728	Elmar Filter Corp.	W. Haven, Conn.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12881	Metex Electronics Corp.	Clark, N.J.
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
12954	Dickson Electronics Corp.	Scottsdale, Arizona
13103	Thermalloy	Dallas, Texas
13396	Telefunken (GmbH)	Hanover, Germany
13835	Midland-Wright Div. of Pacific Industries, Inc.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Calif.
14193	Calif. Resistor Corp.	Santa Monica, Calif.
14298	American Components, Inc.	Conshohocken, Pa.
14433	ITT Semiconductor, A Div. of Int. Telephone & Telegraph Corp.	West Palm Beach, Fla.
14493	Hewlett-Packard Company	Loveland, Colo.
14655	Cornell Dubilier Electric Corp.	Newark, N.J.
14674	Corning Glass Works	Corning, N.Y.
14752	Electro Cube Inc.	San Gabriel, Calif.
14936	Williams Mfg. Co.	San Jose, Calif.
15203	Webster Electronics Co.	New York, N.Y.
15287	Sciemics Corp.	Northridge, Calif.
15291	Adjustable Bushing Co.	N. Hollywood, Calif.
15555	Micron Electronics	Garden City, Long Island, N.Y.
15566	Amphe Inst. Corp.	Lynbrook, N.Y.
15631	Cabletronics	Costa Mesa, Calif.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Calif.
15801	Fenwal Elect. Inc.	Framingham, Mass.
15818	Ameico Inc.	Mt. View, Calif.
16037	Spruce Pine Mica Co.	Spruce Pine, N.C.
16179	Omni-Spectra Inc.	Detroit, Ill.
16352	Computer Diode Corp.	Lodi, N.J.
16688	Ideal Prec. Meter Co., Inc. De Jur Meter Div.	Brooklyn, N.Y.
16758	Delco Radio Div. of G.M. Corp.	Kokomo, Ind.
17109	Thermonetics Inc.	Canoga Park, Calif.
17474	Trones Company	Mountain View, Calif.
17675	Hamlin Metal Products Corp.	Ahren, Ohio
17745	Angstrohm Prec. Inc.	No. Hollywood, Calif.
17870	McGraw-Edison Co.	Manchester, N.H.
18042	Power Design Pacific Inc.	Palo Alto, Calif.
18082	Clevite Corp., Semiconductor Div.	Palo Alto, Calif.
18324	Signetics Corp.	Sunnyvale, Calif.
18476	Ty-Car Mfg. Co., Inc.	Hollliston, Mass.
18486	TRW Elect. Comp. Div.	Des Plaines, Ill.
18583	Curtis Instrument, Inc.	Mt. Kisco, N.Y.
18612	Vishay Intertechnology, Inc.	Malvern, Pa.
18873	E.I. DuPont and Co., Inc.	Wilmington, Del.
18911	Durant Mfg. Co.	Milwaukee, Wis.
19315	The Bendix Corp., Navigation & Control Div.	Teterboro, N.J.

From: FSC. Handbook Supplements
H4-1 Dated AUGUST 1966
H4-2 Dated NOV. 1962

TABLE 6-3.
CODE LIST OF MANUFACTURERS (Cont'd)

Code No.	Manufacturer	Address
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.
19589	Caneco	Baldwin Park, Calif.
19644	LRC Electronics	Horseheads, N.Y.
19701	Electra Mfg. Co.	Independence, Kansas
20183	General Atronics Corp.	Philadelphia, Pa.
21226	Executone, Inc.	Long Island City, N.Y.
21335	Fafnir Bearing Co., The	New Britain, Conn.
21520	Fansteel Metallurgical Corp.	N. Chicago, Ill.
23783	British Radio Electronics Ltd.	Washington, D.C.
24455	G.E. Lamp Division	Nela Park, Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
24681	Mencer Inc., Comp. Div.	Huntington, Ind.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.
26851	Compac/Hollister Co.	Hollister, Calif.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
28520	Heyman Mfg. Co.	Kenilworth, N.J.
30817	Instrument Specialties Co., Inc.	Little Falls, N.J.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Coil Products Ltd.	Hawkesbury, Ontario, Canada
36287	Cunningham, W.H. & Hill, Ltd.	Toronto Ontario, Canada
37942	P.R. Mallory & Co. Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43950	C.A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
46384	Penn Eng. & Mfg. Corp.	Doylestown, Pa.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer & Inst. Co.	Southampton, Pa.
49956	Microwave & Power Tube Div.	Waltham, Mass.
52050	Rowan Controller Co.	Westminster, Md.
52983	Sanborn Company	Waltham, Mass.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Raytheon Co. Commercial Apparatus & Systems Div.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
59446	Telex Corp.	Tulsa, Okla.
59730	Thomas & Betts Co.	Elizabeth, N.J.
60741	Triplett Electrical Inst. Co.	Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Pittsburgh, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Inc. Weston-Newark	Newark, N.J.
66295	Willek Mfg. Co.	Chicago, Ill.
66346	Minnesota Mining & Mfg. Co. Revere Miacom Div.	St. Paul, Minn.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control	New York, N.Y.
70318	Allmetal Screw Product Co., Inc.	Garden City, N.Y.
70417	Amplex, Div. of Chrysler Corp.	Detroit, Mich.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	Union City, N.J.
70674	ADC Products Inc.	Minneapolis, Minn.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71034	Birley Electric Co., Inc.	Erie, Pa.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio, Inc.	Willoughby, Ohio
71279	Cambridge Thermionics Corp.	Cambridge, Mass.
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Cardwell Condenser Corp.	Lindenhurst L.I., N.Y.
71400	Bussmann Mfg. Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Ill
71447	Calif. Spring Co., Inc.	Pico-Rivera, Calif.
71450	CTS Corp.	Elkhart, Ind.
71468	ITT Cannon Electric Inc.	Los Angeles, Calif.
71471	Cinema, Div. Aerovox Corp.	Burbank, Calif.
71482	C.P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71700	Cornish Wire Co., The	New York, N.Y.
71707	Cole Coil Co., Inc.	Providence, R.I.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71785	Cinch Mfg. Co., Howard B. Jones Div.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	Indiana General Corp., Electronics Div.	Keasby, N.J.
72699	General Instrument Corp., Cap. Div.	Newark, N.J.
72765	Drake Mfg. Co.	Harwood Heights, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72962	Elastic Stop Nut Corp.	Union, N.J.
72964	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Technological Products, Inc.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	H.M. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Inst., Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Elect Co.	Hicksville, L.I., N.Y.
73506	Bradley Semiconductor Corp.	New Haven, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73586	Circle F Mfg. Co.	Trenton, N.J.
73682	George K. Garrett Co., Div. MSL Industries Inc.	Philadelphia, Pa.
73734	Federal Screw Products Inc.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	General Industries Co., The	Elyria, Ohio
73846	Goshen Stamping & Tool Co.	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N.Y.
73905	Jennings Radio Mfg. Corp.	San Jose, Calif.
73957	Groov-Pin Corp.	Ridgefield, N.J.
74276	Signalite Inc.	Neptune, N.J.
74455	J.H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75263	Keystone Carbon Co., Inc.	St. Marys, Pa.
75378	CTS Knights Inc.	Sandwich, Ill.
75382	Kulka Electric Co poration	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg Co.	Chicago, Ill.
75915	Littlefuse, Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Calif.
76433	General Instrument Corp., Micamold Division	Newark, N.J.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Calif.
76530	Cinch-Monadnock, Div. of United Carr Fastener Corp.	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio
76703	National Union	Newark, N.J.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	The Bendix Corp., Electrodynamics Div.	N. Hollywood, Calif.
77075	Pacific Metals Co.	San Francisco, Calif.
77221	Phaostron Instrument and Electronic Co.	South Pasadena, Calif.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	American Machine & Foundry Co. Potter & Brumfield Div.	Princeton, Ind.
77630	TRW Electronic Components Div.	Camden, N.J.
77638	General Instrument Corp., Rectifier Div.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78277	Sigma	So. Braintree, Mass.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.
78452	Thompson-Bremer & Co.	Chicago, Ill.
78471	Tilley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	San Gabriel, Calif.
78947	Uclaite Co.	Newtonville, Mass.
79136	Walden Kohinoor Inc.	Long Island City, N.Y.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80120	Schnitzer Alloy Products Co.	Elizabeth, N.J.
80131	Electronic Industries Association. Any brand Tube meeting EIA Standards-Washington, DC.	
80207	Unimax Switch, Div. Maxon Electronics Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Inc.	Riverside, Calif.
80411	Acro Div. of Robertshaw Controls Co.	Columbus, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Label Co.	Monrovia, Calif.
80583	Hammarlund Co., Inc.	New York, N.Y.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
80813	Dimco Gray Co.	Dayton, Ohio
81030	International Instruments Inc.	Orange, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Calif.
81312	Winchester Elec. Div. Litton Ind., Inc.	Oakville, Conn.
81349	Military Specification	. . . . .
81483	International Rectifier Corp.	El Segundo, Calif.
81541	Airpax Electronics, Inc.	Cambridge, Maryland
81860	Barry Controls, Div. Barry Wright Corp.	Watertown, Mass.
82042	Carter Precision Electric Co.	Skokie, Ill.

From: FSC. Handbook Supplements
H4-1 Dated AUGUST 1966
H4-2 Dated NOV. 1962

TABLE 6-3.
CODE LIST OF MANUFACTURERS (Cont'd)

