Errata

Title & Document Type: **8004A Pulse Generator Operating and Service Manual**

Manual Part Number: **08004-90001**

Revision Date: **October 1970**

About this Manual

We've added this manual to the Agilent website in an effort to help you support your product. This manual provides the best information we could find. It may be incomplete or contain dated information, and the scan quality may not be ideal. If we find a better copy in the future, we will add it to the Agilent website.

HP References in this Manual

This manual may contain references to HP or Hewlett-Packard. Please note that Hewlett-Packard's former test and measurement, life sciences, and chemical analysis businesses are now part of Agilent Technologies. The HP XXXX referred to in this document is now the Agilent XXXX. For example, model number HP8648A is now model number Agilent 8648A. We have made no changes to this manual copy.

Support for Your Product

Agilent no longer sells or supports this product. You will find any other available product information on the Agilent Test & Measurement website:

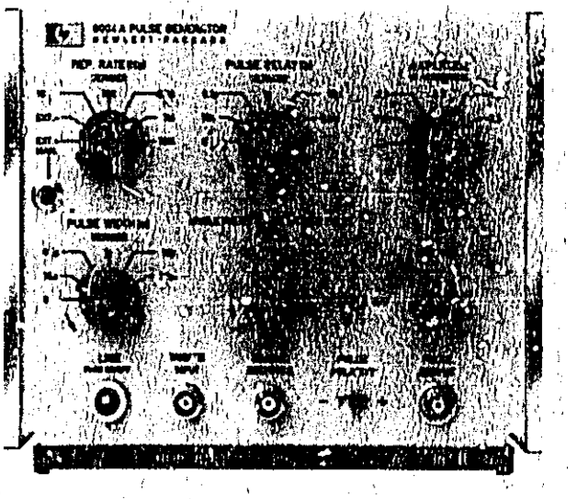
www.agilent.com

Search for the model number of this product, and the resulting product page will guide you to any available information. Our service centers may be able to perform calibration if no repair parts are needed, but no other support from Agilent is available.

Agilent Technologies

OPERATING AND SERVICE MANUAL

PULSE GENERATOR 8004A



HEWLETT hp PACKARD

HEWLETT hp PACKARD

CERTIFICATION

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

WARRANTY AND ASSISTANCE

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

For any assistance contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

OPERATING AND SERVICE MANUAL

MODEL 8004A

PULSE GENERATOR

This manual contains service information for instruments with the serial number prefix

G 944

For supplementary information pertaining to instruments with lower prefix numbers, refer to the backdating section of this manual.

For supplementary information pertaining to instruments with higher prefix numbers, refer to the manual supplement for those instruments.

703 BÖBLINGEN, HERRENBERGER STR. 110, WEST GERMANY

08004-90001

PRINTED: OCT. 1970

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

Table 1–1. Specifications

PULSE CHARACTERISTICS
(50 Ω source and load impedance)

Rise and Fall Time: < 1.5 ns.

Overshoot and Ringing: < 5% of pulse amplitude.

Freshoot: < 5% of pulse amplitude.

Corner Rounding: Occurs no sooner than 95% of pulse amplitude.

Amplitude: 5 V maximum across 50 Ω; seven-step attenuator reduces output to 0.05 V in 5, 2.5, 1 sequence; vernier provides continuous adjustment between steps and reduces minimum output to < 0.02 V. Rotating vernier fully c.c.w., may increase overshoot to 10%. Output short-circuit proof.

Polarity: Positive or negative, selectable.

Source Impedance: 50 Ω, shunted by typically 20 pF.

DC Offset: ± 2 V across 50 Ω load; independent of attenuator and vernier settings; can be switched off.

Pulse Width: 0 to 1 ms in six ranges; vernier provides continuous adjustment between ranges.

Maximum Duty Cycle: > 50% from 100 Hz to 1 MHz; > 25% from 1 to 10 MHz.

Width Jitter: < 0.1% on any width setting, + 50 p sec.

Pulse Position: (with respect to trigger output): 0 to 1 ms delay in 5 ranges; vernier provides continuous adjustment between ranges.

Delay Jitter: < 0.1% on any delay setting.

REPETITION RATE AND TRIGGER

Free Running

Repetition Rate: 100 Hz to 10 MHz in five ranges; vernier provides continuous adjustment between ranges.

Period Jitter: < 0.1% on any delay setting.

Double Pulse: Minimum pulse spacing of 50 ns allows maximum repetition rate of 20 MHz.

External Triggering

Repetition Rate: 0 to 10 MHz can be triggered with sine waves or pulses of either polarity.

Sensitivity: Sine waves, 2 V pp; pulses, 1 V peak at least 15 ns wide; maximum input, ± 10 V.

Delay: Approx. 125 ns between trigger input and trigger output.

Input Impedance: Approx. 1 kΩ, dc coupled.

Manual: Push button for single pulse.

Trigger Output

Amplitude: > + 2 V across 50 Ω.

Width: 15 ns ± 10 ns.

Gating

Synchronous Gating: Gating signal turns pulse 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 normal even if gate ends during pulse.

Asynchronous Gating: Gating signal turns output pulse "on" Trigger output always available; last pulse ends with gate

Gate Input: - 2 V to - 20 V enabling.

Input Impedance; Approx. 1 kΩ, dc coupled.

GENERAL

Power; 115 or 230 V, + 10% - 15%, 50 to 400 Hz, 35 W.

Weight: Net 7 lbs (3.5 kg); shipping 9 lbs (4.5 kg).

Dimensions: 7-3/4 in. wide, 6-1/2 in. high, 11 in. deep from panel (197 x 165 x 279 mm).

SECTION I

GENERAL INFORMATION

1–1. DESCRIPTION

1–2. The HP Model 8004A Pulse Generator is a general-purpose pulse source which generates fast rise and fall time pulses over a wide range of repetition rates. The complete specifications are listed in Table 1–1. The internal repetition rate is continuously variable from 100 Hz to 10 MHz. Pulses of lower repetition rate may be obtained by external triggering. A double pulse mode effectively increases the maximum repetition rate to 20 MHz.

1–3. Either positive or negative pulses can be selected, the amplitude being continuously variable from less than 0.02V to 5V across a 50Ω load by means of a step attenuator and vernier. A dc offset, continuously variable from -2 V to +2 V is also available. Minimum pulse width at full amplitude is about 2.5 ns. Narrower pulses are obtained at the expense of reduced amplitude. Maximum pulse width is 1 ms. Delay of the output pulse w.r.t. the trigger output is continuously variable from 0 to 1 ms.

1–4. The Model 8004A features both synchronous and asynchronous gating. In the former mode, gating signals affect both output pulses and trigger output, while in the latter mode only the output pulses are affected - the trigger signals are always available.

1–5. ACCESSORIES AVAILABLE

1–6. Test equipment, cables, connectors, adapters, and other items are available from Hewlett-Packard. For more information on specific items consult the Hewlett-Packard Catalog or Sales and Service Office.

1–7. INSTRUMENT IDENTIFICATION

1–8. Each Model 8004A is identified by a two-section, eight-digit serial number, preceded by the letter G (000–00000). The first three digits of the serial number, to be found on the rear panel of the instrument, should agree with those on the title page of this manual, otherwise there are differences between your instrument and the one described here. To obtain correct manual information for any instrument, contact your nearest Hewlett-Packard Sales and Service Office; always specify the model number and complete serial number.

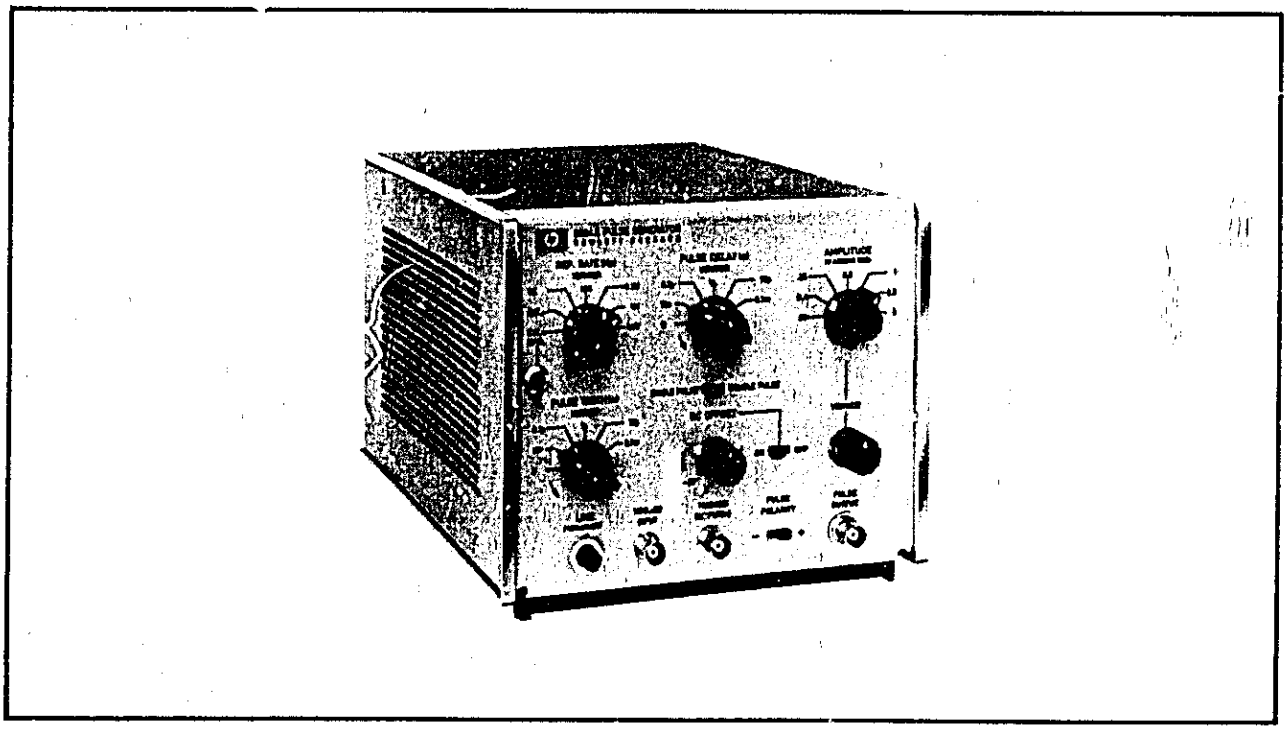


Figure 1–1. HP Model 8004A Pulse Generator

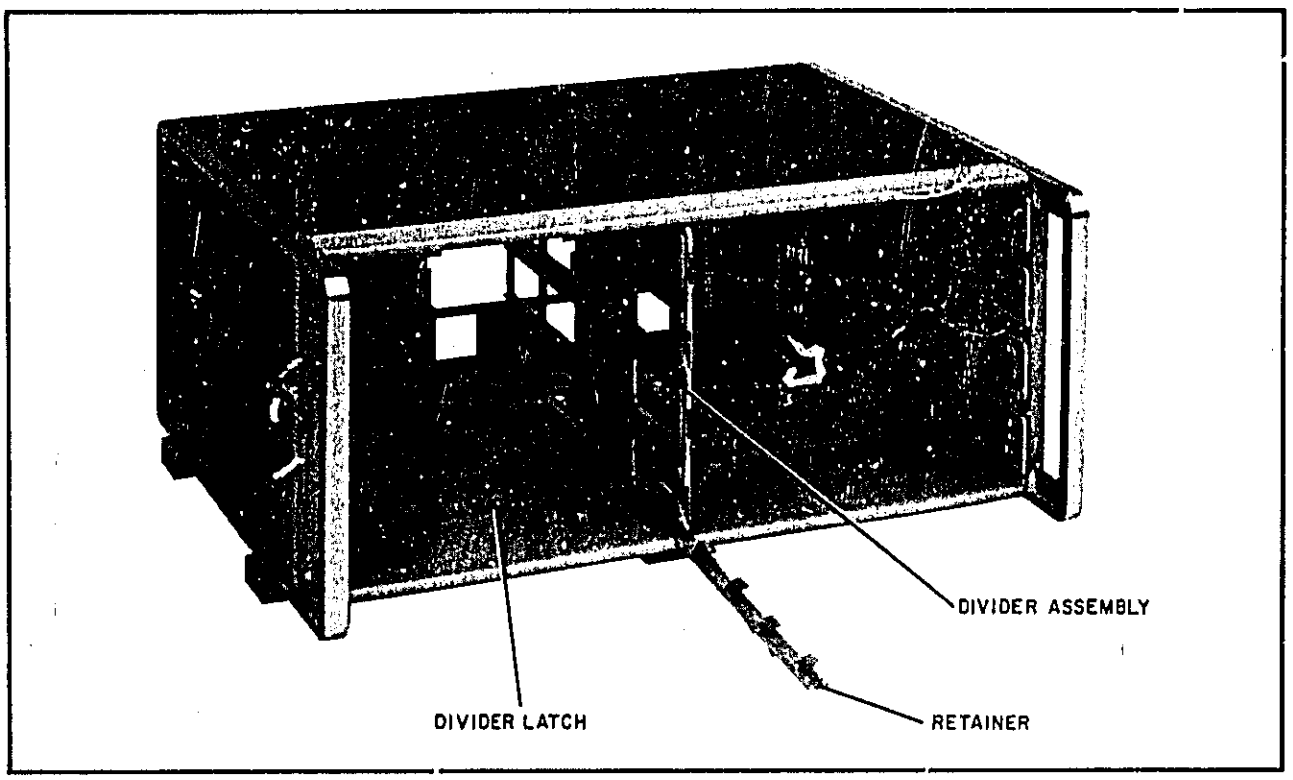


Figure 2-1. The Combining Case

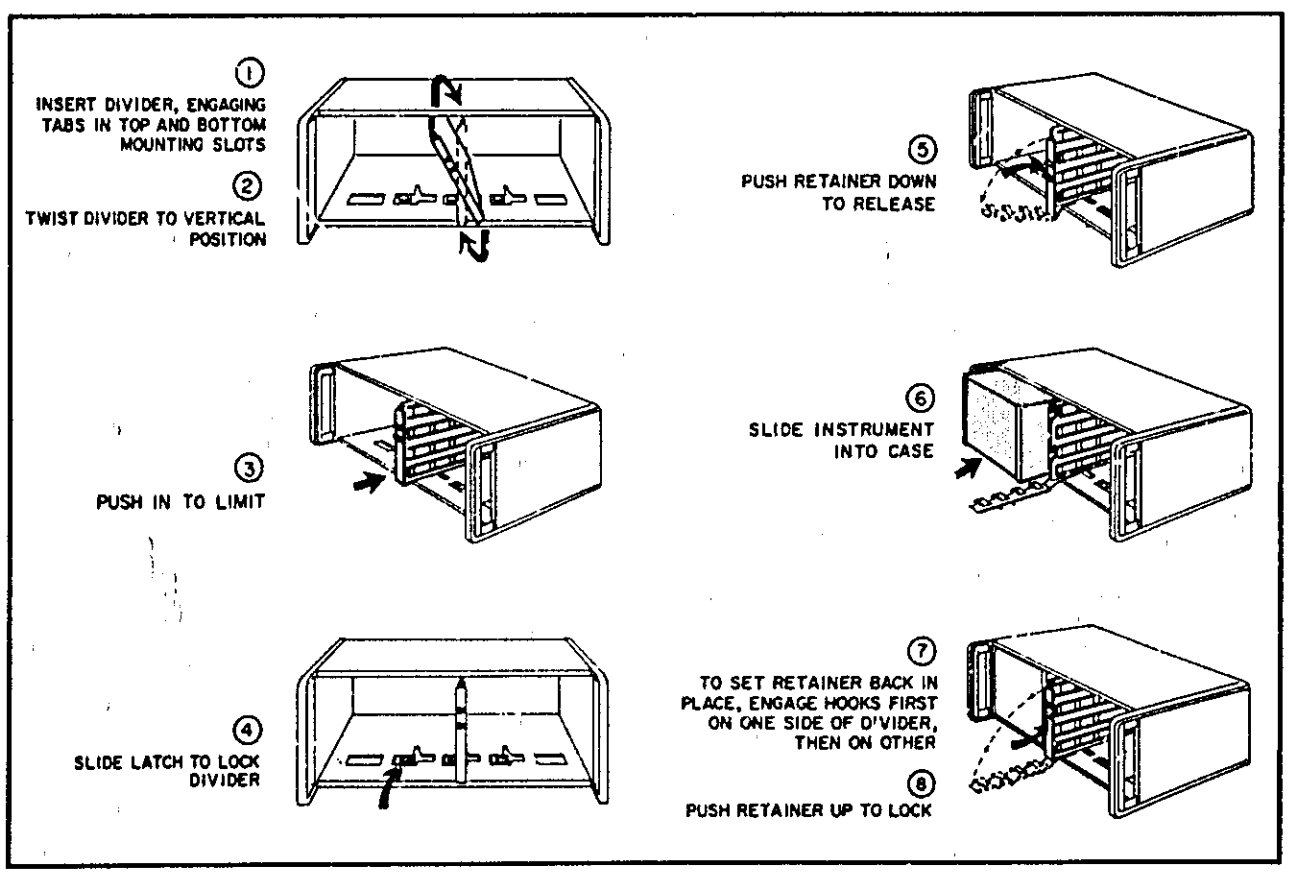


Figure 2-2. Steps to Place Instrument in Combining Case

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. 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. POWER SOURCE REQUIREMENTS

2–4. The HP Model 8004A may be operated from an ac source of 115 or 230 volts + 10%, - 15%, at 50 or 400 Hz. Power dissipation is approximately 35 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 slide switch and the fuse value correspond to the line voltage used before operating the instrument; otherwise, the instrument may be damaged.

2–5. FUSE REPLACEMENT

2–6. 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.

2–7. POWER CABLE

2–8. The HP Model 8004A 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.

2–9. TEMPERATURE REQUIREMENTS

2–10. The HP Model 8004A 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).

2–11. REPACKING

2–12; 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.

2–13. RACK MOUNTING

2–14. The HP Model 8004A 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.

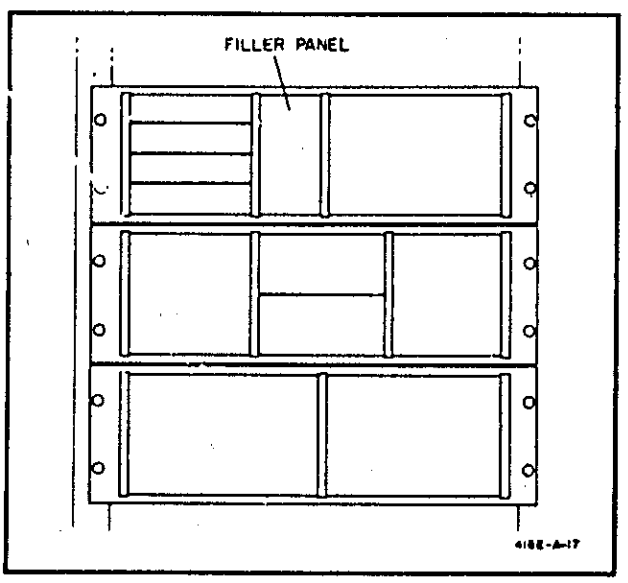


Figure 2-3. Adapter Frame Instrument Combinations

2–15. COMBINING CASE (HP 1051A or 1052A)

2–16. 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 8004A in a combining case are given in Figure 2–2.

2–17. ADAPTER FRAME

2–18. 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 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.

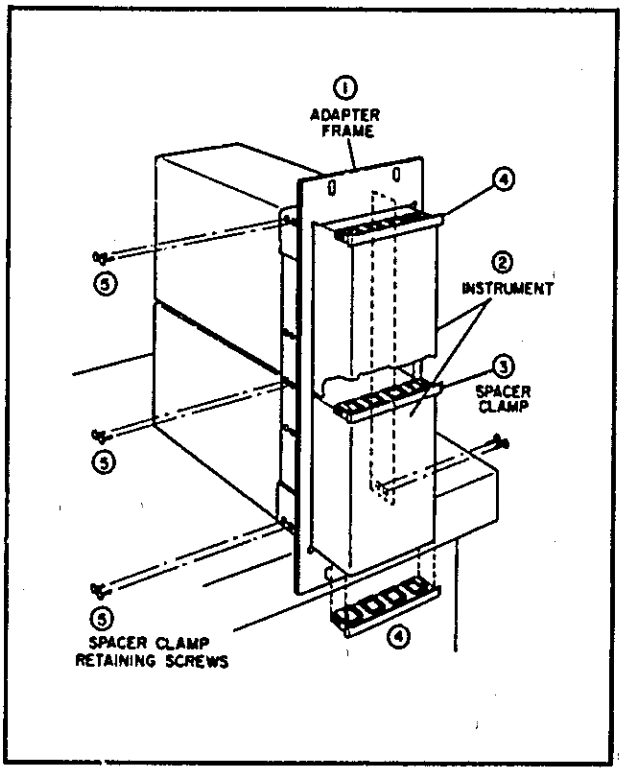


Figure 2–4. Two Half Modules in Rack Adapter

OPERATION AND THEORY

SECTION III

OPERATING INSTRUCTIONS

3–1. INTRODUCTION

3–2. This section contains the operating instructions for the Model 8004A Pulse Generator. Figures 3–1 and 3–2 identify and briefly describe the purpose of each panel control and connector on the instrument. Operating limits are as specified in Table 1–1.

3–3. TRIGGER MODES

3–4. Internal

3–5. The Model 8004A will generate internally any repetition rate from 100 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 VERNIER to the specific rate desired.

3–6. External

3–7. With the REP. RATE selector set to EXT.–, sinusoidal signals or negative pulses with a width of at least 12 ns will trigger the Model 8004A. In the EXT.+ position, sinusoidal signals or positive pulses will trigger the instrument. One output pulse is produced for each period of the trigger signal. The repetition rate of the external signal may be anywhere from 0 to 10 MHz. Maximum input is ± 10 V. Output pulse characteristics are determined by front-panel settings.

3–8. MANUAL

3–9. With the REP. RATE selector set to EXT.+, a single output pulse is produced every time the MAN. button is pressed. Pulse characteristics determined by front-panel settings.

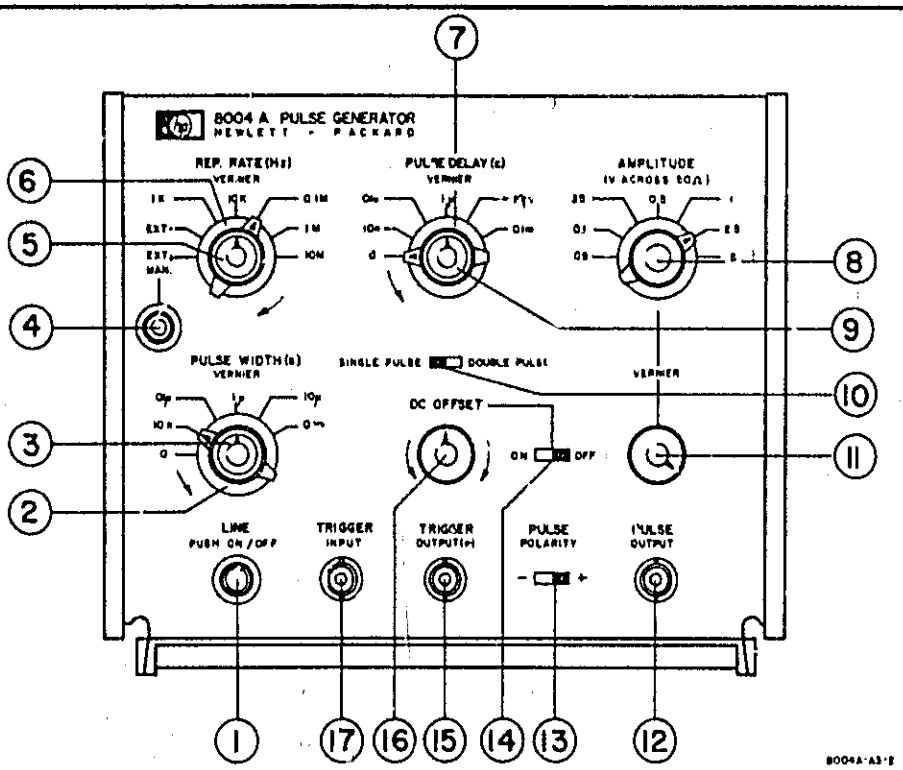
3–10. GATING

3–11. There are two gating modes in the Model 8004A. With OPER.MODE switch in SYN-position, output pulses are only produced when a signal at least - 2 V is present at the GATE INPUT. When this condition is not satisfied, the instrument is in effect turned off, producing neither output pulses nor trigger output. The ASYN-mode of operation is similar, except that the trigger output is always available, even when no gate signal is applied. Figure 3–3 shows the operation of the two gating modes.

NOTE 1: When the instrument is operating normally, i.e. in the ungated mode, the OPER.MODE switch must be in the NORM.-position, otherwise no output pulses are obtained.

NOTE: 2: In all modes of operation, it is important that the width, delay and REP.RATE be compatible, i.e. the width plus delay must be smaller than the period determined by the REP.RATE setting, taking into account the maximum available duty cycle. Illegal settings will not harm the instrument, but the output may be wrongly interpreted.

3–12. The Model 8004A is delivered with a fixed delay of approximately 100 ns between the trigger output and the signal from the internal repetition rate generator. This delay may be removed by switching a slide switch on PC board A1. See Section VII for location.



1. LINE PUSH ON/OFF: On-Off switch, glows red when instrument is on.

2. PULSE WIDTH (s): Switch selects output pulse width range. Indicated width is lower limit of range.

3. VERNIER: Adjusts output pulse width within limits set by 2.

4. MAN.: Pressing of push button causes a single output pulse, width, amplitude, and delay as selected by front-panel controls. REP.RATE switch must be in EXT.+/MAN. position.

5. REP.RATE VERNIER: Adjusts internal repetition rate within limits set by REP.RATE switch 6.

6. REP.RATE (Hz): Switch selects internal repetition rate, external or manual triggering. On internal triggering, setting indicates upper limit of range.

7. PULSE DELAY (s): Switch selects output pulse delay w.r.t. trigger output. Setting indicates lower limit of selected range.

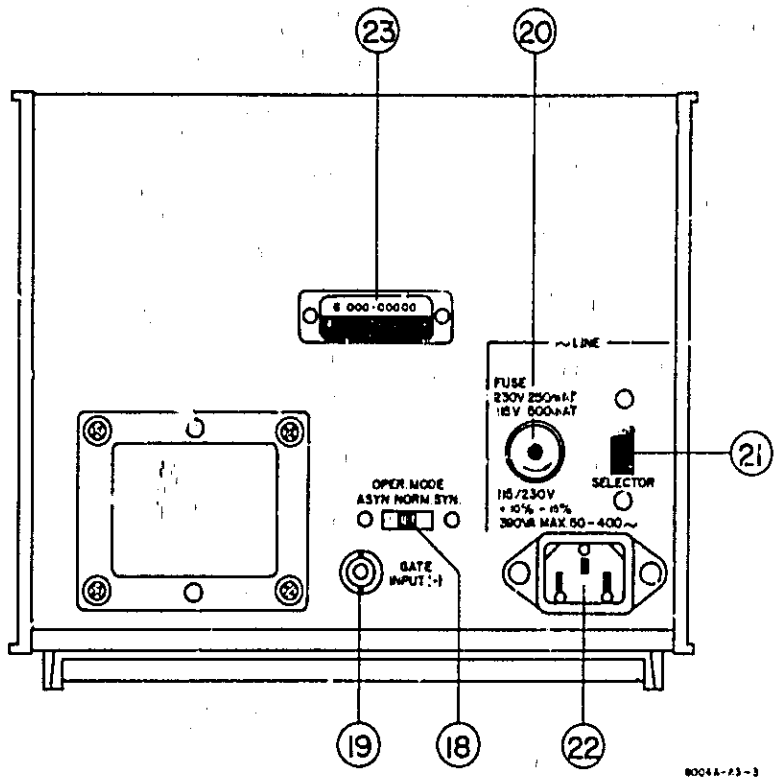
8. AMPLITUDE (V ACROSS 50Ω): Selects amplitude range of output pulse. Setting indicates upper limit of selected range.

9. PULSE DELAY (s) VERNIER: Adjusts delay within limits set by 7.

10. SINGLE PULSE/DOUBLE PULSE: Selects pulse mode. In double pulse mode, PULSE DELAY controls 7. and 9. determine spacing between the double pulses.

11. VERNIER: Adjusts output pulse amplitude within limits set by 8.

Figure 3-1. Front Panel Controls and Connectors



12. PULSE OUTPUT: Female BNC connector supplies output pulse.

13. PULSE POLARITY: Switch selects polarity of output pulse.

14. DC OFFSET ON/OFF: Switch controls presence or absence of baseline shift in output signal.

15. TRIGGER OUTPUT (+): Female BNC connector provides at least a +2V trigger signal into a 50Ω load.

16. DC OFFSET: Vernier controls offset level from –2V to +2V; must be in ON position.

17. TRIGGER INPUT: Female BNC connector accepts external trigger signals, 6. must be in either of the two EXT. positions.

18. OPER.MODE: Selects gating mode. For normal operation, i.e. ungated, this switch must be in NORM. position.

19. GATE INPUT (–): Female BNC connector accepts gating signal. –2V applied with 18. in either the SYN. or ASYN. position opens the gate, permitting output pulses to pass.

20. FUSE: Line fuse (1/2A slow-blow for 230V ac). Use properly rated fuse.

21. 115V/230V: Switch adapts instrument to available line voltage.