Code No.	Manufacturer	Address
82047	Sperti Faraday Inc., Copper Hewitt Electric Div.	Hoboken, N.J.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Fairchild Camera & Inst. Corp. Space & Defense System Div.	Paramus, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Division	Emporium, Pa.
82376	Astron Corp.	East Newark, Harrison, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals & Controls Inc. Spencer Products	Attleboro, Mass.
82768	Phillips-Advance Control Co.	Joliet, Ill.
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Mfg. Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.
83066	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.
83125	General Instrument Corp., Capacitor Div.	Darlington, S.C.
83148	ITT Wire and Cable Div.	Los Angeles, Calif.
83186	Victory Eng. Corp.	Springfield, N.J.
83298	Bendix Corp., Red Bank Div.	Red Bank, N.J.
83315	Hubbell Corp.	Mundelein, Ill.
83324	Rosan Inc.	Newport Beach, Calif.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.
83332	Tech Labs	Palisade's Park, N.J.
83385	Central Screw Co.	Chicago, Ill.
83501	Gavitt Wire and Cable Co. Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp. Electronic Tube Div.	Plainfield, N.J.
83740	Union Carbide Corp. Consumer Prod. Div.	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
83942	Aeronautical Inst. & Radio Co.	Lodi, N.J.
84171	Arco Electronics Inc.	Great Neck, N.Y.
84396	A.J. Glesener Co., Inc.	San Francisco, Calif.
84411	TRW Capacitor Div.	Ogallala, Neb.
84970	Sarkes Tarzian, Inc.	Bloomington, Ind.
85454	Boonton Molding Company	Boonton, N.J.
85471	A.B. Boyd Co.	San Francisco, Calif.
85474	R.M. Bracamonte & Co.	San Francisco, Calif.
85660	Kulka Kords, Inc.	Hamden, Conn.
85911	Seamless Rubber Co.	Chicago, Ill.
86197	Clifton Precision Products Co., Inc.	Clifton Heights, Pa.
86579	Precision Rubber Products Corp.	Dayton, Ohio
86684	Radio Corp. of America, Electronic Comp. & Devices Div.	Harrison, N.J.
87034	Maico Industries	Anaheim, Calif.
87216	Philco Corporation (Lansdale Division)	Lansdale, Pa.
87473	Western Fibrous Glass Products Co.	San Francisco, Calif.
87664	Van Waters & Rogers Inc.	San Francisco, Calif.
87930	Tower Mfg. Corp.	Providence, R.I.
88140	Cutler-Hammer, Inc.	Lincoln, Ill.
88220	Gould-National Batteries, Inc.	St. Paul, Minn.
88698	General Mills, Inc.	Buffalo, N.Y.
89231	Graybar Electric Co.	Oakland, Calif.
89473	G.E. Distributing Corp.	Schenectady, N.Y.
89665	United Transformer Co.	Chicago, Ill.
90030	United Shoe Machinery Corp.	Beverly, Mass.
90179	US Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.
90970	Bearing Engineering Co.	San Francisco, Calif.
91146	ITT Cannon Elect, Inc., Salem Div.	Salem, Mass.
91260	Conner Spring Mfg. Co.	San Francisco, Calif.
91345	Miller Dial & Nameplate Co.	El Monte, Calif.
91418	Radio Materials Co.	Chicago, Ill.
91506	Augat Inc.	Attleboro, Mass.
91637	Dale Electronics, Inc.	Columbus, Nebr.
91662	Elco Corp.	Willow Grove, Pa.
91737	Gremar Mfg. Co., Inc.	Wakefield, Mass.
91827	K F Development Co.	Redwood City, Calif.
91886	Maico Mfg. Co., Inc.	Chicago, Ill.
91929	Honeywell Inc., Micro Switch Div.	Freeport, Ill.
91961	Hahn-Dies. Spring Co.	Oakland, Calif.
92180	Tru-Connector Corp.	Peabody, Mass.
92367	Electro Optical Co. Inc.	Rochester, N.Y.
92607	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
92702	IMC Magnetics Corp.	Westbury Long Island, N.Y.
92866	Hudson Lamp Co.	Kearney, N.J.
93332	Sylvania Electric Prod. Inc. Semiconductor Div.	Woburn, Mass.
93369	Robbins & Myers Inc.	Palisades Park, N.J.
93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio
93632	Waters Mfg. Co.	Culver City, Calif.
93929	G.V. Controls	Livingston, N.J.
94137	General Cable Corp.	Bayonne, N.J.
94144	Raytheon Co., Comp. Div., Ind. Comp. Operations	Quincy, Mass.
94148	Scientific Electronics Products, Inc.	Loveland, Colo.
94154	Wagner Elect. Corp., Tung-Sol Div.	Newark, N.J.
94197	Curtiss-Wright Corp. Electronics Div.	East Paterson, N.J.
94222	South Chester Corp.	Chester, Pa.
94330	Wire Cloth Products, Inc.	Bellwood, Ill.
94335	Automatic Metal Products Co.	Brooklyn, N.Y.
94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
94696	Magnecraft Electric Co.	Chicago, Ill.
95023	George A. Philbrick Researchers, Inc.	Boston, Mass.
95236	Allies Products Corp.,	Davie, Fla.
95238	Continental Connector Corp.	Woodside, N.Y.
95263	Leecraft Mfg. Co., Inc.	Long Island, N.Y.
95265	National Coil Co.	Sheridan, Wyo.
95275	Vitramon, Inc	Bridgeport, Conn.
95348	Gordos Corp.	Bloomfield, N.J.
95354	Methode Mfg. Co.	Rolling Meadows, Ill.
95566	Amel. Engineering Co.	Maranga, Ill.
95712	Dage Electric Co., Inc.	Franklin, Ind.
95984	Siemon Mfg. Co.	Wayne, Ill.
95987	Weckesser Co.	Chicago, Ill.
96067	Huggins Laboratories	Sunnyvale, Calif.
96095	Hi-Q Div. of Aerovox Corp.	Olean, N.Y.
96256	Thordarson-Meissner Inc.	Mt. Carmel, Ill.
96296	Solar Manufacturing Co.	Los Angeles, Calif.
96330	Carlton Screw Co.	Chicago, Ill.
96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.
97464	Industrial Retaining Ring Co.	Irvington, N.J.
97539	Automatic & Precision Mfg.	Englewood, N.J.
97979	Resn Resistor Corp.	Yonkers, N.Y.
97983	Litton System Inc., Adler-Westrex Commun. Div.	New Rochelle, N.Y.
98141	R-Tronics, Inc.	Jamaica, N.Y.
98159	Rubber Tech, Inc.	Gardena, Calif.
98220	Hewlett-Packard Co., Moseley Div.	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealectro Corp.	Mamaroneck, N.Y.
98376	Zero Mfg. Co	Burbank, Calif.
98731	General Mills Inc., Electronics Div.	Minneapolis, Minn.
98734	Paeco Div. of Hewlett-Packard Co.	Palo Alto, Calif.
98821	North Hills Electronics, Inc.	Glen Cove, N.Y.
98978	International Electronic Research Corp.	Burbank, Calif.
99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
99378	Atlee Corp.	Winchester, Mass.
99515	Marshall Ind., Capacitor Div.	Monrovia, Calif.
99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99934	Rembrandt, Inc.	Boston, Mass.
99942	Helfman Electronics Corp. Semiconductor Div.	El Monte, Calif.
99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.

THE FOLLOWING HP VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

0000F	Maico Tool and Die	Los Angeles, Calif.
0000Z	Willow Leather Products Corp.	New York, N.J.
000AB	ETA	England
000BB	Precision Instrument Components Co.	Van Nuys, Calif.
000CS	Hewlett-Packard Co., Colorado Springs	Colorado Springs, Colorado
000MM	Rubber Eng. & Development	Hayward, Calif.
000NN	A "N" D Mfg. Co.	San Jose, Calif.
000QQ	Coaltron	Oakland, Calif.
000WW	California Eastern Lab.	Burlingame, Calif.
000YY	S.K. Smith Co.	Los Angeles, Calif.

From: FSC. Handbook Supplements
H4-1 Dated AUGUST 1966
H4-2 Dated NOV 1967

SCHEMATIC DIAGRAMS

SECTION VII
CIRCUIT DIAGRAMS

7-1. INTRODUCTION

7-2. This section contains the circuit diagrams and component location drawings necessary for the maintenance of the Model 8003A. Table 7-1 lists notes which apply to the schematic diagrams. Table 7-2 gives the control settings for typical dc voltages and waveforms, found on the schematics.

7-3. Some switch and circuit board assemblies are shown in part on different pages. To find a specific instrument component, refer to the REFERENCE DESIGNATIONS box which appears on each schematic diagram. Components are designated using a UNIT NUMBERING SYSTEM. The full designation of a component includes the assembly on which the part is mounted and the individual part designation.

Table 7-1. Schematic Diagram Notes

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

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

= Etched circuit board

= Front panel marking

= Rear panel marking

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

P/O = Part of

= Primary signal path

= Feedback path

= Waveform test point (with number)

= Conducting transistor between pulses (shown only for Schmitt Trigger).

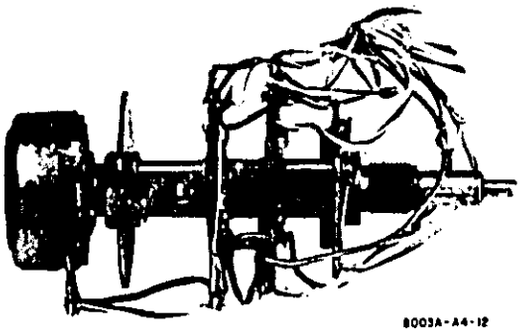
= Avalanche (zener) diode

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

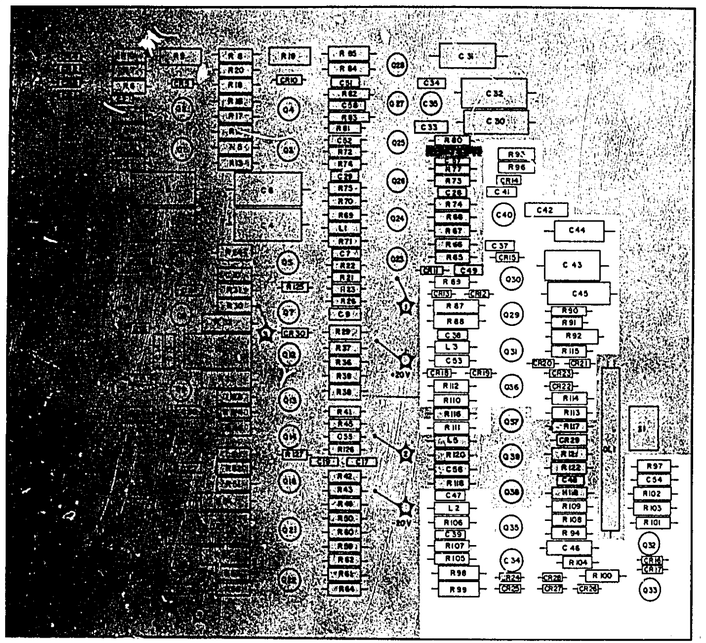
0 - Black	5 - Green
1 - Brown	6 - Blue
2 - Red	7 - Violet
3 - Orange	8 - Gray
4 - Yellow	9 - White

Table 7-2. Control Settings for Checking Waveforms and Tyical DC Voltages

8003A	REP. RATE (Hz)	0. 3 M (Waveforms) Ext.+ (Typical Voltages)	VERNIER (AMPL.+)	cw
			AMPLITUDE (-)	5 V
	VERNIER (R.R.)	ccw	VERNIER (AMPL.-)	cw
	PULSE WIDTH (s)	30 n	OPER. MODE	Normal
	VERNIER (P. WIDTH)	cw	Delay Switch (Internal)	D
	AMPLITUDE (+)	5 V	Termination Switch (Internal)	5 V



Repetition Rate Switch



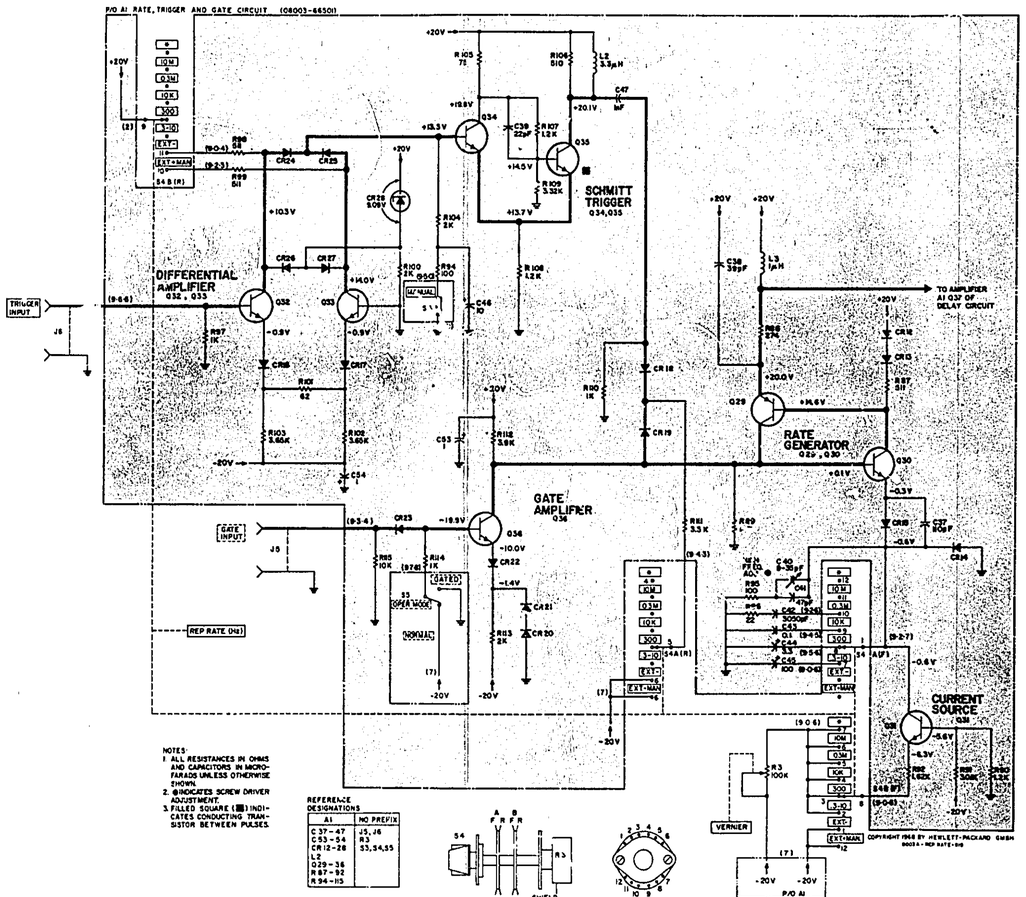
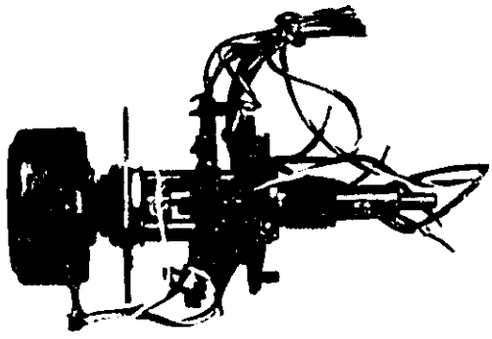
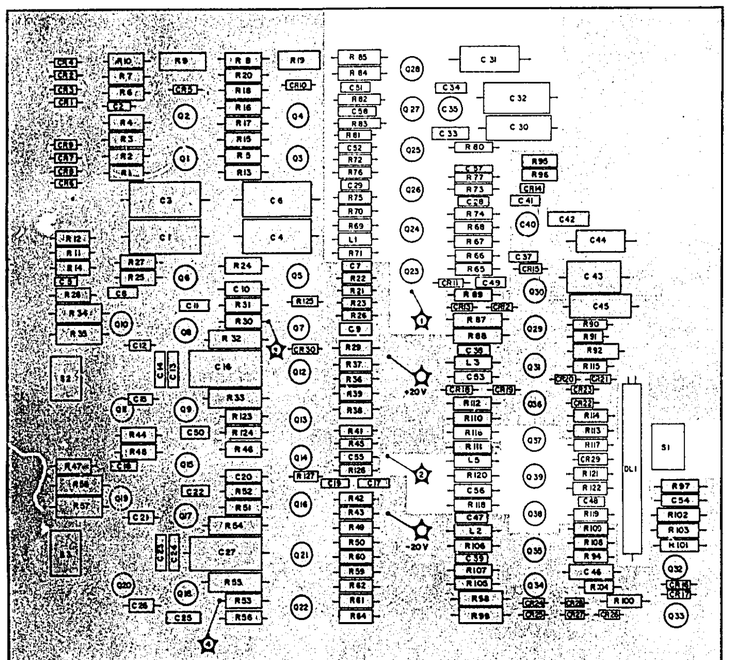
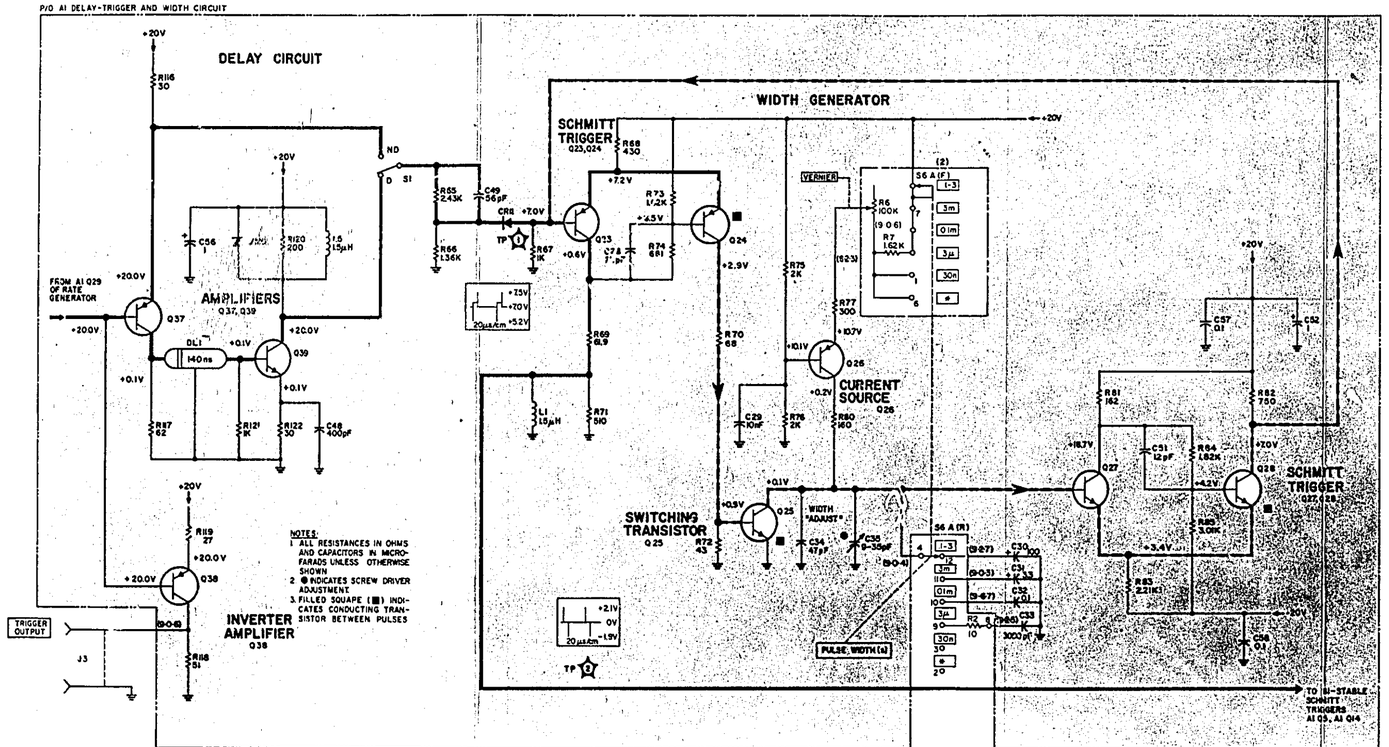


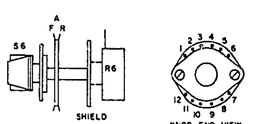
Figure 7-1. Repetition Rate and Gate Circuit



Pulse Width Switch



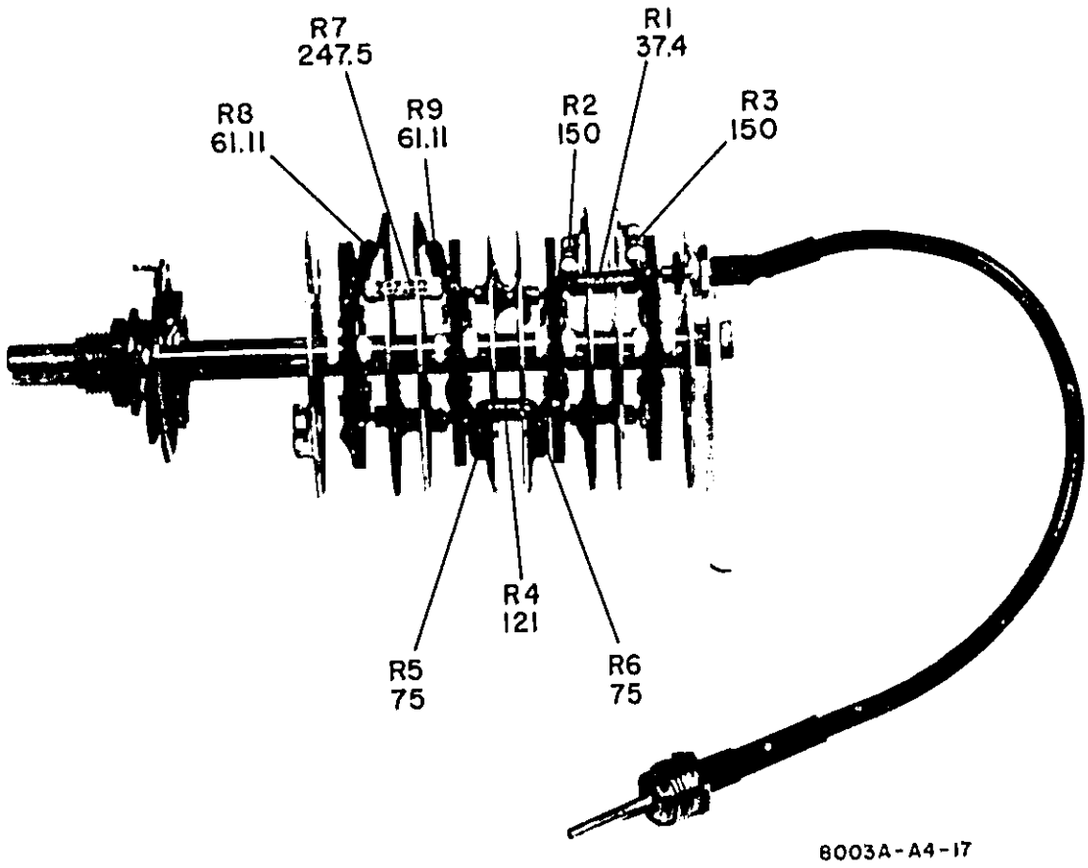




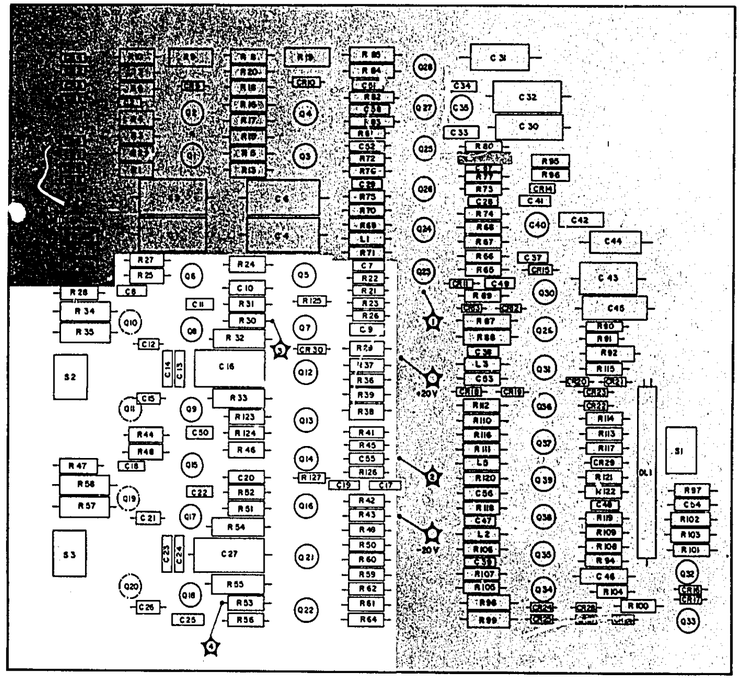
REFERENCE DESIGNATIONS

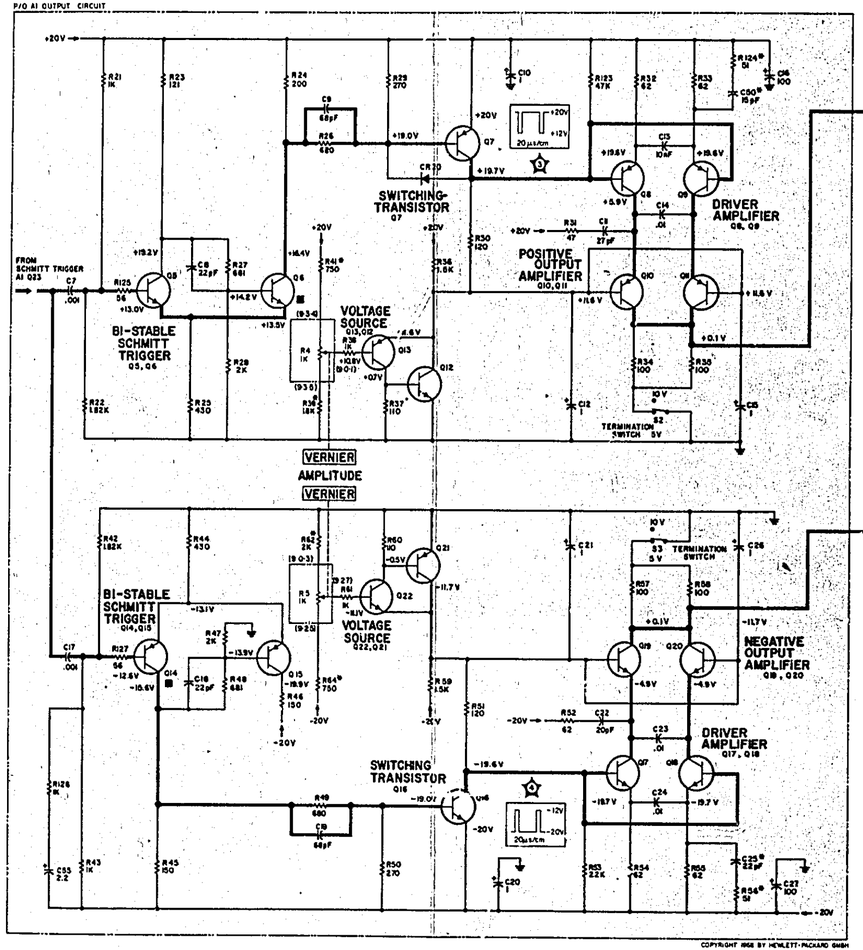
A1	NO PREFIX
C 28 - 29 C 48 - 49 C 51 - 52 C 56 - 58 CR 11, CR 29 DL1 L1, L5 Q 23 - 28 Q 37 - 39 R 65 - 77 R 80 - 85 R 116 - 122 S1	J3 R2, R6, R7

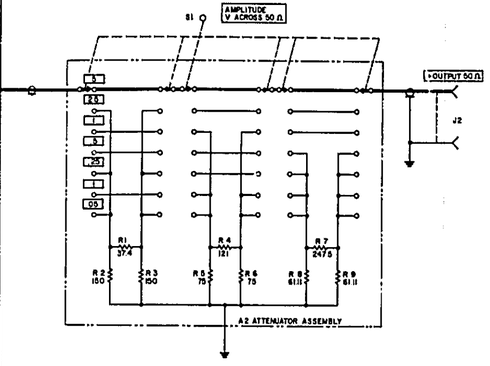
Figure 7-2. Delay, Trigger, and Width Circuit