22. AC LINE: Receptacle for power cable.

23. SERIAL NUMBER: Identifies instrument.

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

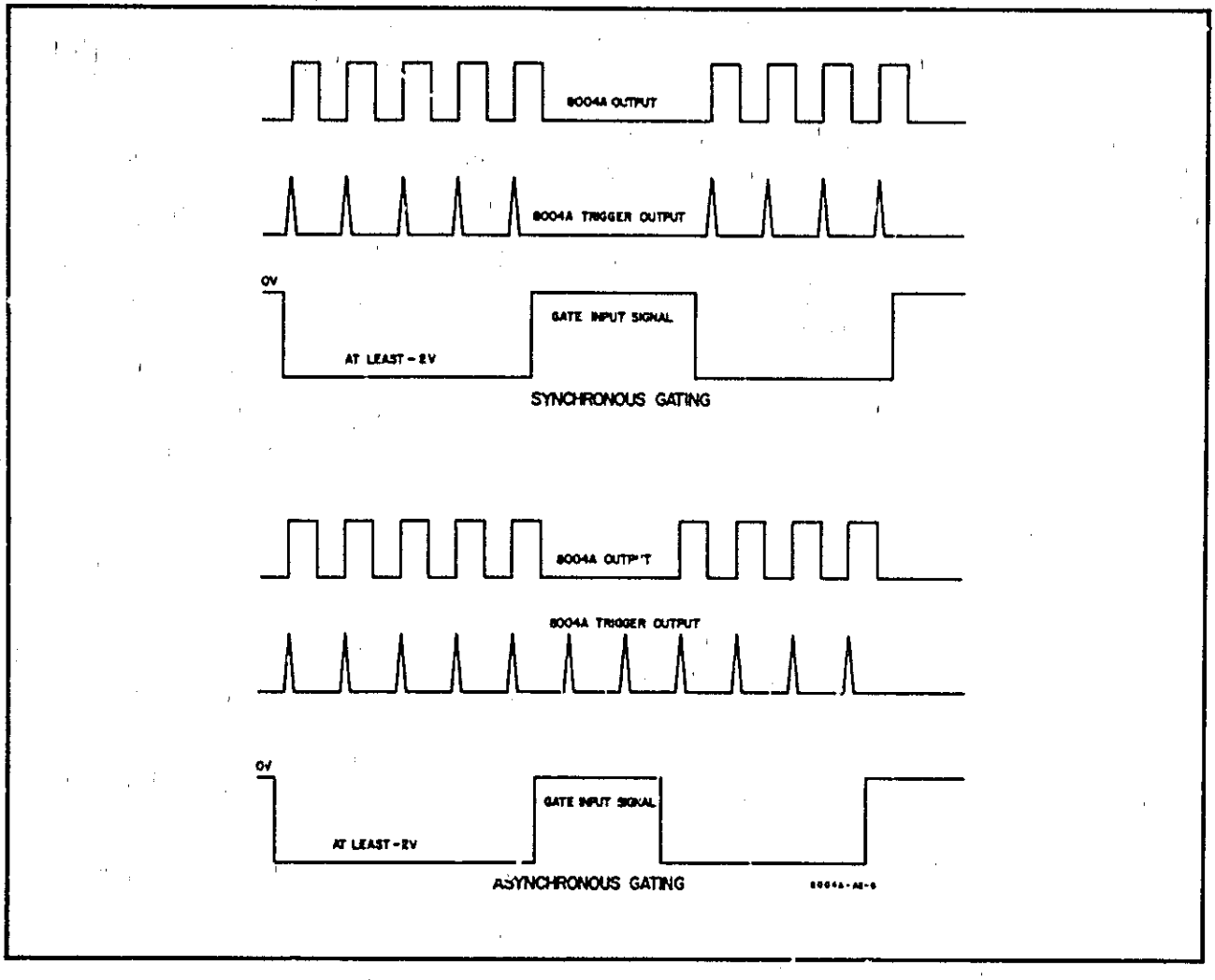


Figure 3–3. Synchronous and Asynchronous Gating

SECTION IV

PRINCIPLES OF OPERATION

4–1. INTRODUCTION

4–2. This section describes the basic principles of operation of the Model 8004A Pulse Generator. The major functions are shown in the block diagram of Figure 4–1. The repetition rate is determined either by the internal generator or an external trigger source. The main signal then passes through the delay circuit which sets up a delay of the output pulse with respect to the trigger output signal. The delay may be varied from 0 to 1 ms by a front-panel control. Pulse width (also variable from 0 to 1 ms) is then established before the signal is fed to the two amplifiers. Either of the two amplifiers, depending on the desired pulse polarity, may be connected to the attenuator and hence to the output connector. A dc offset voltage, continuously variable from - 2 V to + 2 V is superimposed on the signal at the output of the attenuator. The following paragraphs present a more detailed discussion of each base circuit.

4–3. REPETITION RATE CIRCUIT

4–4. The mode of operation of the Model 8004A is established in this circuit (i.e. internal, external, or manual triggering) depending on the setting of REP. RATE selector switch A5S1. Refer to the schematics of Section VII for the following discussion

4–5. Free-Running Mode

4–6. In this mode of operation, REP.RATE switch is set to any of the 5 internal rate settings. Assuming a point in the cycle when the selected range capacitor (C7/C8, C9, C10, C11, or C12) is discharged, as is the case when the instrument is first turned on, the emitter of Q5 is effectively at + 0.2 V. Q5 will start conducting because its base is initially held at approximately + 0.7 V by voltage divider R19/R25. As Q5 starts to conduct, the voltage developed across CR8, CR9 and R17 causes Q6 to conduct also. (CR8 and CR9 increase loop gain for low Q5 collector current, while C13 increases loop gain for high frequencies). Conduction by Q6 raises the base potential of Q5, which thus conducts more heavily. Regeneration causes both transistors to saturate. When the current into the range capacitor is no longer sufficient to keep Q5 saturated. it ceases to conduct and regeneration turns both Q5 and Q6 off (current sink Q7 does not draw enough current to keep Q5 saturated). With both Q5 and Q6 off, the range capacitor is

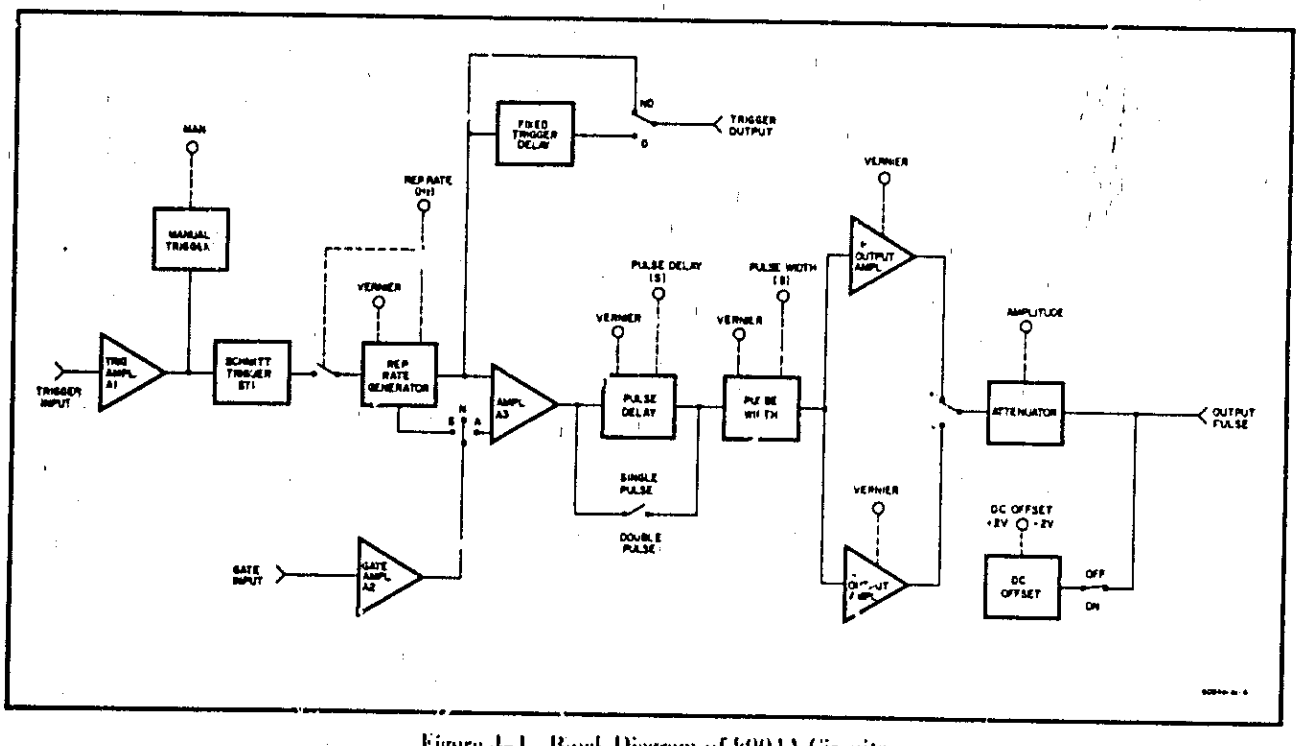


Figure 4–1. Block Diagram of 8004A Circuitry

linearly discharged by current source Q7 until the emitter voltage of Q5 falls again to about + 0.2 V. Q5 then again turns on and the cycle is repeated. The repetition rate is thus determined by the value of the range capacitance, selected by A5S1, and the current drawn by current source control A5R2, plus a time necessary for recharging the ramp capacitor.

4–7. The result is a negative pulse at the emitter of Q6, which is differentiated by L2. The resulting negative and positive spikes are applied to Q8, which clips the positive spike. The negative spike is passed through Q8 to gate Q10/Q11 and is also inverted and fed to the trigger delay circuit. Figure 4–2 shows a set of typical waveforms obtained at various points in the repetition rate circuit.

4–8. In the free-running mode, diodes CR3 and CR4 clamp the collectors of Q1 and Q2 to approximately + 11 V, determined by Zener diode CR7. This ensures that no other collector voltage is developed and no signal is passed to Schmitt trigger Q3/Q4, should an external trigger signal be applied to J1.

4–9. External Triggering

4–10. In this mode of operation, REP.RATE switch A5S1 is set to either EXT.- or EXT.+/MAN. With A5S1 in the EXT.- position, the Model 8004A is triggered by the negative-going slope of a negative trigger applied to J1. With A5S1 in the EXT.+ position, the instrument is triggered by the positive-going slope of a positive trigger signal.

4–11. Trigger signals applied to J1 are fed to differential amplifier Q1/Q2. Diodes CR5 and CR6 protect the base-emitter junctions of Q1 and Q2 against excessive reverse voltages. With A5S1 in the EXT.-position, R2 is connected to + 20 V, so CR2 and CR3 are reverse-biased (the collector of Q2 remains clamped at + 11 V). When a negative trigger is applied, Q1 conducts less and the increase in Q1 collector voltage is fed through CR1 to the base of Q3. This causes Schmitt trigger Q3/Q4 to switch, thereby generating a positive-going spike across L1. The negative-going spike, produced when Schmitt trigger Q3/Q4 switches back at the end of the trigger signal, is blocked by CR12. Figure 4–3 shows some typical waveforms at various points of the trigger circuitry in the EXT.– mode.

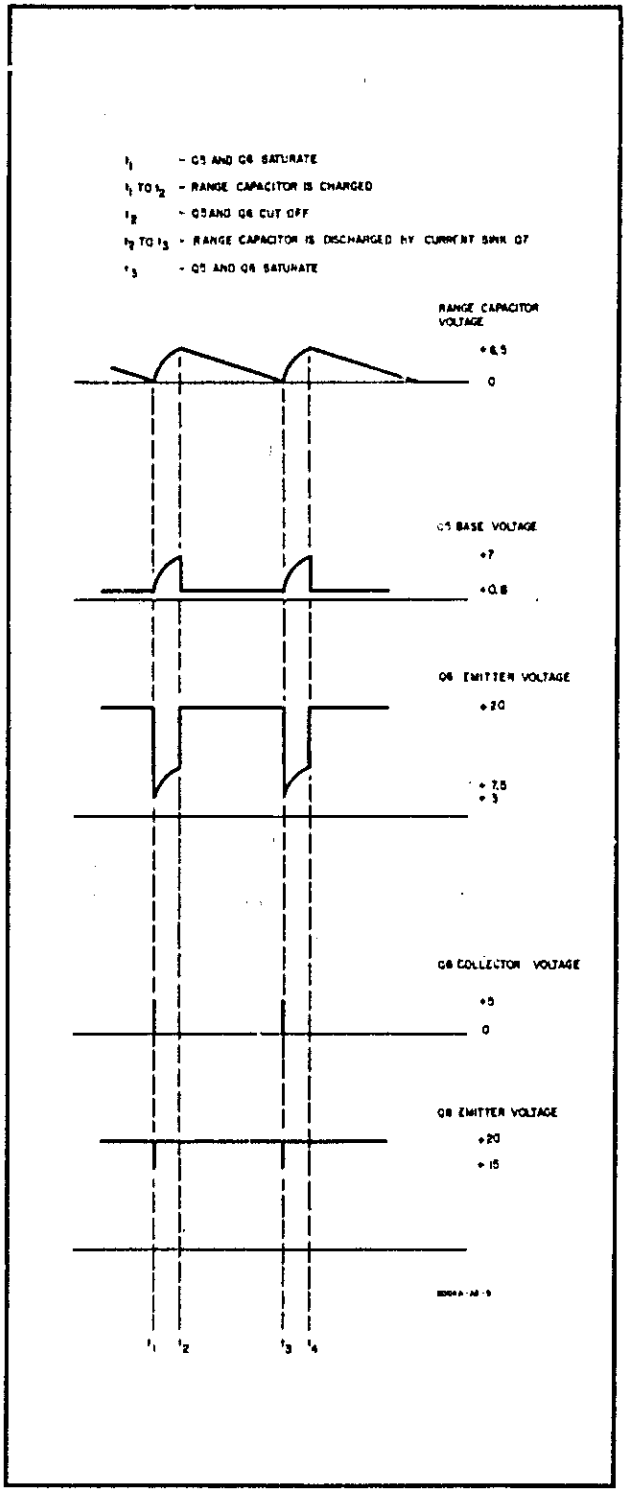


Figure 4–2. Rep. Rate Generator Waveforms

4–12. With A5S1 in the EXT.+ position, R3 is connected to + 20 V, so CR2 and CR3 are reverse-biased (the collector of Q1 remains clamped at + 11 V). A positive trigger signal raises the emitter voltage of Q1, and via R6, also raises the emitter voltage of Q2. Q2 thus conducts less and the increase in its collector voltage is fed through CR2 to the base of Q3. The Schmitt trigger then behaves exactly as in the EXT.- mode described above. Figure 4–4 shows some typical waveforms at various points of the trigger circuitry in the EXT.+ mode.

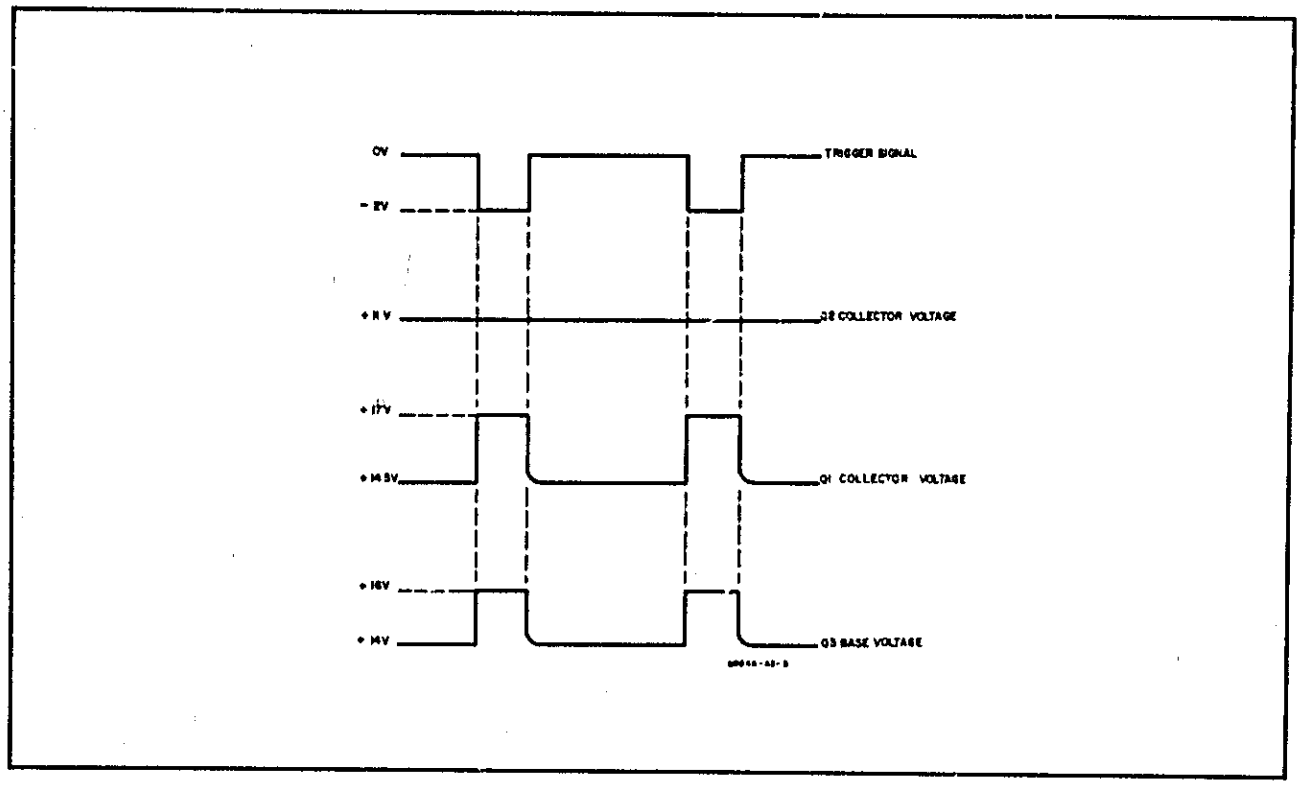


Figure 4–3. Waveforms in EXT.-Mode with Negative External Trigger

4–13. In either of the two EXTernal positions, REP.RATE selector switch A5S1 connects R24 to - 20 V. This holds the base of Q5 at approximately 0 V. Thus REP.RATE generator Q5/Q6 is cut off, current sink Q7 draws all current through CR11 until a positive spike from Schmitt trigger Q3/Q4 momentarily reverse-biases CR13. The base voltage of Q5 then rises and the rep. generator functions as in the internal mode for one cycle. Note that the waveform at the base of Q5 in this mode is identical to one cycle of the free-running mode at 10 MHz, since Q5 charges only C7/C8, and the discharge ramp is extremely short (Q7 draws max. current).

4–14. MANUAL TRIGGERING

4–15. In this mode of operation, A5S1 is set to EXT.+/ MAN. When the MAN. button is pressed, C1 charges and the voltage at the base of Q3 rises, causing Schmitt Trigger Q3/Q4 to switch. When the button is released, C1 discharges, Q3 base voltage falls and the Schmitt trigger returns to its original state.

4–16. TRIGGER DELAY

4–17. The output trigger is delayed with respect to the signal at the repetition rate generator by approximately 100 nanoseconds. This delay may be short-circuited by S1 - a slide switch on the A1 PC board. The positive spike from Q8 collector is fed to the base of Q12. C14 and C15 are charged to approximately the peak value of the spike, after which Q12 base-emitter junction becomes reverse-biased and C14/C15 discharge through R37. The base of Q13 is held at approximately + 0.6 V by CR20 so Q13 turns off when C14/C13 are charged (to approx. + 4.5 V). This produces a positive spike across L3. As the emitter voltage of Q13 falls to about 0 V, Q13 turns on and a negative spike is produced across L3. The positive spike is clipped by Q14 and the negative spike turns Q14 on, producing a positive impulse at the collector which is fed to the trigger output connector via divider network R42/R43. Figure 4–5 shows some typical waveforms.

4–18. GATING

4–19. With OPER.MODE switch S2 in the NORM. position, R27 is connected to + 20 V. The collector of Q9 is thus always at or above about + 15 V. Since Q5 reaches a maximum of about + 7 V, CR14 is always reverse-biased and gating signals do not interfere with the repetition rate generator functions. + 20 V is also connected to Q10 base, cutting Q10 off and permitting Q11 to function as a normal amplifier.

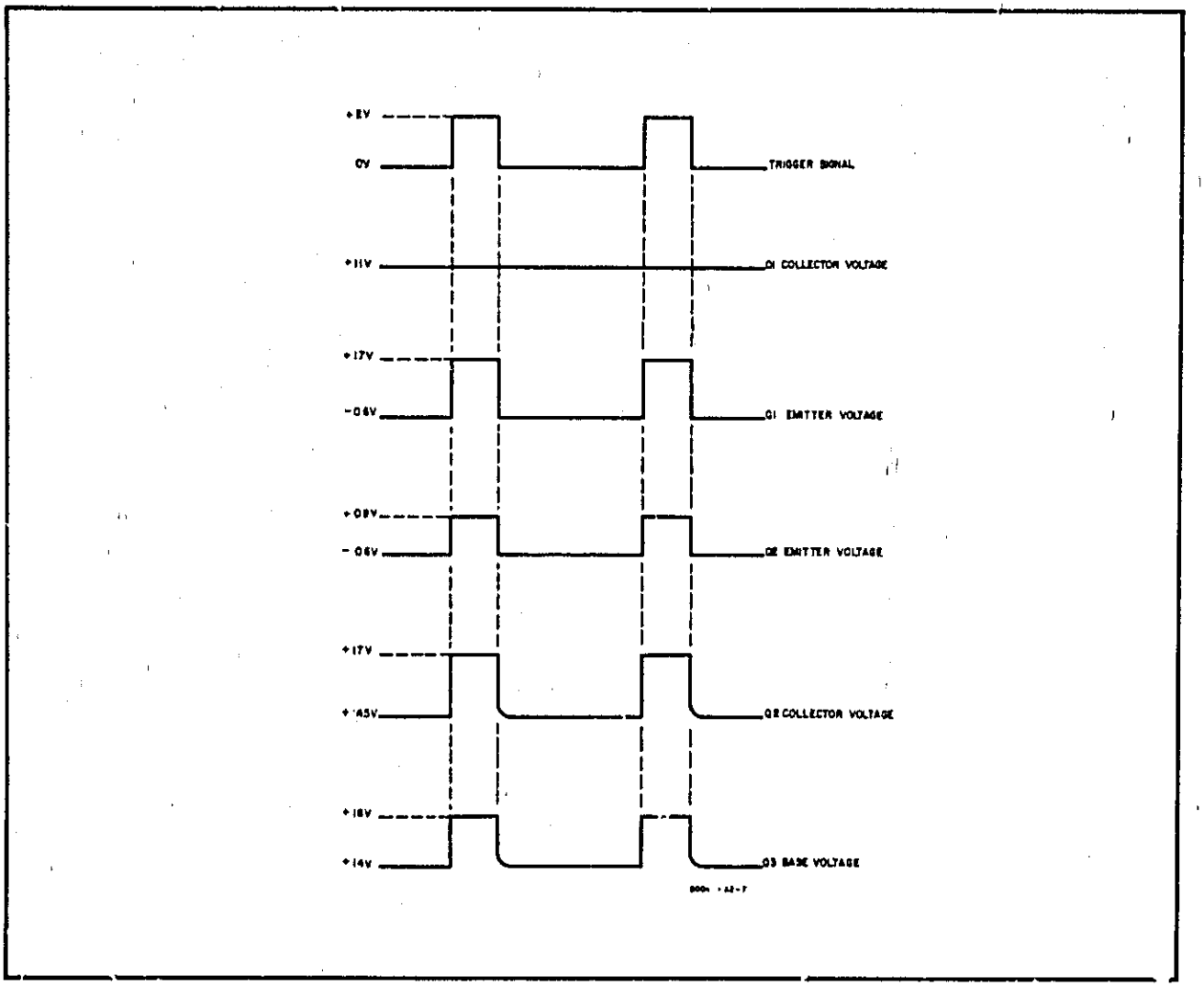


Figure 4–4. Waveforms in EXT.-Mode with Positive External Trigger

4–20. ASYNCHRONOUS GATING

4–21 With S2 in the ASYN position, CR14 is still reverse biased, permitting the repetition rate generator to run, but Q10 base is now connected to the collector of Q9 which is approximately + 15 V. Q10 thus conducts and effectively turns off amplifier Q11, since it draws all available current from R32. A negative signal applied to J2 turns off Q9 and raises its collector voltage to + 20 V. Thus Q10 is switched off, Q11 functions normally and output pulses are obtained for the duration of the gating signal.

4–22. SYNCHRONOUS GATING

4–23. In the SYN. mode, Q10 base is always at + 20 V, so Q10 is off and this part of the circuit functions normally. However, R27 is now connected to ground so that Q9 collector is at or below ground potential, CR14 is forward biased and the repetition rate generator is held off. A negative gating signal turns Q9 off, raises its collector voltage enough to reverse-bias CR14, and the repetition rate generator functions normally for the duration of the gating signal.

4–24. Since the gating takes place before pulse width is established, i.e. while the main signal is still in the form of spikes, the last output pulse before the gating signal is removed will always be completed, even if the gating pulse is stopped immediately after the output pulse has started. The gating function is always the same, regardless of whether the instrument is triggered internally or externally.

4–25. MAIN PULSE DELAY

4–26. The state of the delay circuit (refer to Figure 7–5)

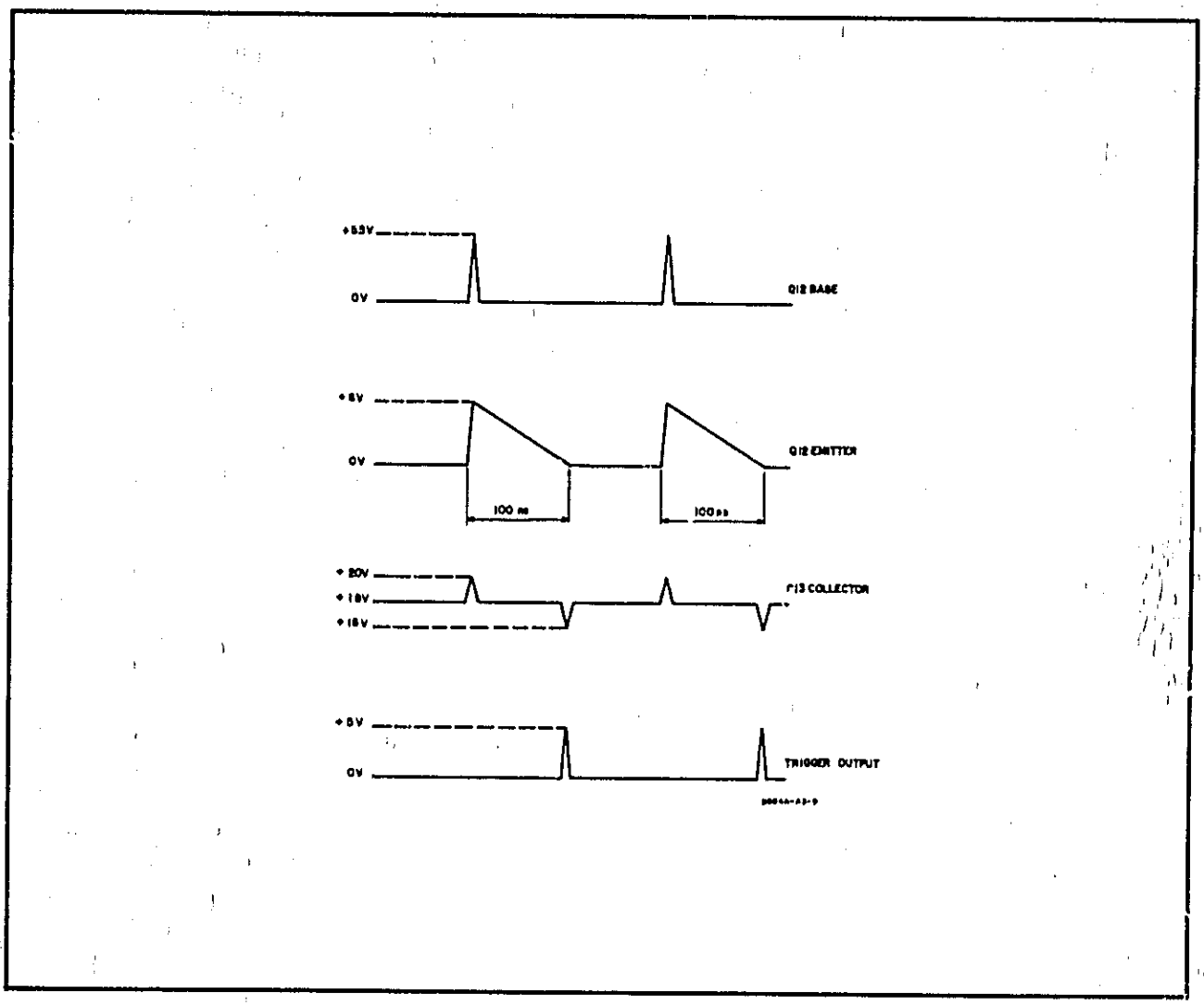


Figure 4–5. Waveforms in Trigger Delay Circuit

between pulses is as follows: Q15 is off, since its base is held at 0 V by Q11 collector. Bistable Schmitt trigger Q16/Q17 is in the state Q16 off, Q17 on. (The Schmitt trigger is "bistable" because the input is biased between the switching thresholds so that spikes exceeding the threshold limits will trigger the circuit into switching to the other state). Q18 is on, holding Q20 base almost at ground potential. Schmitt trigger Q20/Q21 is thus in the state Q20 off, Q21 on.

4–27. A positive spike from Q11 collector momentarily turns on Q15. This drops Q16 base potential and switches schmitt trigger Q16/Q17. Transistor switch Q18 is switched off, and the selected range capacitor is charged by current source Q19. This results in a positive ramp on Q20 base – the slope determined by the value of the range capacitor (selected by delay switch A6S1) and the current output of the current source Q19 (determined by VERNIER setting A6R2). When the ramp voltage reaches about + 4V, Schmitt trigger Q20/Q21 switches, thus raising the base potential of Q16 above the threshold. Q16/Q17 switches back to its original state, Q18 turns on and the range capacitor is discharged very fast. Q20 base voltage drops back to 0V and Q20/Q21 switches to its original state.

4–28. The overall result is a negative pulse at Q17 collector and positive pulse at Q16 collector. The two pulses are differentiated by L4 and L5, each producing positive and negative spikes separated by the DELAY setting.