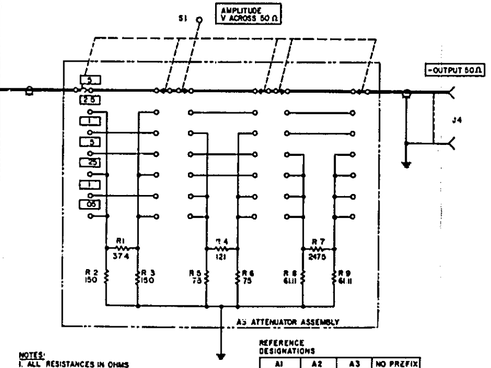


Attenuator A2, A3







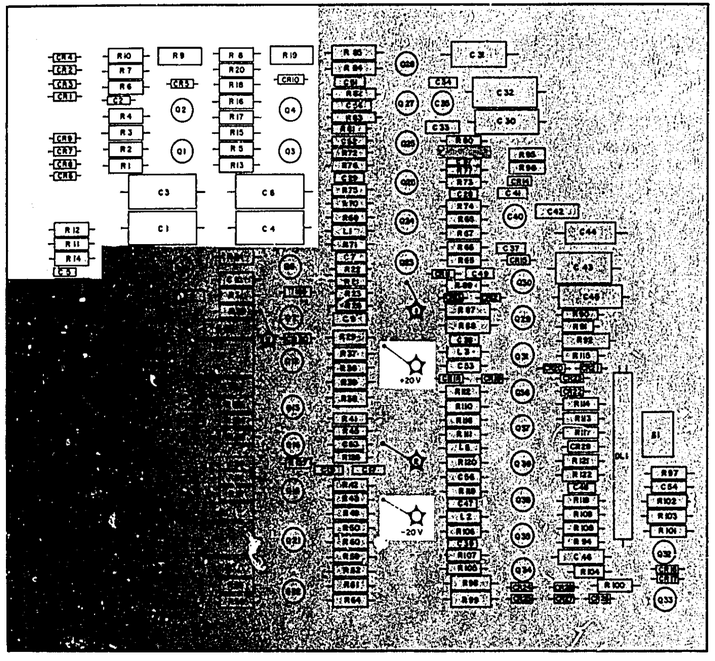


NOTES:
1. ALL RESISTANCES IN OHMS AND CAPACITORS IN MICROFARADS UNLESS OTHERWISE SHOWN.
2. ⊛ INDICATES SCREW DRIVER ADJUSTMENT
3. # FACTORY SELECTED.
4. FILLED SQUARE (■) INDICATES CONDUCTING TRANSISTOR BETWEEN PULSES.

REFERENCE DESIGNATIONS

A1	A2	A3	NO PREFIX
C7-17	R1-9	R1-9	J2, J4
C50, C55	S1	S1	R4, R5
CR 30			
Q5-12			
R21-39			
R41-62			
R64			
S2, S3			

Figure 7-3. Output Circuit



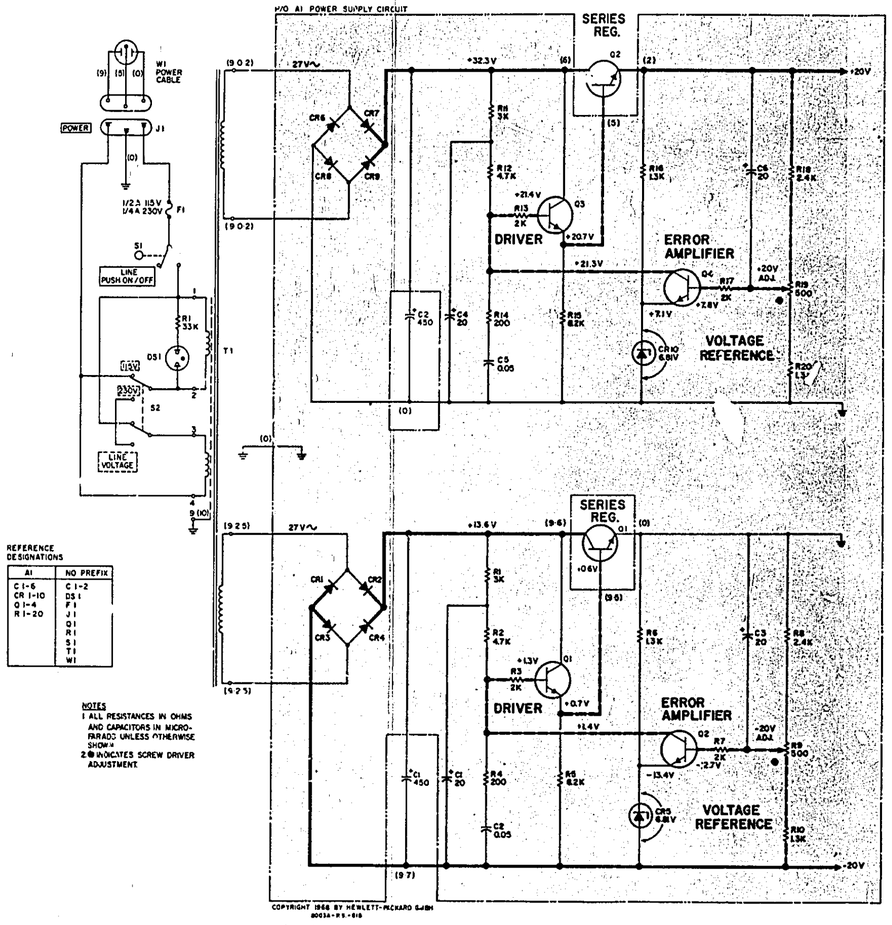
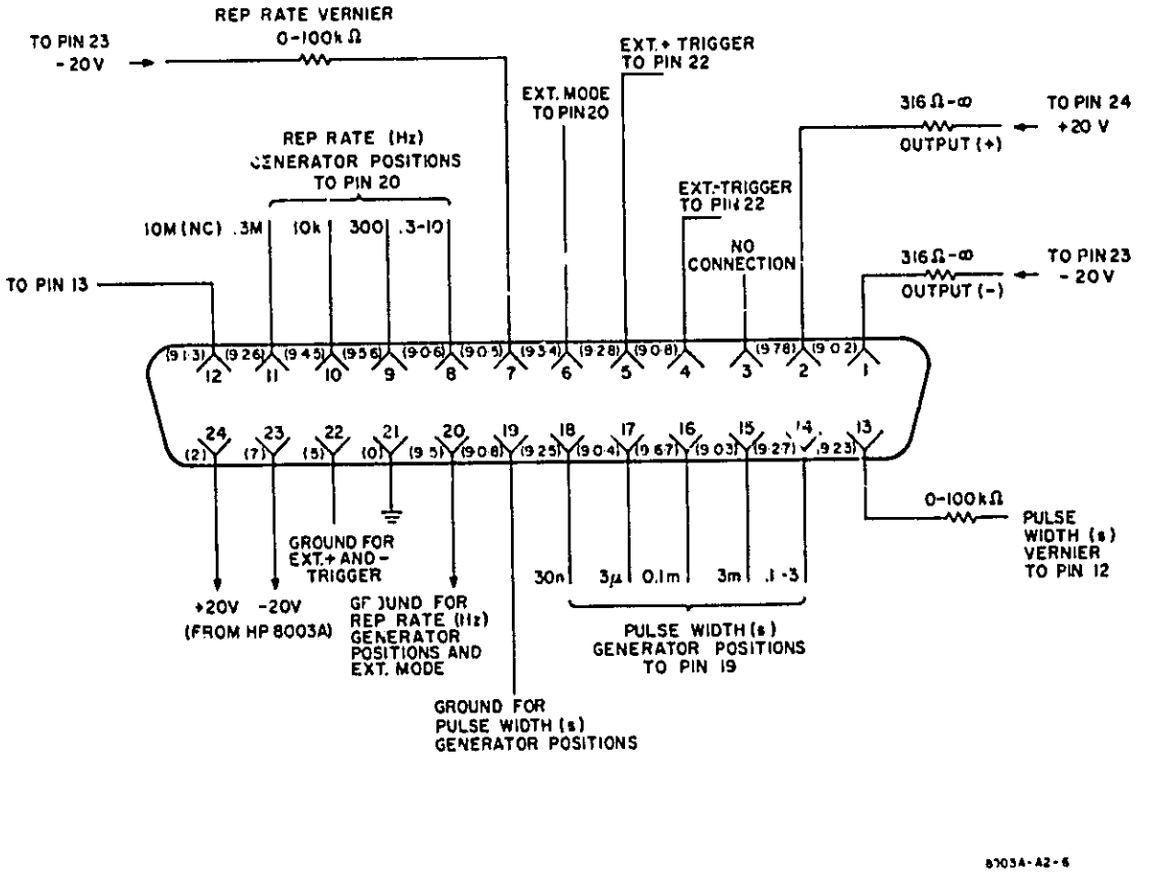


Figure 7-4. Power Supply Circuit

APPENDIX

A



Pin 1 Selected resistance, 316 Ω to ∞, OUTPUT (-).

Pin 2 Selected resistance, 316 Ω to ∞, OUTPUT (+).

Pin 3 No connection.

Pin 4 To be grounded to pin 22 for EXT. - trigger.

Pin 5 To be grounded to pin 22 for EXT. + trigger.

Pin 6 To be grounded to pin 20 when either external mode is used.

Pin 7 Selected resistance, 0 - 100 kΩ for external REP RATE VERNIER Control.

Pin 8 Rep Rate switch positions - Range selected by grounding the appropriate pin to pin 20.

Pin 12 and 13 Variable resistance, 0 - 100 kΩ, connected between these pins to act as external WIDTH VERNIER.

Pin 14 thru 18 WIDTH Switch positions - Range selected by grounding the appropriate pin to pin 19.

Pin 19 Ground connection for WIDTH switch positions.

Pin 20 Ground connection for REP RATE switch positions and EXT. MODE.

Pin 21 Chassis ground.

Pin 22 Ground connection for EXT. + and EXT. - .

Pin 23 Negative 20 V supply from HP 8003A.

Pin 24 Positive 20 V supply from HP 8003A.

Figure A1-1. Pin Identification for Connector J7 (Rear Panel) and its Mating Connector (Wiring Side)

APPENDIX A1
OPTION 01: REMOTE PROGRAMMING

A1-1 INTRODUCTION

A1-2 The HP 8003A Option 01 Pulse Generator provides all the characteristics of the standard HP 8003A besides permitting remote electrical control of the repetition rate, pulse width, and amplitude. The instrument may be wired for a pulse output with fixed characteristics, to a switch and resistance control box for a variable pulse output, or into a system whereby another instrument can program its operation. Remote control of repetition rate and pulse width ranges is accomplished by contact closure, while within the selected range they can be controlled by external resistances. The amplitude is controlled within the range of the attenuator by external resistances.

A1-3 OPERATION

A1-4 For remote programming of the pulse generator, connect the HP 8003A Option 01 as in Table A1-1 for the desired pulse characteristics. For identification of each of the connector pins, refer to Fig. A1-1. Table A1-2 lists the approximate resistances needed for connection to get a desired pulse amplitude with the AMPLITUDE switch set to 5 V. Pin wiring can be connected to a mating connector which plugs into the rear panel connector J7. This mating connector may be ordered from Amphenol Corp. or Cinch Mfg. Co. by order no. 57-30240 or from Hewlett-Packard by order no. 1251-0293. After the appropriate connections have been made, the pulse generator can be controlled electrically by setting the REP. RATE, PULSE WIDTH, and AMPLITUDE VERNIER controls to the asterisk (*) position.

Table A1-1. 8003A Option 01 Connections

For remote programming, make the desired connections through J7 and set 8003A REP RATE (Hz), PULSE WIDTH (s), and AMPLITUDE VERNIER controls to the asterisk (*) position.

Function	Range	Connection
REP RATE (Hz)	Ext. + (positive)	Pin 5 to Pin 22 and Pin 6 to Pin 20
	Ext. - (negative)	Pin 4 to Pin 22 and Pin 6 to Pin 20
	.3 Hz to 10 Hz	Pin 8 to Pin 20
	10 Hz to 300 Hz	Pin 9 to Pin 20
	300 Hz to 10 kHz	Pin 10 to Pin 20
	10 kHz to 0.3 MHz	Pin 11 to Pin 20
	0.3 MHz to 10 MHz	No Connection
VERNIER, R.R.	Variable within each REP. RATE range.	Pin 7 through resistance* (0 - 100 kΩ) to Pin 23
PULSE WIDTH (s)	30 ns to 3 μs	Pin 18 to Pin 19
	3 μs to 0.1 ms	Pin 17 to Pin 19
	0.1 ms to 3 ms	Pin 16 to Pin 19
	3 ms to .1 s	Pin 15 to Pin 19
	.1 s to 3 s	Pin 14 to Pin 19
VERNIER, P.W.	Variable within each PULSE WIDTH range	Pin 13 through resistance* (0 - 100 kΩ) to Pin 12
VERNIER AMPLITUDE OUTPUT (+)	+0.5 V to +5 V	Pin 2 through resistance* (316 Ω - ∞) to Pin 24 (AMPL. VERNIER R4 fully cw)
VERNIER AMPLITUDE OUTPUT (-)	-0.5 V to -5 V	Pin 1 through resistance* (316 Ω - ∞) to Pin 23 (AMPL. VERNIER R5 fully cw)

* A fixed or a variable resistor may be used for the verniers. For AMPLITUDE VERNIERS the approximate resistance is given for a desired pulse amplitude in Table A1-2.

Table A1-2. Resistance For Output Amplitude with Amplitude Switch Set To 5 V

PULSE AMPLITUDE	Selectable Resistance ± 20%
5.0 V	∞ (open)
4.5 V	9.1 kΩ
4.0 V	4.7 kΩ
3.5 V	2.7 kΩ
3.0 V	1.8 kΩ
2.5 V	1.3 kΩ
2.0 V	910 Ω
1.5 V	680 Ω
1.0 V	470 Ω
0.5 V	316 Ω

A1-5 PRINCIPLES OF OPERATION

A1-6 The internally triggered repetition rate range, external triggering, and pulse width range are electrically controlled by grounding the resistor at the base of a switching transistor which turns on the transistor and connects its related circuitry. The resistor at the transistor base is grounded by connecting the appropriate pins of connector J7 as shown in Table A1-1.

A1-7 The repetition rate vernier, pulse width vernier, and amplitude vernier are electrically controlled by connecting a variable or fixed resistance into its respective circuit through one connector J7 pin and supplying it with its necessary supply voltage through another connector J7 pin. For continuous control use a potentiometer; for a fixed or stepped control use fixed resistors.

A1-8 In all other respects the circuits function exactly as described in Section IV of this manual. The internal connections and circuits associated with remote programming may be seen in the circuit diagrams. Refer to Figures A1-2, A1-3, and A1-4. The circuit diagram for the Option 01 power supply may be seen in Figure 7-4.

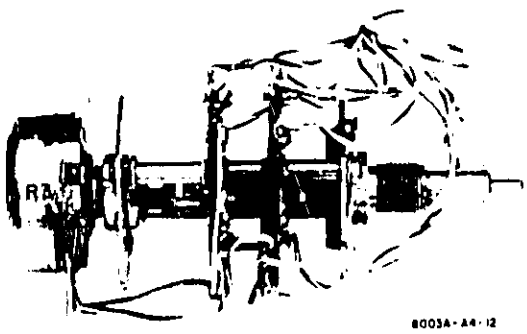
Table A1-3. HP 8003A Option 01 Replaceable Parts

HP Part No.	Description	TQ	RS
0150-0093	C: FXD C_ μF + 80 - 20% 100 VDCW	8	
0160-2150	C: FXD MICA 33 pF 5% 300 VDCW	1	
0180-1706	C: FXD TA 100 μF 20% 25 VDCW	2	
0683-1055	R: FXD COMP 1 MΩ 5% 1/4W	1	
0683-1255	R: FXD COMP 1.2 MΩ 5% 1/4W	1	
0698-4278	R: FXD 10 KΩ 5% 1/8 MET FLM	13	
0757-0428	R: FXD MET FLM 1.62 KΩ 1% 1/8 W	1	
0758-0042	R: FXD MET FLM 1.3KΩ 5% 1/4W	13	
1251-0431	CONNECTOR: FEMALE (24 CONTACTS)	1	
1853-0036	TRANSISTOR SILICON PNP 2N 3906	7	
1854-0215	TRANSISTOR SILICON NPN 2N 3904	6	
2100-0539	R: VAR COMP 1 KΩ 1 W	1	
08003-00203	PANEL: REAR	1	
08003-00211	PANEL: FRONT	1	
08003-61602	CABLE: REMOTE PROGRAMMING	1	
08003-61903	SWITCH: ASSY REP RATE	1	
08003-61904	SWITCH: ASSY WIDTH SWITCH	1	
08003-66502	PRINTED CIRCUIT BOARD ASSEMBLY	-	

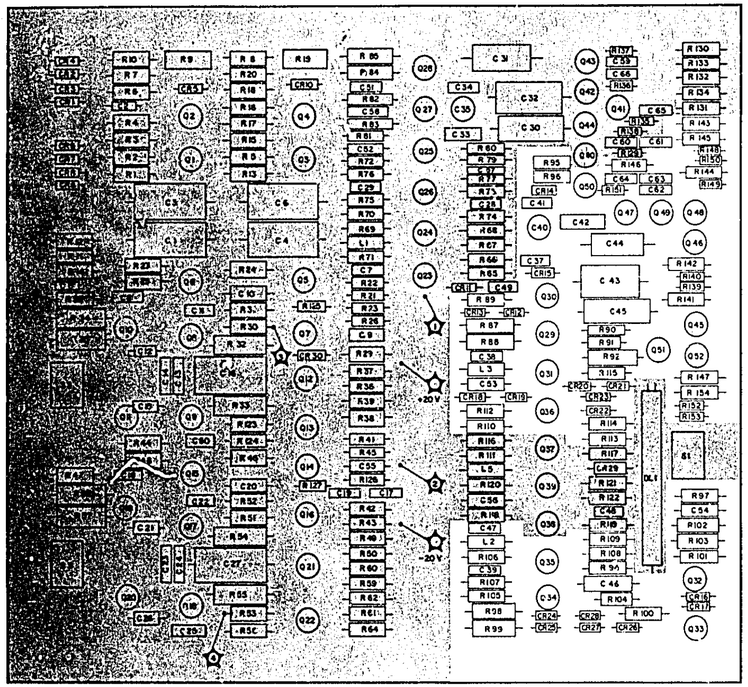
Table A1-4. HP 8003A Option 01 Parts Reference Designation Index

Reference Designation	HP Part No.	Description
Add:		
A1C59 thru A1C66	0150-0093	C: FXD CER 0.01 μF + 80 - 20% 100 VDCW
A1Q40 thru A1Q46	1853-0036	TRANSISTOR SILICON PNP 2N 3906
A1Q47 thru A1Q52	1854-0215	TRANSISTOR SILICON NPN 2N 3904
A1R79	0757-0428	R: FXD MET FLM 1.62 KΩ 1% 1/8 W
A1R129	0757-0948	R: FXD FLM 10 KΩ 2% 1/8 W
A1R130 thru A1R134	0758-0042	R: FXD MET FLM 1.3 KΩ 5% 1/4 W
A1R135 thru A1R140	0757-0948	R: FXD FLM 10 KΩ 2% 1/8 W
A1R141 thru A1R147	0758-0042	R: FXD MET FLM 1.3 KΩ 5% 1/4 W
A1R148 thru A1R153	0698-4278	R: FXD MET FLM 10 KΩ 5% 1/8 W
A1R154	0758-0042	R: FXD MET FLM 1.3 KΩ 5% 1/4 W
A1R155 thru A1R158	0683-1055	R: FXD COMP 1 MΩ 5% 1/4 W
A1R159	0683-1255	R: FXD COMP 1.2 MΩ 5% 1/4 W
A1R160 thru A1R163	0683-1055	R: FXD COMP 1 MΩ 5% 1/4 W
A1R164	0683-1255	R: FXD COMP 1.2 MΩ 5% 1/4 W
A6	08003-61905	SWITCH: ASSY RATE-WIDTH
J7	1251-0292	CONNECTOR: FEMALE (24 CONTACTS)
W2	08003-61602	CABLE: REMOTE PROGRAMMING
Delete:		
R7	0757-0428	R: FXD MET FLM 1.62 KΩ 1%
Change:		
A1 to	08003-66502	PRINTED CIRCUIT BOARD ASSEMBLY
A1C30 to	0180-1706	C: FXD TA 100 μF 20% 25 VDCW
A1C41 to	0160-2150	C: FXD MICA 33 pF 5% 300 VDCW
A1C45 to	0180-1706	C: FXD TA 100 μF 20% 25 VDCW
R4 and R5	2100-0039	R: VAR COMP 1 KΩ 1 W
S4 to	08003-61903	SWITCH: ASSY REP RATE
S6 to	08003-61904	SWITCH: ASSY WIDTH SWITCH

See Introduction to Section VI.



Repetition Rate Switch



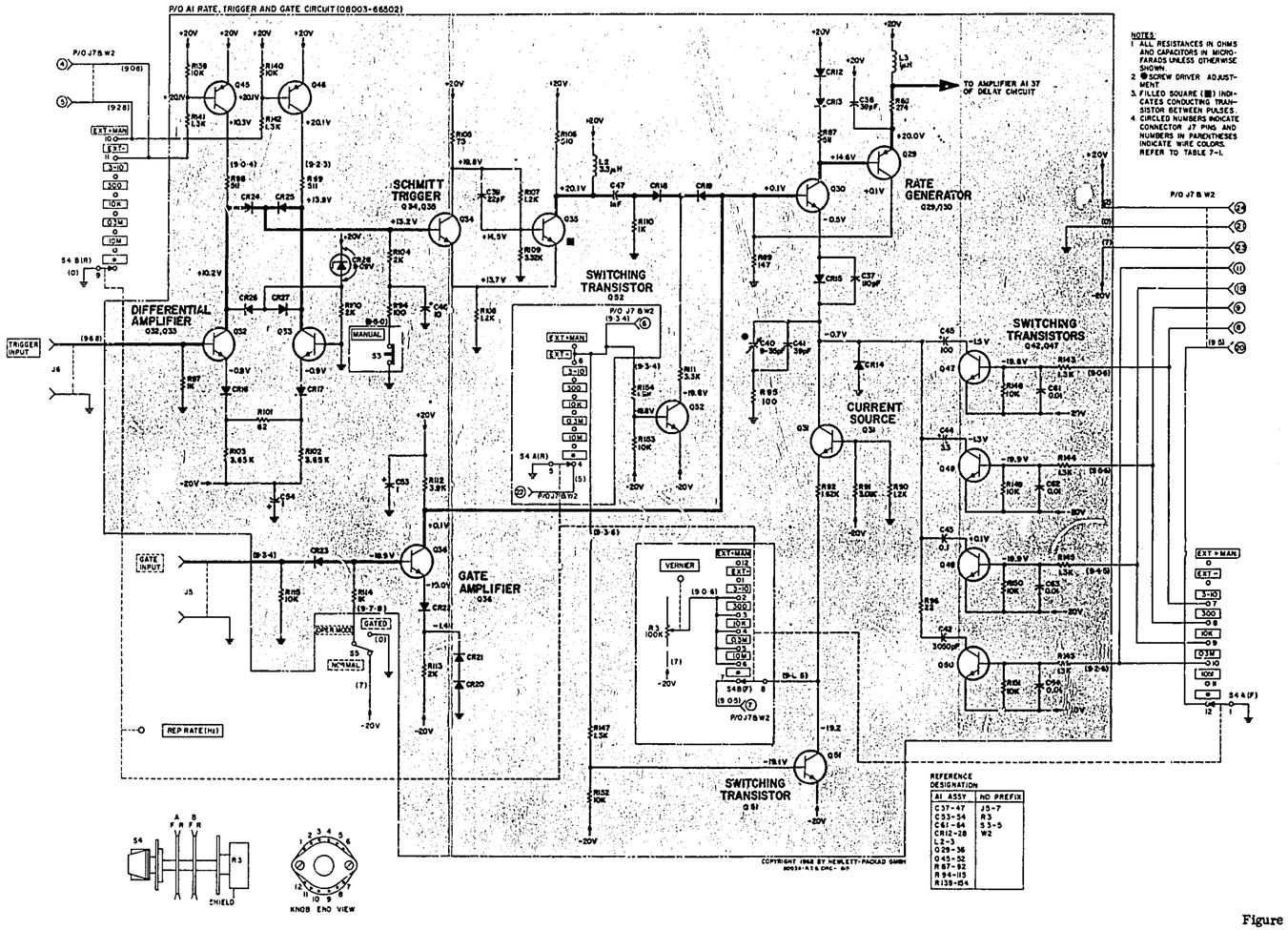
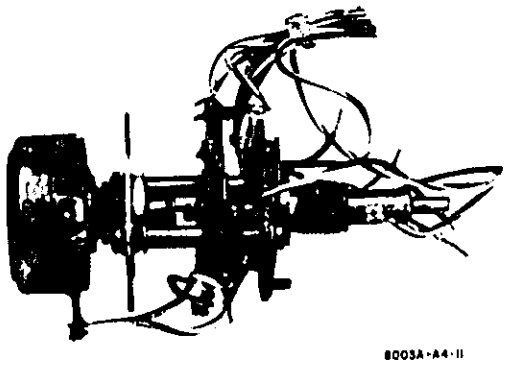
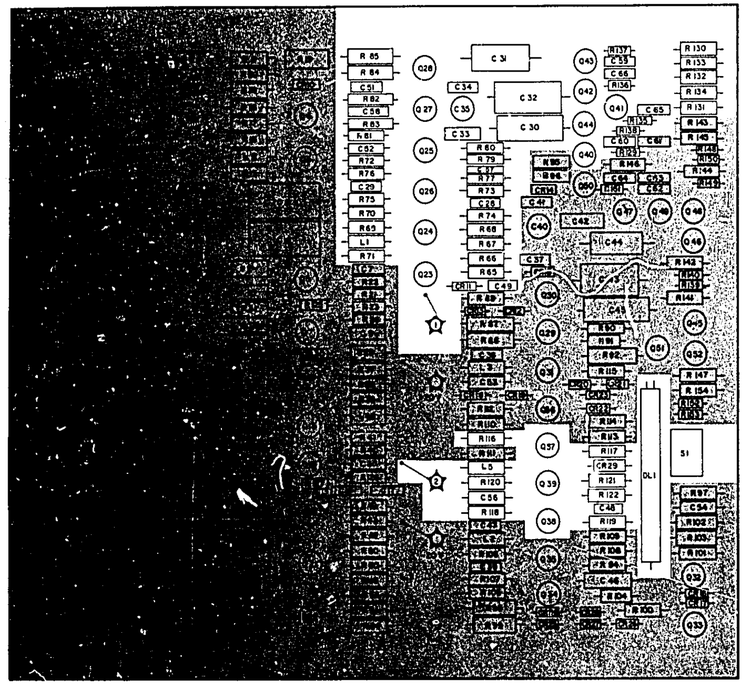