4–29. WIDTH CIRCUIT

4–30. In the SINGLE PULSE mode, Q24 is cut off by Q22, so Q23 functions as a conventional amplifier. Initially

off, Q23 turns on when the negative spike from L4 (delayed w.r.t. the rep.rate generator output) is applied to its base. The preceding positive spike which is not delayed, has no effect. Q23/Q29 is a bistable Schmitt trigger with Q28 initially on and Q29 off. The positive spike at Q28 base, due to Q23 turning on, causes the Schmitt trigger to switch and stay switched.

4–31. Q33, which was previously on, now turns off, permitting current source Q39 to charge the selected range capacitor (C36 through C40). The range capacitors are isolated by switching transistors Q34 through Q38. A particular capacitor is selected by WIDTH switch A7S1, connecting the base of the associated transistor to R8. This saturates the transistor, effectively grounding one side of the range capacitor. The quiescent voltage on the common rail connecting the range capacitors is about - 4 V, while the base voltage of Q40 is held at - 2 V by voltage divider R96/R100. Thus Q40 is reverse-biased until the ramp at its emitter reaches approximately - 1 V. The Q40/Q41 configuration is similar to the REP.RATE generator circuit in that regeneration saturates both transistors very rapidly. The range capacitor is immediately discharged, the voltage on the common rail drops to about - 6 V, and since the current source Q39 does not supply enough current to keep Q40 saturated, both Q40 and Q41 turn off.

4–32. The positive spike generated at Q42 collector during the process described above is fed back to Q27 base. The collector voltage of Q27, and hence the base of Q28, drop and Schmitt trigger Q28/Q29 returns to its original state, lowering Q33 base to about – 5 V. However, Q33 does not turn on again until the second ramp on the common rail has swung back up to approximately – 4 V. During this time Q33 is off, the collectors of Q23/Q24 are held negative via Q26 and Q25. Spikes arriving from the DELAY circuit during this blocking period, have no effect on the WIDTH circuit, so that the duty cycle is limited. The circuit "counts down" if the maximum permissible duty cycle is exceeded.

4–33. The positive spike generated across L7 when Schmitt trigger Q28/Q29 first switches, is amplified by Q32, Q30 and Q31 and is fed to the two output amplifiers. Note: Q32 turning on in fact produces a negative spike at Q30 base, but R81 and L8 are so chosen that the voltage then swings back positive, causing Q30 to conduct. The negative spike at Q41 collector, which occurs at the end of the width period, is amplified by Q42 and Q43, and also applied to the output amplifiers. The net result is a sequence of two spikes - a positive one to indicate the beginning of the output pulse, and a negative one to indicate the end.

4–34. In the DOUBLE PULSE mode, Q22 is off permitting Q23 to switch when a pulse is applied through C31. Thus the negative pulse from L5, corresponding to the start of the DELAY period, causes Q24 to conduct, producing a positive spike at its collector to switch Schmitt trigger Q28/Q29. Thus output pulses are produced both at the beginning and end of the delay period, and the DELAY may be adjusted to vary the spacing between the pulses.

4–35. OUTPUT AMPLIFIERS

4–36. The width-determining spikes from the WIDTH circuit are fed to both positive and negative output amplifiers, but only one is operative at any one time, depending on the setting of PULSE POLARITY switch S5. The operation of the two amplifiers is identical - only the positive output amplifier is described here.

4–37. Q1/Q2 is a bistable Schmitt trigger with Q2 initially on. The positive spike, indicating the beginning of an output pulse, switches the Schmitt trigger, which stays switched with Q1 on and Q2 off until the end of the pulse is indicated by the negative spike turning Q1 off. The pulse at Q2 collector is applied to Q3 which operates between cut-off and saturation, i.e. the collector voltage of Q3 varies between approximately + 20 V and the voltage due to the resistive divider R10 and R12, R13 present at Q7 emitter. The latter may be varied by the AMPLITUDE VERNIER R13a, so that the vernier amplitude adjustment is made before the pulse is fed to Q4 for final amplification. This current delivered from Q4 is fed through a common-base stage Q5 to the 50Ω source resistance. With S5 in the "–" position, Q7 emitter voltage is + 20 V so Q3, Q4, and Q5 all remain cut off and the amplifier is disabled.

4–38. ATTENUATOR

4–39. Either of the two output amplifiers may be connected to the attenuator S7. The attenuator consists of three symmetrical resistive networks with attenuations of 2,5, and 10, when fed from 50Ω source and terminated with a 50Ω load. The networks are used individually or in series to yield attenuations of 2, 5, 10, 20, 50, and 100.

4–40. DC OFFSET

4–41. With DC OFFSET switch S4 in the OFF position, Q44 and Q45 bases are both grounded. Q44 through Q47 are off and no current flows to the attenuator assembly. With S4 in the ON position, and vernier R2 set to such a position that R2 is tapped at the center, all the voltages in the circuit are symmetrical about 0 V, collector currents from Q46 and Q47 are equal and opposite so that they cancel, and there is no current flow to the attenuator. Any

unbalance of R2 in either direction causes a corresponding unbalance in Q46/Q47 collector currents so a net current flows to the attenuator and load. The circuit is in fact a current source with high source impedance so that the output pulses are not shunted.

4–42. POWER SUPPLY

4–43. The Model 8004A operates from either 115 V or 230 V ac, which is stepped-down, rectified and regulated to provide dc outputs of + 20 V, - 8.1 V and - 20 V. The two primary windings on transformer T1 are switched in parallel for 115 V operation or in series for 230 V operation by S7. The regulator circuits for the + 20 V and - 20 V supplies are identical. An error amplifier detects variations in the output voltage. The variations are inverted, amplified and applied to a series regulator via a driver. The - 8.1 V output is obtained from the regulated - 20 V by a bootstrapped voltage source.

MAINTENANCE

Table 5–1. Required Test Equipment

Recommended Instrument		Required Characteristics
Type	Model	
High-Frequency Oscilloscope	HP 180A with HP 1801A and HP 1821A	Band Width: 50 MHz Dual trace, sweep delay capability. Sensitivity: 0.05 – 2 V/cm
Sampling Oscilloscope	HP 140A with HP 1424A and HP 1410A	Band Width: 1 GHz Sweep Time: 10 ns – 5 μs/cm
Square Wave Generator	HP 211B	Rise Time: < 50 ns Repetition Rate: 10 kHz Amplitude: - 1.5 V
Test Oscillator	HP 651B	Frequency Range: 10 kHz to 10 MHz Output Amplitude: > 2 V pk.pk.
Counter	HP 5216A	Frequency: 10 MHz
DC Voltmeter	HP 412A	Accuracy: ±1% Range: 1 to 30 V
50 Ω Attenuator	HP 8491A	Band Width: 1 GHz Attenuation: 20 dB
Tee	HP 10221A	50 Ω System
Feed-Through Termination	HP 11048B	50 Ω (±1 Ω) load
BNC TEE	UG – 274B/U 74868	
Termination	GR 874–W50B	Resistance: 50 Ω Power Rating: 1 W minimum
Adapter	GR 874	Type N to GR
Cable	HP 10120A	3 ft 50 Ω co-ax, terminated at both ends with BNC male connectors (4 required).

SECTION V

MAINTENANCE

5–1. INTRODUCTION

5–2. This section provides maintenance and service information for the Model 8004A 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 8004A 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 8004A 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.

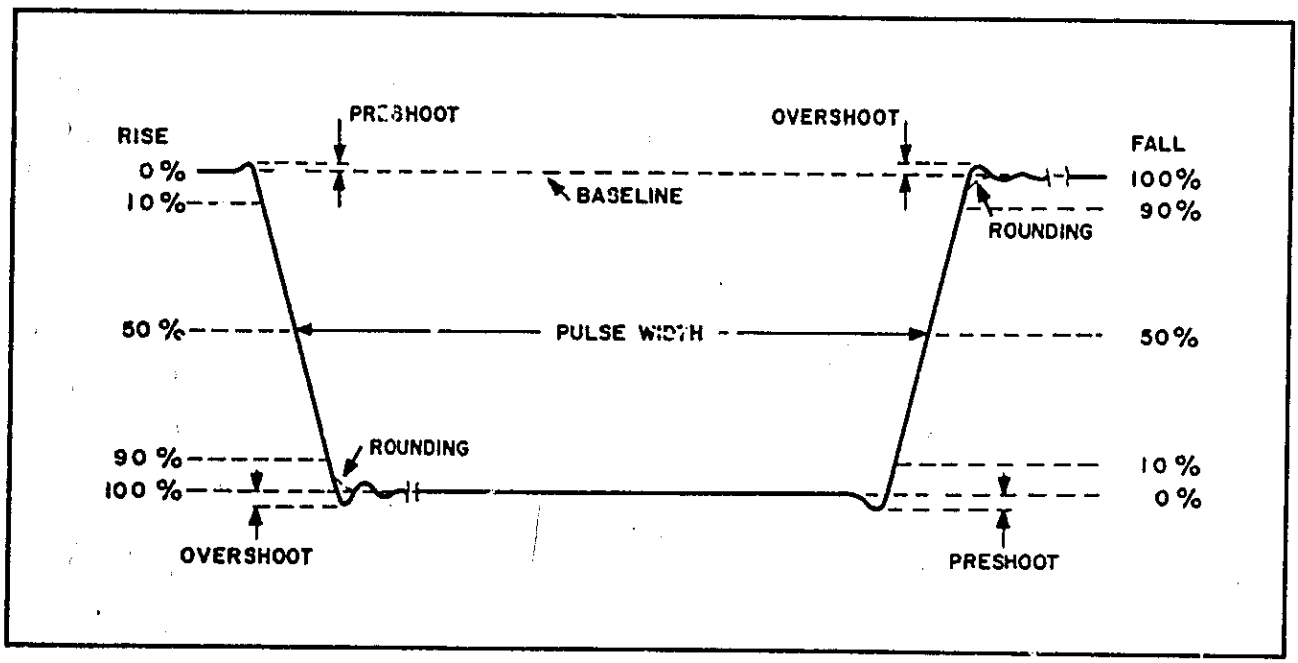
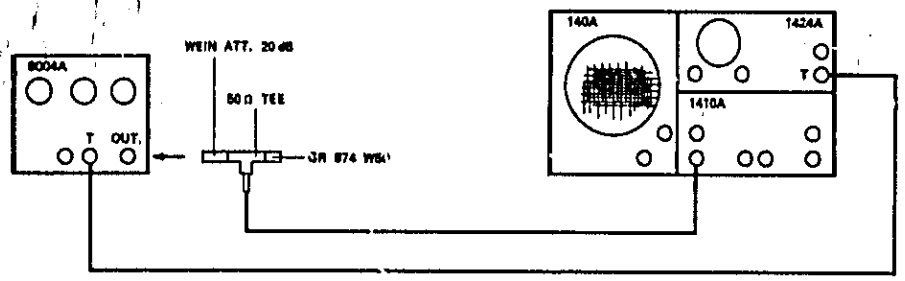


Figure 5–1. Definition of Output Pulse Characteristics

Table 5–2. Performance Checks

1. Rise and Fall Times: Less than 1.5 ns.

a. Connect equipment as shown below.



b. Set controls as follows:

8004A	REP. RATE	1 M
	VERNIER	cw
	PULSE DELAY	0.1 μ
	VERNIER	ccw
	PULSE WIDTH	0.1 μ
	VERNIER	ccw
	AMPLITUDE	5 V
	VERNIER	cw
	DC OFFSET	OFF
	PULSE POLARITY	– (neg.)
	OPER. MODE	NORM
	SINGLE PULSE MODE	
	SWITCH A1S1	ND
Sampling Oscilloscope	TIME SCALE	0.1 μs/cm (EXPANDED)
	TRIGGERING	normal
	TRIGGER SLOPE	+ (pos.)
	CHANNEL A SENS.	50 mV/cm.

c. Adjust the 8004A AMPLITUDE VERNIER for a full-screen picture (10 cm), and the WIDTH VERNIER for a 40% duty cycle.

d. Switch the Oscilloscope time scale to 1 ns.

e. Move the leading edge of the pulse to the center of the graticule with the Oscilloscope delay control. The rise time shall be less than 1.5 ns.

f. Move the trailing edge of the pulse to the center of the graticule. The fall time shall be less than 1.5 ns.

g. Repeat steps e. and f. with the 8004A PULSE POLARITY switched to + (pos).

Table 5–2. Performance Checks (cont'd)

2. Preshoot and Overshoot: Less than 5% of pulse amplitude. CORNER ROUNDING to occur no sooner than 95% of pulse amplitude.

a. Use same equipment setup as shown in Paragraphs 1a and 1b.

b. Set Oscilloscope time scale to 20 ns/cm and sensitivity to 10 mV/cm (2%/cm).

c. Move the leading edge of the pulse to the center of the graticule. The leading edge preshoot and overshoot shall be less than 5%.

d. Move the trailing edge of the pulse to the center of the graticule. The trailing edge preshoot and overshoot shall be less than 5%.

e. Repeat steps c. and d. with the 8004A PULSE POLARITY switched to + (pos.).

f. Connect the Weinschel attenuator to the 8004A output. Set Oscilloscope time scale to 50 ns/cm and sensitivity to 50 mV/cm.

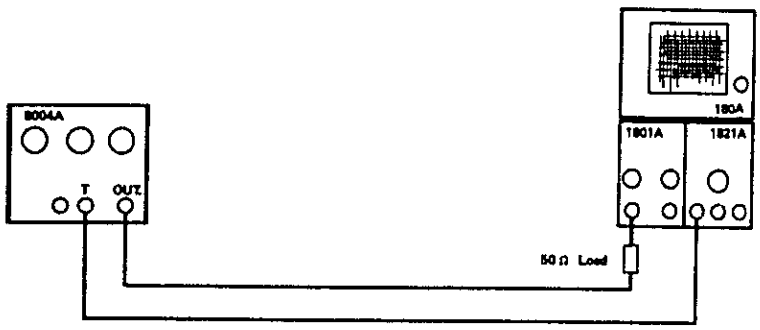
g. Measure the corner rounding on the leading edge of the pulse. Rounding shall occur no sooner than 95% of pulse amplitude.

h. Measure the corner rounding on the trailing edge of the pulse. Rounding shall occur no sooner than 95% of pulse amplitude.

i. Repeat steps g. and h. with the 8004A PULSE POLARITY switched to – (neg.).

3. Pulse Amplitude: 5 V maximum across 50 Ω; seven-step attenuator reduces output to 0.05V in a 5, 2.5, 1 sequence; vernier provides continuous adjustment between steps and reduces minimum output to less than 0.02 V.

a. Connect the equipment as shown below:



b. Set controls as follows:

8004A	REP. RATE	10 M
	VERNIER	ccw
	PULSE DELAY	0

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

	VERNIER	ccw
	PULSE WIDTH	0.1 μ
	VERNIER	ccw
	AMPLITUDE	5 V
	VERNIER	cw
	DC OFFSET	OFF
	PULSE POLARITY	– (neg.)
	OPER. MODE	NORM
	SINGLE PULSE MODE	
High Frequency Oscilloscope	SWEEP TIME	0.1 μs
	TRIGGER SOURCE	EXT. DC
	TRIGGER SLOPE	positive
	SENSITIVITY CH. A	1 V/cm
	POLARITY	positive

c. Adjust Oscilloscope controls for an amplitude deflection of 5 divisions.

d. Set the 8004A and Oscilloscope controls as shown in the table below to obtain the results in column four.

Oscilloscope Sensitivity	8004A Amplitude	Amplitude Vernier	Pulse Amplitude
1 V/div.	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

e. Repeat step d. with the 8004A PULSE POLARITY set to the + (pos.) position.

4. **DC-Offset:** ±2 V across 50 Ω load, independent of attenuator and vernier settings. Can be switched off.

a. Use same equipment setup as shown in Paragraphs 1a. and 1b.

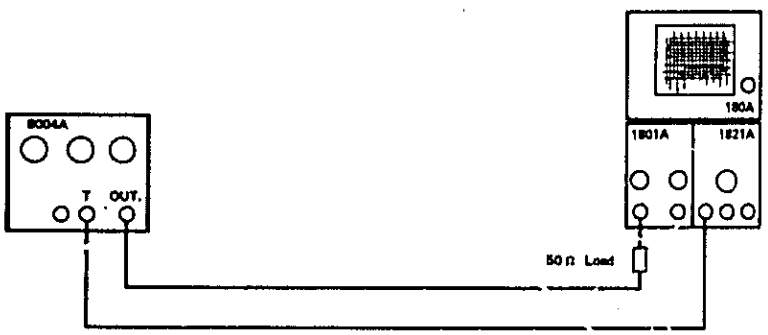
b. Switch Oscilloscope sensitivity to 100 mV/cm, and the 8004A DC OFFSET to ON.

c. Rotate the DC OFFSET control from cw to ccw. The deflection on the Oscilloscope shall be at least ± 2 volts.

Table 5–2. Performance Checks (cont'd)

5. Pulse Width: 0 to 1 ms in six ranges; vernier provides continuous adjustment between ranges.

a. Connect equipment as shown below:



b. Set controls as follows:

8004A	REP. RATE	10 M
	VERNIER	cw
	PULSE DELAY	0
	VERNIER	ccw
	PULSE WIDTH	0.1 μ
	VERNIER	ccw
	AMPLITUDE	5 V
	VERNIER	cw
	DC OFFSET	OFF
	PULSE POLARITY	– (neg.).
	OPER. MODE	NORM
	SINGLE PULSE MODE	
High Frequency Oscilloscope	SWEEP TIME	0.1 μs/cm
	MAGNIFIER	X 10
	TRIGGER SOURCE	EXT. DC. coupled
	TRIGGER SLOPE	positive
	SWEEP SELECTOR	MAIN SWEEP
	SENSITIVITY	2 V/cm DC coupled
	POLARITY	positive

c. Center the picture on the screen and measure pulse width at 50% points of the amplitude. The width shall be less than 9.6 cm.

d. Set the 8004A and Oscilloscope controls as shown in the table below to obtain the results in column six.

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

OSC.	8004A				
SWEEP (s/cm)	REP. RATE SETTINGS	RATE VERNIER	WIDTH SETTINGS	WIDTH VERNIER	LIMTS (cm)
0.1 μ	1 M	ccw	1 μ	ccw	≤ 9.5
1 μ	0.1 M	ccw	10 μ	ccw	≤ 9.5
10 μ	10 K	ccw	0.1 m	ccw	≤ 9.5
0.2 m	1 K	ccw	0.1 m	cw	≥ 5.3
20 μ	10 K	ccw	10 μ	cw	≥ 5.3
2 μ	0.1 M	ccw	1 μ	cw	≥ 5.3
0.2 μ	1 M	ccw	0.1 μ	cw	≥ 5.3
0.1 μ	10 M	ccw	10 n	cw	≥ 1.2

6. **Pulse Position:** (with respect to trigger output) 0 to 1 ms delay in 5 ranges; vernier provides continuous adjustment between ranges.

a. Connect equipment as shown in Paragraphs 5a and b.

b. Change 8004A control settings as follows:

REP. RATE ..... 1 M
VERNIER ..... cw
PULSE DELAY ..... 0.1 μ
VERNIER ..... ccw
PULSE WIDTH ..... 10 ns
VERNIER ..... ccw
DOUBLE PULSE MODE

c. The distance between pulses shall be less than 1.4 cm.

d. Set the 8004A and Oscilloscope settings as shown in the table below to obtain the results in column eight.

OSC.	8004A						
SWEEP (s/cm)	REP. RATE SETTINGS	RATE VERNIER	DELAY SETTINGS	DELAY VERNIER	WIDTH SETTINGS	WIDTH VERNIER	LIMITS (cm)
0.1 μ	0.1 M	cw	1 μ	ccw	0.1 μ	ccw	≤ 9.5
1 μ	10 K	cw	10 μ	ccw	.1 μ	ccw	≤ 9.5
10 μ	1 K	cw	0.1 m	ccw	10 μ	ccw	≤ 9.5
0.2 m	1 K	ccw	0.1 m	cw	10 μ	ccw	≥ 5.3
20 μ	10 K	ccw	10 μ	cw	10 μ	ccw	≥ 5.3
2 μ	0.1 M	ccw	1 μ	cw	1 μ	ccw	≥ 5.3
0.2 μ	1 M	ccw	0.1 μ	cw	0.1 μ	ccw	≥ 5.3
0.2 μ	1 M	ccw	10 n	cw	0.1 μ	ccw	≥ 1.2

Table 5–2. Performance Checks (cont'd)

7. Repetition Rate: 100 Hz to 10 MHz in five ranges; vernier provides continuous adjustment between ranges.

a. Connect equipment as shown in Paragraphs 5a and b.

b. Change 8004A control settings as follows:

PULSE WIDTH ..... 10 n
VERNIER ..... ccw

and the Oscilloscope:

MAGNIFIER ..... X 1

c. The distance between pulses shall be greater than 9.5 cm but less than 10 cm.

d. Set the 8004A and Oscilloscope settings as shown in the table below to obtain the results in column six.

OSC.	8004A				
SWEEP (s/cm)	REP. RATE SETTINGS	RATE VERNIER	WIDTH SETTINGS	WIDTH VERNIER	LIMITS (cm)
0.1 μ	1 M	cw	10 n	ccw	< 9.5
1 μ	0.1 M	cw	0.1 μ	ccw	< 9.5
10 μ	10 K	cw	1 μ	ccw	< 9.5
0.1 m	1 K	cw	10 μ	ccw	< 9.5
2 m	1 K	ccw	10 μ	ccw	> 5.3
0.2 m	10 K	ccw	10 μ	ccw	> 5.3
20 μ	0.1 M	ccw	1 μ	ccw	> 5.3
2 μ	1 M	ccw	0.1 μ	ccw	> 5.3
0.2 μ	10 M	ccw	0.1 μ	ccw	> 5.3

8. Repetition Rate, Pulse Width, and Delay Jitter: Width, less than 0.1% on any width setting, + 50 psec; Rep. Rate and Delay, less than 0.1% on any delay setting.

a. Connect equipment as shown below:

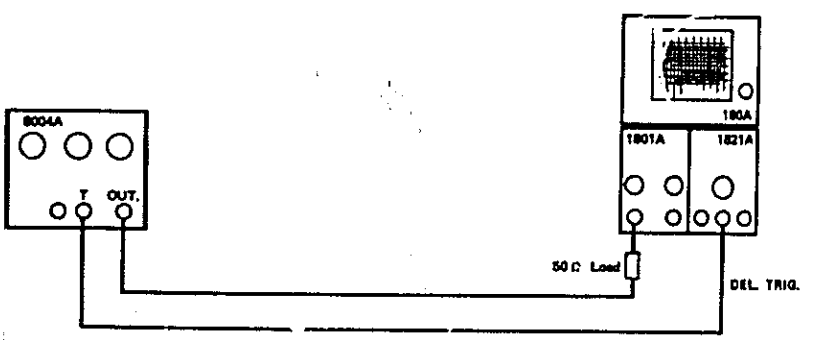


Table 5–2. Performance Checks (cont'd)

b. Set controls as follows:

8004A	REP. RATE	10 K
	VERNIER	cw
	PULSE DELAY	0
	VERNIER	ccw
	PULSE WIDTH	10 μ
	VERNIER	ccw
	AMPLITUDE	5 V
	VERNIER	cw
	DC OFFSET	OFF
	PULSE POLARITY	– (neg.)
	OPER. MODE	NORM
	SINGLE PULSE MODE	
High Frequency Oscilloscope	SWEEP TIME	0.1 ms/cm
	SENS. CH. A	2 V/cm dc coupled
	SWEEP SELECTOR	MAIN SWEEP DELAYED
	DELAY SWEEP TIME	0.1 ms/cm
	TRIGGER SOURCE	EXT. dc coupled
	TRIGGER SLOPE	negative
	DELAY FUNCTION	TRIGGER MAIN SWEEP
	DELAY LENGTH	0

c. REP. RATE JITTER

Adjust 8004A REP. RATE VERNIER for a 0.1 ms period. Switch the Oscilloscope sweep time to 0.1 μs/cm and move the leading edge of the pulse, with the delay control, to the center of the graticule. The jitter on the leading edge of the pulse shall be less than 0.1 μs (10 mm).

d. Switch the Oscilloscope sweep time back to 0.1 ms/cm. Adjust 8004A REP. RATE VERNIER for a 0.1 ms period. Move this signal 0.1 ms by switching PULSE DELAY to 10 μ and appropriately adjusting the VERNIER.

e. Switch the Oscilloscope sweep time to 0.1 μs/cm and move the leading edge of the pulse, with the delay control, to the center of the graticule. The jitter on the leading edge of the pulse shall be less than 0.1 μs (10 mm).

f. WIDTH JITTER

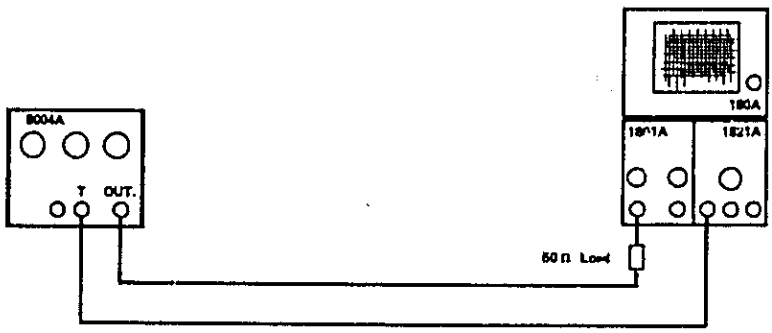
Switch the 8004A PULSE DELAY to 0 and its VERNIER ccw. With the Oscilloscope sweep time back to 0.1 ms/cm, adjust the 8004A PULSE WIDTH VERNIER for a pulse width of 0.1 ms.

g. Switch the Oscilloscope sweep time to 0.1 μs/cm and move the leading edge of the pulse, with the delay control, to the center of the graticule. The jitter on the leading edge of the pulse shall be less than 0.1 μs (10 mm).

Table 5–2. Performance Checks (cont'd)

9.	**Maximum Duty Cycle** Greater than 50% from 100 Hz to 2 MHz, greater than 25% from 1 MHz to 10 MHz.

a. Connect equipment as shown below:



b Set controls as follows:

8004A	REP. RATE	10 M
	VERNIER	cw
	PULSE DELAY	0
	VERNIER	ccw
	PULSE WIDTH	10 n
	VERNIER	ccw
	AMPLITUDE	5 V
	VERNIER	cw
	DC OFFSET	OFF
	PULSE POLARITY	+ (pos.)
	OPER. MODE	NORM
	SINGLE PULSE MODE	
High Frequency Oscilloscope	SWEEP TIME	0.1 μs/cm
	MAGNIFIER	X 10
	TRIGGER SOURCE	EXT. dc coupled
	TRIGGER SLOPE	positive
	SWEEP SELECTOR	MAIN SWEEP
	SENS CH. A	2 V/cm dc coupled pos. polarity

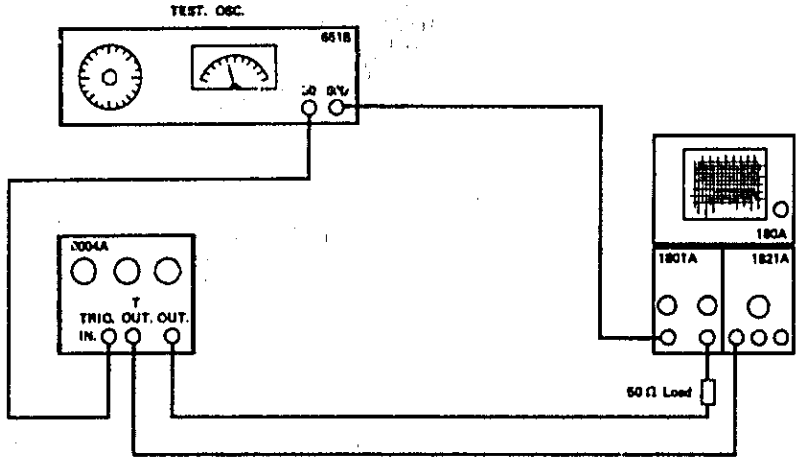
c. Adjust 8004A REP. RATE VERNIER for one period full screen. Rotate the PULSE WIDTH VERNIER slowly cw until the period counts down. The duty cycle at 50% points of the amplitude shall be greater than 25% "on time".

d. Switch the Oscilloscope sweep magnifier to X1. Set the 8004A REP. RATE to 1 M and its VERNIER ccw. Switch the PULSE WIDTH to 1 μ and its VERNIER also ccw. Adjust the Oscilloscope sweep vernier for a pulse width of 5.2 cm. Adjust the 8004A REP. RATE VERNIER for a full screen period. Rotate the PULSE WIDTH VERNIER slowly cw until the period counts down. The duty cycle at 50% points of the amplitude shall be greater than 50% "on time".

Table 5–2. Performance Checks (cont'd)

10. External Triggering: Repetition Rate, 0 to 10 MHz can be triggered with sine waves or pulses of either polarity. Sensitivity, sine waves 2 V pp, pulses 1 V peak at least 15 ns wide, maximum input ±10 V.

a. Connect equipment as shown below:



b. Set controls as follows:

8004A	REP. RATE	EXT. +
	VERNIER	cw
	PULSE DELAY	0
	VERNIER	ccw
	PULSE WIDTH	1 μ
	VERNIER	ccw
	AMPLITUDE	5 V
	VERNIER	cw
	DC OFFSET	OFF
	PULSE POLARITY	– (neg.)
	OPER. MODE	NORM
	SINGLE PULSE MODE	
Test Oscillator	FREQ. RANGE	X 10 K
	DIAL	1
	OUTPUT ATTN.	0.3 V
	AMPLITUDE	0.25 V RMS
High Frequency Oscilloscope	SWEEP TIME	20 μs/cm
	TRIGGER SOURCE	EXT. dc coupled
	TRIGGER SLOPE	positive
	CHANNEL SELECTOR	ALTERNATE
	SENS. CH A	1/cm dc coupled
	SENS. CH B	2 V/cm dc coupled
	SWEEP SELECTOR	MAIN SWEEP

c. Center both channels vertically. The pulse shall occur during the positive slope of the sine wave.

d. Switch the 8004A REP. RATE to EXT. –. The pulse shall occur during the negative slope of the sine wave.

Table 5–2. Performance Checks (cont'd)

e. Switch Oscilloscope sweep time to 0.1 μs/cm, Channel Selector to B. Set Oscillator frequency range to x 1 M and the dial to 10. Switch 8004A PULSE WIDTH to 10 n. Repeat steps c. and d. Observe a pulse rate of 10 MHz.