Figure A1-2. Option 01 Repetition Rate and Gate Circuit



Pulse Width Switch



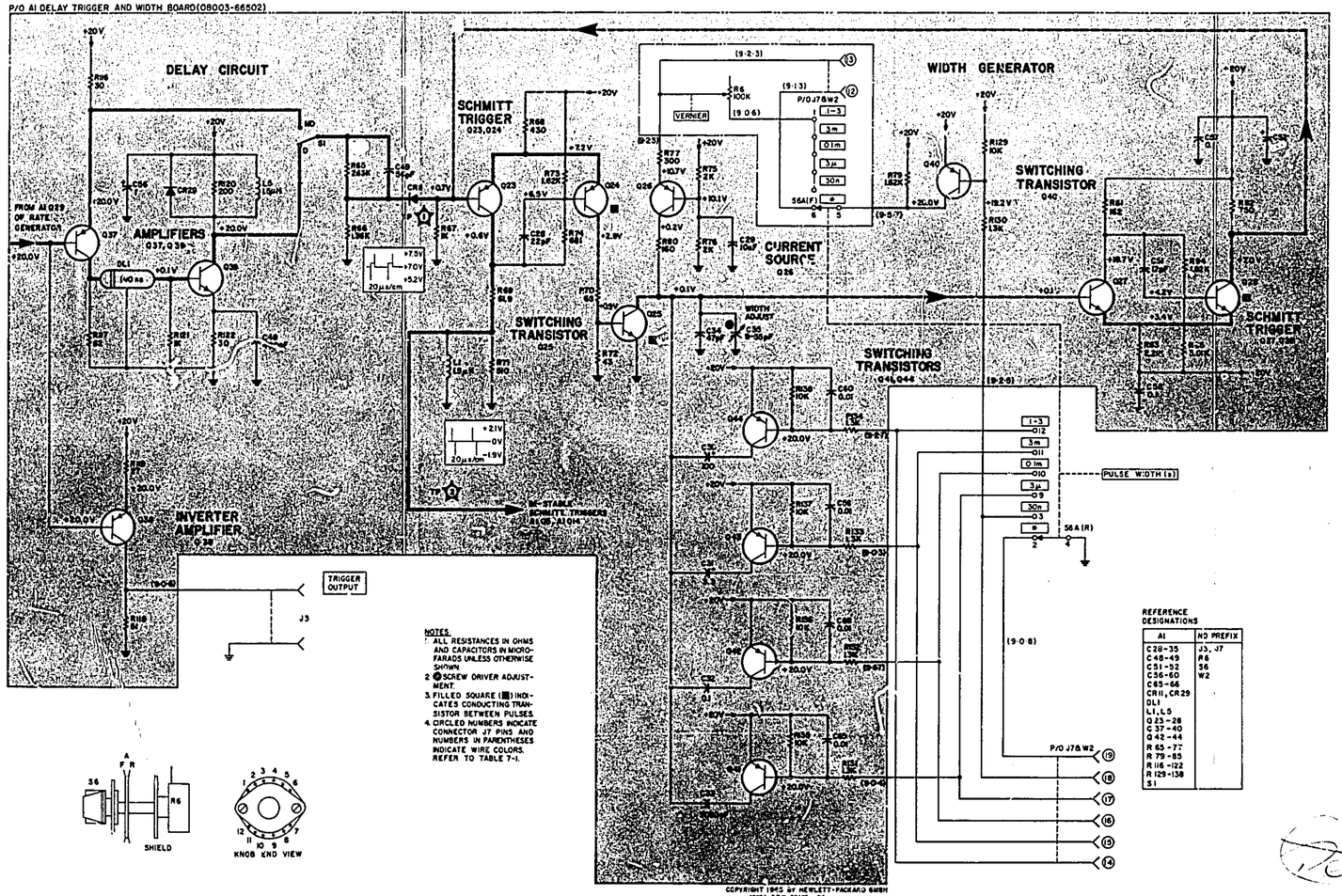
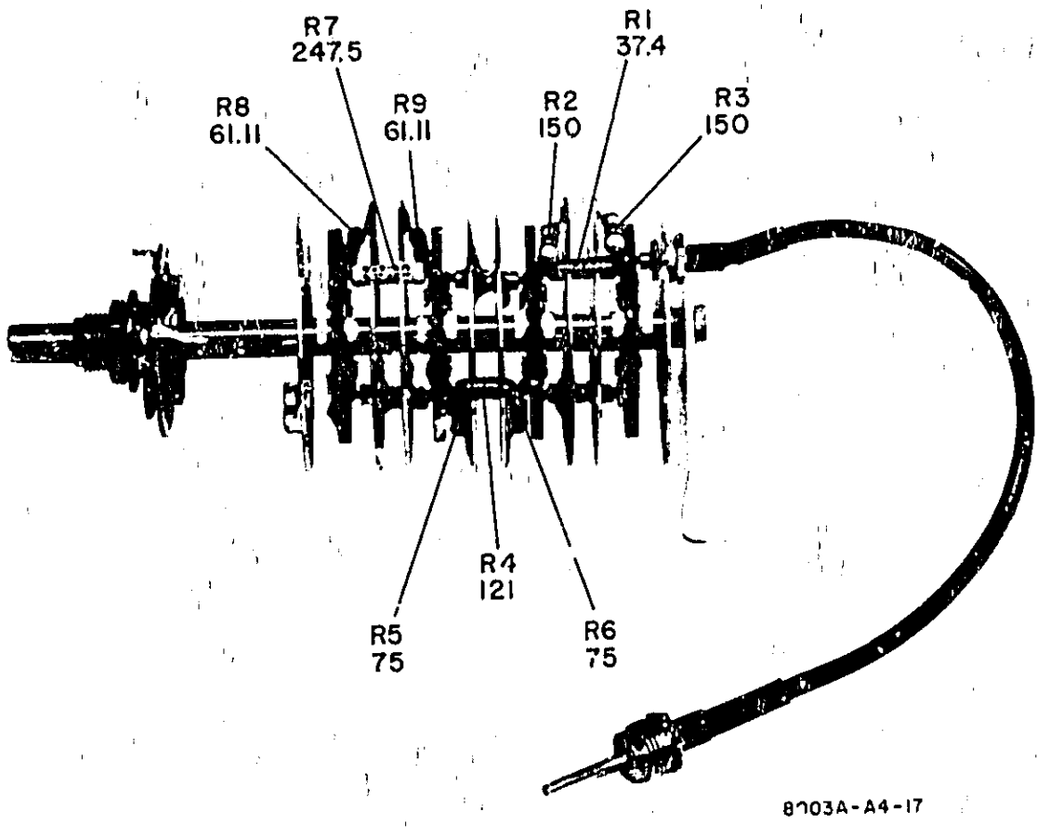
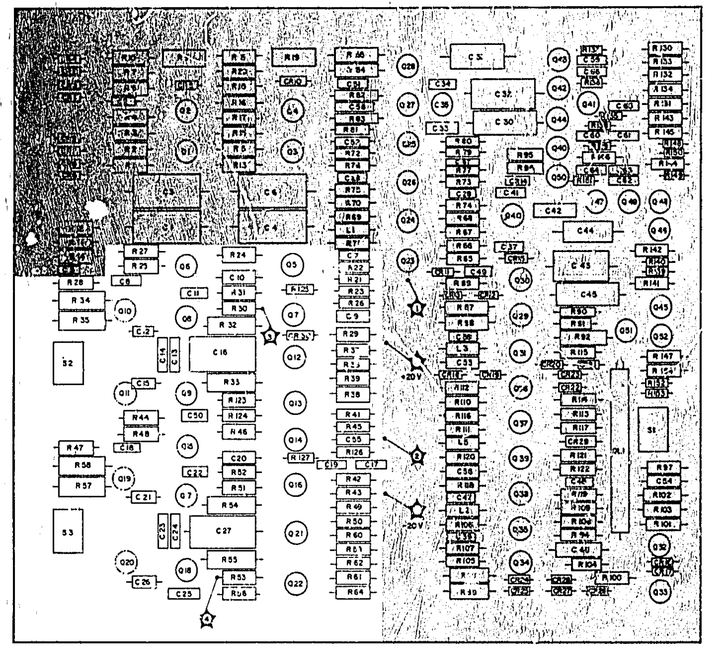
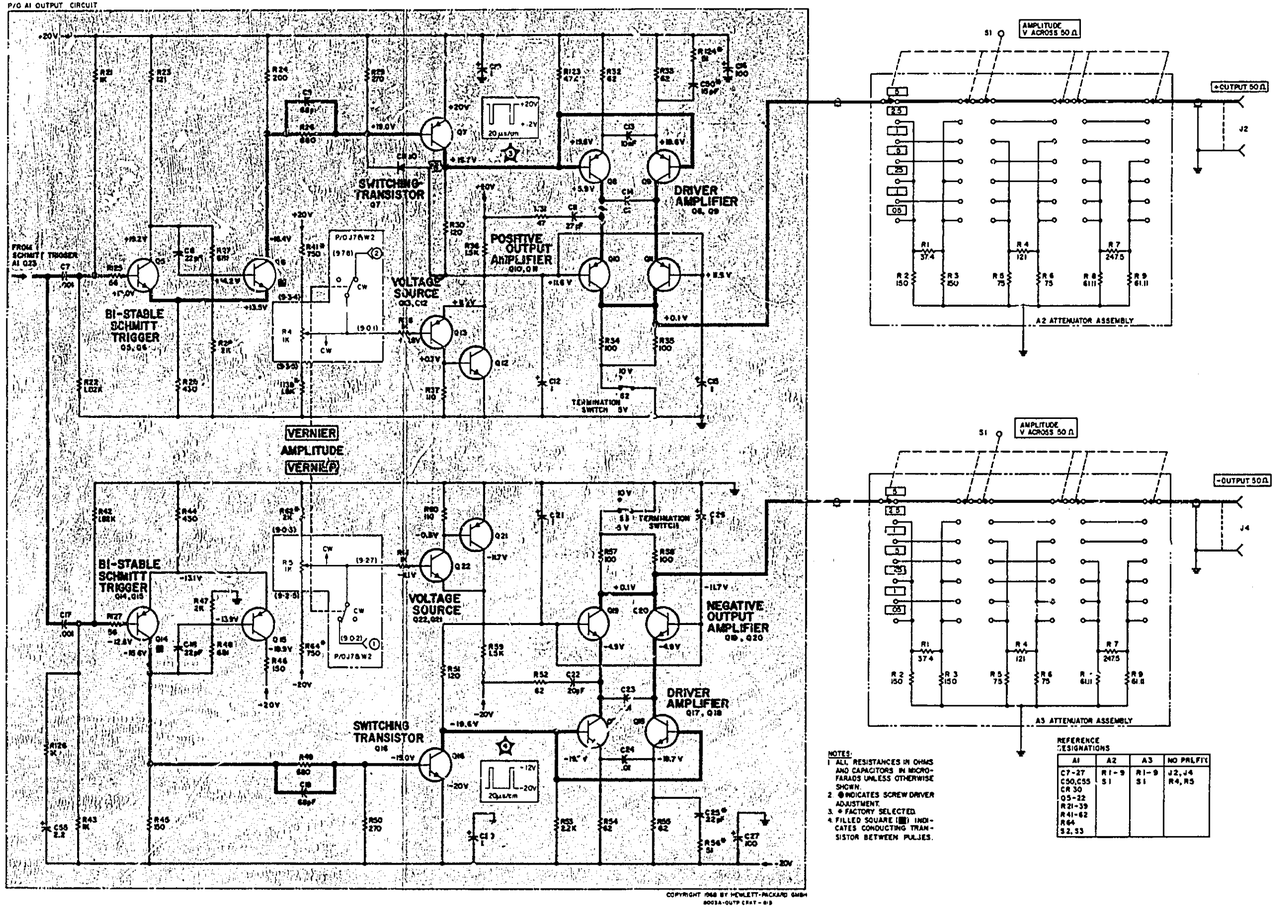


Figure A1-3. Option 01 Delay, Trigger, and Width Circuit



Attenuator A2, A3





NOTES:
1. ALL RESISTANCES IN OHMS AND CAPACITORS IN MICROFARADS UNLESS OTHERWISE SHOWN.
2. ⊕ INDICATES SCREW DRIVER ADJUSTMENT.
3. # FACTORY SELECTED.
4. FILLED SQUARE (■) INDICATES CONDUCTING TRANSISTOR BETWEEN PULSES.