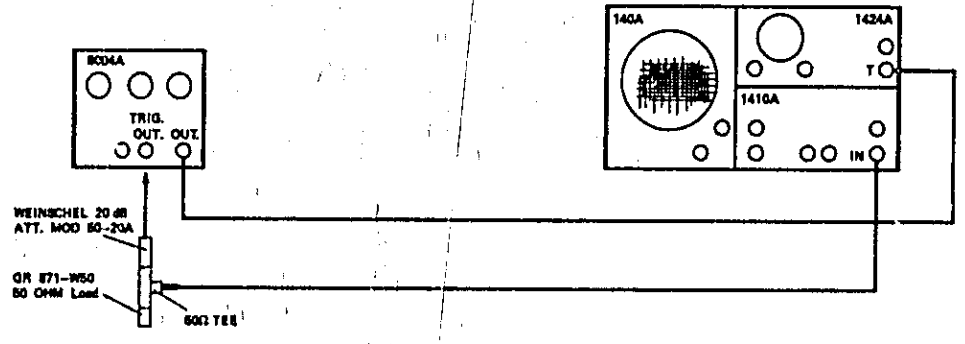
f. MANUAL TRIGGERING

Remove the Oscillator lead from the 8004A trigger input. Switch the REP. RATE to EXT. +/MAN. and PULSE WIDTH to 10 μ. Switch the Oscilloscope sweep time to 20 μs/cm.

g. Press the MAN. push button for one pulse on the Oscilloscope.

11. Trigger Output: Amplitude, greater than + 2 volts across 50 Ω. Width, 15 ns ± 10 ns at 50% amplitude points.

a. Connect equipment as shown below:



b. Set controls as follows:

8004A	REP. RATE	10 M
	VERNIER	12 o'clock
	PULSE DELAY	0
	VERNIER	ccw
	PULSE WIDTH	10 ns
	VERNIER	3 o'clock
	AMPLITUDE	1 V
	VERNIER	cw
	DC OFFSET	OFF
	PULSE POLARITY	+ (pos.)
	OPER. MODE	NORM
	INTERNAL SWITCH(s)	"D"
	SINGLE PULSE MODE	
Sampling Oscilloscope	TIME SCALE	10 ns/cm
	SENS. CH. A	100 mV/cm

Table 5–2. Performance Checks (cont'd)

c. Move the trigger pulse to the center of the graticule. The pulse amplitude shall be greater than + 2 volts (4 cm).

d. Adjust Oscilloscope sensitivity vernier for a full screen picture (10 cm). The trigger pulse width at 50% points of the amplitude shall be 15 ns ± 10 ns.

e. Switch the internal switch (A1S1) to "ND" and repeat steps c. and d.

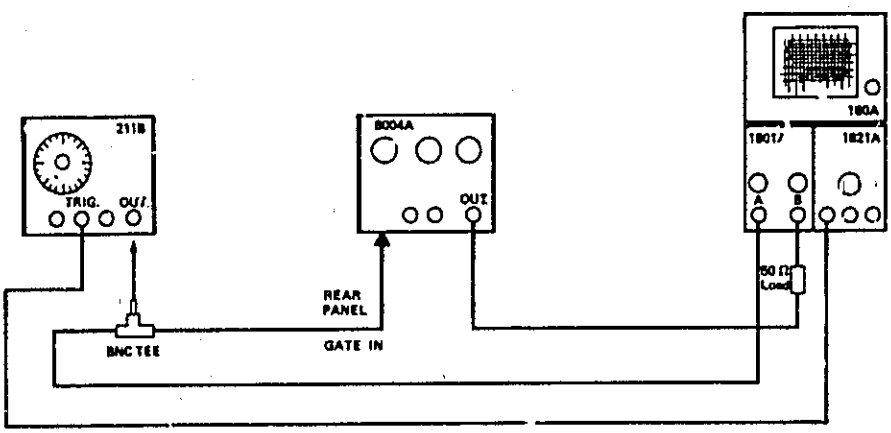
f. Set internal switch back to "D".

12. Gating

Synchronous Gating: Gating signals turn pulse 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 normal even if gate ends during pulse.

Asynchronous Gating: Gating signal turns output pulse "on". Trigger output always available; last pulse ends with gate. Gate input, - 2 volts to - 20 volts enabling.

a. Connect equipment as shown below:



b. Set controls as follows:

8004A	REP. RATE	0.1 M
	VERNIER	cw
	PULSE DELAY	0
	VERNIER	ccw
	PULSE WIDTH	1 μ
	VERNIER	ccw
	AMPLITUDE	5 V
	VERNIER	cw
	DC OFFSET	OFF
	PULSE POLARITY	– (neg.)
	OPER. MODE	SYN.
	SINGLE PULSE MODE	

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

Square Wave Generator	FREQUENCY	10 K
	SYMMETRY	50%
	AMPLITUDE	1.5 V
	POLARITY	negative
High Frequency Oscilloscope	SWEEP TIME	10 μs/cm
	TRIGGER SOURCE.....	EXT. dc coupled
	TRIGGER SLOPE	positive
	CHANNEL SELECTOR	ALT
	SENS CH. A	2 V/cm dc coupled
	SENS CH. B	1 V/cm dc coupled
	SWEEP SELECTOR	MAIN SWEEP

c. Rotate 8004A REP. RATE VERNIER slowly ccw and observe the pulse burst on the crt. Pulses shall occur only during the Square Wave Generator's "on time".

d. Set the 8004A OPER. MODE to ASYN. The pulse burst on the crt shall be non-synchronous with the Square Wave Generator.

e. Disconnect the Square Wave Generator from the 8004A's GATE INPUT. No pulses shall occur.

5–7 ADJUSTMENT PROCEDURE

5–8 This procedure should be conducted only after it has been established that the 8004A 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.

5–9 Power Supply

a. Measure the voltage between test point + 20 V, on circuit board A2, and chassis ground with a digital voltmeter. Adjust A2R66 for + 20 volts.

b. Measure the voltage between test point - 20 V, on circuit board A2, and chassis ground. Adjust A2R76 for - 20 volts.

c. Measure the - 9.1 V supply (cathode CR23) for a reading between - 7.8 and - 8.4 volts.

5–10 Repetition Rate

a. Connect the 8004A PULSE OUTPUT to a Counter.

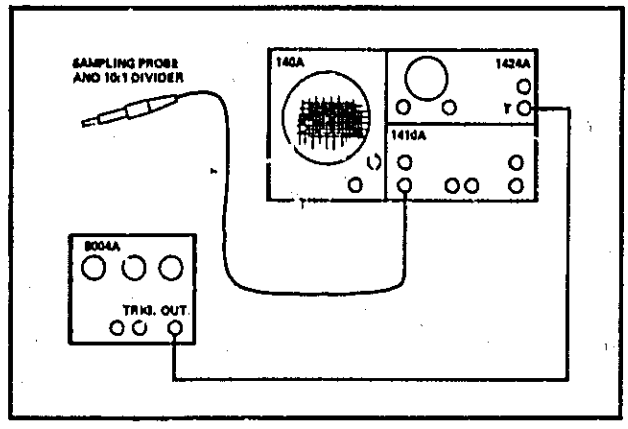
b. Set 8004A controls as follows:

REP. RATE	10 M
VERNIER	cw
PULSE DELAY	0
VERNIER	ccw
PULSE WIDTH	10 n
VERNIER	ccw
AMPLITUDE	5 V
VERNIER	cw
DC OFFSET	OFF
PULSE POLARITY	– (neg.)
OPER. MODE	NORM
SINGLE PULSE MODE SWITCH A1S1	ND

c. Adjust trim capacitor A1C7 for a counter reading of 10.25 MHz.

5–11 Start Pulse and Trigger Output

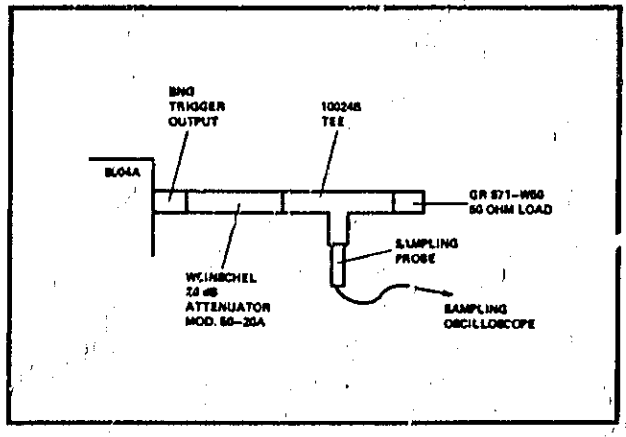
a. Connect equipment as shown below:



b. Set controls as follows:

8004A	REP. RATE	10 M
	VERNIER	12 o'clock
	PULSE DELAY	0
	VERNIER	ccw
	PULSE WIDTH	10 n
	VERNIER	3 o'clock
	AMPLITUDE	1 V
	VERNIER	cw
	DC OFFSET	OFF
	PULSE POLARITY	+ (pos.)
	OPER. MODE	NORM
	SINGLE PULSE MODE INTERNAL SWITCH S1	D
Sampling Oscilloscope	TIME SCALE	100 ns/cm
	MAGNIFIER	x 10
	SENS. CH. A	100 mV/cm

c. With the 10:1 probe monitor the input to A2C13. The amplitude of the pulse shall be between 3 and 4 volts. If incorrect, select the value of A1R93.



d. Trigger Delay Adjustment

Disconnect the divider from the sampling probe and connect as below:

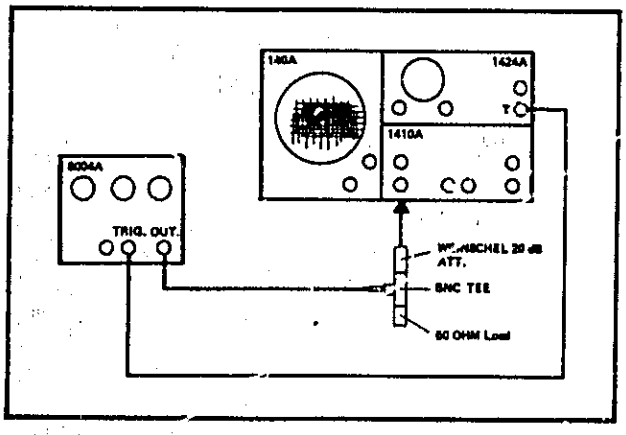
Set 8004A REP. RATE VERNIER ccw and the PULSE WIDTH VERNIER ccw.

Adjust A1C15 until the amplitude of the trigger pulse begins to decrease. Set the Sampling Oscilloscope time scale to 20 ns/cm and the magnifier to x 2. The trigger pulse amplitude shall be greater than 2.2 volts, and the pulse width at 50% points shall be 15 ns ± 4 ns.

e. Repeat step d. with the 8004A internal switch S1 set to its ND position. The pulse amplitude shall be greater than 2.2 volts and the width at 50% points shall be 10 ns ± 4 ns.

5–12 Pulse Width

a. Connect equipment as shown below:



b. Set controls as follows:

8004A	REP. RATE	10 M
	VERNIER	12 o'clock
	PULSE DELAY	0
	VERNIER	ccw
	PULSE WIDTH	0
	VERNIER	cw
	AMPLITUDE	5 V
	VERNIER	cw
	DC OFFSET	OFF
	PULSE POLARITY	– (neg.)
	OPER. MODE	NORM
Sampling Oscilloscope	TIME SCALE	100 ns/cm
	MAGNIFIER	x 20
	SENS. CH. A	50 mV/cm

c. Adjust 8004A DELAY and AMPLITUDE VERNIERS for a pulse on the screen.

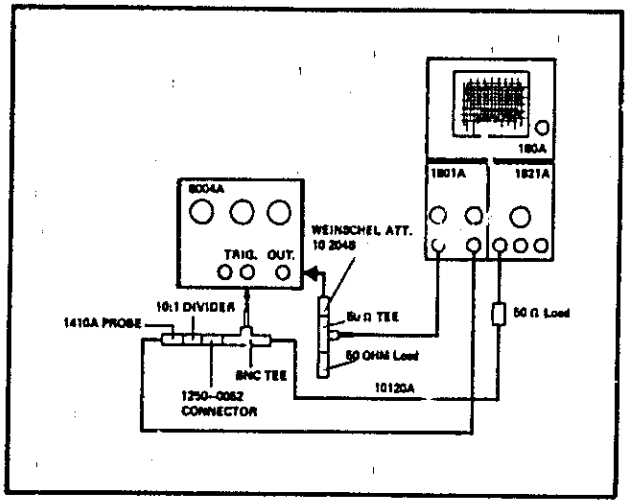
d. Set the 8004A PULSE WIDTH VERNIER to the 10 o'clock position. Adjust A1C46 so that the pulse just disappears. Check with the WIDTH VERNIER setting from ccw to a 9 o'clock position that no pulse appears in either the positive or negative position of the PULSE POLARITY switch.

e. Turn the WIDTH VERNIER fully cw and measure the pulse width. The width shall be greater than 12 ns (2.4 cm).

f. With the PULSE WIDTH set to 10 n and the VERNIER fully ccw, the pulse width shall be less than 9 ns (1.8 cm). If incorrect, readjust A1C46.

5–13 Pulse Delay

a. Connect equipment as shown below:



b. Set controls as follows:

8004A	REP. RATE	10 M
	VERNIER	12 o'clock
	PULSE DELAY	0
	VERNIER	ccw
	PULSE WIDTH	10 ns
	VERNIER	12 o'clock
	AMPLITUDE	2.5
	VERNIER	cw
	DC OFFSET	OFF
	PULSE POLARITY	– (neg.)
	OPER. MODE	NORM
	SINGLE PULSE MODE	
	SWITCH A1S1	D
Sampling Oscilloscope	TIME SCALE	100 ns/cm
	MAGNIFIER	x 10
	SENS. CH. A	100 mV/cm
	SENS. CH. B	50 mV/cm

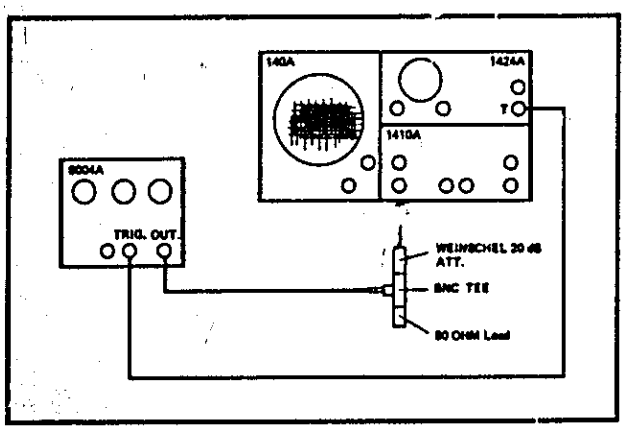
c. Adjust A1C20 for a 1 ns advance between the trigger and output pulse at 50% points of the leading edges.

d. Turn 8004A PULSE DELAY VERNIER cw. The output pulse delay with respect to the trigger pulse shall be at least 15 ns (1.5 cm).

e. Set 8004A PULSE DELAY switch to 10 n and VERNIER ccw. The delay shall now be less than 10 ns.

5–14 Rise Time Adjustment

a. Connect equipment as shown below:



b. Set controls as follows:

8004A	REP. RATE	1 M
	VERNIER	cw
	PULSE DELAY	0.1 μ
	VERNIER	ccw
	PULSE WIDTH	0.1 μ
	VERNIER	ccw
	AMPLITUDE	5 V
	VERNIER	cw
	DC OFFSET	OFF
	PULSE POLARITY	– (neg.)
	OPER. MODE	NORM
	SWITCH A1S1	ND
	SINGLE PULSE MODE	
Sampling Oscilloscope	TIME SCALE	0.1 μs/cm
	TRIGGERING	normal
	TRIGGER SLOPE	+ (pos.)
	CHANNEL A SENS	50 mV/cm

c. Adjust the 8004A AMPLITUDE VERNIER for a full-screen picture (10 cm), and the WIDTH VERNIER for a 40% duty cycle.

d. Switch the Oscilloscope time scale to EXPANDED. With the Oscilloscope delay control move the leading edge of the pulse to the center of the graticule.

e. Adjust A2C21 for the steepest rise time.

f. Set Oscilloscope time scale to 0.5 ns and adjust A2C36 and A2R85 for a good pulse shape (overshoot, ringing etc.).

g. Reduce the 8004A AMPLITUDE for a 40% display on the Oscilloscope. Increase the Oscilloscope sensitivity for a full-screen picture. Overshoot shall be less than 9%. If incorrect adjust C21 for a slightly slower rise time and repeat steps f. and g.

h. Selection of A2R15 is recommended if

(1) ringing is too great, increase the value,

(2) rise time is too slow, decrease the value.

i. Switch 8004A PULSE POLARITY to + (pos.) and AMPLITUDE to 5 V. Set Oscilloscope time scale to 0.1μs/cm (NORMAL).

j. Adjust the 8004A AMPLITUDE VERNIER for a full-screen picture (10 cm), and the WIDTH VERNIER for a 40% duty cycle.

k. Switch the Oscilloscope time scale to EXPANDED.

With the Oscilloscope delay control move the leading edge of the pulse to the center of the graticule.

l. Adjust A2C8 for the steepest rise time.

m. Set Oscilloscope time scale to 0.5 ns and adjust A2C35 and A2R84 for a good pulse shape (overshoot, ringing etc.).

n. Reduce the 8004A AMPLITUDE for a 40% display on the Oscilloscope. Increase the Oscilloscope sensitivity for a full-screen picture. Overshoot shall be less than 9%. If incorrect, adjust C21 for a slightly slower rise time and repeat steps f. and g.

o. Selection of A2R46 is recommended if
   (1) ringing is too great, increase the value,
   (2) rise time is too slow, decrease the value.

5–15. TROUBLESHOOTING

5–16. To locate trouble in the Model 8004A, start with a thorough visual inspection and then proceed to electrical check-out as necessary. During the visual inspection, look for burned or loose components, loose wire connections, or any similar condition which suggests a source of trouble. Be sure to check for a blown fuse during the visual inspection. Use a 0.5 amp slow-blow fuse for 115 V and a 0.25 amp for 230 V. Repair any faulty component or connection that is isolated during the visual inspection and check instrument performance before continuing to troubleshoot the instrument.

5–17. Troubleshooting should be performed in a logical manner. The concept of bracketing should be employed, i.e., establishing circuits or sections which are operating abnormally. Start 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 will help in determining which major part of the instrument is faulty. By utilizing other front panel controls, the source of trouble can be narrowed down even further. Then, with reference to the circuit diagrams and given waveforms, the trouble may be simplified to several components.

5–18. On troubleshooting and replacement in general, always be sure that the transistor, diode, and capacitors are in the correct position as recommended by their manufacturer. To help with proper replacement of semi-conductors, the emitter connection is identified by a small dot 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.

5–19. REPAIR AND REPLACEMENT

5–20. The following paragraphs provide recommended procedures and techniques for repair or replacement of components.

5–21. Cover Removal

5–22. The top, bottom, and both side covers are separately removable. Each cover is held in place by screws. The top and bottom covers slide towards the rear panel; be sure to free the curved portion before lifting off.

5–23. Pulse Attenuator Disassembly

5–24. For access to the pulse amplitude attenuator, assembly A3, and its relevant components proceed as follows:

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 nuts from the attenuator housing.

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

5–25. Etched Circuits

5–26. The etched circuit board is a plated-through type consisting of metallic conductors bonded on 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. Following are recommendations and precautions pertinent to etched circuit repair work:

a. Avoid unnecessary component substitution; it can result in damage to the circuit board and/or adjacent components.

b. Do not use a high-power soldering iron on etched

circuit boards. Excessive heat may lift a conductor or damage the board.

CAUTION

Do not use a short 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.

5–27. Etched Conductor Repair

5–28. A broken or burned section of conductor can be repaired 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.

5–29. Component Replacement

a. Remove defective component from circuit board.

b. Remove solder from mounting hole using a suction desoldering aid or wooden toothpick.

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

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.

5–30 Semi-Conductor Replacement

a. Do not apply excessive heat.

b. Use a heat sink such as pliers or hemostat between sufficient lead length to dissipate heat of soldering by maintaining about the same length of exposed lead as used for original transistor.

Table 5–3. Performance Check Test Card

Paragraph Reference	Check		Results Required	Actual
1.	**Rise and Fall Time**			
Step e	Negative Rise Time		< 1.5 ns	_____
Step f	Negative Fall Time		< 1.5 ns	_____
Step g	Positive Rise Time		< 1.5 ns	_____
	Positive Fall Time		< 1.5 ns	_____
2.	**Preshoot,Overshoot,and Corner Rounding**			
Step c	Negative Leading Edge Preshoot		< 5% < 5 mm	_____
	Negative Leading Edge Overshoot		< 5% < 5 mm	_____
Step d	Negative Trailing Edge Preshoot		< 5% < 5 mm	_____
	Negative Trailing Edge Overshoot		< 5% < 5 mm	_____
Step e	Positive Leading Edge Preshoot		< 5% < 5 mm	_____
	Positive Leading Edge Overshoot		< 5% < 5 mm	_____
	Positive Trailing Edge Preshoot		< 5% < 5 mm	_____
	Positive Trailing Edge Overshoot		< 5% < 5 mm	_____
Step g.	Positive Leading Edge Corner Rounding		Occurs no sooner than 95% of pulse amp.	
Step h	Positive Trailing Edge Corner Rounding			
Step i	Negative Leading Edge Corner Rounding		Occurs no sooner than 95% of pulse amp.	
	Negative Trailing Edge Corner Rounding			
3.	**Pulse Amplitude**			
Step d	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	_____

Table 5–3. Performance Check Test Card

Date: _____

Table 5–3. Performance Check Test Card

Paragraph Reference	Check			Results Required		Actual
	0.5 V	Lower	Limit	≤ 0.25	≤ 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	_____
Step e	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.	**DC Offset**					
Step c	Oscilloscope Deflection			≥ ±2 V		_____
5.	**Pulse Width**					
Step c	0.1 μs	Lower	Limit	≤ 0.1 μs	≤ 9.6 cm	_____
Step d	1 μs	Lower	Limit	≤ 1 μs	≤ 9.5 cm	_____
	10 μs	Lower	Limit	≤ 10 μs	≤ 9.5 cm	_____
	0.1 ms	Lower	Limit	≤ 0.1 ms	≤ 9.5 cm	_____
	0.1 ms	Upper	Limit	≥ 0.1 ms	≥ 5.3 cm	_____
	10 μs	Upper	Limit	≥ 10 μs	≥ 5.3 cm	_____
	1 μs	Upper	Limit	≥ 1 μs	≥ 5.3 cm	_____
	0.1 μs	Upper	Limit	≥ 0.1 μs	≥ 5.3 cm	_____
	10 ns	Upper	Limit	≥ 10 ns	≥ 1.2 cm	_____
6.	**Pulse Position**					
Step c	0.1 μs	Lower	Limit	≤ 0.1 μs	≤ 1.4 cm	_____
	1 μs	Lower	Limit	≤ 1 μs	≤ 9.5 cm	_____
	10 μs	Lower	Limit	≤ 10 μs	≤ 9.5 cm	_____
	0.1 ms	Lower	Limit	≤ 0.1 ms	≤ 9.5 cm	_____
	0.1 ms	Upper	Limit	≥ 0.1 ms	≥ 5.3 cm	_____
	10 μs	Upper	Limit	≥ 10 μs	≥ 5.3 cm	_____
	1 μs	Upper	Limit	≥ 1 μs	≥ 5.3 cm	_____

Table 5–3 Performance Check Test Card

Table 5–3. Performance Check Test Card

Paragraph Reference	Check			Results Required		Actual
	0.1 μs	Upper	Limit	≥ 0.1 μs	≥ 5.3 cm	_____
	10 ns	Upper	Limit	≥ 10 ns	≥ 1.2 cm	_____
7.	**Repetition Rate**					
Step c	10 M	Lower	Limit	≥ 10 MHz	≥ 9.5 cm	_____
Step d	1 M	Upper	Limit	≥ 1 MHz	≤ 9.5 cm	_____
	0.1 M	Upper	Limit	≥ 0.1 MHz	≤ 9.5 cm	_____
	10 K	Upper	Limit	≥ 10 kHz	≤ 9.5 cm	_____
	1 K	Upper	Limit	≥ 1 kHz	≤ 9.5 cm	_____
	1 K	Lower	Limit	≤ 1 kHz	≥ 5.3 cm	_____
	10 K	Lower	Limit	≤ 10 kHz	≥ 5.3 cm	_____
	0.1 M	Lower	Limit	≤ 0.1 MHz	≥ 5.3 cm	_____
	1 M	Lower	Limit	≤ 1 MHz	≥ 5.3 cm	_____
	10 M	Lower	Limit	≤ 10 MHz	≥ 5.3 cm	_____
8.	**Rep.Rate Jitter**					
Step c	< 0.1%			≥ 0.1 μs	≥ 10 mm	_____
	Delay Jitter					
Step e	< 0.1%			≥ 0.1 μs	≥ 10 mm	_____
	Width Jitter					
Step g	< 0.1%			≥ 0.1 μs	≥ 10 mm	_____
9.	**Maximum Duty Cycle**					
Step c	25% at 10 MHz			≥ 2.5 cm		_____
Step d	50% at 1 MHz			≥ 2.6 cm		_____
10.	**External Triggering**					
Step c	EXT +			Pulses only during sine wave positive slope		_____
Step d	EXT –			Pulses only during sine wave negative slope		_____

Table 5–3. Performance Check Test Card

Date: _____

Table 5–3. Performance Check Test Card

Paragraph Reference	Check	Results Required	Actual
Step e	EXT + 10 MHz Input	10 MHz Output	_____
	EXT – 10 MHz Input	10 MHz Output	_____
Step g	**Manual Triggering**		
	Push button for single pulses	One pulse each time button is pressed	_____
11.	**Trigger Output**		
Step c	Amplitude	> + 2 V > 4 cm	_____
Step d	Width	15 ns ± 10 ns 1.5 cm (± 1 cm)	_____
Step e	Amplitude (ND)	> + 2 V > 4 cm	_____
	Width (ND)	15 ns ±10 ns 1.5 cm (± 1 cm)	_____
12.	**Gating**		
Step c	Synchronous Mode	Pulses during Square Wave Generators "on time"	_____
Step d	Asynchronous Mode	Pulses non-synchronous with Square Wave Generator	_____
Step e	No Gate Input	No pulses	_____

Table 5–3. Performance Check Test Card

PARTS LIST

SECTION VI

REPLACEABLE PARTS

6–1. INTRODUCTION

6–2. This section contains information for ordering replacement parts. Table 6–1 lists parts in alphanumerical order of their reference designators and indicates the description and HP stock number of each part, together with any applicable notes. Miscellaneous parts are listed at the end of Table 6–1.

6–3. ORDERING INFORMATION

6–4. Address orders or inquiries either to your authorized Hewlett-Packard sales representative or to:

Customer Service
Hewlett-Packard Company
333 Logue Avenue
Mountain View, Calif. 94040

or, in Western Europe, to:

Hewlett-Packard S.A.
Rue du Bois-du-Lan 7
1217 Meyrin-Geneva

6–5. Specify the following information for each part:

a. Model and complete serial number of instrument,

b. Hewlett-Packard Stock Number,

c. Circuit reference designator,

d. Description.

To order a part not listed in Table 6–1, give a complete description of the part and include its function and location.