REFERENCE DESIGNATIONS

A1	A2	A3	NO PREFIX
C7-27	R1-9	R1-9	J2, J4
C50, C55	S1	S1	R4, R5
CR 30			
Q5-12			
R21-39			
R41-62			
R64			
S2, S3			

Figure A1-4. Option 01 Output Circuit

APPENDIX A2

BACKDATING AND MODIFICATION INFORMATION FOR OPTION 01 HP 8003A PULSE GENERATOR

This manual backdating appendix makes this manual applicable to earlier instruments. Instrument-component values that differ from those in the manual, yet are not listed in the backdating sheet, should be replaced using the part number given in the manual.

Instrument Serial Prefix	Make Manual Changes
732, 805	1, 3
815, 826	2, 3

Instrument Serial Prefix	Make Manual Changes

CHANGE 1

Figure A1-4 and Tables 6-1 and 6-2:

Delete A1CR30 (HP 1901-0040).

Change A1Q7 to HP Stock No. 1850-0099, TRANSISTOR GERMANIUM PNP

Figure A1-3:

Change terminal connections for Pulse Width Switch S6 as shown in Figure A2-1.

NOTE

If this switch is replaced, the current switch should be rewired according to current models as shown in Figure A1-3.

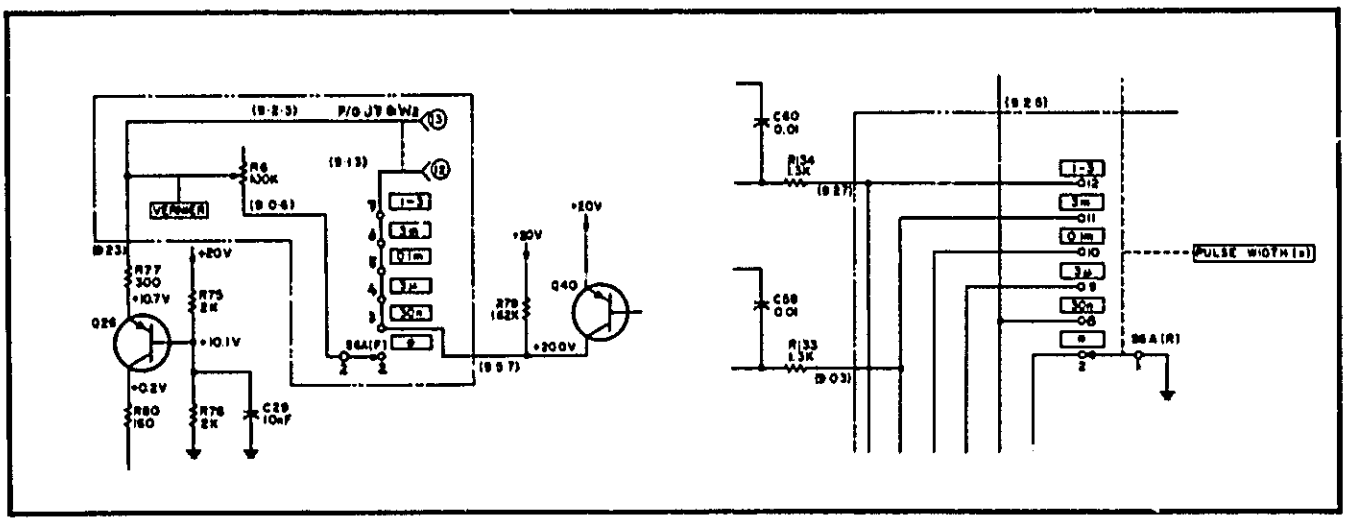


Figure A2-1 S6 Terminal Connections

Figure A1-2:

Change terminal connections for Repetition Rate Switch S4 as shown in Figure A2-2.

NOTE

If this switch is replaced, the current switch should be rewired according to current models as shown in Figure A1-2.

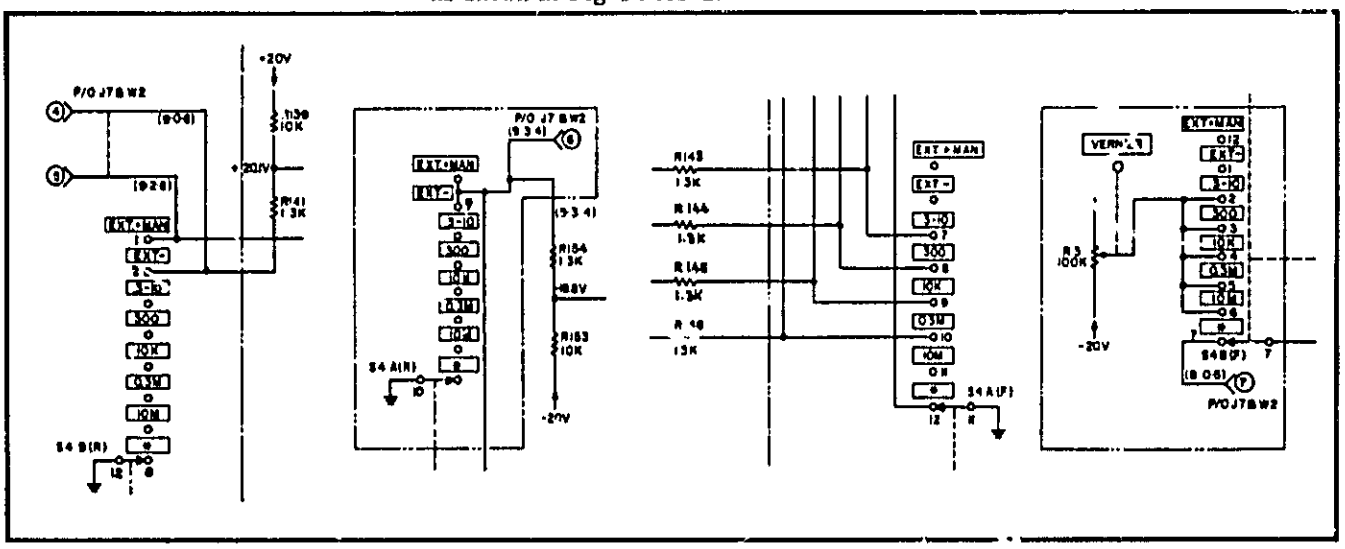


Figure A2-2. S4 Terminal Connections

Figure A1-4:

Change Amplitude Verniers as shown in Figure A2-3.

NOTE

If these verniers are replaced, the current verniers should be rewired according to Figure A2-4.

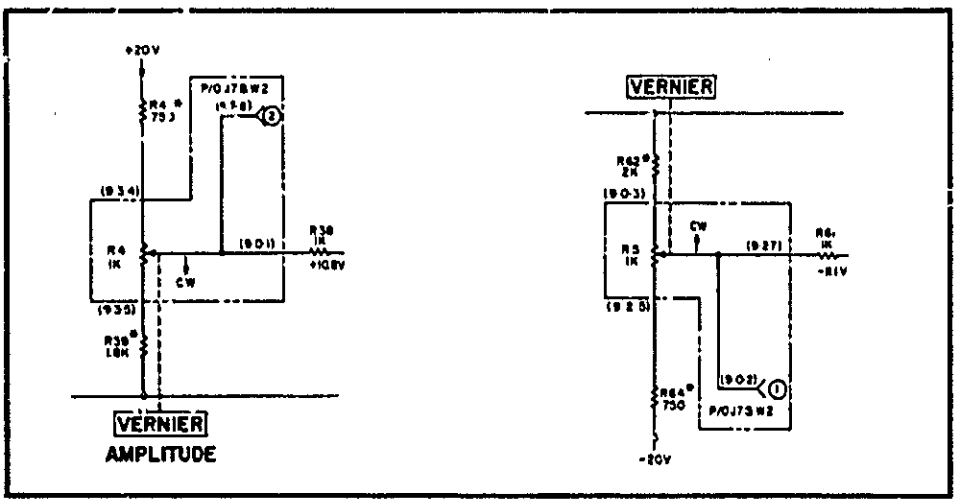


Figure A2-3. 8003A Option 01 Amplitude Verniers

CHANGE 2

Figure A1-4 and Tables 6-1 and 6-2:

Change A1Q7 to HP Stock No. 1853-0082, TRANSISTOR SI PNP and
A1R26 to HP Stock No. 0758-0062, R: FIXED MET OX 200Ω 5% 1/2 W.

Figure A1-2

Change terminal connections for wafer S4 B(F) of Repetition Rate Switch as shown in Figure A2-4.

NOTE

If this switch is replaced, the current switch should be rewired according to current models as shown in Figure A1-2.

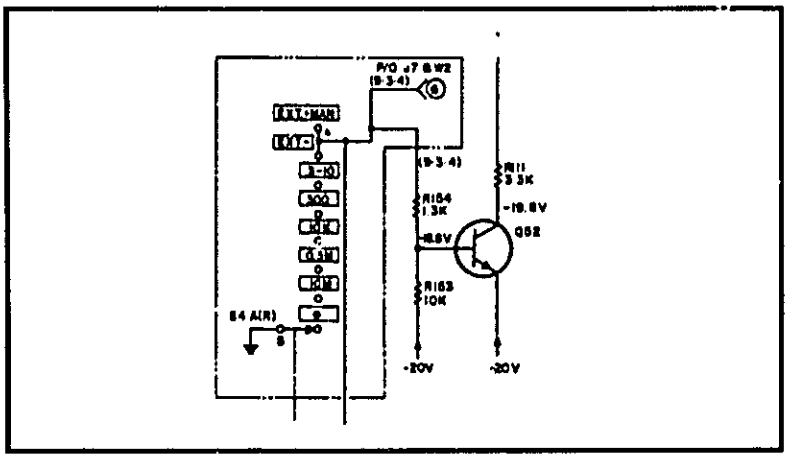


Figure A2-4. S4 A(R) Terminal Connections

Figure A1-3:

Change terminal connections for wafer S6 A (R) of the Pulse Width Switch as shown in Figure A2-5.

NOTE

If this switch is replaced, the current switch should be rewired according to current models as shown in Figure A1-3.

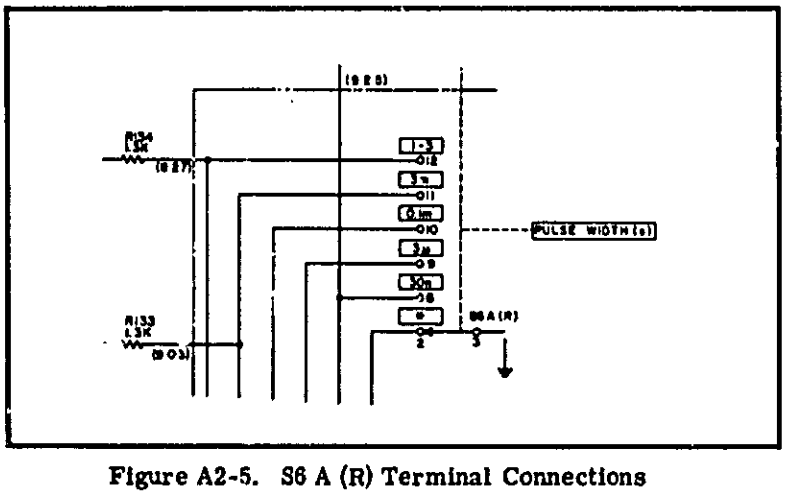


Figure A2-5. S6 A (R) Terminal Connections

CHANGE 3

Figures A1-1 and Table A1-1:

Change Pin 22 to Pin 21 for grounding EXT. + and EXT. - trigger.