REFERENCE DESIGNATORS

A	= assembly	F	= fuse	P	= plug	V	= vacuum tube, neon bulb, photocell, etc.
B	= motor	FL	= filter	Q	= transistor		
BT	= battery	HR	= heater	R	= resistor	VR	= voltage regulator
C	= capacitor	J	= jack	RT	= thermistor	W	= cable
CP	= coupler	K	= relay	S	= switch	X	= socket
CR	= diode	L	= inductor	T	= transformer	Y	= crystal
DL	= delay line	M	= meter	TB	= terminal board		
DS	= lamp	MC	= micro-circuit	TP	= test point		

ABBREVIATIONS

A	= amperes	H	= henries	NPN	= negative-positive-negative	S-B	= slow-blow
AFC	= automatic frequency control	HEX	= hexagonal	NRFR	= not recommended for field replacement	SCHEM.	= schematic
AGC	= automatic gain control	Hg	= mercury	NSR	= not separately replaceable	Se	= selenium
BFO	= beat frequency oscillator					SECT	= section(s)
BeCu	= beryllium copper	IF	= intermediate freq.			SEMICON	= semiconductor
BH	= binder head	IMPG	= impregnated			Si	= silicon
BP	= bandpass	INCD	= incandescent	OBD	= order by description	SIL	= silver
BRS	= brass	INCL	= include(s)	OH	= oval head	SL	= slide
BWO	= backward wave oscillator	INS	= insulation(ed)	OX	= oxide	SPG	= spring
		INT	= internal			SPL	= special
CCW	= counter-clockwise			P	= peak	SST	= stainless steel
CER	= ceramic	k	= kilo = 10^3	PC	= printed circuit	SR	= split ring
CMO	= cabinet mount only			pF	= picofarads = 10^{-12} farads	STL	= steel
COEF	= coefficient	LH	= left hand			Ta	= tantalum
COM	= common	LIN	= linear taper	PH BRZ	= phosphor bronze	TD	= time delay
COMP	= composition	LK WASH	= lock washer	PHL	= Philips	TGL	= toggle
COMPL	= complete	LOG	= logarithmic taper	PIV	= peak inverse voltage	THD	= thread
CONN	= connector	LPF	= low pass filter	PNP	= positive-negative-positive	Ti	= titanium
CP	= cadmium plate			P/O	= part of	TOL	= tolerance
CRT	= cathode-ray tube	m	= milli = 10^{-3}	POLY	= polystyrene	TQ	= total quantity
CW	= clockwise	M	= meg = 10^6	PORC	= porcelain	TRMR	= trimmer
		MET FLM	= metal film	POS	= position(s)	TWT	= traveling wave tube
DEPC	= deposited carbon	MET OX	= metallic oxide	POT	= potentiometer		
DR	= drive	MFR	= manufacturer	PP	= peak-to-peak	VAR	= variable
		MINAT	= miniature	PT	= point	VDCW	= dc working volts
ELECT	= electrolytic	MOM	= momentary	PWV	= peak working voltage		
ENCAP	= encapsulated	MTG	= mounting			W	= watts
EXT	= external	MY	= "mylar"	RECT	= rectifier	WIV	= working inverse voltage
F	= farads	n	= nano (10^{-9})	RF	= radio frequency	WW	= wirewound
FH	= flat head	N/C	= normally closed	RH	= round head or right hand	W/O	= without
FIL H	= fillister head	Ne	= neon	RMO	= rack mount only	μ	= micro = 10^{-6}
FXD	= fixed	NI PL	= nickel plate	RMS	= root-mean square	*	= optimum value selected at factory, average value shown (part may be omitted)
		N/O	= normally open	RS	= recommended spares		
Ge	= germanium	NPO	= negative positive zero (zero temperature coefficient)	RWV	= reverse working voltage		
GRD	= ground(ed)						

Table 6-1. Reference Designation Index

Reference Designation	HP Stock No.	Description
A 1	08004-66501	REP. RATE, DELAY AND WIDTH BOARD
A 2	08004-66502	POWER SUPPLY BOARD
A 3	08004-63401	STEP ATTENUATOR ASSEMBLY
A 4	08004-66503	POLARITY SWITCH ASSEMBLY
A 5	08004-61901	RATE SWITCH ASSEMBLY
A 6	08004-61902	PULSE DELAY SWITCH ASSEMBLY
A 6	08004-61903	WIDTH SWITCH ASSEMBLY
A 1	08004-66501	REP. RATE, DELAY AND WIDTH BOARD
A 1 C 1	0180-0374	C FXD TA ELECT 10 UF 10% 20VDCW
A 1 C 2	0180-0291	C FXD TA ELECT 1 UF 10% 35VDCW
A 1 C 3	0160-2959	C FXD CER 1000PF 600 VDCW
A 1 C 4	0140-0145	C FXD MICA 22 PF 5% 500VDCW
A 1 C 5	0180-0291	C FXD TA ELECT 1 UF 10% 35VDCW
A 1 C 6	0140-0194	C FXD MICA 110 PF 5% 300VDCW
A 1 C 7	0121-0046	C VAR CER 9-35 PF
A 1 C 8	0140-0190	C FXD MICA 39 PF 5% 300VDCW
A 1 C 9	0160-2215	C FXD MICA 750 PF 5% 300VDCW
A 1 C 10	0160-0314	C FXD MYLAR .01 UF 5% 400VDCW
A 1 C 11	0170-0019	C FXD MYLAR .1 UF 5% 200VDCW
A 1 C 12	0160-1980	C FXD TA ELECT 1.0 UF 5% 35VDCW
A 1 C 13	0140-0190	C FXD MICA 39 PF 5% 300VDCW
A 1 C 14	0160-2203	C FXD MICA 91 PF 5% 300VDCW
A 1 C 15	0121-0046	C VAR CER 9-35 PF
A 1 C 16	0180-0291	C FXD TA ELECT 1 UF 10% 35VDCW
A 1 C 17	0140-0145	C FXD MICA 22 PF 5% 500VDCW
A 1 C 18	0160-2930	C FXD CER 0.01 UF +80,-20% 100VDCW
A 1 C 19	0140-0202	C FXD MICA 15PF 5% 500VDCW.
A 1 C 20	0121-0046	C VAR CER 9-35 PF
A 1 C 21	0170-0042	C FXD MYLAR .33 UF 5% 100VDCW
A 1 C 22	0160-0180	C FXD MYLAR .033 UF 5% 200VDCW
A 1 C 23	0160-2230	C FXD MICA 3300 PF 5% 300VDCW
A 1 C 24	0160-2208	C FXD MICA 330 PF 5% 300VDCW
A 1 C 25	0160-2306	C FXD MICA 27 PF 5% 300VDCW
A 1 C 26	0140-0201	C FXD MICA 12 PF 5% 500VDCW
A 1 C 27	0150-0121	C FXD CER .1UF +80%-20% 50VDCW
A 1 C 28	0150-0121	C FXD CER .1UF +80%-20% 50VDCW
A 1 C 29	0180-0291	C FXD TA ELECT 1 UF 10% 35VDCW
A 1 C 30	0160-2930	C FXD CER 0.01UF +80,-20% 100VDCW.
A 1 C 31	0160-2200	C FXD MICA 43 PF 5% 300VDCW
A 1 C 32	0160-2150	C FXD MICA 33 PF 5% 300VDCW
A 1 C 33		NOT ASSIGNED
A 1 C 34		NOT ASSIGNED
A 1 C 35	0150-0121	C FXD CER .1UF +80%-20% 50VDCW
A 1 C 36	0180-1713	C FXD TA ELECT 56 UF 5% 35VDCW
A 1 C 37	0160-0165	C FXD MYLAR .056 UF 10% 200VDCW
A 1 C 38	0160-0158	C FXD MYLAR 5600 PF 10% 200VDCW
A 1 C 39	0160-2212	C FXD MICA 560 PF 5% 300VDCW
A 1 C 40	0160-2200	C FXD MICA 43 PF 5% 300VDCW

Table 6-1. Reference Designation Index (cont'd)

Reference Designation	HP Stock No.	Description
A 1 C 41	0160-2930	C FXD CER 0.01UF +80,-20% 100VDCW
A 1 C 42	0160-2930	C FXD CER 0.01UF +80,-20% 100VDCW
A 1 C 43	0160-2930	C FXD CER 0.01UF +80,-20% 100VDCW
A 1 C 44	0160-2930	C FXD CER 0.01UF +80,-20% 100VDCW
A 1 C 45	0160-2930	C FXD CER 0.01UF +80,-20% 100VDCW
A 1 C 46	0121-0046	C VAR CER 9-35 PF
A 1 C 47	0150-0121	C FXD CER .1UF +80%-20% 50VDCW
A 1 C 48	0180-0374	C FXD TA ELECT 10 UF 10% 20VDCW
A 1 C 49	0180-0291	C FXD TA ELECT 1 UF 10% 35VDCW
A 1 C 50	0180-0374	C FXD TA ELECT 10 UF 10% 20VDCW
A 1 C 51	0180-0291	C FXD TA ELECT 1 UF 10% 35VDCW
A 1 C 52	0160-2197	C:FXD MICA 10 PF 5% 300VDCW
A 1 CR 1	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 CR 2	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 CR 3	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 CR 4	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 CR 5	1910-0016	DIODE GERMANIUM 60PIV
A 1 CR 6	1910-0016	DIODE GERMANIUM 60PIV
A 1 CR 7	1902-0037	DIODE BREAKDOWN 9.09V 10% 400 MW
A 1 CR 8	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 CR 9	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 CR 10	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 CR 11	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 CR 12	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 CR 13	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 CR 14	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 CR 15	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 CR 16	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 CR 17	1910-0016	DIODE GERMANIUM 60PIV
A 1 CR 18	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 CR 19	1910-0016	DIODE GERMANIUM 60PIV
A 1 CR 20	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 CR 21	1901-0179	DIODE SILICON 15PIV 750 MA
A 1 CR 22	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 CR 23	1901-0040	DIODE SILICON 30 PIV 30 MA
A 1 CR 24	1901-0040	DIODE SILICON 30 PIV 30 MA
A 1 CR 25	1901-0040	DIODE SILICON 30 PIV 30 MA
A 1 CR 26	1901-0179	DIODE SILICON 15PIV 750 MA
A 1 CR 27	1912-0004	DIODE GERMANIUM TUNNEL
A 1 CR 28	1901-0040	DIODE SILICON 30 PIV 30 MA
A 1 CR 29	1901-0040	DIODE SILICON 30 PIV 30 MA
A 1 CR 30	1901-0040	DIODE SILICON 30 PIV 30 MA
A 1 CR 31	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 CR 32	1901-0040	DIODE SILICON 30PIV 30 MA
A 1 L 1	9140-0111	COIL FXD RF 3.3 UH
A 1 L 2	9140-0096	COIL FXD RF 1 UH
A 1 L 3	9140-0111	COIL FXD RF 3.3 UH
A 1 L 4	9140-0094	COIL FXD RF .68 UH
A 1 L 5	9140-0094	COIL FXD RF .68 UH

Table 6-1. Reference Designation Index (cont'd)

Reference Designation	HP Stock No.	Description
A 1 L 6	9170-0029	CORE FERRITE BEAD
A 1 L 7	9140-0096	COIL FXD RF 1 UH
A 1 L 8	9100-1613	COIL FXD .47 UH 20%
A 1 L 9	9100-1613	COIL FXD .47 UH 20%
A 1 L 10		NOT ASSIGNED
A 1 L 11	9100-1613	COIL FXD RF 0.47 UH 20%
A 1 L 12	9140-0118	COIL FXD 500 UH 5%
A 1 L 13	9170-0029	CORE FERRITE BEAD
A 1 L 14	9170-0029	CORE FERRITE BEAD
A 1 L 15	9170-0029	CORE FERRITE BEAD
A 1 L 16	9170-0029	CORE FERRITE BEAD
A 1 L 17	9170-0029	CORE FERRITE BEAD
A 1 L 18	9170-0029	CORE FERRITE BEAD
A 1 Q 1	1854-0215	TRANSISTOR SILICON NPN 2N3904
A 1 Q 2	1854-0215	TRANSISTOR SILICON NPN 2N3904
A 1 Q 3	1854-0215	TRANSISTOR SILICON NPN 2N3904
A 1 Q 4	1854-0215	TRANSISTOR SILICON NPN 2N3904
A 1 Q 5	1854-0260	TRANSISTOR SILICON NPN 2N3227
A 1 Q 6	1853-0036	TRANSISTOR SILICON PNP 2N3906.
A 1 Q 7	1854-0215	TRANSISTOR SILICON NPN 2N3904
A 1 Q 8	1853-0036	TRANSISTOR SILICON PNP 2N3906.
A 1 Q 9	1854-0215	TRANSISTOR SILICON NPN 2N3904
A 1 Q 10	1853-0036	TRANSISTOR SILICON PNP 2N3906.
A 1 Q 11	1853-0036	TRANSISTOR SILICON PNP 2N3906.
A 1 Q 12	1854-0215	TRANSISTOR SILICON NPN 2N3904
A 1 Q 13	1854-0215	TRANSISTOR SILICON NPN 2N3904
A 1 Q 14	1853-0036	TRANSISTOR SILICON PNP 2N3906.
A 1 Q 15	1854-0215	TRANSISTOR SILICON NPN 2N3904
A 1 Q 16	1853-0036	TRANSISTOR SILICON PNP 2N3906.
A 1 Q 17	1853-0036	TRANSISTOR SILICON PNP 2N3906.
A 1 Q 18	1854-0019	TRANSISTOR SILICON NPN
A 1 Q 19	1853-0036	TRANSISTOR SILICON PNP 2N3906.
A 1 Q 20	1854-0215	TRANSISTOR SILICON NPN 2N3904
A 1 Q 21	1854-0215	TRANSISTOR SILICON NPN 2N3904
A 1 Q 22	1853-0036	TRANSISTOR SILICON PNP 2N3906
A 1 Q 23	1853-0036	TRANSISTOR SILICON PNP 2N3906
A 1 Q 24	1853-0036	TRANSISTOR SILICON PNP 2N3906
A 1 Q 25	1854-0215	TRANSISTOR SILICON NPN 2N3904
A 1 Q 26	1853-0036	TRANSISTOR SILICON PNP 2N3906.
A 1 Q 27	1854-0215	TRANSISTOR SILICON NPN 2N3904
A 1 Q 28	1853-0203	TRANSISTOR SILICON PNP
A 1 Q 29	1853-0203	TRANSISTOR SILICON PNP
A 1 Q 30	1854-0215	TRANSISTOR SILICON NPN 2N3904
A 1 Q 31	1853-0036	TRANSISTOR SILICON PNP 2N3906
A 1 Q 32	1854-0215	TRANSISTOR SILICON NPN 2N3904
A 1 Q 33	1853-0203	TRANSISTOR SILICON PNP
A 1 Q 34	1853-0036	TRANSISTOR SILICON PNP 2N3906
A 1 Q 35	1853-0036	TRANSISTOR SILICON PNP 2N3906
A 1 Q 36	1853-0036	TRANSISTOR SILICON PNP 2N3906
A 1 Q 37	1853-0036	TRANSISTOR SILICON PNP 2N3906

Table 6-1. Reference Designation Index (cont'd)

Reference Designation	HP Stock No.	Description
A 1 Q 38	1853-0036	TRANSISTOR SILICON PNP 2N3906
A 1 Q 39	1853-0036	TRANSISTOR SILICON PNP 2N3906
A 1 Q 40	1853-0203	TRANSISTOR SILICON PNP
A 1 Q 41	1854-0301	TRANSISTOR SILICON NPN 2N3261
A 1 Q 42	1853-0034	TRANSISTOR SILICON PNP
A 1 Q 43	1854-0215	TRANSISTOR SILICON NPN 2N3904
A 1 Q 44	1854-0215	TRANSISTOR SILICON NPN 2N3904
A 1 Q 45	1853-0036	TRANSISTOR SILICON PNP
A 1 Q 46	1853-0027	TRANSISTOR SILICON PNP
A 1 Q 47	1854-0039	TRANSISTOR SILICON NPN 2N3053
A 1 R 1	0698-4254	R FXD FLM 1000 OHM 5% 1/4W
A 1 R 2	0757-0726	R FXD MET FLM 511 OHM 1% 1/4W
A 1 R 3	0757-0726	R FXD MET FLM 511 OHM 1% 1/4W
A 1 R 4	0757-0354	R FXD MET FLM 3650 OHM 1% 1/4W
A 1 R 5	0757-0354	R FXD MET FLM 3650 OHM 1% 1/4W
A 1 R 6	0698-4226	R FXD FLM 62 OHM 5% 1/4W
A 1 R 7	0698-4261	R FXD FLM 2000 OHM 5% 1/4W
A 1 R 8	0757-0283	R FXD MET FLM 2000 OHM 1% 1/8W
A 1 R 9	0758-0086	R FXD FLM 100 OHM 5% 1/4W
A 1 R 10	0698-4229	R FXD FLM 75 OHM 5% 1/4W
A 1 R 11	0698-4256	R FXD FLM 1200 OHM 5% 1/4W
A 1 R 12	0698-4247	R FXD FLM 510 OHM 5% 1/4W
A 1 R 13	0757-1097	R FXD MET FLM 1200 OHM 1% 1/8W.
A 1 R 14	0757-0433	R FXD MET FLM 3320 OHM 1% 1/8W
A 1 R 15	0758-0086	R FXD FLM 100 OHM 5% 1/4W
A 1 R 16	0698-6744	R FXD FLM 20 OHM 5% 1/4W
A 1 R 17	0757-0726	R FXD MET FLM 511 OHM 1% 1/4W
A 1 R 18	0757-0721	R FXD MET FLM 274 OHM 1% 1/4W
A 1 R 19	0698-3438	R FXD MET FLM 147 OHM 1% 1/8W
A 1 R 20	0757-0419	R FXD MET FLM 681 OHM 1% 1/8W
A 1 R 21	0757-0739	R FXD MET FLM 2000 OHM 1% 1/4W
A 1 R 22	0757-0436	R FXD MET FLM 4320 OHM 1% 1/8W
A 1 R 23	0698-4254	R FXD FLM 1000 OHM 5% 1/4W
A 1 R 24	0698-4266	R FXD FLM 3300 OHM 5% 1/4W
A 1 R 25	0698-4268	R FXD FLM 3900 OHM 5% 1/4W
A 1 R 26	0758-0124	R FXD FLM 51 OHM 5% 1/4W
A 1 R 27	0758-0125	R FXD FLM 430 OHM 5% 1/4W
A 1 R 28	0758-0124	R FXD FLM 51 OHM 5% 1/4W
A 1 R 29	0698-4261	R FXD MET OX 2000 OHM 5% 1/4W.
A 1 R 30	0698-4254	R FXD FLM 1000 OHM 5% 1/4W
A 1 R 31	0698-4278	R FXD FLM 10K OHM 5% 1/4W
A 1 R 32	0698-4235	R FXD FLM 150 OHM 5% 1/4W
A 1 R 33	0698-4245	R FXD FLM 390 OHM 5% 1/4W
A 1 R 34	0698-4250	R FXD FLM 680 OHM 5% 1/4W
A 1 R 35	0698-4250	R FXD FLM 680 OHM 5% 1/4W
A 1 R 36	0698-4245	R FXD FLM 390 OHM 5% 1/4W
A 1 R 37	0698-4261	R FXD FLM 2000 OHM 5% 1/4W
A 1 R 38	0758-0086	R FXD FLM 100 OHM 5% 1/4W
A 1 R 39	0698-4249	R FXD FLM 620 OHM 5% 1/4W
A 1 R 40	0698-4271	R FXD FLM 5100 OHM 5% 1/4W

Table 6-1. Reference Designation Index (cont'd)

Reference Designation	HP Stock No.	Description
A 1 R 41	0698-6744	R FXD FLM 20 OHM 5% 1/4W
A 1 R 42	0698-4227	R FXD FLM 68 OHM 5% 1/4W
A 1 R 43	0758-0124	R FXD FLM 51 OHM 5% 1/4W
A 1 R 44		NOT ASSIGNED
A 1 R 45	0757-0730	R FXD MET FLM 750 OHM 1% 1/4W
A 1 R 46	0698-4235	R FXD FLM 150 OHM 5% 1/4W
A 1 R 47	0757-0280	R FXD MET FLM 1000 OHM 1% 1/8W
A 1 R 48	0698-4234	R FXD FLM 130 OHM 5% 1/4W.
A 1 R 49	0757-0276	R FXD MET FLM 61.9 OHM 1% 1/8W
A 1 R 50	0758-0127	R FXD MET OX 430 OHM 5% 1/2W
A 1 R 51	0757-0428	R FXD MET FLM 1620 OHM 1% 1/8W
A 1 R 52	0757-0419	R FXD MET FLM 681 OHM 1% 1/8W
A 1 R 53	0698-4233	R FXD FLM 120 OHM 5% 1/4W
A 1 R 54	0698-4241	R FXD FLM 270 OHM 5% 1/4W
A 1 R 55	0698-5705	R FXD FLM 39 OHM 5% 1/4W
A 1 R 56	0757-0273	R FXD MET FLM 3010 OHM 1% 1/8W
A 1 R 57	0757-0730	R FXD MET FLM 750 OHM 1% 1/4W
A 1 R 58	0698-4429	R FXD MET FLM 1870 OHM 1% 1/8W
A 1 R 59	0757-0405	R FXD MET FLM 162 OHM 1% 1/8W
A 1 R 60	0757-0740	R FXD MET FLM 2210 OHM 1% 1/4W
A 1 R 61	0757-0738	R FXD MET FLM 1820 OHM 1% 1/4W
A 1 R 62	0757-0339	R FXD MET FLM 3010 OHM 1% 1/4W
A 1 R 63	0698-4267	R FXD FLM 3600 OHM 5% 1/4W
A 1 R 64	0698-4254	R FXD FLM 1000 OHM 5% 1/4W
A 1 R 65	0698-6744	R FXD FLM 20 OHM 5% 1/4W
A 1 R 66	0698-4241	R FXD FLM 270 OHM 5% 1/4W
A 1 R 67	0758-0066	R FXD MET OX 620 OHM 5% 1/2W
A 1 R 68	0757-0281	R FXD MET FLM 2740 OHM 1% 1/8W
A 1 R 69	0698-4238	R FXD FLM 200 OHM 5% 1/4W
A 1 R 70	0698-4238	R FXD FLM 200 OHM 5% 1/4W
A 1 R 71	0757-0420	R FXD MET FLM 750 OHM 1% 1/8W
A 1 R 72	0698-4254	R FXD FLM 1000 OHM 5% 1/4W
A 1 R 73	0757-0401	R FXD MET FLM 100 OHM 1% 1/8W
A 1 R 74	0698-4232	R FXD FLM 110 OHM 5% 1/4W
A 1 R 75	0698-4242	R FXD FLM 300 OHM 5% 1/4W
A 1 R 76	0758-0124	R FXD FLM 51 OHM 5% 1/4W
A 1 R 77	0757-0282	R FXD MET FLM 221 OHM 1% 1/8W
A 1 R 78	0698-4239	R FXD FLM 220 OHM 5% 1/4W
A 1 R 79	0698-6745	R FXD MET FLM 22 OHM 5% 1/4W
A 1 R 80	0757-0412	R FXD MET FLM 365 OHM 1% 1/8W
A 1 R 81	0698-4248	R FXD FLM 560 OHM 5% 1/4W
A 1 R 82		NOT ASSIGNED
A 1 R 83	0698-4302	R FXD FLM 100K OHM 5% 1/4W
A 1 R 84	0698-4302	R FXD FLM 100K OHM 5% 1/4W
A 1 R 85	0698-4302	R FXD FLM 100K OHM 5% 1/4W
A 1 R 86	0698-4266	R FXD FLM 3300 OHM 5% 1/4W
A 1 R 87	0698-4266	R FXD FLM 3300 OHM 5% 1/4W
A 1 R 88	0698-4266	R FXD FLM 3300 OHM 5% 1/4W
A 1 R 89	0698-4266	R FXD FLM 3300 OHM 5% 1/4W
A 1 R 90	0698-4266	R FXD FLM 3300 OHM 5% 1/4W

Table 6-1. Reference Designation Index (cont'd)

Reference Designation	HP Stock No.	Description
A 1 R 91	0698-5702	R FXD FLM 30 OHM 5% 1/4W
A 1 R 92	0698-4239	R FXD FLM 220 OHM 5% 1/4W
A 1 R 93	0698-6745	R FXD MET FLM 22 OHM 5% 1/4W
A 1 R 94	0698-4232	R FXD FLM 110 OHM 5% 1/4W
A 1 R 95	0758-0032	R FXD MET OX 820 OHM 5% 1/2W
A 1 R 96	0757-0401	R FXD MET FLM 100 OHM 1% 1/8W
A 1 R 97	0698-4230	R FXD FLM 82 OHM 5% 1/4W
A 1 R 98	0698-6802	R FXD FLM 10 OHM 5% 1/4W
A 1 R 99		NOT ASSIGNED
A 1 R 100	0698-3444	R FXD MET FLM 316 OHM 1% 1/8W
A 1 R 101	0698-6744	R FXD FLM 20 OHM 5% 1/4W
A 1 R 102	0758-0014	R FXD MET OX 180 OHM 5% 1/2W
A 1 R 103	0698-4241	R FXD MET OX 270 OHM 5% 1/4W
A 1 R 104	0698-6802	R FXD FLM 10 OHM 5% 1/4W
A 1 R 105	0698-4284	R FXD FLM 18K OHM 5% 1/4W
A 1 R 106		NOT ASSIGNED
A 1 R 107		NOT ASSIGNED
A 1 R 108	0698-4284	R FXD FLM 18K OHM 5% 1/4W
A 1 R 109	0698-4247	R FXD FLM 510 OHM 5% 1/4W
A 1 R 110	0698-4247	R FXD FLM 510 OHM 5% 1/4W
A 1 R 111	0698-4254	R FXD FLM 1000 OHM 5% 1/4W
A 1 R 112	0698-4254	R FXD FLM 1000 OHM 5% 1/4W
A 1 R 113	0760-0024	R FXD MET OX 100 OHM 5% 1W
A 1 R 114	0760-0024	R FXD MET OX 100 OHM 5% 1W
A 1 R 115	0698-4280	R FXD FLM 12K OHM 5% 1/4W
A 1 R 116	0698-4266	R FXD FLM 3300 OHM 5% 1/4W
A 1 R 117	0698-4258	R FXD FLM 1500 OHM 5% 1/4W
A 1 R 118	0698-4255	R FXD FLM 1100 OHM 5% 1/4W
A 1 R 119		NOT ASSIGNED
A 1 R 120	0698-4252	R FXD MET OX 820 OHM 5% 1/4W
A 1 S 1	3101-0070	SWITCH SLIDE DPDT .5A 125 V
A 1 S 2	3101-0070	SWITCH SLIDE DPDT .5A 125 V
A 2	08004-66502	POWER SUPPLY BOARD
A 2 C 1	0160-2959	C FXD CER 1000PF 600VDCW
A 2 C 2	0160-2197	C FXD MICA 10 PF 5% 300VDCW
A 2 C 3	0140-0145	C FXD MICA 22 PF 5% 500VDCW
A 2 C 4	0140-0193	C FXD MICA 82 PF 5% 300VDCW
A 2 C 5	0180-0374	C FXD TA ELECT 10 UF 10% 20VDCW
A 2 C 6	0160-2930	C FXD CER 0.01 UF +80,-20% 100VDCW
A 2 C 7	0160-0127	C FXD CER 1.0 UF +80%-20% 50VDCW
A 2 C 8	0121-0061	C VAR 5.5-18PF
A 2 C 9		SELECTED ON TEST
A 2 C 10	0160-0127	C FXD CER 1.0 UF +80%-20% 50VDCW
A 2 C 11	0180-1706	C FXD TA ELECT 100 UF 20% 25VDCW
A 2 C 12	0160-2930	C FXD CER 0.01UF +80,-20% 100VDCW
A 2 C 13	0160-2959	C FXD CER 1000PF 600VDCW
A 2 C 14	0180-0197	C FXD TA ELECT 2.2 UF 10% 20VDCW
A 2 C 15	0160-2259	C FXD MICA 12PF 5% 300VDCW

Table 6-1 Reference Designation Index (cont'd)

Reference Designation	HP Stock No.	Description
A 2 C 16	0140-0145	C FXD MICA 22 PF 5% 500VDCW
A 2 C 17	0140-0193	C FXD MICA 82 PF 5% 300VDCW
A 2 C 18	0180-0374	C FXD TA ELECT 10 UF 10% 20VDCW
A 2 C 19	0160-0127	C FXD CER 1.0 UF +80%-20% 50VDCW
A 2 C 20	0160-2930	C FXD CER 0.01UF +80,-20% 100VDCW
A 2 C 21		SELECTED ON TEST
A 2 C 22		SELECTED ON TEST
A 2 C 23	0160-0127	C FXD CER 1.0 UF +80%-20% 50VDCW
A 2 C 24	0180-1706	C FXD TA ELECT 100 UF 20% 25VDCW
A 2 C 25	0160-2930	C FXD CER 0.01UF +80,-20% 100VDCW
A 2 C 26	0180-1834	C FXD TA ELECT 15 UF 20% 50VDCW
A 2 C 27	0160-0820	C FXD CER .05 UF +80-20% 25VDCW
A 2 C 28	0180-0228	C FXD TA ELECT 22 UF 10% 15VDCW
A 2 C 29	0180-1834	C FXD TA ELECT 15 UF 20% 50VDCW
A 2 C 30	0160-0820	C FXD CER .05 UF +80-20% 25VDCW
A 2 C 31	0180-0228	C FXD TA ELECT 22 UF 10% 15VDCW
A 2 C 32	0180-0137	C FXD TA ELECT 100 UF 20% 10VDCW
A 2 C 33	0160-0127	C FXD CER 1.0UF +80,-20% 25VDCW
A 2 C 34	0160-0127	C FXD CER 1.0UF +80,-20% 25VDCW
A 2 C 35	0121-0046	C. VAR 5.5-18PF
A 2 C 36	0121-0046	C. VAR 5.5-18PF
A 2 CR 1	1901-0045	DIODE SILICON 100PIV 750 MA
A 2 CR 2	1901-0045	DIODE SILICON 100PIV 750 MA
A 2 CR 3	1901-0045	DIODE SILICON 100PIV 750 MA
A 2 CR 4	1901-0045	DIODE SILICON 100PIV 750 MA
A 2 CR 5	1902-0048	DIODE BREAKDOWN 6.81V 5% 400 MW
A 2 CR 6	1901-0045	DIODE SILICON 100PIV 750 MA
A 2 CR 7	1901-0045	DIODE SILICON 100PIV 750 MA
A 2 CR 8	1901-0045	DIODE SILICON 100PIV 750 MA
A 2 CR 9	1901-0045	DIODE SILICON 100PIV 750 MA
A 2 CR 10	1902-0048	DIODE BREAKDOWN 6.81V 5% 400 MW
A 2 L 1	9100-1613	COIL FXD .47 UH 20%
A 2 L 2	08004-61501	COMBINED L-R ASSEMBLY
A 2 L 3	08004-61502	COMBINED L-R ASSEMBLY
A 2 L 4	9140-0096	COIL FXD RF 1 UH
A 2 L 5	08004-61501	COMBINED L-R ASSEMBLY
A 2 L 6	08004-61501	COMBINED L-R ASSEMBLY
A 2 L 7	9170-0029	BEAD
A 2 Q 1	1854-0260	TRANSISTOR SILICON NPN 2N3227
A 2 Q 2	1854-0260	TRANSISTOR SILICON NPN 2N3227
A 2 Q 3	1853-0218	TRANSISTOR SILICON PNP
A 2 Q 4	5080-1038	TRANSISTOR SIL PNP SELECTED WITH Q3
A 2 Q 5	5080-1038	TRANSISTOR SIL. PNP SELECTED WITH Q4
A 2 Q 6	1854-0039	TRANSISTOR SILICON NPN 2N3053
A 2 Q 7	1853-0090	TRANSISTOR SILICON PNP
A 2 Q 8	1853-0203	TRANSISTOR SILICON PNP
A 2 Q 9	1853-0203	TRANSISTOR SILICON PNP
A 2 Q 10	1854-0301	TRANSISTOR SILICON NPN 2N3261

Table 6-1. Reference Designation Index (cont'd)

Reference Designation	HP Stock No.	Description
A 2 Q 11	5080-1029	TRANSISTOR SIL. NPN SELECTED WITH Q12
A 2 Q 12	5080-1029	TRANSISTOR SIL NPN SELECTED WITH Q11
A 2 Q 13	1853-0027	TRANSISTOR SILICON PNP
A 2 Q 14	1854-0307	TRANSISTOR SILICON NPN
A 2 Q 15	1854-0307	TRANSISTOR SILICON NPN
A 2 Q 16	1854-0307	TRANSISTOR SILICON NPN
A 2 Q 17	1854-0307	TRANSISTOR SILICON NPN
A 2 Q 18	1854-0307	TRANSISTOR SILICON NPN
A 2 Q 19	1854-0039	TRANSISTOR SILICON NPN 2N3053
A 2 Q 20	1853-0090	TRANSISTOR SILICON PNP
A 2 R 1	0757-0280	R FXD MET FLM 1000 OHM 1% 1/8W
A 2 R 2	0757-0429	R FXD MET FLM 1820 OHM 1% 1/8W
A 2 R 3	0757-0403	R FXD MET FLM 121 OHM 1% 1/8W
A 2 R 4	0698-4238	R FXD FLM 200 OHM 5% 1/4W
A 2 R 5	0758-0127	R FXD MET OX 430 OHM 5% 1/2W
A 2 R 6	0757-0283	R FXD MET FLM 2000 OHM 1% 1/8W
A 2 R 7	0757-0419	R FXD MET FLM 681 OHM 1% 1/8W
A 2 R 8	0698-4248	R FXD FLM 560 OHM 5% 1/4W
A 2 R 9	0698-4241	R FXD FLM 270 OHM 5% 1/4W
A 2 R 10	0761-0020	R FXD FLM 91 OHM 5% 1W
A 2 R 11		SEE A2L2.
A 2 R 12		NOT ASSIGNED
A 2 R 13	0698-4237	R FXD MET OX 180 OHM 5% 1/4W
A 2 R 14	0698-5705	R FXD FLM 39 OHM 5% 1/4W
A 2 R 15	0698-6746	R FXD MET OX 43 OHM 5% 1/4W
A 2 R 16		NOT ASSIGNED
A 2 R 17	0698-5887	R FXD FLM 30 OHM 5% 1/2W
A 2 R 18	0698-5890	R FXD FLM 39 OHM 5% 1/2W
A 2 R 19	0698-7032	R FXD FLM 100 OHM 2% 1W
A 2 R 20	0698-7032	R FXD FLM 100 OHM 2% 1W
A 2 R 21		SEE A2L3
A 2 R 22	0698-7032	R FXD FLM 100 OHM 2% 1W
A 2 R 23		NOT ASSIGNED
A 2 R 24	0698-4232	R FXD FLM 110 OHM 5% 1/4W
A 2 R 25	0698-4254	R FXD FLM 1000 OHM 5% 1/4W
A 2 R 26	0757-1098	R FXD MET FLM 945 OHM 1% 1/8W
A 2 R 27		NOT ASSIGNED
A 2 R 28		NOT ASSIGNED
A 2 R 29	0757-0283	R FXD MET FLM 2000 OHM 1% 1/8W
A 2 R 30	0698-4254	R FXD FLM 1000 OHM 5% 1/4W
A 2 R 31	0757-0280	R FXD MET FLM 1000 OHM 1% 1/8W
A 2 R 32	0757-0284	R FXD MET FLM 150 OHM 1% 1/8W
A 2 R 33	0698-4235	R FXD FLM 150 OHM 5% 1/4W
A 2 R 34	0758-0127	R FXD MET OX 430 OHM 5% 1/2W
A 2 R 35	0757-0283	R FXD MET FLM 2000 OHM 1% 1/8W
A 2 R 36	0757-0419	R FXD MET FLM 681 OHM 1% 1/8W
A 2 R 37	0698-4248	R FXD FLM 560 OHM 5% 1/4W
A 2 R 38	0698-4241	R FXD FLM 270 OHM 5% 1/4W
A 2 R 39	0698-7032	R FXD FLM 100 OHM 2% 1W
A 2 R 40		SEE A2L5

Table 6-1. Reference Designation Index (cont'd)

Reference Designation	HP Stock No.	Description
A 2 R 41		NOT ASSIGNED
A 2 R 42	0698-4239	R FXD MET OX 220 OHM 5% 1/4W
A 2 R 43	0698-5887	R FXD 30 OHM 5% 1/2W
A 2 R 44	0698-5887	R FXD FLM 30 OHM 5% 1/2W
A 2 R 45		NOT ASSIGNED
A 2 R 46		SELECTED ON TEST
A 2 R 47		SELECTED ON TEST
A 2 R 48	0698-7032	R FXD FLM 100 OHM 2% 1W
A 2 R 49	0698-7032	R FXD FLM 100 OHM 2% 1W
A 2 R 50		SEE A2L6
A 2 R 51	0698-7032	R FXD FLM 100 OHM 2% 1W
A 2 R 52	0698-3800	R FXD FLM 24 OHM 5% 1/4W
A 2 R 53	0698-4232	R FXD FLM 110 OHM 5% 1/4W
A 2 R 54	0698-4254	R FXD FLM 1000 OHM 5% 1/4W
A 2 R 55		NOT ASSIGNED
A 2 R 56		NOT ASSIGNED
A 2 R 57	0757-1098	R FXD MET FLM 945 OHM 1% 1/8W
A 2 R 58	0698-4265	R FXD FLM 3000 OHM 5% 1/4W
A 2 R 59	0698-4270	R FXD FLM 4700 OHM 5% 1/4W
A 2 R 60	0698-4238	R FXD FLM 200 OHM 5% 1/4W
A 2 R 61	0698-4261	R FXD FLM 2000 OHM 5% 1/4W
A 2 R 62	0698-4276	R FXD FLM 8200 OHM 5% 1/4W
A 2 R 63	0698-4264	R FXD FLM 2700 OHM 5% 1/4W
A 2 R 64	0698-4261	R FXD FLM 2000 OHM 5% 1/4W
A 2 R 65	0698-4263	R FXD FLM 2400 OHM 5% 1/4W
A 2 R 66	2100-2741	R VAR VERMET 470 OHM 20% 1/2W
A 2 R 67	0698-4257	R FXD FLM 1300 OHM 5% 1/4W
A 2 R 68	0698-4265	R FXD FLM 3000 OHM 5% 1/4W
A 2 R 69	0698-4270	R FXD FLM 4700 OHM 5% 1/4W
A 2 R 70	0698-4238	R FXD FLM 200 OHM 5% 1/4W
A 2 R 71	0698-4261	R FXD FLM 2000 OHM 5% 1/4W
A 2 R 72	0698-4276	R FXD FLM 8200 OHM 5% 1/4W
A 2 R 73	0698-4264	R FXD FLM 2700 OHM 5% 1/4W
A 2 R 74	0698-4261	R FXD FLM 2000 OHM 5% 1/4W
A 2 R 75	0698-4263	R FXD FLM 2400 OHM 5% 1/4W
A 2 R 76	2100-2741	R VAR VERMET 470 OHM 20% 1/2W
A 2 R 77	0698-4257	R FXD FLM 1300 OHM 5% 1/4W
A 2 R 78	0757-0430	R FXD MET FLM 2210 OHM 1% 1/8W
A 2 R 79	0698-3151	R FXD MET FLM 2870 OHM 1% 1/8W
A 2 R 80	0698-4232	R FXD FLM 110 OHM 5% 1/4W
A 2 R 81	0698-3619	R FXD MET OX 91 OHM 5% 2W
A 2 R 82	0698-4230	R FXD FLM 82 OHM 5% 1/4W
A 2 R 83	0698-4230	R FXD FLM 82 OHM 5% 1/4W
A 2 R 84	2100-1788	R VAR 500 OHM 10% 1/2W
A 2 R 85	2100-1984	R VAR 100 OHM 10% 1/2W
A 2 RT 1	0837-0502	THERMISTOR 130 OHM 20% 1W
A 2 RT 2	0837-0063	THERMISTOR 220 OHM 20% 1W

Table 6-1. Reference Designation Index (cont'd)

Reference Designation	HP Stock No.	Description
A 3	08004-63401	STEP ATTENUATOR ASSEMBLY
A 3 L 1	9170-0029	BEAD
A 3 L 2	9170-0029	BEAD
A 3 L 3	9170-0029	BEAD
A 3 R 1	0757-0172	R FXD MET FLM 37.4 OHM 1% 1/2W
A 3 R 2	0757-0801	R FXD MET FLM 150 OHM 1% 1/2W
A 3 R 3	0757-0801	R FXD MET FLM 150 OHM 1% 1/2W
A 3 R 4	0757-0069	R FXD MET FLM 121 OHM 1% 1/4W
A 3 R 5	0757-0795	R FXD MET FLM 75 OHM 1% 1/2W
A 3 R 6	0757-0795	R FXD MET FLM 75 OHM 1% 1/2W
A 3 R 7	0757-0071	R FXD MET FLM 247.5 OHM 1% 1/2W
A 3 R 8	0757-1005	R FXD MET FLM 61.11 OHM 1/4% 1/2W
A 3 R 9	0757-1005	R FXD MET FLM 61.11 OHM 1/4% 1/2W
A 3 R 10	0698-4253	R FXD MET OX 910 OHM 5% 1/4W
A 4	08004-66503	POLARITY SWITCH ASSEMBLY
A 4 R 1	0757-0431	R FXD MET FLM 2.43K OHM 1% 1/8W
A 4 R 2	0757-0431	R FXD MET FLM 2.43K OHM 1% 1/8W
A 4 S 1	3101-0070	SWITCH SLIDE (PULSE POLARITY).
A 5	08004-61901	RATE SWITCH ASSEMBLY
A 5 R 1	0698-4296	R FXD MET OX 56K OHM 5% 1/4W
A 5 R 2	2100-2684	R VAR 100K OHM 10%
A 5 S 1	3100-0525	SWITCH ROTARY
A 6	08004-61902	PULSE DELAY SWITCH ASSEMBLY
A 6 R 1	0698-4258	R FXD MET OX 1.5K OHM 5% 1/4W
A 6 R 2	08004-21501	R VAR 10K OHM 10%
A 6 S 1	3100-0524	SWITCH ROTARY
A 7	08004-61903	WIDTH SWITCH ASSEMBLY
A 7 R 1	0698-4264	R FXD MET OX 2.7K OHM 5% 1/4W
A 7 R 2	0698-4287	R FXD MET OX 24K OHM 5% 1/4W
A 7 R 3	0698-4292	R FXD MET OX 39K OHM 5% 1/4W
A 7 R 4	0758-0017	R FXD MET OX 1.5K OHM 5% 1/2W
A 7 R 5	08004-21502	R VAR 20K OHM 10%
A 7 S 1	3100-0526	SWITCH ROTARY
		MISCELLANEOUS
	0370-0077	KNOB (AMPLITUDE)
	0370-0084	KNOB (DC OFFSET, AMPL. VERNIER)
	0370-0099	KNOB (REP RATE, WIDTH, DELAY)

Table 6-1. Reference Designation Index (cont'd)

Reference Designation	HP Stock No.	Description
	0370-0134	KNOB 1/2 INCH DIA RED.
	1205-0011	HEAT DISSIPATOR
	1205-0037	HEAT DISSIPATOR
	1205-0061	HEAT DISSIPATOR
	1490-0032	STAND TILT
	5000-0717	COVER-BOTTOM
	5000-1157	COVER SIDE
	5060-0718	COVER-TOP
	5060-0728	FOOT ASSEMBLY
C 1	0180-0353	C FXD ELECT 450 UF 50VDCW
C 2	0180-0353	C FXD ELECT 450 UF 50VDCW
DS 1	-	PART OF S6
F 1	2110-0018	FUSE 1/4A(230 V OPER.) FUSE 1/2A (115 V OPER.)
J 1	1250-0083	CONNECTOR BNC (TRIGGER INPUT)
J 2	1250-0083	CONNECTOR BNC (GATE INPUT)
J 3	1250-0118	CONNECTOR BNC (TRIGGER OUTPUT +).
J 4	1250-0140	CONNECTOR BNC (PULSE OUTPUT)
J 5	1251-0146	CONNECTOR POWER
L 1	9170-0029	BEAD
Q 1	1854-0072	TRANSISTOR SILICON NPN 2N3054
Q 2	1854-0072	TRANSISTOR SILICON NPN 2N3054
R 1	0758-0049	R FXD MET 33K OHM 5% 1/2W
R 2	2100-0234	R VAR 10K OHM 20%(DC OFFSET)
R 3	08004-21503	R. VAR 2X1.2K(AMPLITUDE VERNIER)
S 1	3101-0124	SWITCH-PUSH BUTTON (MANUAL)
S 2	3101-0903	SWITCH-SLIDE(OPER MODE)
S 3	3101-0070	SWITCH-SLIDE (SINGLE-DOUBLE PULSE)
S 4	3101-0070	SWITCH-SLIDE (DC OFFSET ON-OFF)
S 5		NOT ASSIGNED
S 6	3101-1248	SWITCH POWER
S 7	3101-0033	SWITCH-SLIDE (VOLTAGE INDICATOR)
T 1	9100-0525	TRANSFORMER POWER
W 1	8120-0078	CABLE (NEMA) CABLE (SCHUKO)

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 8004A. Table 7-1 lists notes which apply to the schematic diagrams.

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
inducatance in microhenries
resistance in ohms

= Printed circuit board

= Front panel marking

= Rear Panel marking

* = Average value. Optimum value factory-selected

P/O = Part of

= Primary signal path

= Feedback or control signal path

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

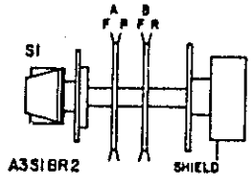
(3) = Page number of schematic

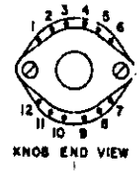
= Avalanche (Zener) Diode

Numbers in parentheses indicate wire color using resistor color code, e.g. WHT-RED-GRN is (9.2.5)

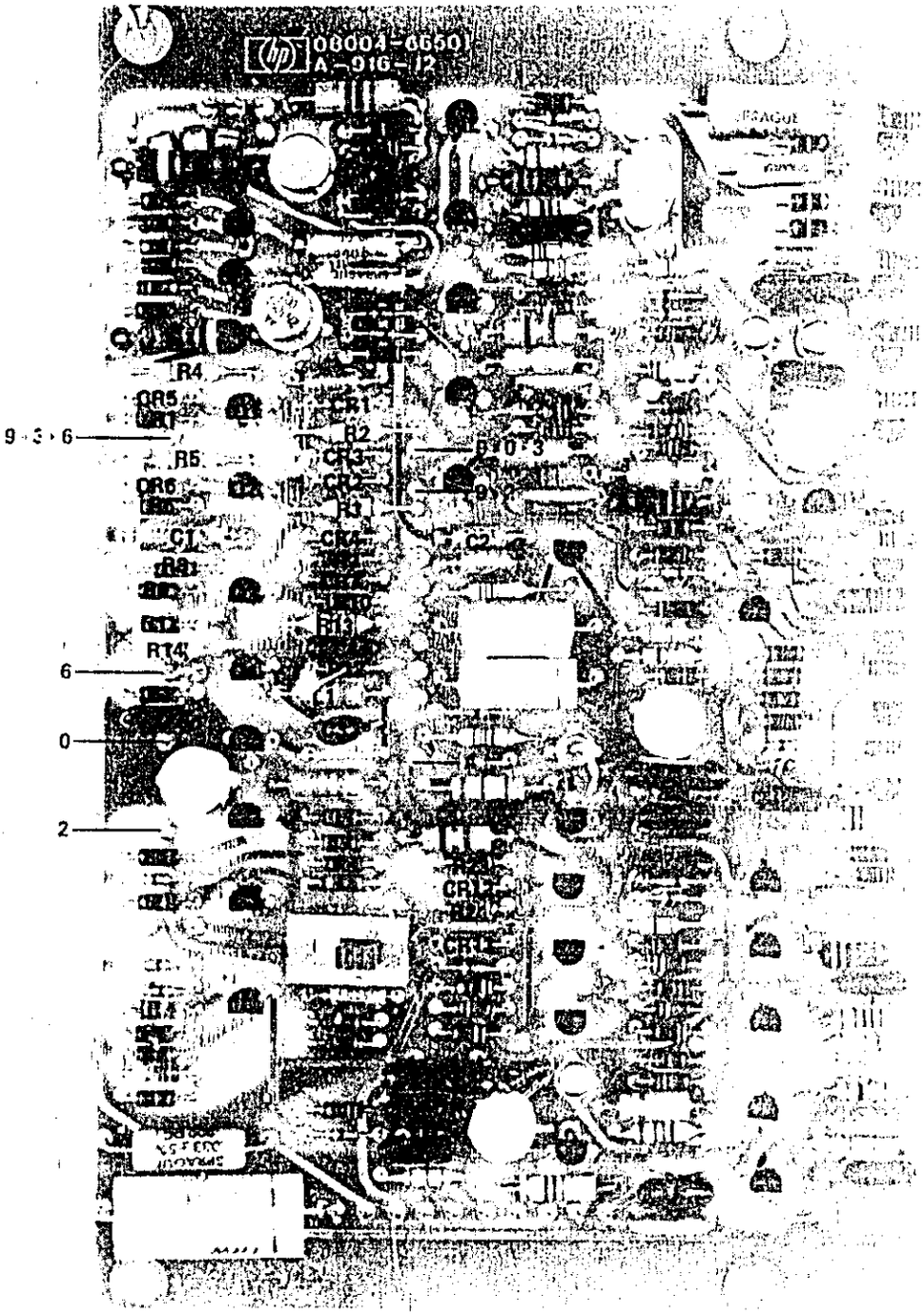
0	Black	5	Green
1	Brown	6	Blue
2	Red	7	Violet
3	Orange	8	Gray
4	Yellow	9	White

SWITCH DESIGNATIONS





A3S1	Switch S1 within Assembly A3
B	2nd Wafer from Front (A=1st,etc)
R	Rear of Wafer (F=Front)
(2)	Terminal Location (2) (Viewed from Front)



Trigger Input Component Location

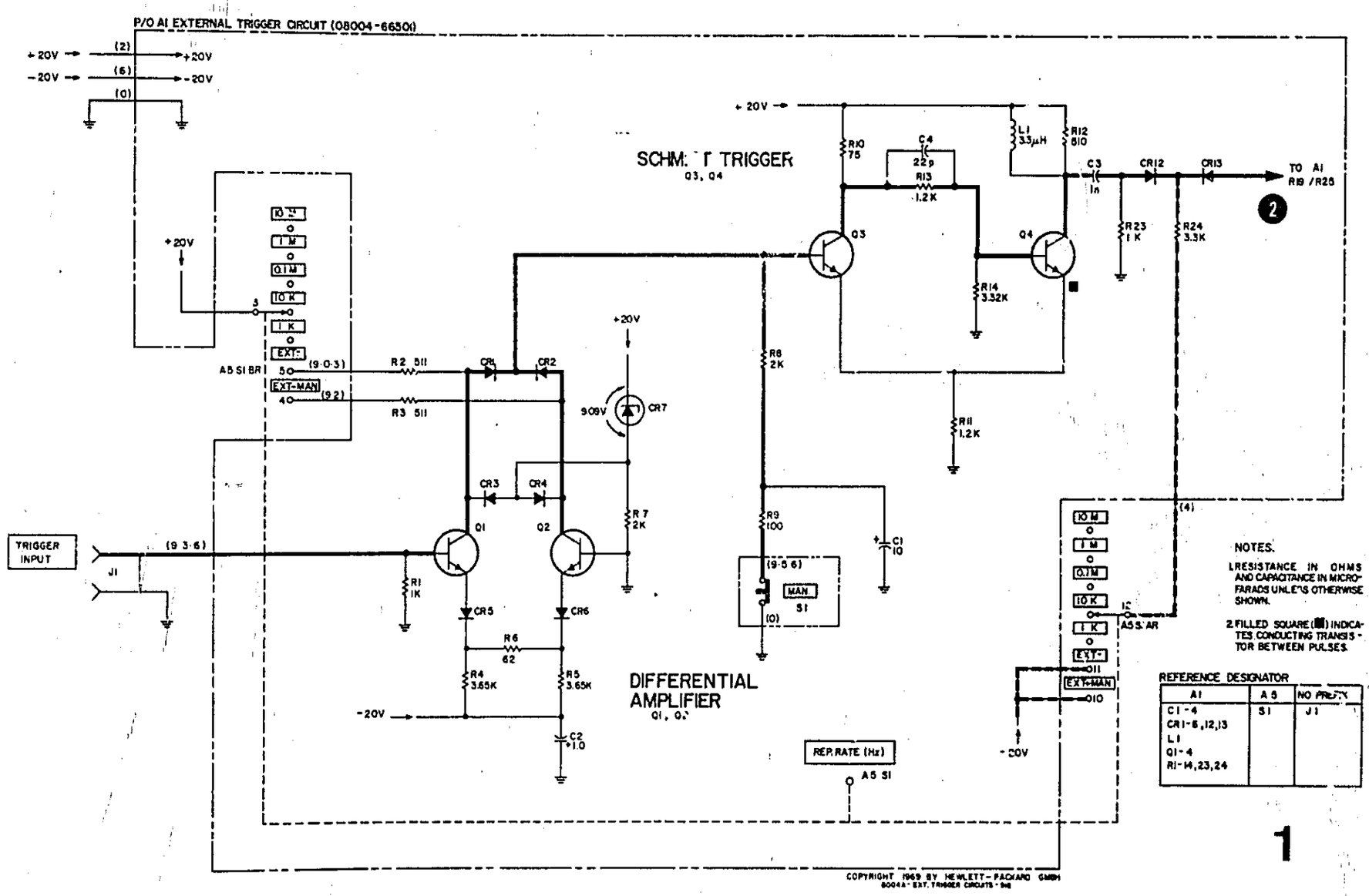
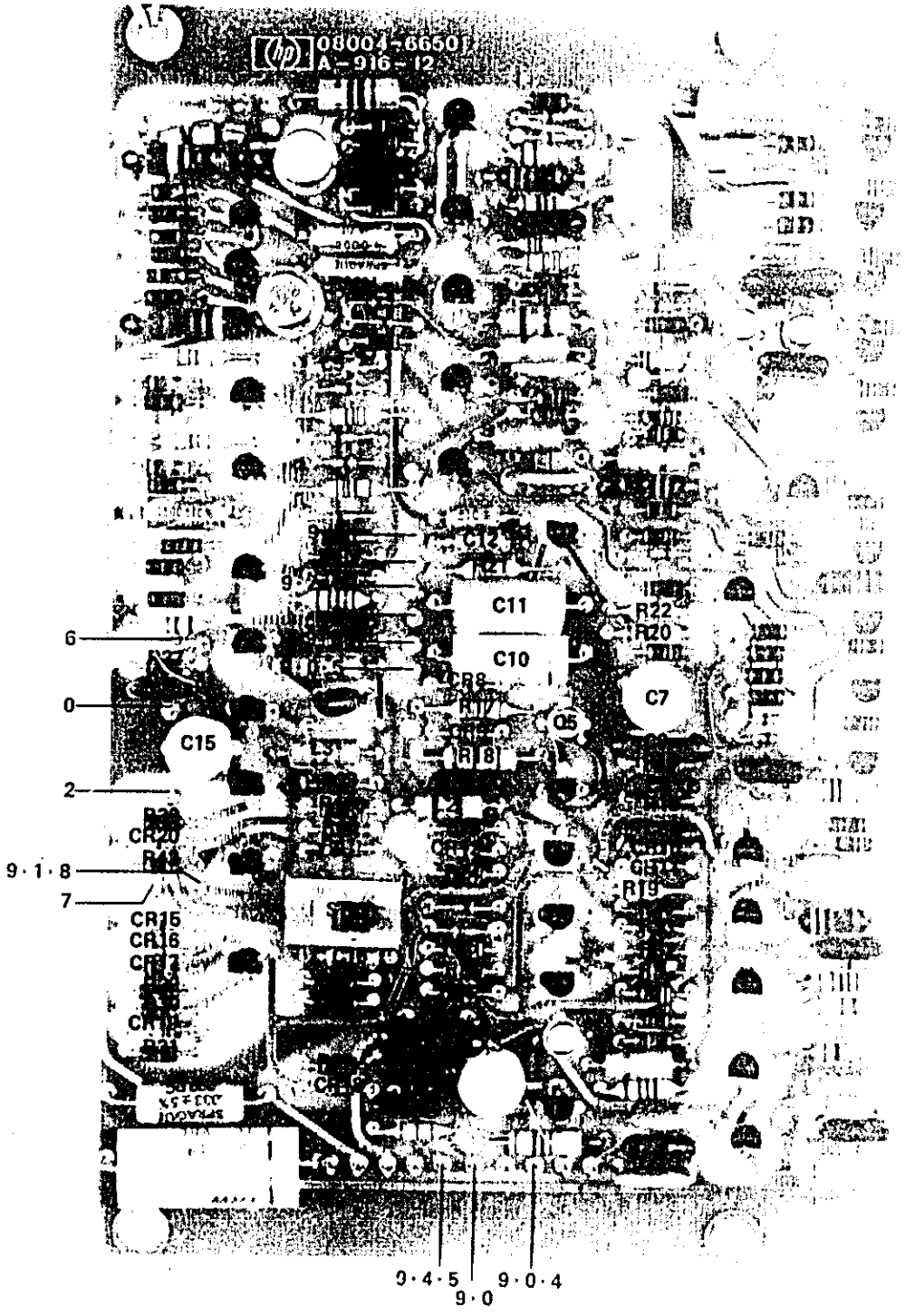
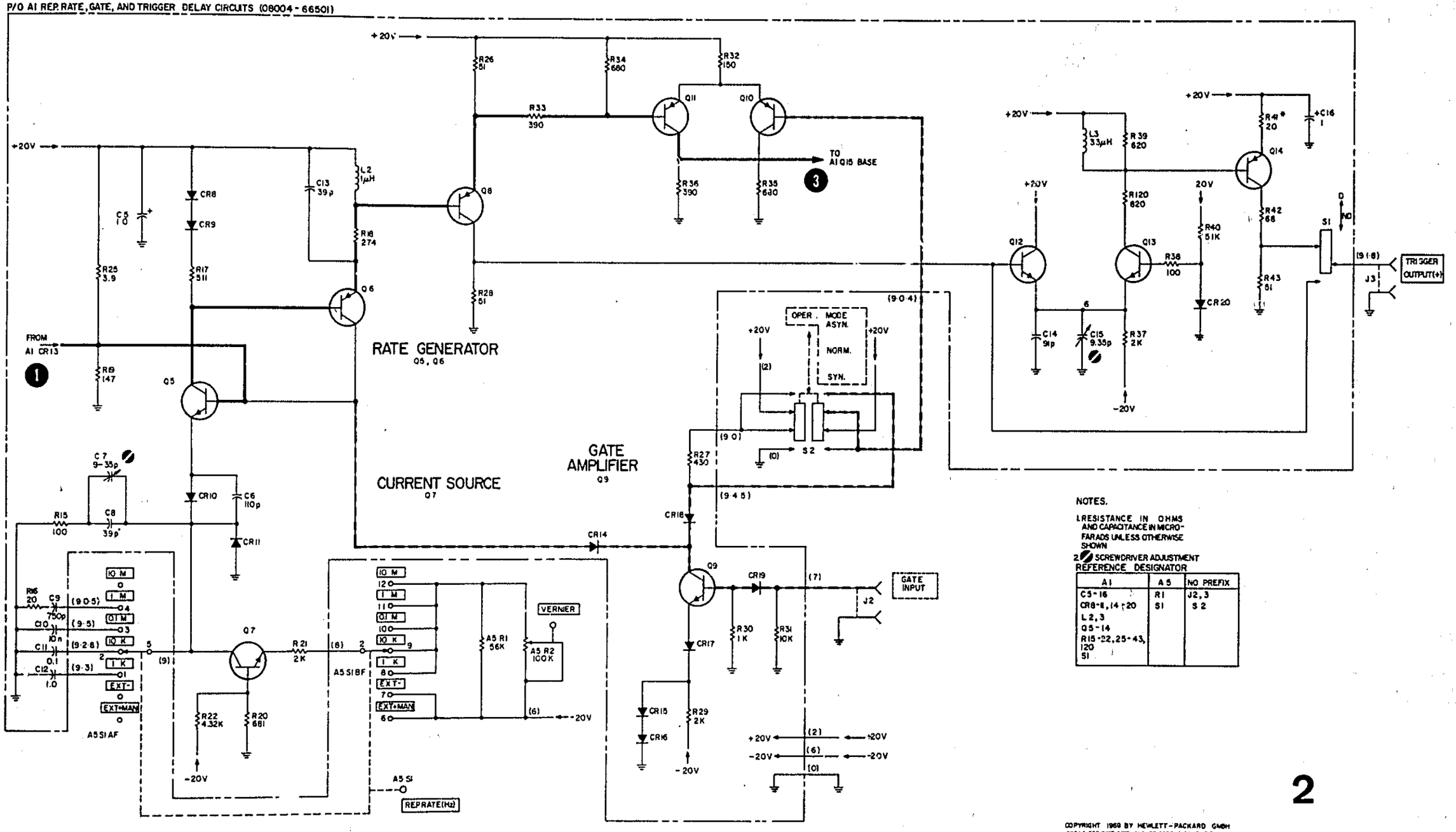


Figure 7-1. Trigger Input Circuits



Rate Generator, Gate, and Trigger Delay Component Location

P/O A1 REP RATE, GATE, AND TRIGGER DELAY CIRCUITS (08004-66501)



NOTES.