APPENDIX

B

APPENDIX B

OPTION X95: LIGHT GRAY COLOR OPTION

B-1 INTRODUCTION

B-2 New color standards and color combinations have been adopted for Hewlett-Packard instruments. Option X95 is offered to those users having need for new instruments with older HP color combinations or for replacement parts for older instruments.

B-3 Parts peculiar to Model 8003A Option X95 are listed in table B-1.

Table B-1. Option X95 Replaceable Parts

Ref Desig	HP Part No.	Description
MP9	08003-00210	MP: Panel front light gray
MP12	08003-00208	MP: Panel rear light gray (Serial prefix 1101A only)
MP12	08003-00202	MP: Panel rear light gray
MP15	5060-0720	MP: Cover top light gray (Serial prefix 1101A only)
MP15	5060-0717	MP: Cover top light gray
MP16	5000-0717	MP: Cover bottom light gray
MP17	5000-0567	MP: Cover side (perforated) light gray

APPENDIX

C

APPENDIX C

BACKDATING AND MODIFICATION INFORMATION FOR STANDARD HP 8003A PULSE GENERATOR

This manual backdating appendix makes this manual applicable to earlier instruments. Instrument-component values that differ from those in the manual, yet are not listed in the backdating sheet, should be replaced using the part number given in the manual.

Instrument Serial Prefix	Make Manual Changes
732, 805	1
815, 826	2

Instrument Serial Prefix	Make Manual Changes

CHANGE 1

Figure 7-3 and Tables 6-1 and 6-2:

Delete A1CR30 (HP 1901-0040)

Change A1Q7 to HP Stock No. 1850-0099, TRANSISTOR GERMANIUM PNP

Figure 7-2:

Change terminal connections for Pulse Width Switch S6 as shown in Figure C-1.

NOTE

If this switch is replaced, the current switch should be rewired according to current models as shown in Figure 7-2.

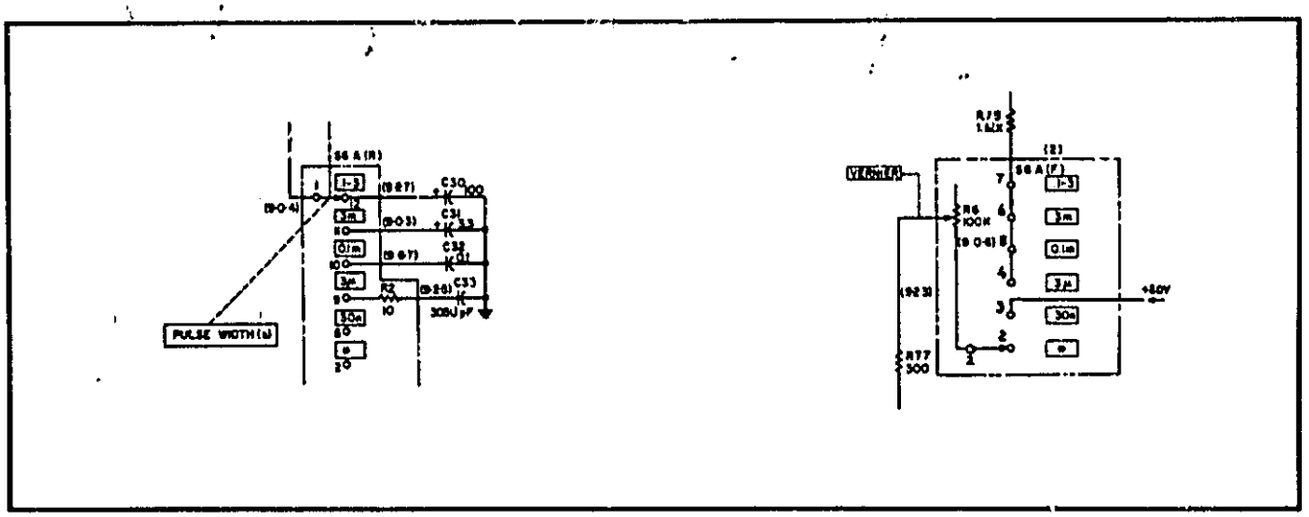


Figure C-1. S6 Terminal Connections

Figure 7-1:

Change terminal connections for Repetition Rate Switch S4 as shown in Figure C-2.

NOTE

If this switch is replaced, the current switch should be rewired according to current models as shown in Figure 7-1.

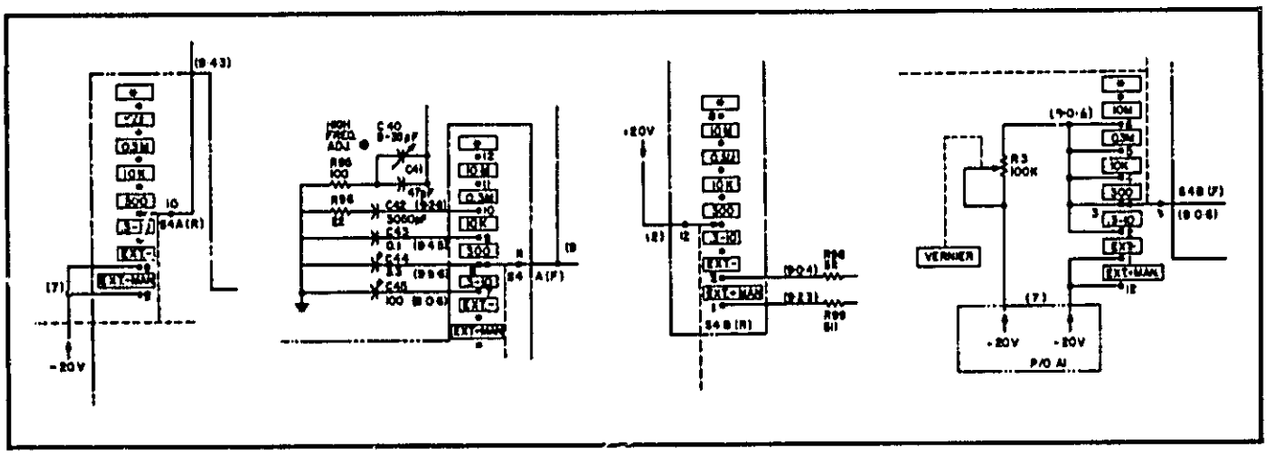


Figure C-2. S4 Terminal Connections

CHANGE 2

Figure 7-3 and Tables 6-1 and 6-2:

Change A1Q7 to HP Stock No. 1853-0082, TRANSISTOR SI PNP and
A1R26 to HP Stock No. 0758-0062, R: FIXED MET OX 200 Ω 5% 1/2 W.

Figure 7-1:

Change terminal connections for wafer S4 B (F) of Repetition Rate Switch as shown in Figure C-3.

NOTE

If this switch is replaced, the current switch should be rewired according to current models as shown in Figure 7-1.

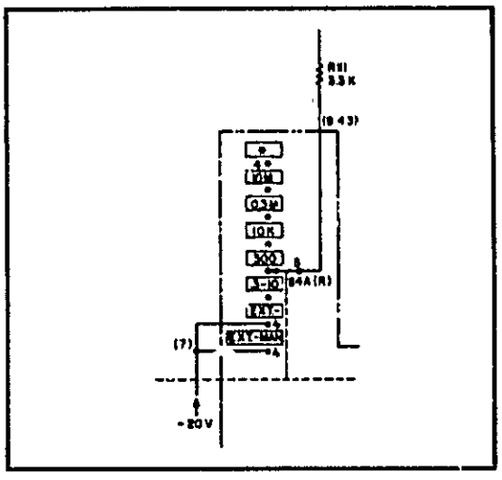


Figure C-3. S4 A (R) Terminal Connections

Figure 7-2:

Change terminal connections for wafer S6 A (R) of the Pulse Width Switch as shown in Figure C-4.

NOTE

If this switch is replaced, the current switch should be rewired according to current models as shown in Figure A7-2.

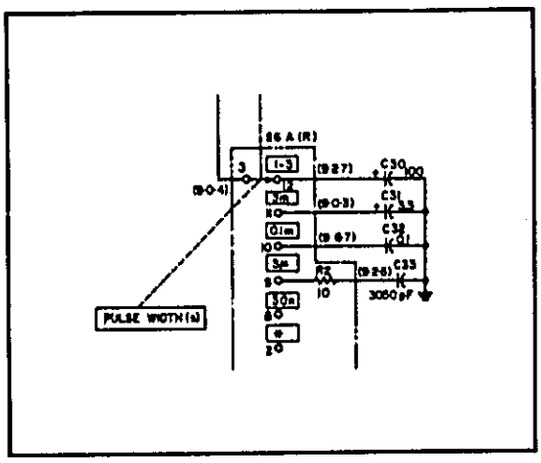


Figure C-4. S6 A (R) Terminal Connections

MANUAL CHANGES

MANUAL CHANGES

MODEL 8003A

PULSE GENERATOR

Manual Serials prefixed: 933-
Manual Printed: Oct 1974

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
1101A	1		
1206A	1, 2		
1233A	1, 2, 3		

Δ ERRATA

Page 7-7/7-8, figure 7-3,
A1R34, A1R35, A1R57, and A1R58: Change values to 150 ohms.
Add: A1R165 (150 ohm) in parallel with A1R34.
Add: A1R166 (150 ohm) in parallel with A1R57.
Add: A1R167 (110 ohm) between collector of A1Q12 and junction of A1Q13/A1R36.
Add: A1R168 (110 ohm) between collector of A1Q21 and junction of A1Q22/A1R59.

Page 7-9, figure 7-4,
Add: C3 (0.005 UF) on J1 from ground terminal to pin connected to T1, pin 4.
Add: C4 (0.005 UF) on J1 from ground terminal to pin connected to F1.

Figure 7-1, 7-2, 7-3, 7-4, A1-2, A1-3, and A1-4,
Add the following components to the component location diagrams:
R165: between R35 and S2.
R166: between R57 and S3.
R167: between C16 and R33.
R168: between C27 and R55.

Appendix A1, figures A1-2, A1-3, and A1-4,
Component location diagram:
A1R155 through A1R164 are located on underside of board assembly A1.

Appendix A1, figure A1-2,
Add: A1R160 (1 megohm) in parallel with A1C45.
Add: A1R161 (1 megohm) in parallel with A1C44.
Add: A1R162 (1 megohm) in parallel with A1C43.
Add: A1R163 (1 megohm) in parallel with A1C42.
Add: A1R164 (1.2 megohm) between +20V and collector A1Q31.
A1Q45: Change designator to A1Q46.
A1Q46: Change designator to A1Q45.
A1R139: Change designator to A1R140.
A1R140: Change designator to A1R139.
A1R141: Change designator to A1R142.
A1R142: Change designator to A1R141.

Appendix A1, figure A1-3,
Add: A1R155 (1 megohm) in parallel with A1C30.
Add: A1R156 (1 megohm) in parallel with A1C31.
Add: A1R157 (1 megohm) in parallel with A1C32.
Add: A1R158 (1 megohm) in parallel with A1C33.
Add: A1R159 (1.2 megohm) between −20V and collector of A1Q25.

Appendix A1, figure A1-4,
A1CR30: Delete connection at junction of A1R30/A1Q7 and redraw to junction of A1R30/A1R36.

21 October 1974
Δ = Latest additions to this change sheet.
This change sheet supersedes all prior change sheets for this manual.

Supplement A for
08003-90003

Δ CHANGE 1

Appendix A1, Table A1-3,
Add: HP Part No. 08003-00207; Panel, rear.

Δ CHANGE 2

Table 6-2,
MP9: Change to HP Part No. 08003-10201,
MP: Panel Front mint-gray.
MP12: Change to HP Part No. 08003-70201,
MP: Panel rear mint-gray.

Table 6-2 (Cont'd)
MP15: Change to HP Part No. 5060-8577,
MP: Cover top mint-gray.
MP16: Change to HP Part No. 5000-8583,
MP: Cover bottom mint-gray.
MP17: Change to HP Part No. 5000-8479,
MP: Cover side mint gray.

Δ CHANGE 3

Table 6-2,
S1: Change to HP Part No. 3101-1248.
MP9: Change to HP Part No. 08003-10203.

Table A1-3,
Change HP Part No. of rear panel to 08003-10206.
Table D-1,
MP9: Change to HP Part No. 08003-10207.