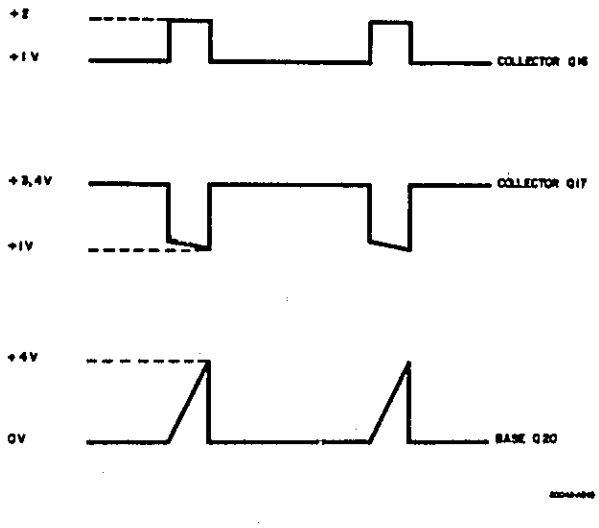
1. RESISTANCE IN OHMS AND CAPACITANCE IN MICROFARADS UNLESS OTHERWISE SHOWN
2. SCREWDRIVER ADJUSTMENT

REFERENCE DESIGNATOR

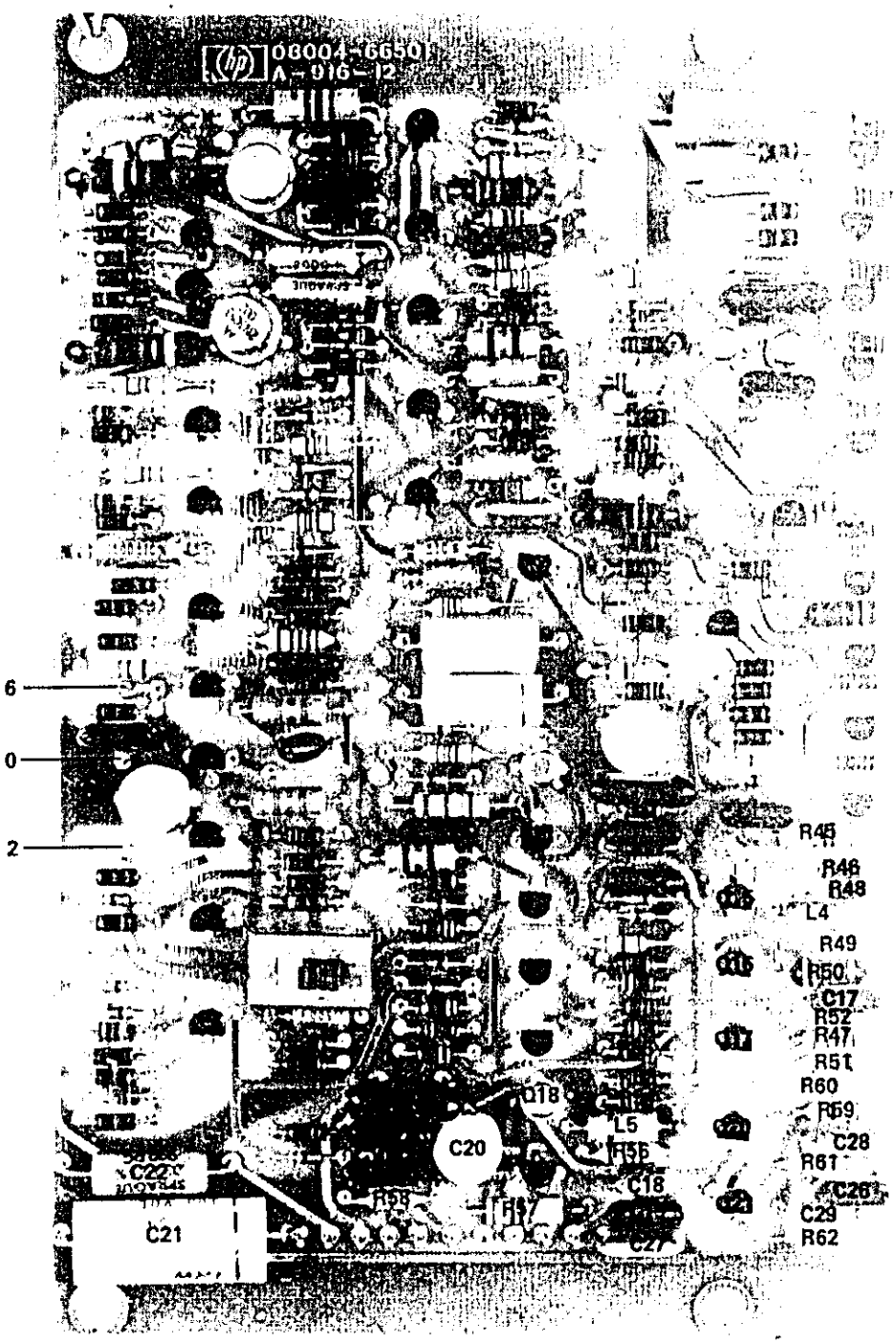
A1	A5	NO PREFIX
C5-16	R1	J2, 3
CR8-8, 14-20	S1	S2
L2, 3		
Q5-14		
R15-22, 25-43, 120		
S1		

2

Figure 7–2. Rate Generator, Gate, and Trigger Delay Circuits



Delay Circuit Waveforms



Pulse Delay Component Location

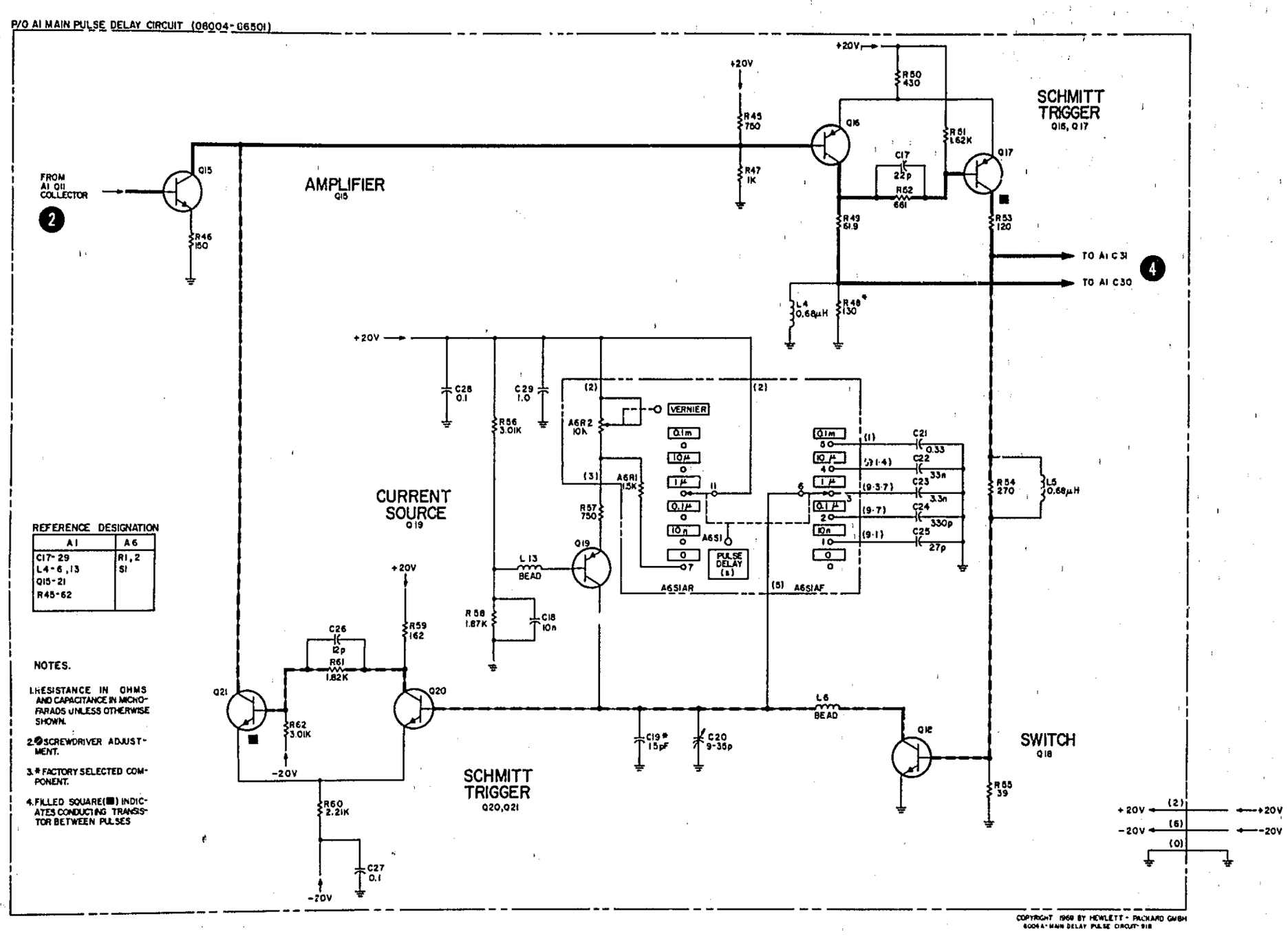
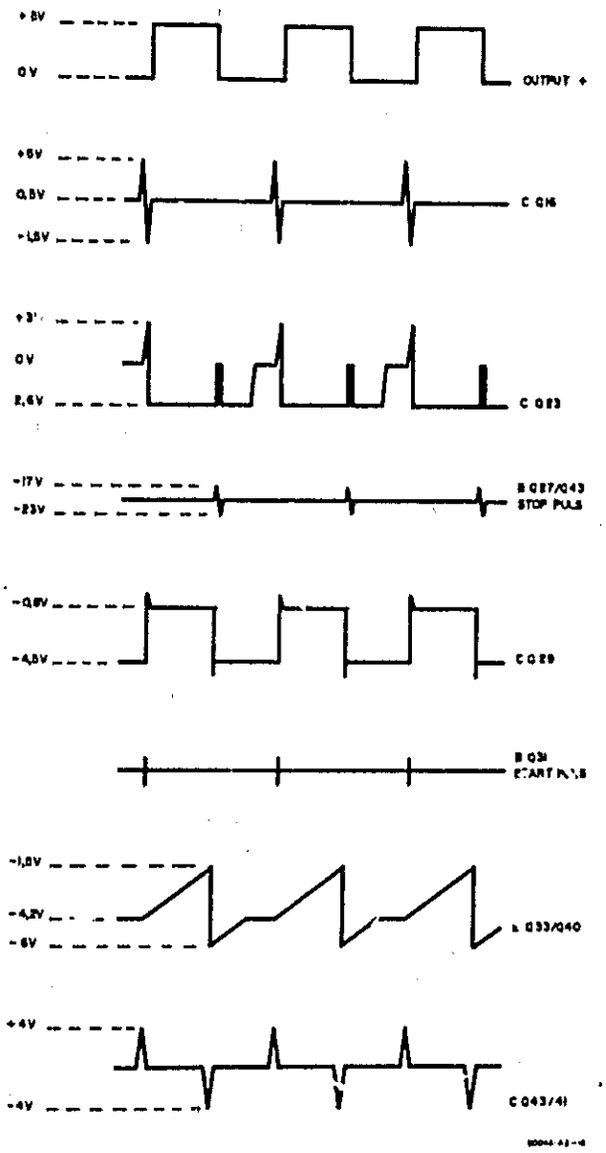
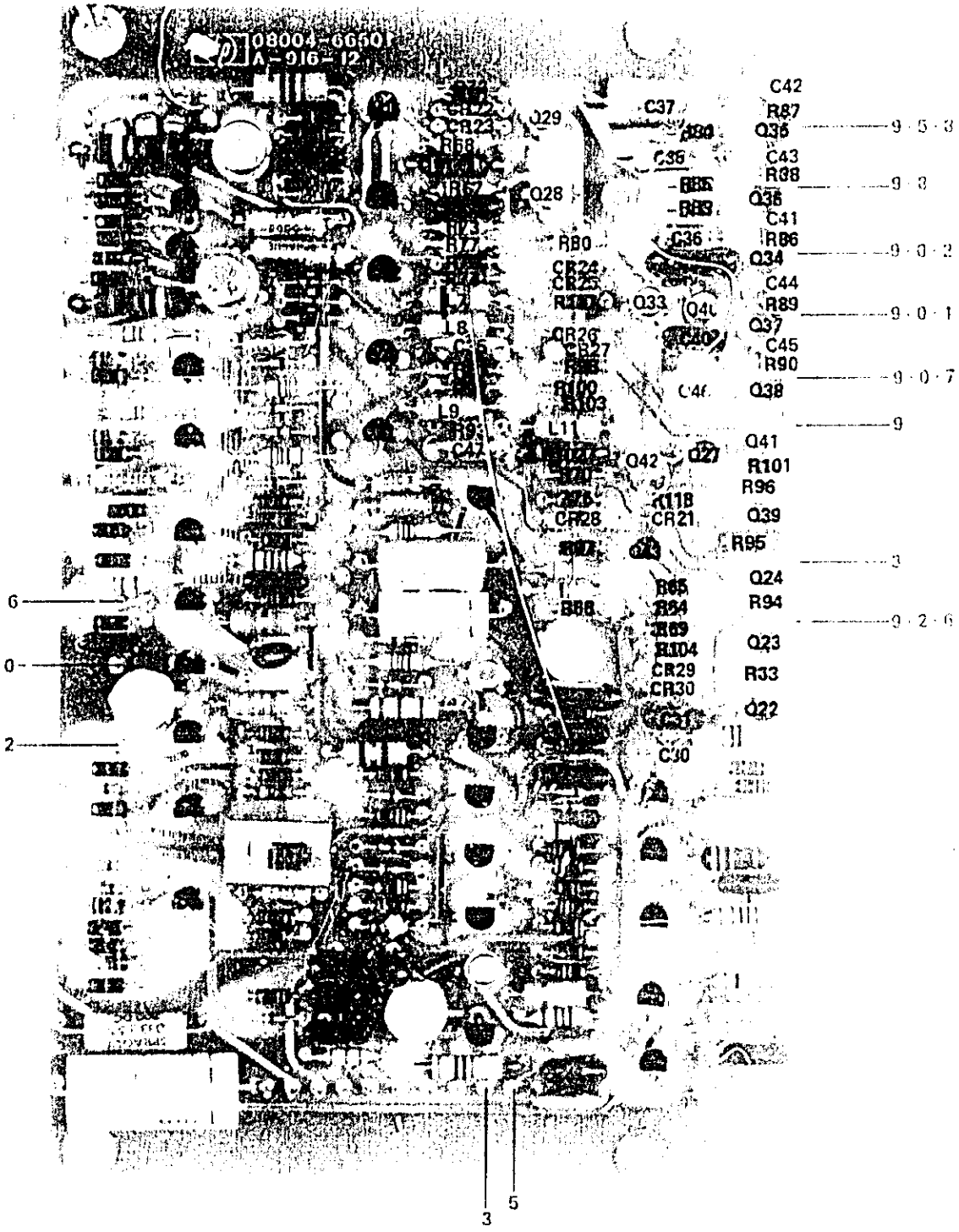


Figure 7–3. Pulse Delay Circuit



Width Circuit Waveforms



Width Component Location

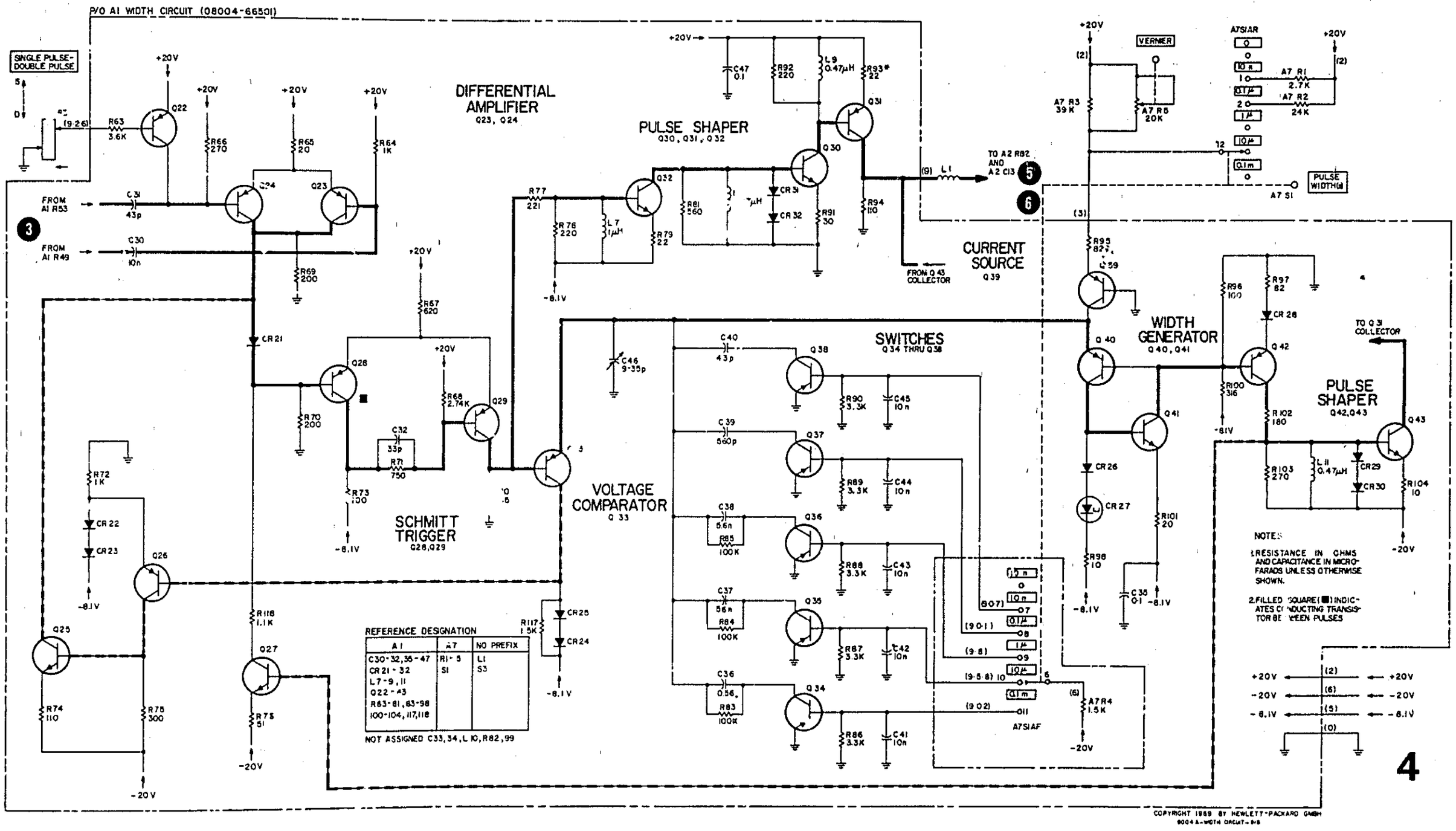
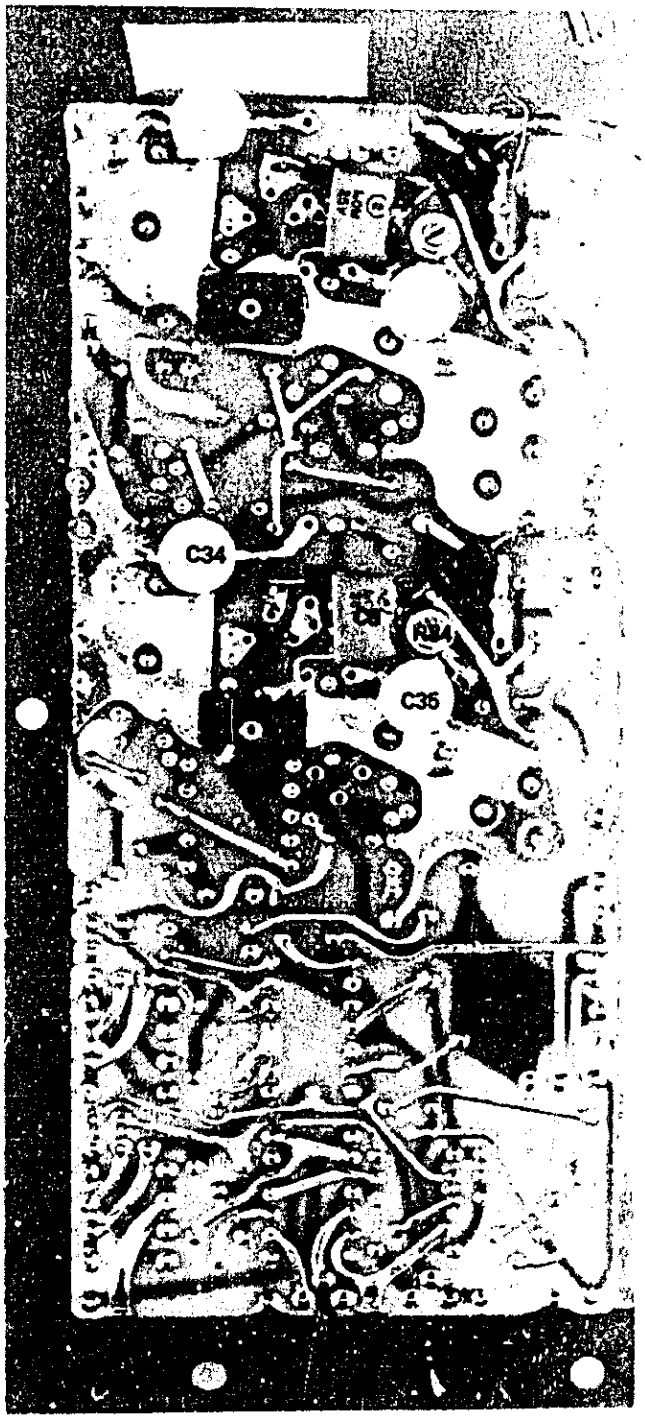
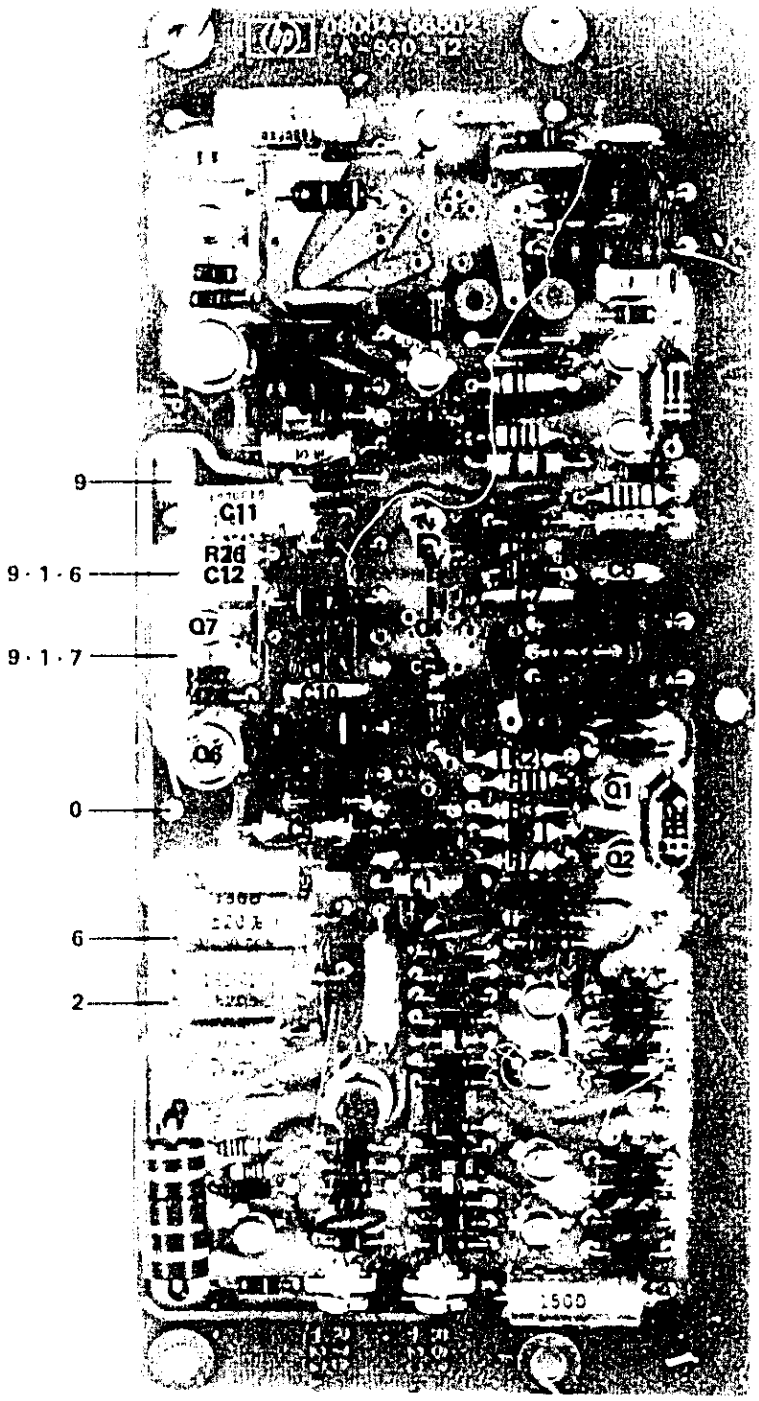


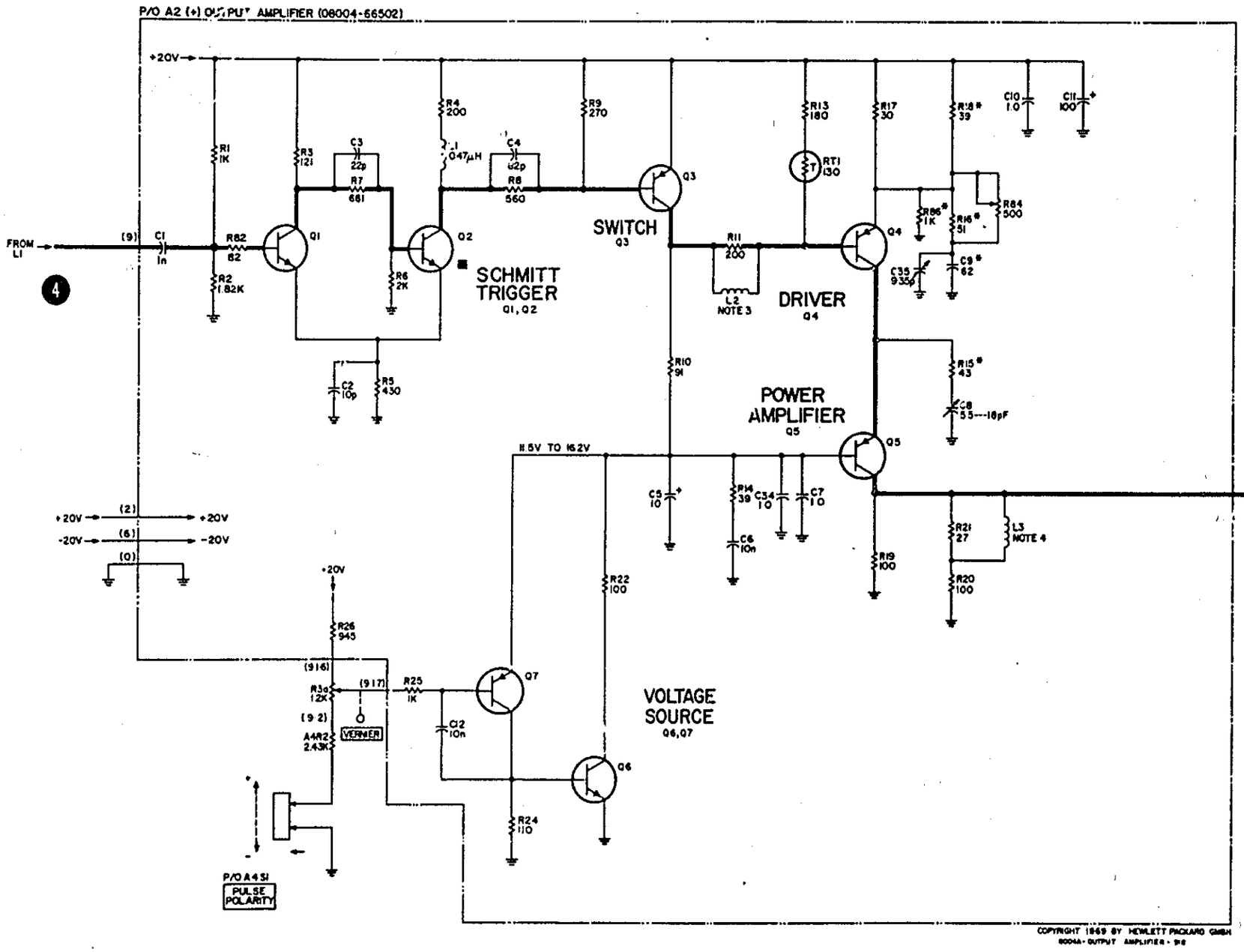
Figure 7–4. Width Circuit



(Rear Side of Board)



Positive Output Amplifier Component Location



NOTES:

1. RESISTANCE IN OHMS AND CAPACITANCE IN MICROFARADS UNLESS OTHERWISE SHOWN.
2. * FACTORY SELECTED COMPONENT.
3. 6 TURNS ON 200 Ω, 1/4 W 5% RESISTOR (R11)
4. 10 TURNS ON 27 Ω, 1/4 W 5% RESISTOR (R21)
5. FILLED SQUARE (■) INDICATES CONDUCTING TRANSISTOR BETWEEN PULSES.

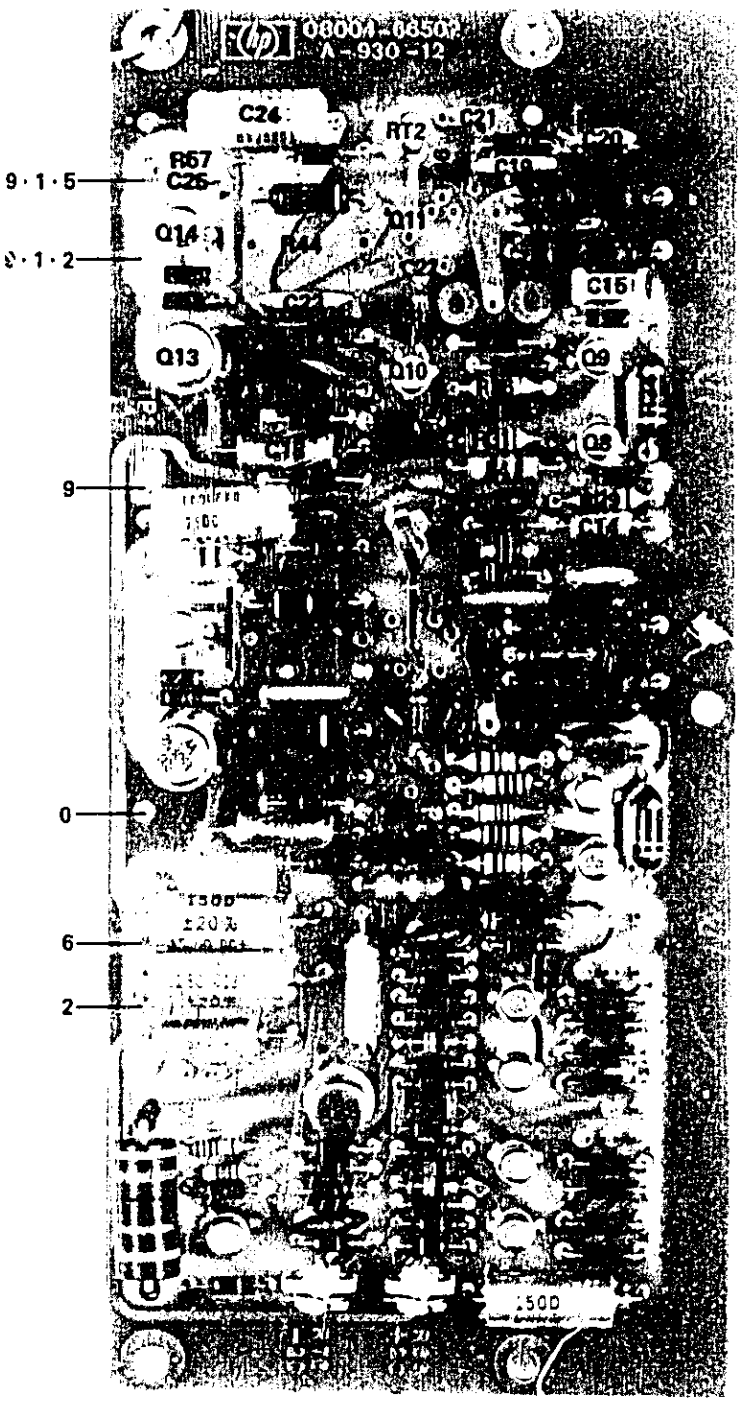
REFERENCE DESIGNATOR

A2	A4	NO PREFIX
C1-12,34,35 L1-3 Q1-7 R1-11, 13-22, 24-26, 82, 84 RT1	R2	R3a, 55

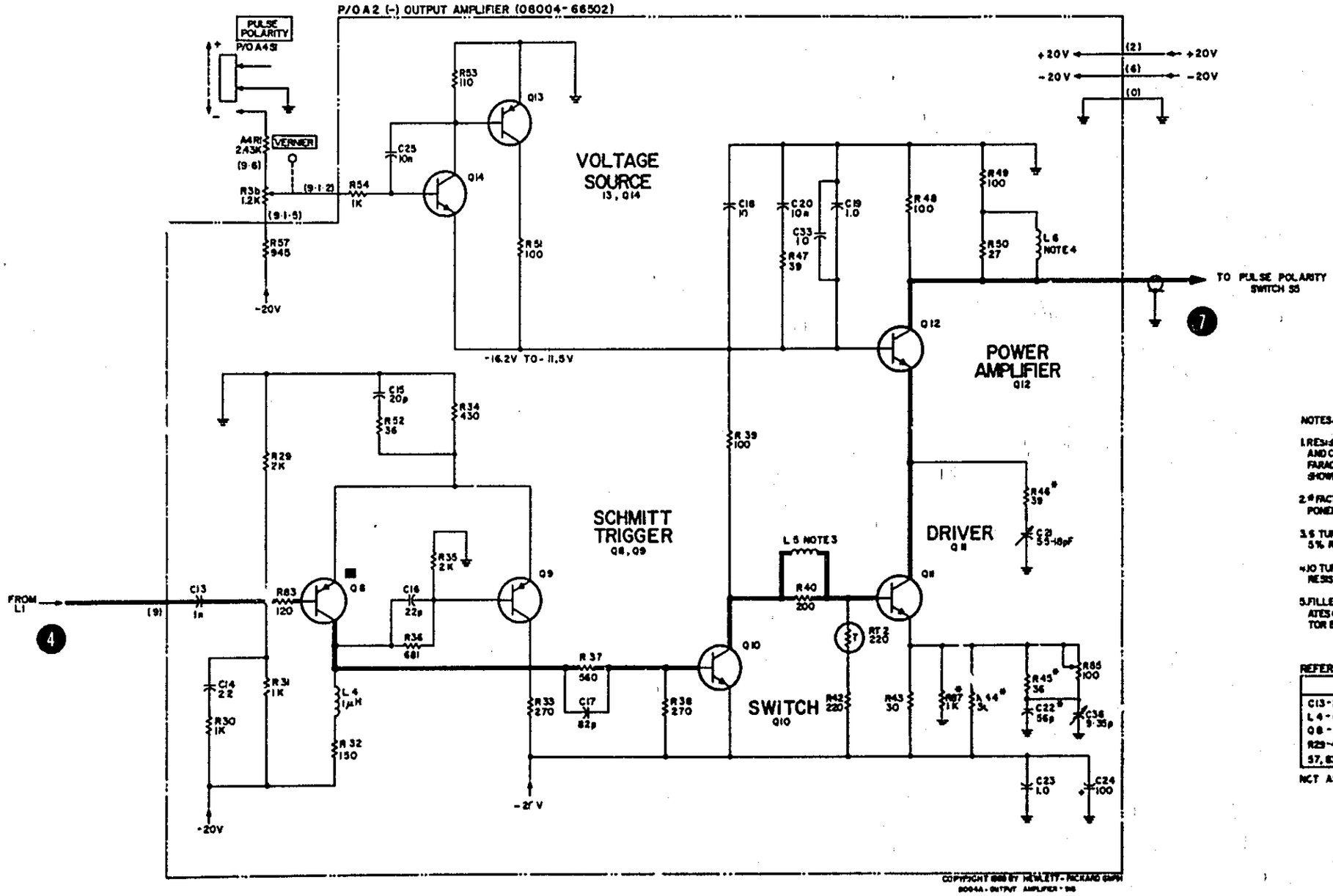
NOT ASSIGNED R12, 23, 27, 28

Figure 7–5. Positive Output Amplifier Circuit

(Rear Side of Board)



Negative Output Amplifier Component Location



NOTES:

1. RESISTANCE IN OHMS AND CAPACITANCE IN MICROFARADS UNLESS OTHERWISE SHOWN.
2. * FACTORY SELECTED COMPONENT.
3. 6 TURNS ON 200Ω,1/4 W 5% RESISTOR (R40)
4. 10 TURNS ON 27Ω,1/4 W RESISTOR (R50)
5. FILLED SQUARE (■) INDICATES CONDUCTING TRANSISTOR BETWEEN PULSES

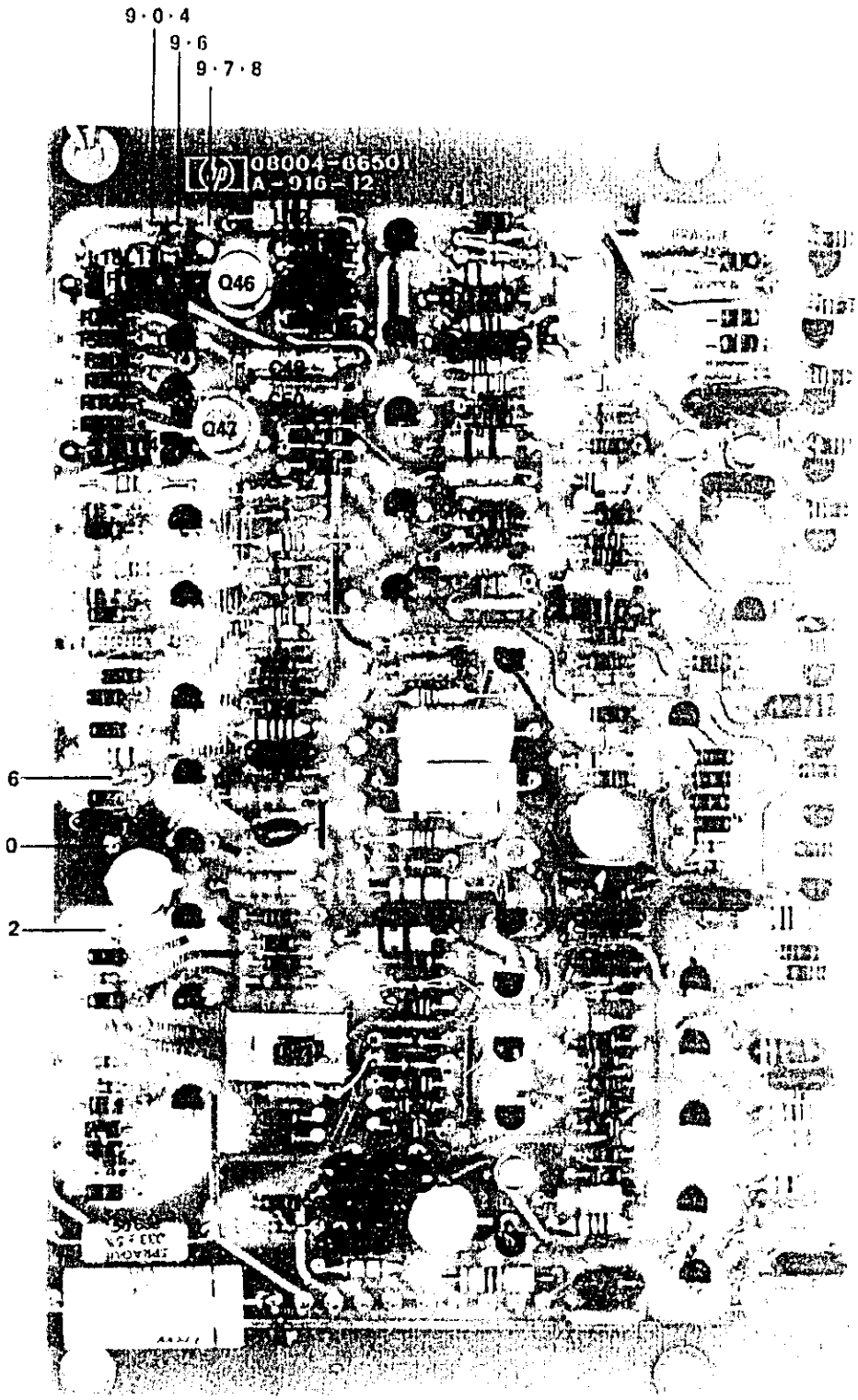
REFERENCE DESIGNATOR

A2	A4	NO PREFIX
C13-25,33,36 L4-6 Q8-14 R29-40,42-54 57, 83, 85	R1	R3b S5

NOT ASSIGNED R44, 55, 56

6

Figure 7-6. Negative Output Amplifier Circuit



Attenuator and DC Offset Component Location

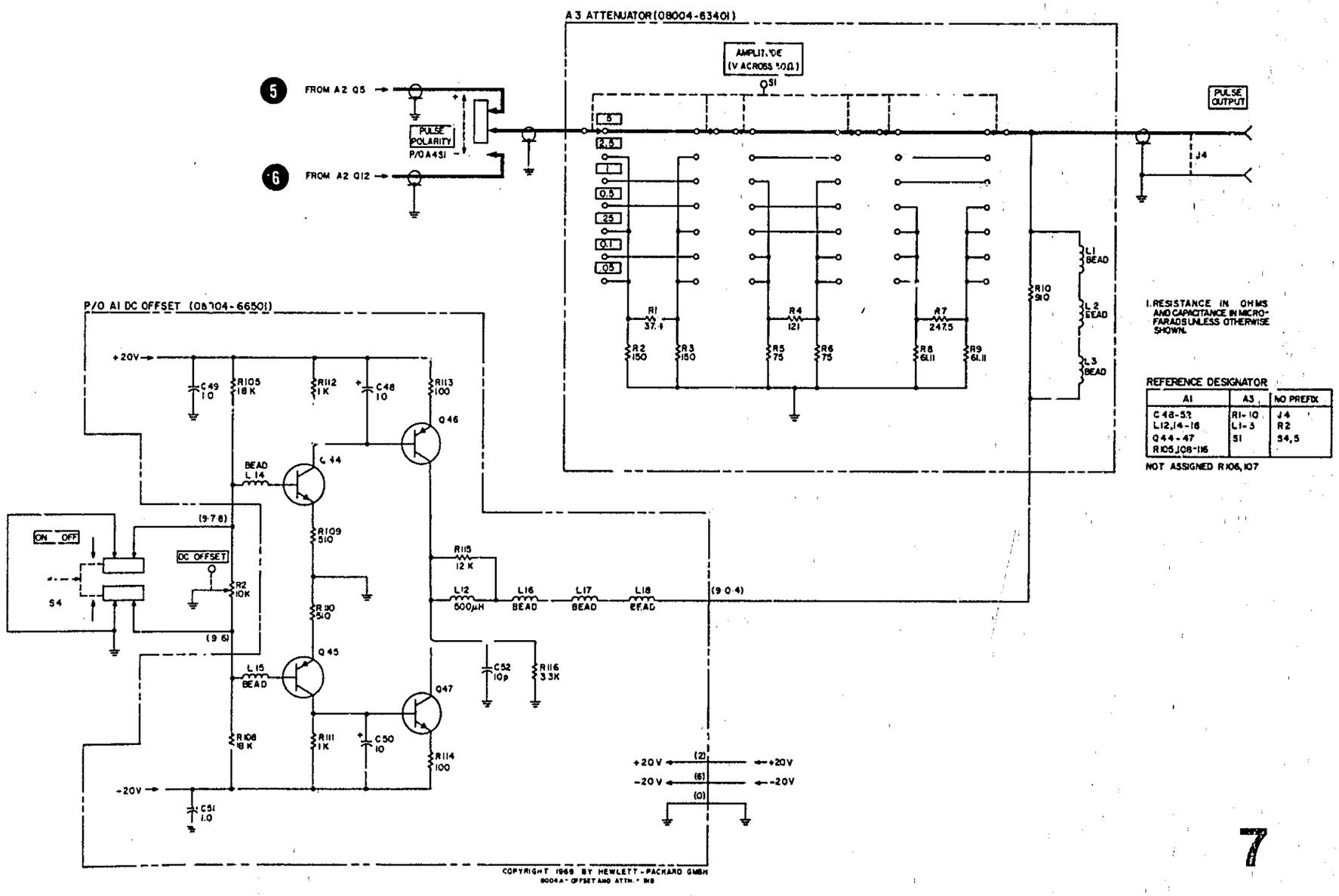
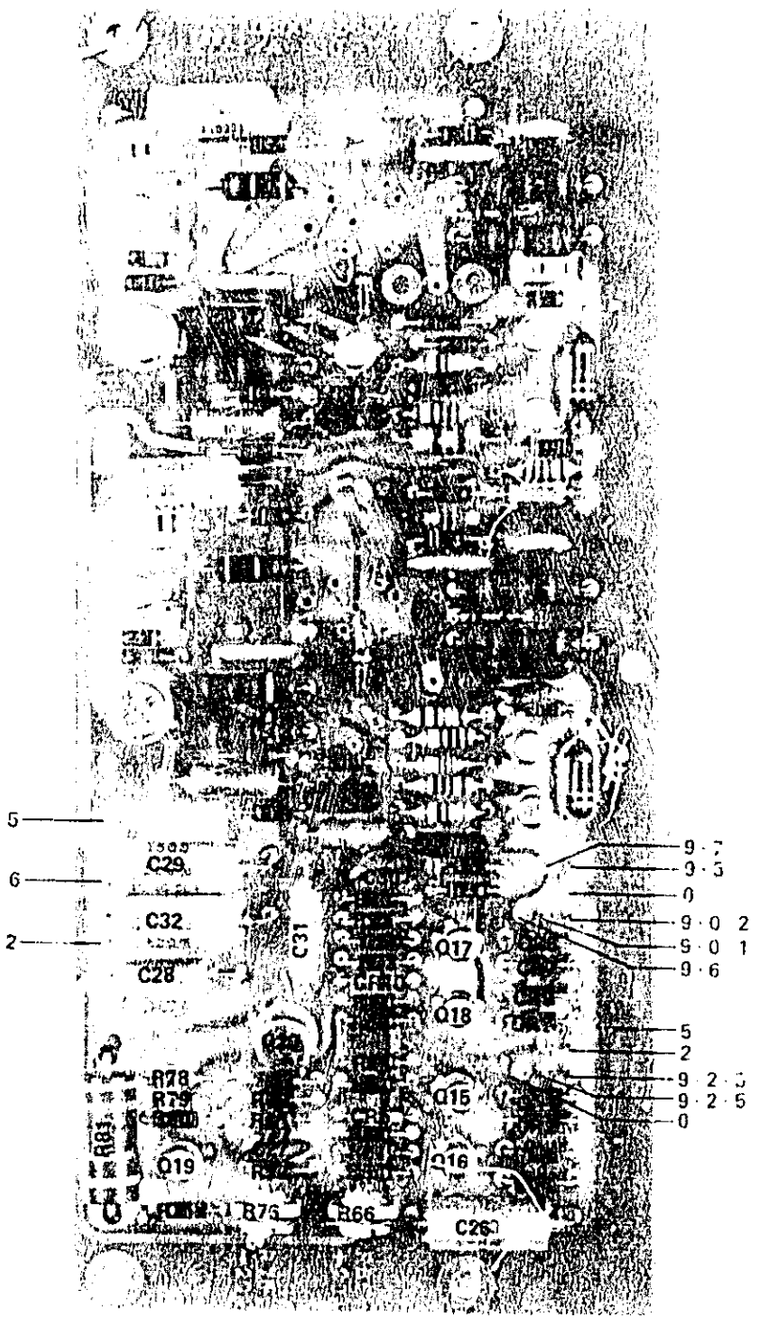
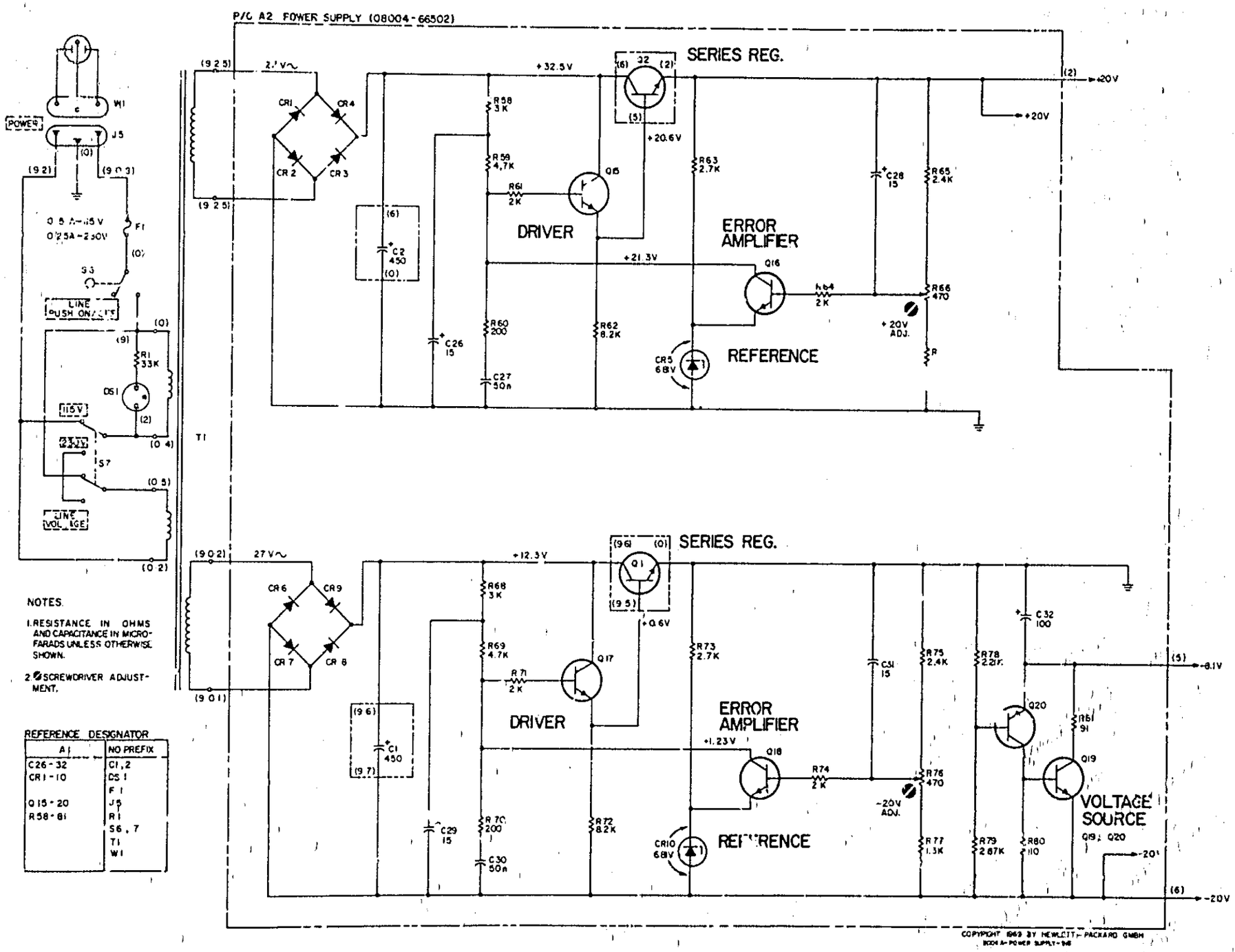


Figure 7-7. Attenuator and DC Offset Circuit

SCHEMATIC DIAGRAMS CON'T



Power Supply Component Location



NOTES.

1. RESISTANCE IN OHMS AND CAPACITANCE IN MICROFARADS UNLESS OTHERWISE SHOWN.
2. Ø SCREWDRIVER ADJUSTMENT.

REFERENCE DESIGNATOR

A1	NO PREFIX
C26 - 32	C1, 2
CR1 - 10	DS1
	F1
Q15 - 20	J5
R58 - 81	R1
	S6, 7
	T1
	W1

Figure 7-8. Power Supply Circuit

BACK DATING MANUAL CHANGES

APPENDIX

BACKDATING

This manual applies directly to 8004A Pulse Generators having the prefix and serial number G 957–00401 and above. To adapt this manual to instruments with prefixes other than G 957–00401 note the changes as follows:

Instrument Serial No. Prefix	Change No.
G 956 – 00331 – 00400	1
G 947 – 00291 – 00330	1, 2,
G 947 – 00231 – 00290	1, 2, 3,
G 944 – 00161 – 00230	1, 2, 3, 4,
G 918 – 00141 – 00160	1, 2, 3, 4, 5,
G 918 – 00061 – 00140	1, 2, 3, 4, 5, 6,
G 902 – 00052 – 00060	1, 2, 3, 4, 5, 6, 7

CHANGE 1: Table 6–1 – Change the following stock numbers

S6 to 3101 – 0100

CHANGE 2: Table 6–1 – Change the following stock numbers

A1C1, A2C1 and A2C13 to 0150 – 0050
A1C18, C30, C41 thru C45 and A2C6, C12, C20 and C26 to 0150–0093

CHANGE 3: Table 6–1 – Change the following stock numbers

A2Q4 and Q5 to 1853 – 0201

CHANGE 4: Table 6–1 and appropriate circuits – Change the following

A1Q42 to 1853 – 0096
A1Q28 and Q29 to 1853 – 0097
A1Q30 and Q40 to 1853 – 0218
A2C15 to 0160 – 2198 C: FXD 20 pF
A2R52 to 0698 – 5704 R: FXD 36 Ω
A2Q8 and Q9 to 1853 – 0096 Transistor PNP

CHANGE 5: Table 6–1 – Change

J4, BNC Connector to read 1250 – 0252

Table 6–1 and Figure 7–5

A1C19 to 0140 – 0204 C: FXD 47 pF

Table 6–1 and Figure 7–8

A2R29 to 0757 – 0429 R: FXD 1.82 kΩ

Table 6–1 and Figures 7–2 and 7–6 – Delete
A2L7

CHANGE 6: (Only applicable to the following instruments: G 918 – 00101, 116, 121, 127, 131, 133, 141 thru 149, 151, 152, 154 thru 160.)

Table 6–1 and Figure 7–7

Change: A2C8 to a selected on test value (starred)

Delete: C34, C35, R84.

Table 6–1 and Figure 7–8

Change: A2C21 to a selected on test value (starred)

Delete: C33, C36, R85.

CHANGE 7: Table 6–1 and Figure 7–4

Add to collector of A1Q12 A1R119: 0698 – 4255 R: FXD 1.1 K OHM

Change: A1R120 to 0698 – 4255 R: FXD 1.1 K OHM

Table 6–1 and Figure 7–6

Change: A1R81 to 0698 – 4239 R: FXD 220 OHM
A1R95 to 0758 – 0003 R: FXD 1K OHM
A1R103 to 0698 – 4148 R: FXD 560 OHM
A1L11 to 9100 – 1612 COIL FXD 0.33 μH

Table 6–1 and Figure 7–7

Change: A2R10 to 0698 – 7032 R: FXD 100 OHM
A2R13 to 0698 – 4232 R: FXD 110 OHM
A2R17 to 0698 – 5890 R: FXD 39 OHM
A2C7 and
A2C10 to 0150 – 0121 C: FXD 0.1 μF

Table 6–1 and Figure 7–8

Change: A2R42 to 0698 – 4232 R: FXD 110 OHM
A2R43 to 0698 – 5891 R: FXD 43 OHM
A2C19 and
A2C23 to 0150 – 0121 C: FXD 0.1 μF

Table 6–1 and Figure 7–10

Change: A2C28 and
A2C31 to 0180 – 0228 C: FXD 22 μF

MANUAL CHANGES

HEWLETT hp PACKARD GmbH

MANUAL CHANGES

Model Number	8004A
Date Printed:	OCT. 70
Part Number	08004-90001

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections

Make all appropriate serial number related changes indicated in the tables below.

Serial Prefix	Make Changes	Serial Prefix	Make Change
1151G 00546	1		
1151G 00566	1, 2		
1151G 00686	1-3		
1151G 00746	1-4		
1151G 01086	1-5		
1615G 01116	1-6		
1615G 01126	1-7		

ERRATA

Frontice Page — Serial number prefix should be G974 not G944.

Parts List — Change and add as follows.

A6	08004-61902
A7	08004-61903
A1C2	0180-0291
A1R27	0757-0915
A1R41	Selected Value
A1R48	Selected Value
A1R93	Selected Value
A1R121	0698-4302
A1R122	0698-4302
A2C28	0180-1746
A2C31	0180-1746
A2L6	08004-61502
A2L8	9170-0029
A2L9	9170-0029

ERRATA (continued)

A2Q11	5080-1061	Matched with A2Q12
A2Q12	5080-1061	Matched with A2Q11
A2Q19	1853-0090	
A2Q20	1854-0039	
A2R15	Selected Value	
A2R18	Selected Value	
A2R44	Selected Value	
A2R47	0698-5705	
A2R86	0686-2025	
A2R87	0686-2025	
A3S1	3100-0509	
F1	2110-0201	(for 230V)
F1	2110-0202	(for 115V)
HP(F1)	1400-0084	HOLDER FUSE
J3	1250-0083	
J5	1251-2357	
R1	0758-0074	
S6	3101-1244	
S7	3101-1234	
W1	8120-1348	(NEMA)
W1	8120-1349	(SCHUKO)

Schematic 4 — Add R121 in parallel with C40.
Add R122 in parallel with C39.

Substitute enclosed layouts and circuits Figures 7-5a and 7-6a for Figures 7-5 and 7-6 in manual.

Change or add the following parts:

A2	C9	0140-0145	C-F 22PF 500V
A2	C21	0120-0061	C-VAR 5.5 - 18 PF
A2	C22	0160-2308	C-F 36PF 300V
A2	C37,38	0150-0011	C-F 1.5PF 500V
A2	C39	0160-2327	C-F .001UF 100V
A2	CR11,12	1901-0533	DIODE HAT CARRIER
A2	L10 to 15	9170-0029	FERRITE BEAD
A2	Q4,5	1853-0315	XSTR PNP TO -5
A2	Q10	1854-0630	XSTR SI 2N 5179
A2	Q11,12	1854-0579	XSTR SI NPN
A2	R86,87	0686-2025	R-F 2K 5% .5W CC
A2	Q3,8,9	1853-0357	XSTR, SI PNP

NOTE: Some components may be differently marked:
A2 Q3,8,9 1853-0218 A2 Q10 1854-0354 A2 Q11,12 1854-0332

Do not use these numbers for re-ordering.

GmbH Manual Change Sheets

Remove the old pages and destroy them.

Replace them with the new Manual Change Sheets.

All other pages were not changed.

CHANGE 1

Instrument now supplied in new livery.
Earlier colours available as options:

Option A85 - light grey panels with olive covers

Option X95 - light grey panels with blue covers.

CHANGE 2

A1	R93 now	0698-6745	RF 22 OHM	5%
A2	C7 now	0160-2327		
A2	C15 deleted			
A2	Q4/5 now	1853-0315		
A2	L8 new	9170-0016	Bead (added to base of A2 Q5)	

CHANGE 3

Change A1Q41 and A2Q10 part number to 5080-4669.

CHANGE 4

On the list of replaceable parts for assemblies 1 and 2 change the part numbers of the following components to 1853-0357:

A1 - Q28, Q29, Q33 and Q40

A2 - Q3, Q8 and Q9

CHANGE 5

PAGE 6-12, add the following components:

MP(F1)	2110-0670	FUSEHOLDER BODY
MP(F1)	1400-0090	WASHER NEOPRENE
MP(F1)	2190-0054	WASHER LOCK
MP(F1)	2110-0467	NUT HEX
MP(F1)	2110-0465	FUSEHOLDER CAP

Errata (page 2 of this document),
delete

MP(F1)	1400-0084	HOLDER FUSE.

CHANGE 6

Page 6-12.

Delete:		08004-00207	PANEL FRONT
	S6	3101-1248	SWITCH PUSHBUTTON
Add:		08004-00208	PANEL FRONT
		08004-01201	BRACKET SWITCH LINE
	S6	3101-1248	SWITCH PUSHBUTTON
		0370-0914	BEZEL PUSHBUTTON
		5040-1124	KNOB PUSHBUTTON
	DS1	1450-0531	LAMP NEON (DS1 is pilot lamp adjacent to LINE switch)
		0510-0097	RETAINER

CHANGE 7

Change:		08004-00209	PANEL REAR
	S7	3101-1740	SW SLIDE